REVIEW OF ENVIRONMENTAL FACTORS
FOR EXPLORATION BOREHOLES

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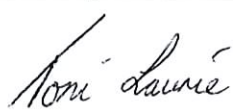
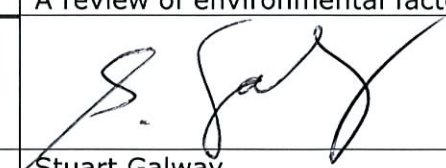
0	April 09	Gloucester Exploration Drilling	TL	SG	DK
REV	**DATE**	**DESCRIPTION**	**PREPARED**	**CHECKED**	**APPROVED**

	Submission of Environmental Assessment Prepared under the Environmental Planning and Assessment Act 1979, Part 5, Section 111.
Environmental assessment prepared by: Name Qualifications Address	 Toni Laurie Bachelor of Natural Resources (Hons), University of New England, Armidale AGL Gloucester L E Pty Ltd 22 Tate St, PO Box 335 Gloucester NSW 2422
Certificate	I certify that I have prepared the contents of this document and to the best of my knowledge: It is in accordance with the requirements of Part 5; It contains all available information that is relevant to the environmental impact assessment of the development to which it relates; and The information contained in the document is neither false nor misleading.
Signature	
Name	Toni Laurie
Date	28/5/09
In respect of:	
Project to which Part 5 applies Applicant name Contact Phone Address Land to be developed	 AGL Gloucester L E Pty Ltd Stuart Galway 02 6558 1166 22 Tate St, PO Box 335, Gloucester, NSW 2422 394//980328; 11//193003; 66//1008585; 241//1011387; 238//753173; 8//1061018; 7//846843; 3//604812
Proposed development	Coal Seam Methane Exploration Drilling
Environmental assessment	A review of environmental factors is attached.
Signature	
Name	Stuart Galway
Date	28/5/09

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1.0 INTRODUCTION

1.1 OBJECTIVES AND PURPOSE OF THE DOCUMENT

This Review of Environmental Factors (REF) addresses the proposed drilling and testing activities of three coal seam methane (CSM) stratigraphic and five coal seam methane (CSM) core boreholes by AGL Gloucester L E Pty Ltd.

The REF has been prepared by officers of AGL to comply with Condition No. 1 (Environmental Assessment) of Petroleum Exploration Licence (PEL) No. 285.

Condition No. 1 states that a Category 3 activity ("in this case the drilling of exploration boreholes for production evaluation testing") requires:

"…a Review of Environmental Factors in accord with Clause 228 of the Environmental Planning and Assessment Regulation 2000 must be submitted to the Environment Unit, Department of Mineral Resources to enable a determination under Part 5 of the Environmental Planning and Assessment Act to be made…"

Consultation with the New South Wales Department of Primary Industries - Mineral Resources (DPI) has confirmed that preparation of a REF is a suitable level of environmental assessment for the proposed works, and this REF has been prepared in accordance with the DPI *Guidelines for Review of Environmental Factors June 2006*.

1.2 PROJECT LOCATION

The location of the PEL area is approximately centred on the township of Stratford, approximately 70 kilometres (km) north of Newcastle in New South Wales (NSW). The area extends approximately 60 km north to south and approximately 20 km east to west comprising some 18 graticular blocks and about 1,308 square kilometres (km^2) (Figure 1). The area completely contains the Gloucester Geological Basin.

The PEL area excludes existing mining leases (except Stratford Colliery), National Parks, state forest or nature reserves, Aboriginal areas and land vested in the Commonwealth of Australia. There are no World Heritage Areas or Ramsar Wetlands within the PEL.

The PEL overlays the Local Government Areas of the Gloucester Shire and Great Lakes Council.

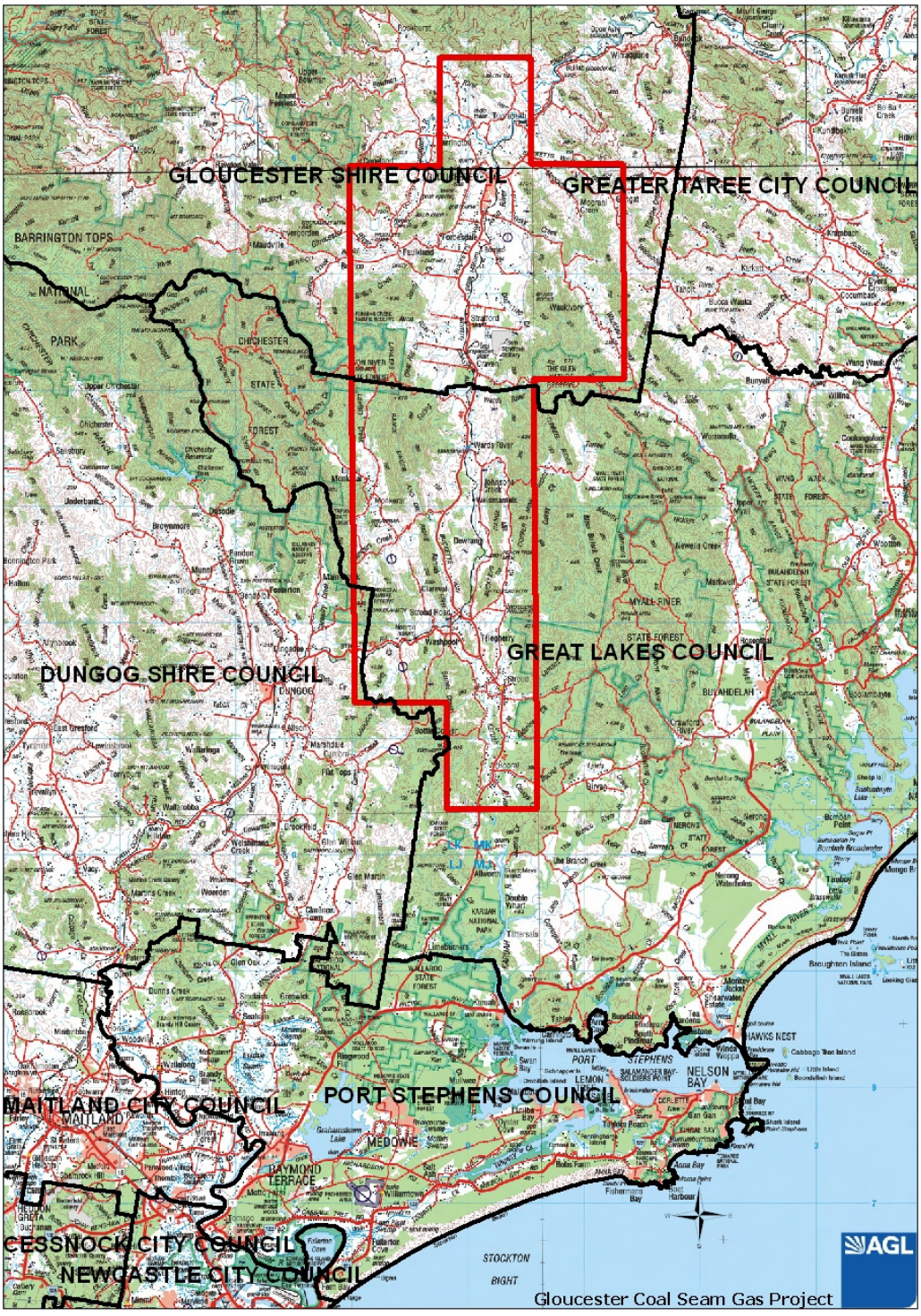

Figure 1: Project Location Map

1.3 BACKGROUND

PEL 285 was granted in 1992 under the *Petroleum (Onshore) Act, 1991*. In December 2008 AGL Energy acquired PEL 285 from the joint venture of Lucas Energy and Molopo to become the sole operator.

The licence enables investigation of the potential for coal seam methane resources in the Gloucester Basin with a view to possible development of a coal seam methane production field in the near future.

All exploration works are to be undertaken in accordance with Licence conditions that are imposed by the Minister for Primary Industries and with the works program agreed with DPI.

1.3.1 Overview of Historical Exploration Activities

In 1970-71, Noranda Australia Ltd, in search of open cut coal deposits, drilled in excess of 300 shallow holes in the Gloucester Basin. From 1977-83, BMI Mining Pty Ltd and Esso Australia Ltd drilled 990 open cut coal exploration holes, mostly shallow and non cored, in the basin. In addition, some 256 line km of Mini-SOSIE seismic reflection surveys was completed.

From a coal seam methane viewpoint, Esso-BMI drilled four deep fully cored stratigraphic holes in the north of the basin, and these have provided useful information on geology and coal development. The holes are named BMI SD 20, 22, 23, and 24, and vary in depth from 401-512 m. Hole BMI SD 20 is located in the centre of the present Stratford Coal Seam Methane (CSM) Prospect.

Three separate dedicated coal seam methane drilling programs were undertaken by Pacific Power at the Stratford Prospect in 1993, 1997, and 1999. A total of 5,590 m of cored 96 mm diameter drilling was completed in nine holes, named PGSD 1 – 9, ranging in depth from 444 m to 895 m.

The 1993 program consisted of boreholes PGSD 1 and 1A. Holes PGSD 2-5 comprised the 1997 program. In 1999, holes PGSD 2, 3 and 5 were deepened, and holes PGSD 6-9 were drilled. The purpose of the drilling was to evaluate the potential for commercial coal seam methane recovery at the Stratford Prospect.

In 2004 the Lucas-Molopo Joint Venture drilled the first dedicated production evaluation wells within the Stratford Prospect (namely LMG01, LMG02 and LMG03). LMG03 was subsequently hydraulic fracture stimulated and placed on production test. LMG01 and LMG02 are a surface to in-seam completion pair currently capped and suspended.

In 2005 the Joint Venture drilled the second set of dedicated CSM evaluation holes in the vicinity of Stratford Prospect (namely LMGW01 and LMGC01). These holes were fully cored, with the main seams tested for CSM properties.

In 2006 the Joint Venture lodged a Review of Environmental Factors to drill four exploration boreholes in the Stratford Prospect (namely LMG04, LMGW02, LMGC02 and LMGC03). To date only LMG04 has been drilled.

In 2007 the Joint Venture drilled five exploration boreholes throughout the Gloucester basin. These were Weismantel 1 (LMGWL03), Weismantel 2 (LMGWL02), Craven 1 (LMGC10), Waukivory 1 (LMGW03) (cored), and Faulkland 1 (LMG10) (chipped). Several other wells were permitted but not drilled during this period.

In 2008 the Joint Venture established a pilot project for production evaluation testing from several wells in the Stratford area (including LMG04, LMG08, LMG05, LMG06 and Stratford 9). Drilling, hydraulic fracture stimulation and production

testing activities are ongoing at these wells. In late 2008 the Joint venture also drilled pilot production boreholes Stratford 7, Stratford 10, Waukivory 3, Craven 6 and Faulkland 3. Faulkland 3 was perforated and hydraulically fractured in March 2009, the remaining wells are in the process of being perforated & fractured throughout May 2009.

1.4 OVERVIEW OF PROPOSED ACTIVITY

The proposed exploration activity involves the drilling of three stratigraphic and five fully cored boreholes. The proposed drilling aims to further test coal seam and gas characteristics and to define methane resources of the area, with a view to the development of a production field in the future.

The proposed wells are identified as **Gloucester 1, Gloucester 2, Craven 7 and Wards River 1 to 5.** All proposed activities are located on privately owned (freehold) land in cleared/pastured grazing paddocks (See **Appendix 1**). It is proposed to utilise 24 hour drilling for seven of the proposed well sites where landholder consent is received. The proposed site "Gloucester 2" is proposed to be only 12 hour drilling (day time hours) due to its proximity to Gloucester township (250m from nearest residences). This work is expected to be completed over a period of approximately 3 to 6 weeks at each well, approximately 8 weeks for Gloucester 2.

The drilling activity would involve establishment of a single, moderate size truck mounted drilling rig and ancillary equipment on a small site (maximum 60 x 40m constructed pad) within cleared grazing land. The depth of the borehole at each site is expected to be between 1200 and 1500m.

Access to most of the works area is available via council maintained roads and existing farm tracks. If required, some minor works may be undertaken to upgrade existing tracks. There is currently limited access to the proposed Craven 7 and Wards River 3, but construction of a new access track will be on land that is currently improved pasture. No clearing of vegetation is required for any of the access tracks. No sites involve crossing a watercourse as defined under the Water Management Act.

If results of the drilling warrant further investigation, AGL may seek further approval from the DPI to convert any of the sites to a single production pilot. In this situation the borehole will be cased whilst relevant approvals are sought. If following casing, approval is not granted, or AGL decides not to go ahead with the pilot, the well will be plugged and abandoned as per the DPI Borehole Sealing Requirements on Land and the site rehabilitated.

It is proposed that these activities would commence in August 2009 and be completed by late 2010.

Details of the activity and general environmental control measures that would be employed during the works are provided in the following sub-sections.

1.5 SITE LAYOUT

The drilling activities on each borehole site will involve temporary ground surface disturbance of an area of maximum 60 m by 40 m. A typical site layout for each of the proposed drilling activities is shown in **Appendix 2**.

Provision would be made for storage of drilling water for circulation within each borehole. The drilling fluid performs the function of both lubricating the bit as well as transporting cuttings back to the surface. This water would be stored in on-site tanks as would all liquid wastes which will be disposed via pump trucks to

approved facilities. No sumps will be used at any of the proposed sites. This will minimise the risk of fluid leakages to the surrounding environment.

Stock proof site fencing would be employed to delineate the works area and to limit the extent of disturbance. A transportable laboratory/office (2.4 m x 3.6 m) would be installed on-site during the drilling and downhole logging operations.

Access to all drilling sites will be via existing tracks where possible and heavy vehicle movements will be minimised or ceased during periods of heavy rain. New tracks will be graded, and vehicle speed limits enforced to minimise dust generation and potential impacts to local wildlife.

1.6 Activity Duration and Working Times

Access tracks will be constructed where required and drill pads established prior to the drilling activity at each site. Pad construction and rehabilitation is expected to occur over 2 days for each site and access tracks constructed at a rate of 2 days per kilometre. Hours of operation for these activities will be day time only hours 7am to 6pm.

The drilling activity for each well would occur over a period of about 3 to 6 weeks. Work is scheduled to take place seven days per week on a 24-hour basis, with landholder consent. The benefit of 24-hour drilling for the local community is a significant reduction in the duration of any disturbance as the drilling process becomes more efficient and takes generally less than half the time as daytime only drilling. 24 hour drilling has been trialled previously and to date has been successfully implemented on four pilot production wells without any complaints during the drilling. Noise attenuation measures will be taken at each site for which details are provided in this review. In the event of landholder deciding against 24 hour drilling either before or during drilling the drilling hours of operation will revert to 12 hour (day-time) only.

Downhole wireline logging will be undertaken over a two day period followed by approximately 3 days for permeability testing on each well once drilling has been completed. Following the permeability testing the site will be fully restored or if it is determined to continue to production testing at any of the sites, the borehole will be cased whilst approval to develop to pilot production is sought.

1.7 Pre Drilling Construction

Access tracks, where required, will be of a maximum 4m disturbance width (3m road) with pavement depth of approx. 300mm for heavy vehicle access. Topsoil will be scraped and collected to be stored in either windrows or in stockpiles, depending on each landholders request. All access roads will have a 3% crossfall for drainage and erosion control measures placed as required.

For each borehole a cleared "pad" is required to be constructed prior to commencement of drilling. The "pad" needs to be prepared on an area of up to 60 x 40 m. The pad is cleared of topsoil (which is stockpiled near the pad for site rehabilitation upon completion), leveled and covered with a layer of compacted gravel laid in preparation for drilling activities (with a 3% cross fall for drainage). Sediment control fencing is also to be placed as required around the pad site. The drilling pad is then fenced ahead of arrival of the drilling rig. All drilling and well completion activities can then take place in the secure enclosed site.

1.8 DRILLING METHODS

1.8.1 General

Drilling of the vertical boreholes would be undertaken with a truck mounted drilling rig. The type of rig to be used is typical of rigs used for coal seam gas drilling and includes equipment to raise and lower rods in the borehole; drive gear for rotary drilling; wireline equipment for recovery of core tubes and downhole devices such as magnets for recovery of any broken bits; Blow Out Prevention (BOP) equipment; and pumps for circulation of drilling fluids.

The results from recent deep drilling in the Stratford Prospect indicate that gas kick conditions are not present. Notwithstanding, blowout preventers would be installed as standard safety equipment at the proposed borehole sites. All boreholes would have grouted casing installed to a depth which is 10% of the total expected vertical depth, providing secure anchorage for the BOP equipment. A flare line, not less than 30 m in length, will have a flare tank installed at its end. For 24 hour drilling each site will be specifically and individually set up with appropriate noise attenuation measures and will have directional lighting to prevent any potential disturbance to nearby residences.

1.8.2 Circulation Fluids

The boreholes would be drilled utilising either a circulation fluid of water containing up to 3 percent of potassium chloride (KCl), or high pressure air. No petroleum based drilling fluids or additives would be used at any stage in the drilling or testing of the boreholes.

All water based drilling fluids would be contained in a series of steel lined tanks at each site. Air circulation returns (namely drill cuttings and ground water) would be directed to the tanks via a blooie line. Any drilling fluids containing excessive amounts of polymer or other additives would be removed from site and disposed of in a licensed facility. On completion of drilling, water remaining in the tanks would be transported to an approved disposal site.

The start-up water required for the drilling would be obtained by truck cartage from the existing Stratford water storage. Approximately 40 kilolitres (L) per borehole would be required to initially fill the tanks and a similar additional amount may be required during the drilling to maintain circulation fluid levels.

As a precaution for periods of heavy rain, upslope surface water flow would be directed around the sites in accordance with the surface water management measures presented in Section 4.2. Sediment traps (e.g. silt fences) will also be used where necessary to prevent soil loss.

No drilling circulation water would be discharged to drainage lines or creeks.

1.9 BOREHOLE GEOPHYSICAL LOGGING AFTER COMPLETION OF DRILLING

Once the vertical boreholes have reached the target depth, downhole wireline geophysical logging would be undertaken for the full depth over a period of about two days on each borehole. The logging would involve the lowering of special purpose probes into the boreholes to record strata characteristics as the probe is slowly raised in the boreholes. One or more of these probes would contain small radioactive sources and only operators that are licensed to use and transport these devices would be considered for the project. The drilling rig would remain in standby during this time.

1.10 COAL SEAM PERMEABILITY TESTING

Once downhole wireline geophysical logging has been completed a program of coal seam permeability testing may be conducted on selected holes over a period of 3 days for each borehole. The testing would involve the lowering of special purpose packers on slim rods into the boreholes. The packer would isolate specific target coal seams for small scale downhole water production and injection tests to determine permeability characteristics. Only experienced contractors/operators would be considered for this testing. The drilling rig would remain in standby during this time.

1.11 SEALING OF BOREHOLES AND RESTORATION OF THE SITE

After completion of drilling activities, the boreholes will be sealed based on the *DPI Borehole Sealing Requirements on Land* guidelines and as per standard oil field practice. Water stored in tanks on-site will be removed for appropriate disposal. The surface of the drilling area would then be restored to its original condition.

As described in Section 1.4 where reasonable coal measures are identified for a core hole, and it is determined to continue to production testing at any of the sites, the borehole will be cased whilst modification of the approval is sought to develop a pilot production test well. If approval for a production well is not granted, then the well be plugged and abandoned as per the DPI Borehole Sealing Requirements on Land and the site rehabilitated.

2.0 PLANNING CONTEXT

2.1 LICENCES AND APPROVALS REQUIRED

The Second Schedule of PEL 285 outlines approval requirements for different types of exploration activity. The DPI recognises three categories of exploration activity. The establishment of petroleum exploration boreholes as proposed are considered Category 3 activities. Category 3 activities require a REF to be submitted to the DPI for approval.

The DPI has advised AGL that the Minister for Primary Industries is the determining authority with respect to exploration activities of this nature and will assess the REF under Part 5 of the *Environmental Planning and Assessment Act 1979.* Clause 228 of the *Environmental Planning and Assessment Regulation 2000* outlines the factors that the DPI must take into account when assessing the REF.

Legislative requirements for petroleum exploration in NSW such as the *Petroleum (Onshore) Act 1991*, *Threatened Species Conservation Act 1995*, *Fisheries Management Act 1994, National Parks and Wildlife Act 1974*, *Native Vegetation Act 2003*, and *Protection of the Environment Operations Act 1997* have been considered in the preparation of the REF.

2.1.1 Matters of National Environmental Significance EPBC Act

Under *the Environmental Protection and Biodiversity Conservation Act 1999* (Commonwealth) AGL is obliged to consider matters of National Environmental Significance (NES) as part of its environmental impact assessment process. An Ecological Assessment was completed by an independent consultant for each proposed borehole site. A search was conducted of the Department of Environment, Water, Heritage and the Arts online database for NES matters covering the proposed activity area.

The results of this database search are shown in Table 1.

Table 1: NES Matters for the Proposed Sites

Factor	Impacts
(a). Any environmental impact on a World Heritage property? *Comments:* No world heritage property in the vicinity of the proposed work sites.	NA
(b) Any environmental impact on a National Heritage place? *Comments:* No national heritage place in the vicinity of the proposed work sites.	NA
(c) Any environmental impact on wetlands of international importance? *Comments:* No wetlands of international importance in the vicinity of the proposed work site.	NA
(d) Any environmental impact on Commonwealth listed threatened species or ecological communities? *Comments:* No listed threatened species are likely to be impacted by the proposed work due to the highly modified nature of the proposed works areas and the minimum impact this proposal is likely to have on the ecology of the study area and locality.	NIL
(e) Any environmental impact on Commonwealth listed migratory species? *Comments:* No listed migratory species are likely to be impacted by the proposed work.	NIL

Factor	Impacts
(f) Does any part of the proposal involve a nuclear action? *Comments:* Not a nuclear action.	NO
(g) Any environmental impact on a Commonwealth marine area? *Comments:* Not in a Commonwealth marine area.	NA
(h) Any direct or indirect effect on Commonwealth land? *Comments:* Not on Commonwealth Land.	NA

2.2 ZONING

All boreholes sites are located on privately owned lands used for grazing cattle.

Proposed boreholes, Gloucester 1 and 2, Wards River 5 are located on land zoned General Rural 1A in the *Gloucester Local Environmental Plan 2000*. An assessment of the *Gloucester Local Environmental Plan 2000* shows that the activities to be carried out are permissible within this land zone.

Proposed boreholes Craven 7 and Wards River 1 to 4 are located on land zoned Zone No 1 (a) (Rural Zone) in the *Great Lakes Local Environment Plan 1996*. An assessment of the *Great Lakes Local Environmental Plan 1996* shows that the activities to be carried out are permissible within this land zone.

2.3 STAKEHOLDER CONSULTATION

Stakeholder consultation has been undertaken by AGL with the directly impacted landholders as well as the Forster Local Aboriginal Land Council in regard to appropriate access arrangements in preparation of this REF.

Additional consultation with adjacent landholders and residents will be conducted prior to the commencement of works.

AGL continues to maintain open and ongoing communication with the local community about its present and future activities, particularly through the regular meeting of the Community Consultative Committee (CCC). One aspect of AGL's activities that has been discussed in more detail with the CCC is the potential – within AGL's application for Project Approval under Part 3a of the Environment and Planning Act 1971 – for drilling to be permitted on a 24-hour-a-day basis.

The CCC is supportive for the proposed exploration activities to be treated as a trial for 24-hour drilling, which would provide the following benefits:
• A demonstration of any noise and lighting impacts from 24-hour drilling during exploration would provide an indication of the potential impacts that could be expected during a longer term drilling program for future field development; and
• The current drilling program provides an opportunity for the CCC to assess the impacts of 24-hour drilling and determine a preferred community position on operational hours for future drilling activities.

While the preferences of the CCC clearly do not override AGL's obligations under relevant NSW legislation and guidelines, they do represent a critical and favourable aspect of AGL's measures to mitigate and manage community impacts. This is particularly true of informing residents about potential noise impacts and managing the temporary disturbance they may cause.

The CCC undertook a survey of local residents in mid 2008 to assess concerns about night-time activities. An email was sent to approximately 100 potentially affected residents and community members, to which only 6 responded, and of those only 4 expressed concerns. Each of the respective landowners affected by the current exploration and within the proposed Stage 1 Field Development area is also supportive of 24-hour drilling for the approved exploration wells.

AGL will seek formal access agreements with the directly affected landowner, permitting access for the proposed drilling activities including 24 hour drilling.

3.0 DESCRIPTION OF THE EXISTING ENVIRONMENT

3.1 LAND RESOURCES

3.1.1 Land Use and Physiography

The borehole sites are situated in the Gloucester Valley, NSW. The landforms of the Gloucester Valley are characterised by north-south oriented linear ridges with intervening undulating lowlands and floodplains.

The topography in the vicinity of the borehole sites varies from 110 m to 130 m AHD. The topography consists of grassy flats and gentle rises. Relief on the sites is generally less than 10 metres.

All borehole sites are located on improved pasture land used for cattle grazing.

3.1.2 Geology

The PEL area contains the geological domain known as the Gloucester Basin or Stroud-Gloucester Syncline. This is a canoe shaped trough containing some 4,000 m of Permian volcanics and sedimentary rocks. The basin contains the Gloucester Coal Measures and Dewrang group which are the targets for the drilling programme.

The basin sequence is summarised in Table 2.

Table 2: Summary of Relevant Stratigraphy

Stratigraphic Unit	Approx. Age	Approx. Thickness (m)
Craven Sub Group	Late Permian	800
Speldon Formation	Late Permian	100
Avon Sub Group	Late Permian	500
Mammy Johnsons Formation	Late Permian	300
Weismantel Formation	Late Permian	20
Duralie Road Formation	Late Permian	250
Alum Mountain Volcanics	Early Permian	2040

Igneous rocks in the form of two thin dykes of presumed tertiary age have been reported in the south of the Basin. In the Stratford Prospect, an irregular dolerite intrusion, 5 m thick, and two thin dolerite dykes were intersected in one previous exploration borehole (PGSD 1) where the intrusion was at the level of the Avon seams. LMGW01 also intersected approximately 5m of dolerite intrusive at the level of the Avon seams.

The strata that outcrops at the surface in the vicinity of some borehole sites is the Craven Sub Group which varies in thickness from approximately 240 m to 520 m. The Craven Sub Group consists of a sequence of delta plain sand and mud deposits, major alluvial channels, minor tuffs and numerous coal seams.

3.1.3 Soil Landscape

All proposed borehole sites are located within the Gloucester soil landscape. The Gloucester group was described by Henderson, 2000 and is summarised in

Table 3.

Table 3: Gloucester Group Soil Landscape Attributes

Attribute	Comment
Landscape	Undulating low hills on Permian sediments in the Stroud-Gloucester Basin region. Relief <50 m, Elevation <200 m and Slopes <10%.
Soils	Moderate to deep, moderately well-drained Brown Sodosols (Yellow Soloths) and moderately well-drained Grey Kurosols (Yellow Soloths) on imperfectly to moderately well drained sideslopes and crests shallow to deep.
Vegetation	The original open-forest which covered most of this landscape has been cleared and replaced with improved pasture. Mature trees of Forest Red Gum (*Eucalyptus tereticornis*), Grey Box (*E. moluccana*) are common but isolated.
Land use	Improved and semi-improved pasture. Agricultural activities including dairying, beef cattle production, orchards, horse stud, and some cultivation.

3.2 CLIMATE

The climate is warm temperate (warm to hot summers, mild to cool winters) with the rainfall pattern having a summer maximum. Meteorological records indicate average annual rainfall is about 980 mm (Bureau of Meteorology [BOM], 2009). The months of July to October are the driest period and represent the period of least risk for erosion associated with earthworks. December to March are generally the wettest months and accordingly earthworks during this period must be undertaken with suitable care.

Temperatures recorded at the Stratford Coal Mine indicate that January and February are the hottest months and June the coldest. Temperatures have been recorded varying from 38.6 to -3.8^{o}C (BOM, 2006).

3.3 WATER RESOURCES

3.3.1 Surface Water

The proposed borehole sites are situated within the catchments of the Gloucester, Avon and Wards River. The Gloucester and Avon Rivers are two of approximately 30 rivers that contribute to the greater Manning River system (SCPL, 2001). Groundwater seepage contributes to flows in the local tributaries and creeks during periods of elevated groundwater levels that follow rainfall events (SCPL, 2001).

Surface water quality assessments undertaken for the Bowens Road North EIS (SCPL, 2001) indicate that water quality in the area is generally in compliance with the ANZECC (1992) livestock watering and aquatic ecosystem guidelines, however, with considerable variability in pH and salinity during periods of low stream flow.

The Wards River is a tributary of the Karuah catchment. The surface water quality varies in relation to flow levels which also vary significantly during seasons (HITS, 2009). Generally the water quality of the Karuah River in the upper reaches is also of levels in compliance with the ANZECC (1992) livestock watering and aquatic ecosystem guidelines (HCRCMA, 2004).

Section 4.2.1 describes potential impacts and mitigation measures that relate to surface water.

3.3.2 Groundwater

A series of assessments of the local and regional hydrogeological regime and local groundwater quality have been undertaken for the Stratford Coal Mine, Bowens Road North Coal Mine. These are summarised in the Bowens Road North EIS (SCPL, 2001).

Previous investigations have identified that the coal seams are the main continuous aquifers in the Gloucester Basin. The conductivity of coal seams may vary over several orders of magnitude and the low hydraulic conductivity of overburden and structural faults compartmentalises groundwater flows.

Groundwaters in the Bowens Road North Mine area are generally saline, highly mineralised, hard waters with slightly alkaline to acidic pH, unsuitable for domestic consumption and in some cases livestock consumption (SCPL, 2001). Shallow groundwaters tend to be more acidic than groundwaters from deeper aquifers (*ibid*.).

CSIRO water quality testing of groundwater samples from previously conducted coal seam methane exploration boreholes in the Stratford Prospect have confirmed that the groundwaters in the evaluation area are generally neutral to slightly basic (7.0-8.7 pH) and generally saline (conductivity 5,220 – 21,700 µS/cm). The results of the CSIRO groundwater testing may overstate the salinity, as a KCl based drilling fluid was utilised for completion of these boreholes to maintain hole stability.

AGL continues to carry out water quality testing of groundwater from several coal seam methane exploration boreholes within the Stratford Prospect area. Samples from borehole LMG03 show groundwater properties for pH are between 7.5 - 9.3 and electrical conductivity is between 3,300 and 5,400 µS/cm. The water testing results and ongoing assessments have now enabled the approval of the produced water from LMG03 to be utilised for pasture irrigation.

Daily measurements of electrical conductivity at boreholes Stratford 4 and Stratford 8 average around 9,400 and 7,400 µS/cm respectively. However, the volume of water produced from these wells is significantly less than that produced historically at LMG03.

3.4 FLORA AND FAUNA

Gloucester Local Government Area – Gloucester 1 and 2; Wards River 5

Gloucester Local Government Area (LGA) contains significant biodiversity values, including the World Heritage listed Central Eastern Rainforest Reserves (Barrington Tops Area) and Barrington Tops National Park, as well as the Woko National Park, six nature reserves and four State conservation areas located throughout the area. In all, 51,090 ha are dedicated to species and ecosystem conservation, around 17% of the entire LGA (Gloucester Shire Council 2005). Nonetheless, the LGA continues to loose biodiversity through:

- Land clearing;
- Habitat alteration through weed invasion;
- Domestic and feral animal activity; and
- Poor land management techniques.

With such significant conservation areas the LGA provides habitat for a number of species and endangered ecological communities listed on the schedules of the NSW *Threatened Species Conservation, 1995* (TSC Act), NSW *Fisheries Management Act, 1994* (FM Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act). The Gloucester Shire Council *Supplementary State of the Environment Report 2008* lists 42 threatened species

of Fauna and 9 Threatened species of Flora that have been recorded in the district.

Great Lakes Local Government Area – Craven 7; Wards River 1 to 4.

Great Lakes Local Government area possesses a unique environment of immense natural beauty, which includes extensive waterways, national parks, rural regions and mountain ranges. These landscapes provide habitat for an incredible diversity of native plant and animals. Vegetation communities include rainforest, moist and dry forests, wetlands and swamps, coastal heaths, seagrass beds, dunal formations and natural grasslands. To date, preliminary data suggests that over 500 fauna species and 1,200 native plant species inhabit the LGA. This includes rare, significant and threatened species. 70,476 ha are currently conserved in public conservation estate (GLC, 2007).

A review of both LGA's threatened species lists indicate that the majority of species and ecological communities would be confined to the vegetated areas within conservation areas, within remnant vegetation in private ownership and in riparian areas and along coastal waterways.

Assessment

A thorough ecological assessment by an appropriately qualified ecologist (**Appendix 3**) of each borehole site was undertaken, involving:

- A review of available literature and databases to assist with identification of site values, especially in relation to threatened species, populations and endangered ecological communities;
- Field investigations to ascertain the current site condition and the presence or likely presence of threatened or protected species;
- An impact assessment to determine the likely effects of the proposal on the ecology of the sites; and
- Preparation of preliminary recommendations to ameliorate and mitigate any impacts.

An assessment of all access tracks and borehole sites was conducted utilising aerial photographs and a site visit. The locations of the proposed access tracks and boreholes are all within highly modified environments that have been cleared of native vegetation, largely revegetated with introduced pasture species and used for grazing of stock over a considerable number of years. None of the proposed borehole sites contain remnant vegetation in the form of shrubs or trees and none would be located in riparian areas. The disturbed nature of the proposed sites indicated that detailed surveys would not be required to characterise the ecology of the sites, their conservation value and the potential impacts of the proposals.

3.4.1 State and Commonwealth legislation

Given the highly modified nature of the sites, none of the Endangered Ecological Communities (EECs) listed as occurring within the Karuah Manning CMA subregion, are present. There are 63 threatened species listed as known or predicted to occur for this subregion under the NSW *Threatened Species Conservation Act 1995* (TSC). A total of 63 species (ten plants, one reptile, four amphibians, 25 birds and 23 mammals) listed under the NSW *Threatened Species Conservation Act 1995* (TSC) have been recorded within the locality, but for the vast majority of species the proposed borehole sites lack the complexity required to provide habitat and their presence is considered unlikely. Likewise, of the 14 fauna, 13 flora and 12 migratory species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

(EPBC) with potential to occur within the locality of the site, the majority are considered unlikely.

Three species recognised under the TSC Act, one of which is also listed under the EPBC Act, have been identified as possibly residing or foraging within the locality of the proposed sites.

Although the potential for these threatened species to be impacted by the proposed work is limited, Assessments of Significance (required under Part 5A of the NSW *Environmental Planning and Assessment Act 1979*) have been undertaken as a precautionary measure. As the Green and Golden Bell Frog is also listed as endangered under the EPBC Act, this species has also been considered using the Significant Impact Criteria for Endangered Species listed in the EPBC Act *Administrative Guidelines for Significance* (Commonwealth of Australia 2006). These assessments were completed by a suitably qualified ecologist and are included in the *Ecological Assessment* in **Appendix 3**.

It was concluded that the proposed works would not impact on any known breeding habitat for these species and would be unlikely to have a significant impact on foraging resources. Given the highly modified nature of the works areas, the minimum impact of the proposed works and the implementation of stringent management measures, it was considered unlikely that any of these species would be significantly impacted.

A Species Impact Statement is therefore not necessary, nor a referral to DEWHA required.

An assessment under *State Environment Planning Policy No. 44 – Koala Habitat Protection* (SEPP 44) is required as Gloucester LGA is listed under Schedule 1 of SEPP 44, which requires the identification and protection of core koala habitat. The proposed borehole sites could not be considered core koala habitat or potential koala habitat as the sites lack any trees and in particular those species listed under Schedule 2 of this SEPP. Consequently no further provisions of SEPP 44 need apply to this application.

Overall outcomes from the ecological assessment include the following:

- The access tracks and borehole sites are located on cleared pasture land away from native shrubs, trees or ecological communities;
- there are no rocky outcrops which could provide habitat for reptiles or small mammals; and
- the proposed areas are clear of creeks or seepages that could act as habitat for amphibians or other water dependant species.

The full ecological assessment is provided in **Appendix 3.**

Section 4.5 describes potential impacts and mitigation measures that relate to flora and fauna.

3.5 HERITAGE

3.5.1 Aboriginal Heritage

The project falls under Part 3A and the consultation was undertaken as per the new DECC Interim Guidelines for Consultation. The notification for registration covered the period from 25th June 2008 to 25th June 2009 and as such the previously registered Aboriginal groups were again consulted throughout the project (McCardle, 2009).

A search of the Department of Environment and Climate Change (DECC) Aboriginal Heritage Information Management System (AHIMS) database was

undertaken for the project areas and surrounding district. This search did not identify any previously recorded Aboriginal heritage sites within close proximity of the proposed borehole sites however six known aboriginal sites were located within 5km surrounding the sites.

The majority of AGL sites were located on slopes with G1 and G2 located on flats/flood plain areas. Disturbances across each site were minimal and included clearing and grazing. Vegetation cover varied from moderate to high thus decreasing visibility. One isolated artefact (grey silcrete flake) was identified at Craven 7 that was situated in a large erosion scar next to a drainage line and in close proximity to a dam. The site was heavily disturbed through dam construction, erosion, clearing and grazing. Visibility on the site was 100% and 10% in the area surrounding. Due to the disturbances, there is limited to no potential for in situ cultural materials at this site.

One PAD was identified at proposed site Wards River 2. This PAD encompasses an area of a gentle slope that overlooks a terrace and Bull Creek (a 4th Order Stream). Disturbances are minimal and soil A horizon remains. Although the PAD is extensive, only the area to be disturbed is included in the PAD for this project.

The PAD is located within what is believed to be an ideal location, landform and distance from a reliable water source and its associated resources along with the minimal disturbances suggests there is a moderate to high potential for subsurface cultural materials at these locations.

A s90 Aboriginal Heritage Impact Permit (s90 Consent to Destroy with Collection) is recommended for site AGLG1 and a s87 Aboriginal Heritage Impact Permit (s87 Preliminary Research Permit for test excavation) is required for PAD 1 (McCardle, 2009).

The full indigenous archaeological assessment is provided in **Appendix 4.**

Section 4.7 describes potential impacts and mitigation measures that relate to heritage aspects.

3.5.2 European Heritage

The evaluation area is located within cleared grazing lands and no European heritage items are known or are likely to be located on the borehole sites.

Section 4.7 describes potential impacts and mitigation measures that relate to heritage aspects.

3.6 AIR QUALITY AND NOISE

The air and noise environment in the vicinity of the proposed well site locations is influenced by typical rural activities such as machinery operation (tractors, generators, pump units, harvestors) and trucking of rural products, together with the noise of livestock, birds and other wildlife. There are existing coal operations that dominate the local noise environment. The Buckett's Way is a main arterial road which bisects the area as does the main northern railway line, both contributing significantly to the local noice environment due to the extent and type of their use (heavy vehicle traffic and freight and coal transport).

Section 4.1 and 4.4 describe potential impacts and mitigation measures that relate to air quality and noise aspects.

3.7 SOCIO-ECONOMIC AND COMMUNITY ASPECTS

The borehole sites are located within the Gloucester and Great Lakes Local Government Areas. Employment is dominated by agriculture, forestry and mining. There are well established community services and a range of hotels and other accommodation facilities available.

Section 4.10 describes potential impacts and mitigation measures that relate to socio-economic and community aspects.

4.0 ASSESSMENT OF THE POTENTIAL IMPACTS AND PROPOSED MITIGATION STRATEGIES

The following section outlines the potential impacts of the exploration borehole activities that have been identified, and the measures to minimise these impacts. In addition a Project Environmental Management Plan (EMP) will be implemented for the project (**Appendix 6**). The EMP sets out the project specific procedures to manage each of the issues identified in this REF. A copy of the EMP will be kept in the site office together with the Emergency Response Procedure (ERP) and Safety Management Plan (SMP). The contractor(s) will be required to conform to the requirements of the EMP.

The EMP includes:

- A statement of objectives;
- The measures to be taken to manage the environmental issues described in this REF;
- The responsibilities of the site supervisor, contractor(s) and any sub-contractors;
- Site induction requirements;
- Reporting requirements; and
- Environmental emergency response plan.

4.1 AIR QUALITY

The potential for dust generation from the proposed drilling is minimal. Access to the majority of the proposed drill sites is expected to be via the existing farm tracks. Dust generation by vehicles moving along these tracks would be minor and similar to existing farm uses. Speed limits will be enforced on all access tracks which will assist dust minimisation. In the event of severe dry conditions dust will be monitored and water trucks employed to moisten gravel access tracks for dust prevention.

The drill pads require minimal earthworks and would occupy a limited area. As a result, dust generation from the operating drill rig would be negligible. Areas of topsoil stored either in windrows or stockpiles will be vegetated and if required moistened to prevent dust under high wind conditions.

4.2 WATER RESOURCES

Potential surface water quality impacts include general migration of sediments, oils, grease or dissolved salts from disturbed areas to downstream watercourses.

4.2.1 Surface Water

Erosion and sediment control measures would be utilised to minimise the potential for sediment migration to downstream surface water catchments from disturbance areas such as drill sites, topsoil/subsoil stockpiles and access tracks. Erosion and sediment control structures may include, but would not necessarily be limited to, silt fences, diversion drains and maintenance of down slope grassed buffer zones.

Water required for commencement of drilling will be supplied from project water storages at the nearby Stratford Pilot Project. Drilling fluid waters would be stored in steel tanks located beside the drill pad. On completion of drilling, water and fluids collected in the tanks would be removed to a licensed disposal facility.

The following general measures would be implemented to protect surface waters:

- Prohibition of petroleum based drilling fluids and additives in the drilling and testing of the boreholes;
- Containment of drill fluids in tanks and where necessary removal and disposal at appropriate facilities;
- The prevention of discharge of drilling fluids to creeks;
- Use of sediment fences/traps to prevent soil loss;
- The storage of fuel and lubricants on-site would be minimised and only approved containers used;
- Bunding of oil and fuel storages and maintenance of a spill control kit on-site;
- Provision and maintenance of spare drilling tanks with capacity to contain overflow from the main tank in the event of increased flow from the borehole; and
- Restoration of all disturbed ground immediately following completion of the works to minimise sediment erosion.

4.2.2 Groundwater

Due to the short duration of the proposed exploration drilling and the depth of the target seams, it is not anticipated that any significant groundwater impacts on other groundwater users or the environment would be expected. Notwithstanding, any intersections of the boreholes with alluvial aquifers will be steel cased with cement (typically to 10% of total hole depth) to create a positive isolation between the borehole and the alluvial aquifer which will minimise any potential affect on other groundwater users that access shallow alluvial aquifers in the local area (typically 20-50 m deep) or the environment surrounding the boreholes.

The borehole sites would be rehabilitated to the satisfaction of the landowner and to DPI guidelines using standard oil field practices.

4.3 LAND RESOURCES

Site preparation for each proposed well will involve minor earthworks for the construction of access tracks and drill pads. This disturbance creates the potential for increased erosion and sedimentation at the evaluation area. Potential impacts to land resources from the drilling operations predominantly relate to the potential for land contamination resulting from contact with, or absorption of, chemicals used and stored on site (namely fuels, lubricants and drilling fluids/agents). This could result from leakages from operating plant, spillage of drilling water/fluids from tanks or uncontrolled spills onto surface soils.

An Erosion and Sediment Control Plan will be developed and will include the following requirements:

- Extent of disturbance to be minimised;
- Topsoil from excavations to be stockpiled or windrowed for use in restoration;
- Upslope drains will divert upslope runoff water around disturbance areas;
- Sediment fences to be erected around the downslope sides of topsoil stockpiles and disturbance areas;
- The sites would be restored immediately after drilling activities have been completed and it has been determined no further work is required.

On completion of the proposed exploration activities, all surface infrastructure and waste (such as litter, used materials and any contaminated soil) will be removed from the site. Where earthworks have been conducted, the stockpiled soil would be returned (topsoil and subsoil) and the area re-contoured to its original or near-original landform. Sediment and erosion control structures would be left in place until the potential for erosion and sedimentation is sufficiently

reduced by site restoration. Given that no native vegetation clearance is required, site restoration is expected to predominantly involve the sowing of suitable pasture species.

4.4 NOISE

Potential sources of noise associated with the proposed drilling activities include earthmoving equipment (namely excavator/backhoe/bobcat); drill rig and generator operation; vehicles travelling to and from the drill site.

All proposed well sites are located over 250m from the nearest residence. A Construction Noise Assessment was completed by suitably qualified persons for each of the eight borehole sites (**Appendix 5**). This assessment details the locations of the nearest residences to each of the sites and the potential impact for each.

All sites were assessed based on 24 hour drilling with the exception of 'Gloucester 2' which had been pre-determined by AGL to be drilled under day time conditions only (7am to 6pm). This decision was made due to the proximity of the site to the many residences on the northern edge of the township of Gloucester, even though the closest residence is still 250m to the south.

In the event that any complaints are received in respect to noise, consultation and investigation would be undertaken to assess the nature of the concerns and identify options to mitigate the noise in consultation with the DPI.

The potential sources of noise associated with the proposed activities are related to well preparation, namely earthmoving machinery for the construction of drill pads and access track (where required), generator operation, vehicles travelling to and from the site, and drilling.

4.4.1 Construction Noise Impact

Each well is generally located in a sparsely populated rural area, though noise impact modeling (**Appendix 5**) for each activity phase identified some residences as being potentially impacted by the proposed works. However, the following factors indicate that significant noise impacts are manageable and prolonged noise impacts unlikely:

- The layout at each borehole site of equipment and ancillary buildings will be specifically orientated based on the noise assessment recommendations for each individual site to minimise noise impacts at nearby residences.
- Drilling activities would be of short duration (about 3 to 6 weeks per hole);
- All other earthmoving, drilling and vehicle movements would be conducted over a short period of time in the site preparation, drilling and restoration phases;
- There will be no movement of rig or large machinery to/from the site during night time operations. Light vehicle movements to the sites at night will also be minimised during night time operations.
- The rig utilised in the noise assessment modelling is of a larger size than the rig to be used for the exploration works and hence predicted noise levels are higher than that generated. Based on the noise assessment there will be no noise exceedance at any of the nearby residences if all mitigation measures recommended are followed for this larger rig, so it can be safely concluded a smaller rig will only improve these conditions.
- Potentially affected residences will be informed in advance as to the extent and timing of activities and responsibly advising when noise levels during such works may be relatively high;

The implementation of reasonable mitigation measures and open communication with the community, coupled with the short term duration of the activities, should work towards minimising the impact of noise on residents where exceedance may occur. Mitigation measures to be employed may include:

- Inclusion of noise management in the EMP so that employees understand and take responsibility for noise control at the sites (such as optimizing the location of plant in relation to sensitive receptors);
- Scheduling activities such that the concurrent operation of plant is limited;
- Where known to be available, deploying plant having lower noise emission levels;
- Routine field monitoring of noise during actual operations;
- Properly maintaining plant to ensure related noise emission levels are not exceeded;
- Providing a contact telephone number via which the public may seek information or make a complaint.

4.4.2 Noise Impacts and Mitigation – Conclusion

The Construction Noise Assessment provided in **Appendix 5** concluded that the noise modeling, of a Drilltec G55 rig, "in the absence of additional noise controls identified potential for noise exceedance at a number of reference residential receiver locations. The G55 unit is larger than the equipment anticipated to be used for exploration drilling and accordingly is considered conservative" (Atkins Acoustics, 2009).

The assessment recommended a number of conceptual noise controls including maximizing directivity characteristics of the drilling plant, location of offices and other ancillary buildings to provide shielding, 'cut and fill' operations to maximize shielding and location of excavated fill material and/or temporary noise walls (Atkins Acoustics, 2009).

The Construction Noise Assessment concluded that with the effective implementation of noise controls, the assessment has shown that the recommended evening/night target noise goal of L_{A10} 35dB(A) is predicted to be satisfied at all reference locations.

The following table provides a break down of further mitigation measures that will be undertaken for each site.

Table 6: Noise impact mitigation – strategies and work practices

Strategy	Work Practice employed by AGL
1 – Universal Work Practices	• Staff and contractors trained to operate equipment in ways to minimise noise; • No stereos, public address systems or unnecessary shouting; • Noise management included in company and project Environmental Management Plans.
2 – Consultation and Notification	• Information provided to local landholders and residents in relation to anticipated construction extent and duration; • Consultation with individual landholders who may be impacted; • Regular community consultation and meetings undertaken as part of the project; • A documented complaints procedure, with senior staff readily responding to community concerns and all reasonable and feasible measures taken to address complaints.
3 – Plant & Equipment	• Recognition that controlling noise at the source is the most effective way of mitigating impacts; • Employing, wherever possible, equipment that represents the quietest alternative for the job; • Considering noise attenuation devices wherever equipment noise is excessive; • Maintaining equipment in good working order, including regular inspections.
4 – On site	• Design site set-up to ensure the greatest distance possible is placed between equipment and sensitive receptors; • Positioning of site-offices, tanks and other objects as potential barriers and as per recommendations in the Construction Noise Assessment; • Site vehicle entrances located away from sensitive receptors.
5 – Work Scheduling	• Consideration of local events, or scheduling around business/school hours where applicable; • Optimising site deliveries and scheduling them for daytime hours only;
6 – Transmission Path	• Reduce the line-of-sight noise transmission to residences using temporary barriers (typically for longer exposure); • If temporary barriers are to be employed, erect them before work commences.
7 – At Sensitive Receptor	• Mitigating noise impacts at the sensitive receptor is considered a last resort and is not preferred; • Temporary relocation may be considered if extended and excessive noise impacts cannot be reasonably or feasibly mitigated.

4.5 FLORA AND FAUNA

The borehole sites are characterised by cleared land and improved pasture which is used for stock grazing. The access tracks and borehole sites have been located to avoid areas of native vegetation and riparian or seepage areas and consequently no native vegetation would be cleared or drainage patterns altered as a consequence of this proposal. The potential removal of two Spotted gum saplings to gain access to the Wards River 2 site is not considered significant, as the saplings lack complexity, dense canopy and tree hollows.

Furthermore, the impact area is relatively small at each of the sites and impacts would be temporary (in the range of 3 - 6 weeks). After this time the sites would be restored to their current condition.

Key Threatening Processes and NSW and Commonwealth Legislative Assessments

There is the potential for threatening processes to be exacerbated by this proposal which could adversely impact on the ecology of the locality and these include:

- Weed invasion (EPBC Act and TSC Act);
- Land clearance (EPBC Act); and
- Competition and land degradation/grazing by feral Rabbits (EPBC Act & TSC Act).

However, it is considered unlikely that any key threatening processes under the TSC Act or EPBC Act would be exacerbated by this proposal, since the borehole sites and access routes have been located to avoid native vegetation and riparian or seepage areas. Consequently no native vegetation (with the possible exception of two saplings) would be cleared or important natural drainage patterns altered.

Assessments of Significance for the Green and Golden Bell Frog, Grey-crowned Babbler and Grass Owl concluded that the proposed works were unlikely to impact on these species (**Appendix 3**).

Consequently, no further consideration under the TSC Act and EPBC Act need apply to this application.

Cumulative Impacts

Cumulative impacts are those that add to the deterioration of the ecological values of a site or locality and generally occur when remaining native vegetation is removed or altered, fauna habitat is removed or altered and / or the natural hydrology of the area is altered. There are unlikely to be cumulative impacts associated with this proposal as native vegetation would not be removed, fauna habitat would not be altered, the hydrology of the site would not be changed and any impacts would be minor and temporary.

Management Measures

To ensure that impacts are temporary and that there are no off-site impacts a number of general flora and fauna management strategies would be incorporated into the drilling specification and the Project EMP with the aim of protecting local flora and fauna:

- Vehicle numbers and speed would be strictly limited to reduce the risk of fauna injuries;

- The sites would be fenced with temporary stock-proof fencing and bunded where appropriate;
- All drilling fluid would be contained on site in steel tanks and no discharge of drilling fluid to waterways, aquatic and riparian environments would be permitted;
- Weeds would be controlled on all restored sites;
- Ongoing monitoring and, if necessary, restoration maintenance would be undertaken until grass cover has re-established;
- Diversion of stormwater to direct run-off to sediment control mechanisms;
- Rubbish should be collected and removed off site to prevent it entering waterways and causing harm to fauna; and
- No chemicals, fuels and / or wastes should be stored within or near any natural or stormwater drainage lines. All such substances are to be contained in sealed vessels of appropriate volumes and, where necessary, stored within bunded areas.

4.6 VISUAL AMENITY

The local landscape accommodates a number of different land use activities, including large coal mines, small rural landholdings and agricultural land, all of which necessitate the need for broad-scale vegetation clearance. This provides a typically 'rural' visual setting largely void of stands of native vegetation and the vegetation varies from cleared and heavily grazed pasture to disturbed open forest, except for remnant river/creek and roadside vegetation stands.

The proposed drilling program would result in minimal visual intrusion on the surrounding countryside given:

- The limited extent of the drilling rig assembly;
- The distance from any vantage point or residence, the undulating topography and screening potential provided by remnant vegetation; and
- That disturbed surfaces will be restored to the pre-existing condition following the completion of the drilling program.

Consequently changes to the visual amenity of the area are not considered to be of significance.

4.7 HERITAGE

There are no known Aboriginal heritage sites in close proximity to the exploration area. The past disturbance to the borehole sites due to European occupation and grazing limits the likelihood of identifying significant Aboriginal sites in the area. A s87 Aboriginal Heritage Impact Permit (s87 Preliminary Research Permit for test excavation) has been submitted to further investigate the site Wards River 2, whilst a s90 Aboriginal Heritage Impact Permit (s90 Consent to Destroy with Collection) has been submitted for Craven 7 for an isolated artefact. No works will proceed on these sites until these permits have been issued and investigations concluded and approval for works given.

During site preparation, personnel will monitor for artefacts and should any relics be encountered during the course of the works, work will cease in the vicinity of the relic/artefact and the site supervisor will seek advice from DECC or Heritage Office personnel so that it can be assessed in accordance with the requirements of the *National Parks and Wildlife Act, 1974* or *Heritage Act, 1977*.

4.8 SAFETY AND RISK MANAGEMENT

4.8.1 Drilling

The drilling specifications would require that contractors ensure that all persons employed by them on the drilling sites are familiar with and comply with the Safety Management Plan and the Manual of Emergency Response Procedures for the drilling program. A site induction would be undertaken prior to all personnel entering or working on the sites.

The principal potential safety issues identified in connection with the proposed works relate to occupational health and safety aspects that are of a temporary nature, as follows:

- Physical safety associated with the drilling;
- Gas kick;
- Mechanical failures, work related accidents and inclement conditions such as wet weather and electrical storm;
- Bushfire risk; and
- Road safety on access tracks.

The longer term safety issue arising from this activity relates to the safe sealing of the boreholes. This would be addressed by the cement sealing of the boreholes as per DPI requirements and standard oil field practice.

4.8.2 Physical Safety

- Suitable protective clothing, headgear and footwear would be worn by all staff on site in accordance with workcover requirements;
- A comprehensive first aid kit, including a snake bite kit would be maintained on site during all activities;
- A reliable system of communication would be maintained on site to enable accidents to be reported and medical assistance to be obtained if required;
- Appropriate signage for safety requirements would be placed at or near all gates; and
- No public access would be allowed to drilling sites.

4.8.3 Night Operations

24-hour drilling is proposed with landholder consent. During this night period traffic movements will be limited to the beginning and end of shift. No rig or heavy vehicle movements will occur at night. Appropriate directional lighting will be installed across the drill site to provide a safe working environment.

4.8.4 Gas Blowout

In accordance with the exploration licence conditions, the risk of a gas kick has been assessed based on experience from previous drilling in the immediate surrounding area, including nine deep coal seam methane exploration boreholes drilled by Pacific Power. As no gas kicks were encountered in any of these boreholes the risk of gas kick in the proposed boreholes is considered to be unlikely. Nevertheless blowout prevention equipment would be installed on all boreholes.

The equipment, its installation and operation would meet the requirements of the *Petroleum (Onshore) Act 1991* and the *Petroleum (Onshore) Regulations 2000*. In addition, a flare line, not less than 30 m in length, with a flare tank at its end would be installed.

4.8.5 Mechanical Safety and Work in Adverse Conditions

Drillers would be required to maintain all equipment in safe operating condition. All contractors would exercise their own discretion as to whether working conditions are safe in the case of heavy rain, strong winds or electrical storms.

4.8.6 Bushfire Risks

The main bushfire risks arise during hot dry periods and could arise from proximity to surrounding bushland or large areas of pastureland.

To minimise bushfire risks, the contractor would be required to:

- During periods of moderate to high fire danger, slash and maintain any grass in excess of 100 mm at the work site;
- Minimise the on site storage of fuel and ensure that it is safely stored at all times;
- Maintain facilities for fighting fires on site, particularly a water pump and hoses;
- Prohibit the lighting of fires on site during periods of bushfire risk or any other time; and
- Prohibit smoking and cease activities which could cause sparks on days of extreme fire danger.

4.8.7 Road Safety

The following measures would assist the mitigation of road safety risks:

- The drilling specification would require all vehicles to comply with all statutory and licence requirements;
- Access to the sites from the local road is at a location that has adequate visibility in both directions. Speeds on local access tracks would be limited to less than 45 kph to ensure safety for stock, native fauna and other users of the tracks; and
- Any locations used for obtaining water for drilling would be assessed for road safety for access by truck and during filling.

4.8.8 Stock Injury and Loss

There are stock present at these locations. All excavation areas would be fenced off to prevent any stock or native animals falling into them. This would prevent access by larger animals such as the Eastern Grey Kangaroo. Other smaller animals would be discouraged from entering the compound by ensuring all rubbish is correctly disposed.

4.9 TRAFFIC

The project will involve short term (3 – 6 weeks) activities on each of the borehole sites for the drilling operation and include the coming and going of drilling contractors for each shift and for the delivery of materials. The drilling contractor will have several heavy vehicles including the drilling rig and ancillary vehicles and equipment. These vehicles will mostly remain located on the drilling sites. Contractors will be required to maintain all vehicles in a roadworthy condition and obtain all necessary approvals and licences. There will be no rig or heavy vehicle movements at night.

There will also be less frequent visits by AGL supervisors, geologists, technicians and contractors.

4.10 SOCIO-ECONOMIC AND COMMUNITY ASPECTS

Due to the limited scale and duration of the proposed evaluation works, no significant socio-economic or community impacts would result from the proposal. Notwithstanding, there would be positive economic effects associated with the short term employment for local contractors and drilling contractors associated with the proposal with expenditure for accommodation, food and entertainment in Gloucester for the duration of the works.

5.0 CONSIDERATION OF ALTERNATIVES AND JUSTIFICATION FOR THE PROPOSAL

The drilling and testing is being conducted at these sites to evaluate the coal seam and gas characteristics in the PEL, with a view to the future development of a trial production field. The works are being conducted in accordance with the requirements of the Third Schedule, Work Program of PEL 285. The PEL 285 licence holders are required, as a licence condition to be committed to a minimum work program as agreed by the NSW DPI, for the period of the licence term.

AGL thoroughly reviewed the proposed borehole locations and strategically placed them based on existing geological information, landholder consultation and potential environmental and cultural heritage impacts as assessed by the independent consultants. Due to this review the location of the proposed core hole known as 'Wards River 3' was moved from the original proposed location to its present proposed location. This change in location minimised environmental risk through eliminating the need for a watercourse crossing for the access track, reducing impact for a potential archaeological deposit site and also eliminating a safety hazard as was posed for access from the Bucketts Way, for both equipment and vehicle access.

6.0 CONCLUSION

The proposed drilling will involve minor disturbance to areas of cleared grazing lands and will be conducted for a period of 3 - 6 weeks for each proposed site. Following completion all disturbance areas would be rehabilitated to the satisfaction of the landowner and DPI.

The drilling activities will be conducted in accordance with suitable environmental management procedures, and in consideration of the potential impacts associated with the activity. Accordingly, the proposed drilling activities at the proposed drill sites can be undertaken with minimal impact to the environment.

7.0 REFERENCES

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APPENDIX 1

ACTIVITY LOCATION MAP

AGL

Revision DRAFT
Created 15 May 2009
Author Upstream Gas

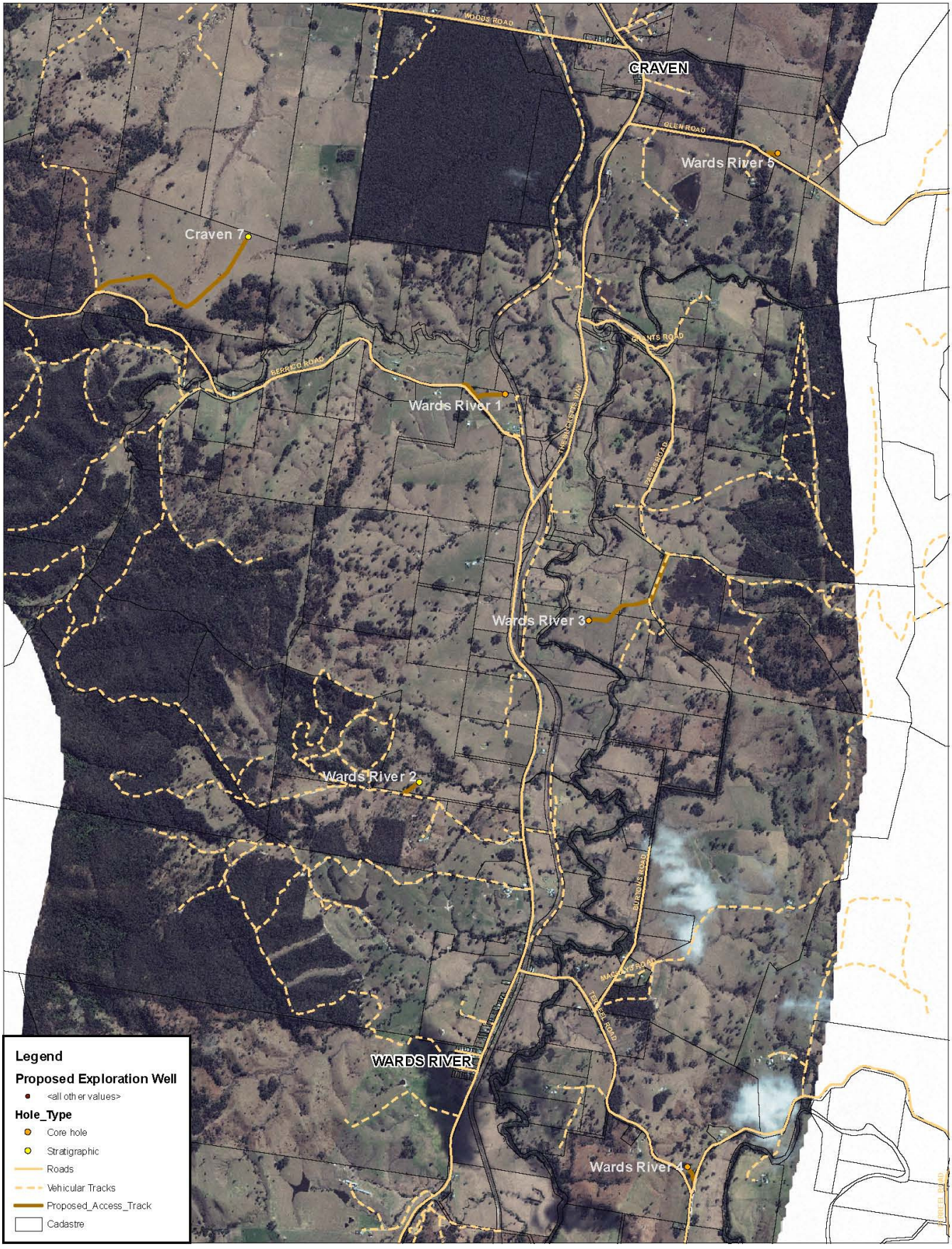
N
W E
S

1:12,500
0 0.125 0.25 0.5 0.75
Kilometers
Map Grid of Australia, Zone 56
Geocentric Datum of Australia 1994

Gloucester Coal Seam Gas Project

Proposed Stratigraphic and Core Holes
Gloucester 1 and 2

STRICTLY CONFIDENTIAL



AGL

Revision DRAFT
Created 15 May 2009
Author Upstream Gas

N
W E
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1:25,000
0 0.25 0.5 1 1.5
Kilometers
Map Grid of Australia, Zone 56
Geocentric Datum of Australia 1994

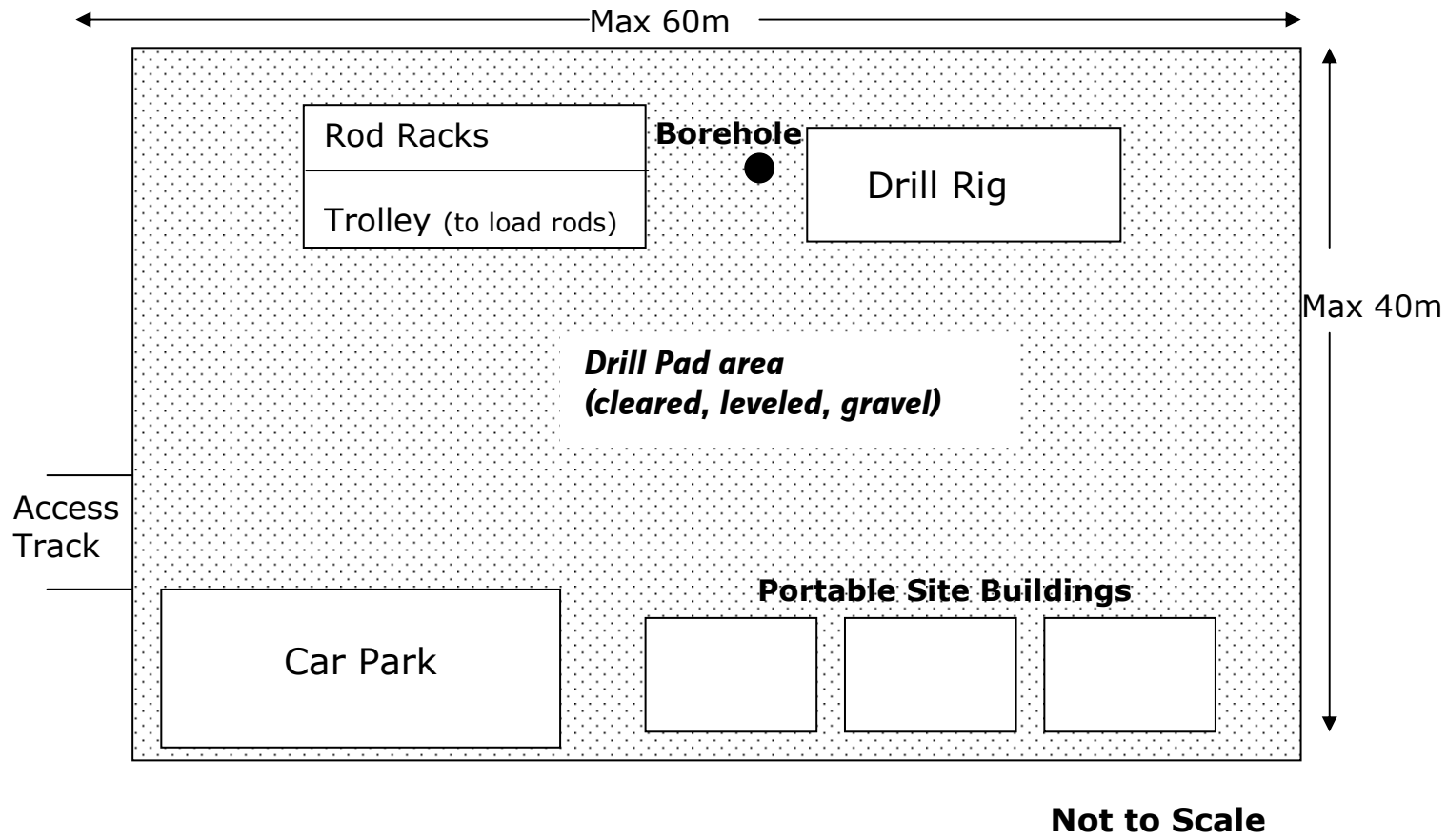
Gloucester Coal Seam Gas Project

Proposed Stratigraphic and Core Holes
Craven 7 & Wards River 1 to 5

STRICTLY CONFIDENTIAL

APPENDIX 2

SITE LAYOUTS



Approximate Exploration Drill Site Layout

(to be specifically orientated for each borehole site)

APPENDIX 3

ECOLOGICAL ASSESSMENT

AGL Gloucester L E Pty Ltd

Coal Seam Methane Gas Exploration Borehole Sites

Gloucester 1 & 2, Wards River 1 - 5 and Craven 7

Ecological Assessment

May 2009

Alison Hunt and Associates Pty Ltd

TERRESTRIAL | MARINE | AQUATIC

Executive Summary

Alison Hunt & Associates Pty Ltd was commissioned by AGL Gloucester L E Pty Ltd (AGL) to undertake an ecological assessment for eight coal seam methane gas exploration sites known as Gloucester 1 and 2, Wards River 1, 2, 3, 4, 5 and Craven 7, all of which are located near Gloucester in NSW. The purpose of the study was to assess the potential direct and indirect impacts of the proposal on biodiversity especially in relation to threatened species and endangered ecological communities with particular reference to Part 5A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), NSW *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Several tasks were addressed in this assessment including a review of available literature and databases to assist with the identification of site values especially in relation to threatened species, populations and endangered ecological communities, field investigations to ascertain the current site condition and the presence or likely presence of threatened or protected species, an impact assessment to determine the likely effects of the proposal on the ecology of the sites and preparation of preliminary recommendations to ameliorate and mitigate any potential impacts.

The proposed activities would all be located within highly modified environments that have been cleared of native vegetation, largely revegetated with introduced pasture species and used for grazing over a considerable number of years. None of the proposed sites contain remnant native shrubs or trees and none would be located within riparian areas or within seepage zones although some access roads would cross drainage lines. None of the 12 Endangered Ecological Communities (EEC) or ten species of plant listed under the TSC Act which are known to occur within the Karuah Manning CMA are likely to occur at any of the proposed borehole locations.

The lack of structural diversity of the sites means that fauna habitat resources, such as trees, shrubs, rocky areas and fallen timber, are extremely limited and in general, habitat suitable for fauna would be limited to those common species of native and introduced fauna regularly found in disturbed areas. Farm dams and creeks in the vicinity of the borehole sites also lack habitat complexity and are unlikely to provide quality resources for waterbirds or amphibians.

Of the 53 species of threatened fauna listed under the TSC Act and known to occur within the locality, the Green and Golden Bell Frog (*Litoria aurea),* Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) and Grass Owl (*Tyto capensis*), were considered further due to the likely presence of nearby habitat. Assessments of Significance for these species concluded that this proposal would not impact on any known breeding habitat for these species and it is unlikely to have a significant impact on foraging resources. With the implementation of stringent management measures it is unlikely that any of these species would be significantly impacted by this proposal and therefore a Species Impact Statement would not be required. The Green and Golden Bell Frog is also listed under the EPBC Act and assessment under this Act concluded that the Green and Golden Bell Frog is unlikely to be impacted by this proposal due to the highly modified nature of the proposed works areas and the minimum impact this proposal is likely to have on the ecology of the study area and locality. Consequently, this proposal is unlikely to be considered a controlled action.

A number of recommendations and management measures are available and should be implemented to mitigate and ameliorate potential impacts within the locality. Central to these measures should be the preparation and implementation of a Construction Environmental Management Plan and Sediment and Erosion Control Plan.

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1 INTRODUCTION

1.1 Background

Alison Hunt & Associates Pty Ltd was commissioned by AGL Gloucester L E Pty Ltd (AGL) to undertake an ecological assessment for eight coal seam methane gas exploration sites known as Gloucester 1 and 2, Wards River 1, 2, 3, 4, 5 and Craven 7 which are located near Gloucester in NSW (Figure 1).

The purpose of the study is to assess the potential direct and indirect impacts of the proposal on biodiversity especially in relation to threatened species and endangered ecological communities. AGL is currently preparing a Review of Environment Factors (REF) in accordance with requirements of Condition No. 1 (Environmental Assessment) of Petroleum Exploration Licence (PEL) No. 285. Accordingly this ecological assessment meets the requirements under Part 5A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), NSW *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Key ecological issues that required clarification included:

- The potential for endangered ecological communities, threatened species and / or their habitat listed under the NSW *Threatened Species Conservation 1995 (*TSC Act) to occur within the study area;
- The potential presence of any matters of National Environmental Significance (NES) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); and
- Any avoidance, management or mitigation options.

1.2 Proposal

Petroleum Exploration Licence (PEL) No. 285 was granted in 1992 under the *Petroleum (Onshore) Act 1991*. This licence allows AGL to investigate the potential for coal seam methane resources in the Gloucester Basin with a view to possible development of a coal seam methane production field. Eight coal seam methane gas exploration sites known as Gloucester 1 (stratigraphic), Gloucester 2 (Core), Wards River 1, 3, 4, 5 (core), Wards River 2 (stratigraphic) and Craven 7 (stratigraphic) are currently being investigated by AGL. The proposal is described below and the location of the boreholes shown in Figure 2.

1.2.1 Exploration Core and Stratigraphic Borehole Construction

At each borehole location a single vertical well will be constructed. Both core and stratigraphic boreholes will be drilled using the same conventional drilling rig (proposed LF117). The stratigraphic borehole only differs in the fact that there are no full core samples produced throughout the drilling process, but drill cuttings are instead analysed. These eight boreholes are initially for exploration, however if the data gained from the exploration proves appropriate it is possible that approval may be

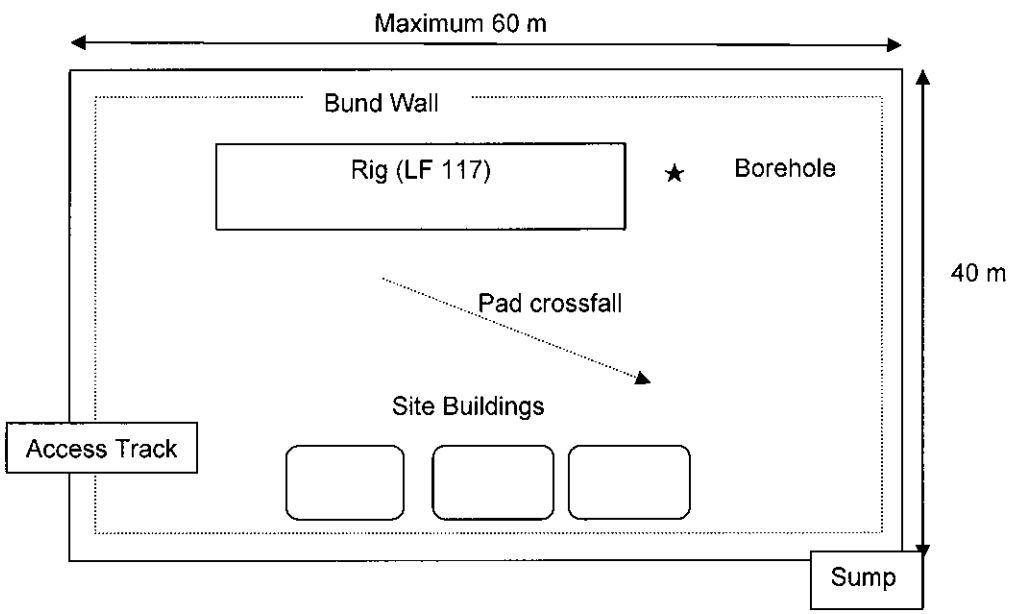
sought to convert some to pilot production wells. In this case the borehole will be capped, whilst approval is being sought from the relevant stakeholders. It is proposed that the drilling for each borehole be on a 24 hour basis, with landholder approval. This will halve the time for completion at each site.

1.2.2 Site Preparation and Associated Infrastructure Works

Access tracks, where required will be of a maximum 4m disturbance width (3m road) with pavement depth of approximately 300 mm to allow heavy vehicle access. Topsoil will be scraped and collected and stored in either windrows or in stockpiles, depending on each landholder's request. All access roads will have a 3% crossfall for drainage and erosion control measures placed as required.

For each borehole a cleared "pad" of an area of up to 60 x 40 m is required to be constructed prior to commencement of drilling. The pad is cleared of topsoil (which is stockpiled near the pad for site rehabilitation upon completion) and levelled, and covered with a layer of compacted gravel laid in preparation for drilling activities (with a 3% crossfall for drainage). A bund wall to 250 mm height is constructed around the pad with drainage toward a small lined sump on a corner of the pad. Sediment control fencing is also placed as required around the pad site. The drilling pad is then fenced ahead of arrival of the drilling rig. All drilling and well completion activities can then take place in the secure enclosed site.

Diagram 1 Typical borehole pad design



Machinery typically used in both access track and pad construction are; D6 Dozer, Rigid trucks and Super dogs, 6 x 6 Artic Dumper, 20 t Digger, Drum Roller, Grader and Smooth – vibrator.

1.2.3 Borehole Drilling Methods

Drilling of wells would be with a truck or small platform mounted drill rig. All wells will have the surface casing installed to a depth of at least 10% of the expected vertical depth of the hole. The surface casing will be cemented to the surface providing secure anchorage for the equipment. All drilling fluids would be contained in a series of tanks on each site. No drilling circulation water would be discharged to local drainage lines or creeks. Open hole wire line logging will be undertaken over a two day period on each well once drilling has been completed.

1.2.4 Sealing of Wells and Restoration of the Site

The boreholes will be sealed and restored to 'good oil field practice' and departmental standards. This will include cementing the hole to 1/5 of the total depth (TD), removal of gravel, spreading of stockpiled topsoil and the revegetation of groundcover to all disturbed areas. Road access tracks may be left in place if the landholder requests or again gravel removed from site and topsoil respread and revegetated. If it is decided to seek further approval for any of the boreholes to be converted to a pilot production hole then the drill string and PW Casing will be removed and the hole capped whilst approval is sought.

1.2.5 Timing

The construction and testing of the boreholes would be occur over a relatively short period of time with stratigraphic boreholes being completed in around two weeks (depending on the length of the access road) and corehole sites being completed in approximately 6 weeks (depending on the length of the access road) (Table 1). These figures are based on 24 hours drilling which would occur only with the consent of the landholder.

Table 1 Time period required for completion of construction and testing of the coreholes

Task	Length of Time
Road access construction	Approximately 2 days / km of road.
Pad construction	Approximately 2 days.
Stratigraphic hole	Approximately 5 days (based on 24 hr drilling).
Corehole	Approximately 30 days (based on 24 hr drilling).
Pad rehabilitation	Approximately 2 days.
Road rehabilitation	Approximately 2 days / km of road.

1.3 *Legislative Framework*

A number of legislative requirements would need to be met in relation to biodiversity issues for the proposed works and these may include but not necessarily be limited to:

1.3.1 NSW *Environmental Planning and Assessment Act 1979*

Pursuant to the NSW *Environment Planning and Assessment Act 1979* (EP&A Act) an assessment of the impacts of the proposed works on land that is critical habitat or is likely to affect threatened species, populations or ecological communities, or their habitats listed under the TSC Act, must be undertaken in the form of an Assessment of Significance. This involves assessing potential impacts of the proposal based on seven criteria that aid in assessing if the proposal is likely to have a significant impact on threatened species or their habitat or endangered ecological communities at the site or that have the potential to occur. If the Assessment of Significance concludes that a significant impact is likely then a Development Application must be accompanied by a Species Impact Statement (SIS).

1.3.2 NSW *Threatened Species Conservation Act 1993*

The NSW *Threatened Species Conservation Act 1995* (TSC Act) applies to terrestrial and aquatic flora and fauna. This Act is administered by the NSW Department of Environment and Climate Change (DECC). Pursuant to the EP&A Act an assessment of the impacts of the proposed works in areas of critical habitat or is likely to affect threatened species, populations or ecological communities, or their habitats listed under the NSW *Fisheries Management Act 1994* (FM Act), must be undertaken in the form of an Assessment of Significance. This involves assessing potential impacts of the proposal based on seven criteria that aid in assessing if the proposal is likely to have a significant impact on threatened species or their habitat or endangered ecological communities at the site or that have the potential to occur. If the Assessment of Significance concludes that a significant impact is likely then a Development Application must be accompanied by a Species Impact Statement (SIS).

1.3.3 Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires assessment of proposed actions that are likely of causing significant impacts on matters of National Environmental Significance (NES) listed under the Act. The EPBC Act identifies seven matters of NES and these include:

- 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).

Those matters of NES relevant to this proposal may include threatened species and ecological communities and migratory species. If, after addressing the criteria set out in the *Administrative Guidelines* for the EPBC Act, it is concluded that a significant impact on matters of NES is likely then a referral to the Department of Environment, Water, Heritage and the Arts (DEWHA) is required.

1.3.4 State Environmental Planning Policy 44 - Koala Habitat Protection

State Environmental Planning Policy No. 44 Koala Habitat (SEPP 44) aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline by:

- Requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat;
- Encouraging the identification of areas of core koala habitat; and
- Encouraging the inclusion of areas of core koala habitat in environment protection zones.

The policy applies to 107 local government areas including Gloucester LGA and therefore this policy is considered in assessing this proposal.

1.3.5 Water Management Act 2000

A controlled activity approval under the NSW *Water Management Act 2000* (WMA Act) is required if a controlled activity is proposed on waterfront lands (i.e. in or near a river, lake or estuary).

Under the WMA Act, a controlled activity means:

- The erection of a building or the carrying out of a work (within the meaning of the *Environmental Planning and Assessment Act 1979*), or
- The removal of material (whether or not extractive material) or vegetation from land, whether by way of excavation or otherwise, or
- The deposition of material (whether or not extractive material) on land, whether by way of landfill operations or otherwise, or
- The carrying out of any other activity that affects the quantity or flow of water in a water source.

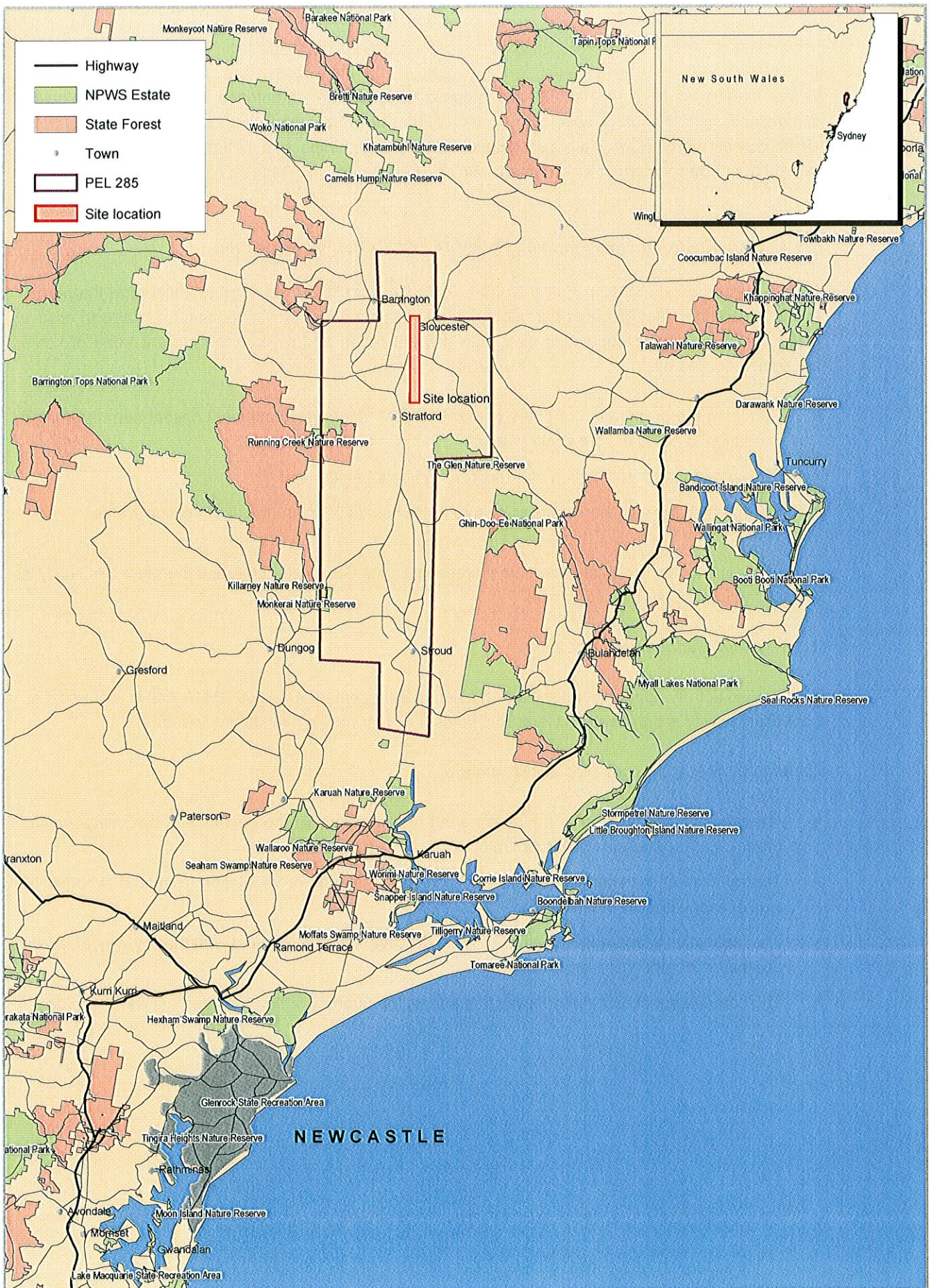


Figure 1 Site Location

AGL

Revision DRAFT
Created 6 April 2009
Author Upstream Gas

Gloucester Coal Seam Gas Project

Proposed Stratigraphic and Core Holes
Gloucester

Figure 2

STRICTLY CONFIDENTIAL

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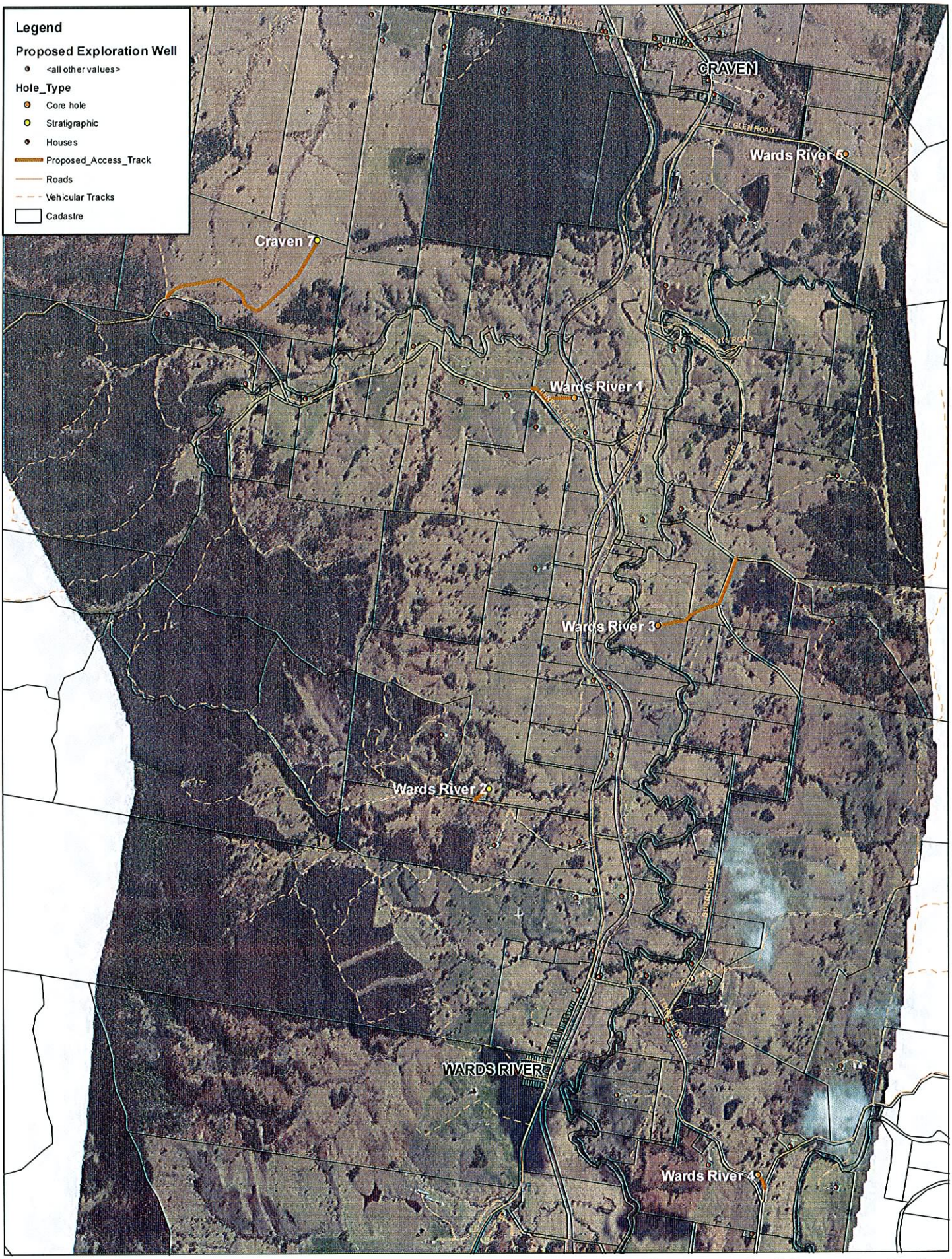

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Author Upstream Gas

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Map Grid of Australia, Zone 56
Geocentric Datum of Australia 1994

Gloucester Coal Seam Gas Project

Proposed Stratigraphic and Core Holes

Figure 3

STRICTLY CONFIDENTIAL

2 METHODS

This assessment was designed with consideration of the present ecological condition of the proposed borehole locations and to meet the requirements of the EP&A Act, TSC Act and EPBC Act. Several tasks were addressed in this assessment including:

- A review of available literature and databases to assist with the identification of site values especially in relation to threatened species, populations and endangered ecological communities;
- Field investigations to ascertain the current site condition and the presence or likely presence of threatened or protected species;
- An impact assessment to determine the likely effects of the proposal on the ecology of the sites; and
- Preparation of preliminary recommendations to ameliorate and mitigate any impacts.

2.1 Literature Review

Available literature and database records pertaining to the site and locality (i.e. within a 10 km radius) were reviewed. The full list of reference materials is provided in Section 7 and those of particular relevance are listed below:

- Department of Environment and Climate Change (DECC) – Threatened species database records (DECC 2009);
- Department of Environment, Water, Heritage and the Arts (DEWHA) – Online protected matters search tool for Matters of National Environmental Significance (NES) (DEWHA 2009); and
- GHD 2008 Report on Gloucester Coal Seam Gas Project. Land and Approvals – Task 4. Prepared for Lucas Energy.

2.2 Site Assessment

An assessment of the proposed sites was conducted utilising aerial photographs and a site assessment which was undertaken on 7 April 2009 and 15 May 2009. The locations of the proposed wells and associated infrastructure are all within highly modified environments that have been cleared of native vegetation, largely revegetated with introduced pasture species and used for grazing of stock over a considerable number of years. Consequently, the disturbed nature of the proposed sites indicated that detailed surveys would not be required to characterise the ecology of the sites, their conservation value and the potential impacts of the proposal.

During the site assessment the dominant plant species were recorded and the likelihood of threatened fauna and flora assessed through determining if suitable habitat was present. For plants this included several factors including the vegetation types present, drainage patterns, weed invasion and present land use activities. A general fauna habitat assessment included an assessment of the nature and condition of habitats, specific resources and features of relevance for native fauna. In addition,

indirect evidence of fauna (e.g. scats, feathers, fur, tracks, dens, nests, scratches, chew marks and owl wash) was recorded.

2.3 Limitations

This assessment was aimed at providing an overall assessment of the ecological values of the site with particular emphasis on the likely presence of threatened species through integration of data from a number of sources to allow an assessment of the impacts of the proposal. It was not designed so that all species, whether resident or transitory to the site, would be recorded so it is likely that a number of species not mentioned within this report would also utilise the resources of the site from time to time.

The findings detailed in this report are particular to the position of the borehole sites specified by AGL on the day of assessment. These findings cannot necessarily be relied upon if borehole positions are altered.

3 FINDINGS

3.1 Environmental Setting

Gloucester and the proposed borehole sites are situated in the Gloucester Valley, NSW. The landforms of the Gloucester Valley are characterised by north-south oriented linear ridges with intervening undulating lowlands and floodplains. The topography consists of grassy flats and gentle rises. The PEL area contains the geological domain known as the Gloucester Basin or Stroud-Gloucester Syncline. This is a canoe shaped trough containing some 4,000 m of Permian volcanics and sedimentary rocks. Soils comprise moderate to deep, moderately well-drained Brown Sodosols (Yellow Soloths) and moderately well-drained Grey Kurosols (Yellow Soloths) on imperfectly to moderately well drained sideslopes and crests shallow to deep (Lucas 2007).

The broader area contains significant biodiversity values including the world heritage listed Central Eastern Rainforest Reserves (Barrington Tops Area) NSW (Barrington Tops National Park) as well as the Woko National Park, six nature reserves and four state conservation areas. In all, 51,090 hectares (ha) (approximately 17% of the entire LGA) are dedicated to species and ecosystem conservation, (Gloucester Shire Council 2005). Nonetheless, the LGA continues to lose biodiversity through:

- Land clearing;
- Habitat alteration through weed invasion;
- Domestic and feral animal activity; and
- Poor land management techniques.

With such significant conservation areas the LGA provides habitat for a number of species and endangered ecological communities listed on the schedules of the NSW TSC Act and Commonwealth EPBC Act and these are listed in Gloucester Shire Council's *Supplementary State of the Environment Report 2005*. A review of these lists indicated that the majority of species and ecological communities would be confined to the vegetated areas within conservation areas, within remnant vegetation in private ownership, and in riparian areas and along coastal waterways.

3.2 Climate

Gloucester and surrounding areas experience their highest mean rainfall and highest mean temperatures between December and March with the highest rainfall occurring in March at 127 mm and the highest temperatures in January and February at 29 °C. During winter, rainfall drops to 47 mm during August and mean maximum temperatures to 19 °C during June and July and mean minimum temperatures to 6 °C during June and July (Table 2).

Table 2 Mean rainfall recorded at Gloucester Post Office and mean temperature at Taree

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
Mean rainfall (mm)	115	122	127	77	68	67	51	47	52	68	82	104	982
Mean maximum temperature (°C)	29	29	27	25	22	19	19	20	23	25	27	28	24
Mean minimum Temperature (°C)	18	18	16	13	10	7	6	6	9	12	14	16	12
Source: Bureau of Meteorology http://www.bom.gov.au/jsp/ncc/cdio/weatherData accessed 21 April 2009.													

3.3 Proposed Stratigraphic and Core Sites and Access Roads

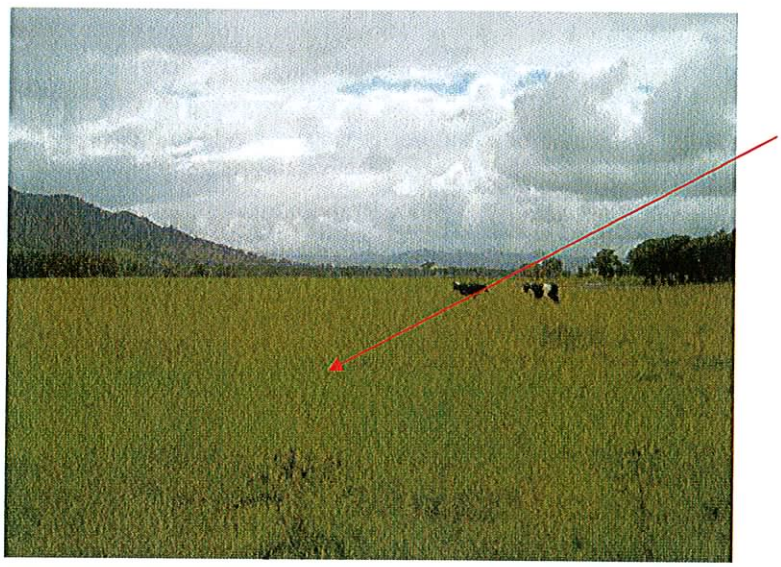
The location of the proposed activities are all within highly modified environments that have been cleared of native vegetation, largely revegetated with introduced pasture species and used for grazing over a considerable number of years. None of the proposed sites contain remnant native shrubs or trees and none would be located in riparian areas or within seepage zones although some access roads would cross drainage lines. Woodlands in the locality have been mapped as a combination of a number of vegetation communities, including Ironbark, Escarpment Redgum, South Coast Shrubby Grey Gum and Stringybark – Apple (Forest Ecosystem Lower North East NPWS). These communities would not be disturbed through the implementation of this proposal. The lack of structural diversity of the sites means that fauna habitat resources, such as trees, shrubs, rocky areas and fallen timber, are extremely limited and in general, habitat suitable for fauna would generally be limited to those common species of native and introduced fauna regularly found in disturbed areas.

3.3.1 Gloucester 1

The proposed stratigraphic site for Gloucester 1 is accessed via a well-formed gravel road off The Bucketts Way. The site is approximately 50 m from the road along flat terrain and is located within a Kikuyu (*Pennisetum clandestinum*) dominated paddock used for grazing of cattle (Plate 1). On the day of assessment the ground was waterlogged from rains in the previous week. Scattered within the paddock were other introduced species commonly associated with agriculture, such as Paspalum (*Paspalum dilatatum*), Veined Verbena (*Verbena rigida*), Catsear (*Hypochaeris radicata*), Fireweed (*Senecio madagascariensis*) and Cudweed (*Euchiton involucratus*).

The lack of complexity in the structure of agricultural lands means that there are few opportunities for fauna other than introduced species such as European Red Fox (*Vulpes vulpes)*, Black Rat (*Rattus rattus*), House Mouse (*Mus musculus*), and domestic cats and dogs.

Plate 1 Gloucester 1 stratigraphic site

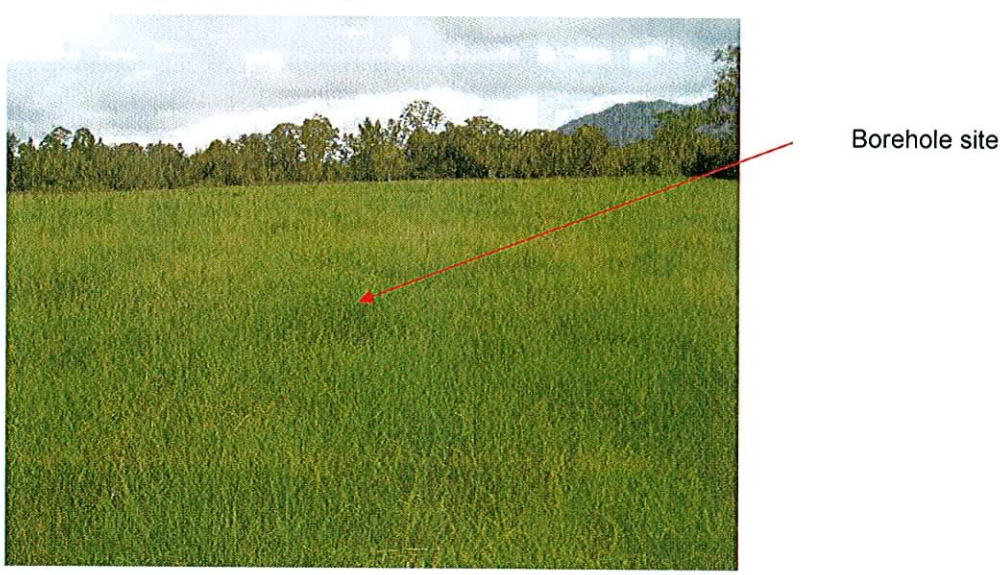


3.3.2 Gloucester 2

Gloucester 2 proposed core site is dominated by Kikuyu (Plate 2). It is accessed via the well formed gravel road, Showground Road. Scattered throughout this grazing paddock are Giant Parramatta Grass (*Sporobolus fertilis*), Paspalum and Scotch Thistle (*Onopordum acanthium*). This borehole site is located approximately 150 m east of the Gloucester River which is narrowly lined with River Oak (*Casuarina cunninghamiana*).

Fauna habitat is limited to those species which frequent agricultural lands, such as introduced rats and mice, fox and domestic cats and dogs. The open grasslands also provide habitat for birds of prey which hunt across grassy areas especially as the trees along the Gloucester River would potentially provide roosting habitat.

Plate 2 Gloucester 2 core site



3.3.3 Craven 7

Craven 7 is accessed via Berrico Road which is a well formed gravel road. The proposed site is approximately 1 km from Berrico Road through grazing paddocks. The access road through the paddocks would pass a substantial farm dam (Plate 3), the dam wall of which is eroded and degraded. As a part of this proposal the dam wall would be restored to allow vehicles to drive across the dam wall to access the proposed site which is beyond this dam. The farm dam has some emergent vegetation, including Cumbungi (*Typha domingensis*) although the banks of the dam are mostly bare and eroded. The proposed borehole site is situated within a Kikuyu dominated paddock on a slight rise (Plate 4). Wooded areas are located to the south and south-west of the proposed site although none are close by.

Fauna habitat at the site is largely restricted to those species which may be found in disturbed agricultural situations and may including birds of prey. The dam along the access road would provide amphibian and waterbird habitat and on the day of assessment Australian Wood Ducks were recorded foraging around the margins of the dam.

Plate 3 Dam along access road

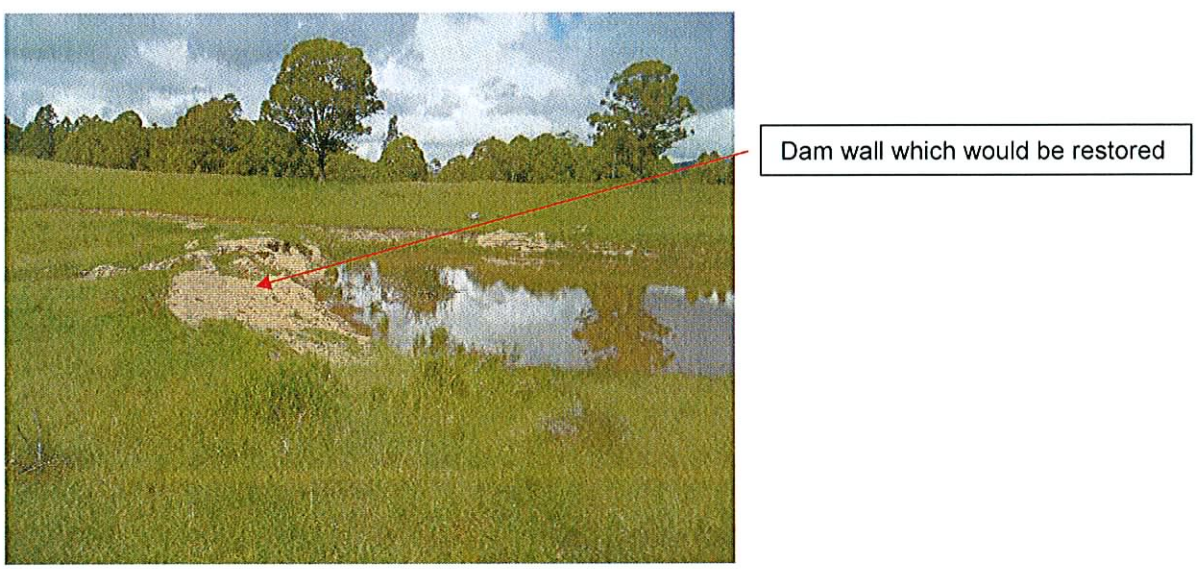
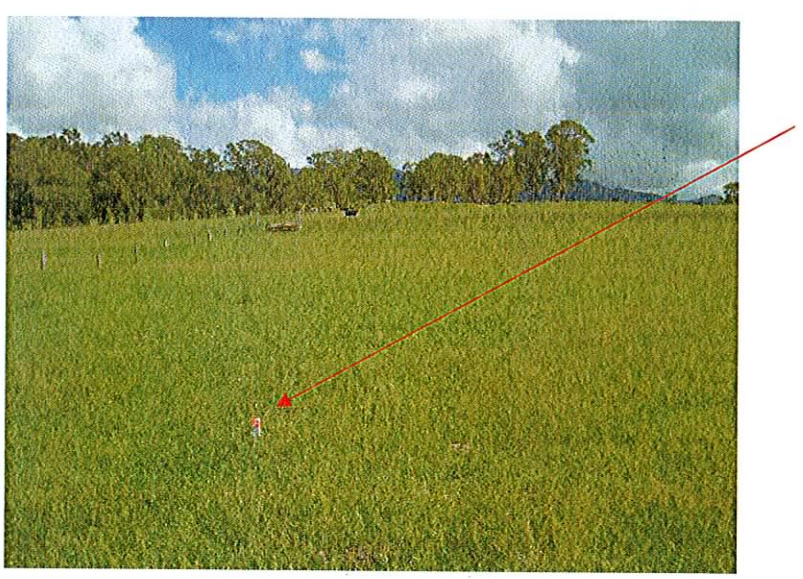


Plate 4 Craven 7 core site

3.3.4 Wards River 1

Wards River 1 core site is accessed off The Bucketts Way via Spring Creek Road and Berrico Road which are well formed gravel road (Plate 4). The proposed site for the borehole is located within a paddock used for cattle grazing and would be accessed through an existing gate. The paddock is dominated by Kikuyu with Cudweed throughout. Weed species included Veined Verbena and Cobblers Peg (*Bidens pilosa*).

Plate 4 Wards River 1 core site



3.3.5 Wards River 2

Access to the proposed Wards River 2 stratigraphic site is along a well formed dirt track which is accessed from The Bucketts Way. The track crosses two existing creek crossings. To increase stability for construction the crossings would be reinforced with a 300 mm layer of quarry gravel to reduce the risk of erosion. The proposed borehole site is located approximately 70 m north of the access road. This section of the track is edged with Spotted Gum (*Corymbia maculata*) which may have originally been planted. There is no existing access to the paddock at this point and consequently the installation of a gate to access the paddock would require removal of two Spotted Gum saplings (Plate 5).

The proposed stratigraphic site is located in a paddock which is currently used for grazing of cattle and is dominated by introduced pasture species (Plate 6). Although this site is on a ridge, soil moisture was still relatively high from recent heavy rains. Damp soils at this site are likely to be relatively common as small regrowth Flax-leaved Paperbark (*Melaleuca linariifolia*) were scattered throughout and this species is known to occur in damper habitats. Away from the borehole site are groups of Broad-leaved Ironbark and Grey Box (*Eucalyptus moluccana*) the majority of which are the result of regrowth. Bull Creek is located approximately 200 m north and downslope of this proposed site.

Fauna habitat is limited at this site although the presence of nearby trees would provide some habitat for woodland birds. An Australian Magpie (*Gymnorhina tibicen*) and Eastern Rosella (*Platycercus eximius*) were both recorded at the site on the day of assessment.

Plate 5 Proposed access to Wards River 2

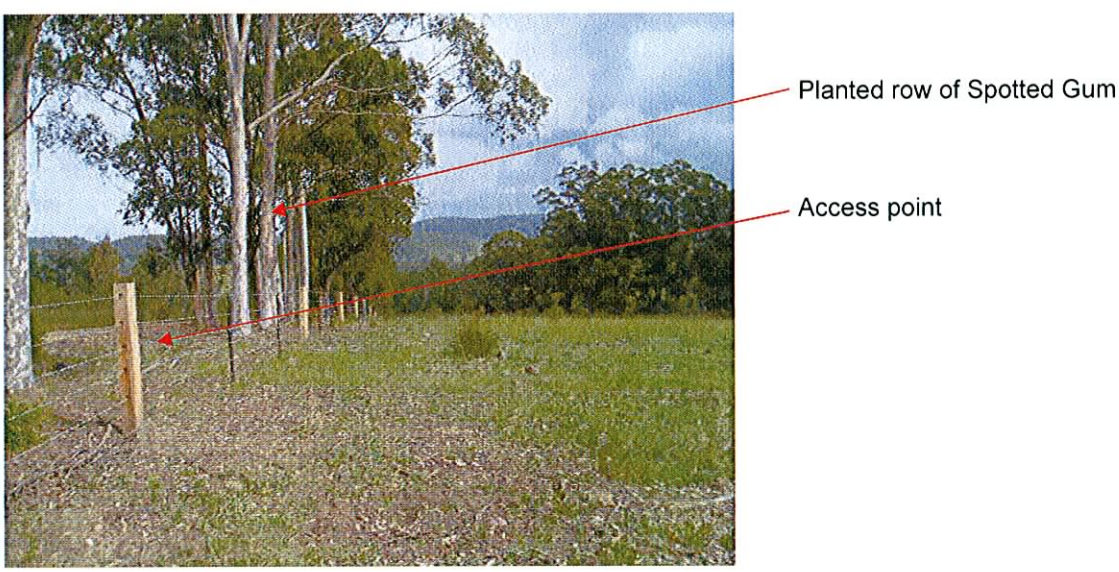


Plate 6 Wards River 2 Stratigraphic site

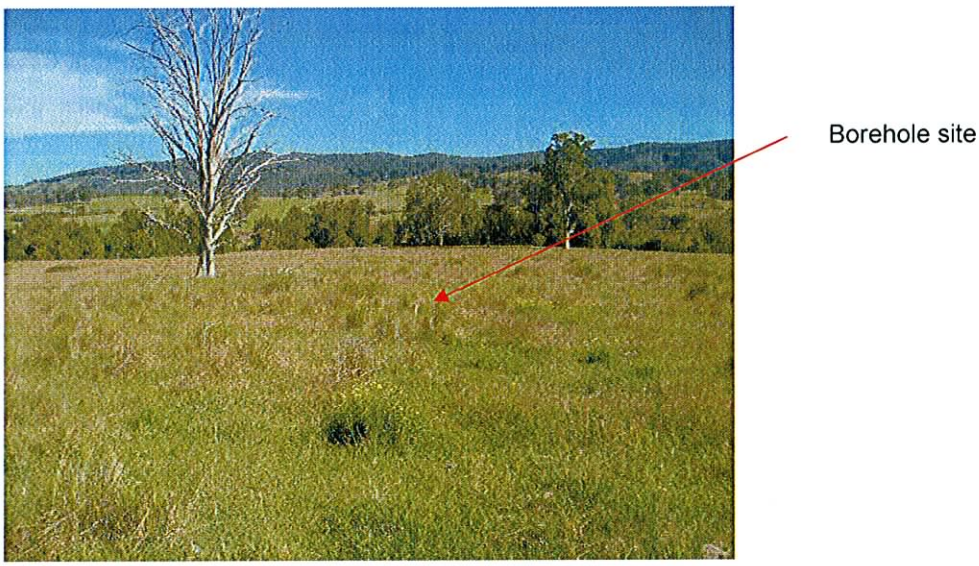
3.3.6 Wards River 3

The proposed Wards River 3 core site is accessed from The Bucketts Way along Pages Road and a well-formed farm track and paddock areas. The proposed track through the paddocks follows the fenceline and then a ridgeline around a small groups of trees comprising Forest Red Gum (*Eucalyptus tereticornis*) and Grey Box and then slightly downslope to the proposed borehole site. The Grey Box and Forest Red Gum all show signs of dieback. The cause of the dieback is not known but it is recommended that compaction and soil disturbance within the drip line of these trees be avoided.

The proposed core site is located in a paddock which is currently used for grazing of cattle and is dominated by introduced pasture species (Plate 7). Clumps of a Poaceae and Pale Rush (*Juncus pallidus*) are also scattered throughout. A number of stag trees and fallen trees occur in this paddock and these should be retained and protected as they may provide valuable fauna habitat for a range of microchiropteran bats and birds. Several living trees remain within the paddock and these include *Angophora* trees (potentially *Angophora floribunda* x *hispida* hybrids). These trees would not be impacted by this proposal.

Fauna habitat is limited due to the lack of habitat complexity. However, the clumping nature of the Poaceae and Pale Rush would provide refuge and nest sites for small ground dwelling mammals and reptiles.

Plate 7 Ward River 3 core site

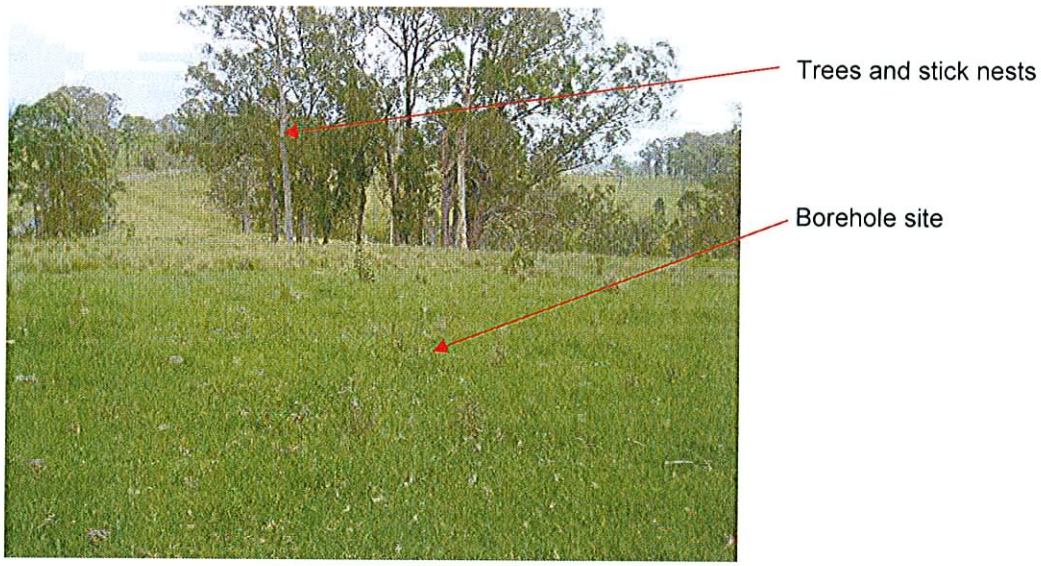


3.3.7 Wards River 4

The access road to the proposed site is along Terreel Road. The proposed borehole location is approximately 50 m slightly downslope from the road and is accessed through an existing gate. The Wards River 4 core site is on a small rise in a paddock used for grazing and which is dominated by introduced pasture species (Plate 8). Scattered throughout were Giant Parramatta Grass (*Sporobolus fertilis*), Yorkshire Fog (*Holcus lanatus*), Paspalum (*Paspalum dilatatum*), Kidney Weed (*Dichondra repens*), Veined Verbena (*Verbena rigida*), Catsear (*Hypochaeris radicata*), Native Geranium (*Geranium solanderi*), Cudweed (*Euchiton involucratus*) and *Glycine tabacina*.

There are small patches of trees within the paddock and these are dominated by Grey Gum (*Eucalyptus punctata*) and Broad-leaved Ironbark (*Eucalyptus fibrosa*). Scratch marks on the bark of the Grey Gums indicates that these trees are habitat for arboreal mammals. Given that these trees are isolated and within an agricultural setting these would most likely be limited to those common species of native fauna regularly found in disturbed areas, such as the Common Brush-tailed Possum (*Trichosurus vulpecula*). Two stick nests were recorded within one tree and although these did not appear to be currently in use these could be nests of the Grey-crowned Babbler (*Pomatostomus temporalis temporalis*). Approximately 80 m to the north of the proposed site is a small farm dam and on the day of assessment Australian Wood Ducks (*Chenonetta jubata*) were recorded foraging within the dam.

Plate 8 Wards River 4 site



3.3.8 Wards River 5

Wards River 5 is accessed from The Bucketts Way via Glen Road. It is located approximately 50 m from the road. There is no existing access to the paddock at this point and consequently the installation of a gate to access the paddock would be required. Although there are a number of trees bordering Glen Road none occur along the section from which access would be obtained. Instead this area is vegetated with roadside weeds such as Stinking Roger (*Tagetes minuta*) and Cobblers Pegs.

The proposed borehole site (Plate 9) is located in a paddock currently used for grazing cattle and this paddock is dominated by improved pasture species and agriculture weeds.

Plate 9 Wards River 5 site

3.4 Conservation Significance

3.4.1 NSW *Threatened Species Conservation Act 1995*

Endangered Ecological Communities

A number of Endangered Ecological Communities (EEC) are listed as occurring within the Karuah Manning CMA and these are:

- Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions;
- Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions;
- Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions;
- Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion;
- Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions;
- Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion;
- Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion;
- River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions;
- Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion;
- Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions;
- Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions; and
- Sydney Freshwater Wetlands in the Sydney Basin bioregion.

The sites are highly modified with the majority of the area comprising paddocks of improved pasture and consequently none of the EECs listed above occur across any of the sites.

Species

A total of 63 threatened species listed under the TSC Act have been recorded within the locality and these include ten species of plant, one reptile, four amphibians, 25 birds and 23 mammals and these data are listed in Appendix A. The sites lack the complexity required to provide habitat for a range of threatened species as pasturelands generally have few refuge areas or foraging resources, especially for mammals and reptiles. The farm dams and creeks also mostly lack habitat complexity and therefore provide few resources for waterbirds or amphibians although it is considered that there may be marginal habitat for the Green and Golden Bell Frog (*Litoria aurea)* in adjacent areas, e.g. farm dams. The Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) is known from the area, and although there is no habitat at any of the borehole sites, nearby woodland areas may provide nesting and foraging habitat for this species. In particular, two stick nests which may have been disused nests of the Grey-crowned Babbler were recorded in nearby trees at the Wards River 4 site. Similarly, the

Grass Owl (*Tyto capensis*) may occasionally forage across the study area as its favoured habitat is tall grass, including grass tussocks in swampy areas, grassy plains, swampy heath, and cane grass, or sedges on flood plains.

3.4.2 Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

Although remote to the study area, Myall Lakes which is listed as a Wetland of International Significance (Ramsar Sites) is listed under the EPBC Act as being within the same catchment as the study area.

Predictive modelling indicates that 14 fauna, 13 flora and 12 migratory species listed under the EPBC Act have the potential to occur within the locality of the site (i.e. 10 km) and these are shown in Appendix A along with their likelihood of occurrence. Those species for which potential habitat occurs adjacent to the site are detailed in Table 3. The Green and Golden Bell Frog which is listed as vulnerable under the EPBC Act may have a low likelihood of occurring within adjacent dams and creeks and under the precautionary principle is considered further.

Table 3 Threatened species for which habitat occurs locally

Species	Conservation Status	Habitat	Likelihood of occurrence on site
Green & Golden Bell Frog *Litoria aurea*	E-TSC V-EPBC	Marshes, dams & stream-sides particularly those containing *Typha* or *Eleocharis*.	Cleared paddocks. Perhaps very marginal habitat.
Grey-crowned Babbler *Pomatostomus temporalis temporalis*	V-TSC	Open woodlands.	May occur in nearby woodland areas.
Grass Owl *Tyto capensis*	V-TSC	Tall grass, including grass tussocks in swampy areas, grassy plains, swampy heath, and cane grass, or sedges on flood plains.	Cleared paddocks. Unlikely-but may occasionally forage across wetter paddock areas.

Note: TSC = NSW *Threatened Species Conservation Act 1995*. EPBC = Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. V = Vulnerable, E = Endangered.

3.5 Corridors and Connectivity

The borehole sites are all situated in an agricultural landscape and most of the adjacent lands have been cleared with only pockets of remnant bushland remaining within the broad valley area around Gloucester. The Gloucester River and Avon River and unnamed tributaries would provide the strongest linkages along the valley floor. This project would not affect movement corridors and connectivity for any species of plant or fauna within the locality.

3.6 SEPP 44 - Koala Habitat Protection

An assessment under *State Environment Planning Policy No. 44 – Koala Habitat Protection* (SEPP 44) is required as the Gloucester LGA is listed under Schedule 1 of SEPP 44. This SEPP requires the identification and protection of core koala habitat within the LGA. The proposed works areas could not be considered core koala habitat or potential koala habitat as the sites lack any trees and in particular those species listed under Schedule 2 of this SEPP. It is possible that nearby woodland areas could provide habitat for the Koala. However, all site works would be undertaken outside of any woodland area. Consequently no further provisions of SEPP 44 need apply to this application.

4 IMPACT ASSESSMENT

A number of disturbances would be associated with the proposed works and these are listed Table 4

Table 4 Disturbances associated with the proposal

Proposal Stage	Disturbance
Site preparation	Clearance of existing groundcover and topsoil (to be stored for site rehabilitation).
	Import of gravel and erection of site fence around an area of up to 60m x 40m.
Preparation of access tracks	Grading and improvement of access tracks for heavy vehicle access maximum 4m disturbance width.
Borehole drilling	Movement of vehicles to and from the established drill pad.
	Operational noise of drill rig and associated activities.

As a consequence, a number of direct and indirect impacts associated with construction and operation of the proposal have the potential to occur and these are discussed below.

4.1 Direct Impacts

4.1.1 Vegetation Clearance

The site is characterised by cleared land which has been used for grazing of stock over a number of years. A key aim of the proposal has been to locate the borehole sites and associated infrastructure in such a way as to avoid the removal of any trees and shrubs and this has been largely achieved. As the works are situated within paddocks, the majority of vegetation cleared would be agricultural pasture species and pasture weeds. There is the potential for two saplings of Spotted Gum to be removed to gain access to the proposed Wards River 2 borehole site. Removal of these individuals could not be considered to have a significant impact on the ecological values of the site or surrounds.

4.1.2 Hydrological Changes

Some minor changes to hydrological regimes at some of the sites have the potential to occur and these are shown in Table 5.

Table 5 Potential changes to hydrology at each proposed borehole site

Site	Changes to hydrological regimes
Gloucester 1	Unlikely.
Gloucester 2	Unlikely.
Craven 7	Restoration of dam wall. Likely to reduce erosion at the dam and downstream.
Wards River 1	Unlikely.
Wards River 2	Existing drainage line crossings which would be reinforced with gravel to reduce risk of erosion.
Wards River 3	Unlikely.
Wards River 4	Unlikely.
Wards River 5	Unlikely.

Changes to hydrological processes can have a number of potential affects including:

- Alteration of the ecology of an area including the vegetational composition and loss of fauna habitat;
- Increased run-off speed and rates and subsequent increases in the risk of erosion;
- Changes in soil moisture content; and
- May create conditions conducive to invasion by exotic species.

The restoration works of the dam wall to allow for access to Craven 7 would be undertaken outside of the aquatic habitat of this dam. The reinforcement of the dam wall would assist in the control of the current levels of erosion at the dam and downstream.

The addition of gravel at existing creek crossings at Ward River 2 would be used to stabilise the track substrate to meet requirements for the use of these crossings by trucks. Stabilisation would also reduce the risk of erosion of these tracks due to the temporary increase in traffic.

4.1.3 Loss of Fauna Habitat

Some habitat for grazing species, such as the Eastern Grey Kangaroo, would be temporarily lost from the site. However, these areas would be reinstated to their current condition through reseeding of pasture grasses and hence impacts would be temporary and minor. The proposal has been designed to avoid the removal of trees and consequently there are not expected to be any additional direct losses of fauna habitat.

4.2 Indirect Impacts

4.2.1 Runoff and Sedimentation

Potential impacts on the drainage lines, down slope areas and farm dams are possible, during construction and following construction, from run-off and sedimentation through earthworks and the removal of pasture. Provided appropriate stormwater and sediment trapping systems are implemented and that revegetation of the area is undertaken as soon as is practical after construction, then indirect impacts are not anticipated. However, it is also recommended that works be undertaken during the drier months of the year, i.e. June to September (refer to Table 2).

4.2.2 Disturbance of fauna

Disturbance of fauna during construction could occur through an increase in noise and activity levels across the site, including increases in traffic. Disturbance of fauna can result in changes to the behaviour and patterns of usage of resources by certain fauna species and / or increases in roadkill. As the majority of construction activities would be within the highly modified paddock areas of the site it is anticipated that this proposal would provide few risks to fauna.

4.3 Key threatening processes

It is unlikely that any key threatening processes listed under the TSC Act or EPBC Act would be exacerbated by this proposal as the sites of the boreholes and access ways have been located to avoid areas of native vegetation and riparian or seepage areas and consequently no native vegetation except for two Spotted Gum saplings) would be cleared or important natural drainage patterns altered as a consequence of this proposal.

4.4 Priority Actions for Gloucester Shire Council LGA

There are 90 priority actions identified as being 'High priority' in the Gloucester Shire Council LGA and these include actions which apply to 31 threatened species, populations and communities, and one key threatening process. None of the actions of this proposal are inconsistent with any of the strategies or actions identified for this area.

4.5 NSW *Environmental Planning and Assessment Act 1979*

Three threatened species may have a slight potential of being impacted by this proposal. Even though the potential for these threatened species to be impacted by this proposal is limited, Assessments of Significance as required under Part 5A of the EP&A Act, have been undertaken as a precautionary measure and these species are:

- Green and Golden Bell Frog (*Litoria aurea*);
- Grey-crowned Babbler (*Pomatostomus temporalis temporalis*);and
- Grass Owl (*Tyto capensis*).

The Assessments of Significance for these species are contained in Appendix B.

It was concluded that this proposal would not impact on any known breeding habitat for these species and it is unlikely to have a significant impact on foraging resources and that with the implementation of stringent management measures it is unlikely that any of these species would be significantly impacted by this proposal and therefore a Species Impact Statement is not necessary.

4.6 Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

The site supports very limited habitat for native fauna and flora as it is highly modified through clearing and agricultural landuses. However, marginal potential habitat for the Green and Golden Bell Frog (GGBF), which is listed as endangered under the EPBC Act, may occur adjacent to the some access roads and consequently this species has been considered using the Significant Impact Criteria for Endangered Species listed in the EPBC Act *Administrative Guidelines for Significance* (Commonwealth of Australia 2006). This assessment is contained in Appendix C.

It was concluded that the Green and Golden Bell Frog is unlikely to be impacted by this proposal due to the highly modified nature of the proposed works areas and the minimum impact this proposal is likely to have on the ecology of the study area and locality. Consequently, this proposal is unlikely to be considered a controlled action.

4.7 Cumulative Impacts

Cumulative impacts are those that add to the deterioration of the ecological values of a site or locality and generally occur when remaining native vegetation is removed or altered, fauna habitat is removed or altered and / or the natural hydrology of the area is altered. There are unlikely to be cumulative impacts associated with this proposal as native vegetation would not be removed, fauna habitat would not be altered and with stringent management measures the hydrology of the site would not be changed and any impacts would be minor and temporary.

5 RECOMMENDATIONS

A number of recommendations and management measures are available and should be implemented to mitigate and ameliorate potential impacts within the locality. Central to these measures should be the preparation and implementation of a Construction Environmental Management Plan and Sediment and Erosion Control Plan.

5.1 Mitigation Measures

A number of mitigation measures are recommended to protect adjacent biodiversity.

5.1.1 Performance Objectives

- To minimise impacts on remaining biodiversity values of the site; and
- Protect biodiversity values across the locality.

5.1.2 Goals

Goals for the proposed works should be to:

- Minimise the amount of vegetation to be removed;
- Protect the remaining vegetation and fauna habitat;
- Ensure that erosion of the works areas does not occur and that sedimentation of adjacent areas is avoided; and
- Ensure that impacted areas are protected from erosion and weed invasion and restored to their current levels at the completion of the drilling operations.

5.1.3 Mitigation Measures

Mitigation measures associated with the proposal should include:

- It is recommended that construction be undertaken during the driest period of the year, i.e. June to September, where possible;
- Preparation and implementation of a Construction Environmental Management Plan for the works on site which includes:
    - On site environmental management to advise machinery operators and other on-site personal on ways of minimising ecological impacts;
    - The works area should be fenced to ensure that machinery remains in the designated works zone;
    - Any trees within this fenced area should also be fenced out to the drip line to avoid machinery compacting or disturbing soil around the root area;
    - Vehicle numbers and speed would be strictly limited to reduce the risk of fauna injuries;

- The drilling sites would be fenced with temporary stock-proof fencing and bunded where appropriate;
- All drilling fluid would be contained on site and no discharge of drilling fluid to waterways, aquatic and riparian environments would be permitted without suitable licences or approvals;
- Weeds would be controlled on all restored sites;
- Ongoing monitoring and, if necessary, restoration maintenance would be undertaken until grass cover has re-established;
- Rubbish should be collected and removed off site to prevent it entering the waterway and causing harm to fauna;
- No chemicals, fuels and / or wastes should be stored within or near any natural or stormwater drainage lines. All such substances are to be contained in sealed vessels of appropriate volumes and, where necessary, stored within bunded areas;

- Preparation and implementation of an Erosion and Sediment Control Management Plan prepared for the proposed redevelopment which includes:
  - Installation of sediment fences to prevent stormwater runoff and sediment entering the adjacent drainage lines and stormwater drains;
  - Stockpiling of soil that may contain seeds of exotic species away from the creeks, drainage lines and other areas of native vegetation to prevent transportation to adjacent areas during rainfall or wind events; and
  - Measures to ensure that erosion and movement of sediments down slope do not occur during construction and these should include protection of bare ground with the use of jute mats or similar, weed control and revegetation of disturbed areas with pasture species.

6 CONCLUSIONS

The minor and temporary nature of disturbance from the proposal means that any impacts on flora and fauna are likely to be temporary and minor and could be managed to protect current values. The project would involve a period of construction and testing over six weeks at which time equipment would be removed and the sites rehabilitated. The footprint of the project would fall entirely within cleared grazing lands and would avoid the removal of trees.

Assessments under the NSW EP&A Act, including those species, populations and communities listed under the TSC Act concluded that significant impacts are unlikely and that a Species Impact Statement is not required. Similarly, it was concluded that matters of NES listed under the Commonwealth EPBC Act would not be significantly impacted and consequently is unlikely to be considered a controlled action.

7 REFERENCE MATERIALS

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APPENDIX A

THREATENED SPECIES RECORDED WITHIN THE LOCALITY OF PEL 285

Threatened Species recorded within the locality of PEL 285

Species / Community	Conservation Status	Habitat	Likelihood of occurrence on site
FLORA			
Asperula asthenes	V-TSC V-EPBC	Damp sites along river beds.	Cleared paddocks. Unlikely-no habitat.
Angophora inopina Charmhaven Apple	V-TSC V-EPBC	Occurs must frequently in woodland / forest, wet heath, sedge woodland.	Cleared paddocks. Not recorded.
Callistemon linearifolius	V-TSC	Grows in dry sclerophyll forest on the coast and adjacent ranges.	Cleared paddocks. Not recorded.
Cynanchum elegans	E-TSC E-EPBC	Most frequently on the edge of dry rainforest vegetation.	Cleared paddocks. Unlikely-no habitat.
Slaty Red Gum *Eucalyptus glaucina*	V-TSC V-EPBC	Grows in grassy woodland and dry eucalypt forest	Cleared paddocks. Not recorded.
Grevillea guthrieana	E-TSC E-EPBC	Grows along creeks and cliff lines in eucalypt forest, on granitic or sedimentary soil.	Cleared paddocks. Unlikely-no habitat.
Small-flower Grevillea *Grevillea parviflora* ssp. *parviflora*	V-TSC V-EPBC	Occurs in a range of vegetation types from heath and shrubby woodland to open forest.	Cleared paddocks. Not recorded.
Melaleuca groveana	V-TSC	Grows in woodland, heath and shrubland, often in exposed sites, at high elevations.	Cleared paddocks. Unlikely-no habitat
Brush Cherry *Syzygium paniculatum*	V-TSC V-EPBC	Occurs on gravels, sands, silts and clays in rainforests.	Cleared paddocks. Not recorded.
Tetratheca juncea	V-TSC V-EPBC	Mainly in low open forest / woodland with a mixed shrub understorey and grassy groundcover.	Cleared paddocks. Unlikely-no habitat.

Species / Community	Conservation Status	Habitat	Likelihood of occurrence on site
FAUNA			
Stephens' Banded Snake *Hoplocephalus stephensi*	V - TSC	Rainforest and eucalypt forests and rocky areas.	Cleared paddocks. Unlikely-no habitat.
Wallum Froglet *Crinia tinnula*	V - TSC	Paperbark swamps and sedge swamps of the coastal 'wallum' country.	Cleared paddocks. Unlikely-no habitat.
Green & Golden Bell Frog *Litoria aurea*	E-TSC V-EPBC	Marshes, dams & stream-sides particularly those containing *Typha* or *Eleocharis.*	Cleared paddocks. Perhaps very marginal habitat.
Booroolong Frog *Litoria booroolongensis*	E-EPBC	Along the western-flowing streams of the Great Dividing Range.	Cleared paddocks. Unlikely-no habitat.
Davies' Tree Frog *Litoria daviesae*	V - TSC	Permanently flowing streams above 400 m elevation.	Cleared paddocks. Unlikely-no habitat.
Black-necked Stork *Ephippiorhynchus asiaticus*	E - TSC	Permanent freshwater wetlands. Feeds on fish, frogs, eels, turtles, crabs and snakes.	Cleared paddocks. Unlikely-prey items not present.
Powerful Owl *Ninox strenua*	V - TSC	Large tracts of forest from, from woodland and open sclerophyll forest to tall open wet forest and rainforest.	Cleared paddocks. Unlikely-no habitat.
Grey-crowned Babbler *Pomatostomus temporalis temporalis*	V - TSC	Open woodlands.	May occur in nearby woodland areas.
Speckled Warbler *Pyrrholaemus sagittatus*	V - TSC	Eucalypt communities with grassy understorey.	Cleared paddocks. Unlikely-no habitat.
Sooty Owl *Tyto tenebricosa*	V - TSC	Rainforest and moist Eucalypt forests.	Cleared paddocks. Unlikely-no habitat.
Masked Owl *Tyto novaehollandiae*	V - TSC	Lives in dry eucalypt forests and woodlands.	Cleared paddocks. Unlikely-no habitat.
Glossy Black-Cockatoo *Calyptorhynchus lathami*	V-TSC E-EPBC	Open woodlands with stands of She-oak.	Cleared paddocks. Unlikely-no habitat.

Species / Community	Conservation Status	Habitat	Likelihood of occurrence on site
Magpie Goose *Anseranas semipalmata*	V - TSC	Mainly found in shallow wetlands with dense growth of rushes or sedges.	Cleared paddocks. Unlikely-no habitat.
Australasian Bittern *Botaurus poiciloptilus*	V-TSC	Emergent vegetation in freshwater & brackish wetlands.	Cleared paddocks. Unlikely-no emergent vegetation.
Bush Stone-curlew *Burhinus grallarius*	E-TSC	Open forests & woodlands with sparse grassy ground layer & fallen timber.	Cleared paddocks. Unlikely-no habitat.
Brown Treecreeper *Climacteris picumnus*	V-TSC	Eucalypt forests & woodlands of inland plains and slopes of the Great Dividing Range. Less commonly found on coastal plains and ranges.	Cleared paddocks. Unlikely-too coastal.
Barred Cuckoo-shrike *Coracina lineata*	V-TSC	Rainforest, eucalypt forests and woodlands, clearings in secondary growth, swamp woodlands and timber along watercourses.	Cleared paddocks. Unlikely-no habitat.
Emu *Dromaius novaehollandiae*	EP-TSC	Open forest, woodland, coastal heath, coastal dunes, wetland areas, tea tree plantations and open farmland, and occasionally in littoral rainforest between Evans Head and Red Rock.	Unlikely-not known from area.
Comb-crested Jacana *Irediparra gallinacea*	V-TSC	Inhabits permanent wetlands with a good surface cover of floating vegetation, especially water-lilies.	Unlikely-no habitat.
Black Bittern *Ixobrychus flavicollis*	V-TSC	Forested, freshwater & saline wetlands. Breeding along watercourses.	Unlikely-no habitat.
Hooded Robin *Melanodryas cucullata*	V-TSC	Structurally diverse lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee.	Unlikely-no habitat.
Black-chinned Honeyeater *Melithreptus gularis gularis*	V-TSC	Upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts.	Unlikely-no habitat.
Swift Parrot *Lathamus discolor*	E-TSC E-EPBC	Occur in areas where eucalypts are flowering profusely or where there are abundant lerp infestations.	Cleared paddocks. Unlikely-no habitat.
Turquoise Parrot *Neophema pulchella*	V-TSC	Lives on edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	Cleared paddocks. Unlikely-no habitat.
Barking Owl *Ninox connivens*	V-TSC	Breeding HBT >20 cm diam. Forage woodlands, grassy woodlands, forests & into grasslands 250 m.	Unlikely – no substantial woodland areas within 250 m of sites.

Species / Community	Conservation Status	Habitat	Likelihood of occurrence on site
Powerful Owl *Ninox strenua*	V-TSC	Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest.	Cleared paddocks. Unlikely-no habitat.
Regent Honeyeater *Xanthomyza phrygia*	E-TSC E-EPBC	Inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak.	Cleared paddocks. Unlikely-no habitat.
Wompoo Fruit-Dove *Ptilinopus magnificus*	V-TSC	Occurs in, or near rainforest, low elevation moist eucalypt forest and brush box forests.	Cleared paddocks. Unlikely-no habitat.
Rose-crowned Fruit-Dove *Ptilinopus regina*	V-TSC	Sub-tropical and dry rainforest.	Cleared paddocks. Unlikely-no habitat.
Superb Fruit-Dove *Ptilinopus superbus*	V-TSC	Rainforest and similar closed forests.	Cleared paddocks. Unlikely-no habitat.
Grass Owl *Tyto capensis*	V-TSC	Tall grass, including grass tussocks in swampy areas, grassy plains, swampy heath, and cane grass, or sedges on flood plains.	Cleared paddocks. Unlikely-but may occasionally forage across wetter paddock areas.
Eastern Cave Bat *Vespadelus troughtoni*	V - TSC	Cave-roosting species found in dry open forest and woodland, near cliffs or rocky overhangs.	Cleared paddocks. Unlikely-no habitat.
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	V - TSC	Prefers moist habitats with trees >20 m. Roosts in HBT or under bark or in buildings.	Cleared paddocks. Unlikely-no habitat.
Golden-tipped Bat *Kerivoula papuensis*	V - TSC	Rainforest and adjacent sclerophylla forest.	Cleared paddocks. Unlikely-no habitat.
Large-eared Pied Bat *Chalinolobus dwyeri*	V-TSC V-EPBC	Roosts in caves, derelict mines frequenting low to mid elevation dry open forest and woodland close to these features.	Cleared paddocks. Unlikely-no habitat.
Little Bentwing-bat *Miniopterus australis*	V - TSC	Moist Eucalypt forests whilst roosting in caves and man-made structures	Cleared paddocks. Unlikely-no habitat.
Eastern Bent-wing Bat *Miniopterus schreibersii oceanensis*	V - TSC	Roosting – caves, derelict mines, storm-water tunnels, buildings. Foraging - forested areas.	Cleared paddocks. Unlikely-no habitat.
Eastern Freetail-bat *Mormopterus norfolkensis*	V - TSC	Dry sclerophylla forest & woodland. Roosts - hollows & under bark or man-made structures.	Cleared paddocks. Unlikely-no habitat.

Species / Community	Conservation Status	Habitat	Likelihood of occurrence on site
Large-footed Myotis *Myotis adversus*	V - TSC	Forages over streams and pools catching insects and small fish by raking their feet across the water surface	Cleared paddocks. Unlikely-no habitat.
Greater Broad-nosed Bat *Scoteanax rueppellii*	V - TSC	Woodland, moist & dry eucalypt forest & rainforest but prefers tall wet forest.	Cleared paddocks. Unlikely-no habitat.
Grey-headed Flying-fox *Pteropus poliocephalus*	V-TSC V-EPBC	Subtropical & temperate rainforests, tall sclerophylla forests & woodlands, heaths & swamps.	Cleared paddocks. Unlikely-no habitat.
Spotted-tailed Quoll *Dasyurus maculatus*	V - TSC	Forests and heathlands.	Cleared paddocks. No habitat.
Koala *Phascolarctos cinereus*	V - TSC	Eucalypt forests and woodlands.	Cleared paddocks. No habitat.
Squirrel Glider *Petaurus norfolcensis*	V - TSC	Eucalypt forests and woodlands.	Cleared paddocks. No habitat.
Rufous Bettong *Aepyprymnus rufescens*	V - TSC	Tall, moist eucalypt forest to open woodland, with a tussock grass understorey.	Cleared paddocks. No habitat.
Eastern Pygmy-possum *Cercartetus nanus*	V - TSC	Rainforest, sclerophylla forest & woodland to heath – but heath & woodland preferred. .	Cleared paddocks. No habitat.
Parma Wallaby *Macropus parma*	V - TSC	Moist eucalypt forest with thick, shrubby understorey.	Cleared paddocks. No habitat.
Yellow-bellied Glider *Petaurus australis*	V - TSC	Occur in tall mature eucalypt forest generally in areas with high rainfall.	Cleared paddocks. No habitat.
Squirrel Glider *Petaurus norfolcensis*	V - TSC	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest with heath understorey in coastal areas.	Cleared paddocks. No habitat.
Brush-tailed Rock-wallaby *Petrogale penicillata*	E-TSC V-EPBC	Rocky escarpments, outcrops, steep slopes or cliffs – especially those with caves, ledges or overhangs & shrub cover.	Cleared paddocks. No habitat.
Brush-tailed Phascogale *Phascogale tapoatafa*	V - TSC	Dry sclerophylla open forest with sparse groundcover. Also heath, swamps, rainforest & wet sclerophylla forest.	Cleared paddocks. No habitat.

Species / Community	Conservation Status	Habitat	Likelihood of occurrence on site
Common Planigale *Planigale maculata*	V - TSC	Rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas.	Cleared paddocks. No habitat.
Long-nosed Potoroo *Potorous tridactylus*	V-TSC V-EPBC	Inhabits coastal heaths and dry and wet sclerophyll forests.	Cleared paddocks. No habitat.
Red-legged Pademelon *Thylogale stigmatica*	V - TSC	Forest with dense understorey and ground cover.	Cleared paddocks. No habitat.
Note: TSC = NSW *Threatened Species Conservation Act 1995.* EPBC = Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.* V = Vulnerable, E = Endangered, Mig = Migratory, EEC = Endangered Ecological Community, EP = Endangered Population.			

APPENDIX B

ASSESSMENT OF SIGNIFICANCE UNDER THE EP&A ACT

APPENDIX B

Assessment of Significance

Background

As required under the Section 5A of the *Environmental Planning & Assessment Act 1979* (EP&A Act), Assessments of Significance were undertaken to determine the significance of impacts of the proposal on threatened species listed on Schedules of the NSW *Threatened Species Conservation Act 1995* (TSC Act). A number of threatened species were listed as occurring within the locality but habitat for only a very small percentage of these occur at the site due to the highly modified nature of the proposal area. Therefore, Assessments of Significance have been undertaken only for those species for which potential habitat occurs either across the study area or within the near locality. Those species addressed are:

- Green and Golden Bell Frog (*Litoria aurea*);
- Grey-crowned Babbler (*Pomatostomus temporalis temporalis*); and
- Grass Owl (*Tyto capensis*).

Grey-crowned Babbler

Grey-crowned Babbler (GCB) (*Pomatostomus temporalis temporalis*) (eastern subspecies) is listed as Vulnerable under the TSC Act. This species is found throughout large parts of northern Australia and in south-eastern Australia. In NSW, the eastern sub-species occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Hay. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. It may be extinct in the southern, central and New England tablelands. This species is a laborious flyer so birds prefer to hop to the top of a tree and glide down to the next one. Birds are generally unable to cross large open areas. GCB feed on invertebrates, either by foraging on the trunks and branches of eucalypts and other woodland trees or on the ground, digging and probing amongst litter and tussock grasses.

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.

The proposal would not directly impact on any known breeding or foraging areas of this species as all works would be undertaken outside of woodland areas. However, the GCB is known extensively from the Gloucester Shire Council LGA and it is possible that this species would occur in nearby woodland or trees. No potential habitat would be removed or altered for this proposal. The Grey-crowned Babbler appears to be relatively disturbance tolerant as this bird has been observed foraging and nesting in gardens, parks and small remnants, along fence boundaries and man-made structures near major roads (Parsons Brinckerhoff 2005). However, this species is a laborious flyer and is known to feed on the ground placing it at risk of being struck by construction traffic which would increase temporarily during drilling operations. To

avoid bird strike stringent traffic management should be implemented and traffic flow, vehicle speed and vehicle numbers entering and leaving the sites should be controlled.

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.

Not an endangered population.

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.

Not an endangered ecological community.

d) 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

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

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.

The proposed action would not result in habitat being removed or altered and habitat would not become fragmented or isolated from other areas. All proposed works are to be undertaken within pasture improved paddocks.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

There is no critical habitat listed for this species.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

Although the Grey-crowned Babbler Retention Plan – Gloucester Shire Council (Parsons Brinckerhoff 2005) deals with potential family groups outside of the study area, several of the management measures are applicable to management of the GCB within the study area and these are:

- Habitat protection and maintenance: to maintain and protect woodland remnants that form part of a corridor network and other habitats that have potential for regeneration for the longer term benefit of the species; and
- Road and traffic management: prevent / reduce the incidence of collision of GCB with motor vehicles through the implementation of go slow areas and increasing public awareness through signage.

This proposal would not remove or modify current habitat for this species and a Construction Environment Management Plan would ensure that vegetated areas are protected, through fencing where appropriate and education of personnel to raise awareness of the importance of this species. Stringent traffic management would also be implemented to ensure that the incidence of collision does not increase due to the increase of traffic and it will address such matters as traffic numbers, traffic speed and traffic flow.

DEC have also identified five strategies to help recover the species (DEC 2005d) and these include community and land-holder awareness, development and implementation of protocols and guidelines, habitat rehabilitation / restoration, research and survey / mapping and habitat assessment. None of the actions of this proposal are inconsistent with any of the strategies or actions outlined in the PAS.

g) **Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

It is unlikely that any key threatening processes listed under the TSC Act would be exacerbated by this proposal as the proposed work sites have been located to avoid areas of native vegetation and consequently no native vegetation would be cleared as a consequence of this proposal. Threats identified by DEC (2005) include clearing of woodland remnants, heavy grazing and removal of woody debris and nest predation by bird species. None of these threats would be increased as a consequence of this proposal.

Conclusion

No changes to GCB habitat would occur through removal or modification as all proposed works are outside of woodland and remnant vegetation and potential disturbance through an increase in traffic movement would be managed through stringent traffic controls. Therefore, it is considered unlikely that this proposal would have significant impacts on this species.

Grass Owl

The Grass Owl (*Tyto capensis*) is listed as Vulnerable under the TSC Act. Grass Owls have been recorded occasionally in all mainland states of Australia but appear to be more commonly recorded in northern and north-eastern Australia. In NSW they are more likely to be found in the north-east. Grass Owl numbers often increase when rodent numbers increase. They are found in areas of tall grass, including grass tussocks in swampy areas, grassy plains, swampy heath, and cane grass, or sedges on flood plains. They rest by day in a 'form' - a trampled platform in a large tussock or other heavy growth. They also nest in trodden-down grass (DECC 2005).

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.**

Disturbance to grassed and tussocky areas within paddocks would be minimal and temporary. Substantial areas of foraging and nesting habitat would remain within the locality and

consequently it is unlikely that this species would be adversely affected or placed at the risk of extinction as a consequence of this proposal.

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.**

Not an endangered population.

c) **In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

III. **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**

IV. **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.**

Not an endangered ecological community.

d) **in relation to the habitat of a threatened species, population or ecological community:**

IV. **The extent to which habitat is likely to be removed or modified as a result of the action proposed, and**

V. **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**

VI. **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.**

The proposal would only temporarily disrupt potential habitat for this species. Disturbance would be minimal and the borehole sites would revegetated with pasture species as soon as practicable after completion of the drilling operations.

e) **Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).**

There is no critical habitat listed for this species.

f) **Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.**

There has not been a recovery plan or threat abetment plan prepared for the Grass Owl.

g) **Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

It is unlikely that any key threatening processes listed under the TSC Act would be exacerbated by this proposal as the proposed work sites have been located to avoid areas of native vegetation and consequently no native vegetation would be cleared as a consequence of this proposal. However, threatening processes listed by DECC (2005) for the Grass Owl include, loss of suitable habitat due to grazing, agriculture and development and disturbance and habitat

degradation by stock. Disturbance to any potential habitat for this species would be minimal and temporary as the sites would be returned to their current condition at the completion of testing.

Conclusion

It is considered unlikely that this proposal would result in significant impacts on this species as disturbance to any potential habitat would be minimal and temporary as the sites would be returned to their current condition at the completion of testing.

Green and Golden Bell Frog

The Green and Golden Bell Frog (GGBF) (*Litoria aurea*) is listed as Endangered under the TSC Act. This species inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available.

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.

The GGBF has not been recorded within the Gloucester Shire Council LGA (Gloucester Shire Council 2007). The closest record is approximately 50 km to the south-west of the study area near Dungog. However, marginal potential habitat is located near some of the access roads and nearby farm dams. Environmental management of the site during construction could ensure that these areas would be protected from the affects of run-off and sedimentation during construction through the use of sedimentation fences and revegetation. Consequently, should the GGBF occur in adjacent areas it is unlikely that this species would be impacted by this proposal.

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.

Not an endangered population.

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.

Not an endangered ecological community.

d) 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**

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**

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.**

This proposal would not remove potential habitat for this species and consequently a reduction in the area of potential occupancy would not occur. This proposal is unlikely to fragment existing populations as habitat for this species is unlikely to be removed or habitat corridors interrupted.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

This area has not been identified as critical habitat for this species.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

This proposal would not be pose a threat to the recovery of the GGBF as potential habitat of this species would be maintained and protected through environmental management during construction. Recognised threats would not be exacerbated.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Two Key Threatening Processes have potential relevance to this proposal. These are *Predation by Gambusia holbrooki (Plague Minnow)* and *Infection of frogs by amphibian chytrid causing the disease chytridiomycosis*. The adjacent potential habitat is likely to already contain the invasive Plague Minnow which is a known predator of tadpoles of the GGBF although it was not recorded on the day of assessment. If this invasive species is not currently present it is unlikely that this proposal would introduce it to the study area. The fungal pathogen, Frog Chytrid Fungus, is a known threat to the GGBF. Chytrid fungus is probably transferred by direct contact between frogs and tadpoles, or through exposure to infected water. This proposal would not involve the moving of frogs or tadpoles, exposing frogs to infected water or handling of frogs in any way.

Conclusion

The Green and Golden Bell Frog is unlikely to be impacted by this proposal due to the highly modified nature of the proposed works areas and the minimum impact this proposal is likely to have on the ecology of the study area and locality. Consequently, it is considered that a Species Impact Statement is not required.

APPENDIX C

ASSESSMENT UNDER THE EPBC ACT

Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

The study area supports very limited habitat for native fauna as it is highly modified and predominately agricultural lands. However, marginal potential habitat for the Green and Golden Bell Frog (GGBF) (*Litoria aurea*), which is listed as endangered under the EPBC Act, could potentially occur in areas adjacent to the access roads at some sites and consequently this species has been considered below using the Significant Impact Criteria for Endangered Species listed in the EPBC Act *Administrative Guidelines for Significance* (Commonwealth of Australia 2006).

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- Lead to a long-term decrease in the size of a population;

  The GGBF has not been recorded within the Gloucester Shire Council LGA (Gloucester Shire Council 2007). The closest record is approximately 50 km to the south-west of the study area near Dungog. However, marginal potential habitat is located near some access roads and nearby farm dams. Environmental management of the site during construction could ensure that these areas would be protected from the affects of run-off and sedimentation during construction through the use of sedimentation fences and revegetation. Consequently, should the GGBF occur in adjacent areas it is unlikely that this species would be impacted by this proposal.

- Reduce the area of occupancy of the species;

  This proposal would not remove potential habitat for this species and consequently a reduction in the area of potential occupancy would not occur.

- Fragment an existing population into two or more populations;

  This proposal is unlikely to fragment existing populations as habitat for this species is unlikely to be removed or habitat corridors interrupted.

- Adversely affect habitat critical to the survival of a species;

  Potential habitat has not been identified as critical habitat within the recovery plan for this species or listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act and so is unlikely to provide habitat critical to survival of this species.

- Disrupt the breeding cycle of a population;

  This proposal is very unlikely to disrupt the breeding cycle of a population. None are known from the area and should they occur in adjacent areas environmental management of the site during drilling could ensure that these potential habitat areas would be protected from the affects of run-off and sedimentation through the use of sedimentation fences and revegetation. Consequently, should the GGBF occur it is unlikely that the breeding cycle of this species would be disrupted.

- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

  This proposal is unlikely to directly impact on potential habitat and management of environmental risks would assist in the protection of this potential habitat and consequently this species is unlikely to decline due to this proposal.

- Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;

The adjacent potential habitat is likely to already contain the invasive Plague Minnow which is a known predator of tadpoles of the GGBF although it was not recorded on the day of assessment. If this invasive species is not currently present it is unlikely that this proposal would introduce it to the study area.

- Introduce disease that may cause the species to decline; or

  The fungal pathogen, Frog Chytrid Fungus, is a known threat to the GGBF. Chytrid fungus is probably transferred by direct contact between frogs and tadpoles, or through exposure to infected water. This proposal would not involve the moving of frogs or tadpoles, exposing frogs to infected water or handling of frogs in any way.

- Interfere with the recovery of the species.

  This proposal would not pose a threat to the recovery of the GGBF as potential habitat of this species would be maintained and protected through environmental management during drilling activities. Recognised threats would not be exacerbated.

The Green and Golden Bell Frog is unlikely to be impacted by this proposal due to the highly modified nature of the proposed works areas and the minimum impact this proposal is likely to have on the ecology of the study area and locality. Consequently, it is considered that this proposal is unlikely to constitute a controlled action under the EPBC Act.

APPENDIX D

NORTHING AND EASTINGS FOR POTENTIAL BOREHOLE SITES

Northings and Eastings for Potential Borehole Sites

Borehole Site	Northing / Easting
Gloucester 1	400617 / 6455520
Gloucester 2	401652 / 6458980
Craven 7	397969 / 6440465
Wards River 1	399923 / 6439251
Wards River 2	399215 / 6436333
Wards River 3	400539 / 6437558
Wards River 4	401297 / 6433461
Wards River 5	401926 / 6440992
Note: Etrex Legend, WGS 84, 56 UTM, accuracy varied from 5 to 10 m.	

Alison Hunt and Associates Pty Ltd
8 Duncan Street Arncliffe NSW 2205
T 02 9599 0402
E alison@ahecology.com
W www.ahecology.com

ABN 76 233 543 751

APPENDIX 4

INDIGENOUS ARCHAEOLOGICAL ASSESSMENT

McCardle Cultural Heritage Pty Ltd

AGL Gloucester

Gloucester Coal Seam Gas Project: Proposed Core Hole Sites (Gloucester 2, Wards River 1, Wards River 3, 4 & 5) and Proposed Straitgraphic Sites (Gloucester 1, Wards River 2 and Craven 7) at Gloucester, Wards River & Craven.

Indigenous Archaeological Assessment

May 2009

McCardle Cultural Heritage Pty Ltd
P.O. Box 166,
Adamstown, NSW, 2289
Ph: 0412 702 396
Fax: 02 4952 5501
Email: mcheritage@iprimus.com.au

Report No: J09008

Approved by:	**Penny McCardle**
Position:	**Project Manager**
Signed:	
Date:	**May 2009**

This report has been prepared in accordance with the scope of services described in the contract or agreement between McCardle Cultural Heritage Pty Ltd (MCH), ACN: 104 590 141, ABN: 89 104 590 141 AGL Gloucester. The report relies upon data, surveys, measurements and specific times and conditions specified herein. Any findings, conclusions or recommendations only apply to the aforementioned circumstances and no greater reliance should be assumed or drawn by AGL Gloucester. Furthermore, the report has been prepared solely for use by AGL Gloucester and MCH accepts no responsibility for its use by other parties.

Executive Summary

McCardle Cultural Heritage Pty Ltd (MCH) has been commissioned by AGL Gloucester (formerly Lucas Energy) to prepare an indigenous archaeological assessment of five proposed Core Hole sites and three stratigraphic sites as part of the Gloucester Coal Seam Gas Project. The Core Hole sites are referred to as Gloucester 2, Wards River 1, 3, 4 and 5 and the Stratigraphic sites are referred to as Gloucester 1, Wards River 2 and Craven 7.

The project falls under Part 3A and the consultation was undertaken last year as per the new DECC Interim Guidelines for Consultation. The notification for registration covered the period from 25th June 2008 to 25th June 2009 and as such the previously registered Aboriginal groups were again consulted throughout the project.

The majority of AGL sites were located on slopes with G1 and G2 located on flats/flood plain areas. Disturbances across each site were minimal and included clearing and grazing. Vegetation cover varied from moderate to high thus decreasing visibility. One isolated artefact (grey silcrete flake) was identified at Craven 7 and situated in a large erosion scar next to a drainage line and in close proximity to a dam. The site was heavily disturbed through dam construction, erosion, clearing and grazing. Visibility on the site was 100% and 10% in the area surrounding. Due to the disturbances there is limited to no potential for in situ cultural materials at this site.

One PAD was identified (PAD 1) at Wards River 2. PAD 1 encompasses an area of a gentle slope that overlooks a terrace and Bull Creek (a 4th Order Stream). Disturbances are minimal and soil A horizon remains. Although The PAD is extensive, only the area to be disturbed is included in the PAD for this project.

The PAD is located within what is believed to be an ideal location, landform and distance from a reliable water source and its associated resources along with the minimal disturbances suggests there is a moderate to high potential for subsurface cultural materials at these locations.

A s90 Aboriginal Heritage Impact Permit (s90 Consent to Destroy with Collection) is recommended for site AGLG1 and a s87 Aboriginal Heritage Impact Permit (s87 Preliminary Research Permit for test excavation) is required for PAD 1.

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1 INTRODUCTION

1.1 OVERVIEW

McCardle Cultural Heritage Pty Ltd (MCH) has been commissioned by AGL Gloucester (formerly Lucas Energy) to prepare an indigenous archaeological assessment of five proposed Core Hole sites and three stratigraphic sites as part of the Gloucester Coal Seam Gas Project. The Core Hole sites are referred to as Gloucester 2, Wards River 1, 3, 4 and 5 and the Stratigraphic sites are referred to as Gloucester 1, Wards River 2 and Craven 7.

The assessment employs a regional approach, taking into consideration both the landscape (landforms, water resources, soils, geology etc) of the study area and the regional archaeological patterning identified by past studies.

The objective of the assessment is to identify areas of indigenous cultural heritage value and to develop management recommendations.

1.2 SCOPE OF WORKS

The following tasks were carried out:

- a review of relevant statutory registers and inventories for indigenous cultural heritage including the NSW NPWS Aboriginal Heritage Information Management System (AHIMS) for known archaeological sites, the Register of the National Estate, the NSW State Heritage Inventory and the Australian Heritage Places Inventory;
- a review of local environmental information (topographic, geological, soil, geomorphological and vegetation descriptions) to determine the likelihood of archaeological sites and specific site types, prior and existing land uses and site disturbance that may effect site integrity;
- a review of previous cultural heritage investigations to determine the extent of archaeological investigations in the area and any archaeological patterns;
- the development of a predictive archaeological statement based on the data searches and literature review;
- consultation with the Aboriginal community as per DECC Interim Community Consultation Requirements for Applicants (2005);
- identification of impacts in relation to known and recorded archaeological sites and predicted archaeological potential of the study area, and
- the development of mitigation and conservation measures.

1.3 STUDY AREA

Part of the study area (Gloucester 1 and Gloucester 2) are located north and south of the township of Gloucester, Craven 7 is located to the west of Craven, Wards River 5 to the east of Craven and Wards River 1, 2, 3 and 4 to are situated around Wards River (Refer to *Figures 1.1* to *1.11*). All sites are situated on pastural property.

1.4 PROPOSED USE OF THE STUDY AREA

The following description of works and disturbances for the project are provided by AGL Gloucester.

Preparation and Associated Infrastructure Works

Access tracks, where required will be of a maximum 4m disturbance width (3m road) with pavement depth of approx. 300mm for heavy vehicle access. Topsoil will be scraped and collected to be stored in either windrows or in stockpiles, depending on each landholders request. All access roads will have a 3% cross fall for drainage and erosion control measures placed as required.

For each borehole a cleared "pad" is required to be constructed prior to commencement of drilling. The "pad" needs to be prepared on an area of up to 60 x 40 m. The pad is cleared of topsoil (which is stockpiled near the pad for site rehabilitation upon completion) and levelled and covered with a layer of compacted gravel laid in preparation for drilling activities (with a 3% cross fall for drainage). A bund wall to 250mm height is constructed around the pad with drainage toward a small lined sump on a corner of the pad. Sediment control fencing is also to be placed as required around the pad site. The drilling pad is then fenced ahead of arrival of the drilling rig. All drilling and well completion activities can then take place in the secure enclosed site.

Machinery typically used in both access track and pad construction are as follows:

D6 Dozer	Rigid trucks and Super dogs	6 x 6 Artic Dumper
20 t Digger	Drum Roller	
Grader	Smooth – vibrator	

Disturbance:

- Clearance of existing groundcover and topsoil (to be stored for site rehabilitation), import of gravel and erection of site fence around an area of up to 60m x 40m;
- Grading and improvement of access tracks for heavy vehicle access maximum 4m disturbance width.

Exploration Core and Stratigraphic Borehole Construction

At each borehole location a single vertical will be constructed. Both core and stratigraphic boreholes will be drilled using the same conventional drilling rig (proposed LF117). The stratigraphic borehole only differs in the fact that there is no full core samples produced throughout the drilling process, but drill cuttings are instead analysed. These eight boreholes are initially for exploration however

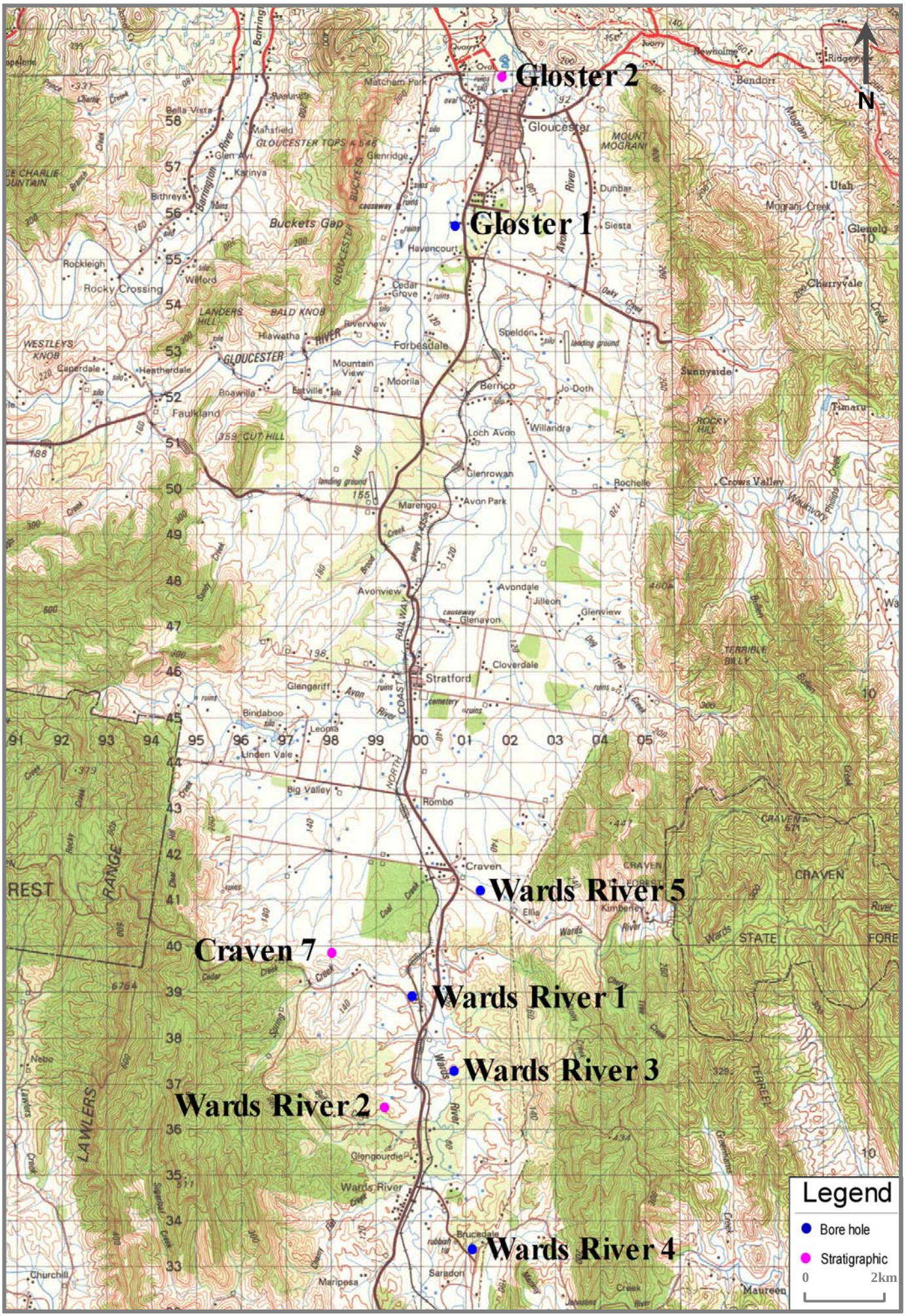

Figure 1.1 Regional location of the study area

Source: 1:100 000 Topographic Series: Dungog, Bulahdelah, Upper Manning, Wingham

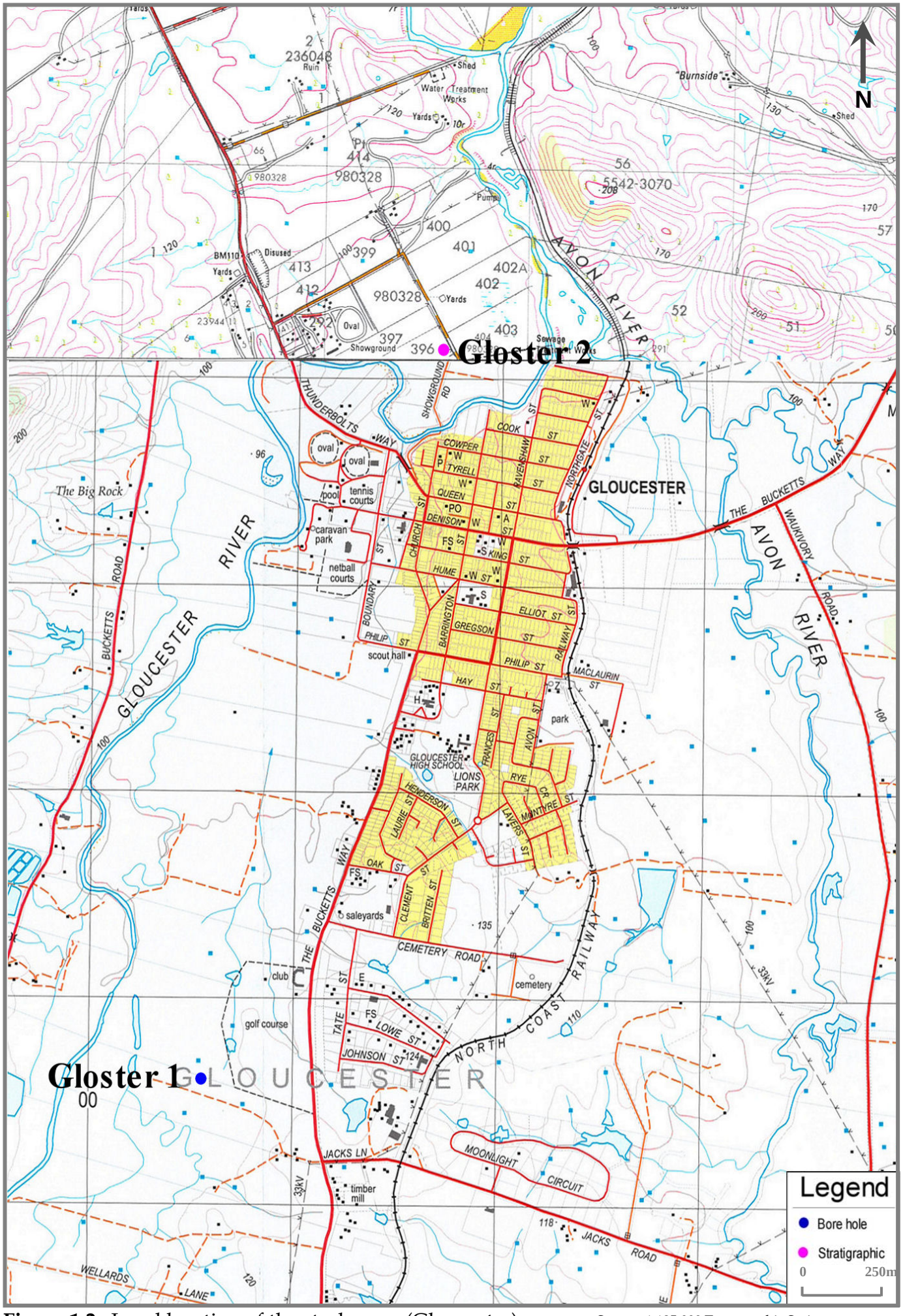

Figure 1.2 Local location of the study area (Gloucester)

Source: 1:125 000 Topographic Series: Gloucester & Bowman

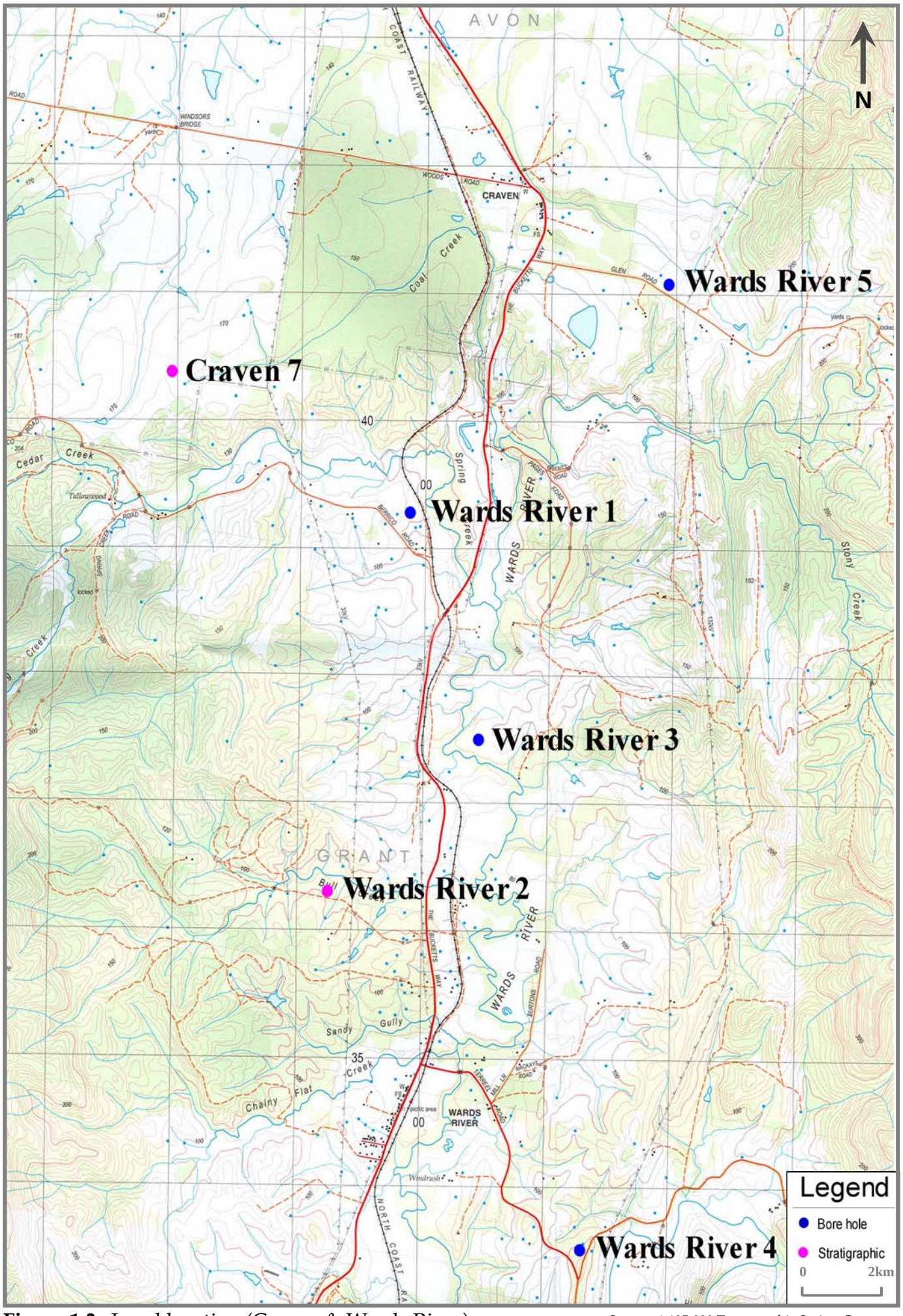

Figure 1.3 Local location (Craven & Wards River)

Source: 1:125 000 Topographic Series: Craven

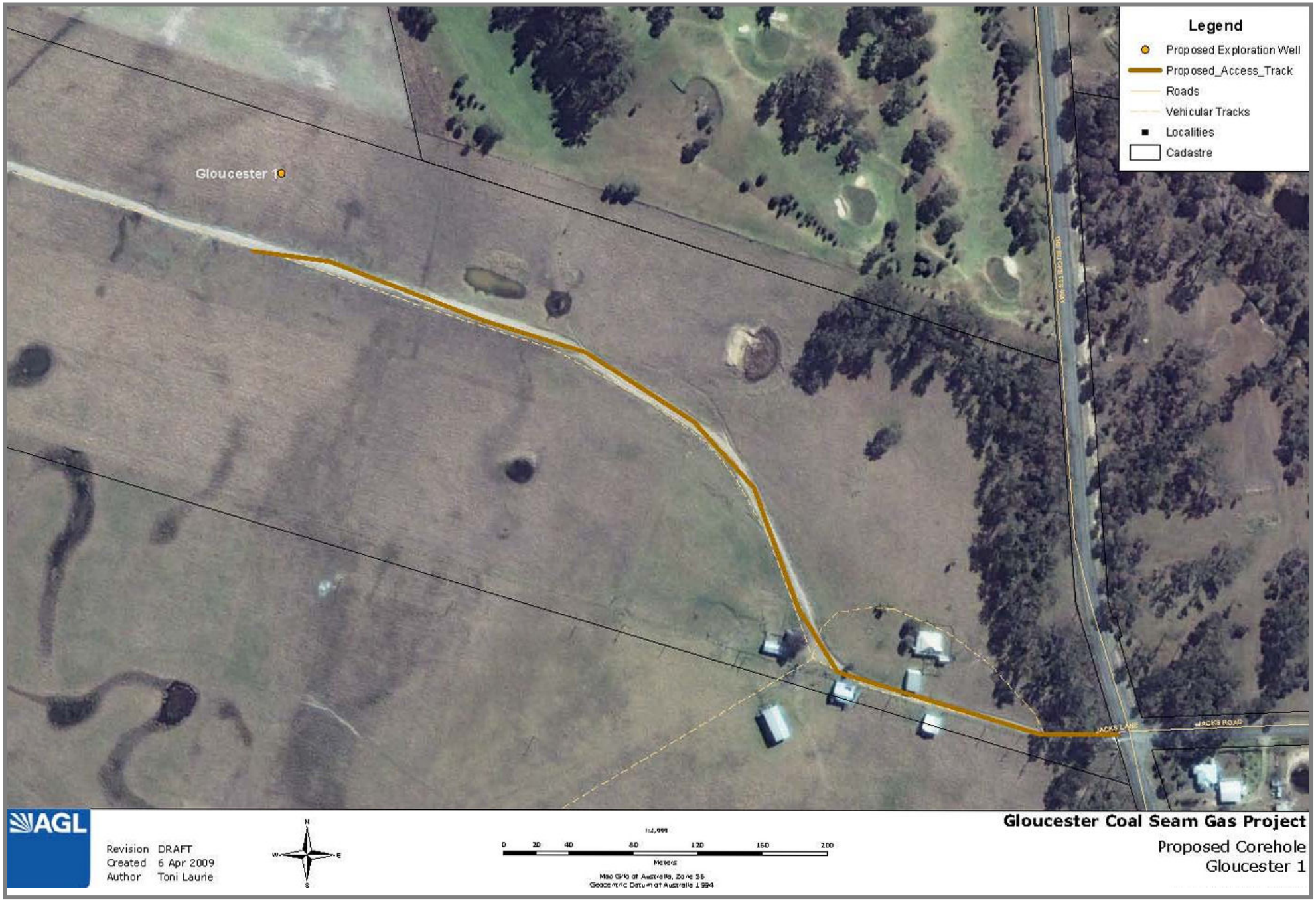

Figure 1.4 Aerial: Gloucester 1

Source: AGL Gloucester

Figure 1.5 Aerial: Gloucester 2

Source: AGL Gloucester

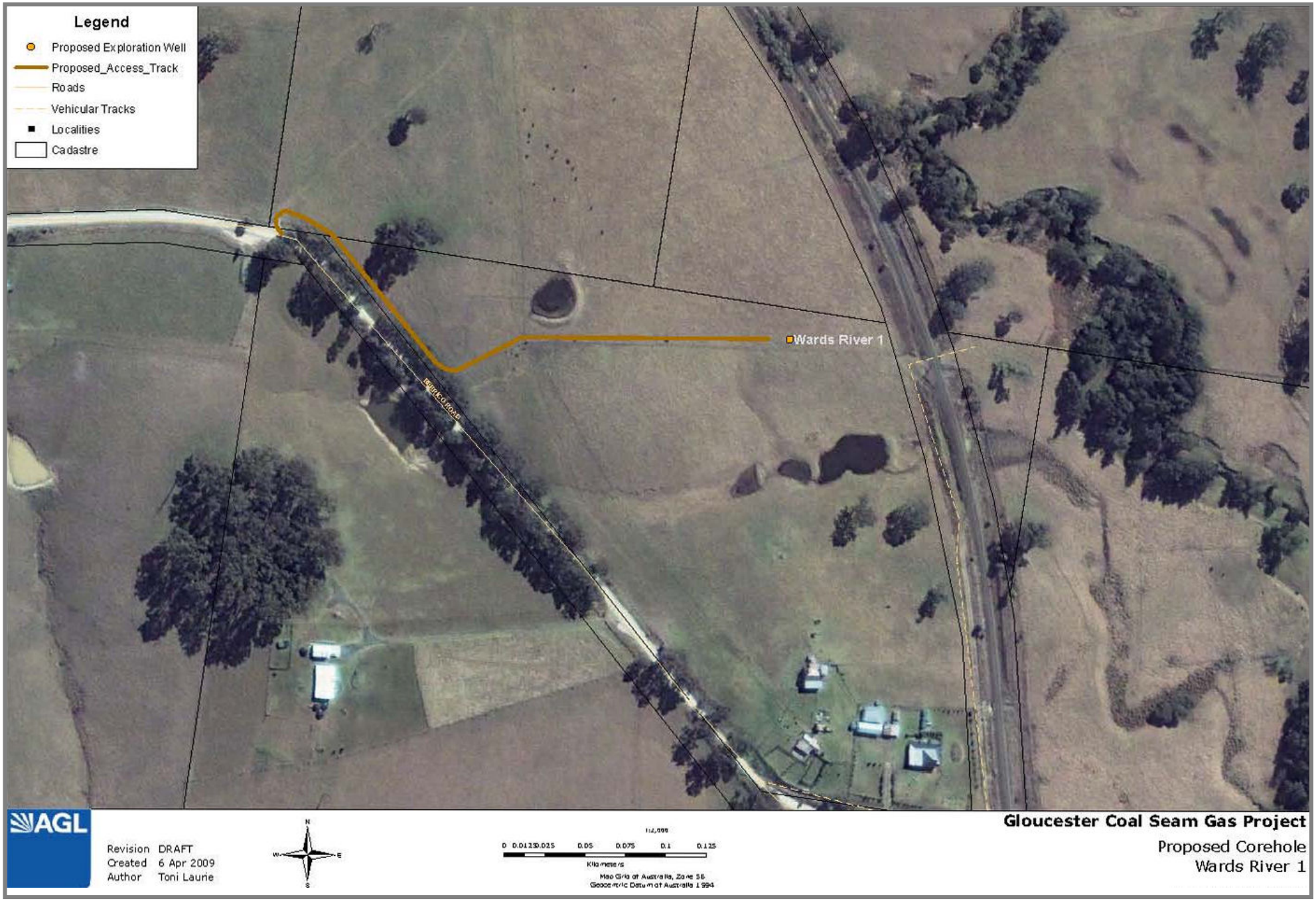

Figure 1.6 Aerial: Wards River 1

Source: AGL Gloucester

Figure 1.7 Aerial: Wards River 2

Source: AGL Gloucester

Figure 1.8 Aerial: Wards River 3

Source: AGL Gloucester

Figure 1.9 Aerial: Wards River 4

Source: AGL Gloucester

Figure 1.10 Aerial: Wards River 5

Source: AGL Gloucester

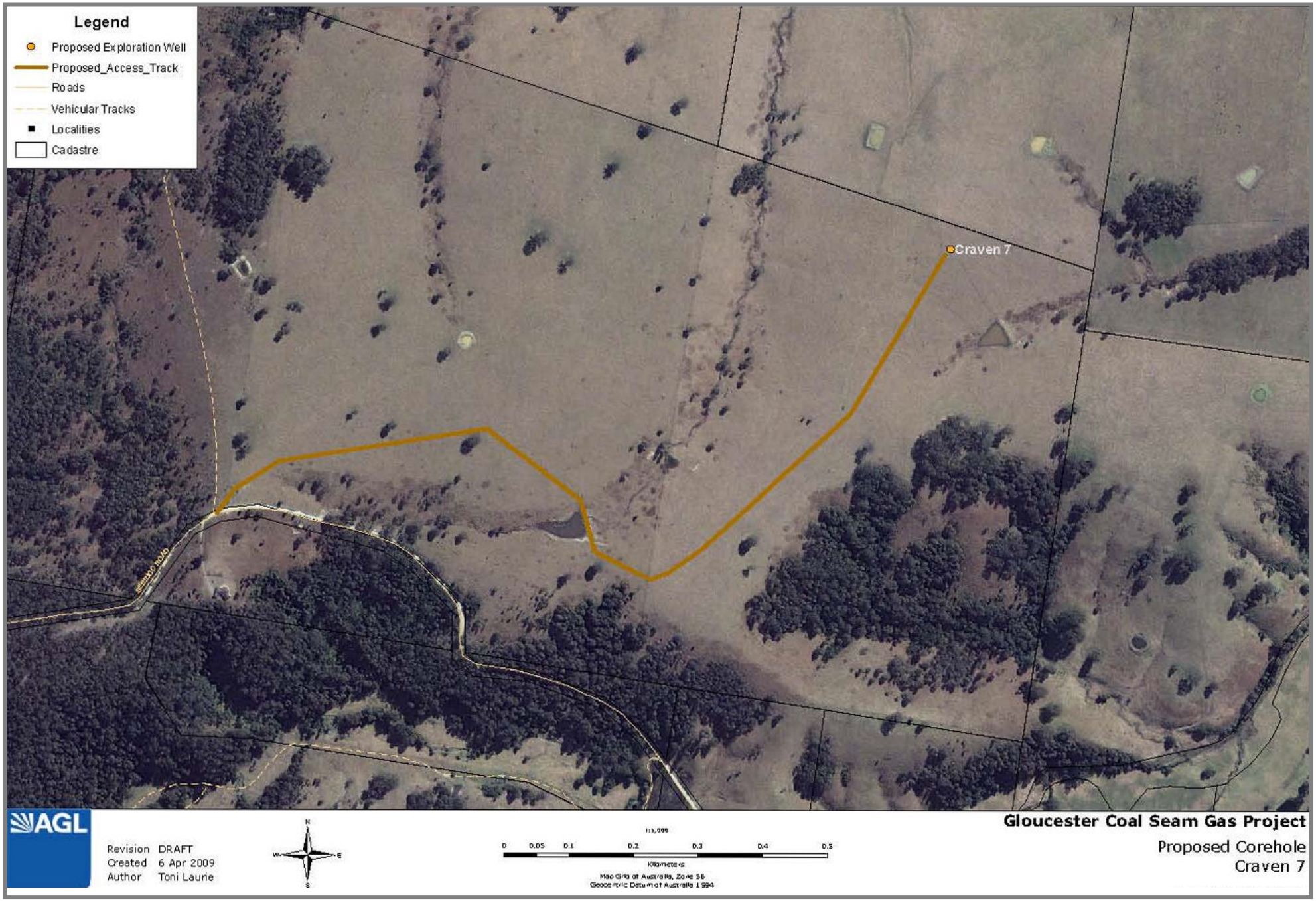

Figure 1.11 Aerial: Craven 7

Source: AGL Gloucester

if the data gained from the exploration proves appropriate it is possible that approval may be sought to convert some to pilot production wells. In this case the borehole will be capped, whilst approval is being sought from the relevant departments.

It is proposed that the drilling for each borehole be on a 24 hour basis, with landholder approval. This will halve the time for completion at each site.

Borehole Drilling Methods

Drilling of wells would be with a truck or small platform mounted drilling rig. All wells will have the surface casing installed to a depth of at least 10% of the expected vertical depth of the hole. The surface casing will be cemented to surface providing secure anchorage for the equipment.

All drilling fluids would be contained in a series of tanks on each site. No drilling circulation water would be discharged to local drainage lines or creeks.

Open hole wire line logging will be undertaken over a two day period on each well once drilling has been completed.

Disturbance:

- Movement of vehicles to and from the established drill pad;
- Operational noise of drill rig and associated activities.

Sealing of Wells and Restoration of the Site

Depending on the data collected from each borehole, most will be sealed and restored to good oil field practice and departmental standards. This will include cementing the hole to 1/5 of the total depth (TD), removal of gravel, spreading of stockpiled topsoil and the revegetation of groundcover to all disturbed areas. Road access tracks may be left in place if the landholder requests or again gravel removed from site and topsoil respread and revegetated.

If it is decided to seek further approval for any of the boreholes to be converted to a pilot production hole then the drill string and PW Casing will be removed the hole capped whilst approval is sought

A generic plan of a site is provided in *Figure 1.12*.

1.5 CONSULTATION

This project falls under Part 3A and the consultation was undertaken last year as per the new DECC Interim Guidelines for Consultation. The notification for registration covered the period from 25th June 2008 to 25th June 2009 and as such the previously registered groups were again consulted with (Refer to *Table 1.1*).

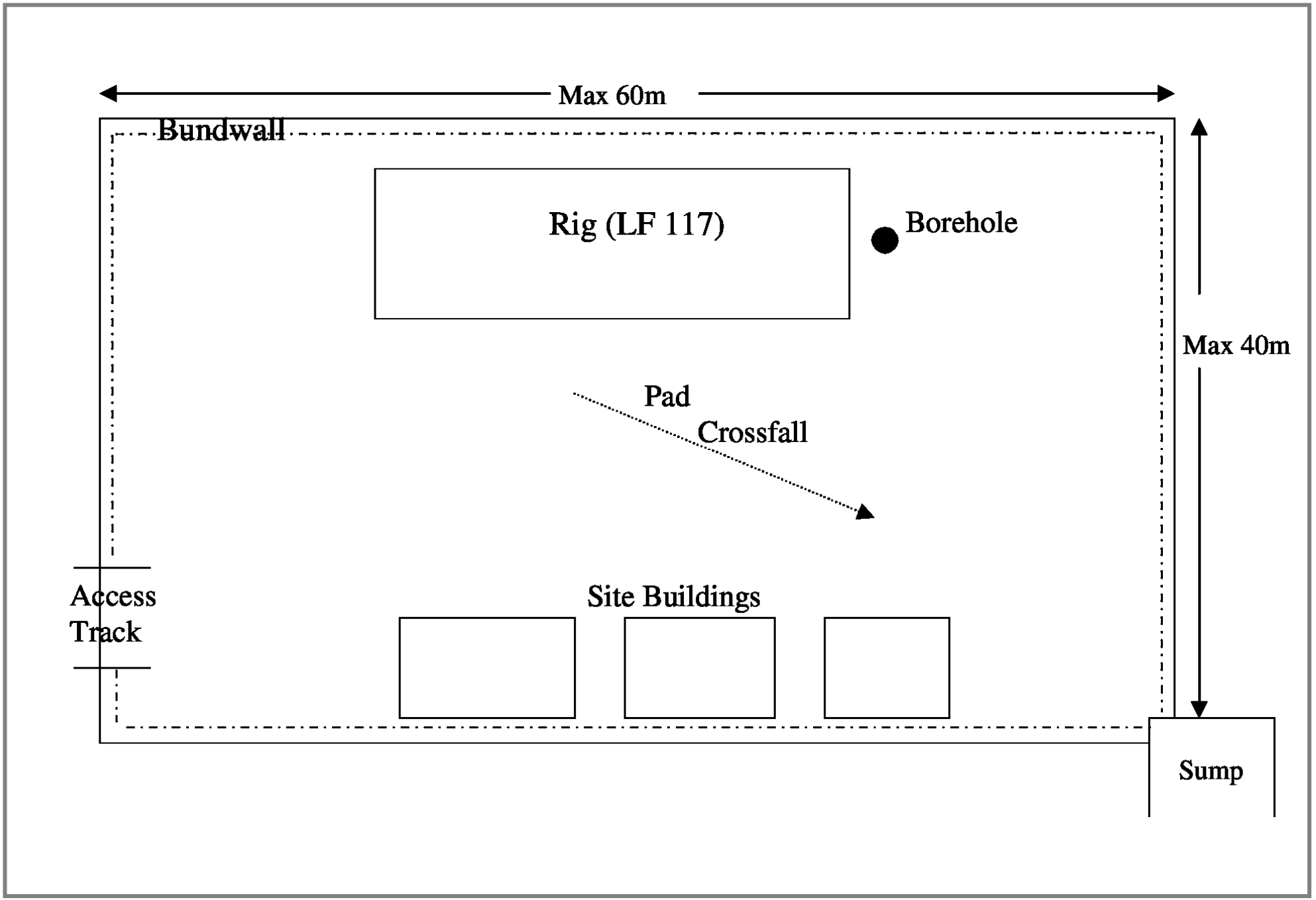

Figure 4.12 Generic Plan

Source: AGL Gloucester

Table 1.1 Registered groups/individuals

Group/individual
Indigenous Cultural Resources Management Services
Forster LALC
Booken Booken Elders Group
Nora Fisher (Elder)
Garigal Aboriginal Community Inc (Glen Jonas)
The Minimbah & District Aboriginal Elders Inc. (Eva Leon)

All groups were invited to participate in the survey on 14th April 2009. No group attended the survey and MCH undertook the survey on the 14th April and 18th May. MCH forwarded a draft copy of the report, s87 and s90 applications to all registered groups and asked the community if they would like a meeting to discuss the survey, results, s87 and s90 applications and if they would like to provide a cultural significance assessment for its inclusion in the final report if they wished to do so (See *Annex A*). MCH attempted to contact all registered groups to discuss the project and Permit applications three times, but received no response.

MCH consulted with all groups identified who registered an interest in the project. All documentation regarding the consultation process can be forwarded to DECC upon request.

1.6 STATUTORY CONTROLS

Land managers are required to consider the affects of their activities or proposed development on the environment under several pieces of legislation. Indigenous cultural heritage in NSW is protected and managed under the following Commonwealth and State legislation:

- New South Wales National Parks and Wildlife Act 1974, Amendment 2001 (State)

All indigenous objects within the state of New South Wales are protected under Section 90 of the National Parks and Wildlife Act 1974 (NPW Act). Under s.5 of the Act, "object" means any deposit, object or material evidence (not being a handicraft made for sale) relating to indigenous habitation of the area that comprises New South Wales, being habitation both prior to and concurrent with the occupation of that area by persons of European extraction, and includes Aboriginal remains.

Sites of traditional significance that do not necessarily contain archaeological materials may be gazetted as "Aboriginal places" and are protected under Section 84 of the Act. This protection applies to all sites, regardless of their significance or land tenure. Under Section 90, it is an offence to knowingly disturb, damage or destroy objects or Aboriginal Places without the prior written consent of the Director-General of National Parks and Wildlife. Amendments introduced by the National Parks & Wildlife Amendment Act 2001, include renaming Section 90 "consent" to "Heritage Impact Permit", removal of the term "knowingly" from Section 90, and adding reasonable

precaution and due diligence as defences against prosecution under the amended Section 90. At the time of writing, these amendments have yet to commence.

- Environmental Planning and Assessment Act 1979, (EP&A Act), (State)

The Minister for Planning has declared this project as being subject to Part 3A of the EP&A Act. The EP&A Act requires that environmental impacts be considered in land-use planning, including impacts on indigenous and non indigenous heritage. Local Environmental Plans prepared in accordance with the EP&A Act identify permissible lands use and development constraints, and provide guidance on the level of environmental assessment required.

- The Heritage Act 1977 (State)

The Heritage Act 1977 protects the natural and cultural history of NSW with emphasis on non-indigenous cultural heritage through protection provisions and the establishment of a Heritage Council. While Aboriginal heritage sites and objects are protected primarily by the NPW Act 1974, if an Aboriginal site, object or place is of great significance it can be protected by a heritage order issued by the Minister on the advice of the Heritage Council.

- The Aboriginal and Torres Strait Islander Heritage Protection Act 1984, Amendment 1987 (Commonwealth)

The Aboriginal and Torres Strait Islander Heritage Protection Act 1984 protects areas and/or objects which are of significance to Aboriginal people and which are under threat of destruction. A significant area or object is defined as one that is of particular importance to Aboriginal people according to Aboriginal tradition. The Act can, in certain circumstances override state and territory provisions, or it can be implemented in circumstances where state or territory provisions are lacking or are not enforced. The Act must be invoked by or on behalf of an Aboriginal or Torres Strait Islander or organisation.

- The Australian Heritage Commission Act 1975 (Commonwealth)

The Australian Heritage Commission Act 1975 established the Australian Heritage Commission, which assesses places to be included in the National Estate and maintains a register of these places, which are significant in terms of their association with particular community or social groups for social, cultural or spiritual reasons. The Act does not include specific protective clauses.

1.7 REPORT STRUCTURE

This report has the following structure:

Chapter 2 outlines the environmental context;

Chapter 3 provides the archaeological context;

Chapter 4 provides the results of the archaeological fieldwork;

Chapter 5 provides the significance assessment;

Chapter 6 provides the impact statement;

Chapter 7 provides the mitigation and management strategies, and

Chapter 8 provides the recommendations.

2 ENVIRONMENTAL CONTEXT

2.1 INTRODUCTION

The nature and distribution of Aboriginal cultural materials in a landscape are strongly influenced by environmental factors such as topography, geology, landforms, climate, geomorphology, hydrology and the associated soils and vegetation (Hughes and Sullivan 1985). These factors influence the availability of plants, animals, water, raw materials, the location of suitable camping places, ceremonial grounds, burials, and suitable surfaces for the application of rock art. Differing environmental constraints result in the physical manifestation of different spatial distributions and forms of archaeological evidence and therefore these environmental factors are used in constructing predictive models of Aboriginal site locations.

Environmental factors also affect the degree to which cultural materials have survived in the face of both natural and human influences and influence the likelihood of sites being detected during ground surface survey. Site detection is dependent on a number of environmental factors including surface visibility (which is determined by the nature and extent of ground cover including grass and leaf litter etc), the survival of the original land surface and associated cultural materials (due to the deposition and/or removal of flood alluvium and slope wash materials), and the exposure of the original landscape and associated cultural materials (by water, sheet and gully erosion, ploughing, vehicle movement etc) (Hughes and Sullivan 1985). The full range of environmental factors is therefore assessed to determine the likelihood of both surface and subsurface cultural materials surviving and being detected.

It is therefore necessary to have an understanding of the environmental factors, processes and activities, all of which affect site location, preservation, detection during surface survey and the likelihood of sub-surface cultural materials being present. The environmental factors, processes and disturbances of the surrounding environment and specific study area are discussed below.

2.2 TOPOGRAPHY

The topographical context is important to identify potential factors relating to past Aboriginal land use patterns. The specific study areas consist of low lying lower slopes and flats that are situated within a landscape characterised by slopes and crests with flats, flood planes, creeks and drainage channels.

2.3 GEOLOGY

The nature of the surrounding and local geology has a number of implications for Aboriginal land use, mainly relating to the procurement of stone resources or materials for manufacturing and modification for stone tools.

Based on the Newcastle Geological Map, with the exception of Gloucester 1 all site situated within Quaternary deposits of gravel, sand, silt, clay and marine and freshwater deposits. Gloucester 1 is situated on the Permian Craven Coal Measure consisting of conglomerate, sandstone, mudstone, shale and coal.

The availability and distribution of stone materials has a number of archaeological implications. Evidence of stone extraction, and manufacture, can be predicted to be concentrated in the areas of stone availability. However, stone can be transported for manufacture and/or trading across the region.

Due to a lack of investigations in the region, it is unknown what raw materials are most dominant in stone tool manufacture throughout the region.

2.4 GEOMORPHOLOGY

Geomorphology is the study of landscapes, their evolution and the processes operating within earth systems. Cultural remains are part of these systems, having being deposited on, and in part, resulting from interactions within landscapes of the past. An understanding of geomorphological patterning and alterations is therefore of integral importance in understanding the archaeological record.

There are no known reports regarding the geomorphology of this region. However, given that the Hunter Valley is a similar landscape and environment, studies from there are used as an inference here.

The geomorphology of the Hunter Valley is applied to the study area and is complex. Therefore is briefly summarised below based upon from studies undertaken by Galloway (1963) and Hughes (1984).

The region contains a variety of landforms ranging from rugged mountains to plains and varying in elevation from sea level to over 1500 metres (AHD). The soils throughout the region reflect the influence of a range of factors including the parent geological material, topography, climate, organisms and length of formation time. Differences between these elements are reflected in variation in soil types across the area.

Texture contrast soils mantle the undulating to hilly landscapes on Permian and Carboniferous rocks and the older alluvial terraces and valley fills. The two major groups of texture contrast soils include solonetzic and podzolic soils. These soils consist of an upper soil Horizon A and underlying B (referred to as duplex soils). The upper A unit consists of grey to buff silts and sand with gravels, is usually no greater than one metre in depth, has a weakly developed soil profile and is typically discontinuous, especially along hill slopes. The underlying B unit consists of brown-red gravel rich clays with evidence of deep weathering and strongly contrasting horizons.

Unit A and Unit B are interpreted as being Holocene and Pleistocene in age respectively. Within the region, sites tend to occur on or within soil Horizon A or are often present at the interface of the A and B horizons.

Within the A horizon the lowermost (in terms of vertical positioning) artefact assemblages tend to contain artefacts broadly attributable to the mid-Holocene (5000 years before present), as characterised by an increase in the number of backed artefacts. It is therefore generally argued that the A-horizon is sedimentary in origin and has accumulated in the last 5000 years.

In contrast, the underlying weathered nature of the clayey B-horizon indicates that its parent material is much older. Evidence of earlier occupation of the region was identified at Glennies Creek, north of Singleton. Koettig (1986) reports that radiocarbon dated charcoal and geomorphological evidence from this site suggests that artefacts found in the B-horizon were deposited between 10,000 and 13,000 BP (before present).

The B-horizon parent material in hill slope formations is typically composed of weathered, in-situ bedrock whereas soils along the valley floors are generally alluvial or colluvial in origin.

The archaeological importance of foot slopes and valley floors with soils of this type is also related to the fact that they are prone to erosion which may broadly reveal previously buried archaeological evidence. Extensive sheet and gully erosion occurs throughout the area, potentially resulting in artefacts that were originally deposited on or within the A-horizon being exposed as highly visible lag. Thus, although erosion greatly increases the visibility of artefacts, it also disturbs and damages them.

Similarly, the impacts of bioturbation upon the archaeological record must also be addressed. Focussed studies regarding bioturbation has primarily been conducted outside Australia (e.g. Armour-Chelu & Andrews 1994; Fowler *et al* 2004; Peacock & Fant 2002). Therefore, whilst the subsequent findings are broadly applicable within the Australian context, further research is certainly warranted. In general, it appears that, within duplex soils, the burrowing activities of fauna including earthworms can often cause the lateral movement of artefacts through the soil profile, eventually resulting in the formation of a stone layer at the interface of the A and B horizons. The other important element to address is the differential movement of artefacts according to size/weight. In this respect, bioturbation has the potential to artificially conflate and separate artefacts according to size grouping as opposed to depositional context (Fowler *et al* 2004; Armour-Chelu & Andrews 1994).

As it is expected that the majority of archaeological sites in the region will be present within localities with duplex soils, the inherent properties of these soils must be taken into consideration in regard to the likelihood of site detection (through exposure by erosion), the stratigraphic context and age of sites, potential site location in relation to past use of the landscape and landscape instability.

2.5 SOILS

The nature of the surrounding soil landscape has implications for Aboriginal land use and site preservation, mainly relating to supporting vegetation and the

preservation of organic materials and burials. The project area is situated on a number of soil landscapes (Henderson 2000) which vary according to landform and these are discussed below.

Gloucester 1, Gloucester 2 and Wards River 5 are situated on the Gloucester Soil Landscape. This landscape is located on undulating low hills and consists of an A1 horizon of brownish black loam that overlies the A2 horizon of hard setting bleached loam. Depth is up to 15 centimetres and soil pH is 5.5 to 6.0. The B horizon consists of brown strong prismatic clays or grey mottled clay. Depth can be up to 150 centimetres and pH is also 5.5 to 6.0. Some sheet wash and minor to moderate gully erosion is common (Henderson 2000:102-105).

The remaining sites are located on the erosional Wards River Soil Landscapes. The landscape includes rolling low gills with relief of 30-100 metres and elevation of 100-240 metres. Slopes are >20% with mass movement hazards. Soils include a topsoil (A1 horizon) of brownish black earthy loams that overlay an A2 horizon of brown hard setting, bleached loam. The A horizons range in depth from 5 to 20 centimetres and soil pH is 5.5 – 6.0. Soil horizon B consists of brown or yellow prismatic clays that range in depth up to 60 centimetres. Some sheet wash and minor to moderate gully erosion is common (Henderson 2000:138-141).

This landscape is subject to localised flooding, water runoff and erosion. Together this results in a disturbed landscape which also disturbs the cultural materials within this landscape.

The deposit of alluvial sediments and colluvium movement of fine sediments (including artefacts) results in the movement and burying of archaeological materials. The increased movement in soils by this erosion is likely to impact upon cultural materials through the post-depositional movement of materials, specifically small portable materials such as stone tools, contained within the soil profiles.

2.6 CLIMATE

Climatic conditions would also have played a part in occupation of an area as well as impacted upon the soils and vegetation and associated cultural materials (Kovac and Lawrie 1991). The climate of the area includes warm, hot, humid summers (average 29oC) and cool to cold winters (average 3oC). Rain fall is summer-autumn dominated with a mean annual rainfall of 1221mm (Henderson 2000).

Rainfall is known to impact upon soils through runoff and rain splash, resulting in further aggravation of the landscape through erosion and the associated movement of cultural materials.

2.7 *WATERWAYS*

The availability of water (along with the fauna and flora resources utilising water) is one of the most important factors influencing patterns of past Aboriginal land use.

The order of streams was determined based on the Strahler method and using the Singleton 1:25 000 topographic map. This method of stream ordering involves labelling all upper tributaries as first order streams. When two first order streams meet they form a second order stream. Where two second order streams converge they form a third order stream and so on. When a stream of lower order joins a stream of higher order the downstream section of the stream will retain the order of the higher order upstream section (Anon 2003; Wheeling Jesuit University 2002).

The Wards, Gloucester and Avon Rivers (4th Order) are the most dominant Rivers in the area. However all sites are located more than 100 metres from these. All sites are located in close proximity to 1st order streams and their location will be further clarified during the survey.

With the Wards, Gloucester and Avon Rivers located near to the study area, they may have been a more optimal area for past occupation rather than 1st order streams.

2.8 *VEGETATION*

The availability of flora and associated water sources affect fauna resources, all of which are primary factors influencing patterns of past Aboriginal land use and occupation. The preservation and detection of surface cultural materials from past Aboriginal land uses are also influenced by flora and fauna.

European settlers of the Gloucester, Craven and Wards River areas were extensively cleared the original native vegetation from the 1820's to the 1850's. Much of the study area today is cleared for grazing cattle but remnant vegetation in the area includes several varieties of eucalypts, and includes mature river gum, ironbark, mahogany, spotted gum and paperbark. Several resource plants were noted particularly along the creek and drainage lines.

Typically, due to vegetation cover, most artefacts identified through surface inspection are identified when they are visible on exposures created by erosion or ground surface disturbances (Dean-Jones and Mitchell 1993; Kuskie and Kamminga 2000). The grass ground cover throughout the study area is expected to result in limited visibility, hence reducing the detection of surface cultural materials.

2.9 *LAND USES*

Based upon archaeological evidence, the occupation of Australia extends back some 40,000 years (Mulvaney and Kamminga 1999) whilst Aboriginal people

have been present within the Hunter Valley for at least 20,000 years (Koettig 1987). Although the impact of past Aboriginal occupation on the natural landscape is thought to have been relatively minimal, it cannot simply be assumed that 20,000 years of land use have passed without affecting various environmental variables.

The practice of 'firestick farming' whereby the judicious setting of fires served to drive game from cover, provide protection and alter vegetation communities significantly influenced seed germination, thus increasing diversity within the floral community.

The Gloucester mountains known as the Bucketts Range and the area's main arterial road, the Bucketts Way, derive their name from the local Aboriginal word Buccans which means "big rocks". In the early to mid 1800's, agricultural activities in the area included wool, wheat and beef production, dairying and timber milling. Following European settlement of the area by the 1850s, the landscape has been subjected to a range of different modifactory activities including extensive logging and clearing, agricultural cultivation (ploughing), pastoral grazing, residential developments and mining (Turner 1985). In 1855 major coal deposits were discovered in the Mammy Johnsons Creek area and gold mines were worked near Monkerai from 1899 until 1931. The associated high degree of landscape disturbance has resulted in the alteration of large tracts of land and the cultural materials contained within these areas.

The specific study areas have been cleared and primarily used for pastoral (grazing) and agricultural practices, involving the wholesale clearance of native vegetation, the introduction of pasture grass and the construction of fencing and dams.

Although pastoralism is a comparatively low impact activity, it does result in disturbances due to vegetation clearance and the trampling and compaction of grazed areas. These factors accelerate the natural processes of sheet and gully erosion, which in turn can cause the horizontal and lateral displacement of artefacts. Furthermore, grazing by hoofed animals can affect the archaeological record due to the displacement and breakage of artefacts resulting from trampling (Yorston et al 1990). Pastoral land uses are also closely linked to alterations in the landscape due to the construction of dams, fence lines and associated structures.

As a sub-set of agricultural land use, ploughing typically disturbs the top 10-12 centimetres of topsoil (Koettig 1986) depending on the method and machinery used during the process. Ploughing increases the occurrence of erosion and can also result in the direct horizontal and vertical movement of artefacts, thus causing artificial changes in artefact densities and distributions. Ploughing may also interfere with other features and disrupt soil stratigraphy (Lewarch and O'Brien 1981). Ploughing activities are typically evidenced through 'ridges and furrows' however a lengthy cessation in ploughing activities dictates that these features may no longer be apparent on the surface.

Whilst the impacts of vehicular movements on sites have not been well documented, based on general observations it is expected that the creation of

dirt tracks for vehicle access would result in the loss of vegetation and therefore will enhance erosion and the associated relocation of cultural materials.

The processes of bioturbation can also adversely affect the integrity of the soil profile. Due to the activities of plants and animals, soils may be artificially sorted and thus artefacts deposited within the soils will also be disturbed. Depending on the severity and nature of the bioturbation factors in operation, artefacts may be subject to significant lateral and/or vertical disturbance (Fowler *et al* 2004; Peacock and Fant 2002).

2.10 DISCUSSION

The regional and local environment provided a range of resources, including raw materials, fauna, flora and water, that would have allowed for use of the area.

However, natural agencies, including sheet wash result in the movement of fine materials down slope, and alluvial flooding and deposition of sediments results in the movement of fine materials, including cultural materials. This affects archaeological sites by altering the horizontal and vertical relationship of artefacts, altering archaeological assemblages, changing artefact densities, and through the deposition of sediment, burying artefacts. These agencies appear to have been moderate within the study area and therefore significant impact upon the archaeological evidence is expected.

European land uses such as clearing and grazing would have also displaced any cultural materials that may have been present. Although this is expected to be minimal, such land uses would have accelerated erosion and displaced the associated cultural materials. The extensive vegetation cover across the study area reduces ground surface visibility and therefore reduces the potential to identify archaeological evidence by surface inspection.

Whilst site integrity cannot be assumed in light of these inter-relating activities and agencies, the existence of in situ cultural materials cannot be ruled out.

3 ARCHAEOLOGICAL CONTEXT

A review of the archaeological literature of the area, a NPWS AHIMS search and discussions with the appropriate Aboriginal groups will be discussed. These reports, recorded sites and consultations provide a broader picture of the wider cultural landscape highlighting the range of site types throughout the region, frequency and distribution patterns and identify site locations. Combined, this background understanding of the archaeological record assists with the construction of a predictive model of site location for the study area.

3.1 ARCHAEOLOGICAL CONTEXT

Very few archaeological assessments have been undertaken in the region and in the local area. DECC have one record of one report relating to an area of five kilometre circumference around the study area.

3.2 NSW NPWS ABORIGINAL HERITAGE INFORMATION MANAGEMENT SYSTEM

A search of the National Parks and Wildlife Service's (NPWS) AHIMS has shown that six known Aboriginal sites are currently recorded within five kilometres surrounding the study area. These include one stone arrangement, one burial, one carved tree, one bora/ceremonial, one unknown site and one artefact. Site co-ordinates are not provided due to site protection and conservation, however their general location are shown in *Figure 3.1*.

3.3 LOCAL ARCHAEOLOGICAL CONTEXT

Heritage Search (2000) undertook an assessment for the proposed Bowens Road North Project. The survey was undertaken by vehicle and foot. Visibility was low across the survey area and areas of exposure included vehicle tracks, dam walls, stock tracks and bulldozer scrapes. One isolated find was located on a dam wall along an ephemeral creek. The artefact, determined to be of low significance, was a broken flake manufactured from a fine grained siliceous black stone.

Whilst a PAD was identified along the Foot slopes and flats adjacent to Dog Trap Creek, Heritage Search state that test excavation is not warranted as the potential scientific significance of materials identified is not considered high enough to warrant test excavation. This is unfortunate as very little is known about past occupation of the area and region.

This report also mentions a previous study undertaken by Brayshaw (1984a) that was not identified by DECC. Heritage Search state that Brayshaw assessed land extending from Craven in the south to Dog Trap Creek in the north. This survey was undertaken prior to the development of Stratford Mine and two sites (artefact scatter and isolated find) were identified. Both sites were located on foot slopes on the edge of an ephemeral watercourse and exposed by erosion.

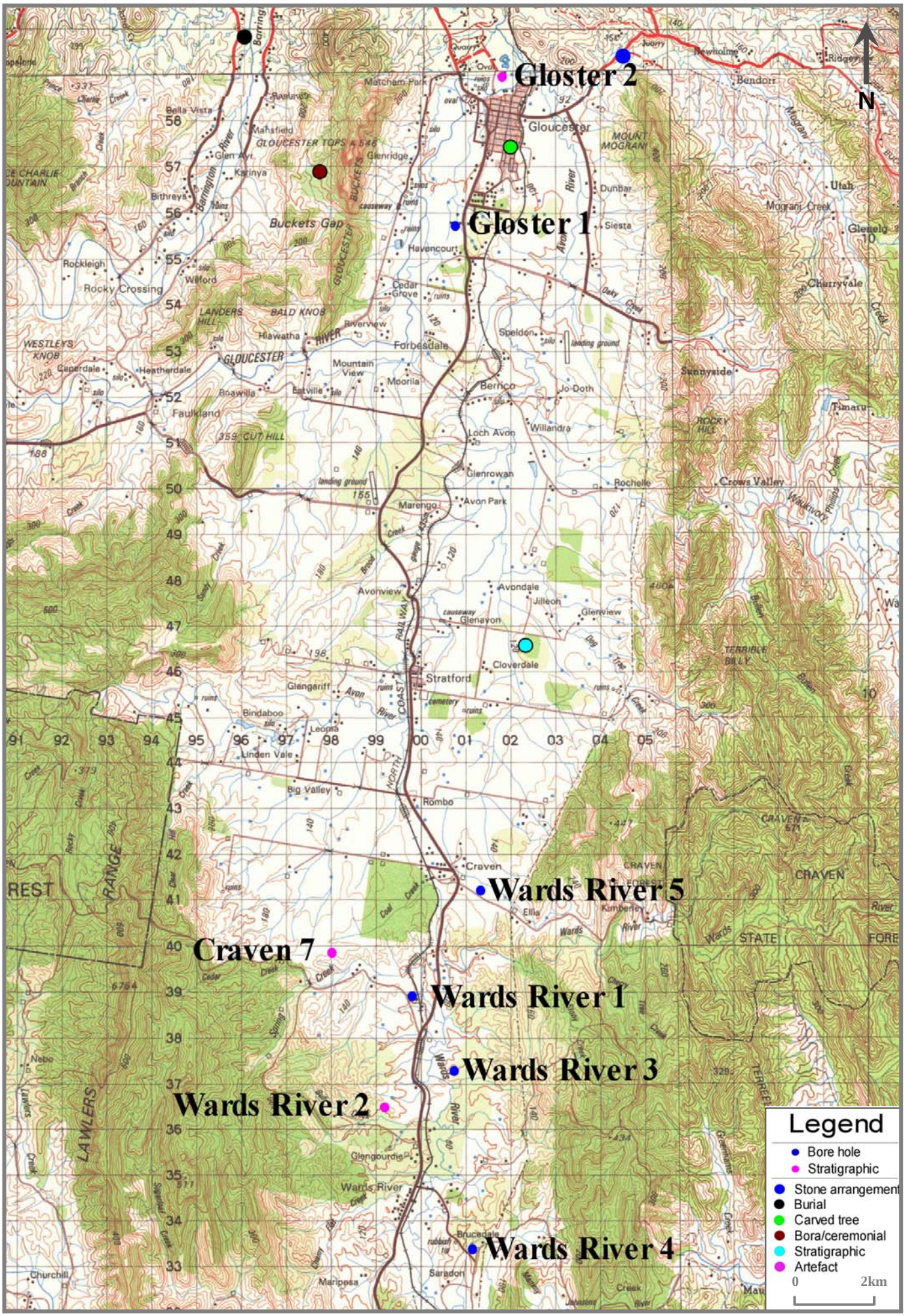

Figure 3.1 Known sites

Source: 1:100 000 Topographic Series: Dungog, Bulahdelah, Upper Manning, Wingham

Heritage Search also discusses another assessment undertaken by Brayshaw (1994b) as part of the Stratford Mine EIS. An additional three sites were identified and included one artefact scatter and two isolated artefacts. The artefact scatter was located on a flat approximately five metres from a first order stream and the location of the isolated finds is unknown. Subsurface testing along water ways was not recommended as it was considered low potential but testing next to the artefact scatter was recommended.

McCardle Cultural Heritage Pty Ltd (2008) undertook an indigenous archaeological assessment of five proposed Gas Well sites as part of the Gloucester Coal Seam Gas Project. The Gas Well sites are referred to as Waukivory 3, Waukivory 4, Faukland 2, Stratford 7 and Stratford 10. The study areas included low lying lower slopes and flats that were situated within a similar landscape as this study. That being a landscape characterised by slopes and crests with flats, flood planes, creeks and drainage channels.

Dense grass cover hindered visibility, disturbances were moderate and the vegetation was relatively consistent across all study areas. No sites were identified and due to the location of the study areas (not near reliable water sources) and the disturbances within all areas, no PAD's were identified.

Given the lack of assessments in the region, it is difficult to establish a reliable predictive model. However, inferences may be made from similar environments such as the Hunter Valley.

The majority of archaeological surveys and excavations throughout the Hunter Valley region have been undertaken in relation to environmental assessments for the coal mining and power industries of the Central Lowlands. A review of the most relevant investigations (Dyall 1979 Davidson *et al* 1993; Dean-Jones and Mitchell 1993; Koettig and Hughes 1984; McDonald 1997; Kuskie 2000; HLA-Envirosciences 2002; AMBS 2002; MCH 2003a, b) illustrates consistency in site type and location across the region as well as a possible bias in the results due to a focus on specific landforms.

Based on the available information it is possible to identify a number of trends in site location and patterning within the region. Open campsites are the most common site type with isolated finds also well represented. A variety of other site types have been identified in far lower concentrations and include grinding grooves, scarred trees, rock shelters, shelters with art, ceremonial grounds and burials. The high representation of sites containing stone artefacts is to be expected due to the durability of stone in comparison to other raw materials.

In relation to stone artefact raw materials, it is important to note that there is a potential for discrepancies in the way in which archaeologists classify lithic materials. This will consequently affect the proportional representation of raw materials within the recorded assemblages. However, as a whole, in the Hunter Valley mudstone is the most common lithic artefactual material found followed by silcrete. Chert, tuff, quartz, quartzite, petrified wood, porcellanite, hornfels, porphyry, basalt, limestone, sandstone, rhyolite, basalt, European glass and other non-specific lithic types also occur in smaller quantities. It is important to note that if stone resources that are suitable to manufacture tools from are not

present in the area, any raw materials used in stone tool production would have been traded or imported form another area.

Variation in the classificatory definitions employed by archaeologists will again significantly influence the range of artefact types identified within a study area. For example, the distinction between a waste flake, a debitage flake and a flaked piece may be heavily subject to the perspective of the recorder. Thus, it is not productive to attempt to quantify the proportionate representation of artefact types identified in previous studies.

That said, based on the information collated from previous regional studies (refer to MCH 2004b) it is apparent that the most common artefact types are flakes, flake fragments and flaked pieces. Cores, edge ground axes, millstones, grindstones, hammer stones and backed artefacts including backed blades, bondi points, geometric microliths and eloueras also occur though in lower frequencies.

In general, the stone artefact assemblage in the area has been relatively dated to what was previously known as the Small Tool Tradition (10,000 years BP). On the basis of stone tool technology, the overwhelming majority of Aboriginal open sites within the region are attributed to the Holocene period. However, at Glennies Creek, north of Singleton, based on radiocarbon dated charcoal and geomorphological evidence it is suggested that artefacts found in the B-horizon may have been deposited between 10,000 and 13,000 BP (Koettig 1986a, 1986b).

When assessing sites in terms of distance to water, there is a bi-modal distribution, in that the majority of sites are situated within 50 metres of water and the next highest proportion of sites are over 100 metres from water, with comparatively few sites present in the zone 50-100 metres from water. This contrasts somewhat with the generally accepted theorem that, within the Hunter Valley, site numbers decrease with distance from water. Rather, it appears that there is a distinct pattern whereby site numbers are greatest within 50 metres of water, becoming scarce 50-100 metres from water before again increasing in number beyond this distance category.

This bimodal pattern is echoed in relation to site size. The bulk of large and medium sites are situated within 50 metres of water, dropping in representation in the area 50-100 metres from water before reaching another lesser peak at distances over 100 metres from water.

Thus, it is apparent that open campsites/isolated finds are most concentrated in number and size within 50 metres of water. A secondary, lesser, peak in site numbers and size occurs at distances over 100 metres from water. This represents a refinement of the generally accepted premise that site numbers and artefact quantities within sites decrease in inverse proportion with distance to water. However, it must also be said that this pattern can be considered indicative only and is by no means conclusively proven.

As is to be expected, the majority of sites within 50 metres of water are present on creek lines whilst slopes and crest/ridge formations are also common site

locations. The frequent presence of sites on crest/ridges and slopes is also noticeable for sites located over 50 metres from water.

All grinding groove sites (for which all variables could be assessed) were located within 50 metres of water. Due to the importance of water in the grinding process, it is not surprising that sites of this type are situated close to water.

Unfortunately, due to the very small number of sites of other types (for example, shelter with art, burials and scarred trees) recorded it is not possible to reliably discuss patterning in these varied sites.

3.4 PREDICTIVE MODELLING

Based on the results of previous heritage studies, sites registered on the NSW NPWS AHIMS Register, landforms and past land use activities, and Hunter Valley predictive modelling a general predictive model for the specific study area has been developed.

3.4.1 Predictive Model for the Study Area

Research has shown that occupation sites (open camps or artefact scatters) and isolated finds are the most predominant site types. The most common site locations are along watercourses, gentle slopes, hilltops and ridges. Artefact density is greatest within 50 metres of watercourses and also appears to be comparatively high on elevated landforms over 100 metres from water.

The major rivers (Gloucester, Wards and Avon) are located between 50 and 100 metres from most of the study areas and lower order streams are located throughout the area. Whilst it is expected that high density open camps in increased numbers would be located along the major rivers, it is also expected that low density artefact scatters and isolated finds may be found along the lower order streams as these would have been utilised during travel and short term camping/hunting.

It is anticipated that sites will contain assemblages dating from the mid to late Holocene, featuring mudstone and silcrete as the dominant raw materials, with lesser quantities of quartz, chert, petrified wood and other raw materials. Artefacts will consist predominantly of debitage from flaking, flakes, broken flakes and few cores. Small numbers of modified artefacts including retouched flakes, and asymmetrical and symmetrical backed artefacts can be expected.

Dependent on the level of exposure within the study area, artefacts are expected to be located within the disturbed context of erosion scars and within the remnant A soil horizon and on top of the B horizon. Whilst it is possible that sub-surface deposits will be present within parts of the study area, this is entirely reliant on the level of disturbance across the site.

It must be emphasised that sites within the study area are expected to have been disturbed by both natural (erosion) and human disturbances (clearing, tracks etc) and thus, the accuracy of these predictions will be largely determined by the degree of such disturbances. The occurrence of disturbance dictates that the extent and spread of surface archaeological material may not reflect sub-surface deposits but rather may be a result of differential disturbance and exposure.

3.5 ARCHAEOLOGICAL POTENTIAL IN THE STUDY AREA

Based on archaeological sites registered in the region and the results of past archaeological studies, two site types are likely to occur throughout the site and include open artefacts scatters and isolated finds.

- Artefact Scatter

Also described as open campsites, these deposits include archaeological remains such as stone artefacts, shell, and sometimes hearths. These sites are usually identified as surface scatters of artefacts in areas where ground surface visibility is increased due to lack of vegetation. Erosion, agricultural activities (such as ploughing) and access ways can also expose surface campsites. Stone artefacts are the most common archaeological remains. They are the most numerous of all the relics produced by Aboriginal occupation, and the least susceptible to post-depositional destruction and decay. Given the recording of artefact scatters, it can be assumed that artefact scatters are present, either on the surface in erosion features, or when disturbing subsurface deposits.

- Isolated finds

Isolated finds are single artefacts that are usually identified in areas where ground surface visibility is increased due to lack of vegetation. Erosion, agricultural activities (such as ploughing) and access ways can also expose surface artefacts.

4 SURVEY RESULTS

4.1 METHODOLOGY

The study area was surveyed on foot by one person. The survey strategy was based on levels of vegetation cover and focused on areas of high ground surface visibility and exposures.

4.2 LANDFORMS

McDonald *et al* (1998) describes the categories of landform divisions. This is a two layered division involving treating the landscape as a series of 'mosaics'. The mosaics are described as two distinct sizes: the larger categories are referred to as landform patterns and the smaller being landform elements within these patterns. Landform patterns are large-scale landscape units, and landform elements are the individual features contained within these broader landscape patterns. There are forty landform pattern units and over seventy landform elements. However, of all the landform element units, ten are morphological types. For archaeological investigations they divide the landscape into standardised elements that can be used for comparative purposes and predictive modelling. *Table 4.1* lists the landforms for each site.

Table 4.1 Landforms of the well sites

Well site	Landform
Gloucester 1	flood plain
Gloucester 1	flats
Wards River 1	slope
Wards River 2	slope
Wards River 3	flats, ridge
Wards River 4	slope
Wards River 5	slope
Ridge, slope	Slope

4.3 SURVEY UNITS

For ease of management, the core hole and stratigraphic sites were identified as separate survey units (SU's), which are described below.

SU1: Gloucester 1

This survey unit consists of two Sections:

Section 1: is an access road that starts from The Bucketts Way heading north west along an existing access road (650 metres x 4 metres) in private property. This section begins as a slope that flows into flats in the north west. This section is heavily disturbed through clearing and access road construction. Exposure and visibility was excellent at 90%.

Section 2: includes the actual bore hole location (60m x 40m) which is located in the flood plain area and has been subject to clearing and cattle grazing. Visibility is low due to dense vegetation cover and exposures were not evident.

SU2: Gloucester 2

Access to this well site is via Park Street. This survey unit (60 m x 40m) is situated on a gentle slope/flat area that is situated approximately 120 metres east of The Avon River (a 5th Order Stream). The site has been greatly disturbed through clearing, fencing and cattle. Visibility is low due to dense grass cover and no exposures were evident.

SU3: Wards River 1

This survey unit consists of two Sections:

Section 1: is an access road that starts from Berrico Road and enters private property and follows an existing fence line down slope (south easterly) for approximately 140 metres, then heads east through open flat paddock for about 235 metres. This section is heavily disturbed through clearing, grazing, fences and a dam. Visibility was low due to vegetation cover and exposures included the dam and cattle pads.

Section 2: includes the bore hole location (60m x 40m). This site is located in a flat area approximately 130 metres west of Spring Creek (a 3rd Order Stream) and has been subject to clearing and grazing cattle and is currently covered in pasture grass hence reducing visibility. No exposures were evident.

SU4: Wards River 2

This survey unit consists of two Sections:

Section 1: is an access road that starts from an unnamed road and enters private property that traverses a gentle slope in a north eastern direction (150 metres x 4 metres). Being open pasture, the study area has been subject to clearing and grazing. Visibility was low and exposures were minimal.

Section 2: includes the bore hole location (60m x 40m). This site is located on a slope overlooking a terrace and Bull Creek (a 4th Order Stream). The site has been subject to clearing and grazing and is currently covered in pasture grass hence reducing visibility.

SU5: Wards River 3

This survey unit consists of two Sections:

Section 1: Access to this site is via a public road that enters a property at which point the track traverses pasture land consisting a ridge. The road through the open pasture area is approximately 880 metres x 4 metres that has been disturbed through clearing and grazing and ends at approximately 200 metres east of Wards River.

Section 2: includes the bore hole location (60m x 40m) that is situated on the ridge at approximately 200 metres east of Wards River The site has been subject to clearing and grazing. Dense pasture grass reduced visibility and exposures were minimal (erosion).

SU6: Wards River 4

This survey unit consists of two Sections:

Section 1: is an access road that enters from Terreel Road into private property along open pasture for approximately 100 metres. The road traverses a slope and is disturbed through clearing and grazing. Dense pasture grass reduced visibility and exposures were minimal (creek bank erosion).

Section 2: includes the bore hole location (60m x 40m) that is situated on a slope approximately 30 metres from a 1st order drainage line. The site has been previously cleared and is used for cattle grazing. Dense pasture grass reduced visibility and exposures were minimal (creek bank erosion).

SU7: Wards River 5

This survey unit consists of two Sections:

Section 1: is an access road that enters from Glen Road into private property along a slope of open pasture for approximately 50 metres. Disturbances include previous clearing and grazing. The road traverses a slope and is disturbed through clearing and grazing. Vegetation was dense grass cover hence reducing visibility.

Section 2: includes the bore hole location (60m x 40m). This site is located on a slope approximately 100 metres from a 1st order drainage line and over 160 metres from a 2nd order stream. The site has been previously cleared and used for cattle grazing. Visibility was low and few exposures present.

SU8: Craven 7

This survey unit consists of two Sections:

Section 1: is an access road that enters from Berrico Road into private property along open pasture for approximately 1.5 kilometres. The road traverses a slope, drainage line, slope and a ridge, all of which area disturbed through clearing and grazing. A dam is also located along the access road. Vegetation was dense and hindered visibility.

Section 2: includes the bore hole location (60m x 40m). This site is located on a slope approximately 300 metres from a 1st order drainage line. The site has been subject to clearing and grazing and is currently covered in dense pasture grass.

4.4 ECTIVE COVERAGE

Effective coverage is an estimate of the amount of ground observed taking into account local constraints on site discovery such as vegetation and soil cover. The effective coverage for the study area was determined and *Table 4.2* details the visibility rating system used.

Table 4.2 Ground surface visibility rating

Description	GSV Rating %
Very Poor – heavy vegetation, scrub foliage or debris cover, dense tree of scrub cover. Soil surface of the ground very difficult to see.	0-9%
Poor – moderate level of vegetation, scrub, and / or tree cover. Some small patches of soil surface visible in the form of animal tracks, erosion, scalds, blowouts etc, in isolated patches. Soil surface visible in random patches.	10-29%
Fair – moderate levels of vegetation, scrub and / or tree cover. Moderate sized patches of soil surface visible, possibly associated with animal, stock tracks, unsealed walking tracks, erosion, blow outs etc, soil surface visible as moderate to small patches, across a larger section of the study area.	30-49%
Good – moderate to low level of vegetation, tree or scrub cover. Greater amount of areas of soil surface visible in the form of erosion, scalds, blowouts, recent ploughing, grading or clearing.	50-59%
Very Good – low levels of vegetation / scrub cover. Higher incidence of soil surface visible due to recent or past land-use practices such as ploughing, grading, mining etc.	60-79%
Excellent - very low to non-existent levels of vegetation/scrub cover. High incidence of soil surface visible due to past or recent land use practices, such as ploughing, grading, mining etc.	80-100%
Note: this process is purely subjective and can vary between field specialists, however, consistency is achieved by the same field specialist providing the assessment for the one study area/subject site.	

As indicated in *Table 4.3,* the effective coverage for study area is low. Dense grass cover hindered visibility exposures were minimal. Disturbances ranged from low to moderate and examples of vegetation cover and disturbances are provided in *Figures 4.1* to *4.8*.

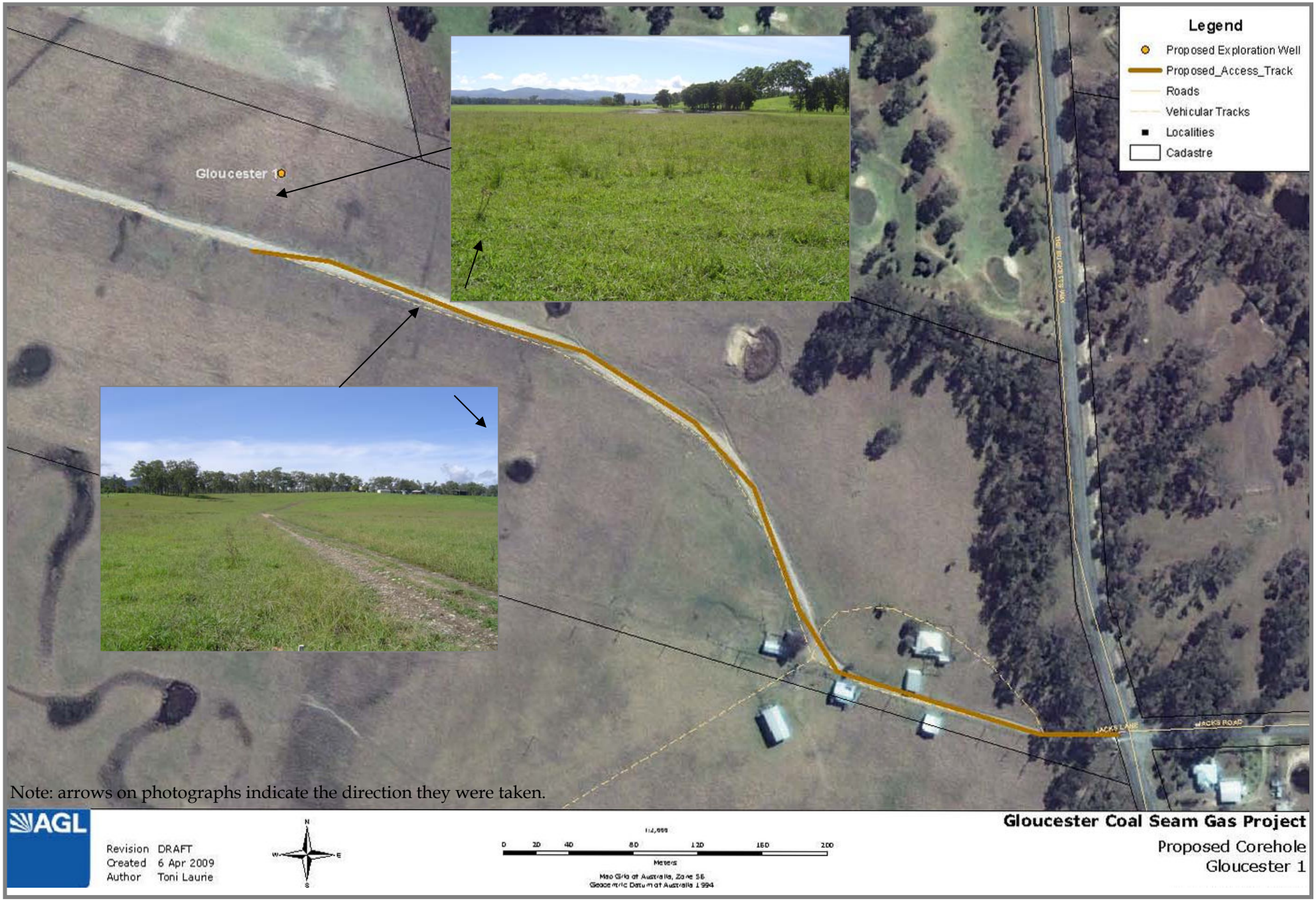

Figure 4.1 Aerial: Gloucester 1 vegetation and disturbances

Source: AGL Gloucester

Figure 4.2 Aerial: Gloucester 2 vegetation and disturbances

Source: AGL Gloucester

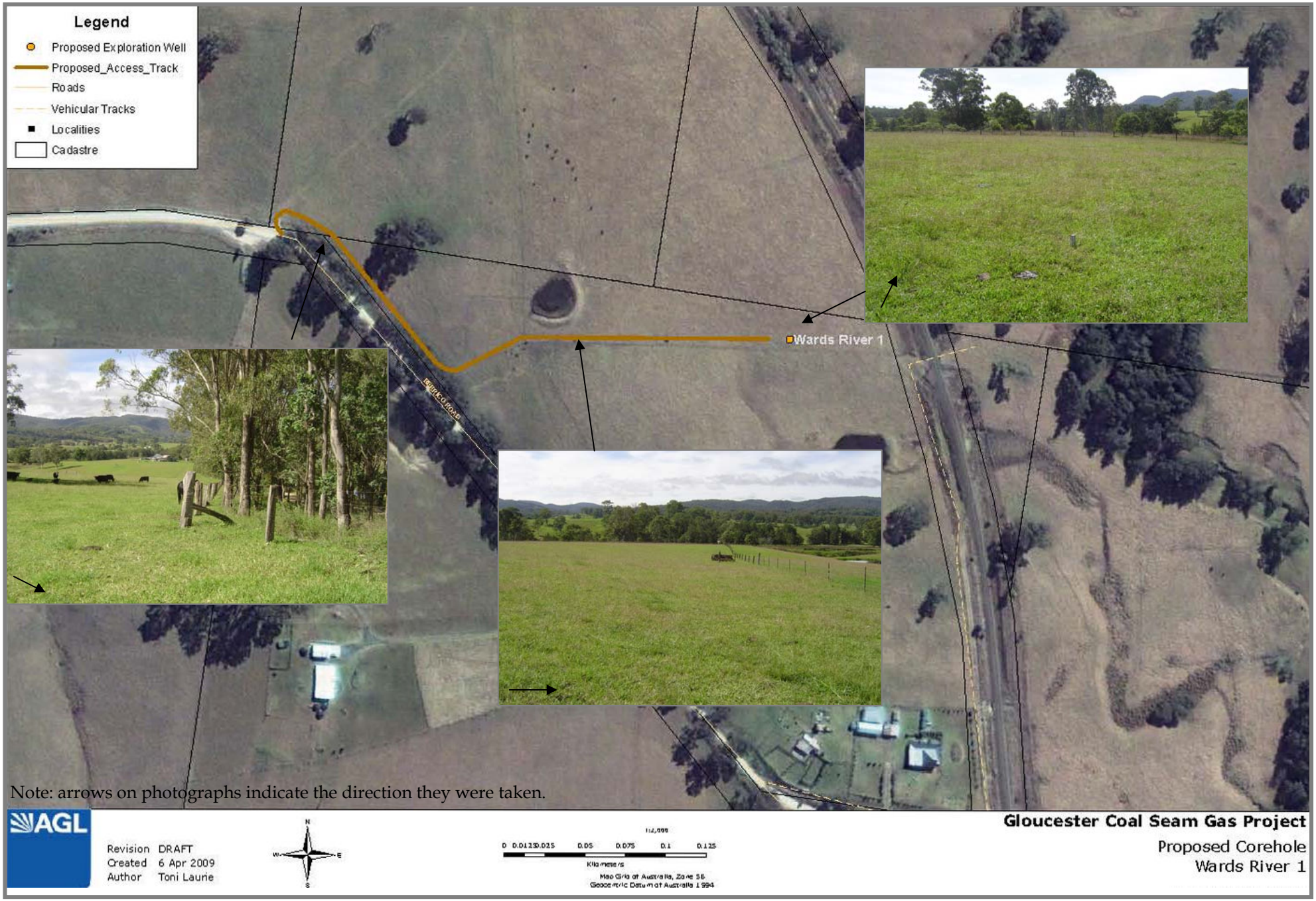

Figure 4.3 Aerial: Wards River 1 vegetation and disturbances

Source: AGL Gloucester

Figure 4.4 Aerial: Wards River 2 vegetation and disturbances

Source: AGL Gloucester

Figure 4.5 Aerial: Wards River 3 vegetation and disturbances

Source: AGL Gloucester

Figure 4.6 Aerial: Wards River 4 vegetation and disturbances

Source: AGL Gloucester

Figure 4.7 Aerial: Wards River 5 vegetation and disturbances

Source: AGL Gloucester

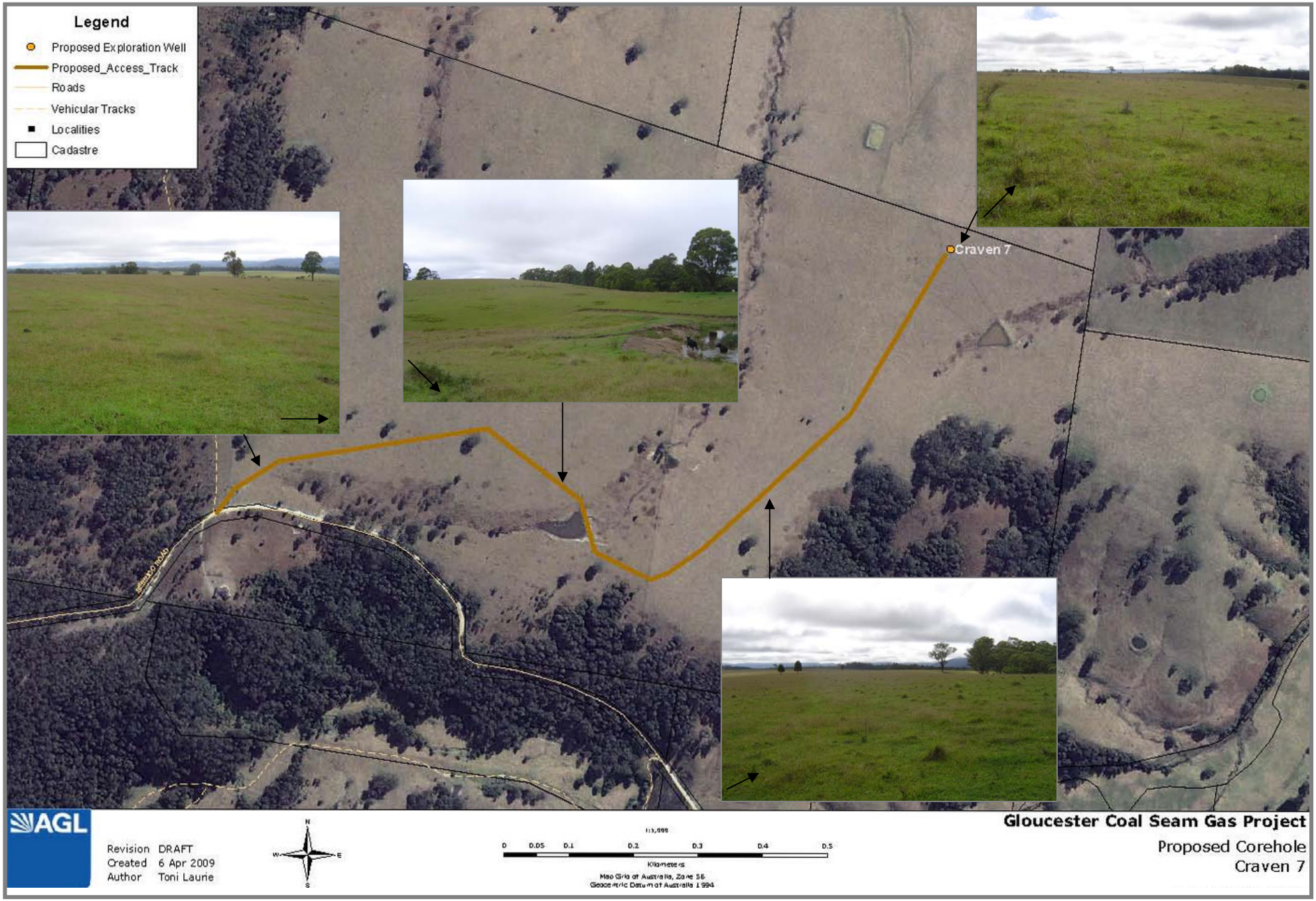

Figure 4.8 Aerial: Craven 7 vegetation and disturbances

Source: AGL Gloucester

Table 4.3 Effective Coverage

Survey Unit	Landform	Area (m2)	Exp %	Vis %	Exposure type	Previous disturbances	Present disturbances	Limiting visibility factors	Effective coverage (m2)
SU1:G1	flood plain	5000	80	80	erosion, track,	clearing, dam, cattle	cattle	grass cover	3200
Totals		**2,400**							**3200**
								Effective coverage %	**64.00%**

Survey Unit	Landform	Area (m2)	Exp %	Vis %	Exposure type	Previous disturbances	Present disturbances	Limiting visibility factors	Effective coverage (m2)
SU2:G2	flats	2,400	0%	0%	NA	clearing, grazing	cattle	grass cover	0
Totals		**2,400**							**0**
								Effective coverage %	**0.00%**

Survey Unit	Landform	Area (m2)	Exp %	Vis %	Exposure type	Previous disturbances	Present disturbances	Limiting visibility factors	Effective coverage (m2)
SU3:WR1	slope	3,900	5%	5%	erosion, cattle pads	clearing, grazing	cattle	grass cover	10
Totals		**3,900**							**10**
								Effective coverage %	**0.25%**

Survey Unit	Landform	Area (m2)	Exp %	Vis %	Exposure type	Previous disturbances	Present disturbances	Limiting visibility factors	Effective coverage (m2)
SU4:WR2	slope	2,400	5%	5%	erosion, cattle pads	clearing, grazing	cattle	grass cover	6
Totals		**2,400**							**6**
								Effective coverage %	**0.25%**

Survey Unit	Landform	Area (m2)	Exp %	Vis %	Exposure type	Previous disturbances	Present disturbances	Limiting visibility factors	Effective coverage (m2)
SU5:WR3	ridge	3,520	1%	5%	erosion, cattle pads	clearing, grazing	cattle	grass cover	2
Totals		**4,300**							**2**
								Effective coverage %	**0.05%**

Survey Unit	Landform	Area (m2)	Exp %	Vis %	Exposure type	Previous disturbances	Present disturbances	Limiting visibility factors	Effective coverage (m2)
SU6:WR4	slope	2,800	5%	10%	erosion	clearing, cattle	cattle	grass cover	14
Totals		**2,800**							**14**
								Effective coverage %	**0.50%**

Survey Unit	Landform	Area (m2)	Exp %	Vis %	Exposure type	Previous disturbances	Present disturbances	Limiting visibility factors	Effective coverage (m2)
SU7:WR5	slope	2,600	5%	5%	erosion	clearing, cattle	cattle	grass cover	7
Totals		**2,600**							**7**
								Effective coverage %	**0.25%**

Survey Unit	Landform	Area (m2)	Exp %	Vis %	Exposure type	Previous disturbances	Present disturbances	Limiting visibility factors	Effective coverage (m2)
SU8:C7	ridge, slope	8,400	5%	10%	erosion, dam	clearing, dam, cattle	cattle	grass cover	42
Totals		**8,400**							**42**
								Effective coverage %	**0.50%**

4.5 ARCHAEOLOGICAL SITES

Sites were labelled according to the project title, e.g. AGKG1 where AGLG represents AGL Gloucester, and 1 indicates the site number allocated consecutively.

4.5.1 AGLG1: isolated

This grey silcrete flake was located in a large erosion scar next to a drainage line and in close proximity to a dam at Craven 7 (Refer to *Figure 4.9*). The site was heavily disturbed through dam construction, erosion, clearing and grazing. Visibility on the site was 100% and 10% in the area surrounding. There is limited to no potential for in situ cultural materials at this site.

4.6 POTENTIAL ARCHAEOLOGICAL DEPOSIT (PAD)

The terms 'Potential Archaeological Deposit (PAD)' and 'area(s) of archaeological sensitivity' are used to describe areas that are likely to contain sub-surface cultural deposits. These sensitive landforms or areas are identified based upon the results of fieldwork, the knowledge gained from previous studies in or around the subject area and the resultant predictive models. Any or all of these attributes may be used in combination to define a PAD.

The likelihood of a landscape having been used by past Aboriginal societies and hence containing archaeologically sensitive areas is primarily based on the availability of local natural resources for subsistence, artefact manufacture and ceremonial purposes. The likelihood of surface and subsurface cultural materials surviving in the landscape is primarily based on past land uses and preservation factors.

One PAD is identified and is discussed below and illustrated in *Figure 4.10*.

PAD 1: Wards River 2

PAD 1 is located at Wards River 2. It encompasses an area of a gentle slope that overlooks a terrace and Bull Creek (a 4th Order Stream). Disturbances are minimal and soil A horizon remains. The PAD covers the area of the core hole which is approximately 70 metres south of the Creek. This location, being within what is believed to be an ideal location, landform and distance from a reliable water source and its associated resources along with the minimal disturbances suggests there is a moderate to high potential for subsurface cultural materials.

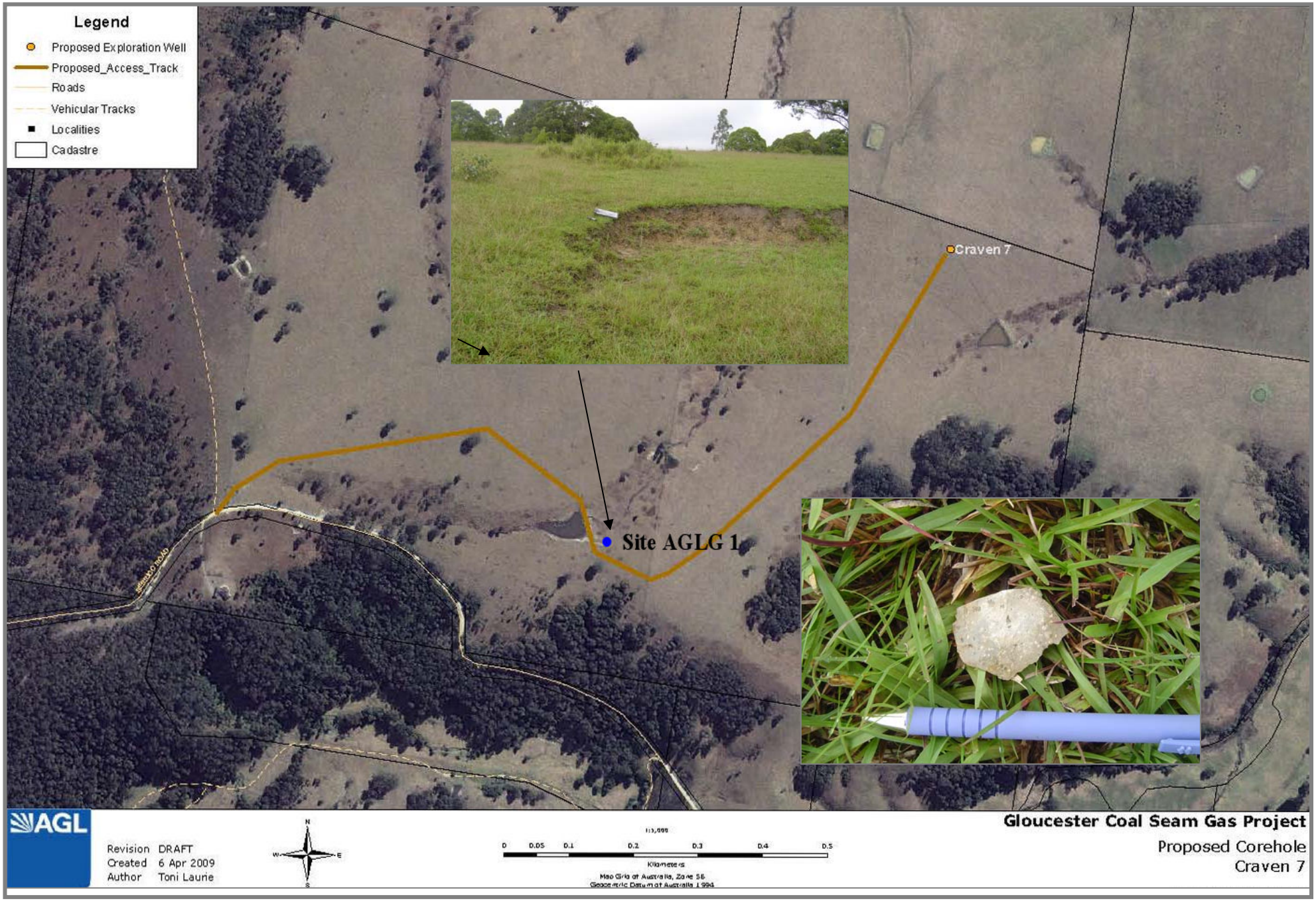

Figure 4.9 Location of Site AGLG 1

Source: AGL Gloucester

Figure 4.10 Location of PAD 1: Wards River 2

Source: AGL Gloucester

4.7 DISCUSSION

Sites provide valuable information about past occupation, use of the environment and its specific resources including diet, raw material transportation, stone tool manufacture, and movement of groups throughout the landscape.

In environments that are similar to the study area, such as the Hunter Valley, proximity to water was an important factor in past occupation, with sites reducing in number away from water with most sites located within 50 – 100 metres of reliable water and associated resources.

The specific study area has undergone both natural and human disturbances, all of which have had an impact on the landscape and any associated cultural materials that may have been present. One site and two PADs have been identified all of which will add to the archaeological record of the area thus enabling more data for predictive modelling and forward planning.

5 ASSESSMENT OF ARCHAEOLOGICAL SIGNIFICANCE

5.1 THE SIGNIFICANCE ASSESSMENT PROCESS

One of the key steps in the process of cultural heritage management is the assessment of significance. Not all sites are equally significant and not all are worthy of equal consideration and management (Sullivan and Bowdler 1984; Pearson and Sullivan 1995: 7).

The determination of significance can be a difficult process as the social and scientific context within which these decisions are made is subject to change (Sullivan and Bowdler 1984). This does not lessen the value of the heritage approach, but enriches both the process and the long-term outcomes for future generations as the reasons for, and objectives of, site conservation also change over time.

The assessment of significance of archaeological sites and resources is defined in most cases by what these entities can contribute to our understanding or knowledge of a place or site. In most cases, it is not possible to fully articulate or comprehend the extent of the archaeological resource at the outset, let alone its value. Therefore, the evaluation of the significance of archaeological material is based on the potential this resource has to contribute to our understanding of the past. Of importance is the type of information that can be revealed. In particular, site significance can be due to knowledge not available through other sources, and the contribution that it can make to our understanding of a place or a cultural landscape.

5.2 BASIS FOR EVALUATION

The significance of indigenous archaeological sites or cultural places can be assessed on the criteria of the Burra Charter, the Australian Heritage Commission Criteria of the National Estate, and the Department of Environment and Climate Change (DECC) (previously part of National Parks and Wildlife Service) guidelines that are derived from the former two.

The NSW NPWS Aboriginal Cultural Heritage Standards and Guidelines Kit (1997) emphasises two realms of significance assessment:

Aboriginal cultural significance

Archaeological (scientific) significance

The cultural significance of the sites or landscape will be assessed by the Aboriginal groups mentioned previously (Refer to Annex A).

5.3 ARCHAEOLOGICAL (SCIENTIFIC) SIGNIFICANCE

Scientific significance is assessed according to the contents of a site, state of preservation, integrity of deposits, representativeness/rarity of the site type,

and potential to answer research questions on past human behaviour (NPWS 1997).

For open campsites, evidence required to adequately assess significance includes information about the presence of sub-surface deposits, the integrity of these deposits, the nature of site's contents and extent of the site. A review of information pertaining to previously recorded sites within the local area and region enables the rarity and representativeness of a site to be assessed.

High significance is usually attributed to sites that are so rare or unique that the loss of the site would affect our ability to understand an aspect of past Aboriginal use/occupation of an area. In some cases a site may be considered highly significant because its type is now rare due to destruction of the archaeological record through development. Medium significance can be attributed to sites that provide information on an established research question. Low significance is attributed to sites that cannot contribute new information about past Aboriginal use/occupation of an area. This may be due to site disturbance or the nature of the site's contents.

In order to clarify the significance assessment, the criteria used are explained below.

5.3.1 Research potential

Research potential refers to the potential for information gained from further investigations of the evidence to be used in answering current or future research questions. Research questions can relate to any number of issues concerning past human material culture and associated behaviour (including cultural, social, spiritual etc) and/or use of the environment. Several inter-related factors to take into consideration include the intactness or integrity of the site, the connectedness of the site to other sites, and the potential for a site to provide a chronology extending back in the past. Several questions are posed for each site or area containing evidence of past occupation:

- Can the evidence contribute information not available from any other resource?
- Can the evidence contribute information not available from any other location or environmental setting?
- Is this information relevant to questions of past human occupation (including cultural, social and/or spiritual behaviour) and/or environments or other subjects?

Assessing research potential therefore relies on comparisons with other evidence both within the local and regional context. The criteria used for assessing research potential include:

- potential to address specific local research questions;
- potential to address specific regional questions;

- potential to address general methodological and theoretical questions;
- potential sub-surface deposits; and
- potential to address future research questions.

The particular questions asked of the available evidence should be able to contribute information that is not available from other resources or evidence and are relevant to questions about past human societies and their material culture. Levels for defining research potential are as follows:

High	Has the potential to provide new information not obtained from any other resource to answer current and/or future research questions.
Medium	Has the potential to contribute significant additional information to answer current and/or future research questions.
Low	Has no potential to contribute significant information to answer current or future research questions.

5.3.2 Representativeness and rarity

Representativeness and rarity are assessed at a local, regional and national level (although assessing at a national level is difficult and commonly not possible due to a lack of national reports and available database). As the primary goal of cultural resource management is to afford the greatest protection to a representative sample of Aboriginal heritage throughout a region, this is an important criterion. The more unique or rare the evidence is, the greater its value as being representative within a regional context.

The main criteria used for assessing representativeness and rarity include:

- the extent to which the evidence occurs throughout the region;
- the extent to which this type of evidence is subject to existing and potential future impacts in the region;
- the integrity of the evidence compared to that at other locations within the region;
- whether the evidence represents a primary example of its type within the region; and
- whether the evidence has greater potential for educational purposes than at other similar locations within the region.

5.3.3 Nature of the evidence

The nature of the evidence is related to representativeness and research potential. For example, the less common the type of evidence, the more likely it is to have representative value. The nature of the evidence is directly related to

its potential to be used in addressing current and/or future research questions. Criteria used in assessing the nature of the evidence include:

- presence, range and frequency of artefacts;
- presence, range and frequency of artefact types; and
- presence and types of other features.

5.3.4 Integrity

The state of preservation and disturbances of the evidence (integrity) is also related to representativeness and research potential. The higher the integrity (well preserved and not disturbed) of the evidence, the greater the level of information that is likely to be obtained from further study. This translates to greater importance for the evidence within a local and regional context, as it may be a suitable example for preservation/conservation. The criteria used in assessing integrity include:

- horizontal spatial distribution of artefacts;
- vertical spatial distribution of artefacts;
- preservation of intact features such as hearths or knapping floors;
- preservation of site contents such as charcoal which may enable direct dating providing a reliable date of occupation of a given area;
- preservation of artefacts which may enable use-wear/residue analysis to determine tool use and possibly diet; and
- preservation of other cultural materials that may enable interpretation of the evidence in relation to cultural/social behaviour (e.g. burial types and associated mortuary practices may have been based on cultural, social, age, and/or gender distinctions).

Many of these criteria can only be obtained through controlled excavation. Generally high levels of ground disturbance (such as erosion, tracks, dams etc) limit the possibility that an area would unlikely contain intact spatial distributions, intact features, in situ charcoal et cetera.

Definitions for defining levels of site integrity and condition have been derived from Witter (1992) and HLA (2002) and are as follows:

Excellent	Disturbance, erosion or development is minimal.
Good	Relatively undisturbed deposits or partially disturbed with an obvious in situ deposit.
Fair	Some disturbance but the degree of disturbance is difficult to assess.

Poor	Clearly mostly destroyed or disturbed by erosion or development.
Very Poor	Sites totally disturbed or clearly not in situ.
Destroyed	A known site that is clearly no longer there.

5.4 CULTURAL SIGNIFICANCE

While Aboriginal sites and places may have scientific significance, they also have cultural/social significance to the Aboriginal people from that area. Determining cultural/social significance can only be determined by the Aboriginal people from the area in which the sites and/or places were identified. All groups were invited to provide a report/letter discussing cultural significance.

5.5 EVALUATION

The archaeological significance of the three sites identified are presented in *Table 5.1*

Table 5.1 Significance Assessment (original sites)

Site	Site Type	Representativeness	Integrity	Res. Pot	Sci. Sig
AGLG1	isolated	well represented	poor	no	limited

5.6 STATEMENT OF CULTURAL SIGNIFICANCE

The Aboriginal groups will assess the cultural significance of this site (Refer to *Annex A).*

6 ASSESSMENT OF IMPACTS

The archaeological record is a non-renewable resource that is affected by many processes and activities. As outlined in Chapter 2, the various natural processes and human activities may impact on archaeological deposits. Chapter 4 describes the impacts within the study area, showing how these processes and activities have disturbed the landscape and associated cultural materials in varying degrees.

The impacts of the proposed development, including excavation and construction works, must be considered in relation to the archaeological record in the landscape in order to determine the most appropriate management options.

6.1 IMPACTS

Works typically associated with the access road construction and bore hole pad preparation will include stripping of the topsoils and the laying of road base gravels. The drilling and removal of the core hole will also occur at the bore hole locations. Following drilling, landscaping and re-vegetation will occur at all sites.

Mitigation measures to minimise these impacts are outlined in the following chapter.

7 MANAGEMENT STRATEGIES

Specific strategies, as outlined in the Aboriginal Cultural Heritage Standards and Guidelines Kit (NPWS 1987), are considered below for the management of identified sites and potential archaeological deposits within the study areas. One of the most important considerations in selecting the most suitable and appropriate strategy is the recognition that Aboriginal cultural heritage is very important to the local Aboriginal community. Decisions about the management of sites and potential archaeological deposits should be made in consultation with the appropriate local Aboriginal community.

7.1 CONSERVATION/PROTECTION

The Department of Environment and Conservation (DEC) is responsible for the conservation/protection of Indigenous sites and they therefore require good reason for any impact on an indigenous site.

Conservation is the first avenue and is suitable for all sites, especially those considered high archaeological significance and/or cultural significance.

Conservation includes the processes of looking after an indigenous site or place so as to retain its cultural significance and are managed in a way that is consistent with the nature of peoples' attachment to them.

No sites have been identified at this time that would warrant conservation.

7.2 FURTHER INVESTIGATION

When a site is identified but its extent, the nature of its contents, level of integrity and/or its significance cannot be adequately assessed through a surface survey, subsurface testing can be an appropriate strategy to further assess the site to determine its extent, nature, content, integrity and significance.

Subsurface testing is also appropriate where artefact deposits are predicted to occur in a Potential Archaeological Deposit (PAD) based on a predictive model. Subsurface testing can identify whether such deposits exist, their nature, extent, content, integrity and significance.

Test excavations can include either or a combination of auger holes, shovel test pits, mechanically excavated trenches or surface scrapes. The method of subsurface testing is determined by the terrain, vegetation cover, disturbances, available time, expected deposit and discussions/consultation with the local Aboriginal community.

An Aboriginal Heritage Impact Permit (AHIP) is required for a Section 87 Preliminary Research Permit is required from DECC to undertake the testing.

The identified PAD (Wards River 2) requires subsurface investigations. Given the landform, proximity to reliable water and associated resources as well as minimal disturbances suggests that evidence of past occupation may be present. Therefore further investigation at this PAD is justified and warranted.

7.3 MITIGATED DESTRUCTION

Mitigated destruction is considered when a site is of significance within a local context and the options for conservation are limited. Additionally, if the surface collection of artefacts or excavation of deposits could provide benefits and information for the Aboriginal community and/or archaeological study of past Aboriginal occupation, a salvage strategy may be considered.

Salvage may include the collection of surface artefacts or systematic excavation of known artefact deposits. Where the option of conservation is not possible, this strategy is the primary means of minimising impacts to Aboriginal heritage from development.

An Aboriginal Heritage Impact Permit (AHIP) is required for a Section 90 Consent to Destroy with Permit to Salvage from the DECC, is required to undertake such excavations.

Disturbances along with distance from reliable water and associated resources exclude site AGLG1 from further investigation. Therefore a Section 90 Consent to Destroy with Permit to Collect is required for the isolated artefact (AGLG1).

7.4 MONITORING

An alternative strategy for areas where archaeological deposits are predicted to occur is to monitor development works for cultural materials, predominantly during the initial earth moving and soil removal works. This is the main strategy for managing the possible occurrence of Aboriginal skeletal remains. Monitoring is also used to identify the presence of artefacts and cultural materials that are important to the Aboriginal community, who may be looking to identify and salvage any materials that were not identified on the surface during the preliminary surface investigation. Monitoring may also include the sieving of a sample of graded/scraped soils.

Monitoring (in preference to sub-surface testing) is not a widely accepted method within the context of scientific investigation as it could result in costly delays to development and late/continued revisions to development plans. However, monitoring when Development Consent is granted can be of great scientific benefit and a benefit to the Aboriginal community. Monitoring undertaken in some circumstances (specifically where there is a possibility of skeletal remains) will enable the correct identification of such evidence (by qualified personnel) and thus ensure the appropriate methods of salvage or protection/conservation are undertaken. Monitoring is not considered appropriate at this stage.

8 RECOMMENDATIONS

8.1 GENERAL

1) The persons responsible for the management of any works on site will ensure that all staff, contractors and others involved in construction and maintenance related activities are made aware of the statutory legislation protecting sites and places of significance. Section 90(1) of the National Parks and Wildlife Act, 1974 states that it is an offence to knowingly destroy, deface or damage, or cause or permit the destruction or defacement of or damage to, an object or Aboriginal place without first obtaining the consent of the DECC;

8.2 SITE AGLG1

2) A Section 90 Consent to Destroy with Permit to Collect is required from DECC for site AGLG1 Prior to any works in that location, and

8.3 PAD

3) A Section 87 Preliminary Research Permit is required from DECC for PAD1 (Wards River 2) prior to any works in those areas.

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APPENDIX 5

POTENTIAL NOISE IMPACTS

ATKINS ACOUSTICS

Postal Address
P.O. Box 432
Gladesville
N.S.W. 1675
AUSTRALIA
A.C.N. 068 727 195
A.B.N. 19 068 727 195
Telephone: 02 9879 4544
Fax: 02 9879 4810
Email: AtkinsAcoustics@bigpond.com.au

Atkins Acoustics and Associates Pty Ltd.
Consulting Acoustical & Vibration Engineers

CONSTRUCTION NOISE ASSESSMENT
EXPLORATION DRILLING
GLOUCESTER BASIN

39.6439.R1:CFCD3
Rev 01

Prepared for: AGL Gloucester LE Pty Ltd
PO Box 335
GLOUCESTER NSW 2422

Prepared by: Atkins Acoustics & Associates Pty Ltd
8-10 Wharf Road
GLADESVILLE NSW 2111

May 2009

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1.0 INTRODUCTION

The Gloucester Basin is currently the focus of a large-scale coal seam gas project by *AGL Gloucester LE Pty Ltd.* The Project consists of three (3) key components to produce, compress and transport coal seam gas from the Gloucester region to Newcastle.

Atkins Acoustics was commissioned by *AGL* to prepare a noise assessment for construction activities involved in the exploration drilling. The exploration drilling program assessed in this report consists of eight (8) sites comprising both core and stratigraphic holes.

The main aims of the investigations and assessment included:

- inspections of study area and eight (8) drill sites;
- review of aerial photography in conjunction site inspections to identify residential receiver locations potentially exposed to noise from construction activities;
- comment on the ambient background noise levels in the vicinity of the drill sites ;
- establish project noise goals in accordance with procedures documented in the *DECC* Industrial Noise Policy *(INP),* the Environmental Noise Control Manual *(ENCM),* and the New South Wales Construction Noise Guideline (Draft for consultation August 2008) *(CNG)*;
- predict and evaluate noise impacts from the envisaged construction activities; and,
- where assessment goals are predicted to be exceeded, recommend conceptual ameliorative control options.

The information presented in the report has been prepared for the investigation described herein, and should not be used in any other context or for any other purpose without written approval from *Atkins Acoustics* and *AGL.*

2.0 PROPOSED EXPLORATION WELLS

2.1 Overview

The study area considered in this report extends from north of the township of Gloucester to Wards River and consists of eight (8) exploration wells. The well locations are identified in *Appendix 1* and consist of both core and stratigraphic holes as follows:

- *Gloucester 2* – Core Hole
- *Gloucester 1* – Stratigraphic
- *Wards River 1* – Core Hole
- *Wards River 2* – Stratigraphic
- *Wards River 3* – Core Hole
- *Wards River 4* – Core Hole
- *Wards River 5* – Core Hole
- *Craven 7* - Stratigraphic

The main components of the construction and duration of the envisaged activities are summarised below:

- initial site access and development of pad for drilling purposes – 2 days;
- drilling operations
  - stratigraphic holes: 5 days (24hrs) to 10 days (11-12hrs)
  - core holes: <30days (24hrs) to 60 days (11-12hrs)
- decommission site and rehabilitate – 2 days.

It is the intention of *AGL,* where feasible, to conduct exploration drilling operations 24 hours to reduce the duration of the activities and limit noise exposure for residential properties. With respect to *Gloucester 2*, it is acknowledged that a large number of residential dwellings are located in relative close proximity, accordingly it is proposed to restrict drilling at this site to eleven (11) hours per day, typically 7.00am to 6.00pm.

Initial site establishment, access road, pad preparation, decommissioning and rehabilitation would be conducted during daytime hours (nominally 7.00am to 6.00pm).

2.2 Potentially Affected Receivers

Residential areas in the vicinity of the drilling sites are located at varying distances. *Table 1* presents a summary of reference residential dwellings/areas utilised in the assessment for the prediction and assessment of construction noise from the activities. Where numerous residences are located together (e.g. *Gloucester 2*) the assessment has considered a receiver area and representative locations within those areas. For description and assessment purposes, the drilling sites have been considered from north to south. Assessment locations and drilling sites are shown in *Appendix 1*.

Table 1: Reference Assessment Locations

Reference Location	Direction Relative to Drilling Site	Approximate Distance from Site (m)
Gloucester 2		
G2-R1	North	1010
G2-R2	North-west	920
G2-R3	North-west	810
G2-R4	North-west	715
G2-R5	West	500
G2-R6	South-west	385
G2-R7	South	275
G2-R8	South-south-east	255
G2-R9	South-east	360
G2-R10	East	570
Gloucester 1		
G1-R1	North-north-east	970
G1-R2	North-east*	660
G1-R3	South-east	690
G1-R4	South	635
G1-R5	South-west	1090
G1-R6	North-west	1015

* *Motel*

Table 1: Reference Assessment Locations (cont.)

Reference Location	Direction Relative to Drilling Site	Approximate Distance from Site (m)
Wards River 5		
WR5-R1	South-east	375
WR5-R2	South-west	275
WR5-R3	South-west	900
WR5-R4	North-west	765
WR5-R5	North-west	1080
Craven 7		
CR7-R1	North	1730
CR7-R2	North	1560
CR7-R3	South-east	1060
CR7-R4	South-east	1510
CR7-R5	South	1175
CR7-R6	South-south-west	1185
CR7-R7	South-west	1245
Wards River 1		
WR1-R1	North-east	1080
WR1-R2	North-east	825
WR1-R3	South-east	1035
WR1-R4	South-east	270
WR1-R5	South-west	360
WR1-R6	West	505
WR1-R7	West	845
Wards River 3		
WR3-R1	North	890
WR3-R2	North	795
WR3-R3	South-west	1020
WR3-R4	South-west	580
WR3-R5	South-west	625
WR3-R6	North-west	1010
Wards River 2		
WR2-R1	North-east	1120
WR2-R2	East-north-east	950
WR2-R3	South-east	785
WR2-R4	South-east	1090
WR2-R5	South-east	1035
WR2-R6	South	420
WR2-R7	North-west	525

Table 1: Reference Assessment Locations (cont.)

Reference Location	Direction Relative to Drilling Site	Approximate Distance from Site (m)
Wards River 4		
WR4-R1	North-east	1030
WR4-R2	North-east	330
WR4-R3	East	590
WR4-R4	South	800
WR4-R5	South	440
WR4-R6	West	370

3.0 EXISTING AMBIENT NOISE ENVIRONMENT

Atkins Acoustics has been involved in the assessment and measurements associated with the Gloucester Basin Coal Seam Project. Due to the size of the study area, noise measurements both attended and unattended monitoring have been conducted in a number of areas. Noise measurements have confirmed that daytime background L_{A90} noise levels typically range from 30-38dB(A), whilst during the evening and night-time background noise levels were typically 30-32dB(A).

Considering the isolated locations of the exploration drilling sites and number of residential dwellings and the short-term nature of the works, *Atkins Acoustics* has not monitored the existing noise environment for each of the construction sites. For the purpose of assessing possible noise impacts from the construction activities, a qualitative assessment has been undertaken taking into account the rural nature of the drilling locations.

In the absence of ambient noise monitoring, the assessment adopted an *RBL* 30-35dBA for daytime activities; and 30dB(A) for evening and night-time activities for the purpose of assessing noise impacts.

4.0 CONSTRUCTION NOISE

The Department of Environment and Climate Change (*DECC*) recommend goals for the assessment of construction noise and vibration in the Environmental Noise Control Manual [Chapter 171] (*ENCM*).

Additionally, the *DECC* published a Draft Guideline titled *New South Wales Construction Noise Guideline (August 2008).* The *Construction Noise Guideline (CNG)* was developed by the *DECC* in response to concerns raised with respect to construction noise impacts and the practicability and feasibility of achieving stringent numeric noise levels established from procedures developed for permanent industrial noise sources. In accordance with the *DECC* procedures, and practicability and feasibility concerns with respect to assessing and controlling construction noise impacts, the objectives of the recent *DECC, CNG* guideline have been considered.

The main objectives of the *CNG* are to:

- identify and minimise noise from construction sites,
- focus on applying all 'feasible and reasonable' work practices to minimise construction noise impacts, and
- provide flexibility in selecting site-specific feasible and reasonable work practices in order to minimise noise impacts.

The *CNG* is a current draft guideline for comment and subject to review, accordingly in the absence of a final gazetted document, the procedures of the *ENCM* [Chapter 171] have been adopted. The procedures and recommendations published by the *DECC* for assessing temporary construction activities are best regarded as planning tools. They are not mandatory, and their application for assessing construction noise is not determined purely on the basis of compliance or otherwise with numerical noise levels.

4.1 Environmental Noise Control Manual

The *DECC, ENCM* [Chapter 171] construction noise guidelines address and recommend the following goals for short, medium and long-term daytime construction activities. The *ENCM* target assessment goals are based on the $L_{A10,15min}$ noise descriptor i.e., the A-weighted sound level exceeded for 10% of the time over which the sound is measured.

(i) ***Short Term Construction Periods***

For construction periods of less than four (4) weeks the $L_{A10,15min}$ construction noise levels should not exceed the rating background noise level (RBL) by more than 20dBA.

(ii) ***Medium Term Construction Periods***

For construction periods extending from four (4) to twenty-six (26) weeks, the $L_{A10,15min}$ construction noise levels should not exceed the *RBL* by more than 10dBA.

(iii) ***Long Term Construction Periods***

For construction periods greater than twenty-six (26) weeks, the $L_{A10,15min}$ construction noise levels should not exceed the RBL by more than 5dBA.

For evening/night-time construction activities, the *DECC* accepts that the $L_{A10,15min}$ construction noise should not exceed the background level by more than 5dBA.

In setting these goals, the *DECC* recognise that construction noise by nature is temporary and not always amenable to built controls applied to permanent industrial site, there is limited opportunity to reduce noise from construction activities, and that the goals are not always satisfied.

Where feasible and reasonable measures have been considered and the noise level is predicted to be more than target management level, the *DECC* recommend that the proponent should consult with the community.

Considering the *ENCM* [Chapter 171] and the adopted background L_{A90} noise levels, the target assessment goals were developed for evaluating noise from the site establishment and drilling activities for all reference assessment locations. From the scheduled duration of the site activities (stratigraphic: 5-10 days / 1-2 weeks and core: 30-60 days / 4-9 weeks) target noise assessment goals are presented below:

Day	50-55dB(A) (1-4 weeks)	40-45dB(A) (5-26weeks)
Evening/Night	35dB(A)	

Discussions with *AGL* confirmed that twenty-four (24) hour drilling, results in a greater that 50% reduction in the duration of the total drilling activities, as 'start up' and 'shut down' processes are not required. Thus, where feasible and reasonable, *AGL* will endeavour to drill on a 24hr basis, to reduce the duration of noise exposure for residential properties. Due to the close proximity of numerous residents, *AGL* has committed to 11hr (7.00am to 6.00pm) drilling program for *Gloucester 2*.

Community consultation has and will continue to be a key component of the development for current and future operations associated with the Gloucester Basin Coal Seam Project and includes regular meetings with the Community Consultative Committee (CCC).

Outcomes of meetings in the past have confirmed that the CCC is supportive of 24hr drilling, as it typically halves the duration of the activities. A CCC survey assessing concerns about night-time activities was forwarded to one hundred (100) local residents and community members potentially affected by night-time drilling activities. Only six (6) responses were received of which four (4) expressed concerns. In addition, respective landowners affected by current exploration and within the proposed Stage 1 Field Development areas are also supportive of 24hr drilling for approved exploration wells.

5.0 CONSTRUCTION NOISE SOURCES

The main construction activities envisaged for the project include: vegetation clearing, access track construction, pad establishment, site drilling and site decommissioning.

5.1 Overview of Construction Activities

The envisaged sequence of construction activities for each of the exploration sites is as follows:

- site access and clearing;
- site levelling/pad establishment using excavators and dozers
- erection and location of drilling structures and ancillary plant;
- drilling;
- site decommissioning; and,
- site rehabilitation.

Discussions with *AGL* confirmed that access and site preparation would be conducted during daytime hours (7.00am to 6.00pm) for two (2) days prior to commencement of drilling operations. Following conclusion of drilling activities, site decommissioning and rehabilitation would take a further two (2) days. Duration of drilling activities would be between 5-60 days subject to type of hole, 12hr or 24hr drilling approval and unforseen circumstances including weather, equipment malfunction etc.

5.2 Construction Equipment Noise Emission Levels

For the assessment of noise from the vegetation clearing and access track construction activities, the assessment considered a nominal sound power level of 115dB(A) for a typical dozer and water cart. Pad preparation noise levels with an excavator, grader, bobcat and similar plant would be significantly lower. For decommissioning a sound power level of 110dB(A) was adopted.

In terms of the drilling activities, site attended audit measurements of a Drilltec G55 drilling unit with associated water plant (mud pump) and generator have been conducted. *Table 2* presents a summary of the individual and cumulative sound power levels established from audit measurements. Discussions with AGL confirmed that the mud pump would not be required for exploration drilling.

Table 2: ***Drilling Source Noise Levels***
dB(A) re: 20 × 10^{-6} Pa

Source	Octave Band Sound Power Levels										dB(A)
	31.5	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**16k**	
Mud Pump	108.5	113.7	114.9	109.6	106.9	103.2	98.5	91.3	83.5	80.9	108.5
Atlas Copco Generator	105.2	105.4	102.9	101.7	97.6	91.2	89.0	84.3	74.9	65.5	98.5
Drilltec G55	108.7	111.3	112.0	108.4	104.5	102.9	97.4	91.5	81.5	76.5	107.3
Cumulative	112.5	116.1	116.9	112.4	109.2	106.2	101.3	94.8	86.0	82.3	111.5
Cumulative (-mud pump)	**110.3**	**112.3**	**112.5**	**109.2**	**105.3**	**103.2**	**98.0**	**92.3**	**82.4**	**76.8**	**108.1**

Audit measurements also confirmed that the noise emitted from the drilling operations also exhibit directional characteristics. Particularly noticeable was that noise levels at the 'rear' or the drive side of the drilling rig were in the order of 8-10dB(A) higher than measurements 180° or the 'front' of the drilling unit. Additional measurements at further setbacks confirmed the directional characteristics reduced with a difference in the order of 6-8dB(A) 'front' to 'rear'. Noise levels presented in *Table 2* are for the 'rear' side of the drilling rig, accordingly with careful site establishment and orientation for sensitive receiver locations, additional noise reductions are readily available.

It is noted that the Drilltec G55 is a 'production size' drilling operation. Drilling equipment proposed to be utilised for the core and stratigraphic is anticipated to be smaller. Notwithstanding that smaller plant is anticipated, the assessment has utilised noise data (-mud pump) established for the larger G55 rig, and therefore is considered conservative.

6.0 CONSTRUCTION NOISE MODELLING

Noise from the eight (8) exploration drilling sites was modelled with the *DECC* approved Environmental Noise Model *(ENM)* computer model. The model considers attenuation factors including distance, ground absorption, atmospheric absorption, topographical features of the area and normal operating conditions. In terms of meteorological conditions, the model utilised an air temperature of 10°C and humidity of 80%.

6.1 Site Establishment

In terms of initial site establishment including access construction and site decommissioning, *Table 3* presents a summary of predicted noise levels at reference distances.

Table 3: ***Predicted Noise Levels from Site Establishment***
L_{A10} *dB(A) re:* 20×10^{-6} *Pa*

Construction Activity	Distance from Construction Activity (m)						
	25m	100m	250m	500m	1000m	2000m	3000m
Access Track / Pad Preparation	79	67	59	53	47	41	37
Decommission / Rehabilitation	74	62	54	48	42	36	32

The modelling results show that noise levels during access track construction / pad preparation exceed the daytime target assessment goal (50-55dBA) at rural residential properties within two hundred and fifty (250) metres of the activities.

6.2 Exploration Drilling

Noise from drilling operations has been predicted to the reference receiver locations identified in *Table 1* and graphically depicted in *Appendix 1*. The noise modelling utilised the cumulative source noise level from drilling operations as referenced in *Table 2* with no allowance for directional characteristics or additional site shielding beyond the natural topography and hence presents a worst case scenario.

A summary of the predicted noise levels are presented in *Table 4*.

Table 4: ***Predicted Noise Levels from Drilling***
L_{A10} dB(A) re: 20×10^{-6} Pa

Reference Location	Direction Relative to Drilling Site	Target Noise Goal $L_{A10,15min}$	Predicted Noise Level dB(A)
Gloucester 2			
G2-R1	North	40-45	34
G2-R2	North-west	40-45	38
G2-R3	North-west	40-45	36
G2-R4	North-west	40-45	39
G2-R5	West	40-45	42
G2-R6	South-west	40-45	45
G2-R7	South	40-45	48
G2-R8	South-south-east	40-45	49
G2-R9	South-east	40-45	46
G2-R10	East	40-45	41
Gloucester 1			
G1-R1	North-north-east	50-55 (35)	33
G1-R2	North-east*	50-55 (35)	35
G1-R3	South-east	50-55 (35)	33
G1-R4	South	50-55 (35)	37
G1-R5	South-west	50-55 (35)	36
G1-R6	North-west	50-55 (35)	37
Wards River 5			
WR5-R1	South-east	50-55 (35)	46
WR5-R2	South-west	50-55 (35)	48
WR5-R3	South-west	50-55 (35)	36
WR5-R4	North-west	50-55 (35)	35
WR5-R5	North-west	50-55 (35)	33
Craven 7			
CR7-R1	North	50-55 (35)	23
CR7-R2	North	50-55 (35)	23
CR7-R3	South-east	50-55 (35)	18
CR7-R4	South-east	50-55 (35)	18
CR7-R5	South	50-55 (35)	17
CR7-R6	South-south-west	50-55 (35)	17
CR7-R7	South-west	50-55 (35)	30

Level in () brackets for 24hr drilling (evening/night operations)

Table 4: Predicted Noise Levels from Drilling (cont.)
L_{A10} dB(A) re: 20×10^{-6} Pa

Reference Location	Direction Relative to Drilling Site	Target Noise Goal $L_{A10,15min}$	Predicted Noise Level dB(A)
Wards River 1			
WR1-R1	North-east	50-55 (35)	35
WR1-R2	North-east	50-55 (35)	27
WR1-R3	South-east	50-55 (35)	32
WR1-R4	South-east	50-55 (35)	49
WR1-R5	South-west	50-55 (35)	48
WR1-R6	West	50-55 (35)	30
WR1-R7	West	50-55 (35)	23
Wards River 3			
WR3-R1	North	50-55 (35)	34
WR3-R2	North	50-55 (35)	38
WR3-R3	South-west	50-55 (35)	36
WR3-R4	South-west	50-55 (35)	41
WR3-R5	South-west	50-55 (35)	41
WR3-R6	North-west	50-55 (35)	36
Wards River 2			
WR2-R1	North-east	50-55 (35)	16
WR2-R2	East-north-east	50-55 (35)	38
WR2-R3	South-east	50-55 (35)	39
WR2-R4	South-east	50-55 (35)	20
WR2-R5	South-east	50-55 (35)	21
WR2-R6	South	50-55 (35)	44
WR2-R7	North-west	50-55 (35)	39
Wards River 4			
WR4-R1	North-east	50-55 (35)	36
WR4-R2	North-east	50-55 (35)	36
WR4-R3	East	50-55 (35)	28
WR4-R4	South	50-55 (35)	26
WR4-R5	South	50-55 (35)	40
WR4-R6	West	50-55 (35)	45

Level in () brackets for 24hr drilling (evening/night operations)

Noise modelling for drilling activities at *Gloucester 2* show that the daytime target noise goal (40-45dBA) for could be exceeded at a number of residential properties to the south-west, south and south-east.

With respect to the other drilling sites the results of the noise modelling (*Table 4*) show that the predicted noise levels satisfy the daytime noise goal (50-55dB(A)). Noise exceedances are predicted for a number of the sites and multiple residences for 24hr and evening/night drilling activities.

7.0 ASSESSMENT AND RECOMMENDATIONS

The findings of the modelling have shown there would be situations where construction noise levels are predicted to exceed the target assessment goals. When assessing noise from the short term construction activities it is recognised that the procedures and recommendations published by the *DECC* are regarded as planning tools. The recommendations are not mandatory, and their application for assessing noise from construction activities is not determined purely on the basis of compliance or otherwise with numerical noise levels.

It is noted that the noise modelling was based on a drill rig larger than envisaged, and hence predicted noise levels are higher than generated by the smaller plant.

7.1 Conceptual Noise Control Recommendations

General principles that could be considered to reduce noise from drilling activities involve maximising benefits from directivity characteristics of drilling plant, location of offices and other ancillary buildings to provide shielding, 'cut & fill' operations to maximise shielding to residential receivers and the location of excavated fill material and/or installation of temporary noise walls. The following recommendations and anticipated noise reductions are presented to assist with planning the site layouts and reducing noise:

Gloucester 2

- Orientate drive motor unit to north (0°) to north-north-west (340°)
- Locate offices and ancillary sheds to south of drill rig

Anticipated noise reductions of 8-10dB(A) and compliance with the daytime noise goal for 12hr drilling.

Gloucester 1

- Orientate drive motor unit to east (90°)
- Locate offices, ancillary sheds and any earth bunding to south, south-east and north-east of drill rig

Anticipated noise reductions of 6-8dB(A) and compliance with the 24/7 goal of L_{A10} 35dB(A).

Wards River 5

- Orientate drive motor unit to north-east (45°)
- Locate offices, ancillary sheds, temporary screens and any earth bunding to south-east and south-west of drill rig

Anticipated noise reductions of 8-14dB(A) and compliance with the 24/7 goal of L_{A10} 35dB(A) at the reference locations.

Craven 7

Predicted noise levels satisfy 24/7 goal of L_{A10} 35dB(A) at all reference locations, accordingly no additional noise controls recommended.

Wards River 1

- Orientate drive motor unit to north (0°)
- Locate offices, ancillary sheds, temporary screens and any earth bunding to south-east and south-west of drill rig

Anticipated noise reductions of 8-14dB(A) and compliance with the 24/7 goal of L_{A10} 35dB(A) at the reference locations.

Wards River 3

- Orientate drive motor unit to east (90°)
- Locate offices, ancillary sheds, temporary screens and any earth bunding to south-west of drill rig

Anticipated noise reductions of 8-10dB(A) and compliance with the 24/7 goal of L_{A10} 35dB(A) at all reference locations.

Wards River 2

- Orientate drive motor unit to north-north-east (25-30°)
- Locate offices, ancillary sheds, temporary screens and any earth bunding to east, south and north-west of drill rig

Anticipated noise reductions of 8-12dB(A) and compliance with the 24/7 goal of L_{A10} 35dB(A) at the reference locations.

Wards River 4

- Orientate drive motor unit to east (90°)
- Locate offices, ancillary sheds, temporary screens and any earth bunding to south and west of drill rig. Consider lining work side of screens / sheds with hay bales or similar to reduce potential for reflected noise.

Anticipated noise reductions of 8-12dB(A) and compliance with the 24/7 goal of L_{A10} 35dB(A) at the reference locations.

8.0 CONCLUSION

Atkins Acoustics was commissioned by *AGL* to conduct noise assessment for the activities involved in exploration drilling proposed at Gloucester. The drilling program assessed in this report consists of eight (8) sites comprising core and stratigraphic holes.

It is the intention of *AGL,* where feasible, to conduct the exploration drilling operations 24hours to reduce the duration of the activities and limit noise exposure for residential properties. With respect to *Gloucester 2*, a number of residential dwellings are located in relative close proximity to the proposed operations, accordingly it is proposed to restrict the drilling at this site to eleven (11) hours during the day (7.00am to 6.00pm).

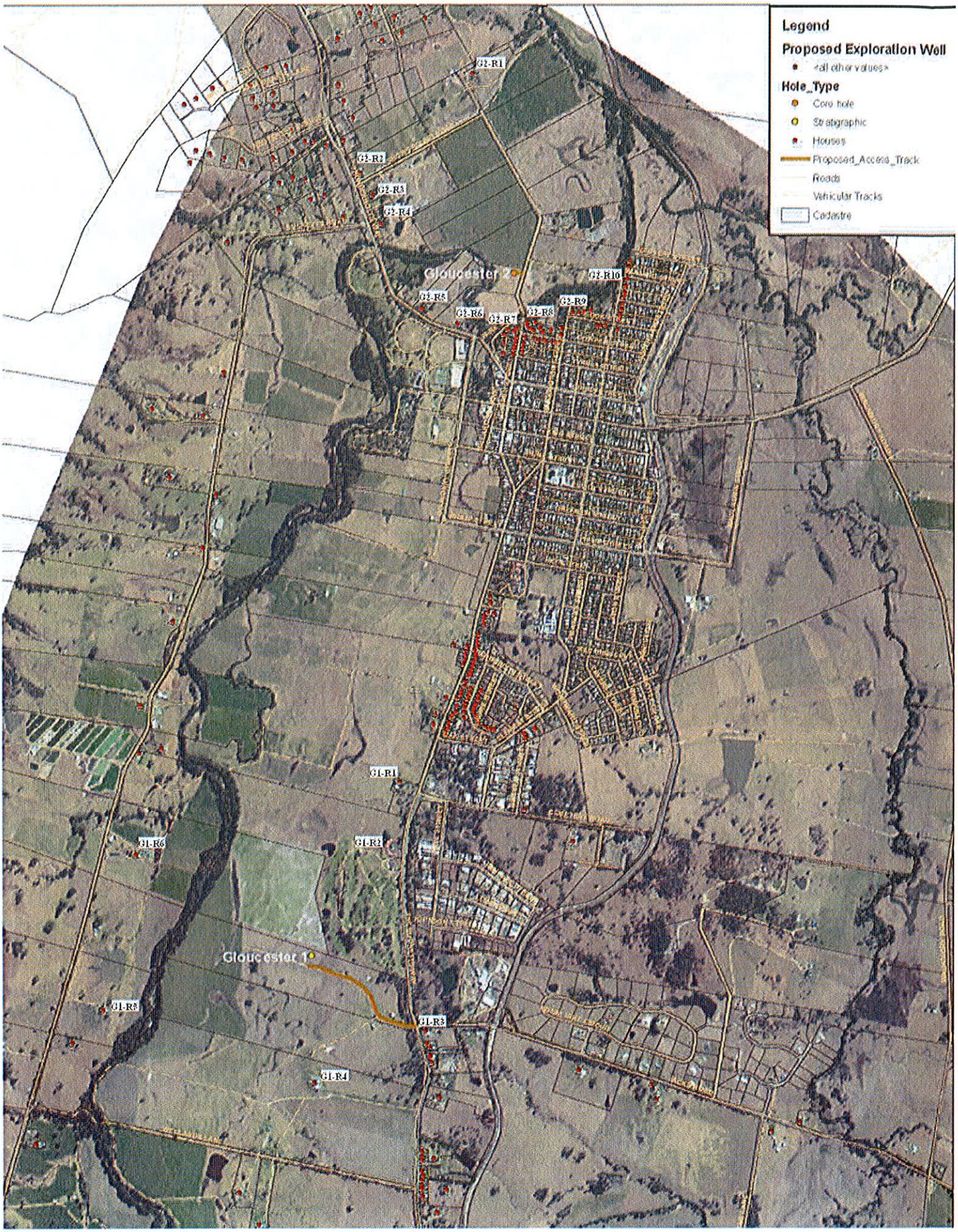
Due the extent of the study area and envisaged short duration of the construction / drilling activities the assessment has utilised assumed background noise levels of 30-35dB(A) day and 30dB(A) evening / night.

Noise from drilling activities was modelled with source noise data from site attended noise audits of a Drilltec G55 rig and utilised the Environmental Noise Model (ENM). The results of the modelling in the absence of additional noise controls identified the potential for noise exceedances at a number of reference residential receiver locations. The G55 unit is larger than the equipment anticipated to be used for the exploration drilling and accordingly is considered conservative.

The assessment has recommended a number of conceptual noise controls including maximising directivity characteristics of the drilling plant, location of offices and other ancillary buildings to provide shielding, 'cut & fill' operations to maximise shielding and location of excavated fill material and/or temporary noise walls.

With the effective implementation of noise controls, the assessment has shown that the recommended evening / night target noise goal of L_{A10} 35dB(A) is predicted to be satisfied at all reference locations.

APPENDIX 1: LOCATION OF WELLS & REFERENCE RECIEVERS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Roads
Vehicular Tracks
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G2-R2
G2-R3
G2-R4
Gloucester 2
G2-R5
G2-R6
G2-R7
G2-R8
G2-R9
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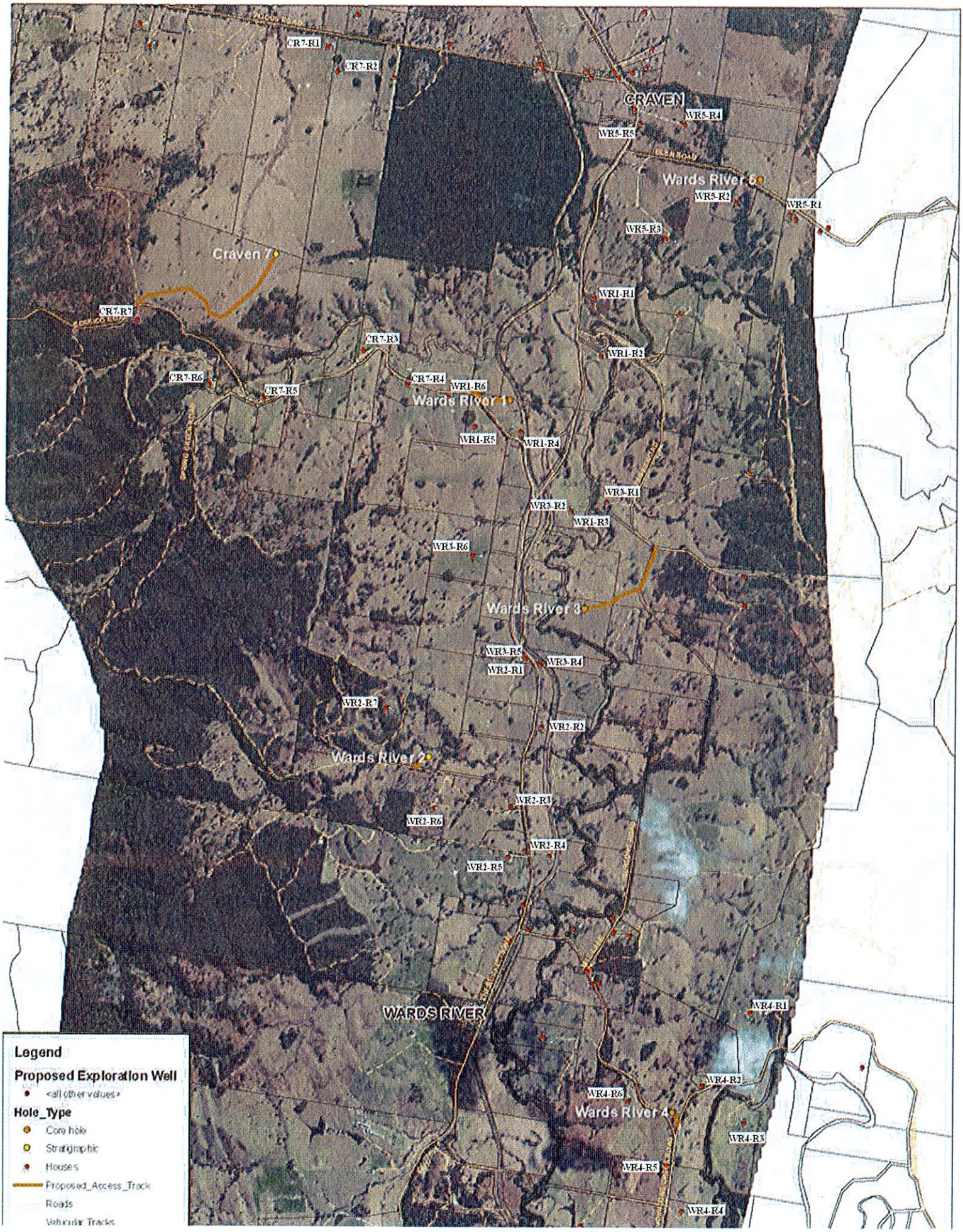
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CR7-R7
CR7-R3
WR1-R2
CR7-R6
CR7-R4
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WARDS RIVER
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WR4-R6
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WR4-R5
WR4-R4
Legend
Proposed Exploration Well
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Hole_Type
Core hole
Stratigraphic
Houses
Proposed_Access_Track
Roads
Vehicular Tracks

APPENDIX 6

PROJECT ENVIRONMENTAL MANAGEMENT PLAN

AGL GLOUCESTER LE Pty Ltd

ENVIRONMENTAL MANAGEMENT PLAN

GLOUCESTER BASIN (PEL 285)

COAL SEAM METHANE GAS – EXPLORATION DRILLING AND PRODUCTION EVALUATION TESTING

Document No.: Environmental Management Plan					
Rev	**Date**	**Description**	**Prepared**	**Checked**	**Approved**
0	April 2009	Gloucester EMP	TL	SG	SG

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1.0 PURPOSE

AGL has developed this Environmental Management Plan (EMP) to control and manage the environmental impacts of its activities in undertaking exploration drilling and production evaluation testing for coal seam methane gas in the Gloucester Basin.

This EMP has been prepared under the framework of the ISO 14001 Environmental Management System (EMS) standard.

The AGL Energy Health, Safety and Environment Policy and documentation should be considered in parallel with this EMP to promote a better understanding of the requirements and standards implied.

2.0 INTRODUCTION

This EMP has been developed for the activities currently being undertaken as part of AGL's exploration and production testing activities in the Gloucester Basin, as well as a basis for those that are proposed for the future as the project develops.

2.1 Background

The Gloucester Basin is located in New South Wales, approximately 100 km north of Newcastle. AGL is the operator for exploration activities for coal seam methane gas in the basin. The area is administered under Petroleum Exploration Licence (PEL) 285, which enables investigation of resources with a view to possible development of a production field in the near future.

The location of the PEL area is approximately centred on the township of Stratford, some 70 kilometres (km) north of Newcastle in New South Wales (NSW). The area extends approximately 60 km north to south and approximately 20 km east to west comprising some 18 graticular blocks and about 1,308 square kilometres (km^2) (Figure 1). The area completely contains the Gloucester Geological Basin.

The project is a conventional coal seam methane gas project, involving petroleum exploration activities including drilling and production evaluation testing.

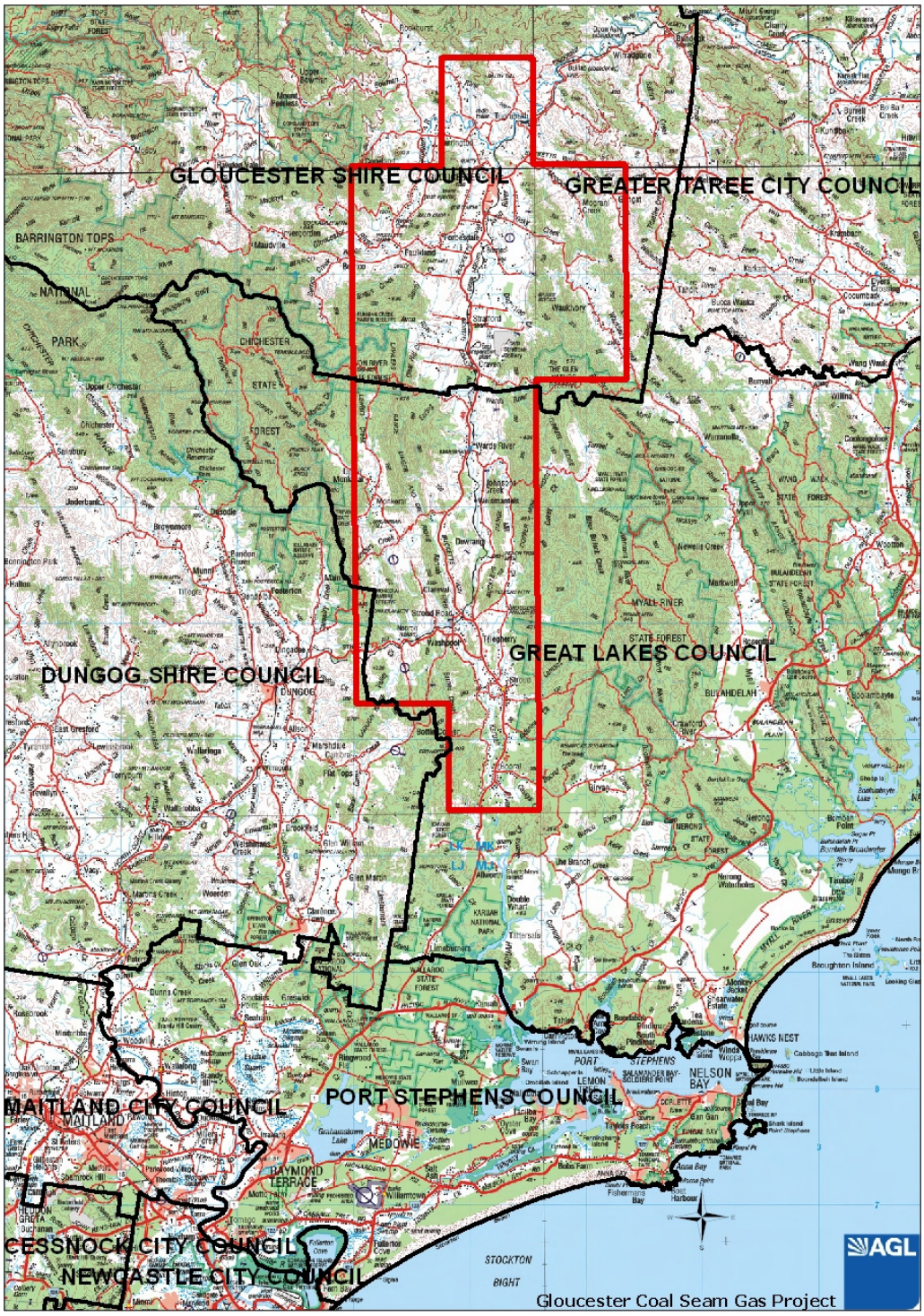

Figure 1– Project Area

2.2 Description of company activities

AGL is an ASX listed group and has been operating in Australia for 170 years and was one of its first listed companies. The company has activities in investing in sustainable energy businesses such as wind farms and innovative environmentally friendly projects such as the underground Bogong hydroelectric

power station in Victoria's High Country, and manages various coal bed methane assets, which include interests in permits in Queensland and NSW.

Coal seam gas (CSG) has developed rapidly in Australia over the last decade, emerging as a flexible, clean and competitive source of energy in an expanding economy seeking lower pollution fuels.

As extraction technology has developed and with the world increasingly carbon-conscious (coal seam gas produces approximately half the greenhouse gas emissions of coal) coal seam gas is seen as an increasingly valuable resource in Australia and abroad.

Extraction of coal seam gas differs from natural gas by targeting specific seams of coal, often at significant depths that make mining otherwise economically unviable. Removal of the gas is induced by reducing the hydrostatic pressure of water also contained in the coal seams. As the water is pumped out the reduction in pressure enables the flow of gas, which increases as the water level is reduced over time.

2.3 Scope

This EMP incorporates the environmental policies of AGL that are to underpin each activity the company takes in the exploration and development of coal seam methane prospects. AGL aims to meet, if not exceed best industry practice in environmental management associated with all its activities. This document has been produced in the framework of ISO 14001.

All subcontractors, consultants and suppliers working on any AGL project shall be bound to the requirements of the AGL Environmental Management Plan for that project, if they do not have in place a compliant Management System of their own.

3.0 OBJECTIVES & TARGETS

AGL aims to conduct its operations to the highest practicable level with regard to environmental protection and in accordance with all standards and regulation. AGL's environmental objectives include:

- To achieve a zero incident rate by good forward planning, implementation of environmental controls through training and awareness of all employees.

- To achieve compliance with all applicable regulatory requirements and other relevant industry standards and codes.

4.0 DEFINITIONS

For a full list of definitions, refer to **Environmental Management Systems – Specification with guidance for use** (Australia/New Zealand AS/NZS ISO 14001:2004) and **Occupational Health and Safety Management System**-AS/NZS 4801:2001).

5.0 ENVIRONMENTAL POLICY

a) AGL adheres to the AGL Health, Safety and Environment Policy, which has been developed with consideration for:

- The nature, scale and environmental impacts of the company's activities, products and services
- Prevention of pollution
- Statutory and other requirements
- Scope for continual improvement
- Providing a framework for setting and reviewing environmental objectives and targets

b) The Health, Safety and Environment Policy is communicated to all persons working for or on behalf of the organisation.

c) Top Management shall review this Policy at least annually.

6.0 PLANNING

6.1 Environmental Aspect Identification and Evaluation

AGL shall endeavour to minimise the impacts of its activities on the environment by identifying environmental hazards and putting into place controls to eliminate, where ever possible, any identified risk to the environment. Components of the environment to be considered include, but are not limited to:

- Water quality
- Marine environment
- Noise
- Air quality
- Visual quality
- Flora and fauna
- Heritage significance
- Surrounding community
- Vibration
- Natural resources

The Land and Approvals Manager and Operations Manager shall continually identify the environmental aspects of AGL's activities and develop safeguards/actions to mitigate the environmental impacts of these aspects. Resources for identifying a project's aspects include;

- EMP Status Plan,
- cross checked with Project Risk Assessments and
- JSEA record.

This information can then be used to formulate and revise the Project Environmental Management Plan, including a detailed environmental risk assessment and required actions to protect the environment. A register of

Activities, Aspects and Impacts has been developed as part of this process.

To determine those aspects that carry significant environmental risk, a risk assessment (as shown in Table 1) is used to rank the identified impacts. Environmental impacts are determined according to the:

- probability of occurrence; and
- severity of impact.
-

Likelihood	Minor	Important	Serious	Major	Catastrophic
Almost Certain	2.5 Moderate	5 High	7.5 High	20 Extreme	25 Extreme
Likely	2 Moderate	4 Moderate	6 High	16 Very High	20 Extreme
Possible	1.5 Low	3 Moderate	4.5 High	12 Very High	15 Very High
Unlikely	1 Low	2 Moderate	3 Moderate	8 High	10 Very High
Rare	0.5 Low	1 Low	1.5 Low	4 Moderate	5 High

Consequence

Table 1 - Risk matrix

The risk assessment enables AGL to prioritise and focus on those activities that present significant environmental risk to the organisation.

Table 2 summarises the activities, aspects and impacts along with the associated environmental risk.

Activity	Aspect	Impact	Likelihood	Severity	Consequence
All Activities	Vegetation clearing	Removal or damage to threatened or endangered species	Unlikely	Serious	Moderate
		Introduction of weed species	Likely	Important	Moderate
>Establishing drill pads & access tracks		Loss of visual amenity	Unlikely	Minor	Low
	Flora & Fauna	Removal of wildlife habitat	Likely	Important	Moderate
		Disturbance to local fauna	Likely	Important	Moderate
>Pond, sump & water storage construction	Soil & Erosion	Instability caused by earthworks	Likely	Serious	High
		Disruption to soil structure and horizons	Likely	Important	Moderate
		Runoff to local waterways	Possible	Major	Very High
>Drilling, perforation and fraccing		Contamination from hazardous materials	Possible	Major	Very High
	Noise	Heavy machinery movement for long durations	Almost Certain	Important	High
	Air	Dust creation from machinery and earthworks	Almost Certain	Important	High
>Pipeline and gathering line construction	Water	Runoff of sediment into local waterways	Possible	Serious	High
		Runoff of fuel and chemicals to surface and ground waters	Unlikely	Major	High
	Cultural Heritage	Disturbance of culturally sensitive sites	Possible	Serious	High
>Well operation	Waste	Inefficient resource use	Unlikely	Minor	Low
		Loss of visual amenity	Unlikely	Minor	Low
		Health risk	Unlikely	Minor	Low
	Bushfire	Personal safety	Rare	Major	Moderate
		Loss of property and wildlife habitat	Rare	Major	Moderate
	Community	Increased traffic	Almost Certain	Important	High
		Loss of amenity	Rare	Important	Low
Pond, sump & water storage construction	Flora & Fauna	Fauna falling into water sumps or storages	Unlikely	Serious	Moderate
	Soil & Erosion	Damage to soil structure from excavations	Almost Certain	Serious	High
		Enhanced risk of soil erosion	Almost Certain	Serious	High
	Water	Leaching of contaminated water into groundwater	Possible	Major	Very High
		Disposal of contaminated water	Almost Certain	Serious	High
Drilling, perforation and fraccing	Air	Dust or emission creation from heavy machinery	Likely	Important	Moderate
		Gas emissions from well	Likely	Critical	Moderate
	Noise	Increased noise nuisance from fraccing	Likely	Important	Moderate
	Soil & Erosion	Contamination from hazardous material spills	Likely	Serious	High
	Water	Contamination from hazardous material spills	Likely	Serious	High
Well operation	Air	Venting or release of greenhouse gases	Possible	Important	Low
	Soil & Erosion	Contamination of soils from inappropriate disposal of poor quality water	Possible	Important	Moderate
		Erosion caused by excess runoff from water disposal	Possible	Important	Moderate
	Water	Potential spill of poor quality water produced from wells to surface and ground	Possible	Serious	High

Table 2 – Register of Activities, Aspects and Impacts

6.2 Legal and Other Requirements

Environmental management for exploration activities throughout NSW is controlled largely by State Government legislation, although there is also applicable Commonwealth legislation which must be adhered to. AGL understands the importance of meeting its regulatory requirements, and therefore the Land & Approvals Manager will continually keep abreast of State and Federal legislation.

The current applicable legislation (outlined below) will be regularly reviewed and updated as required.

- Environment Protection and Biodiversity Conservation Act 1999 *(EPBC Act)*
- Environmental Planning and Assessment Act 1979 *(EPA)*
- State Environmental Planning Policy *(Major Projects)*
- SEPP(Infrastructure) 2007
- SEPP (Mining, Petroleum Production and Extractive Industries) 2007 *(SEPP (Mining))*
- SEPP 14 Coastal Wetlands *(SEPP 14)*
- SEPP 26 – Littoral Rainforests
- SEPP 33 – Hazardous and Offensive Industries
- SEPP 44 – Koala Habitat Protection

- SEPP - 71 Coastal Protection
- Pipelines Act 1967 *(Pipelines Act)*
- Petroleum (Onshore) Act 1991
- Water Act 1912 *(the Water Act)*
- Water Management Act 2000 *(WM Act)*
- Protection of the Environment Operations Act 1997 *(POEO Act)*
- Fisheries Management Act 1994 *(FM Act)*
- Roads Act 1993
- Native Vegetation Act 2003
- Heritage Act 1977
- Contaminated Land Management Act 1997
- Threatened Species Conservation Act 1995
- National Parks and Wildlife Act 1974
- Gloucester Local Environmental Plan
- Great Lakes Local Environmental Plan
- Australian Pipeline Industry Association Code of Environmental Practice

The AGL Environment Officer shall visit relevant Government department websites to ensure that this legislation is up to date, and shall advise personnel of changes and the impact on work activities. All environmental incidents must be recorded investigated and reported to project authority (including AGL Management) and or the appropriate local authority.

6.3 Objectives and Targets & Programmes

The AGL Gloucester Environmental Committee has set the objective of no breaches in compliance with statutory or other regulatory requirements. Therefore to achieve this, project specific objectives and targets have been set, taking into consideration the nature of activities, characteristics of the site, and the environmental aspects and impacts. These objectives and targets are included within the Environmental Management Procedures established for all key activities. Checklists are also in place to ensure procedures are followed.

The following procedures – included in Appendix 1 – have been developed to address identified activities and impacts:

- Produced Water Management
- Soil and Ground Stability
- Vegetation Management
- Bushfire Prevention
- Air Emissions
- Noise and Vibration
- Clearing and Grading
- Drilling, Perforation & Fraccing
- Pond Construction
- Trenching

- Cultural Heritage
- Community and Social Impact
- Waste Management
- Fuel and Chemical Storage and Spills
- Pipe stringing and welding
- Pipe laying and backfilling
- Hydrotesting
- Clean-up and Rehabilitation

The Project Environment Officer shall monitor, maintain records and report the progress made in achieving targets.

Objectives and targets shall be reviewed annually; however the following targets have been set as a minimum:

- Zero incident rate
- No breaches in compliance
- Participation in training, group meetings, environmental promotions, emergency drill and preparedness for control of potential environmental incident
- Effective management of subcontractors and project plant and equipment
- Effective implementation of safe work practices, risk analysis and risk controls
- Continual improvement in environmental performance
- Effective waste management and recycling

An Environmental Management Program has been developed to ensure all procedures are adhered to on an ongoing basis.

The Environmental Management Program includes the following information:

- Roles and responsibility
- What is to be monitored, frequency, methods for monitoring and storage of this information
- Targets and objectives
- Timeframes for achieving these objectives

The Environmental Management Program is to be reviewed at least annually, taking into consideration any changes in legislation, activities or the development of new technology.

7.0 IMPLEMENTATION AND OPERATION

7.1 Resources, Roles, Responsibility and Authority

Overall responsibility for the EMP lies with the Head of Land and Approvals. However, all staff and contractors are responsible for

undertaking activities in a way that minimises environmental impact with the aim of improving the company's environmental performance.

The organisational chart in Figure 2 outlines the key responsibilities attributed to AGL personnel involved in the development and implementation of the EMP. A description of the individual roles and responsibilities follows-:

- The Head of Land and Approvals has overall responsibility to ensure the EMP is implemented and is compliant according to the Environmental Policy. The Head of Land and Approvals will report to the Group General Manager.

- The Land and Approvals Manager is responsible for the development, implementation, monitoring and reporting in compliance with the operational components of the EMP, and Complaints Register. This includes the continuous improvement of environmental performance of people and equipment. This person reports to the General Manager.

- The Operations Manager is responsible for the daily operational requirements of site activities and associated facilities. This person will report to the General Manager.

A Project Environment Officer has been appointed to assist the Land and Approvals Manager and shall undertake the following-:

- Implement and monitor site or project specific plans
- Conduct Environmental Inductions for new employees
- Liaise with the Operations and the Land and Approvals Managers on environmental matters

Site staff shall carry out their duties as listed in their job descriptions in an environmentally responsible manner.

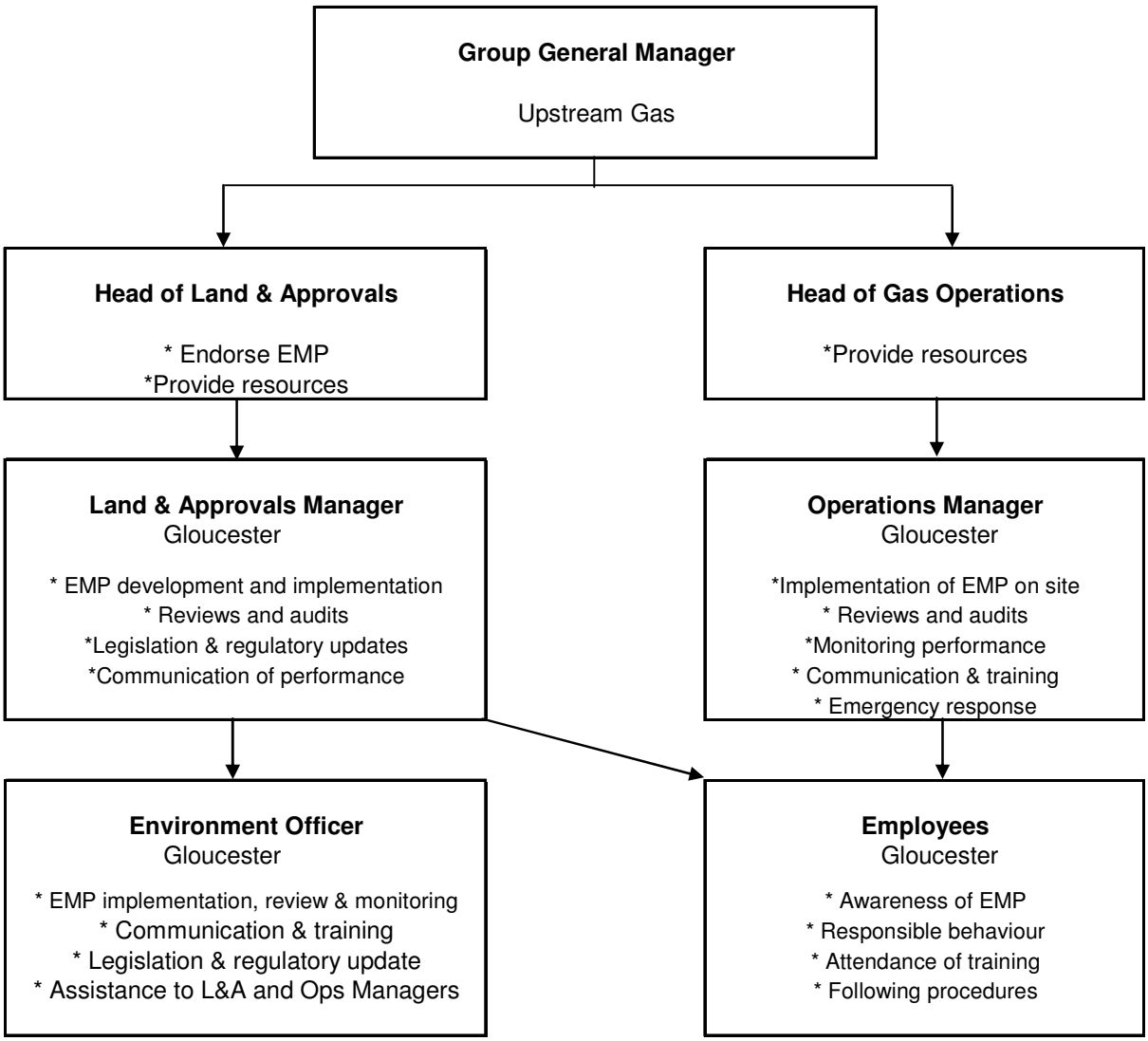

Figure 2 – Roles and Responsibilities

7.2 Competence, Training and Awareness

The authority for implementation and management of AGL Group environmental systems and controls is by competent people within the Group. Where circumstances demand, specialised skills and competencies will be employed.

New employees, project personnel and site visitors shall undergo a site induction.

Site inductions shall cover the following issues:

- Environmental aspects and impacts of the project
- Relevant legislation, permit conditions and other restrictions

- Compliance requirements and consequences of non-compliance
- Emergency procedures and contacts (covered in existing document)

Training and induction records for project personnel and visitors shall be kept on site, both electronically and on paper as Register of Plant & Equipment Licences, Site Induction Register and Site Visitors Register. Individual competencies for AGL employees and subcontractors will be regularly assessed by a competent environmental officer to ensure a high standard of environmental understanding.

Personnel selected to undertake tasks with the potential to cause significant environmental impact will not be deemed to be competent unless they have undergone the above training as a minimum.

7.3 Communication

The Land and Approvals Manager and Environment Officer shall be responsible for all environmental related communication, within AGL and with interested external parties and regulatory parties.

For project personnel, the location and access to sites shall be considered when deciding appropriate methods of communication.

Correspondence shall be documented in accordance with Data and Document Control.

7.4 Documentation

For details of all documentation contained within this EMP, refer to the appendix for an index.

All documents referenced in this EMP are contained in an Environmental Section within the Quality Folder on the project server.

7.5 Document Control

For control of documents refer to the procedure Data and Document Control / Project File System**.** Regular project weekly and/or monthly reporting of environmental status is required to ensure senior management is fully informed of environmental status of any project. Corporate systems will be reported on as a minimum annually or as legislation or other Government changes imply.

7.6 Emergency Preparedness and Response

An Emergency Response Procedure has been developed for the project to identify, prevent, mitigate and respond to accidents that are likely to have an environmental impact.

A Safety Management Plan has also been developed for the project to identify and mitigate against safety risks on site.

These procedures shall be reviewed with input from Project Managers and site personnel, at least annually or after the occurrence of an emergency event. Any changes to procedures must be approved by senior management.

Site Management shall display these plans in prominent locations around sites.

Site Management shall enlist local emergency response crews to carry out mock drills to test these procedures and the preparedness of site and emergency personnel.

8.0 CHECKING

8.1 Monitoring and measurement

The Environmental Monitoring Program details the procedures and timing for ongoing monitoring, review and revision of environmental management procedures.

All monitoring equipment shall be maintained as specified in the procedure for Inspection and Testing.

Refer to the Routine Environmental Monitoring Checklist and Site Inspection for a list of routine site environmental monitoring and inspection requirements.

Project Managers and Project Environment Officers shall identify project or site specific monitoring requirements, carry out a Hazard Identification and Risk Assessment, assign personnel to monitor and record this information, to track performance of operational and maintenance procedures, check for compliance with statutory or other requirements and targets and objectives and predict the likelihood of future corrective action.

8.2 Evaluation of Compliance

A review of applicable legislation shall be undertaken periodically to determine AGL's compliance with its applicable legal requirements.

A review of any industry standards or codes that are applicable to AGL's activities shall be undertaken periodically to determine AGL's compliance with those requirements to which it subscribes.
Records shall be kept of the above evaluations. Any deficiencies shall be recorded and corrective actions draw up and communicated to all affected personnel.

8.3 Non-conformance and Corrective and Preventative Action

Non conformances and corrective actions shall be dealt with as given in procedure Non Conformance**.**

8.4 Environmental Management Plan Audit

Internal Environmental Management Plan Audits shall be carried out in accordance with Internal Audit Procedures.

The Environmental Management Program will detail the timing of EMP audits, but at the minimum these should be conducted every three months.

External audits shall be conducted at least annually by suitably qualified auditors.

Any non-conformance or corrective action report shall be addressed as soon as practicably possible and be signed off during the completion of the next scheduled audit.

The results of audits shall be made available to all employees and AGL Management.

8.5 Management Review

To ensure continual improvement and effectiveness of the Environmental Management Plan, AGL Management shall participate in Management Reviews of the Plan at least annually.

Management reviews shall cover the following areas:

- Results of audits conducted;
- AGL's overall environmental performance;
- Frequency or recurrence of environmental incidents;
- Effectiveness of existing procedures (SWPs and JSEAs) for hazard identification, risk assessment and control;
- Changes in legislation, codes of practice or Australian Standards that may have an affect on compliance requirements and consequently existing risk control measures;
- Employee suggestions or recommendations;
- Any feedback from Government Agencies on environmental performance; and

- Recommendations for improvement of the Environmental Management System.

The details of Management Review meetings such as comments, observations and recommendations shall be documented.

Management shall assign responsibilities and timeframes for follow up action on recommendations to ensure these are implemented.

9.0 ASSOCIATED DOCUMENTS

AGL

* Safety Management Plan
* Emergency Response Procedure

OTHER

* AS/NZS ISO 14001:1996 Environmental Management Systems, *REVISED 2004* Environmental Management System – Specification with guidance for use (Australia/New Zealand AS/NZS ISO 14001: 2004)

'POEO' Protection of the Environment Operations Act 1997

APIA Environmental Policy and Code for Environmental Practice

State and Federal Occupation Health and Safety Legislation

NSW Government Environmental Management Systems Guidelines 1998

AS/NZS 4360:2004 Risk Management

ENVIRONMENTAL MANAGEMENT PLAN

Appendix 1 – Environmental Management Procedures

1. Produced Water Management	
Goals	To avoid potential impacts to quality of local ground and surface water systems and the surrounding environment
Responsibility	Operations Manager
Performance Objective	◗ To reuse at least 10% per year of the production water for agricultural purposes. ◗ To prevent contamination of watercourses and creeks, particularly with regard to salinity. ◗ To prevent contamination of surrounding soils, particularly with regard to salinity and sodicity. ◗ To minimise impact on riparian, aquatic and water dependant flora and fauna.
Mitigation Measures	◗ All produced water to be collected in localised storages. ◗ Storage ponds to be lined with a suitable polyurethane liner to prevent contamination of soil. ◗ Sufficient freeboard to allow for 1-in-100-year 72 hour rainfall event to be maintained in all storages. ◗ Production to cease when freeboard is exceeded until water can be appropriately disposed of. ◗ Water quality monitoring to be undertaken on an ongoing basis to inform disposal options. ◗ Disposal options to be discussed and agreed with relevant authorities. ◗ Comprehensive assessment of disposal options to be undertaken, giving preference wherever possible to beneficial use. ◗ Where irrigation using product water is approved, ongoing soil quality monitoring will be undertaken to assess any impacts on the local environment. ◗ Water quality monitoring to be undertaken prior to irrigation events.
Performance Measures	◗ Proportion of production water applied to beneficial use (eg irrigation). ◗ No uncontrolled release of produced water into the environment.
Monitoring / Auditing / Reporting	◗ Water quality monitoring to be conducted for each well (water quality monitoring procedures in place). ◗ Stored produced water to be quality monitored prior to release for agricultural purposes. ◗ Audits of produced water management procedures to be undertaken each three months, with implementation of any recommendations and corrective actions.
Corrective Action	◗ Investigations/corrective actions undertaken as a result of audits and regular monitoring will be documented and incorporated into the EMP. Corrective actions shall be closed out by senior management according to an agreed responsibility and timescale.
Associated Documents	◗ Engineering Design and Specifications for Produced Water Storages. ◗ Water Quality Monitoring Procedures. ◗ Produced Water Management Plan (under development).

2. Soil and Ground Stability	
Goals	To prevent project work areas, including well drill pads, pipeline alignments, surface water storages and access tracks, from becoming vulnerable to soil erosion.
Responsibility	Land and Approvals Manager
Performance Objective	To control and manage access to, and work at all site locations with the following objectives: ◗ to minimise the potential for soil erosion; ◗ to adequately prevent or control sediment release to land, waterways, and dams; ◗ to avoid unacceptable damage to native vegetation or wildlife habitats; ◗ to prevent impact on agricultural production or other legitimate land uses; ◗ to minimise the risk of the exposure of buried assets; ◗ to adequately control the subsidence of any subsurface earthworks; and ◗ to undertake all earthworks, including site remediation, such that soil horizons and structure are maintained as far as possible.
Mitigation Measures	◗ Sedimentation traps shall be installed where appropriate to prevent sedimentation runoff into waterways, dams, and agricultural land. ◗ Erosion control structures to be regularly inspected to ensure they are in good condition and operating effectively. ◗ If erosion is occurring due to inadequate vegetation, revegetation of the erosion area should be undertaken. Revegetation works should be conducted in consultation with the landowner and relevant authorities. ◗ Vehicular access should be restricted to stable ground where possible. Additional care should be taken near waterways and drainage lines, especially after rainfall. ◗ Restored ground should be routinely checked for subsidence and/or exposure, particularly at waterways and drainage lines and especially after flooding rains. If restoration is to occur, any imported soil will require landowner approval and shall be free of weeds and /or contamination. ◗ Drilling pad areas will be reduced to that required for operation once drilling and associated activities are complete. Sumps will be drained and the area surrounding the wellhead restored to its original condition. ◗ Earthen banks of above-ground water storages will be either lined with a geomembrane or planted with vegetation to avoid erosion and sediment runoff. ◗ The volume of produced water applied during any approved irrigation should be such that there is no risk of soil erosion. ◗ A monitoring program should be developed to monitor potential impacts associated with soil and ground stability.
Performance Measures	◗ Reduced soil erosion in highly susceptible areas. ◗ Reduced amounts of sediment discharge to land and watercourses. ◗ No impact to existing agricultural land or existing land uses.
Monitoring / Auditing / Reporting	◗ Audits will be conducted in accordance with the Environmental Management Program, with implementation of the recommendations and corrective actions.

2. Soil and Ground Stability	
	◗ Inspections of all work sites should be undertaken on a regular basis, particularly following any major work. At the least, an audit of procedures will be undertaken every three months. ◗ Well pads should be inspected following establishment and again when any work is undertaken to increase or reduce the pad size. ◗ Areas prone to soil erosion should be inspected following significant rainfall.
Corrective Action	◗ Investigations/corrective actions undertaken as a result of the audit or regular monitoring will be documented and incorporated into this EMP. Correction actions shall be closed out by senior management according to an agreed responsibility and timescale.
Associated Documents	Erosion & Sediment Control ◗ Daily Site Environmental Controls Checklist ◗ Site Environmental Checklist

3. Vegetation Management	
Goals	To protect all work areas from soil erosion and to ensure the integrity of all wildlife habitats is maintained while protecting visual amenity
Responsibility	Land and Approvals Manager
Performance Objective	To control and manage work areas and access to all site areas with the following objectives: ◗ to promote and maintain stable vegetation cover; ◗ to minimise impact to native flora and fauna; ◗ to minimise soil erosion and sedimentation; ◗ to avoid losses to agricultural production; ◗ to reduce visual impacts; and ◗ to prevent and control weed invasions.
Mitigation Measures	◗ In areas of poor vegetation cover and where further impacts are likely, appropriate management measures shall be taken to ensure reseeding of these areas occurs. ◗ Regrowth trees within 3 metres of any trench centreline shall be removed to ensure tree roots do not pose a risk to pipeline integrity. ◗ Access tracks shall be maintained to ensure they remain navigable, including periodic reduction of regrowth. ◗ Areas where recent revegetation has taken place shall remain free of vehicles or machinery movement until such time that they are deemed suitable again for traffic. ◗ Appropriate flora species will be selected for revegetation, and suitable guidance will be sought and consultation undertaken to ensure this. ◗ Vegetation outside strictly delineated work areas – such as drill pads or a pipeline corridor – should not be disturbed. ◗ A monitoring program shall be developed to assess the success of revegetation. Further revegetation may be required where previous attempts are less than adequate.
Performance Measures	◗ Reduced soil erosion. ◗ No areas within the project area to be without adequate vegetation cover.
Monitoring / Auditing / Reporting	◗ Regular monitoring by patrol officers. ◗ Sites to be inspected regularly following revegetation until deemed successful. ◗ Audits will be conducted in accordance with the Environmental Management Program, with implementation of any recommendations and corrective actions.
Corrective Action	◗ Investigations/corrective actions undertaken as a result of the audit or regular monitoring will be documented and incorporated into this EMP. Corrective actions shall be closed out by senior management according to an agreed responsibility and timescale.
Associated Documents	◗ Site Environmental Checklist ◗ Weed Control Checklist ◗ ROW Clear and Grade Checklist

4. Weed Management	
Goals	To prevent the introduction and spread of Declared Plants and environmental weeds.
Responsibility	Land and Approvals Manager
Performance Objective	◗ No new weed species to be introduced into the area. ◗ The growth potential of existing noxious weeds in the project area should be minimised.
Mitigation Measures	◗ Pre Construction Procedures ◗ An inventory of noxious weed species occurring in the project area to be undertaken and appropriate weed control procedures to be developed based on regulatory pest plant control guidelines, regional weed control programs and an assessment of weed risk. ◗ Washdown and Hygiene Procedures ◗ All on-site personnel will follow the following weed hygiene procedures: o Prior to arrival at the project area, all vehicles, equipment and portable infrastructure (including trailers, generators, workshop and accommodation huts etc.) will be washed down (spray-cleaned). o Cleaning procedures need to remove soil and organic matter from the surfaces of vehicles, equipment and portable infrastructure, including undercarriage and running gear. o Proof of inspection, such as “washdown tickets” from state operated facilities, is required for all vehicles coming from known area of infestation, before permission is granted to enter uninfected tenure areas. If the vehicle is not considered clean by a trained weed inspector, it shall be re-washed and re-inspected before certification. o A weed washdown sticker (coloured yellow) is to be placed on the windscreen of vehicles that have been certified weed free. o Vehicles and machinery certified weed free shall be noted in the Weed Register to be updated regularly and located at the Site Office. ◗ Liaise with Local Councils and other authorities for specific weed data sets. ◗ Only approved access tracks and roads are to be used for access to the project area. ◗ Appropriate training of all personnel. ◗ Superintendents and supervisors will be briefed on the recognition of noxious weeds.
Performance Measures	◗ During construction, regular field inspections for the presence of weeds will be undertaken, particularly in problem areas, and weed control carried out as determined by the land and Approvals Manager in consultation with Environmental Authorities. ◗ It will be the responsibility of the Operations Manager to ensure that proper weed management controls have been undertaken.
Monitoring / Auditing / Reporting	◗ Regular monitoring by patrol officers. ◗ Audits will be conducted in accordance with the Environmental Management Program, with implementation of any recommendations and corrective actions. ◗ Any introduction of declared flora or other environmental weeds will be reported to the Land and Approvals Manager who will notify relevant

4. Weed Management	
	authorities.
Corrective Action	◗ Investigations/corrective actions undertaken as a result of the audit or regular monitoring will be documented and incorporated into this EMP. Corrective actions shall be closed out by senior management according to an agreed responsibility and timescale. ◗ If a substantial outbreak of a declared noxious weed is found in the project area, the following will be implemented: o Vehicle movement through the area will be immediately halted. o The Operations Manager will be notified as soon as practicable and in turn will notify relevant Local Council of the location of the weed problem. In addition, the local Land Protection Officer and the Administering Authority shall also be notified. o The area will be assessed and treated, if necessary, by hand pulling individual plants or by boom or spot spraying, before any earth moving equipment or machinery enters the area. Under no circumstances will the plants found be chopped slashed or burned due to the potential for spreading seeds. o Any vehicle leaving the affected area will be rewashed and inspected. The vehicle will then obtain a new certification sticker with a new register number and date of inspection.
Associated Documents	◗ Weed Control

5. Bushfire Prevention	
Goals	To prevent the cause of bushfire as a result of operational activities.
Responsibility	Operations Manager
Performance Objective	◗ To minimise the risk of bushfire; ◗ To protect the public and personnel; ◗ To protect property and minimise damage or loss; ◗ To protect flora, fauna and habitats; ◗ To prevent the spread of bushfire in the event of ignition; and ◗ To provide adequate response in the event of ignition.
Mitigation Measures	Implement measures to prevent and respond to bushfire incidents that are in accordance with the following-: ◗ AS2885.3 ◗ Safety and Emergency Plans ◗ Bushfire management plans which include prevention, preparedness, emergency contacts, equipment, response and training. ◗ Project activities should adhere to regulatory and local fire authority guidelines and comply with fire restrictions, notification requirements and permitting procedures. ◗ All vehicles shall be equipped with appropriate vehicle fire extinguishers. ◗ Firebreaks are to be installed around facilities. ◗ Regular checks to ensure there is no build up of debris or vegetation matter that could cause an ignition. ◗ Where combustible or flammable chemicals are required to be stored on site, appropriate fire fighting equipment shall be available. Incompatible chemicals should not be stored together, and where possible, flammable liquids should be stored in a flammable liquids cabinet.
Performance Measures	◗ No outbreaks of bushfire as a result of project activities.
Monitoring / Auditing / Reporting	◗ Audits will be conducted in accordance with the Environmental Management Program, with implementation of the recommendations and corrective actions.
Corrective Action	◗ Investigations/corrective actions undertaken as a result of a bushfire are to be documented and incorporated within this EMP. Corrective actions shall be closed out by senior management according to an agreed responsibility and timescale.
Associated Documents	◗ AS2885.3 ◗ Safety Management Plan ◗ Emergency Response Plan

6. Air Emissions	
Goals	To minimise the release of air pollutants.
Responsibility	Operations Manager
Performance Objective	◗ To minimise atmospheric emissions; ◗ To minimise greenhouse gas emissions; ◗ To minimise the creation of safety hazards; and ◗ To minimise disturbance to the community.
Mitigation Measures	**GAS** ◗ The venting of coal seam methane gas from site infrastructure shall be minimised. ◗ The flaring of gas from production wells shall be limited to that necessary as part of the production evaluation process, following which flaring will be halted. ◗ Flaring is recognised as preferable to venting of coal seam methane gas, as the associated greenhouse gas emissions are reduced by a factor of more than 20. ◗ Where possible, planned venting of gas shall be conducted under favorable meteorological conditions to help assist rapid dispersion of the gas. ◗ Leak detection surveys shall be periodically performed along any pipeline as per AS2885.3 requirements. ◗ Where gas is to be released to the atmosphere, it should be flared wherever technically and economically feasible. ◗ Gas vent areas are to be located in accordance with regulatory and relevant Australian Standard requirements. ◗ Consultation with nearby residents and local authorities shall be undertaken prior to any major venting exercise. **DUST** ◗ To minimise dust problems in the project area the following mitigation measures should be adopted as appropriate-: ◗ revegetate with existing species and restrict access until the vegetation is established; ◗ ensure designated speed limits are being observed and are appropriate; ◗ minimise vehicular movement; ◗ utilise geotextiles, hessian, mulched vegetation to help settle high dust areas; and ◗ Use dust suppression water where appropriate and available. ◗ Areas impacted by heavy bulldust should be stripped and the subsurface watered to provided a firmer base.
Performance Measures	◗ Zero complaints from local residents or regulatory authorities.
Monitoring / Auditing / Reporting	◗ Monitoring will be on a regular basis during inspections by patrol officers. ◗ Audits will be conducted in accordance with the Environmental Management Program, with implementation of the recommendations and corrective actions.

6. Air Emissions	
Corrective Action	◗ Investigations/corrective actions undertaken as a result of the audit or regular monitoring will be documented and incorporated into this EMP. Corrective actions shall be closed out by senior management according to an agreed responsibility and timescale.
Associated Documents	◗ AS2885.3 ◗ Dust Control

7. Cultural Heritage	
Goals	To avoid impact on sites which have heritage or cultural value.
Responsibility	Land and Approvals Manager
Performance Objective	◗ To avoid impact to known sites or sites discovered within or near the project area. ◗ To implement an effective consultation program with traditional landowners, community groups, regulatory authorities, and other relevant stakeholders.
Mitigation Measures	◗ The inventory of heritage sites compiled for the Cultural Heritage Management Plan shall be referred to prior to any maintenance or construction activity. ◗ Heritage sites within or close to project areas shall be adequately marked or barricaded off to ensure they are not disturbed. ◗ Patrol officers and field operations staff shall be adequately trained in Cultural and Heritage issues and management. ◗ A consultation program shall be implemented to help facilitate discussions between traditional owners, community groups, regulatory authorities, and relevant stakeholders.
Performance Measures	◗ Zero complaints from traditional owners, regulatory authorities, community groups or relevant stakeholders. ◗ No disturbance to heritage or cultural sites.
Monitoring / Auditing / Reporting	◗ Monitoring during construction, operation or maintenance activities. ◗ Audits will be conducted in accordance with the Environmental Management Program, with implementation of the recommendations and corrective actions.
Corrective Action	◗ Investigations/corrective actions undertaken as a result of the audit or regular monitoring will be documented and incorporated into this EMP. Correction actions shall be closed out by senior management according to an agreed responsibility and timescale.
Associated Documents	◗ Regulatory legislation. ◗ Project Environmental Assessments (detail heritage locations from database searches).

8. Community and Social Impact	
Goals	To foster positive relationships with local communities and avoid negative impacts, including on visual amenity, traffic and local businesses.
Responsibility	Land and Approvals Manager
Performance Objective	◗ To engage interested parties in consultation at all stages. ◗ To manage vehicle traffic to minimise disruption to local traffic flows. ◗ To use local suppliers and businesses wherever possible. ◗ Design permanent infrastructure such that there is no impact on visual amenity.
Mitigation Measures	◗ Development of relationships with local interest groups. ◗ Implementation of a stakeholder consultation plan. ◗ Minimising vehicle movements, particularly on routes of high flow or at peak times. ◗ Using local suppliers and businesses wherever possible. ◗ Planning and designing permanent infrastructure with consideration for existing visual amenity.
Performance Measures	◗ Regular presentations to local councils and interest groups to update community on project progress. ◗ Zero complaints from local residents about traffic disruptions. ◗ No loss of visual amenity.
Monitoring / Auditing / Reporting	◗ Monitoring of community relationship by Land and Approvals Manager, including consideration of ways in which consultation with all interest groups can be improved. ◗ Reporting of all complaints and community consultation.
Corrective Action	◗ Investigations/corrective actions undertaken as a result of any complaints will be documented and incorporated into this EMP. Correction actions shall be closed out by senior management according to an agreed responsibility and timescale.
Associated Documents	◗ Stakeholder Consultation Plan (under development).

9. Waste Management	
Goals	To operate more efficiently and thereby reduce waste outputs; to recycle and reuse materials where possible; and to dispose of waste materials appropriately.
Responsibility	Operations Manager
Performance Objective	◗ To avoid the contamination of soil and water; ◗ To minimise potential health risks to workers and the public; ◗ To minimise adverse effects on native vegetation and wildlife.
Mitigation Measures	◗ Development and implementation of detailed waste management procedures. ◗ Management measures for solid waste materials such as timber, pallets, drums, plastic, glass, metal and rubber to include: ▪ stockpiling reusable and recyclable materials such as pallets, timber skids, drums, and scrap metals; ▪ installation of designated bins at all sites for aluminium cans, glass, and paper; and ▪ disposal of general refuse at approved local authority landfill sites. ◗ Disposal of hazardous wastes such as waste oils or chemicals shall be in accordance with the relevant regulatory requirement. Management measures should include-: ▪ provision of a designated safe storage area for wastes prior to their collection and transport to an offsite facility for either reuse, recycling, treatment, or disposal. The facility is to be approved by the relevant local authority; and ▪ appropriate design measures for storage areas to prevent any spills to the local environment. ◗ Sewerage disposal should be either an approved septic system or mobile chemical treatment systems. ◗ Management procedures for the disposal of general refuse, such as food scraps, domestic garbage, and commercial waste, should include-: ▪ collection and transport to an approved local authority landfill site; ▪ on site disposal at camp or work sites should only be considered for remote sites, providing approval from the relevant local authority has been granted or if storage of the refuse poses a health risk; ▪ site facilities to be maintained to an orderly and hygienic standard; and ▪ litter bins to be provided at all sites and regular site maintenance to be conducted to ensure litter accumulation is avoided.
Performance Measures	◗ Re-use and recycling program being maintained. ◗ Site facilities are kept clean.
Monitoring / Auditing /	◗ Audits will be conducted in accordance with the Environmental Management Program, with implementation of the recommendations

9. Waste Management	
Reporting	and corrective actions. ◗ Monitoring on a regular basis by all staff.
Corrective Action	◗ Investigations/corrective actions undertaken as a result of the audit or regular monitoring will be documented and incorporated into this EMP. Correction actions shall be closed out by senior management according to an agreed responsibility and timescale.
Associated Documents	◗ Waste Minimisation & Disposal ◗ Waste Management Checklist

10. Fuel and Chemical Storage and Spills	
Goals	To minimise risk of a fuel or chemical spill and minimise environmental impacts should a spill occur.
Responsibility	Operations Manager
Performance Objective	◗ To avoid any fuel or chemical spills; ◗ To avoid unacceptable safety hazards; ◗ To prevent the contamination of soil and water; and ◗ To minimise atmospheric emissions.
Mitigation Measures	◗ The storage and handling of fuels and chemicals shall be in accordance with AS 1940:1993 – *The storage and handling of flammable and combustible materials* and relevant legislation. ◗ When purchasing chemicals, the material safety data sheets (MSDS) should also be obtained and made available on site to personnel. Personnel handling chemicals shall be appropriately trained and provided with the necessary personal protective equipment. ◗ Chemical use should be minimised and only a practicable amount of chemicals shall be stored on site. ◗ Appropriate design measures for storage areas, such as bunding and grease traps, to be employed to prevent any spills from being released into the local environment. ◗ Appropriate handling procedures for fuels and chemicals should be developed to help prevent spills to the local environment. ◗ Fuels and chemicals should not be stored or handled in the vicinity of waterways or creeks where possible. ◗ Workforce training shall be provided for fuel and chemical handling and spill response and recovery procedures.
Performance Measures	◗ Zero fuel or chemical spills to the local environment.
Monitoring / Auditing / Reporting	◗ Audits will be conducted in accordance with the Environmental Management Program, with implementation of the recommendations and corrective actions. ◗ Monitoring on a regular basis by all staff.
Corrective Action	◗ Investigations/corrective actions undertaken as a result of the audit or regular monitoring will be documented and incorporated into this EMP. Correction actions shall be closed out by senior management according to an agreed responsibility and timescale.
Associated Documents	◗ AS 1940:1993 – *The storage and handling of flammable and combustible materials* ◗ Control of Hazardous Substances (General) ◗ Control of Hazardous Substances (Solvents & Flammables)

11. Noise and Vibration	
Goals	To ensure that noise from well construction and operation is within acceptable limits at adjacent residential premises and other noise sensitive receptors.
Responsibility	Operations Manager
Performance Objective	◗ Minimise the level and time of noise disturbance.
Mitigation Measures	◗ Local residents shall receive adequate notice of potential noise incursions. ◗ Heavy traffic use of local roads will be restricted to the hours of 6 am to 6 pm Monday to Saturday. ◗ Construction camp stores and stockpiles shall be located as far as possible from noise sensitive areas. ◗ Where practicable, excessively noisy construction activities (fraccing) shall be scheduled for periods which are less likely to result in a noise nuisance. ◗ Construction equipment shall be equipped with appropriate noise abatement devices. ◗ Noise generating equipment shall be located at appropriate distances from residences and/or will be enclosed or screened if necessary. ◗ Noise Abatement procedures will be undertaken in accordance with Section 3 of the EPP Noise 1997. ◗ If required, blasting shall be undertaken in accordance with criteria for reasonable noise from Schedule 2 of the EPP Noise 1997.
Performance Measures	◗ Zero noise related complaints received during construction.
Monitoring / Auditing / Reporting	◗ Audits will be conducted in accordance with the Environmental Management Program, with implementation of the recommendations and corrective actions. ◗ In response to noise complaints, noise monitoring will be undertaken at locations close to where the activities are occurring.
Corrective Action	◗ Investigations/corrective actions undertaken as a result of the audit or regular monitoring will be documented and incorporated into this EMP. Correction actions shall be closed out by senior management according to an agreed responsibility and timescale. ◗ Complaints received about noise and will be investigated within 24 hours and, if required, operating activities will be modified to reduce noise impacts.
Associated Documents	◗ Noise Control

12. Clearing and Grading	
Goals	To ensure successful vegetation rehabilitation through topsoil management and to minimise the impact to ecological communities from the clearing of vegetation.
Responsibility	Operations Manager
Performance Objective	◗ Minimise disturbance of flora and fauna habitats. ◗ Avoid adverse impacts on cultural and heritage sites. ◗ Optimise the success of vegetation rehabilitation. ◗ Minimise soil erosion and degradation. ◗ Minimise the risk of weeds spreading. ◗ Minimise impact on visual amenity. ◗ Minimise modification to surface water flows (drainage lines) and water quality. ◗ Minimise disruption to landholders and third parties. ◗ Minimise erosion due to disturbance of sodic soils.
Mitigation Measures	◗ Conduct searches of the EPA Contaminated Sites Register prior to construction. ◗ Known EPA Contaminated Sites to be avoided. ◗ No clearing outside of designated well and pipeline construction areas. ◗ No clearing of remnant vegetation or protected species for access tracks or temporary work space. ◗ Reduction in clearing through sensitive environments will be marked clearly on alignment sheets and in the field. ◗ Permits must be obtained prior to any clearing being conducted. ◗ Cleared vegetation will be stored (not burnt) for respreading during re-instatement. ◗ Cleared vegetation or soil is not to be pushed up against trees or stored against fencelines. ◗ Erosion control measures will be installed where appropriate to minimise topsoil loss. ◗ Topsoil depth removal will be typically be 20 – 30 cm. In areas of agricultural cropping this will be increased to 40 - 50 cm. ◗ Topsoil will be stored above the potential floodline, particularly at water courses and known flooding areas. ◗ Special consideration will be given to the handling of sodic soils to ensure that they are exposed for as short a time as practicable to minimise potential erosion impacts.
Performance Measures	◗ Topsoil and vegetation to be removed and stored appropriately to allow for successful reinstatement. ◗ No damage to flora and fauna from unapproved or unplanned vegetation clearing. ◗ Erosion control measures installed during clear and grade.
Monitoring / Auditing / Reporting	◗ Audits will be conducted in accordance with the Environmental Management Program, with implementation of the recommendations and corrective actions.

12. Clearing and Grading	
Corrective Action	◗ Investigations/corrective actions undertaken as a result of the audit or regular monitoring will be documented and incorporated into this EMP. Correction actions shall be closed out by senior management according to an agreed responsibility and timescale.
Associated Documents	◗ Right of Way Clearing & Grading

13. Drilling, Perforation and Fraccing	
Goals	To avoid impacts on the local environment, including on vegetation, soils and surface and ground water, from drilling and associated activities; and to minimise associated noise impacts and air emissions.
Responsibility	Operations Manager
Performance Objective	◗ Minimise disturbance of flora and fauna habitats. ◗ Minimise noise impacts during well construction. ◗ Minimise impacts on local soil environment from vehicle movement and pad construction. ◗ Minimise impacts on local surface waters associated with well construction. ◗ Minimise risk of contamination of groundwater.
Mitigation Measures	◗ Observance of all relevant Procedures as described above to minimise risks associated with erosion and soil stability, ground and surface water contamination, noise impacts, air emissions, waste and fuel and chemical management, and vegetation and weed management, ◗ Observance of detailed Drilling and Testing EMP, which is to be available in the Site Office.
Performance Measures	◗ Zero complaints relating to noise from local residences. ◗ No contamination of surface or ground water, or local soil environments. ◗ Successful restoration of drill pads at completion of construction activities.
Monitoring / Auditing / Reporting	◗ Audits will be conducted in accordance with the Environmental Management Program, with implementation of the recommendations and corrective actions.
Corrective Action	◗ Investigations/corrective actions undertaken as a result of the audit or regular monitoring will be documented and incorporated into this EMP. Correction actions shall be closed out by senior management according to an agreed responsibility and timescale.
Associated Documents	◗ Drilling and Testing EMP

14. Pond Construction	
Goals	To avoid impacts on the local environment, including on vegetation, soils and surface and ground water, from construction of produced water storages.
Responsibility	Operations Manager
Performance Objective	◗ Minimise impacts associated with construction of produced water ("turkey's nest") storages.
Mitigation Measures	◗ Observance of all relevant EMPs as described above to minimise risks associated with erosion and soil stability, ground and surface water contamination, noise impacts, air emissions, waste and fuel and chemical management, and vegetation and weed management, ◗ Design and construction of storages based on engineering specifications to minimise environmental impacts, including: ▪ storage capacity to take into consideration probable water production rate as well as climate conditions, in order to minimise risk of spillage; ▪ installation of geomembrane liner to eliminate leaching; ▪ inclusion of spillway to facilitate safe spillage during exceptional conditions; ▪ operational guidelines to minimise risk of spillage; and ▪ cut-and-fill construction techniques to avoid the need to import soil from other sites.
Performance Measures	◗ No soil erosion or air emissions. ◗ No contamination of surface or ground water, or local soil environments. ◗ Successful operation of water storages such that there are no spills to the environment.
Monitoring / Auditing / Reporting	◗ Audits will be conducted in accordance with the Environmental Management Program, with implementation of the recommendations and corrective actions.
Corrective Action	◗ Investigations/corrective actions undertaken as a result of the audit or regular monitoring will be documented and incorporated into this EMP. Correction actions shall be closed out by senior management according to an agreed responsibility and timescale.
Associated Documents	◗ Conceptual Design and Specifications for Produced Water Storages.

15. Trenching	
Goals	To reduce the impact of trenching on the topsoil quality, native fauna, domestic stock and agricultural production of the land.
Responsibility	Operations Manager
Performance Objective	◗ Minimise risk of topsoil and subsoil mixing. ◗ Successful rehabilitation of native vegetation and agricultural cropping. ◗ Minimise disruption to landholders and other stakeholders. ◗ Avoid damage to third party buried infrastructure.
Mitigation Measures	◗ Trenching is to be undertaken as per agreed specifications. ◗ Third Party infrastructure will be identified and accurately shown on alignment sheets and marked in the field prior to trenching. ◗ Trenching Supervisor and Superintendent will be instructed of the procedure if a previously unidentified contaminated site is uncovered during construction. This includes: – Stopping trenching at the location; – Relocation and starting trenching 50 m ahead; – Advising the Operations Manager and Land and Approvals Manager; – Instigating site assessment according to EPA; – Instigating actions according to the assessment. This may include remediation of the site or movement of the pipeline alignment to avoid the site. ◗ Trench spoil (subsoil) is to be separated from the topsoil. ◗ Subsoil will be stored above the potential floodline, particularly at water courses and known flooding areas. Erosion control measures will be installed where appropriate to minimise erosion risk. ◗ All major roads will be bored. ◗ If an open cut crossing of a road or track is necessary, consultation will be undertaken with landholders and third parties. Detours and signage will be installed as required. ◗ Where appropriate, gaps in the topsoil will be provided, and subsoil and vegetation stockpiled to assist the movement of livestock and native fauna. ◗ Where appropriate, gaps in soil stockpiles and resultant backfill mounds will be provided to mitigate the potential impact of overland flow that is not parallel to the backfill mounds. ◗ The trench will be left open for the minimum period practical. It will not be left open for extended periods on slopes leading to a watercourse or drainage line. ◗ Native fauna ramps shall be installed at the ends of trenching (at least every 1 km), and at each normal break e.g. road and water crossing.
Performance Measures	◗ Disruption to landholders and third parties to be minimised. ◗ Trench spoil (subsoil) and topsoil to be separated. ◗ Trench plugs and erosion mitigation measures implemented to reduce the risk of erosion. ◗ Ramps to be installed at trench breaks and appropriate locations.
Monitoring / Auditing /	◗ During construction, the work areas will be regularly inspected to assess the implementation of the construction mitigation management

15. Trenching	
Reporting	procedure. ◗ Audits will be conducted in accordance with the Environmental Management Program, with implementation of the recommendations and corrective actions.
Corrective Action	◗ Investigations/corrective actions undertaken as a result of the audit or regular monitoring will be documented and incorporated into this EMP. Correction actions shall be closed out by senior management according to an agreed responsibility and timescale.
Associated Documents	◗ Trenching ◗ Road Crossings Open Cut

16. Pipe Stringing and Welding	
Goals	To reduce the impact of stringing and welding on landholders and the environment.
Responsibility	Operations Manager
Performance Objective	◗ Minimise the disturbance to landholders and third parties. ◗ Minimise the risk of bushfire. ◗ Ensure that native fauna and livestock have access across the pipeline.
Mitigation Measures	◗ Trucks delivering pipe shall be scheduled during daylight hours and along designated access roads to minimise noise and dust impacts. ◗ All pipeline packaging and welding waste shall be removed from site to an approved disposal facility. ◗ When the pipe is strung, ensure gaps are left to allow access for native fauna and livestock. The gaps shall be aligned with access tracks, stored vegetation and topsoil, fences and gates. ◗ Pipeline caps shall be placed over the ends of the pipe to prevent dust and wildlife from getting in. ◗ During welding, the following pre-cautions will minimise the risk of starting bushfires: – Working area shall be cleared of vegetation; – Welding trucks shall be equipped with a fire fighting unit with adequate water storage capacity and fire extinguishers. Welding crews shall be trained in the use of the fire fighting equipment; and – Water trucks (used for dust suppression) shall be available with water storage capacity in the event of a fire.
Performance Measures	◗ Disruption to landholders and third parties is minimised. ◗ Native fauna and livestock have areas where they can cross the easement. ◗ No uncontrolled fires to be started.
Monitoring / Auditing / Reporting	◗ During construction, the work areas will be regularly inspected to access the implementation of construction mitigation management procedures. ◗ Audits will be conducted in accordance with the Environmental Management Program, with implementation of the recommendations and corrective actions.
Corrective Action	◗ Investigations/corrective actions undertaken as a result of the audit or regular monitoring will be documented and incorporated into this EMP. Correction actions shall be closed out by senior management according to an agreed responsibility and timescale.
Associated Documents	◗ Pipeline Stringing & Welding

17. Pipe laying and Backfilling	
Goals	To reduce the impact of pipe laying and backfilling on the environment.
Responsibility	Operations Manager
Performance Objective	◗ Minimise the disturbance to landholders and third parties. ◗ Minimise the risk of topsoil and subsoil mixing. ◗ Ensure that native fauna and livestock have access across the pipeline.
Mitigation Measures	◗ Erosion berms will be constructed on slopes to divert rainfall away from the alignment. ◗ Compaction over the working area will be ripped prior to re-spreading of topsoil. ◗ Trench plugs to be provided and backfilled soils compacted along the trench to prevent erosion along backfilled trench. ◗ A small crown shall be left over the backfilled trench to allow for settling. Breaks of the crown shall be provided to allow for water flow across the alignment at regular points. These breaks shall be determined using the overland flowpaths developed by the relevant authority. ◗ Pipeline markers will be installed according to land use to locate the pipeline. ◗ Topsoil will only be respread over the working area following the backfilling of all subsoil. Topsoil will not be used as padding material. ◗ In areas of particularly sodic soil, special precautions will be taken to ensure that topsoil and sodic subsoil is not mixed. In addition, these areas will be backfilled at a quicker rate to ensure minimal exposure time for highly erodible soils. Sodic soils will be placed at the base of the trench to further limit exposure. ◗ Obvious low-lying floodways will be identified during the pipeline route survey process to identify those areas requiring a management of floodway strategy to be developed and applied in order to mitigate potential erosion impacts. ◗ At the start of each day, any exposed trench shall be inspected for the presence of wildlife and, if found, it should be appropriately removed. ◗ The ends of exposed pipe shall be sealed at the end of each day. ◗ At the end of each day, no extensive lengths of trench shall be left exposed.
Performance Measures	◗ Subsoil returned to the trench prior to topsoil. ◗ Appropriate erosion berms to be installed on sloped areas.
Monitoring / Auditing / Reporting	◗ During construction, the work areas will be regularly inspected to access the implementation of construction mitigation management procedures. ◗ Audits will be conducted in accordance with the Environmental Management Program, with implementation of the recommendations and corrective actions.
Corrective Action	◗ Investigations/corrective actions undertaken as a result of the audit or regular monitoring will be documented and incorporated into this EMP. Correction actions shall be closed out by senior management according to an agreed responsibility and timescale.
Associated Documents	◗ Pipeline Laying & Backfilling ◗ Backfill & Reinstatement Gas Pipelines

18. Hydrotesting	
Goals	To minimise all impacts associated with hydrostatic testing on the surrounding soil and water environments.
Responsibility	Operations Manager
Performance Objective	◗ Minimise impacts to soils, groundwater and general water quality. ◗ Minimise the amount of water used. ◗ Minimise the risk of soil erosion.
Mitigation Measures	◗ If water quality is sufficient, water will be sourced from existing storages within the production field. ◗ If another source of water is required, it shall be approved in advance by the Environment and Land Manager. ◗ All permits to source water shall be approved in advance. ◗ Biodegradable biocides shall be selected where possible. ◗ Ensure there is no damage from discharge of the water. ◗ All additional approvals from landholders and for water disposal options. ◗ Where sufficient water is not available it will be trucked in as required. ◗ Water quality testing procedures and values will be approved prior to discharge by the Environment and Land Manager. ◗ Prior to discharge, the Land and Approvals Manager shall be consulted about the water quality and testing required, and consult with Council and relevant authorities. ◗ Discharge hydrotest water to land to avoid runoff to creeks, agricultural drainage lines, erosion or flooding. At the discharge point materials shall be used to reduce the force and to dissipate the water to avoid soil erosion.
Performance Measures	◗ Testing Procedures will be in accordance with AS 2885. ◗ Discharge will be within all regulatory and landholder requirements.
Monitoring / Auditing / Reporting	◗ Monitor test water discharges from the site to ensure compliance with water standards. ◗ During construction, the work areas will be regularly inspected to access the implementation of construction mitigation management procedures. ◗ Audits will be conducted in accordance with the Environmental Management Program, with implementation of the recommendations and corrective actions.
Corrective Action	◗ Should the disposal of hydro-test waters fail to meet the performance criteria the Construction Contractor will review disposal options. ◗ Investigations/corrective actions undertaken as a result of the audit or regular monitoring will be documented and incorporated into this EMP. Correction actions shall be closed out by senior management according to an agreed responsibility and timescale.
Associated Documents	◗ Pipeline Testing & Commissioning

19. Clean Up and Rehabilitation	
Goals	To rehabilitate all disturbed areas to a land use capability compatible with the surrounding land use. Any rehabilitation will utilise all actable methods to ensure that a stable land form is reinstated.
Responsibility	Land and Approvals Manager
Performance Objective	◗ Minimise loss of vegetation and habitat; ◗ Minimise erosion and sediment runoff; ◗ Minimise the risk of subsidence; ◗ Minimise the loss of visual amenity; ◗ Minimise the modification of drainage patterns; and ◗ Minimise the damage to any infrastructure.
Mitigation Measures	◗ Minor surface roughness will be encouraged when spreading topsoil to trap water and seed. ◗ Other cleared vegetation will be removed and disposed of in consultation with the appropriate landholder or respread over cleared areas to assist in seed distribution and provide shelter for fauna. ◗ Areas affected by operations and development will be re-profiled to original and stable contours, re-establishing surface drainage lines and other land features. ◗ Erosion and sediment controls will be installed if necessary. Existing soil erosion measures will be reinstated to a condition at least equal to the pre-existing state. ◗ Above-ground infrastructure shall be fenced to discourage third party, stock and wildlife entry. ◗ Signs, fences or other barriers shall be installed where appropriate to prevent unauthorised easement access. ◗ Permanent pipeline warning signs shall be erected along easements. ◗ In general, revegetation will occur through the re-spreading of cleared topsoil and vegetation. Active revegetation will only occur where stabilisation is required to prevent erosion. ◗ Where active revegetation is required, local native species will be selected in preference to introduced. ◗ In other areas where seeding or replanting is required, the seed mix will be agreed with the relevant land holder. ◗ Environmental features such as rocks and dead timber will be replaced in cleared areas as appropriate. ◗ Trees will be permitted to grow within 3m of the pipeline as long as: – pipeline integrity is not affected; – regrowth is considered; and – signage remains visible.
Performance Measures	◗ Land and infrastructure affected by the planning, construction and post construction phases will be restored to pre-disturbance status or better. ◗ No new weed species to be introduced. ◗ Revegetation shall return areas to similar composition as surrounding vegetation. ◗ Drainage patterns returned following construction.

19. Clean Up and Rehabilitation	
Monitoring / Auditing / Reporting	◗ Audits will be conducted in accordance with the Environmental Management Program, with implementation of the recommendations and corrective actions. ◗ Monitoring on a regular basis by all staff.
Corrective Action	◗ Investigations/corrective actions undertaken as a result of the audit or regular monitoring will be documented and incorporated into this EMP. Correction actions shall be closed out by senior management according to an agreed responsibility and timescale. ◗ Investigate complaints and take all steps to restore area according to land holder requirements.
Associated Documents	◗ Site Clean Up & Clearance ◗ Pipeline Clean Up & Rehabilitation