



Review of Environmental Factors

Goran South I Core Hole – PEL I, Gunnedah Basin

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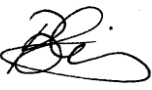
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REF Prepared by:	Belinda Lewis RPS Level 12 92 Pitt Street Sydney NSW 2000 Position: Senior Planner Qualifications: B Env Sci (Hons) Signature:  Date: 5 October 2011
Application Subject Land Address	Goran South 1 Core Hole Land titles comprise the following: Lot 28 DP 755500
Titleholder Declaration (Joint Titleholder)	As joint titleholder I declare that the information contained in this Review of Environmental Factors is neither false nor misleading. Name: Santos QNT Pty Ltd (as joint title holder declaration) Signature: Date:

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Appendix B:	Santos Drill Rig Noise Assessment, prepared by Heggies (now SLR)
Appendix C:	Aboriginal Heritage Due Diligence Assessment, prepared by RPS
Appendix D:	Core Hole Design, prepared by Santos
Appendix E:	Advice on Flood Levels, prepared by RPS Aquaterra
Appendix F:	Environmental Management Plan, prepared by RPS

Executive Summary

Overview

RPS has prepared this Review of Environmental Factors (REF) on behalf of Santos QNT Pty Ltd (Santos) as Operator for and on behalf of the titleholder to assess the environmental impact of the proposed drilling of a core hole and ancillary activities within a property known as “Boenery Park” in the Gunnedah Basin. The purpose of the proposal is to investigate the potential coal seam gas resource within Petroleum Exploration Licence No. 1 (PEL 1).

The proposal includes the drilling of “Goran South 1” as a core hole within the Goran South lease area to obtain information on coal depths, seam thickness, continuity and permeability at a site referred to as “Goran South 1”. In summary, the process involves:

- preparation of lease access tracks utilising existing access tracks with minor improvements and construction of new track;
- preparation of a level drill pad (also referred to as “well lease area”);
- placement of a drilling rig and ancillary equipment at the well lease;
- drilling of the core hole;
- collection and analysis of drill core;
- conduct well testing and wireline logging (as required);
- plugging and abandonment of the well including suspension of steel casing over mineable coal seams (as required);
- removal of equipment and imported materials and the rehabilitation of the site; and
- rehabilitation of the site in line with legislative and landholder requirements.

There will be 14 days of lease construction activities and the drilling of the core hole well is expected to occur over a 56 day period. Rehabilitation activities will take 30 days following the drilling of the well.

The following technical investigations have been prepared to assist in the preparation of this REF:

- Ecological Assessment, prepared by RPS
- Santos Drill Rig Noise Assessment, prepared by Heggies (now SLR)
- Aboriginal Heritage Due Diligence Report, prepared by RPS
- Advice on Lake Goran Flood Levels, prepared by RPS Aquaterra

Consideration has also been given to a broader range of environmental impacts, including air, surface water, soils, chemical and hazardous substances management, contaminated land, waste minimisation and management, natural resources, local community and neighbouring properties, visual impacts, land use and cumulative environmental effects.

Environmental Impacts

Ecology

An ecological assessment has been prepared by RPS for the proposal, which has guided the location of the well leases and assessed the impact of the proposal on the ecological values of the site. The ecological assessment is presented in **Appendix A**.

Two communities listed under the *Threatened Species Conservation Act 1995* (TSC Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) occur across the property, White Box - Yellow Box - Blakely's Red Gum Woodland and Derived Native Grasslands, and Weeping Myall Woodland. However, the proposed core hole lease has been located within an area that is not commensurate with either community. The core hole lease has been selected as it is of low ecological value, due to intensive grazing and selective clearing. The proposed well lease is void of canopy vegetation, and consists of disturbed ground covers, including weeds.

Access to the well lease is predominantly along existing access tracks. The existing access track is located within an area of White Box – Yellow Box – Blakely's Red Gum Woodland, however no widening of this portion of the track will be required. Construction of approximately 1500m of new access track will be required. While Weeping Myall occurs adjacent to the proposed access track location, the track has been located to avoid all canopy vegetation. The new access track will be located in areas that is comprised of disturbed grassland vegetation only. As such, minimal disturbances are expected to arise from the access track.

No threatened flora species listed under the TSC Act and/or EPBC Act were identified as occurring within the well lease or access tracks. Two Class 4 noxious weeds, Prickly Pear and African Boxthorn, were recorded in the study area during the pre-clearance survey. Additionally, Noogoora Burr is known to occur on the property.

Woodland adjacent to the existing access track and proposed new access track, is considered to provide potential suitable marginal habitat to support several listed threatened species. Additionally, Koala scats were observed in this area, however the proposed well lease does not comprise suitable habitat resources to support these listed species.

The potential direct and indirect impacts that may be associated with the proposal are considered to be minimal. A range of mitigation and management measures have been identified, to minimise potential indirect ecological impacts. No significant impact on the White Box - Yellow Box - Blakely's Red Gum Woodland or Weeping Myall Woodland will occur as a result of the proposed activity.

Matters of National Significance

Pursuant to the EPBC Act, an assessment of potential impacts arising from the proposal on matters of national environmental significance (MNES) has been undertaken. The assessment has concluded that no significant impact is likely to relevant MNES.

Heritage

An Aboriginal Heritage Due Diligence Report has been prepared by RPS (**Appendix C**). As part of the due diligence investigation, RPS undertook a desktop review of the environmental and archaeological contexts of the project area, including an analysis of the landscape surrounding the project area, a review of prior archaeological investigations and a search of the Office of Environment and Heritage's (OEH's) Aboriginal Heritage Information Management System (AHIMS) database. That search showed a total of 19 previously recorded sites within 10km of the proposed core hole location. The most common site identified was scarred/modified trees. A site inspection was also conducted. As a result of the desktop study and site inspection, it was concluded that there were no archaeological constraints to the drilling of the core hole.

Regarding other cultural heritage, there are no items of heritage significance listed as occurring on the subject site in either the Gunnedah LEP 1998 or on the NSW State Heritage Register.

Potential impacts associated with any unknown Aboriginal sites or objects or any items of European cultural heritage significance can be appropriately managed with the mitigation measures specified in the REF.

Groundwater

Due to the type of drilling activity proposed, associated water from the targeted coal seams is not anticipated to be lifted.

There is some potential for groundwater contamination due to spills of fuels and chemicals, however this can be adequately managed through implementation of appropriate mitigation measures. Cross contamination of groundwater from drilling fluid will be avoided because the core hole will be plugged and abandoned with permanent casing installed across the shallowest formations in accordance with regulatory requirements and specific well design.

Air

The air emissions associated with the proposal will be dust from drilling and the transportation of equipment and greenhouse gases from construction traffic, plant and site power generation.

To minimise impacts on air quality access tracks are to be maintained in a compacted state, land disturbance areas are to be minimised and slow speed restrictions will be enforced on internal site access tracks.

Noise

Temporary noise generation will occur as a result of the construction, drilling and rehabilitation of the core hole. This is likely to occur over approximately 14 days for construction, 56 days for drilling and 30 days for rehabilitation. The closest residence is approximately 2.5km from the proposed core hole. Based on a generic noise assessment undertaken by Heggies (now SLR) for the relevant drill rig to be used in the proposal, noise levels at the residence are anticipated to be negligible and well within guideline levels.

Mitigation of impacts will be through appropriate community consultation and complaints handling.

Surface Water

Lake Goran (also known as Goran Lake) is located to the south of the site. The lake is ephemeral, with water levels fluctuating throughout the year and is identified as a nationally important wetland (however is not listed as a RAMSAR wetland). The well lease is approximately 1.5km from the highest water level of the lake.

Given the site is located a significant distance from Lake Goran, it is unlikely that the proposed activities to will impact on the surface water quality of the lake. It is considered that the potential impacts associated with surface water can be appropriately managed if the mitigation measures identified in the REF are implemented. These include the handling and storage of fluids, fuels and waste water and the installation of sediment fences and traps.

Soils

The proposed activities will involve earthworks within a defined footprint for the installation of temporary infrastructure and the well lease and upgrading/new areas of track. There is a potential risk for soil erosion to occur resulting in sediment transport to Lake Goran. The use of existing access tracks and the selection of level or gently sloping sites will minimise the disturbance footprint of the exploration activities.

Any topsoil will be stripped and stockpiled and topsoil to be reinstated as part of the rehabilitation process. No soil is proposed to be removed from the site.

Once the drilling and testing activities are complete, the disturbed area will be rehabilitated with appropriate mitigation measures and environmental safeguards implemented to minimise potential impacts. Erosion and

sediment control measures will be implemented. To reduce the risk of soil contamination, measures to be implemented include the provision of spill kits; storage, handling, use and disposal of potential contaminants in accordance with the stipulations of the relevant Materials Safety Data Sheet (MSDS) and containment of fluids. Any soil that becomes contaminated through contact with drilling fluids, fuels, or lubricants will be removed from the site and disposed of at an appropriate licensed disposal facility.

Chemical and Hazardous Substance Management

The drilling operations would generally only use chemicals such as drilling fluids/agents, fuels, and lubricants. While these substances are not considered highly hazardous, there is still the potential risk of fire and pollution to land, water and air, if an accidental spillage was to occur. The *Occupational Health and Safety Act 2000* and the *Protection of the Environment Operations Act 1997* are the legislative Acts that regulate the use of dangerous goods. The *Dangerous Goods (Road and Rail Transport) Act 2008* regulates the transport of dangerous goods. These Acts would be adhered with through all operations for the proposal.

Any spills of chemicals used during drilling operations would be managed by applying best practice principles, be in accordance with all legislation and standards for the safe handling and storage of hazardous substances and dangerous goods and comply with all occupational health and safety requirements. Any contaminated soil shall be removed from the drill location and disposed of at an appropriate licensed facility.

Contaminated Land

Based upon the history of the locations and the minimal impact to site soils during operations, land contamination issues are considered to be minimal for the proposed activity.

It is considered that the potential impacts associated with contamination can be appropriately managed if the mitigation measures set out for surface water, soils and chemical and hazardous substances management are implemented.

Waste Minimisation and Management

Drill cuttings and some general site operations waste will be produced as part of the proposed drilling operations. Any solvents, oils and other general waste would need to be managed in an appropriate manner to avoid health risks and contamination of land and waterways. As previously stated, following drilling and removal of excess drilling fluid from the sump, dried cuttings are removed and transported to an appropriate licensed waste facility.

A regular service of amenities will be conducted and waste is to be removed to a licensed facility.

Mitigation measures include a general waste management strategy based upon the principles of reduce, reuse and recycling; a specific Site Waste Management Plan for drilling activities; all staff and contractors are to be made aware of waste management procedures during induction; appropriate waste containers provided on site; any waste generated is to be disposed of in an appropriate manner in accordance with relevant standards and guidelines; spills of waste material shall be dealt with in a prompt and thorough manner, and reported to the appropriate authority if necessary; general refuse shall be collected and transported to an approved recycling or disposal site; onsite waste disposal is prohibited; and hazardous waste shall be managed in accordance with existing guidelines and standards.

Natural Resource Use

The key natural resources that would be affected by the proposed drilling operations are agricultural land resources and fuels for the drilling equipment and transportation of staff. A relatively minor proportion of the overall area of the property would be taken from agricultural use during the duration of works, approximately 70 days for construction and drilling and 30 days for rehabilitation. The disturbed areas will be rehabilitated by returning them to at least their pre-operational state or to a condition agreed by the landholder. Therefore, there would be a temporary loss of the use of this agricultural land in agreement with the landholder and, in the context of the total agricultural land holding and the wider agricultural uses of the region, is of minimal significance.

Fuels will be used for equipment and also for works and staff vehicles although this is not likely to be a significant quantity of fuel use. However, the fuel should be used as efficiently as possible through appropriate work behaviour (e.g. switching off equipment when not in use).

Local Community and Neighbouring Properties

Santos is committed to providing ongoing information on activities with key stakeholders prior to work starting and for the duration of their presence in the region.

The nearest residential dwelling is approximately 2.5km to the east of the site. The closest community is the township of Curlewis which is approximately 17km to the north east of the site.

The effect associated with the temporary loss of the agricultural use of the land is outlined above. Santos has secured access to the location and is finalising execution of a landowner agreement as required under the *Petroleum (Onshore) Act 1991*. This will address land access conditions, compensation and rehabilitation. The landholder will therefore experience the effects of the temporary loss of the use of approximately 13,200m² of land and associated effects such as disturbance to current farming activities, stock and flora and fauna.

Drilling will be undertaken on a 24 hour basis and measures to mitigate noise are identified. There is not anticipated to be a significant visual impact because the activities are temporary.

In order to minimise impacts on landholders, mitigation measures include ongoing landholder and stakeholder consultation; responding promptly to any community concerns or complaints; informing the community promptly of any changes to timing or scheduling which will have an adverse impact on them.

Visual Assessment

The operations are temporary in nature, with a duration of approximately 70 days of construction and drilling and 30 days of rehabilitation, and all equipment will be removed on completion of site activities. The closest residence is approximately 2.5km away. Following completion of the works all sites will be rehabilitated and would not detract from the overall scenic qualities of the area.

No significant impacts on the visual amenity of the area are expected from the proposed drilling.

Land Use

There will be a temporary loss of approximately 13,200m² the agricultural use of the land at the site. During the works, new fencing and a gate will be erected to allow for the movement of the landowners livestock and minimise disruption to the landholder.

The site is located within PEL 1, which has overlapping coal tenures. There are no known coal mining operations planned for this site, however the wells are designed such that they will pose no threat or hazard to future coal mining.

Cumulative Environmental Impacts

There will be no cumulative impacts associated with the proposal. There is only 1 well (Lake Goran 1) located within a 10km radius of the proposed well lease. It is plugged and abandoned.

Conclusion

This REF has been prepared in accordance with Clause 228 of the *Environmental Planning and Assessment Regulation 2000* and provides consideration of the environmental impact of the proposed works as required by Section 111 of the *Environmental Planning and Assessment Act 1979*. The proposal comprises temporary, small scale works of a short term duration. The REF has identified that the proposed core hole and associated activities is not likely to significantly affect the environment or threatened species, populations or ecological communities or their habitats.

1.0 Introduction

1.1 Background

RPS has prepared this Review of Environmental Factors (REF) on behalf of Santos QNT Pty Ltd (Santos) as Operator for and on behalf of the titleholders to assess the environmental impacts of the proposed drilling of a core hole and ancillary activities within a property known as “Boenery Park” in the Gunnedah Basin. The purpose of the proposal is to investigate the potential coal seam gas resource within Petroleum Exploration Licence No. 1 (PEL 1).

In accordance with the Petroleum Exploration Licence Conditions issued for PEL 1 under Part 3 of the *Petroleum (Onshore) Act 1991*, petroleum exploration holes are classified as a Category 3 activity. A Category 3 activity requires notification of the activity to an Environmental Officer of the Department of Primary Industries (DPI) – Mineral Resources (Department of Trade & Investment, Regional Infrastructure and Services) and in most circumstances, a specific determination of the proposal under Part 5 of the *Environmental Planning and Assessment Act 1979*.

This REF has been prepared in accordance with Clause 228 of the *Environmental Planning and Assessment Regulation 2000* and provides consideration of the environmental impact of the proposed works as required by Section 111 of the *Environmental Planning and Assessment Act 1979*.

1.2 Technical Investigations

The following technical investigations have been prepared to assist in the preparation of this REF:

- Ecological Assessment, prepared by RPS
- Aboriginal Heritage Due Diligence Report, prepared by RPS
- Santos Drill Rig Noise Assessment, prepared by Heggies (now SLR)
- Advice on Lake Goran Flood Levels, prepared by RPS Aquaterra.

1.3 Structure of REF

This REF comprises the following:

- Section 1 introduces the proposal and provides an overview of the REF.
- Section 2 provides an overview of the site, locality and key site features.
- Section 3 provides a detailed description of the activities to be undertaken as part of the proposal.
- Section 4 discusses the relevant planning legislation associated with the proposal.
- Section 5 considers the likely environmental impacts of the proposal and proposed mitigation measures to ensure these impacts are appropriately managed.
- Section 6 concludes the REF.

2.0 Site Description and Context

2.1 Location and description

The site is located within Petroleum Exploration Licence (PEL) 1. PEL 1 is located within the Gunnedah region. It overlays three local government areas: Narrabri, Gunnedah and Liverpool Plains. The proposed activities are located solely within the Gunnedah LGA (refer Figure 2-1 and Figure 2-2). The region has been used extensively for agricultural activities since the 1830s. Agricultural activities include mixed farming of sheep, cattle and grain crops with a gradually larger reliance on cattle.

The proposed works are to be undertaken at the property known as “Boenery Park”. Boenery Park is located at 1349 Voca Road, Curlewis which is approximately 17km to the south west of the township of Curlewis. Curlewis is located approximately 15km to the south of Gunnedah and approximately 25km to the north west of Breeza (Figure 2-3).

The proposed core hole, identified as Goran South 1, is located within the north western corner of Lot 28 in DP 755500 (refer Figure 2-4). Lot 28 comprises an area of approximately 64ha. Part of the access tracks to be utilised on the property are “paper roads” which the landowner is in the process of purchasing. The purchase of these roads is expected to be finalised prior to operations commencing.

References to “the site” throughout this REF include both the well lease and access track.

There are no structures located within the subject lots.

The coordinates of the Goran South 1 core hole are detailed in the following table.

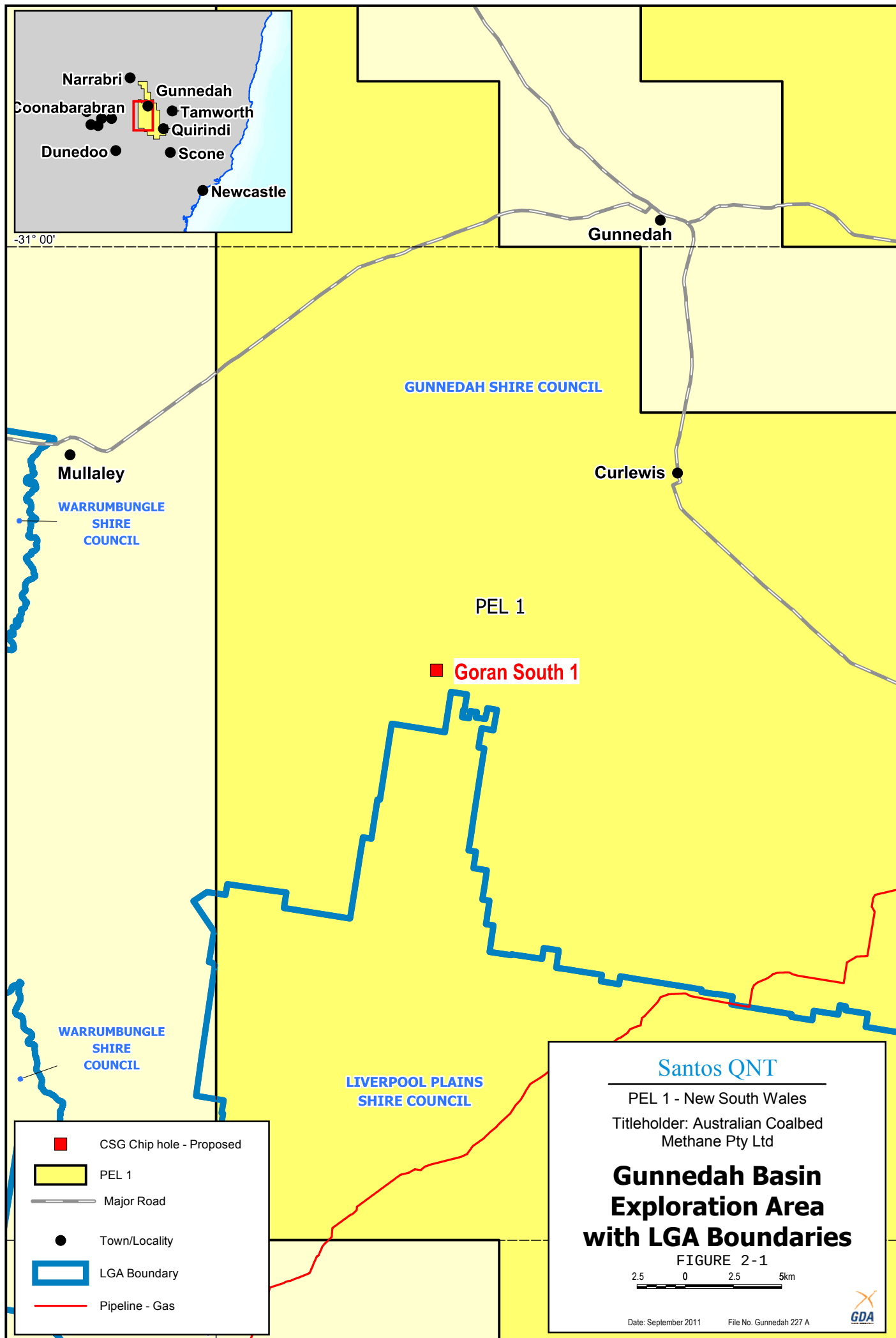
Table 2-1 Coordinates (GDA94) for Goran South 1

Name	Latitude	Longitude
Goran South 1	-31° 12' 47.16"	150° 7' 47.2404"

As shown in Plates 2-1 to 2-9, the core hole is located within a part of the Boenery Park property that is currently used for grazing. It is surrounded by other grazing and cropping lands. Lake Goran (also known as Lake Goran) lies approximately 1.5km to the southeast of the proposed well lease (based on high water level of lake). The well lease is devoid of any trees and does not contain any structures. It is in poor condition and currently provides limited ecological function.

2.2 Topography

The Breeza topographic map (89352N) shows the project area to be on flat to gently undulating land, within 1.5km of the high water mark of Lake Goran. Slopes are generally 0-3% with local relief at <3m, as shown in Figure 2-5.





Santos QNT

PEL 1 - New South Wales
Titleholder: Australian Coalbed
Methane Pty Ltd

Gunnedah Basin Area of Interest

FIGURE 2-2

2.5 0 2.5 5km

Date: September 2011

File No. Gunnedah 227 C

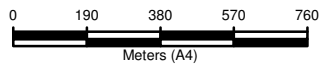




Legend

Indicative Study Area

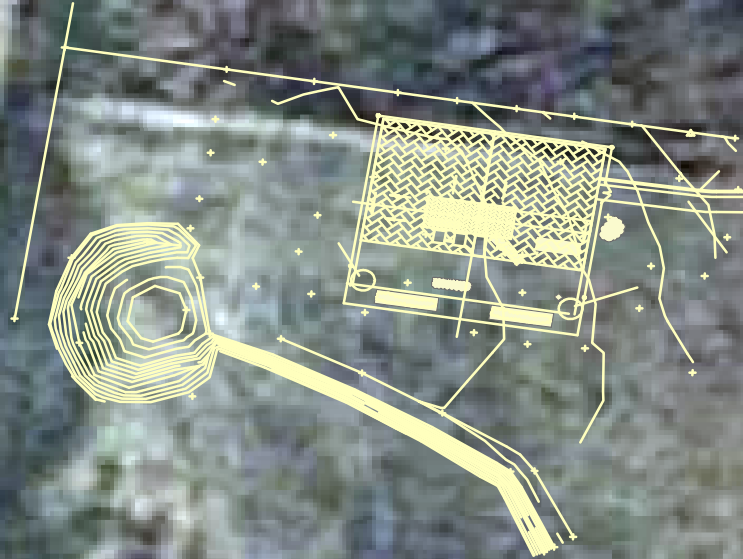
AERIAL PHOTOGRAPHY:
The aerial photography used in this plan has not been rectified.
The image has been overlaid as a best fit on the boundaries shown and position is approximate only.



Project Manager
BD
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HR
Map Projection
MGAz56
Map Datum
GDA94
File Reference
PR107872.mxd
Sheet Number
1 of 1

Client
Santos QNT Pty Ltd
Title
Figure 2.3 Aerial Photo & Location Goran South 1

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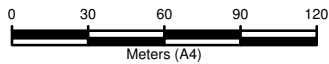


Legend

- Indicative Study Area
- Site Layout
- Existing Track
- Existing Track - Gravel Top
- New Track



AERIAL PHOTOGRAPHY
The aerial photography used in this plan has not been rectified.
The image has been overlaid as a best fit on the boundaries shown and position is approximate only.



Project Manager	BD
Compiled by	HR
Map Projection	MGaz56
Map Datum	GDA94
File Reference	PR107872.mxd
Sheet Number	1 of 1

Client

Santos QNT Pty Ltd

Title

Figure 2.4 Site Layout
Goran South 1

RPS

SCALE (A4)	DATE	DRAWING NO.	ISSUE
1:2,982	07/06/2011	PR107872-1	1

The following photographs illustrate subject site.



Plate 2-1 View west along route of proposed access track to well lease



Plate 2-2 View south along route of proposed access track



Plate 2-3 View east along proposed access track from well lease



Plate 2-4 View south across proposed well lease



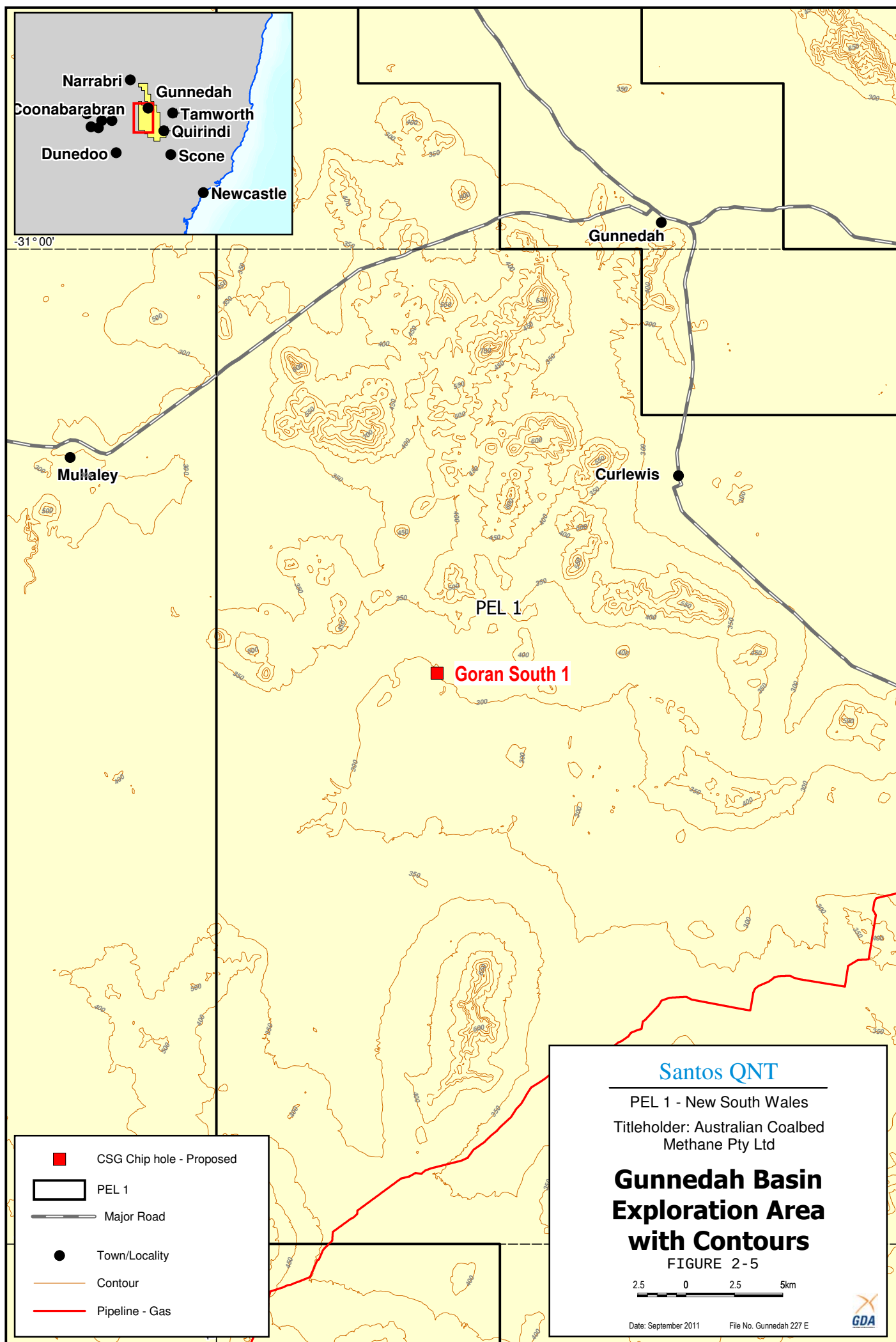
Plate 2-5 View north across proposed well lease



Plate 2-6 View east along route of proposed access track



Plate 2-7 View east across proposed well lease



2.3 Flora and Fauna

2.3.1 Flora

The subject site (i.e. the well lease and proposed access track) is comprised of grazed grasslands and is highly disturbed due to historical land management practices. RPS has undertaken an Ecological Assessment for the site and surrounds, which included a desktop assessment and a pre-clearance assessment of the proposed lease area and tracks. A copy of this report is included at **Appendix A**.

The study area for the assessment was limited to the area surrounding the proposed well lease and the proposed access tracks. The majority of the study area is comprised of grazing land, and is largely cleared of native vegetation communities.

Three vegetation communities were observed within the study area, including:

- Grazed Grasslands within the well lease;
- Weeping Myall (*Acacia pendula*) Woodland adjacent the proposed access track; and
- White Box (*Eucalyptus albens*) – Yellow Box (*E. melanophloia*) Woodland adjacent the existing access track.

While the proposed well lease is located within highly disturbed grazing land, vegetation adjacent to the proposed access track comprises Acacia and Eucalypt Woodland communities. The latter two communities are listed as threatened ecological communities under both the EPBC Act and TSC Act. The lease area is devoid of canopy and shrub species due to the current land management practices and no threatened flora species listed under the TSC Act and/or EPBC Act were identified as occurring within the well lease or access tracks.

Two Class 4 noxious weeds, Prickly Pear and African Boxthorn, were recorded in the study area during the pre-clearance survey. Additionally, Noogoora Burr is known to occur on the property.

2.3.2 Fauna

The study area includes areas of Eucalypt and Acacia woodland, primarily located adjacent to the existing and proposed access tracks. Additionally, stands of Acacia woodland occur throughout the study area. Mature eucalypts with hollows are common within this habitat type, and provide a breeding habitat for numerous native birds and mammals. This habitat type also provides foraging opportunities for a range of birds, mammals and reptiles. A range of birds were observed utilising this habitat, including Torresian Crow (*Corvus orru*), Australasian Pipit (*Anthus novaeseelandiae*), Apostle Bird (*Struthidea cinerea*), Galah (*Eolophus roseicapilla*), Laughing Kookaburra (*Dacelo novaeguineae*), White-Winged Chough (*Corcorax melanorhamphos*) and Red-Rumped Parrot (*Psephotus haematonotus*) as well as a Frill-neck Lizard (*Chlamydosaurus kingii*). Additionally, Koala (*Phascolarctos cinereus*) scat was observed under White Box and Bimble Box across the study area.

The study area is dominated by grassy grazing paddocks that have been historically cleared to facilitate the current land use. These areas are heavily grazed, and comprise of native and introduced grasses. While no canopy vegetation occurs in this area, it is considered to provide foraging resources for a range of species, including birds, macropods and reptiles. Fauna observed in this area was limited to generalist bird species such as Torresian Crow, Australian Magpie (*Cracticus tibicen*), and White-faced Heron (*Egretta novaehollandiae*).

Lake Goran to the south of the site is highly ephemeral and when at capacity, is considered to provide a range of habitat resources, including breeding habitat for a variety of amphibians, reptiles and birds. This area also provides potential habitat for an array of migratory species and water birds. It is likely that species utilising Lake Goran may occasionally utilise the study area for foraging purposes.

The study area is largely isolated from tracts of remnant vegetation, however scattered stands of vegetation provide stepping stone connectivity to Goran State Forest.

2.4 Water Resources

2.4.1 Surface Water

The permit PEL 1 overlies the Namoi catchment management area. The Namoi Catchment in northwest NSW is bounded by the Great Dividing Range in the east, the Liverpool Ranges and Warrumbungle Ranges in the south, and the Nandewar Ranges and Mt. Kaputar to the north. Major tributaries of the Namoi River include Coxs Creek and the Mooki, Peel, Cockburn, Manilla, and Macdonald Rivers, all of which join the Namoi upstream of Boggabri (Figure 2-6). Stretching from Woolbrook in the east to Walgett on the western boundary the catchment is over 350 kilometres long (NCMA 2011).

The subject site is located in the Goran sub-catchment. Goran sub-catchment comprises an area of 590km² with elevations ranging from 680m on Coolanbilla Mountain to 300m within Lake Goran. Landscapes within this sub-catchment range from floodplains to broad gentle inclined foot slopes. The significant feature of this area is Lake Goran which is a wetland located in centre of the sub-catchment, covering an area of approximately 8,200ha when full. Yarraman Creek, Hut Gully and Coomoo Coomoo Creek drain into Lake Goran which then drains via Native Dog Gully into the Mooki River near Breeza. Lake Goran is largely an inland drainage feature and surface water does not leave the area except during flooding or above average periods of rainfall when lake levels exceed its nominal “full level” at 296.4m AHD (this is some 0.15m below the elevation of the proposed drill platform). Further information is outlined in **Appendix E**.

The issues within the sub-catchment include flooding, soil erosion, high watertables and salinity hazard in some areas.

2.4.2 Groundwater

There are a total of 700 licence holders in the Namoi Catchment. The groundwater sources include all water contained in the unconsolidated alluvial sediment aquifers associated with the Namoi River and its tributaries.

The main aquifers in the area of the proposed core hole are associated with both the shallow alluvium and those occurring in the underlying basement rock units.

The Gunnedah Basin is divided into Groundwater Management Areas (GMAs), which each correspond to a different hydrogeological system. The well lease is within the Gunnedah Basin GMA (GMA604).

The target CSG bearing formations for this proposal are the Permian coals of the Black Jack Group (Hoskissons Coal). Other bores completed within the Black Jack Group have water levels between 10 and 16m below ground level. The aquifers of the Black Jack Group are low yielding with two bores indicating a yield of approximately 1 litre per second.

There are three licensed bores and three registered piezometers within a 3km radius of the proposed well lease. The most dominant groundwater use in the area is for domestic and stock water.



2.5 Heritage

2.5.1 Aboriginal heritage

An Aboriginal Heritage Due Diligence Report has been prepared over the site by RPS (**Appendix C**). As part of the due diligence investigation, RPS undertook a desktop review of the environmental and archaeological contexts of the site, including an analysis of the landscape surrounding the site, a review of prior archaeological investigations and a search of the Office of Environment and Heritage's (OEH) Aboriginal Heritage Information Management System (AHIMS) database. That search showed a total of 19 previously recorded sites within 10km of the proposed well lease. The most common site identified was scarred/modified trees.

A site inspection by RPS and a Santos Cultural Heritage Officer was also conducted on 23 August 2011. Given that there were no mature trees, no stone outcropping, no overhangs or rocky shelters, no sandstone nor any other discernible landform feature or environmental resource suitable for Aboriginal exploitation or occupation, the report concluded that it is highly unlikely that the proposed core hole would have any ability to harm Aboriginal cultural heritage or material items. The archaeological field survey identified no Aboriginal material at risk of impact from the proposed works.

An area exceeding the core hole footprint was assessed for the purposes of due diligence and included areas likely to undergo modification during drilling works, proposed access routes to the drill locations and turning circles for vehicles. The proposed core hole was not situated close to known cultural heritage sites. There was no evidence of any Aboriginal artefacts at the core hole location or along the proposed core hole access track; therefore it is considered that there is no impediment for work for the proposed drilling programme to proceed at the proposed core hole locations investigated in this report.

The proposed core hole was positioned in a highly modified landform. As such, any core hole works undertaken in this location meets the low impact activity criteria under the *National Parks and Wildlife Service NSW 2009* and described in Section 7.5 of the NSW Department of Environment, Climate Change and Water (DECCW) *2010 Due Diligence Code of Practice for the protection of Aboriginal Objects in NSW*.

No Aboriginal or European Cultural Heritage sites were identified at the core hole location inspected during the course of the archaeological survey. As such no archaeological constraints apply to the proposed drilling within the bounds of the drilling footprints at the core hole location.

As a result of the desktop study and site inspection, it was concluded that there were no archaeological constraints to the drilling of the core hole.

2.5.2 Other heritage

As stated above, no European cultural heritage sites were identified during the site inspection.

There are no items of heritage significance listed as occurring on the subject site in either the Gunnedah LEP 1998 or on the NSW State Heritage Register. A number of items of local and State heritage significance were recorded as occurring within the Gunnedah Local Government Area, however these are not located in close proximity to the subject site.

Four sites within the Gunnedah LGA are listed on the Commonwealth Register of National Estate, however none of these are on the subject site.

2.6 Environmentally Sensitive Areas

The subject site is not identified as occurring within an Environmentally Sensitive Area (refer

Table 2-2) however Lake Goran is located approximately 1.5km south of the site (to the highest water level). It is listed as a nationally significant wetland in the '*Directory of important wetlands in Australia*', however it is not listed as a Ramsar wetland.

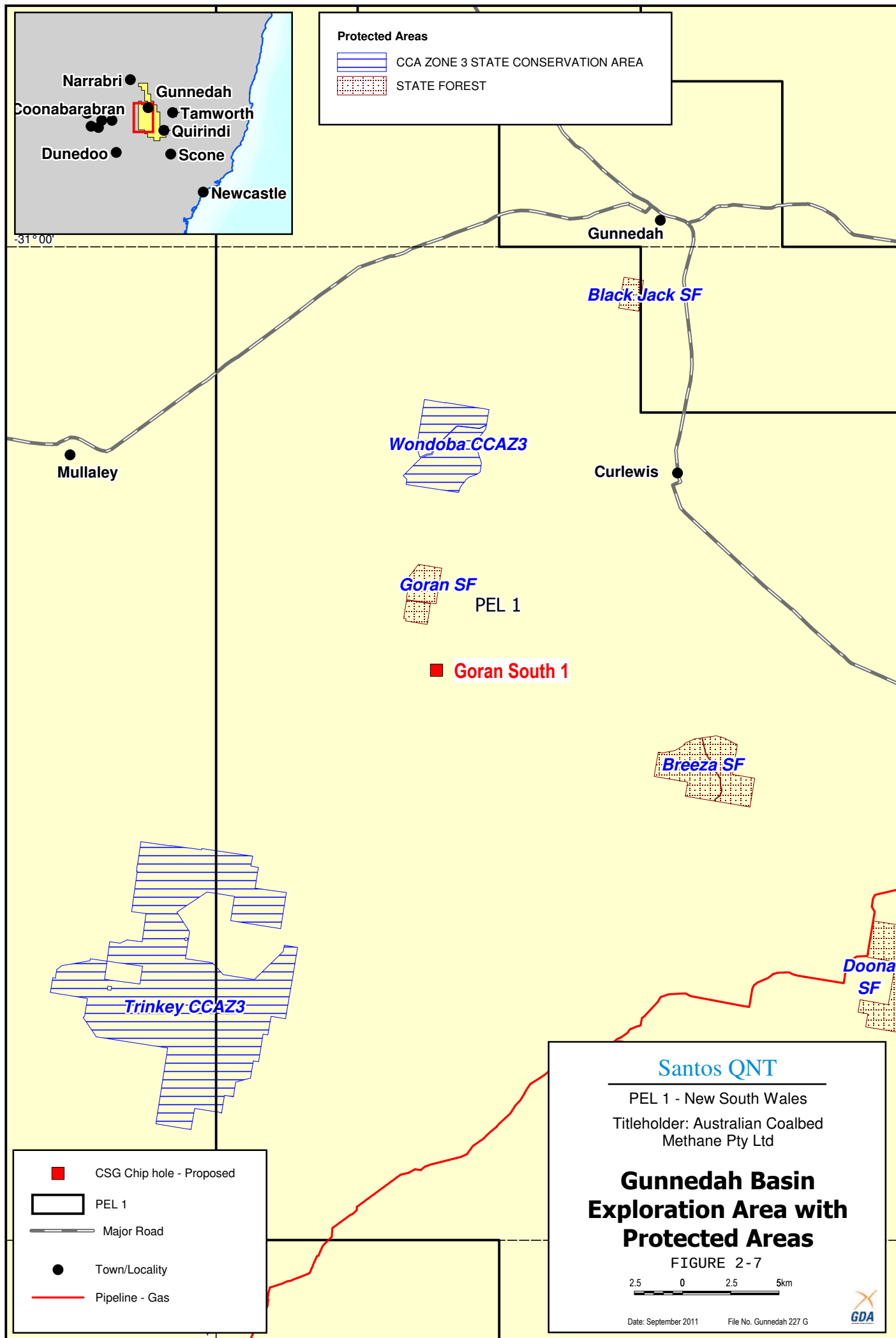
There are also a number of State Forests and State Conservation Areas located in the vicinity of the subject site (Figure 2-7). These include:

- Goran State Forest: approximately 2.5km to the north
- Wondoba State Conservation Area: approximately 9.8km to the north
- Breeza State Forest approximately 12.3km to the east of the site
- Trinkey State Conservation Area: approximately 14km to the south west of the site.

Table 2-2 Environmentally Sensitive Areas

Is the proposal located within any of the following:	Yes/No
An area reserved or dedicated under the <i>National Parks and Wildlife Act 1974</i> ?	No
Is the proposal located within land reserved or dedicated within the meaning of the <i>Crown Lands Act 1989</i> for preservation of other environmental protection purposes?	No
A World Heritage Area?	No
Environmental Protection Zones in environmental planning instruments?	No
Lands protected under SEPP 14 – Coastal Wetlands?	No
Lands protected under SEPP 26 – Littoral Rainforests?	No
Land identified as wilderness under the <i>Wilderness Act 1987</i> or declared as wilderness under the <i>National Parks and Wildlife Act 1974</i> ?	No
Aquatic reserves dedicated under the <i>Fisheries Management Act 1994</i> ?	No
Wetland areas dedicated under the Ramsar Wetlands Convention?	No
Land subject to a conservation agreement under the <i>National Parks and Wildlife Act 1974</i> ?	No
Land identified as <i>State Forest under the Forestry Act 1916</i> ?	No
Western Lands Lease	No
Freehold or Crown Land. If Crown Land, what type?	Freehold*

*note that parts of the proposed access tracks are situated on "paper roads", which are not freehold land. These roads are currently being purchased by the landholder and it is anticipated that they will be fully owned by the landholder prior to operations commencing.



2.7 Climate

The Bureau of Meteorology (BoM) weather station considered to be most representative of the subject locality was Quirindi Post Office. The local climate is temperate with a slight dominance of summer rainfall. The average daily maximum temperature is around 24.6°C, while the average daily minimum temperature is around 8.9°C (BoM, 2011). Long-term mean annual rainfall for the locality is 684.3 mm and is known to range between 337.7 mm (lowest record 1919) to 1,149 mm (highest record 1921).

As shown in Table 2-3, based on mean temperature records the warmest month is January and the coolest month is July. December receives the greatest rainfall and April the least, however very little variation occurs throughout an average year.

Table 2-3 Climate Statistics from Quirindi Post Office BoM Weather Station

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Max Temp (°C)	32.2	31.3	29.3	24.9	20.5	16.6	15.9	17.9	21.5	25.2	28.4	31.2
Mean Min Temp (°C)	16.4	16.1	13.5	8.9	5.1	2.8	1.6	2.4	5.0	8.7	11.9	14.8
Mean Rainfall (mm)	80.7	65.5	53.1	42.1	44.4	51.3	48.5	45.4	46.6	60.7	64.8	80.9

2.8 Soils

The soils across the region vary depending on the local sediment source. Gunnedah Shire Council has provided a description of the types of soils found within the Shire on their website, as follows (GSC, 2011):

Cracking Clay Soils

The dominate soils within the region are the black earths, largely formed from the basaltic alluvium and colluvium derived from Werrie Basalt which outcrops to the east of Porcupine Lookout Ridge, are found primarily along the Mooki River. They have a uniformly textured profile of well structured clay, and vary in colour from a very dark grey and very dark brown to black when moist.

The black earths have a clay content of between 50 and 80 per cent. One of the prominent characteristics of this soil type is its extensive cracking during dry periods. This is due to a high volume of montmorillonite, an expanding lattice clay mineral which causes swelling and shrinkage on wetting and drying respectively.

The pH of these soils is neutral at the surface and becomes increasingly alkaline (pH 8 - 9) with depth. Fertility is naturally high although responses to some applied nutrients, especially nitrogen and zinc, can be expected after cropping.

These have similar characteristics to the black earths but are not associated with gilgai formation.

Clay and Loam Soils.

The loam textured soils are primarily associated with the Rangari Creek floodplain, while the clay soils have been formed along the Namoi River floodplain.

The clay soils appear to have a similar structure to the black earths and cracking clays, the difference being a thin band of recent alluvium on the surface which is subject to seasonal cracking. These soils graduate from black earths (heavy clays) next to the river, to brown medium to light clays along the perimeter of the floodplain.

These soils have a medium to high level of fertility responding under various conditions to applications of phosphorus, sulphur and nitrogen. The surface pH of both soils are neutral, increasing with depth.

Some of these clays have a shrink-swell capacity ranging from 16.8 to 21.2 per cent.

Duplex and 'Gravelly' Soils

The gravelly red brown earths form the dominant soil type in and around Gunnedah and are associated with the mesozoic sedimentary and volcanic rocks of the ridge systems in the Wean, Kelvin and Tambar Springs areas of the Shire.

They are characterised by a dark grey to brown sandy loam to loam, graduating into a reddish brown clay, with gravel being present throughout the profile.

These soils are very poor in terms of fertility and are of lesser value due to their porosity and high leaching qualities. They are likely to be deficient in phosphorus, nitrogen, sulphur and some trace elements. The pH ranges from mildly acid at the surface (pH 6 to 6.5) to alkaline at depth (pH 8 to 8.5).

They have a low to medium shrink-swell capacity ranging from 10 per cent at the surface to 11.2 per cent at 50 centimetres, 13.6 per cent at 100 centimetres and 16.4 per cent at 200 centimetres.

Clay Loams with Red Clay Subsoils

These soils are found around Gunnedah and to the west of the central ridge system with the major soil type being the Euchrozems.

Characteristically, the Euchrozem's colour graduates from red to reddish-brown and brown and grades from a clay loam or light clay into a medium to heavy textured clay soil at depth. The A1 horizon is self mulching with a depth of 15 centimetres. The structure of the A1 changes from a weak to strong crumb structure at the surface to a fine to medium blocky structure at depth. The boundary between the A1 and B1 horizons is gradual with no evidence of an A2 horizon. The B2 horizon is more blocky in structure with smooth faced, dense peds. When moist the soil is moderately friable but becomes hard when dry. The B2 horizon is much larger than the B1 and often consists of gravelly clay. Some calcium carbonate nodules are evident in the B horizon.

The pH ranges from 6.5 at the surface to 7.8 to 8 at depth while the shrink-swell capacity is low to moderate ranging from about 11 per cent at the surface to 16 per cent at a depth of 1 metre.

Highly Erodable - Hard Setting Soils

These soils have been formed on Mandowa Mudstones, Lower Carboniferous, Baldwin and Caroda Formations North and West of the Keepit Catchment.

Their high degree of erodability is due to a slightly dispersible A2/B1 horizon. Where undisturbed, the A1 horizon is dark grey-brown to red-brown in colour varying from loamy sands to clay loams with a weak to blocky structure. These soils set hard when dry and become moderately friable when moist. However the A1 is often eroded away leaving an exposed A2 or B1 horizon as the surface.

In the Red-Brown earths the A2 horizon is only weakly developed. The B horizon consists of a reddish brown to red clay having a moderate to strong blocky structure, often with a shiny smooth-faced ped fabric.

Skeletal Soils

These soils are primarily found along the ridge crests and the steeper slopes with the major soil type being Lithosols. They contain large amounts of parent rock material and are usually very stony with soil depth ranging from 2 to 20 centimetres.

2.9 Geology

2.9.1 Regional geology

PEL 1 is located in the central portion of the Gunnedah Basin where Jurassic and Cretaceous Surat Basin sediments unconformably overlie Permo Triassic Gunnedah Basin sediments (Figure 2-8). The Gunnedah Basin covers an area of more than 15,000km² and is defined in structural terms as being bounded to the east by the Hunter Mooki Thrust Fault System and the New England Fold Belt, and to the west by the Lachlan Fold Belt onto which the Gunnedah Basin sediments gradually onlap.

Metavolcanics, meta-sediments and minor ignimbritic volcanics of the Lachlan Fold Belt form much of the basement under the western part of the Gunnedah Basin and the Rocky Glen Ridge. Widespread Late Carboniferous and Early Permian mafic lavas were succeeded by paralic-lacustrine environments with sediments of the Leard and Goonbri Formations deposited. This was followed by low energy fluvial conditions in which the coal measures of the Maules Creek Formation were deposited.

An Early Permian transgression then inundated the area and deposited shallow marine para-conglomerate, sandstone and siltstone of the Porcupine and lower Watermark Formations and culminating in the deposition of the upper Watermark Formation marine claystone.

The Black Jack Formation was deposited in a major delta system with a dominantly northeast sediment source from the New England region. A minor westerly provenance associated with the emergence of the Lachlan Fold Belt is also apparent. The New England provenance of the lower Black Jack Formation resulted in generally quartz lithic and arkosic sandstones with limited reservoir potential. The sandstones were deposited in a lower delta plain/marginal marine environment.

Deposition of the lower Black Jack Formation sediments was followed by an episode when marine conditions affected the Gunnedah Basin, with the deposition of sandstones of poor to fair reservoir quality. Deposition of the western derived quartzose sandstones was followed by very widespread coal swamp conditions depositing the thick Hoskissons Coal seam that is readily correlated across the Basin. The thickness of the Hoskissons Coal ranges from less than 1m in the west to more than 12m in the north and to 18m in the south-east.

Late Permian volcanic activity and tectonism to the east resulted in renewed deposition of more lithic sediments with an easterly provenance and consequently the upper Black Jack Formation has only limited potential for reservoir development. A period of tectonism, uplift and erosion of variable intensity throughout the Basin followed Late Permian deposition. The end of the Permian is marked by a major regional unconformity.

The Digby Formation is marked by a basal conglomerate that has been derived from the New England Fold Belt. This unit thickens towards the east and onlaps onto the older sediments and basement to the west. Reservoir quality is generally poor due to a tight sandstone matrix. Thick near-shore marine shales of the overlying Napperby Formation are considered a potential seal to any hydrocarbons reservoir in the Digby Formation.

NEW STRATIGRAPHY (Tadros 1993a, e; 1995 & herein)							DEPOSITIONAL SYSTEMS (modified from Tadros 1986b, Tadros & Hamilton 1991, Hamilton 1993a & herein)
PERIOD	PALYNOLOGY ZONE	GROUP	SUBGROUP	FORMATION	MEMBER	SEAM	
TRIASSIC	MIDDLE	PT2.2- PT3		GARRAWILLA VOLCANICS			GARRAWILLA VOLCANICS
				DERIAH FORMATION			
	EARLY	PT1- PT2.1		NAPPERBY FORMATION			NAPPERBY LACUSTRINE SYSTEM
				DIGBY FORMATION	ULINDA SANDSTONE BOMERA CONG.		DIGBY ALLUVIAL SYSTEM
PERMIAN	LATE	PP5	NEA SUBGROUP	TRINKEY FORMATION	SPRINGFIELD C.M.	DOONA	EASTERN FLUVIAL SYSTEM
				WALLALA FORMATION	CLIFT C.M.		
			COOGAL SUBGROUP	CLARE SANDSTONE	BREEZA C.M. HOWES HILL C.M. CAROON C.M.		LACUSTRINE & WESTERN FLUVIAL SYSTEMS
				BRIGALONG FORMATION			HOSKINS FERT. SWAMP SYSTEM
		PP4.3	BROTHERS SUBGROUP	PAMBOOLA FORMATION	MELVILLES C.M.		ARKARULA SHALLOW MARINE SYSTEM
							UPPER WATERMARK / LOWER BLACK JACK DELTA SYSTEMS
	EARLY	PP4.2	MILLIE GROUP	WATERMARK FORMATION			PORCUPINE- LOWER WATERMARK MARINE-SHELF SYSTEM
				PORCUPINE FORMATION			
		PP3.2- PP3.3	BELLATA GROUP	MAULES CREEK FORMATION		BROWN	LEARD-MAULES CREEK ALLUVIAL/ LACUSTRINE SYSTEMS
		PP3.1		GOONBRI & LEARD FORMATIONS			
		PP2.2					
		PP2.1		BOGGABRI VOLCANICS, WERRIE BASALT, METAVOLCANICS & METASEDIMENTS			BOGGABRI VOLCANICS & WERRIE BASALT

September 2007, GUNDAH 002a

Figure 2-8 Stratigraphy of the Gunnedah Basin

A major period of uplift and erosion during the Late Triassic ended Gunnedah Basin deposition. Deposition of the Surat Basin sequence commenced during the Early Jurassic, preceded by lava flows, pyroclastics with intercalated claystones of the Garrawilla Volcanics (Nandewar Range). During the Tertiary period of tectonism, the Liverpool Ranges were formed by massive extrusions of basalts.

In the Triassic period, deposition of these alluvials continued forming beds of sandstones and mudstones. These outcrop in a belt which runs parallel to the Mooki and Goondiwindi fault regions, forming a non-marine wedge that was derived partly from the New England Tablelands.

Volcanic activity in the late Triassic or early Jurassic periods caused the eruption of basalts in the Mullaley district between Gunnedah and Coonabarabran. During the Tertiary period of tectonism, the Liverpool Ranges were formed by massive extrusions of basalts representing the last major depositional episode in PEL 1.

The present landscape is dominated by Quaternary sediments in the form of alluvial fans and outwash slopes that resemble the larger fans of the adjacent Darling Riverine Plains Bioregion to the west but are composed of coarser sediment and fan out at slightly steeper angles. The relative distribution of sediment from basalt or sandstone has a major impact on soil quality and vegetation.

3.0 Project Description

3.1 Introduction

Santos proposes to undertake drilling activities to assess the coal seam gas potential of the Gunnedah Basin in PEL 1, which are the subject of this REF.

The proposed activity is to conduct drilling at the Goran South 1 location to obtain information on coal depths, seam thickness, continuity and permeability. Coal seams of a particular interest will be cored for gas composition testing. Drill stem testing (DST) or equivalent downhole evaluation is also planned to be undertaken on coal seams to collect pressure and permeability information.

In summary, the process involves:

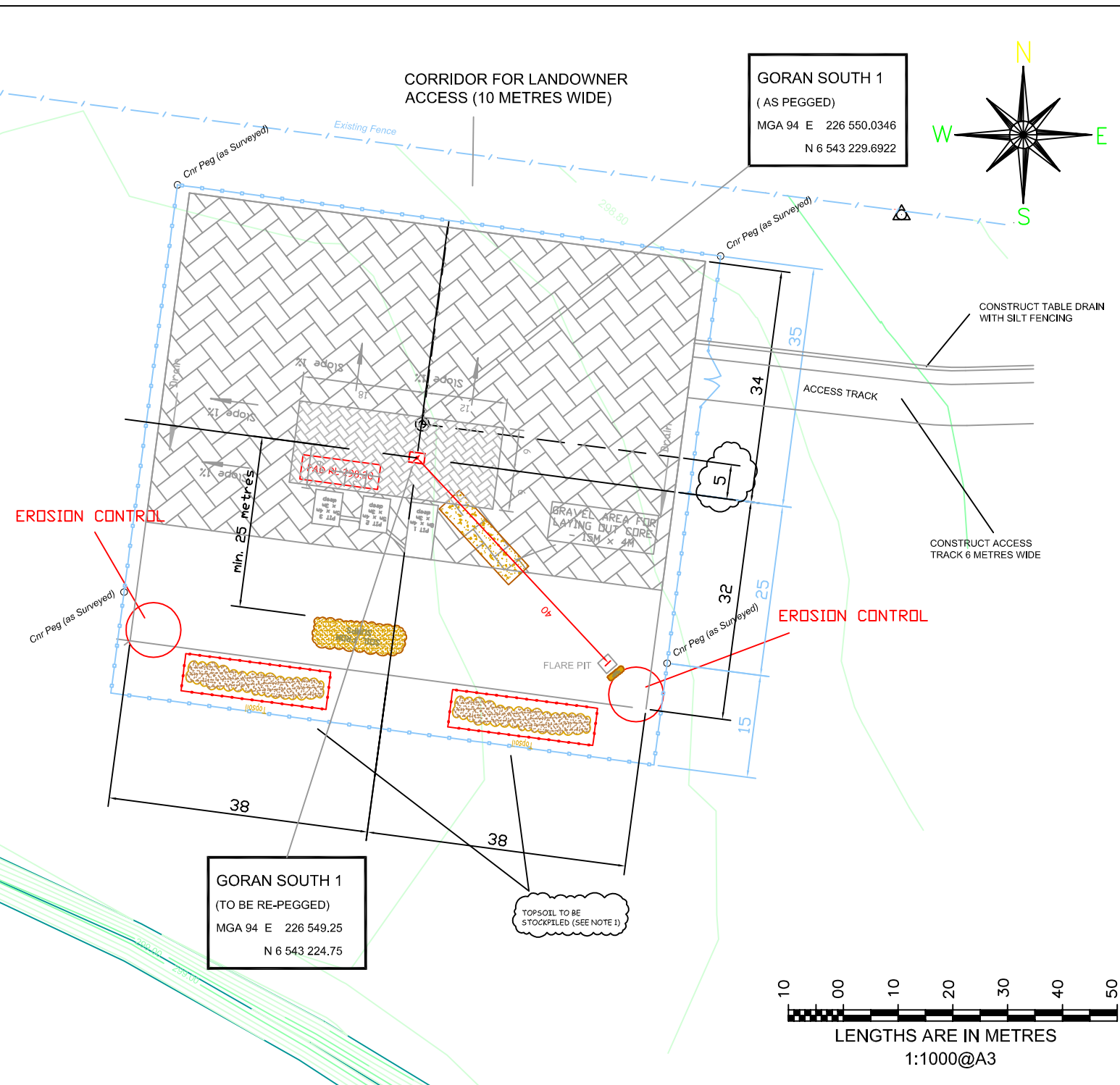
- preparation of lease access tracks utilising existing access tracks with minor improvements and construction of new track;
- preparation of a level drill pad (also referred to as “well lease area”);
- placement of a drilling rig and ancillary equipment at the well lease;
- drilling of the core hole;
- collection and analysis of drill core;
- conduct well testing and wireline logging (as required);
- plugging and abandonment of the well including suspension of steel casing over mineable coal seams (as required);
- removal of equipment and imported materials and the rehabilitation of the site; and
- rehabilitation of the site in line with legislative and landholder requirements.

Due to the type of drilling activity proposed, associated water from the targeted coal seams is not anticipated to be lifted.

Santos has negotiated an access, compensation and rehabilitation agreement with the affected landowner in respect to land access, compensation and rehabilitation. A scouting survey has been undertaken in consultation with the relevant landholder prior to drilling taking place to locate the site with an emphasis on minimisation of impacts on the environment and property operations.

3.2 Site Preparation and Equipment

Various works will be required in order to prepare the site for the proposed drilling, including preparation of the well lease, access track improvements and construction as well as positioning the drill rig and associated temporary buildings and equipment on the site. The major equipment used on site will be a drilling rig and associated temporary buildings. These works are summarised further in this section. Figure 3-1 and Figure 3-3 illustrate the proposed site layout for the well lease and access tracks.



Notes:

- Strip 150mm Topsoil of site and stockpile in area shown. Erect silt fence around topsoil to segregate soil from excavated material.
- Contour bank (0.5 metres high x 1 metre wide) to be constructed as shown
- All batters to be 1:1
- Gravel to be placed at the direction of Santos Representative
- All sites to be fenced and 1 x 8m double gates installed
- Access tracks to be constructed as shown
- Excavated material from Sump/ Pit to be placed behind pit and compacted as shown
- Cellar and Conductor (6 metre x10 $\frac{3}{4}$ ") to be installed. Conductor to be set in centre of cellar with top of conductor at 1.6m below surface level. Cellar floor to be 1.8m below surface level. Covers to be placed on cellar after installation
- Handstand area to be excavated (if required), backfilled and compact with suitable gravel. Area to be graded on level
- Area outside of handstand area to be graded at 1% away from pad and appropriate drainage, bunding and erosion control installed
- Fence to be 6 line 70cm hingejoint fence, steel corner posts & droppers.

FIGURE 3-1

Rev 2	12th Aug 11	Lease moved to new location
Rev 1	10th Aug 11	Lease turned to suite Contours

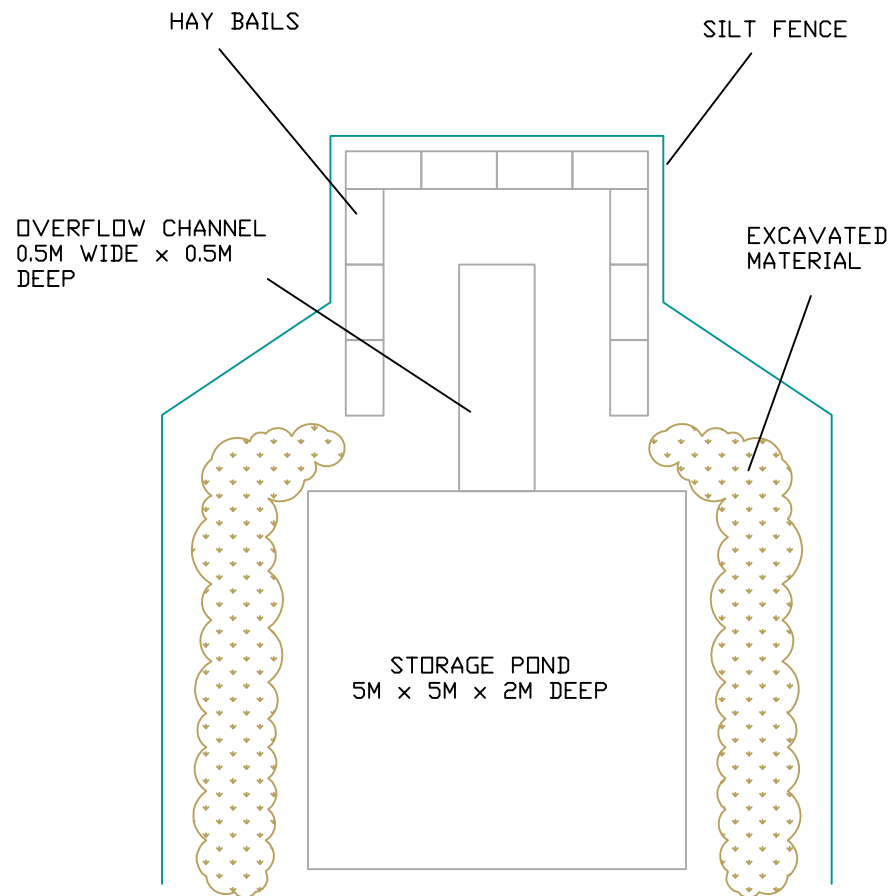
GORAN SOUTH 1 - FINAL

SANTOS LTD.

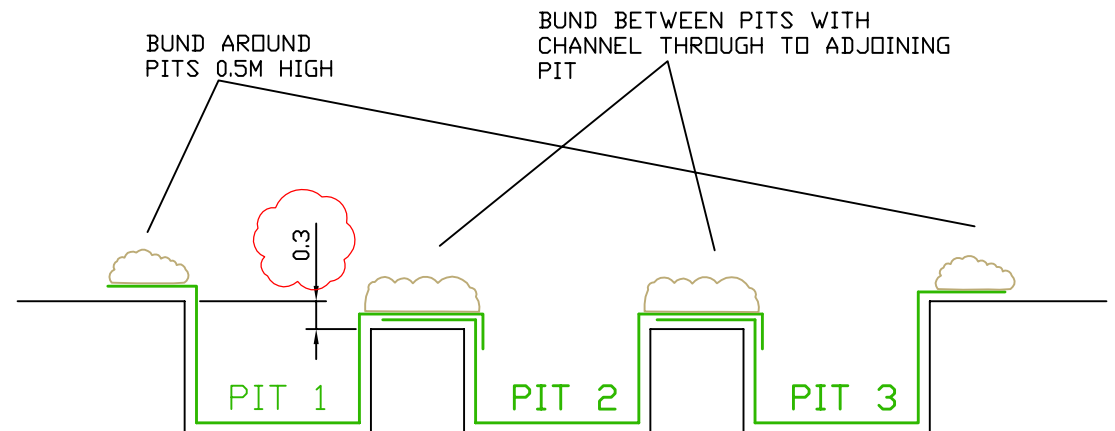
RIG 13 - WELL PAD DRILLING

LEASE BUILD DETAILS

Drawn: CSS	Date: 15th August 2011	Revision: 2
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EROSION CONTROL



LINER INSTALLATION SEQUENCE

FIGURE 3-2

PITS TO BE LINED WITH
0.05
LDPE FLAT SHEET LINER
(SANTOS SUPPLIED)

GORAN SOUTH 1 - FINAL		
SANTOS LTD.		
1 WELL LEASE PAD		
SUMP & EROSION CONTROL		
Drawn: CSS	Date: 15th August 11	Rev No: 0

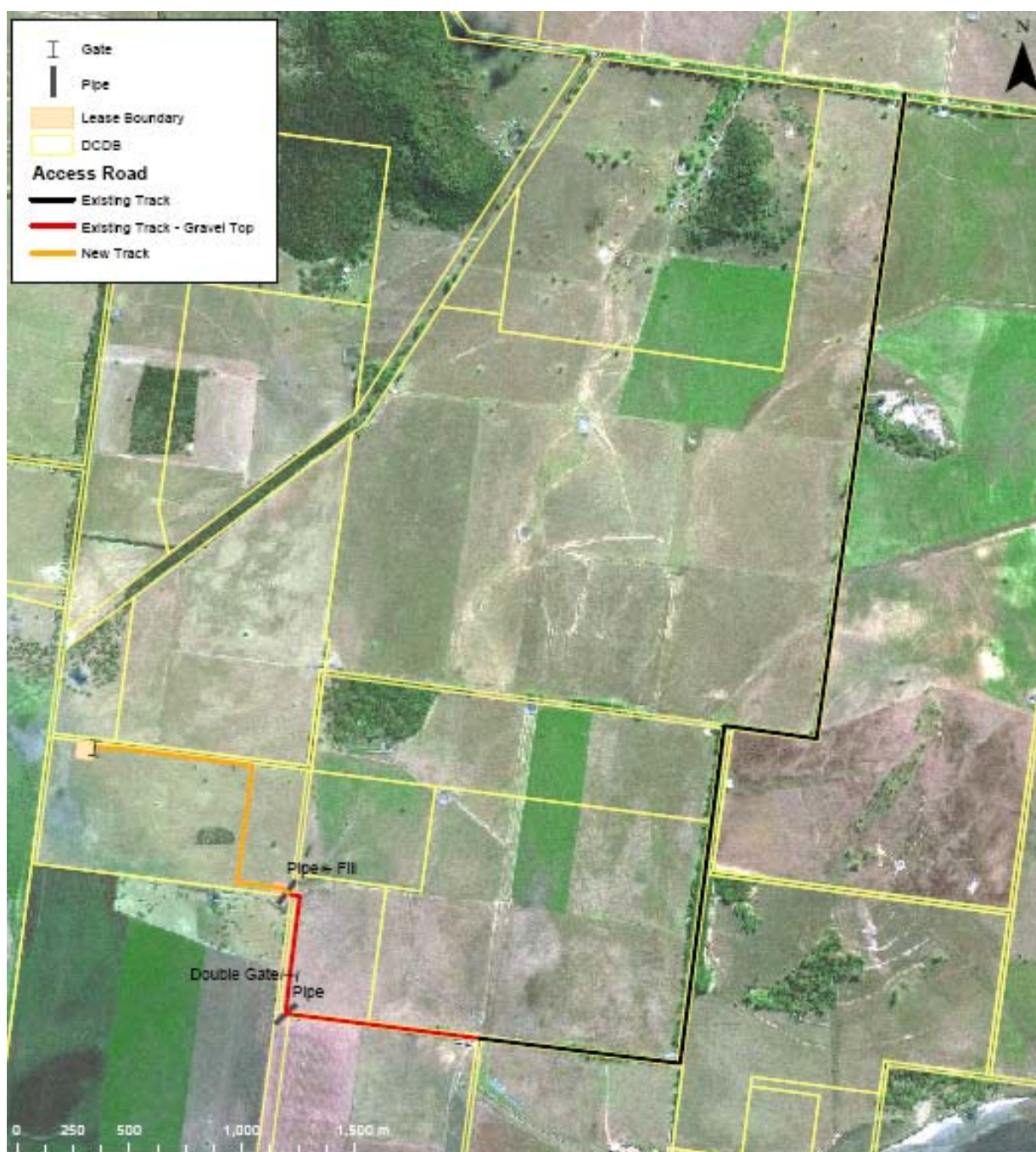


Figure 3-3 Goran South 1 Site Layout – Site Plan

During site preparation, there will be some soil disturbance as a level drill pad will need to be constructed at the well lease. Associated lined drilling sumps and a flare pit will also be constructed on site.

The area to be disturbed for drilling activity is outlined in Table 3-1.

Table 3-1 Areas of disturbance & cut and fill for well leases & access track

Well Lease	Area	Level
Goran South 1	75m x 76m with an overall area of disturbance of approximately 5,700m ² .	Cut and fill will be required to establish a pad level at approximately RL 298.20m AHD
Access Track	New track 5m wide, approximately 1500m long = 7,500m ² .	Following existing site levels, with some filling and piping required in isolated

Well Lease	Area	Level
	Some minor filling required at various locations on access track.	locations (refer Figure 3-3)

Well Lease Construction

- Civil works equipment will be moved to site including bulldozer, excavator, grader, roller, water trucks, other trucks and support and light vehicles.
- Portable amenities will be located on site during construction.
- Any topsoil will be stripped and stockpiled.
- Required sumps will be excavated and lined with impermeable plastic sheeting.
- The lease area will be graded, rolled and otherwise constructed per Figure 3-1.
- Required sumps will be excavated and lined with impermeable plastic sheeting. Sump and erosion control is shown on Figure 3-2.
- A 10-3/4" steel conductor casing will be pre-installed at approximately 6m depth by the civil works crews ahead of the rig arriving on site.
- The lease will be fenced with appropriate fencing to manage livestock movements.

Access Track Improvements and Construction

Access to the "Boenery Park" property is via existing, good quality roads. The only works required to these roads may be grading to ensure a good quality surface is maintained. There will need to be some additional works to ensure all weather access through the property to the well lease, as illustrated on Figure 3-3.

The following is a list of the detailed works involved:

- Existing 1500m of track indicated in Figure 3-3 to be topped with 100mm road base.
- New 1500m long x 5m wide access track indicated on Figure 3-3 to be prepared using 100mm road base.
- Track is to be constructed to allow wet weather access. This will require piping and some minor filling in parts as identified on Figure 3-3.
- Sensitive vegetation (Weeping Myall) located along the northern boundary of Lot 28 will be avoided by offsetting the track 10m from the drip-line of the trees.

Drill Rig Positioning & Operation

- Equipment will include generator units, lighting towers, site offices, stores and other various buildings and equipment required for the duration of drilling.
- Moving and rigging up/down of equipment (i.e. installation and dismantling of rig equipment) is expected to take up to 3 days per site (3 per rig up, 3 per rig down).

Ancillary equipment will be required on site during the course of the drilling activities, including wireline trucks, cementing trucks and service company vehicles, these vehicles will exit and enter the site as required.

3.3 Drilling Activities

The well site will have a specific well design ensuring compliance with relevant legislation. The specific well design is provided in **Appendix D**.

A nominal 10-3/4" (273mm) cemented conductor is to be installed by the lease builder to approximately 6 m below ground level. A surface hole of 8-1/2" (216mm) will be rotary drilled to approximately 100mRT, where a 7" (178mm) surface casing will be landed and cemented to the surface. The main hole of 6-1/8" (156mm) will be drilled from the 7" (178mm) casing shoe to total depth of approximately 934mRT (20m into the Boggabri Volcanics) based on the pre-drill geological prognosis. DSTs or equivalent downhole evaluations may be conducted over selected Late and Early Permian Coals with testing to be performed in accordance with legislative requirements.

On penetrating target coal seams, coal cores will be collected and sampled for gas content and composition to evaluate local variations in coal seam permeability and composition. Any testing will be performed in accordance with legislative requirements.

Once the well has reached the total depth, geophysical wire-line logs will be run over the main section of the hole to identify major stratigraphic units, intersected coal seam depth and seam thickness. Further DST or equivalent downhole evaluation may follow after completion of logging. Following logging and any post total depth activities, the well will be fully plugged and abandoned with cement plugs from bottom to top. It is planned to cut and remove the 4-1/2" casing from approximately 50m above the casing shoe prior to setting cement plugs. A separate plug and abandon program will be issued at a later date. Approval is required for this abandonment program prior to abandonment operations commencing. The placement of cement plugs will effectively isolate the penetrated formations from each other and from the surface.

3.4 Abandonment and Rehabilitation

The well will be cemented, plugged and abandoned in accordance with regulatory requirements and rehabilitated following completion of activities within the allowed regulatory timeframe, unless needed for further exploration testing. In the case of plug and abandonment, the intermediate casing would be removed above the top of cement (where required and practicable) and a steel identification plate installed near the top of the hole > 1 metres below the surface.

Once the drilling and testing activities are complete, the disturbed area is proposed to be rehabilitated with appropriate mitigation measures and environmental safeguards implemented to minimise potential impacts. All rehabilitation works will be undertaken with maximum regard to environmental protection and rehabilitation, vegetation, subsoil and topsoil management, weed control, erosion and sedimentation management and revegetation in accordance with the relevant statutory requirements.

Revegetation & rehabilitation will be undertaken within the required regulatory timeframe. Gravel from the new track will be removed following the completion of works to enable this area of land to be utilised for grazing again.

3.5 Duration

Drilling activities are temporary. The drilling of the core hole well is expected to occur over a 56 day period not including lease build, or site restoration. There will be 14 days of lease construction activities prior to drilling the well. Rehabilitation activities of 30 days following the drilling of the well will be additional to this period.

This equates to a total of approximately 70 days of construction and drilling and 30 days of rehabilitation, as outlined in the table below.

Table 3-2 Duration of drilling and site activities

Activity	Expected Duration
Lease Build	14 days
Drilling	56 days
Rehabilitation	30 days

3.6 Staff and Hours of Operation

The number of employees present on the site at any one time is expected to be up to 20 persons. It is not proposed to provide a workers camp on the site, with off-shift drilling crews to be located in nearby accommodation with travel to and from site to be provided.

The hours of operation during the drilling and work over will be on a 24-hour a day, 7 days a week basis as negotiated with the landholder. Hours of operation during lease construction and rehabilitation will be on a 12-hour a basis between 6am and 6pm. During drilling personnel movements to and from site will be minimised outside of a single shift change per day but may be necessary due to emergency situations or specific activities (e.g. crews and service companies entering and leaving site to conduct specific activities).

3.7 Chemicals

A number of chemicals are planned to be utilised to facilitate the efficient and safe drilling of the wells in line with best oilfield practice. These chemicals are typical of those generally used in oilfield activities. These chemicals will be used either to deliver the wells as planned or will be held in contingency to handle unplanned scenarios (e.g. stuck pipe, excessive mud losses etc.). The Materials Safety Data Sheet (MSDS) information for all of these chemicals can be found on the Santos web site (<http://www.santos.com/exploration-acreage/gunnedah-basin-gas/fact-sheets-msds.aspx>). The fluids are water based (not synthetic or oil based) and recycled for reuse as much as possible during the drilling process. The following list summarises the relevant chemical MSDS for the proposed activities.

- AMC Xtra-Sweep
- Sodium Bicarbonate
- Soda Ash Dense
- SAPP
- CSR Raw Sugar / Brown Sugar
- Poly-Bore™
- Pheno Seal
- Mud Flush III
- Guar gum, propoxylated
- Fly Ash – Eraring
- Flocele 3/8"
- AMC EP Bit Lube
- Econolite Additive
- Drispac (Regular and Superlo) Polymer
- AMC CR-650
- Cement – Standard – Class A
- CFR-3
- CAL-Seal 60
- Calcium Chloride – Flake
- Bentonite
- AMC Superfoam
- AMC Lime
- AMC Hammer Oil
- AMC Aus-Ben
- AMC Aus-Gel
- AMC Aus-Plug
- Barite
- Caustic Soda (Rheochem)
- Citric Acid (Rheochem)
- Frascseal Fine, Medium
- Idcide-20
- JK-261
- Potassium Chloride (Rheochem)
- Kwikseal (Fine/Medium/Coarse)
- Quickseal (Fine/Medium/Coarse)
- Xanthan Gum (XC)
- Rheopac R/LV/UL/RD/LVD
- Salt (Rheochem)
- AMC PAC R
- Baroid Quikmud
- Rheolube
- Defoam-A
- Trugel 13-A
- JK 161-LV

3.8 Justification of Activity

Drilling of the Goran South 1 well is a necessary step in the ongoing exploration of the hydrocarbon potential in PEL 1, which to date has undergone limited petroleum exploration. Discovery and appraisal of coal seam gas resources in the area has the potential to increase the state's reserves and revenue from gas and underpin future exploration or production in the region.

The proposed activities consist of drilling a well, wireline geophysical logging, drill stem tests, casing and cementing using steel casing strings. These procedures are required to define and identify commercially valuable reserves of coal seam gas.

3.9 Alternatives

There is limited previous drilling in this area of the Gunnedah Basin that is sufficiently deep for the purposes of petroleum exploration. The proposed exploration hole drilling operation is essential to gain accurate gas composition and detailed stratigraphic data. Due to the highly specialised nature of the proposed works, drill cutting sampling and testing is the only feasible method available to obtain reliable and accurate gas composition and permeability data for the local coal resource. Geophysical methods available (e.g. seismic), which could be applied to exploration would show the structure of the basin but would not provide the ability to sample and analyse the stratigraphy of the Gunnedah Basin to quantify coal seam gas potential.

The location of exploration holes is a substantial factor in the evaluation of the potential coal seam gas resource. The initial location of the core hole was carefully considered by the project team, in consultation with specialist consultants and agricultural operators and taking into account the underlying geology, the existing environment and the current land use at each location.

The selection of the proposed core hole site located on privately owned land has been based upon the ecological protection principles of avoidance and harm minimisation. The site has been selected to avoid and/or minimise potential ecological impacts and in particular those to Lake Goran. The well lease site selection process identified areas where historical disturbances had modified the natural condition and where zero or minimal vegetation clearing, tree removal and earthworks would be required to establish the well lease and associated infrastructure, including the access track. A site was originally located closer to Lake Goran, however was relocated further away following a review of the environmentally sensitive nature of this area.

The site was located in consultation with the landholder and with the assistance of a scouting party comprised of Santos' Project Representatives, Cultural Heritage Officers and Lease Construction Experts. Third party surveyors and Ecologists were also consulted to assist in positioning of the well lease as part of the scouting process.

Once all known constraints were identified on the site, this information was used to delineate areas to be avoided in the initial location identification process. This included areas which would require unnecessary intrusion on sensitive ecological communities.

The final area identified for the exploration hole operations has been determined to avoid existing constraints as much as is practical. By undertaking the site identification methodology outlined above, the evaluation of sites for the drilling program was undertaken using an adaptive management approach, where constraints were identified, verified in the field and avoided. The resulting exploration hole location area is considered the most appropriate location both from a resource investigation perspective and to minimise any potential environmental impacts.

3.10 Stakeholder Consultation

Santos has a commitment to open and transparent consultation with the communities that it works in. Since beginning their Gunnedah Basin coal seam gas exploration in 2008, the Gunnedah Project Execution Team has held more than 30 community information sessions within the Gunnedah Basin. Santos is committed to consultation with key stakeholders, including:

- Landholders
- Business
- Local, State and Federal government
- NSW Farmers Association
- Namoi Catchment Management Authority
- Utilities operators
- Local Aboriginal Land Councils
- Special interest and activist groups

Consultation aims to:

- Increase understanding of the coal seam gas industry in NSW
- Explain what is involved in coal seam gas exploration and appraisal activities
- Explain the differences between petroleum exploration legislation and mining legislation in NSW
- Identify issues that generate community interest and concern in the Gunnedah Basin

Santos provides information about its activities across the entire exploration area using the following consultation methods:

- Notification of neighbours (those sharing boundaries with properties where Santos is working) prior to commencement of activities.
- Community consultation sessions and presentations are held throughout the year at areas that are close to upcoming work. Community consultation sessions are attended by subject specialists (e.g. geologists, drilling engineers, hydrologists and hydrogeologists) to enable the community to speak directly to the people responsible for the work being undertaken in the area.
- AgQuip (every August) - Santos displays equipment and has up to eight subject specialists in attendance to answer questions from the public. The display at Agquip in August 2010 included a mock pilot well site with all of the kit that will be on site for a pilot test.
- 1800 number - attended during business hours, all calls returned within 48 business hours.
- Public email address – emails returned within 48 business hours.
- Newsletter (4 times per year, direct mailed to a database of over 5 000 stakeholders).
- Briefing of key Local, State and Federal government staff and elected representatives.
- Field trips to drill and seismic work sites (on request, year round).
- Presentations to community groups (on request, year round).
- Factsheets – a set of six factsheets (CSG Overview, CSG Regulation in NSW, Exploration Core Hole Drilling and Pilot Testing, Incidental Water Management, Seismic Testing) available in printed or electronic versions (<http://www.santos.com/exploration-acreage/gunnedah-basin-gas/factsheets-msds.aspx>).

- Website www.santos.com/gunnedah – information includes factsheets, newsletters and presentations, frequently asked questions, photographs of sites and equipment, materials safety data sheets for chemicals used, upcoming events, industry terminology and a link to the Namoi Catchment Water Study website.
- Gunnedah regional office – 88 Marquis Street, Gunnedah.

To ensure that the community was aware of the proposed activities within the area, the following consultation activities were undertaken:

- Community consultation sessions (public meetings) were run at Spring Ridge on Tuesday 23 March and Gunnedah on Wednesday 24 March 2010. Both ran from 2-8pm. In the afternoon, team members (drilling engineer, geologist, hydrologist) engaged with landholders in one-on-one conversations. In the evening, pilot-focused presentations on geology, drilling and water handling were given in a facilitated session. The sessions were advertised in local papers (2 weeks prior to event), in the March edition of the newsletter (sent to 5,000 recipients) and by email. Approximately 70 people attended the session held in Spring Ridge.
- In addition to the sessions early last year, eight Ask Santos Community consultation sessions have been held late last year and early this year as outlined in the table below. The presentations used at each of these sessions are available on Santos' website at www.santos.com/gunnedah.

4.0 Regulatory Context

There is a range of legislation applicable to the proposed activities which are addressed below.

4.1 Petroleum (Onshore) Act

The *Petroleum (Onshore) Act 1991* (NSW) (Petroleum Act) regulates the onshore exploration for and production of petroleum. Under the Petroleum Act, petroleum means:

(a) any naturally occurring hydrocarbon, whether in a gaseous, liquid or solid state, or

(b) any naturally occurring mixture of hydrocarbons, whether in a gaseous, liquid or solid state, or

(c) any naturally occurring mixture of one or more hydrocarbons, whether in a gaseous, liquid or solid state, and one or more of the following, that is to say, hydrogen sulphide, nitrogen, helium, carbon dioxide and water,

and includes any substance referred to in paragraph (a), (b) or (c) that has been returned to a natural reservoir, but does not include coal or oil shale or any substance prescribed to be a mineral for the purposes of the Mining Act 1992.

The holder of an exploration licence has the right to prospect for petroleum on the land comprised in the licence. The proposed activities will be undertaken within the area of PEL 1 granted under the Petroleum Act. PEL 1 indicates categories of works that are permissible as follows:

Category 1

- Geological mapping
- Rock sampling (by hand held equipment)
- All reconnaissance drilling other than petroleum exploration holes
- Geophysical surveys other than seismic
- Airborne surveys

Category 2

- Access tracks or line clearing involving formed construction or significant native vegetation disturbance

Category 3

- Petroleum exploration holes
- Seismic surveys

The proposed activities fall under Category 3. Under Condition 1 of PEL 1, Category 3 activities require notification to the Department of Primary Industries, submission of a Review of Environmental Factors (REF) under Part 5 of the EP&A Act and approval of the Assistant Director, Environment of the Department of Primary Industries. This REF is being submitted in accordance with Condition 1 of PEL 1.

4.2 Environmental Planning & Assessment Act

4.2.1 Overview

The *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act) regulates development carried out in New South Wales. The carrying out of development is regulated under either Part 4 or Part 5 of the EP&A Act.

Development is required to be assessed under Part 5 of the EP&A Act if the relevant environmental planning instruments provide that the development does not require consent or is not exempt development and the development is either carried out by a determining authority or requires the approval of a determining authority.

The proposed activities fall within the local government area (LGA) of Gunnedah Shire. The subject site is zoned 1(a) Rural (Agricultural Protection) under the *Gunnedah Local Environmental Plan 1998* (NSW) (Gunnedah LEP). The proposed activities are permissible with development consent under the Gunnedah LEP. However, *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (NSW) (Mining SEPP) applies to the activities. The Mining SEPP aims "to provide for the proper management and development of mineral, petroleum and extractive material resources for the social and economic welfare of [New South Wales]". Clause 6 of the Mining SEPP provides that development for the purposes of petroleum exploration may be carried out without development consent. Clause 6 applies despite the provisions of the Gunnedah LEP. This has the effect that the proposed activities are required to be assessed under Part 5 of the EP&A Act.

A determining authority, for the purposes of this activity, is defined in Part 5 to include a public authority whose approval is required before an activity may be carried out. The Assistant Director, Environment of the Department of Primary Industries and the New South Wales Office of Water will be determining authorities for the purposes of Part 5 of the EP&A Act because their approval is required for the proposed development under the legislation administered by these determining authorities.

4.2.2 Determining Authorities and the REF

Under Part 5 of the EP&A Act, a determining authority is required to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

Additionally, clause 228 of the *Environmental Planning and Assessment Regulation 2000* (NSW) sets out the factors that must be taken into account concerning the impact of an activity on the environment.

The determining authorities are required to consider whether the proposed activity is likely to significantly affect the environment or threatened species, populations or ecological communities, or their habitats to determine whether an EIS or SIS is required. In deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities or their habitats, section 5A of the EP&A Act requires the following factors to be taken into account (the "seven part" test of significance):

(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,*

(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,*

(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,

(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,

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

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

(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.

This REF has been prepared to assist the determining authorities in meeting their obligations under the EP&A Act. This REF concludes that the proposed core hole activities are not likely to significantly affect the environment or threatened species, populations or ecological communities or their habitats.

4.2.3 Gunnedah Local Environmental Plan 1998

The site of the proposed core hole activities is zoned 1(a) Rural (Agricultural Protection) under the Gunnedah LEP. As stated above, the effect of the Mining SEPP is to require the proposed development to be assessed under Part 5 of the EP&A Act. However, consideration has been given to the nature and objectives of the 1(a) Rural (Agricultural Protection) zone. The objectives of zone 1(a) Rural (Agricultural Protection) are:

(a) to protect the use and efficiency of prime agricultural land while permitting appropriate development subject to suitable subdivision controls,

(b) to permit other forms of development which are ancillary to rural land uses or that, as a result of their nature, require siting outside the urban area,

(c) to avoid further fragmentation and alienation of useable rural land,

(d) to retain the low density nature of settlement within the rural areas and ensure that any future development does not create unreasonable demands on the existing infrastructure or available services,

(e) to provide for the requirements of the rural community,

(f) to maintain safety and convenience along main roads by discouraging uses that are likely to generate traffic volumes which disrupt traffic flow,

(g) to ensure that the existing level of scenic amenity is maintained by requiring development to have regard for significant ridgelines and hilltops.

The proposed development of the core hole is not expected to impact on the use and efficiency of prime agricultural land or fragment usable rural land and is considered generally consistent with the objectives of the zone.

4.2.4 State Environmental Planning Policy No. 44 – Koala Habitat Protection

State Environmental Planning Policy No. 44 – Koala Habitat Protection (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".

Schedule 1 of SEPP 44, which lists the LGAs to which SEPP 44 applies, includes the Gunnedah LGA. SEPP 44 applies to local councils determining development applications under Part 4 of the EP&A Act. Although SEPP 44 does not apply in relation to the assessment of development under Part 5 of the EP&A Act, it has been considered in the preparation of this REF.

SEPP 44 requires that before granting development consent under Part 4 of the EP&A Act for development on land over 1 hectare in area, a consent authority must form a view as to whether the land is "potential" and "core" koala habitat. Potential koala habitat is defined as:

areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.

Core koala habitat is defined as:

an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.

Where core koala habitat is found to occur, SEPP 44 requires that a koala plan of management be prepared for the site.

RPS undertook field surveys across the site as part of an ecological assessment (refer to **Appendix A**). No Koala food tree species were found to be present on the well lease or location of new track. Therefore, the site is not considered to be potential or core Koala habitat. SEPP 44 would therefore not prevent the consent authority from determining a development application on the land and a site-specific koala plan of management is not required.

4.3 Environmental Protection and Biodiversity Conservation Act

The *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) provides that a person proposing to take an action that the person thinks may be a "controlled action" must refer the proposal to the Minister for Sustainability, Environment, Water, Population and Communities (Minister). A "controlled action" is an action that:

- will have or is likely to have a significant impact on
 - » World heritage areas

- » National heritage places
- » Ramsar wetlands of international importance
- » Commonwealth listed threatened species and communities
- » Commonwealth listed migratory species
- » Commonwealth marine areas
- » The environment on Commonwealth land
- » Great Barrier Reef Marine Park;
- Is undertaken by the Commonwealth and will have or is likely to have a significant impact on the environment;
- Is undertaken by any person on Commonwealth land and will have or is likely to have a significant impact on the environment; or
- Is a nuclear action.

These are referred to as "matters of national environmental significance" (MNES). The EPBC Act sets out the process for identifying and listing the MNES including listed threatened species and listed migratory species.

If the Minister decides that the proposed action is a controlled action, then the approval of the Minister is required under the EPBC Act.

A person proposing to take an action that the person thinks is not a controlled action may refer the proposal to the Minister for the Minister's decision whether or not the action is a controlled action. The proposed core hole and associated activities are not expected to have, or be likely to have, a significant impact on MNES including, in particular, listed threatened species or listed migratory species under the EPBC Act. A referral to the Minister under the EPBC Act is therefore not required.

4.4 Threatened Species Conservation Act

The objects of the *Threatened Species Conservation 1995* (NSW) (TSC Act) include:

- To conserve biological diversity and promote ecologically sustainable development;
- Prevent the extinction and promote the recovery of threatened species, populations and ecological communities;
- To protect the critical habitat of those threatened species, populations and ecological communities that are endangered; and
- To ensure that the impact of any action affecting threatened species, populations and ecological communities preventing the extinction and promoting the recovery of threatened species, populations and ecological communities is properly assessed.

The TSC Act provides the procedure for the listing of threatened species, populations and ecological communities and key threatening processes in New South Wales and the preparation and implementation of recovery plans and threat abatement plans.

The TSC Act also provides the mechanism for applying for and obtaining licences to take actions which will or is likely to result in harm to any animal that is a threatened species, population or ecological community, the picking of any plant which is part of a threatened species, population or ecological community, damage to critical habitat or damage to habitat of a threatened species, population or ecological community where such actions require a licence to be obtained.

TSC Act and EPBC Act listed communities occur across the property, White Box - Yellow Box - Blakely's Red Gum Woodland and Derived Native Grasslands, and Weeping Myall Woodland. However, the proposed well lease has been located within an area that is not commensurate with either community. No threatened flora or fauna species were located on the well lease or access tracks. The potential direct and indirect impacts that may be associated with the proposal are considered to be minimal. A range of mitigation and management measures have been identified, to minimise potential indirect ecological impacts. No significant impact on the White Box - Yellow Box - Blakely's Red Gum Woodland or Weeping Myall Woodland will occur as a result of the proposed activity.

4.5 National Parks and Wildlife Act

Threatened Species

Part 8A of the *National Parks and Wildlife Act 1974* (NPW Act) regulates the undertaking of activities which may impact on threatened species, populations and ecological communities listed under the TSC Act and their habitats. The NPW Act provides that a person must not harm any animal that is a threatened species, population or ecological community, pick any plant which is part of a threatened species, population or ecological community, damage any critical habitat or damage any habitat of a threatened species, population or ecological community without a licence being obtained under the NPW Act or TSC Act or unless another exception applies.

The NPW Act provides that these requirements do not apply if the action was essential for the carrying out of an activity in accordance with an approval of a determining authority under Part 5 of the EP&A Act where the determining authority has complied with Part 5.

Aboriginal Cultural Heritage

The NPW Act conserves places, objects and features of significance to Aboriginal people.

It is an offence under the NPW Act to:

- harm or desecrate an object that the person knows is an Aboriginal object except in accordance with an Aboriginal heritage impact permit;
- harm or desecrate Aboriginal objects and Aboriginal places except in accordance with an Aboriginal heritage impact permit or where the person can show they exercised due diligence to reasonably determine that no Aboriginal object would be harmed;

An Aboriginal Heritage Due Diligence Report has been prepared by RPS (**Appendix C**). As part of the due diligence investigation, RPS undertook a desktop review of the environmental and archaeological contexts of the project area, including an analysis of the landscape surrounding the project area, a review of prior archaeological investigations and a search of the OEH's AHIMS database. That search showed a total of 19 previously recorded sites within 10km of the proposed core hole location. The most common site identified was scarred/modified trees. A site inspection was also conducted. As a result of the desktop study and site inspection, it was concluded that there were no archaeological constraints to the drilling of the core hole.

4.6 Native Vegetation Act

The *Native Vegetation Act 2003* (NV Act) sets a framework for:

- Encouragement of revegetation and rehabilitation of land with appropriate native vegetation;
- Providing incentives for landholders to undertake management of native vegetation on their properties; and
- An end to broad scale clearing, unless it improves or maintains the environment.

The NV Act provides three categories of native vegetation including regrowth, protected regrowth and remnant vegetation with clear definitions.

The NV Act provides greater flexibility and incentives for landholders to manage native vegetation sustainably. The Act gives effect to the Government's commitment to ending broad scale clearing unless it improves or maintains environmental outcomes.

Under section 25(h), the NV Act does not apply to any clearing that is part of an activity carried out in accordance with an approval from a determining authority within the meaning of Part 5 of the EP&A Act where the determining authority has complied with Part 5. Under section 25(m), the NV Act does not apply to any clearing authorised under the *Petroleum (Onshore) Act 1991 (NSW)*.

4.7 Protection of the Environment Operations Act

The primary objective of the *Protection of the Environment Operations Act 1997 (NSW)* (POEO Act) is to "protect, restore and enhance the quality of the environment in New South Wales, having regard to the need to maintain ecologically sustainable development". The POEO Act requires entities intending on carrying out an activity declared to be a "scheduled activity" under schedule 1 to hold an environmental protection licence (EPL) and comply with the conditions set out in the EPL.

The proposed activities are not a scheduled activity and an EPL is not required.

4.8 Heritage Act

The main objective of the *Heritage Act 1977 (NSW)* (Heritage Act) is to encourage the conservation of the heritage of New South Wales. It prevents impacts on "relics", which are defined as:

any deposit, artefact, object or material evidence that:

(a) relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and

(b) is of State or local heritage significance.

Under the Heritage Act, it is an offence to "disturb or excavate any land knowing or having reasonable cause to suspect that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed unless the disturbance or excavation is carried out in accordance with an excavation permit". The proposed activities have been located to reduce the risk of impacting upon relics. There are no items of heritage significance listed as occurring on the subject site in either the Gunnedah LEP 1998 or on the NSW State Heritage Register. A number of items of local and State heritage significance were recorded as occurring within the Gunnedah Local Government Area, however these are not located in close proximity to the subject site.

Four sites within the Gunnedah LGA are listed on the Commonwealth Register of National Estate, however none of these are on the subject site.

4.9 Water Legislation

Water Act 2007 (Cth)

The *Water Act 1997 (Cth)* (Commonwealth Water Act) regulates the management of water resources in the Murray-Darling Basin. One of the main objectives of the Commonwealth Water Act is to establish the powers for the Murray-Darling Basin Authority to prepare and implement the Murray-Darling Basin Plan.

The Murray Darling Basin Plan will establish limits on the quantities of surface water and groundwater which can be accessed from "Basin water resources" in each of 78 "sustainable diversion limit" (SDL) areas within the Murray Darling Basin. "Basin water resources" includes all water resources within, or beneath the Murray Darling Basin but does not include groundwater that forms part of the Great Artesian Basin (GAB).

Water Act 1912 (NSW)

The *Water Act 1912* (Water Act) was the principal legislation for regulating access to surface water and groundwater in NSW from 1912 to 2000. The Water Act is being phased out and replaced with the *Water Management Act 2000* (NSW) (Water Management Act). However, the Water Act still applies to some activities in parts of NSW.

The Water Act currently applies to the drilling of wells for groundwater. Under Part 5 of the Water Act, a bore licence will be required to be obtained from the NSW Office of Water for the sinking of the core hole.

Under Part 8 of the Water Act Approval is required for controlled works (earthworks, embankments or levees) on a designated floodplain. Any land within the Liverpool Plains that has a slope of less than 2% slope is designated floodplain under Section 166 of the Water Act 1912.

Water Management Act 2000 (NSW)

The *Water Management Act 2000* applies in respect of groundwater resources which are regulated by water sharing plans (WSPs). A WSP is a statutory water management instrument prepared under the Water Management Act.

A Draft Water Sharing Plan for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2011 has been prepared but is not yet in force. The location of the proposed core hole falls within the Gunnedah-Oxley Basin MDB Groundwater Source within the WSP. If the Draft Water Sharing Plan commences, then approvals will be required to be considered under the Water Management Act instead of the bore licences under the Water Act. Water licences, water use approvals and water supply work approvals under the Water Management Act will not be required because the *Water Management (General) Regulation 2004* (NSW) provides an exemption from the requirement to obtain these licences and approvals for prospecting for petroleum under the Petroleum (Onshore) Act 1991 in relation to water required for that purpose.

5.0 Environmental Impacts and Mitigation

5.1 Introduction

This section of the REF addresses the potential environmental impacts associated with the proposal and any mitigation measures required to ensure that they are appropriately managed. A number of specialist investigations were prepared to assist in assessing these impacts, including:

- Ecological Assessment, prepared by RPS
- Noise Assessment prepared by Heggies (now SLR)
- Aboriginal Heritage Due Diligence Report, prepared by RPS
- Advice on Lake Goran Flood Levels, prepared by RPS Aquaterra

5.2 Ecology

5.2.1 Flora & Fauna

Impacts

An ecological assessment has been prepared by RPS for the subject site and is provided in **Appendix A**. The findings of this report are outlined in Section 2.3 of this REF. In summary, no threatened flora or fauna species were identified on the site, nor was the site identified as likely to provide habitat for threatened species.

The vegetation located on the site is not representative of a federally listed Threatened Ecological Community (TEC), state Endangered Ecological Community (EEC) or potential koala habitat, however two listed (Federal and State) vegetation communities were found to occur in the broader study area Weeping Myall (*Acacia pendula*) Woodland and White Box (*Eucalyptus albens*) – Yellow Box (*E. melanophloia*) Woodland. These communities occur adjacent the access tracks and will not be impacted by the proposal.

A range of short-term impacts are associated with the proposed activities, including impacts arising from vegetation removal, soil disturbances, and construction activities.

The potential impacts associated with the proposed activities are generally short-term and temporary. The proposed core hole lease is located within an area that has been heavily disturbed by intensive grazing. This area is in poor ecological condition and of little habitat value due to the high levels of disturbance. As such, impacts are considered to be negligible.

An assessment of potential ecological impacts associated with the proposal has been undertaken, including:

- Threatened Species;
- Potential short-term and long-term impacts;
- Potential disturbances to Lake Goran;
- Disruption of breeding cycle, roosting and sheltering behaviour;
- Introduction and spread of weeds and feral pest species; and
- Noise.

Each of the above listed potential impacts is discussed in greater detail below.

Threatened Species

Section 5A of the EP&A Act lists seven factors that must be taken into account in the determination of the significance of potential impacts proposed activities on ‘threatened species, populations or ecological communities (or their habitats)’ listed under the TSC Act. The Assessment of Significance (7-part test) is used to determine whether activities are ‘likely’ to cause ‘a significant impact’ on threatened biota and thus whether a Species Impact Statement (SIS) is required.

A number of threatened fauna species, five threatened flora species and two ecological communities were identified as potentially occurring, or occurring in the broader study area, however these were not identified as occurring on the subject site. The likely level of impact on these species and ecological communities was assessed in Appendix C of the Ecological Assessment (**Appendix A**). While the assessment indicated that no significant impact is likely for each threatened species and community, a 7-part test of significance has been conducted for the following species and communities (Appendix D of the Ecological Assessment (**Appendix A**)):

- White Box – Yellow Box and Blakely’s Red Gum Woodland;
- Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes Bioregions; and
- Koala.

The application of the 7-part test concluded that there is not likely to be a significant impact on the above species or communities arising from the proposed activities.

The access track traverses an area of White Box – Yellow Box Woodland, which is considered to be suitable Koala habitat. While the proposed activity will not result in the removal or interference of canopy trees, an Environmental Management Plan has been prepared for the site, outlining Koala mitigation measures (**Appendix F**).

Potential Short-term and Long-term Impacts

Temporary short-term impacts will be associated with the establishment and operation of the core hole. There will be no long term impacts.

The proposed rehabilitation and revegetation of the well lease and access track will reinstate vegetation of greater structural diversity and habitat value over the long-term in comparison to what currently occurs at the well lease. Rehabilitation will be completed within 6 months of decommissioning.

In consideration of site rehabilitation and revegetation activities that are to occur at the core hole site once decommissioning has occurred, it is unlikely that there will be any long-term impacts associated with the proposed activities. Furthermore the rehabilitation and revegetation of the activity site and study area is likely to benefit the local ecology over the long-term, particularly given the current poor ecological condition of the site.

Potential Disturbances to Lake Goran

The proposed well lease is located approximately 1.5km from the highest water level of Lake Goran. Construction activities have the potential to impact upon Lake Goran, due to erosion and sedimentation, chemical spills, and runoff. An Environmental Management Plan has been prepared for the proposed works, based on the mitigation measures outlined in this REF (**Appendix F**). This EMP will be complied with by all personnel during construction and operation. This will ensure that the potential impacts on Lake Goran associated with construction activities will be appropriately managed.

Disruption of Breeding Cycle, Roosting and Sheltering Behaviour

The breeding cycle, roosting, sheltering and foraging behaviour for some species may potentially be impacted by the proposed activities that utilise Lake Goran, due to additional noise, light, and vehicle traffic.

Introduction of Weeds and Feral Pest Species

The proposed activities have the potential to create favourable conditions for additional introduced weed species within the study area, which could potentially lead to an increase of existing weed populations. This is most likely to occur where soil disturbance is to occur.

All plant and machinery will be washed down and cleaned of any foreign soil and seed prior to being transported onsite to prevent the potential spread of introduced weeds and pathogens.

Disturbance of surface soils along access roads/ tracks and where re-shaping/ re-levelling earthworks are proposed to occur may encourage weed growth. Weed species, especially those listed as noxious, shall be removed from site or controlled by means of herbicide applications to help prevent or minimise their re-occurrence within the proposed activities footprints. Where practical these weeds shall be removed from site or controlled by means of herbicide applications to help prevent or minimise their re-occurrence.

Noise

Noise pollution as a result of vehicles, machinery and drilling may deter native fauna from the study area. The proposed activities could affect the migration and dispersal ability of native fauna particularly in relation to noise and vehicular movements. The proposed activities may result in short term increased noise pollution which has the potential to temporarily disrupt the breeding cycle and the foraging and roosting behaviour of some native fauna species.

5.2.2 Matters of National Environmental Significance

An EPBC Act Protected Matters Search was undertaken within the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) on-line database to generate a list of those Matters of National Environmental Significance (MNES) from the area, which may have the potential to occur within the subject site. This data, combined with other local knowledge and records, was utilised to assess whether the type of activity proposed on the site will have, or is likely to have a significant impact upon a MNES, or on the environment of Commonwealth land*.

* The site is not land owned by the Commonwealth, and hence this portion of the Act is not applicable. The MNES and site-specific responses are listed below.

Table 5-1 Matters of National Environmental Significance

Matter of National Environmental Significance	Overview
World Heritage Areas	The site is not a World Heritage area, and is not in close proximity to any such area.
Wetlands protected by international treaty (the RAMSAR convention)	The site is not part of any RAMSAR Wetland area. Lake Goran, located approximately 1.5km to the south of the core hole site is not a RAMSAR wetland. However, it is listed on the Directory of Important Wetlands in Australia as a Seasonal/intermittent freshwater lake.
Nationally listed threatened species, migratory species and	Five threatened fauna species, six threatened flora species and two ecological communities were identified as potentially occurring, or occurring in the site locale.

Matter of National Environmental Significance	Overview
ecological communities	A likely level of impact on these species and ecological communities was assessed. While the assessment indicated that no significant impact is likely for each threatened species and community, an assessment under the <i>EPBC Act Policy Statement 1.1 - Significant Impact Guidelines Matters of National Environmental Significance</i> (DEWHA, 2009) has been conducted for the following TEC identified as occurring on site: ▪ White Box – Yellow Box, and Blakely's Red Gum Woodland and Derived Native Grasslands; and ▪ Weeping Myall Woodland. The application of the assessment of significance concluded that there is not likely to be a significant impact on the above communities arising from the proposed activities.
All nuclear actions	No type of nuclear activity is proposed for the site.
Commonwealth marine areas	The proposed activity on the site will not have a significantly adverse effect on any Commonwealth marine area.

Mitigation Measures

- All liquids (fuel, oil, cleaning agents, drilling liquids etc) will be stored appropriately and disposed of at suitably licensed facilities.
- Spill management procedures will be implemented as required.
- Rubbish will be collected and removed from the site to ensure it does not enter surrounding areas.
- Appropriate erosion and sediment control will be installed.
- The disturbance area will be minimised to reduce unnecessary clearing and earthworks. Additionally, the disturbance area around the lease will be appropriately fenced to ensure machinery is limited to the designated disturbance area.
- Vehicle speeds will be limited to reduce dust generation.
- Where access tracks are required, they will be located along existing track routes. Additional clearing will result in the clearing of disturbed grasslands only.
- Weed management procedures will be implemented to prevent the spread of weeds both on and off site.
- Where vehicles and machinery are moving between the site and weed free areas, wash down procedures will be implemented.
- Noogoora Burr, a Class 4 declared noxious weed will be appropriately controlled within the proposal footprint and along the proposed access road and tracks prior to the construction stage.
- Weed monitoring will occur throughout the construction phase, and weed removal will be carried out as necessary.
- Following drilling of the core hole and plug and abandonment, the disturbance area will be appropriately rehabilitated to meet landholder requirements. Given that the core hole lease is currently used for grazing, it will be re-instated to natural grassland to provide site stability.
- No weed species will be used to rehabilitate the core hole site.

5.3 Heritage

5.3.1 Aboriginal Heritage

Impacts

An Aboriginal Heritage Due Diligence Report has been prepared over the site by RPS (**Appendix C**). As part of the due diligence investigation, RPS undertook a desktop review of the environmental and archaeological contexts of the project area, including an analysis of the landscape surrounding the project area, a review of prior archaeological investigations and a search of the OEH's AHIMS database. That search showed a total of 19 previously recorded sites within 10km of the proposed core hole location. The most common site identified was scarred/modified trees.

A site inspection by RPS and a Santos Cultural Heritage Officer was also conducted on 23 August 2011. Given that there were no mature trees, no stone outcropping, no overhangs or rocky shelters, no sandstone nor any other discernible landform feature or environmental resource suitable for Aboriginal exploitation or occupation, the report concluded that it is highly unlikely that the proposed core hole would have any ability to harm Aboriginal cultural heritage or material items. The archaeological field survey identified no Aboriginal material at risk of impact from the proposed works.

An area exceeding the core hole footprint was assessed for the purposes of due diligence and included areas likely to undergo modification during drilling works, proposed access routes to the drill locations and turning circles for vehicles. The proposed core hole was not situated close to known cultural heritage sites. There was no evidence of any Aboriginal artefacts at the core hole location or along the proposed core hole access track. Therefore it is considered that there is no impediment for work for the proposed drilling programme to proceed at the proposed core hole locations investigated in this report.

The proposed core hole was positioned in a highly modified landform. As such, any core hole works undertaken in this location meets the low impact activity criteria under the *National Parks and Wildlife Service NSW 2009* and described in Section 7.5 of the *NSW DECCW 2010 Due Diligence Code of Practice for the protection of Aboriginal Objects in NSW*.

No Aboriginal or European Cultural Heritage sites were identified at the core hole location inspected during the course of the archaeological survey. As such no archaeological constraints apply to the proposed drilling within the bounds of the drilling footprints at the core hole location.

As a result of the desktop study and site inspection, it was concluded that there were no archaeological constraints to the drilling of the core hole. It is considered that the potential impacts associated with Aboriginal heritage can be appropriately managed if the mitigation measures presented below are proposed.

Mitigation Measures

To limit any potential impact on any unknown Aboriginal sites or objects the following measures are proposed:

- All relevant Santos staff and subcontractors should be made aware of their statutory obligations for heritage under NSW NPW Act (1974) and the NSW Heritage Act (1977), which may be implemented as a heritage induction.
- Minimise impact to areas outside the area of operation through appropriate on-site induction of all employees and contractors attending site.
- Vehicle access is to remain within existing tracks where possible in order to minimise potential impacts on surrounding vegetation and reduce erosion.

- In the event that any vegetation clearing is required to allow large machinery access to a given area, soil disturbance shall be kept to a minimum. Subject to ecological constraints, it is preferable for vegetation to be cut with a chain saw rather than bulldozed, and trees and bushes shall be cut at their base just above ground level where possible.
- If works fall outside of the areas inspected for the purposes of the cultural heritage assessment or access routes are altered those areas must be further investigated by a qualified archaeologist.
- If Aboriginal site/s are identified in the project area during works, then all works in the area should cease, the area cordoned off and contact made with OEH Enviroline 131 555, a suitably qualified archaeologist and the relevant Aboriginal stakeholders, so that it can be adequately assessed and managed.
- In the event that skeletal remains are uncovered, work must cease immediately in that area and the proponent, Santos QNT Pty Ltd, will need to contact the NSW Police Coroner to determine if the material is of Aboriginal origin. If determined to be Aboriginal, they must then contact OEH Enviroline 131 555 and relevant Aboriginal stakeholders in order to determine an action plan for the management of the skeletal remains prior to works re-commencing.

5.3.2 Other Cultural Heritage

Impacts

As stated above, no European cultural heritage sites were identified during the site inspection.

There are no items of heritage significance listed as occurring on the subject site in either the Gunnedah LEP 1998 or on the NSW State Heritage Register. A number of items of local and State heritage significance were recorded as occurring within the Gunnedah Local Government Area, however these are not located in close proximity to the subject site.

Four sites within the Gunnedah LGA are listed on the Commonwealth Register of National Estate, however none of these are on the subject site.

It is considered that the potential impacts associated with other cultural heritage can be appropriately managed if the mitigation measures presented below are implemented.

Mitigation Measures

It is considered highly unlikely that any items of other cultural heritage significance will be impacted by the proposed drilling. Nonetheless, heritage items are protected by legislation in NSW. If, during the course of development works, significant European cultural heritage material is uncovered, work should cease in that area immediately. OEH should be notified and works only recommence when an appropriate and approved management strategy instigated.

5.4 Groundwater

Impacts

Due to the type of activity proposed, water from the targeted coal seams is not anticipated to be lifted. Potential impacts associated with drilling and well installation are the result of improper drilling, well installation or borehole abandonment. The primary risks include;

- (1) Creating an artificial connection between water-bearing formations that bypasses aquitards or aquicludes; and
- (2) Loss of drilling fluid into the formation (resulting in degradation of water quality).

There are potential impacts of any drilling in mixed multi-aquifer systems that relate to the possibility of cross contamination of aquifers, the possibility of contamination of the aquifers by drilling muds/fluids and groundwater discharging to the surface, which might cause flooding or impact on surface water quality depending on the discharge and receiving water qualities.

The factors that traditionally contribute to these risks include inadequate design, construction and well head completion techniques for the wells, poor planning of drilling programmes, inappropriate drilling techniques and/or drilling fluid selection, and inappropriate abandonment methods. The proposed drilling and well construction and abandonment methodologies would eliminate this risk.

During drilling, the circulating drilling mud will establish a wall cake (low permeability “skin” around the wall of the hole) and also maintain a positive head (pressure) on the various aquifers intercepted. This will both prevent the ingress of groundwater to the hole (and any possible mixing or discharge to the surface) and also limit the ingress of drilling mud into the aquifers to the immediate vicinity of the chip hole.

At the completion of the drilling of the shallow and intermediate sections of the wells, each section will be cased with steel pipe and pressure cemented into place and this will provide a solid barrier to prevent any ingress, mixing or discharge of groundwater. Following the completion of drilling activities, the wells will be plugged and cement grouted, further providing a solid barrier to any of the possible mixing and cross contamination processes.

Mitigation measures to minimise/negate the risk of impacts and to confirm that no impact has occurred are identified below.

Mitigation Measures

To minimise impacts on groundwater, the following mitigation measures are proposed.

- Drilling and installation of the well is to be consistent with good industry practice.
- Monitoring of private groundwater bores within a 2km radius (with landholder permission) be undertaken before drilling commences, to more clearly establish baseline conditions and then continue monitoring on a regular basis throughout the duration of all drilling activities. It is proposed that monitoring will include water level and water quality (electrical conductivity) observations.
- Drilling sumps will be lined (with an appropriate impermeable material) and that all drilling fluids are completely removed from site prior to site rehabilitation.
- Once the well is no longer required it will be decommissioned.

In addition to the above, the natural existence of shallow subsurface alluvium (which contains relatively impermeable clays) will further minimize potential water quality risks associated with possible partial failure of these mitigation measures. These clays will tend to hold any contaminant in the near surface zone above the water table.

The management measures to control the handling and storage of chemical and hazardous substances and for spill prevention and response are identified in Section 5.9. Measures to minimise and manage waste are identified in Section 5.11.

5.5 Air

Impacts

The existing air quality of the locality is typical of a rural area with the majority of air emissions and pollutants arising from existing agricultural activities including stock grazing, land clearing and soil preparation, sowing and harvesting of crops, vehicle and heavy machinery movements, bushfires and burn-offs.

The potential for the activity to introduce additional air emissions would arise from the following sources:

- vehicle movements to and from the sites;
- construction and rehabilitation of the proposed access tracks and core hole site;
- drilling and testing of the core hole;
- flaring of gas; and
- operation of plant (such as temporary power generation).

The primary air emissions associated with the proposal will be dust and greenhouse gases.

The dust generated by drilling and ancillary equipment travelling to and from the site would vary depending on road and weather conditions. The existing access track is in good condition and is proposed to be topped with gravel prior to the commencement of drilling activities. The new access track will also be constructed with gravel. Vehicle movement would be very slow and therefore minimal dust would be generated. In the context of the surrounding agricultural activities this will not be a significant issue.

Damage to any access roads would be repaired as soon as possible after occurrence to minimise any impact on the landholder or the public. No impact on roadside vegetation is anticipated.

The inclusion of a flare pit is a safety precaution associated with the drilling activities to minimise potential risk to personnel or plant on the site so that any gas that is encountered during drilling can safely flare in accordance with Santos' established process for flaring.

Santos will notify the Gunnedah Shire Council of the proposed start time of drilling prior to its commencement and will liaise with the appropriate Council representatives should any repairs to Council roads be necessary.

As the proposed activities are associated with exploration, potential contributions to greenhouse gases, for the duration of the activities, are confined to:

- the operation of diesel fuelled vehicular traffic;
- plant including the drilling rig;
- flaring in the event of an emergency; and
- site power generation.

Collectively these represent minimal emissions when compared with the agricultural activities that take place throughout the region. It is considered that the potential impacts associated with air emissions can be appropriately managed if the mitigation measures presented below are implemented.

Mitigation Measures

To minimise impacts on air quality the following actions will be undertaken:

- Access tracks are to be gravelled and maintained in a compacted state.

- Land disturbance areas are to be minimised.
- Slow speed restrictions will be enforced on internal site access tracks.

5.6 Noise

Impacts

The site is located in an agricultural area and the existing noise levels are relatively low.

Drilling activities are temporary and noise will be generated by the construction of the lease and track infrastructure for a duration of approximately 14 days, drilling over approximately 56 days and rehabilitation for approximately 30 days.

This equates to a total of approximately 70 days of construction and drilling and approximately 30 days of rehabilitation. Drilling activities will be 24 hours per day 7 days per week with lease and track construction activities to be conducted over a 12 hour 6am to 6pm shift. Mufflers are installed on the power plants and prime movers used for the powering and mobilisation of the drilling rig.

Drilling operations will be undertaken in accordance with landowner and State government requirements.

The nearest residence is approximately 2.5km from the site.

A generic, or 'flat earth', noise assessment was undertaken by Heggies (now SLR) in 2009 for a Santos Drill Rig 13 (the drill rig to be used for this proposal) and the results of this are useful in indicating potential impacts to the properties identified above. This noise assessment is presented in **Appendix B**.

The results of the study show the predicted noise levels at a range of distances from the equipment and considers both neutral and worst case weather conditions.

Noise Criterion

Background noise for the location is assumed to be below 30dBA and therefore the Rating Background Level (RBL) is taken to be 30dBA, as per the NSW Industrial Noise Policy (INP).

The Noise Affected level for daytime according the NSW DECCW Interim Construction Noise Guideline is determined as RBL plus 10 dBA. The Noise Affected level for evening and night (i.e. outside recommended hours, which are defined as Monday to Friday 7am to 6pm and Saturday 8am to 1pm, with no work Sundays or public holidays) is determined as RBL plus 5 dBA. This equates to a daytime noise goal of 40 dBA and a night time goal of 35dBA.

According to the generic Drill Rig 13 (previously known as McD 29) assessment, in neutral weather at 2km from the site noise levels are predicted to be 19 LAeq dBA and in worst case conditions 23 LAeq dBA. However the nearest residential property is further away at 2.5km from the site and therefore noise levels are expected to be lower than those at 2km from the site, will be negligible and well below the specific noise criteria of 40 dBA and 35 dBA for daytime and night time (i.e. outside recommended hours) activities respectively.

It is considered that the potential impacts associated with noise can be appropriately managed if the mitigation measures presented below are implemented.

Mitigation Measures

To minimise the potential impacts on noise the following actions will be implemented:

- Santos will ensure that any community issues of concern will be met with a prompt response.
- Santos will undertake to refine on site noise mitigation measures and plant operating procedures where practical.
- Landholder notification will be given prior to commencement of drilling.
- Equipment will be maintained so that noise levels remain constant.

5.7 Surface Water

Impacts

Lake Goran is located to the south of the proposed core hole. The location of the well lease within the Boenery Park property has been selected to avoid potential impacts on Lake Goran and is therefore located 1.5km from the highest water level of the lake.

The lake is ephemeral, with water levels fluctuating throughout the year and is identified as a nationally important wetland (however is not listed as a RAMSAR wetland).

During flood events, Lake Goran spills to the east into the Mooki River (Zhang et al, 1997). Recharge under Lake Goran has also been estimated at approximately 6mm per year (Zhang et al, 1997).

RPS Aquaterra have undertaken an investigation into the water levels of the lake (refer **Appendix E**). The proposed well lease is located above the highest recorded flood level of the lake and will therefore not be impacted by flooding.

There is the potential for the proposed activities to impact on the surface water quality of Lake Goran through sedimentation and site run-off. These issues and associated mitigation measures are discussed in detail in Section 5.8 below.

There is also the potential for chemicals and fuels to come in contact with surface waters. These issues and associated mitigation measures are discussed in detail in Sections 5.9 and 5.10 below.

Water for drilling operations will be sourced from Council or another licensed provider.

It is considered that the potential impacts associated with surface water can be appropriately managed if the mitigation measures presented below are implemented.

Mitigation Measures

Proposed measures to protect surface waters include:

- Contaminated waters will be contained and where necessary disposed of at an appropriate facility.
- Drilling fluids will be contained on site and not discharged to surrounding watercourses. Over-balanced drill techniques to be utilised to prevent formation fluid from rising through the well to the surface.
- Excessive fluid losses will be cured by LCM (cellulose material such as sawdust) to ensure most fluids return to the surface.
- Sediment fences and traps will be installed so as to prevent soil loss or sedimentation.
- Fuel and lubricants will be stored on site only when necessary and maintained off site whenever possible.
- All areas storing or handling fuel, fuel using equipment, and chemicals will be bunded in accordance with Australian Standard 1940 – 2004; The Storage and Handling of Flammable and Combustible Liquids.
- The maintenance and cleaning of vehicles and other equipment or plant will be carried out in areas from

where the resultant contaminants cannot be released into any waters.

- Wastewater removed from site will be managed by a contractor licensed to carry and handle water.
- Where applicable maintenance of roads, drains, bund walls, contour and diversion banks to occur. All drainage structures will be maintained for the life of the development.
- Disturbed land will be rehabilitated to pre-operational quality or better, to minimise sediment erosion.
- During rehabilitation, diversion banks and ripping along the contour will be completed to prevent the concentration and momentum of water flow as required.

5.8 Soils

Impacts

The proposed activities will involve earthworks within a defined footprint for the installation of temporary infrastructure and upgrading of track. There is still a potential risk for soil erosion to occur resulting in sediment transport to local waterways. The use of existing access tracks and the selection of a relatively level site will minimise the disturbance footprint of the exploration activities.

Any topsoil will be stripped and stockpiled and topsoil to be reinstated as part of the rehabilitation process. No soil is proposed to be removed from the site.

The site layout plan (Figure 2-3) shows areas where soil will be stockpiled and the locations of erosion control facilities.

Once the drilling and associated activities are complete, the disturbed area will be rehabilitated with appropriate mitigation measures and environmental safeguards implemented to minimise potential impacts. All rehabilitation works will be undertaken with maximum regard to environmental protection and rehabilitation, vegetation, subsoil and topsoil management, weed control, erosion and sedimentation management and revegetation in accordance with the relevant statutory requirements.

There is also a small potential risk of soil contamination occurring from the proposed activities (refer Section 5.10 for further information). The drilling activities require the use of chemicals (particularly drill fluid additives) and other hazardous substances (fuel). These goods will be transported and stored on site for use.

It is considered that the potential impacts associated with soils can be appropriately managed if the mitigation measures presented below are implemented.

Mitigation Measures

The erosion and sediment control measures are proposed as follows:

- Any displaced soil gathered during operations will be stockpiled within the compound. This soil is to be used as backfill at the conclusion of drilling operations.
- Existing ground cover will be maintained where possible.
- Entry/exit points will be stabilised to the work area or any high traffic areas.
- Sediment fences will be installed at the downstream limit of the disturbance area.
- The disturbed area will be rehabilitated upon completion of activities.

The following mitigation measures are proposed to reduce the risk of soil contamination:

- A spill kit will be provided for clean up of spills of diesel, lubricants, oil etc.

- Any spills or leaks will be cleaned up immediately.
- Daily pre-start inspection of plant and equipment will be undertaken to identify any maintenance requirements.
- All potential contaminants will be stored, handled, used and disposed of in accordance with the Materials Safety Data Sheets (MSDS).
- All wastes (other than drill cuttings and sump fluid) will be removed from the site as required.
- Drilling fluids will be contained in sumps or above-ground tanks.
- On-site storage of fuel and lubricants will be minimised.
- Sumps will be adequately maintained.
- Sumps will have overflow capacity in case of heavy rain.
- Any soil that becomes contaminated through contact with drilling fluids, fuels, or lubricants will be removed from the site and disposed of at an appropriate licensed disposal facility.

5.9 Chemical and Hazardous Substances Management

Impacts

The drilling operations would generally only use chemicals such as drilling fluids/agents, fuels, and lubricants. While these substances are not considered highly hazardous, there is still the potential risk of fire and pollution to land, water and air, if an accidental spillage was to occur. The *Occupational Health and Safety Act 2000* and the *Protection of the Environment Operations Act 1997* are the legislative Acts that regulate the use of dangerous goods. The *Dangerous Goods (Road and Rail Transport) Act 2008* regulates the transport of dangerous goods. These Acts would be adhered with through all operations for the proposal.

It is considered that the potential impacts associated with chemical and hazardous substances can be appropriately managed if the mitigation measures presented below are implemented.

Mitigation Measures

Any spills of chemicals used during drilling operations would be managed applying best practice principles, be in accordance with all legislation and standards for the safe handling and storage of hazardous substances and dangerous goods and comply with all occupational health and safety requirements. Any contaminated soil would be removed from the drill location. The drilling contractor is required to comply with their operations EMP and OHS requirements.

5.10 Contaminated Land

Impacts

The location's history of agriculture suggests that the area is unlikely to have been previously contaminated.

The drilling operation will pose minimal impact on the soils. No soil is proposed to be removed from the site. On the completion of drilling all excavated material would be backfilled. Based upon the history of the locations and the minimal impact to site soils during operations, land contamination issues are considered to be minimal for the proposed activity.

It is considered that the potential impacts associated with contamination can be appropriately managed if the mitigation measures presented below are implemented.

Mitigation Measures

Those mitigation measures identified in Sections 5.8, 5.9 and 5.11 aim to ensure that any contamination risk is appropriately managed. No other specific measures are considered necessary.

5.11 Waste Minimisation and Management

Impacts

Drill cuttings and some general site operations waste will be produced as part of the proposed drilling operations. Any solvents, oils and other general waste would need to be managed in an appropriate manner to avoid health risks and contamination of land and waterways. As previously stated, following drilling and removal of excess drilling fluid from the sump, dried cuttings are removed and transported to an appropriate licensed waste facility.

A regular service of amenities will be conducted and waste is to be removed to a licensed facility.

It is considered that the potential impacts associated with waste can be appropriately managed if the mitigation measures presented below are implemented.

Mitigation Measures

- A general Waste Management Strategy based upon the principles of reduce, reuse and recycling shall be implemented.
- A specific Site Waste Management Plan for drilling activities shall be prepared and implemented by the drilling contractor.
- All staff and contractors shall be made aware of waste management procedures during induction.
- Appropriate waste containers shall be provided on the site.
- Any waste generated is to be disposed of in an appropriate manner in accordance with relevant standards and guidelines.
- Spills of waste material shall be dealt with in a prompt and thorough manner, and reported to the appropriate authority if necessary.
- General refuse shall be collected and transported to an approved recycling or disposal site.
- Onsite waste disposal is prohibited.
- Hazardous waste shall be managed in accordance with existing guidelines and standards.

5.12 Natural Resource Use

Impacts

The key natural resources that would be affected by the proposed drilling operations are agricultural land resources and fuels for the drilling equipment and transportation of equipment and staff. While there are coal mines situated in the area, the proposal will have no impact on their operation or production.

The property is currently used for the grazing of cattle. The location for the proposed core hole has been selected taking into account the potential temporary loss of the land during this time and will be fenced such that the remainder of the property can continue to operate for grazing and farming purposes.

The total area of works on the subject site and therefore the amount of agricultural land that would be temporarily taken out of agricultural use for the duration of the project is approximately 13,200m². This represents a relatively minor proportion of the overall area of the subject property.

The lease build and drilling is anticipated to take a approximately 70 days and the rehabilitation approximately 30 days (see Section 3.5). The disturbed areas will be rehabilitated by returning them to at least their pre-operational state or to a condition agreed by the landholder. In the context of the total agricultural land holding and the wider agricultural uses of the region, this temporary loss of agricultural land is of minimal significance.

Fuels will be used for equipment and also for works and staff vehicles although this is not likely to be a significant quantity of fuel use.

It is considered that the potential impacts associated with natural resource use can be appropriately managed if the mitigation measures presented below are implemented.

Mitigation Measures

The temporary loss of the use of the agricultural land will be mitigated through rehabilitation following completion of the temporary activities.

The use of fuel is not considered to be significant however the fuel shall be used as efficiently as possible through appropriate work behaviour (e.g. switching off equipment when not in use).

5.13 Local Community & Neighbouring Properties

Impacts

As described in Section 3.10 Santos has a commitment to open and transparent consultation with the communities that they work in. Over 30 community information sessions have been held since beginning their Gunnedah Basin coal seam gas exploration in 2008. Therefore, the community are kept informed about the activities, stakeholders have the opportunity to speak directly with those undertaking the works and Santos are able to identify matters of concern to stakeholders.

The proposed works that are the subject of this REF are temporary. The nearest residential dwelling is approximately 2.5km to the north east of the site and the site is within an agricultural holding including farm buildings within 1km of the site. The community of Curlewis is approximately 17km from the subject site.

The effect associated with the temporary loss of the agricultural use of the land is described in Section 5.12 above. Santos has entered into a Land Access Agreement with the landholder as required under the Petroleum (Onshore) Act 1991.

Based on the available noise investigation, it is not anticipated that there will an exceedance of relevant noise criteria at the closest residence (refer Section 5.6).

There is not anticipated to be a significant visual impact because the activities are temporary.

It is considered that the potential impacts associated with the local community and neighbouring properties can be appropriately managed if the mitigation measures presented below are implemented.

Mitigation Measures

In order to minimise impacts on landholders the following measures are identified:

- Undertake ongoing landholder and stakeholder consultation.
- Respond promptly to any community concerns or complaints.
- Inform community promptly of any changes to timing or scheduling which will have an adverse impact on them.

5.14 Visual Assessment

Impacts

The operations are temporary in nature, with a duration of approximately 100 days and all equipment will be removed on completion of site activities. The closest residence is approximately 2.5km away. Following completion of the works all sites will be rehabilitated and would not detract from the overall scenic qualities of the area.

No significant impacts on the visual amenity of the area are expected from the proposed drilling.

Mitigation Measures

Visual impacts will be mitigated through rehabilitation in the short to medium term.

No other specific measures are proposed to mitigate against visual impacts, as any impacts would be negligible and short term.

5.15 Land Use

Impacts

As described in Section 2.1 the site is currently used for cattle grazing. The land will be rehabilitated to its pre-operation state or to a condition agreed with the landholder. Refer Section 5.12 for further details.

The site is located within PEL 1, which has overlapping coal tenures as identified on Figure 5-1. There are no known coal mining operations planned for this site, however the well is designed such that it will pose no threat or hazard to future coal mining.

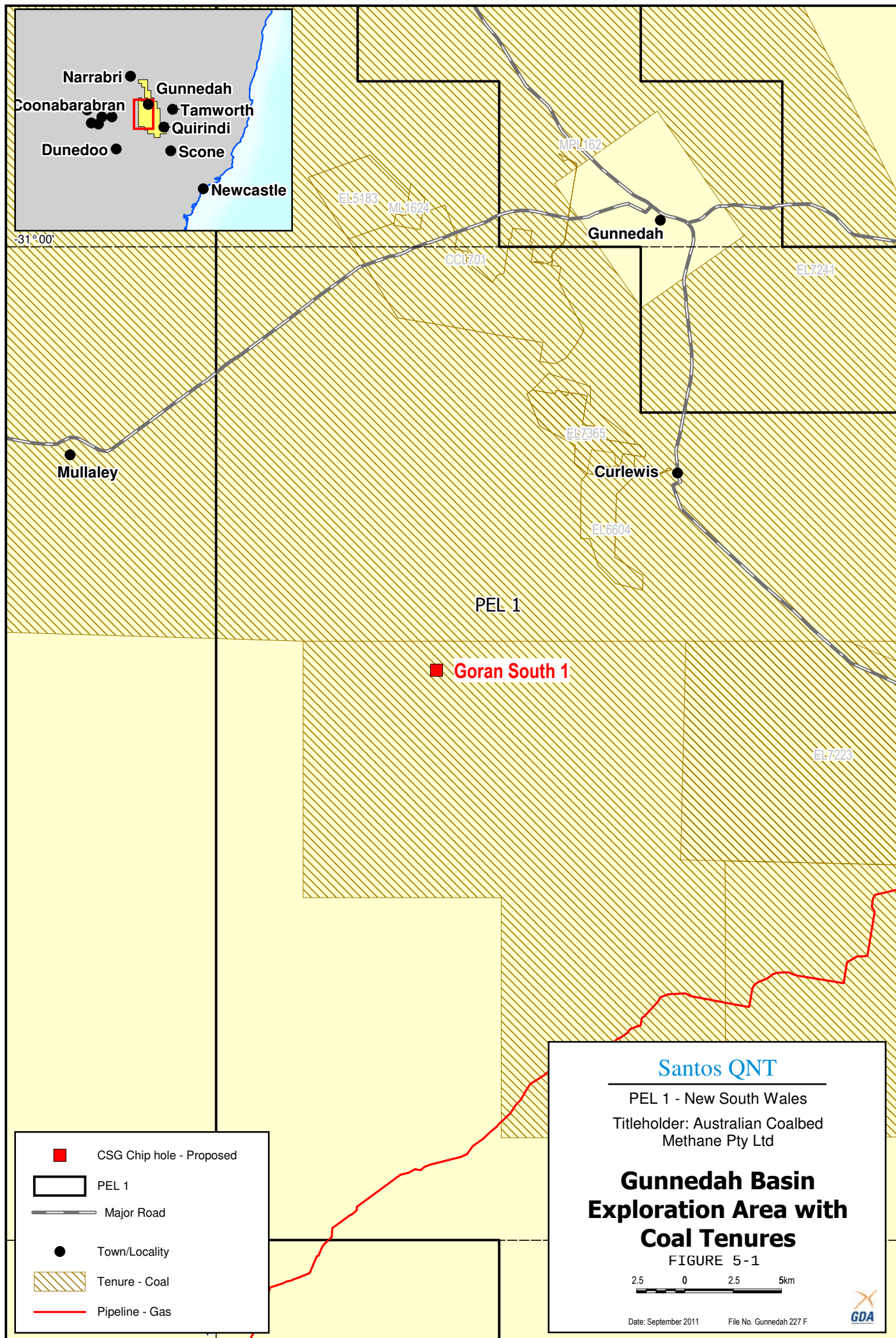
It is considered that the potential impacts associated with land use can be appropriately managed if the mitigation measures presented below are implemented.

Mitigation Measures

The loss of the use of the agricultural land will be mitigated through rehabilitation following completion of the temporary activities.

5.16 Cumulative Environmental Impacts

The only well within 10km of the site is the Lake Goran 1. This well has been plugged and abandoned and there will therefore be no cumulative impacts associated with drilling or site activities associated with the well. This includes impacts in relation to noise, traffic and ecology.



5.17 Summary of Mitigation Measures

The following table provides an overview of the mitigation measures proposed in Section 5. It is considered that all potential impacts identified in this section can be appropriately managed if these mitigation measures are implemented.

Table 5-2 Summary of Mitigation Measures

Potential Impact	Proposed Mitigation Measure
Ecology	- All liquids (fuel, oil, cleaning agents, drilling liquids etc) will be stored appropriately and disposed of at suitably licensed facilities. - Spill management procedures will be implemented as required. - Rubbish will be collected and removed from the site to ensure it does not enter surrounding areas. - Appropriate erosion and sediment control will be installed. - The disturbance area will be minimised to reduce unnecessary clearing and earthworks. Additionally, the disturbance area around the lease will be appropriately fenced to ensure machinery is limited to the designated disturbance area. - Vehicle speeds will be limited to reduce dust generation. - Where access tracks are required, they will be located along existing track routes. Additional clearing will result in the clearing of disturbed grasslands only. - Weed management procedures will be implemented to prevent the spread of weeds both on and off site. - Where vehicles and machinery are moving between the site and weed free areas, wash down procedures will be implemented. - Noogoora Burr, a Class 4 declared noxious weed will be appropriately controlled within the proposal footprint and along the proposed access road and tracks prior to the construction stage. - Weed monitoring will occur throughout the construction phase, and weed removal will be carried out as necessary. - Following drilling of the core hole and plug and abandonment, the disturbance area will be appropriately rehabilitated to meet landholder requirements. Given that the core hole lease is currently used for grazing, it will be re-instated to natural grassland to provide site stability. - No weed species will be used to rehabilitate the core hole site.
Aboriginal Heritage	- All liquids (fuel, oil, cleaning agents, drilling liquids etc) will be stored appropriately and disposed of at suitably licensed facilities. - Spill management procedures will be implemented as required. - Rubbish will be collected and removed from the site to ensure it does not enter surrounding areas. - Appropriate erosion and sediment control will be installed. - The disturbance area will be minimised to reduce unnecessary clearing and earthworks. Additionally, the disturbance area around the lease will be appropriately fenced to ensure machinery is limited to the designated disturbance area. - Vehicle speeds will be limited to reduce dust generation. - Where access tracks are required, they will be located along existing track routes. Additional clearing will result in the clearing of disturbed grasslands only. - Weed management procedures will be implemented to prevent the spread of weeds both on and off site. - Where vehicles and machinery are moving between the site and weed free areas, wash down procedures will be implemented. - Noogoora Burr, a Class 4 declared noxious weed will be appropriately controlled within the proposal footprint and along the proposed access road and tracks prior to the construction stage. - Weed monitoring will occur throughout the construction phase, and weed removal will be carried out as necessary.

Potential Impact	Proposed Mitigation Measure
	- Following drilling of the core hole and plug and abandonment, the disturbance area will be appropriately rehabilitated to meet landholder requirements. Given that the core hole lease is currently used for grazing, it will be re-instated to natural grassland to provide site stability. - No weed species will be used to rehabilitate the core hole site.
Other Heritage	It is considered highly unlikely that any items of European cultural heritage significance will be impacted by the proposed drilling. Nonetheless, heritage items are protected by legislation in NSW. If, during the course of development works, significant European cultural heritage material is uncovered, work should cease in that area immediately. OEH should be notified and works only recommence when an appropriate and approved management strategy instigated.
Groundwater	- Drilling and installation of the well is to be consistent with good industry practice. - Monitoring of private groundwater bores within a 2km radius (with landholder permission) be undertaken before drilling commences, to more clearly establish baseline conditions and then continue monitoring on a regular basis throughout the duration of all drilling activities. It is proposed that monitoring will include water level and water quality (electrical conductivity) observations. - Drilling sumps will be lined (with an appropriate impermeable material) and that all drilling fluids are completely removed from site prior to site rehabilitation. - Once the well is no longer required it will be decommissioned. - In addition to the above, the natural existence of shallow subsurface alluvium (which contains relatively impermeable clays) will further minimize potential water quality risks associated with possible partial failure of these mitigation measures. These clays will tend to hold any contaminant in the near surface zone above the water table.
Air	- Access tracks are to be gravelled and maintained in a compacted state. - Land disturbance areas are to be minimised. - Slow speed restrictions will be enforced on internal site access tracks.
Surface Water	- Contaminated waters will be contained and where necessary disposed of at an appropriate facility. - Drilling fluids will be contained on site and not discharged to surrounding watercourses. Over-balanced drill techniques to be utilised to prevent formation fluid from rising through the well to the surface. - Excessive fluid losses will be cured by LCM (cellulose material such as sawdust) to ensure most fluids return to the surface. - Sediment fences and traps will be installed so as to prevent soil loss or sedimentation. - Fuel and lubricants will be stored on site only when necessary and maintained off site whenever possible. - All areas storing or handling fuel, fuel using equipment, and chemicals will be bunded in accordance with Australian Standard 1940 – 2004; The Storage and Handling of Flammable and Combustible Liquids. - The maintenance and cleaning of vehicles and other equipment or plant will be carried out in areas from where the resultant contaminants cannot be released into any waters. - Wastewater removed from site will be managed by a contractor licensed to carry and handle water. - Where applicable maintenance of roads, drains, bund walls, contour and diversion banks to occur. All drainage structures will be maintained for the life of the development. - Disturbed land will be rehabilitated to pre-operational quality or better, to minimise sediment erosion. - During rehabilitation, diversion banks and ripping along the contour will be completed to prevent the concentration and momentum of water flow as required.
Soils	- Any displaced soil gathered during operations will be stockpiled within the compound. This soil is to be used as backfill at the conclusion of drilling operations. - Existing ground cover will be maintained where possible. - Entry/exit points will be stabilised to the work area or any high traffic areas. - Sediment fences will be installed at the downstream limit of the disturbance area.

Potential Impact	Proposed Mitigation Measure
	▪ The disturbed area will be rehabilitated upon completion of activities. ▪ A spill kit will be provided for clean up spills of diesel, lubricants, oil etc. ▪ Any spills or leaks will be cleaned up immediately. ▪ Daily pre-start inspection of plant and equipment will be undertaken to identify any maintenance requirements. ▪ All potential contaminants will be stored, handled, used and disposed of in accordance with the MSDS. ▪ All wastes (other than drill cuttings and sump fluid) will be removed from the site as required. ▪ Drilling fluids will be contained in sumps or above-ground tanks. ▪ On-site storage of fuel and lubricants will be minimised. ▪ Sumps will be adequately maintained. ▪ Sumps will have overflow capacity in case of heavy rain. ▪ Any soil that becomes contaminated through contact with drilling fluids, fuels, or lubricants will be removed from the site and disposed of at an appropriate licensed disposal facility.
Noise	▪ Santos will ensure that any community issues of concern will be met with a prompt response. ▪ Santos will undertake to refine on site noise mitigation measures and plant operating procedures where practical. ▪ Landholder notification will be given prior to commencement of drilling. ▪ Equipment will be maintained so that noise levels remain constant.
Chemical and Hazardous Substances	▪ Any spills of chemicals used during drilling operations would be managed applying best practice principles, be in accordance with all legislation and standards for the safe handling and storage of hazardous substances and dangerous goods and comply with all occupational health and safety requirements. Any contaminated soil would be removed from the drill location. The drilling contractor is required to comply with their operations EMP and OHS requirements.
Waste	▪ A general Waste Management Strategy based upon the principles of reduce, reuse and recycling shall be implemented. ▪ A specific Site Waste Management Plan for drilling activities shall be prepared and implemented by the drilling contractor. ▪ All staff and contractors shall be made aware of waste management procedures during induction. ▪ Appropriate waste containers shall be provided on the site. ▪ Any waste generated is to be disposed of in an appropriate manner in accordance with relevant standards and guidelines. ▪ Spills of waste material shall be dealt with in a prompt and thorough manner, and reported to the appropriate authority if necessary. ▪ General refuse shall be collected and transported to an approved recycling or disposal site. ▪ Onsite waste disposal is prohibited. ▪ Hazardous waste shall be managed in accordance with existing guidelines and standards.
Natural Resource Use	▪ The temporary loss of the use of the agricultural land will be mitigated through rehabilitation following completion of the temporary activities. ▪ The use of fuel is not considered to be significant however the fuel shall be used as efficiently as possible through appropriate work behaviour (e.g. switching off equipment when not in use).
Community	▪ Undertake ongoing landholder and stakeholder consultation. ▪ Respond promptly to any community concerns or complaints. ▪ Inform community promptly of any changes to timing or scheduling which will have an adverse impact on them.
Visual	▪ Visual impacts will be mitigated through rehabilitation in the short to medium term. ▪ No other specific measures are proposed to mitigate against visual impacts, as any impacts would be negligible and short term.

Potential Impact	Proposed Mitigation Measure
Land Use	The loss of the use of the agricultural land will be mitigated through rehabilitation following completion of the temporary activities.

5.18 Clause 228 Guidelines

Clause 228 of the EP&A Regulation states that for the purpose of Part 5 of the EP&A Act the following factors are to be taken into account concerning the impact of an activity on the environment. These factors are considered in Table 5-3 and, where relevant, considered elsewhere in this document.

Table 5-3 Clause 228 Guidelines

Factor	Impact
<i>Any environmental impact on the community</i>	Short term negative. The proposed site lies approximately 17 km south west of the closest town, Curlewis. Minor short term impacts such as increase in local traffic would be experienced in the immediate locality. Safeguards proposed in Section 5 and Table 5-2 would minimise these impacts.
<i>Any transformation of a locality</i>	Short term negative. There would be localised and non-permanent visual impact on the immediate vicinity of the core hole for the duration of the programme. Safeguards proposed in Section 5 and Table 5-2 would minimise these impacts.
<i>Any environmental impact on the ecosystems of the locality.</i>	Minor negative. Some temporary disruption to the ecosystem will occur during site operations, however these are minor acceptable impacts and can be appropriately managed.
<i>Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality</i>	Nil. During drilling there may be a reduction in these values due to affecting visual amenity. Given the short-term nature of activities and the safeguards/mitigation detailed in Section 5 and Table 5-2 the potential for a reduction is considered negligible.
<i>Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations</i>	Nil. No locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations will be impacted by the proposal.
<i>Any impact on the habitat of protected fauna (within the meaning of the National Parks and Wildlife Act 1974)</i>	Short term negative. There will be minimal impacts on fauna habitat and mitigation measures are identified. Refer Section 5.2 for further details.
<i>Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air</i>	Nil. The proposal would not endanger any species of animal, plant or other form of life, whether living on land, in water or in the air.
<i>Any long-term effects on the environment</i>	Nil. The proposal would have no long-term effects on the environment. Rehabilitation of the well lease will occur.
<i>Any degradation of the quality of the environment</i>	Minor short term negative. There is potential for minor short term environmental degradation due to visual or dust impacts. Safeguards proposed in Section 5 and Table 5-2 would minimise these impacts.
<i>Any risk to the safety of the environment</i>	Minor short term negative. The proposal may result in short term potential risks to the safety of the environment

Factor	Impact
	due to incidents and spills. The likelihood and consequence of an incident occurring would be reduced through the application of Santos's Standards and mitigation proposed in Section 5.
<i>Any reduction in the range of beneficial uses of the environment</i>	Nil. The footprint of activities for the proposal would not result in any reduction in the range of beneficial use of the environment.
<i>Any pollution of the environment</i>	Nil. The proposal may result in short term potential risk of pollution of the environment due to incidents and spills. The likelihood and consequence of an incident occurring would be reduced through the application of Santos's Standards and mitigation proposed in Section 5.
<i>Any environmental problems associated with the disposal of waste</i>	Nil. Any waste generated by the activities, including drill cuttings, will be collected and removed from site for disposal at approved landfill sites. Given the short term of the proposed activity waste production will be minimal.
<i>Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply</i>	Nil. Resources required for the proposal are not in limited supply in the area.
<i>Any cumulative environmental effect with other existing or likely future activities</i>	Nil. The closest wells have been plugged and abandoned.
<i>Any impact on coastal processes and coastal hazards, including those under projected climate change conditions</i>	Nil. The site is not near the coast.

6.0 Conclusion

RPS has prepared this REF on behalf of Santos QNT Pty Ltd to assess the environmental impact of the proposed drilling and completion of a core hole and ancillary activities within a property known as “Boenery Park” in the Gunnedah Basin. The purpose of the proposal is to investigate the potential coal seam gas resource within Petroleum Exploration Licence No. 1 (PEL 1).

The proposal includes drilling of a core hole at the Goran South 1 location to obtain information on coal depths, seam thickness, continuity, gas composition (as required) and reservoir pressure and permeability. Drill stem testing (DST) or equivalent downhole evaluation is planned to be undertaken on target coal seams to collect information on reservoir pressure and gain an indication of permeability. Drill cuttings may also be collected and analysed for gas composition information.

The proposal comprises temporary, small scale works of a short term duration. Following drilling to the well total depth and required well logging and testing, the well will be plugged and abandoned with cement plugs from total depth to surface.

Specialist assessments have been prepared for the proposal to assist in guiding the location of facilities assessing the potential impacts of the operations. Site specific assessments were undertaken in relation to ecology and cultural heritage. Generic noise assessments for the proposed drill rig and advice regarding flood levels of Lake Goran were considered as part of the assessment.

Consideration has also been given to a broader range of environmental impacts, including air, surface water, soils, chemical and hazardous substances management, contaminated land, waste minimisation and management, natural resources, local community and neighbouring properties, visual impacts, land use and cumulative environmental effects.

There are not anticipated to be any cumulative impacts associated with the proposed core hole and associated activities.

This REF has been prepared in accordance with Clause 228 of the *Environmental Planning and Assessment Regulation 2000* and provides consideration of the environmental impact of the proposed works as required by Section 111 of the *Environmental Planning and Assessment Act 1979*. The REF has identified that the proposed core hole and associated activities are not likely to significantly affect the environment or threatened species, populations or ecological communities or their habitats.

7.0 References

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Appendix A

Ecological Assessment

prepared by RPS



Ecological Assessment

Goran South I – PEL I, Gunnedah Basin

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Document Status

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I.0 Introduction

I.1 Background

Santos QNT Pty Ltd (Santos) as Operator for and on behalf of the Titleholders of PEL 1, is investigating opportunities for activities associated with Coal Seam Gas exploration currently underway in the Gunnedah Basin. RPS was engaged to undertake an ecological pre-clearance assessment of a portion of Lot 28 on DP75500 to identify ecological constraints, potential impacts and mitigation measures associated with the development of a core hole referred to as Goran South 1, located within PEL 1 (Figure 1.1).

This ecological assessment accompanies the review of environmental factors (REF) prepared in accordance with the *Environmental Planning and Assessment Act 1979* (NSW) in relation to the proposed activities.

I.2 Site Particulars

I.2.1 Regional Location

The study area is located approximately 18km south west of Curlewis, in the Brigalow Belt South IBRA Bioregion and Liverpool Plains IBRA Subregion. The study area is within the Gunnedah Shire Council Local Government Area (LGA).

The study area is located approximately 1.5km to the north of the highest known level of Lake Goran, a nationally Important Wetland (NSW005), mapped by the Office of Environment and Heritage (OEH) as a Freshwater Wetland. Additionally, the study area is located approximately 5km south of Goran State Forest, and 12km west of Breeza State Forest. Trinkey State Forest occurs approximately 13km to the south west of the site.

I.2.2 Study Area

The study area is limited to an approximate 40ha surrounding the proposed core hole lease, and the proposed access tracks and associated vegetation (**Figure 1.1**). The majority of the study area is comprised of grazing land, and is largely cleared of native vegetation communities. While the proposed core hole lease is located within highly disturbed grazing land, vegetation adjacent to the proposed access track comprises Acacia and Eucalypt Woodland communities.

I.2.3 Topography

The topography of the study area is gentle. Elevation is approximately 296.6m Australian Height Datum (AHD) and land falls towards Lake Goran.

1.3 Proposed Activity

Santos proposes to undertake drilling activities to assess the coal seam gas potential of the Gunnedah Basin in PEL 1, which are the subject of this REF.

The proposed activity is to conduct drilling at the Goran 1 location to obtain information on coal depths, seam thickness, continuity and permeability. Coal seams of a particular interest will be cored for gas composition testing. Drill stem testing (DST) or equivalent downhole evaluation is also planned to be undertaken on coal seams to collect pressure and permeability information.

In summary, the process involves:

- preparation of lease access tracks utilising existing access tracks with minor improvements;
- preparation of a level drill pad (also referred to as “well lease area”);
- placement of a drilling rig and ancillary equipment at the well lease;
- drilling of the core hole;
- collection and analysis of drill core;
- conduct well testing and wireline logging (as required);
- plugging and abandonment of the well including suspension of steel casing over mineable coal seams (as required);
- removal of equipment and imported materials and the rehabilitation of the site; and
- rehabilitation of the site in line with legislative and landholder requirements.

Due to the type of drilling activity proposed, associated water from the targeted coal seams is not anticipated to be lifted.

Santos has negotiated an access, compensation and rehabilitation agreement with the affected landowner in respect to land access, compensation and rehabilitation. A scouting survey has been undertaken in consultation with the relevant landholder prior to drilling taking place to locate the site with an emphasis on minimisation of impacts on the environment and property operations.

1.3.1 Site Preparation & Equipment

Various works will be required in order to prepare the site for the proposed drilling, including preparation of the well lease, access track improvements and construction as well as positioning the drill rig and associated temporary buildings and equipment on the site. The major equipment used on site will be a drilling rig and associated temporary buildings. These works are summarised further in this section. **Figure 1.2** illustrates the proposed site layout for the well lease and access tracks.

During site preparation, there will be some soil disturbance as a level drill pad will need to be constructed at the well lease. Associated lined drilling sumps and a flare pit will also be constructed on site.

The area to be disturbed for drilling activity is outlined in **Table 1.1**.

Table 1.1 Areas of disturbance & cut and fill for well leases & access track

Well Lease	Pad Area	Pad Level
Goran South 1	75m x 76m with an overall area of disturbance of approximately 5,700m ² .	Cut and fill will be required to establish a pad level at approximately RL 298.20m AHD
Access Track	New track 5m wide, approximately 1500m long = 7,500m ² . Some minor filling required at various locations on access track.	Following existing site levels, with some filling and piping required in isolated locations (refer Figure 3.3 of REF)

Well Lease Construction

- Civil works equipment will be moved to site including bulldozer, excavator, grader, roller, water trucks, other trucks and support and light vehicles.
- Portable amenities will be located on site during construction.
- Any topsoil will be stripped and stockpiled.
- Required sumps will be excavated and lined with impermeable plastic sheeting.
- The lease area will be graded, rolled and otherwise constructed per Figure 3.1 of the REF.
- Required sumps will be excavated and lined with impermeable plastic sheeting. Sump and erosion control is shown on Figure 3.2 of the REF.
- A 10-3/4" steel conductor casing will be pre-installed at approximately 6m depth by the civil works crews ahead of the rig arriving on site.
- The lease will be fenced with appropriate fencing to manage livestock movements.

Access Track Improvements and Construction

Access to the "Boenery Park" property is via existing, good quality roads. The only works required to these roads may be grading to ensure a good quality surface is maintained. There will need to be some additional works to ensure all weather access through the property to the well lease, as illustrated on **Figure 1.2**.

The following is a list of the detailed works involved.

- Existing 1500m of track indicated in Figure 1.2 of the REF to be topped with 100mm road base.
- New 1500m long x 5m wide access track indicated on **Figure 1.2** to be prepared using 100mm road base.
- Track is to be constructed to allow wet weather access. This will require piping and some minor filling in parts.
- Sensitive vegetation (Weeping Myall) located along the northern boundary of Lot 28 will be avoided by offsetting the track 10m from the drip-line of the trees.

Drill Rig Positioning & Operation

- Equipment will include generator units, lighting towers, site offices, stores and other various buildings and equipment required for the duration of drilling.
- Moving and rigging up/down of equipment (i.e. installation and dismantling of rig equipment) is expected to take up to 3 days per site (3 per rig up, 3 per rig down).

Ancillary equipment will be required on site during the course of the drilling activities, including wireline trucks, cementing trucks and service company vehicles, these vehicles will exit and enter the site as required.

1.3.2 Drilling Activities

The well site will have a specific well design ensuring compliance with relevant legislation. The specific well design is provided in Appendix D of the REF.

A nominal 10-3/4" (273mm) cemented conductor is to be installed by the lease builder to approximately 6 m below ground level. A surface hole of 8-1/2" (216mm) will be rotary drilled to approximately 100mRT, where a 7" (178mm) surface casing will be landed and cemented to the surface. The main hole of 6-1/8" (156mm) will be drilled from the 7" (178mm) casing shoe to total depth of approximately 934mRT (20m into the Boggabri Volcanics) based on the pre-drill geological prognosis. DSTs or equivalent downhole evaluations may be conducted over selected Late and Early Permian Coals with testing to be performed in accordance with legislative requirements.

On penetrating target coal seams, coal cores will be collected and sampled for gas content and composition to evaluate local variations in coal seam permeability and composition. Any testing will be performed in accordance with legislative requirements.

The closest offset wells to the proposed activities are Goran Lake 1 (2.9km), Howes Hill 1 (5.4km) and Goran 1 (6.5km).

Once the well has reached the total depth, geophysical wire-line logs will be run over the main section of the hole to identify major stratigraphic units, intersected coal seam depth and seam thickness. Further DST or equivalent downhole evaluation may follow after completion of logging. Following logging and any post TD activities, the well will be fully plugged and abandoned with cement plugs from bottom to top. It is planned to cut and remove the 4-1/2" casing from approximately 50m above the casing shoe prior to setting cement plugs. A separate plug and abandon program will be issued at a later date. Approval is required for this abandonment program prior to abandonment operations commencing. The placement of cement plugs will effectively isolate the penetrated formations from each other and from the surface.

1.3.3 Abandonment and Rehabilitation

The well will be cemented, plugged and abandoned in accordance with regulatory requirements and rehabilitated following completion of activities within the allowed regulatory timeframe, unless needed for further exploration testing. In the case of plug and abandonment, the intermediate casing would be removed above the top of cement (where required and practicable) and a steel identification plate installed near the top of the hole > 1 metres below the surface.

Once the drilling and testing activities are complete, the disturbed area is proposed to be rehabilitated with appropriate mitigation measures and environmental safeguards implemented to minimise potential impacts. All rehabilitation works will be undertaken with maximum regard to environmental protection and rehabilitation, vegetation, subsoil and topsoil management, weed control, erosion and sedimentation management and revegetation in accordance with the relevant statutory requirements.

Revegetation & rehabilitation will be undertaken within the required regulatory timeframe. All private tracks used during operations are generally returned to their pre-operations state or to a condition agreed by the landholder.

1.3.4 Duration

Drilling activities are temporary. The drilling of the core hole well is expected to occur over a 56 day period not including lease build, or site restoration. There will be 14 days of lease construction activities prior to drilling the well. Rehabilitation activities of 30 days following the drilling of the well will be additional to this period.

This equates to a total of approximately 70 days of construction and drilling and 30 days of rehabilitation, as outlined in the table below.

Table 1.2 Duration of drilling and site activities

Activity	Expected Duration
Lease Build	14 days
Drilling	56 days
Rehabilitation	30 days

1.3.5 Staff & Hours of Operation

The number of employees present on the site at any one time is expected to be up to 20 persons. It is not proposed to provide a workers camp on the site, with off-shift drilling crews to be located in nearby accommodation with travel to and from site to be provided.

The hours of operation during the drilling and work over will be on a 24-hour a day, 7 days a week basis as negotiated with the landholder. Hours of operation during lease construction and rehabilitation will be on a 12-hour a basis between 6am and 6pm. During drilling personnel movements to and from site will be

minimised outside of a single shift change per day but may be necessary due to emergency situations or specific activities (e.g. crews and service companies entering and leaving site to conduct specific activities).

1.3.6 Chemicals

A number of chemicals are planned to be utilised to facilitate the efficient and safe drilling of the wells in line with best oilfield practice. These chemicals are typical of those generally used in oilfield activities. These chemicals will be used either to deliver the wells as planned or will be held in contingency to handle unplanned scenarios (e.g. stuck pipe, excessive mud losses etc.). The Material Safety Data Sheet (MSDS) information for all of these chemicals can be found on the Santos web site (<http://www.santos.com/exploration-acreage/gunnedah-basin-gas/fact-sheets-msds.aspx>). The fluids are water based (not synthetic or oil based) and recycled for reuse as much as possible during the drilling process. The following list summarises the relevant chemical MSDS for the proposed activities.

- | | | |
|---|----------------------------------|------------------|
| ▪ AMC Xtra-Sweep | ▪ AMC Superfoam | ▪ Baroid Quikmud |
| ▪ Sodium Bicarbonate | ▪ AMC Lime | ▪ Rheolube |
| ▪ Soda Ash Dense | ▪ AMC Hammer Oil | ▪ Defoam-A |
| ▪ SAPP | ▪ AMC Aus-Ben | ▪ Trugel 13-A |
| ▪ CSR Raw Sugar / Brown Sugar | ▪ AMC Aus-Gel | ▪ JK 161-LV |
| ▪ Poly-Bore™ | ▪ AMC Aus-Plug | |
| ▪ Pheno Seal | ▪ Barite | |
| ▪ Mud Flush III | ▪ Caustic Soda (Rheochem) | |
| ▪ Guar gum, propoxylated | ▪ Citric Acid (Rheochem) | |
| ▪ Fly Ash – Eraring | ▪ Frascseal Fine, Medium | |
| ▪ Flocele 3/8" | ▪ Idcide-20 | |
| ▪ AMC EP Bit Lube | ▪ JK-261 | |
| ▪ Econolite Additive | ▪ Potassium Chloride (Rheochem) | |
| ▪ Drispac (Regular and Superlo) Polymer | ▪ Kwikseal (Fine/Medium/Coarse) | |
| ▪ AMC CR-650 | ▪ Quickseal (Fine/Medium/Coarse) | |
| ▪ Cement – Standard – Class A | ▪ Xanthan Gum (XC) | |
| ▪ CFR-3 | ▪ Rheopac R/LV/UL/RD/LVD | |
| ▪ CAL-Seal 60 | ▪ Salt (Rheochem) | |
| ▪ Calcium Chloride – Flake | ▪ AMC PAC R | |
| ▪ Bentonite | | |

I.3.7 Justification of Activity

Drilling of the Goran South 1 well is a necessary step in the ongoing exploration of the hydrocarbon potential in PEL 1, which to date has undergone limited petroleum exploration. Discovery and appraisal of coal seam gas resources in the area has the potential to increase the state's reserves and revenue from gas and underpin future exploration or production in the region.

The proposed activities consist of drilling a well, wireline geophysical logging, drill stem tests, casing and cementing using steel casing strings. These procedures are required to define and identify commercially valuable reserves of coal seam gas.

I.4 Scope of the Study

The objective of this assessment was to undertake an ecological assessment of the proposed core hole lease and access roads to identify ecological impacts of the proposed activities, and recommend appropriate mitigation measures. The specific scope of the assessment was to:

- Conduct a background review of relevant environmental databases, maps and policies;
- Verify the vegetation communities and ecosystems occurring on site;
- Identify threatened species habitat values of the site;
- Identify significant weed species;
- Identify constraints associated with the ecological features of the site in a legislative and planning context;
- Identify potential ecological impacts associated with the core hole lease; and
- Recommend appropriate mitigation measures to minimise potential ecological impacts.

A desktop assessment of the proposed well lease was conducted prior to conducting pre-clearance assessments on the 11th and 23rd August, 2011. This assessment details the findings of the background review and pre-clearance surveys. Additionally, Commonwealth, state and local legislation relevant to the proposal have been addressed in this assessment.

I.5 Licensing and Certification

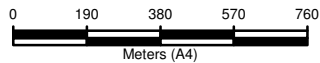
Research was conducted under the NSW National Parks and Wildlife Service Scientific Investigation Licence S10300 (Valid 30 November 2011).



Legend

Indicative Study Area

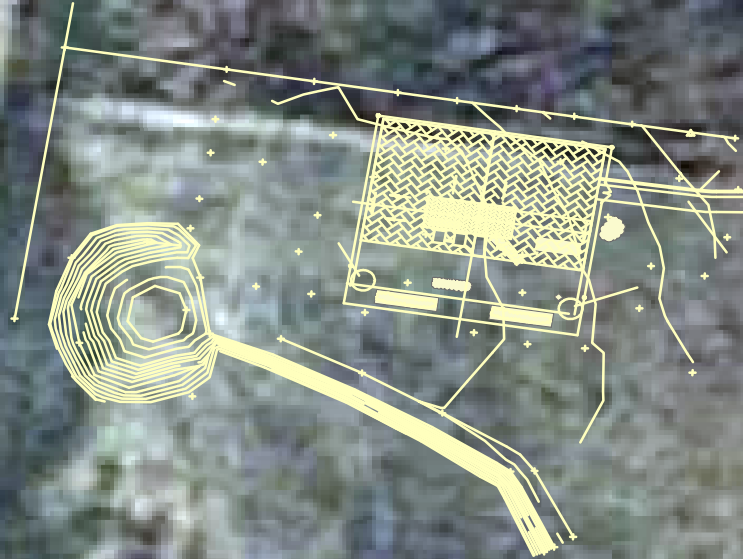
AERIAL PHOTOGRAPHY
The aerial photography used in this plan has not been rectified.
The image has been overlaid as a best fit on the boundaries shown and position is approximate only.



Project Manager
BD
Compiled by
HR
Map Projection
MGAz56
Map Datum
GDA94
File Reference
PR107872.mxd
Sheet Number
1 of 1

Client
Santos QNT Pty Ltd
Title
Figure 1.1 Aerial Photo & Location Goran South 1

RPS			
SCALE (A4)	DATE	DRAWING NO.	ISSUE
1:19,523	07/06/2011	PR107872-1	1

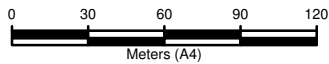


Legend

- Indicative Study Area
- Site Layout
- Existing Track
- Existing Track - Gravel Top
- New Track



AERIAL PHOTOGRAPHY:
The aerial photography used in this plan has not been rectified.
The image has been overlaid as a best fit on the boundaries shown and position is approximate only.



Project Manager	BD
Compiled by	HR
Map Projection	MGaz56
Map Datum	GDA94
File Reference	PR107872.mxd
Sheet Number	1 of 1

Client

Santos QNT Pty Ltd

Title

Figure 1.2 Site Layout
Goran South 1

RPS

SCALE (A4)	DATE	DRAWING NO.	ISSUE
1:2,982	07/06/2011	PR107872-1	1

2.0 Legislative Context

2.1 Environmental Protection and Biodiversity Conservation Act 1999

The Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) provides that a person proposing to take an action that the person thinks may be a "controlled action" must refer the proposal to the Minister for Sustainability, Environment, Water, Population and Communities (Minister). A "controlled action" is an action that:

- will have or is likely to have a significant impact on
 - » World heritage areas
 - » National heritage places
 - » Ramsar wetlands of international importance
 - » Commonwealth listed threatened species and communities
 - » Commonwealth listed migratory species
 - » Commonwealth marine areas
 - » The environment on Commonwealth land
 - » Great Barrier Reef Marine Park;
- Is undertaken by the Commonwealth and will have or is likely to have a significant impact on the environment;
- Is undertaken by any person on Commonwealth land and will have or is likely to have a significant impact on the environment; or
- Is a nuclear action.

These are referred to as "matters of national environmental significance" (MNES). The EPBC Act sets out the process for identifying and listing the MNES including listed threatened species and listed migratory species.

If the Minister decides that the proposed action is a controlled action, then the approval of the Minister is required under the EPBC Act.

A person proposing to take an action that the person thinks is not a controlled action may refer the proposal to the Minister for the Minister's decision whether or not the action is a controlled action.

2.2 NSW State Legislation

2.2.1 Environmental Planning and Assessment Act 1979

Overview

The *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act) regulates development carried out in New South Wales. The carrying out of development is regulated under either Part 3A, Part 4 or Part 5 of the EP&A Act.

Development is required to be assessed under Part 5 of the EP&A Act if the relevant environmental planning instruments provide that the development does not require consent or is not exempt development and the development is either carried out by a determining authority or requires the approval of a determining authority.

The proposed activities fall within the local government area (LGA) of Gunnedah Shire. The subject site is zoned 1(a) Rural (Agricultural Protection) under the *Gunnedah Local Environmental Plan 1998* (NSW) (Gunnedah LEP). The proposed activities are permissible with development consent under the Gunnedah LEP. However, *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (NSW) (Mining SEPP) applies to the activities. The Mining SEPP aims "to provide for the proper management and development of mineral, petroleum and extractive material resources for the social and economic welfare of [New South Wales]". Clause 6 of the Mining SEPP provides that development for the purposes of petroleum exploration may be carried out without development consent. Clause 6 applies despite the provisions of the Gunnedah LEP. This has the effect that the proposed activities are required to be assessed under Part 5 of the EP&A Act.

A determining authority, for the purposes of this activity, is defined in Part 5 to include a public authority whose approval is required before an activity may be carried out. The Assistant Director, Environment of the Department of Primary Industries and the New South Wales Office of Water will be determining authorities for the purposes of Part 5 of the EP&A Act because their approval is required for the proposed development under the legislation administered by these determining authorities.

Determining Authorities and the REF

Under Part 5 of the EP&A Act, a determining authority is required to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

Additionally, clause 228 of the *Environmental Planning and Assessment Regulation 2000* (NSW) sets out the factors that must be taken into account concerning the impact of an activity on the environment.

The determining authorities are required to consider whether the proposed activity is likely to significantly affect the environment or threatened species, populations or ecological communities, or their habitats to determine whether an EIS or SIS is required. In deciding whether there is likely to be a significant effect

on threatened species, populations or ecological communities or their habitats, section 5A of the EP&A Act requires the following factors to be taken into account (the "seven part" test of significance):

- (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,*
- (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,*
- (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,*
- (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,*
- (e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),*
- (f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,*
- (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.*

This EA has been prepared to assist the determining authorities in meeting their obligations under the EP&A Act.

Gunnedah Local Environmental Plan

The site of the proposed core hole activities is zoned 1(a) Rural (Agricultural Protection) under the Gunnedah LEP. As stated above, the effect of the Mining SEPP is to require the proposed development to be assessed under Part 5 of the EP&A Act. However, consideration has been given to the nature and objectives of the 1(a) Rural (Agricultural Protection) zone. The objectives of zone 1(a) Rural (Agricultural Protection) are:

- (a) to protect the use and efficiency of prime agricultural land while permitting appropriate development subject to suitable subdivision controls,*
- (b) to permit other forms of development which are ancillary to rural land uses or that, as a result of their nature, require siting outside the urban area,*

- (c) to avoid further fragmentation and alienation of useable rural land,
- (d) to retain the low density nature of settlement within the rural areas and ensure that any future development does not create unreasonable demands on the existing infrastructure or available services,
- (e) to provide for the requirements of the rural community,
- (f) to maintain safety and convenience along main roads by discouraging uses that are likely to generate traffic volumes which disrupt traffic flow,
- (g) to ensure that the existing level of scenic amenity is maintained by requiring development to have regard for significant ridgelines and hilltops.

SEPP No. 44 – Koala Habitat Protection

State Environmental Planning Policy No. 44 – Koala Habitat Protection (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".

Schedule 1 of SEPP 44, which lists the LGAs to which SEPP 44 applies, includes the Gunnedah LGA. SEPP 44 applies to local councils determining development applications under Part 4 of the EP&A Act. Although SEPP 44 does not apply in relation to the assessment of development under Part 5 of the EP&A Act, it has been considered in the preparation of this REF.

SEPP 44 requires that before granting development consent under Part 4 of the EP&A Act for development on land over 1 hectare in area, a consent authority must form a view as to whether the land is "potential" and "core" koala habitat. Potential koala habitat is defined as:

areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.

Core koala habitat is defined as:

an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.

Where core koala habitat is found to occur, SEPP 44 requires that a koala plan of management be prepared for the site.

2.2.2 Threatened Species Conservation Act 1995

The objectives the *Threatened Species Conservation 1995* (NSW) (TSC Act) include:

- To conserve biological diversity and promote ecologically sustainable development;
- Prevent the extinction and promote the recovery of threatened species, populations and ecological communities;
- To protect the critical habitat of those threatened species, populations and ecological communities that are endangered; and
- To ensure that the impact of any action affecting threatened species, populations and ecological preventing the extinction and promoting the recovery of threatened species, populations and ecological communities is properly assessed.

The TSC Act provides the procedure for the listing of threatened species, populations and ecological communities and key threatening processes in New South Wales and the preparation and implementation of recovery plans and threat abatement plans.

The TSC Act also provides the mechanism for applying for and obtaining licences to take actions which will or is likely to result in harm to any animal that is a threatened species, population or ecological community, the picking of any plant which is part of a threatened species, population or ecological community, damage to critical habitat or damage to habitat of a threatened species, population or ecological community where such actions require a license to be obtained.

2.2.3 National Parks and Wildlife Act

Part 8A of the *National Parks and Wildlife Act 1974* (NPW Act) regulates the undertaking of activities which may impact on threatened species, populations and ecological communities listed under the TSC Act and their habitats. The NPW Act provides that a person must not harm any animal that is a threatened species, population or ecological community, pick any plant which is part of a threatened species, population or ecological community, damage any critical habitat or damage any habitat of a threatened species, population or ecological community without a licence being obtained under the NPW Act or TSC Act or unless another exception applies.

The NPW Act provides that these requirements do not apply if the action was essential for the carrying out of an activity in accordance with an approval of a determining authority under Part 5 of the EP&A Act where the determining authority has complied with Part 5.

2.2.4 Key Threatening Processes

A key threatening process is defined under the TSC Act as ‘a process that threatens, or that may threaten, the survival or evolutionary development of a species, population or ecological community. Threatening processes that adversely affect threatened species, populations or ecological communities, or possibly cause others that are not currently threatened; to become threatened may be eligible for listing as a key threatening process (KTP).

2.3 Noxious Weeds Act

The *Noxious Weeds Act 1993* (NW Act) is a NSW government instrument outlining the definition, declaration, and control of noxious weeds throughout the State. Local government bodies have the responsibility to ensure that the Act is complied with within their boundaries.

For a plant to be declared a Noxious Weed it must be considered to pose a serious threat to humans, agriculture and/or the environment. There must also be consideration given to the feasibility of control and enforcement of those methods. Plants are declared noxious by order of the Minister for Agriculture.

Landowners or occupiers have obligations under the NW Act to control any declared weed on their property. Council is required to conduct inspections of private properties to check compliance with the NW Act and Noxious Weed Officers have the authority to issue control notices for any breach.

2.4 Native Vegetation Act

The *Native Vegetation Act 2003* (NV Act) sets a framework for:

- Encouragement of revegetation and rehabilitation of land with appropriate native vegetation;
- Providing incentives for landholders to undertake management of native vegetation on their properties; and
- An end to broad scale clearing, unless it improves or maintains the environment.

The NV Act provides three categories of native vegetation including regrowth, protected regrowth and remnant vegetation with clear definitions.

The NV Act provides greater flexibility and incentives for landholders to manage native vegetation sustainably. The Act gives effect to the Government's commitment to ending broad scale clearing unless it improves or maintains environmental outcomes.

Under section 25(g), the NV Act does not apply to any clearing that is part of an activity carried out by a determining authority within the meaning of Part 5 of the EP&A Act where the determining authority has complied with Part 5. Under section 25(m), the NV Act does not apply to any clearing authorised under the *Petroleum (Onshore) Act 1991* (NSW).

3.0 Methods

3.1 Desktop Assessment

A desktop assessment was undertaken to identify potential development constraints as well as significant ecosystems and species that may potentially occur on in the study area. The following databases and maps were reviewed:

- EPBC Protected Matters Search Tool (Department of Sustainability, Environment, Water, Population and Community (SEWPaC), 2011) (**Appendix A**);
- Review of threatened fauna and flora records contained in the Office of Environment and Heritage (OEH) Atlas of NSW Wildlife for the Curlewis Map Sheet, as well as the Liverpool Plains sub-catchment listing;
- National Vegetation Information Systems mapping; and
- Aerial photography.

3.2 Field Assessment

A pre-clearance assessment was carried out on the 11th and 23rd August 2011 to:

- Verify the results of the desktop assessment;
- Ground-truth vegetation communities;
- Undertake a fauna habitat assessment and incidental fauna observations;
- Identify potential habitat for potentially occurring significant species as listed under the EPBC and TSC Act;
- Search for weed species; and
- Identify required mitigation measures to minimise ecological impacts associated with the core hole.

Surveys of the proposed core hole lease consisted of a threatened species search, a vegetation survey and a flora and fauna habitat assessment. The threatened species search targeted threatened species listed within the EPBC Protected Matters search and within the Atlas of NSW Wildlife database (Curlewis Mapsheet and Liverpool Plains sub-region). The flora survey consisted of a random meander, and targeted threatened flora searches in suitable habitat. This method generated a flora species list for and a description of the dominant flora species for the study area.

3.3 Survey Limitations

It should be noted that the detectability of plants and the ability to accurately identify plants to species level may vary greatly with the time of year, prevailing climatic conditions and the presence of reproductive material (e.g. flowers, fruit, and seed capsules). Consequently, the survey conducted for the study area should not be regarded as conclusive evidence that certain protected plants do not occur within the study area; however every effort has been made to detect these species in habitats that were considered suitable. Specifically, native grass species can be difficult to identify due to seasonality.

In response to the abovementioned limitations the precautionary approach has been adopted; as such 'assumed presence' of known and expected threatened species, populations and ecological communities has been made where relevant to ensure a holistic assessment.

4.0 Flora

4.1 Existing Condition

Three vegetation communities were observed within the study area, including:

- Grazed Grasslands;
- Weeping Myall (*Acacia pendula*) Woodland; and
- White Box (*Eucalyptus albens*) – Yellow Box (*E. melanophloia*) Woodland.

A description of these communities is provided below, while the location and extent is outlined in **Figure 4.1**. A detailed flora species list for the study area is included in **Appendix B**.

4.1.1 Grazed Grasslands



Plate 4.1 Grazed Grasslands in the core hole lease

Description

This vegetation community occurs across the study area, including within the core hole lease. It is characterised by a sparse grassy ground layer, with occasional shrubs, and no canopy layer.

Shrub

0.3 to 1m, >5% cover. Occasional Black Roly-Poly (*Sclerolaena muricata*) occurs, including within the study area.

Ground Layer

0.1 to 0.75m, >approx 55% cover. Dominant species observed include Slender Bamboo Grass (*Austrostipa verticillata*), Saffron Thistle (*Carthamus lanatus*), Plains Grass (*Austrostipa aristiglumis*), Three-awn Spear Grass, Couch (*Digitaria didactyla*), Galvanised Burr (*Sclerolaena birchii*), and Rough Saw-sedge (*Gahnia aspera*).

Condition

This vegetation community is highly disturbed, as it has recently been heavily grazed. Historically, this vegetation community has been cleared. This community comprises occasional weeds. This community is considered to be in poor condition.

Classification

This vegetation community does not constitute any community that is listed within the schedules of the EPBC Act or the TSC Act.

4.1.2 White Box – Yellow Box Woodland



Plate 4.2 White Box – Yellow Box Woodland located along access track

Description

This vegetation community occurs adjacent to the existing access tracks, within the eastern extent of the study area. This community comprises an intact, mature canopy with occasional shrubs and sparse ground cover. This community is not present within the core hole lease.

Canopy

14m to 18m, patchy 40% PFC. Common species include White Box, Yellow Box, White Cypress (*Callitris glaucophylla*), Belah (*Casuarina cristata*), and Bimble Box (*Eucalyptus populnea*).

Shrub

0.5m to 2m, 10% cover. Common species include Black Roly-Poly, Weeping Myall (*Acacia pendula*), African Boxthorn (*Lycium ferocissimum*).

Ground Layer

0.1 to 1m, 60% cover. Common species include Plains Grass, Slender Bamboo Grass and Saffron Thistle.

Condition

This community occurs adjacent to an existing access track as a linear patch. This community has been disturbed as a result of the construction and use of the existing access track, with edge effects such as weed infestation and disturbed ground covers present. Additionally, historical clearing has isolated this community. This community is considered to be in moderate condition.

Classification

Despite the moderately disturbed condition and small patch size of this vegetation community, the floristic structure and character corresponds with the Endangered Ecological Community (EEC) known as White Box – Yellow Box – Blakely's Red Gum Woodland, which is listed within the Schedules of the TSC Act. This vegetation community is also commensurate with the federally listed Threatened Ecological Community (TEC) known as White Box – Yellow Box – Blakely's Red Gum Woodland and Derived Native Grasslands. This community is listed as Critically Endangered under the EPBC Act.

4.1.3 Weeping Myall Woodland



Plate 4.3 Weeping Myall Woodland adjacent to the access track

Description

This vegetation community occurs adjacent to the existing access tracks. Additionally, isolated stands occur within the study area. This community comprises an intact canopy with occasional shrubs and sparse ground cover. This community is not present within the core hole lease.

Canopy

8m to 12m, patchy 20% PFC. Common species include Weeping Myall and Bimble Box, with occasional Belah and Boonery (*Alectryon oleifolius*). Grey Mistletoe (*Amyema quandang*) was observed within the canopy layer.

Shrub

0.5m to 1.5m, 5% cover. Common species include Black Roly-Poly, African Boxthorn, Wilga (*Geijera parvifolia*), and Weeping Myall.

Ground Layer

0.1 to 0.75m, 60% cover. Common species include Plains Grass, Slender Bamboo Grass, Saffron Thistle.

Condition

This community occurs adjacent to the proposed access track, and also in isolated stands within the study area. This extent of this community has been greatly reduced due to historical clearing. Additionally, grazing has resulted in intensive disturbances to the understorey of this community. This community is considered to be intact, and in a moderate condition.

Classification

The floristic structure and character corresponds with the EEC known as Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Penepplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions, which is listed within the Schedules of the TSC Act. This vegetation community is also commensurate with the federally listed Threatened Ecological Community (TEC) known as Weeping Myall Woodland, listed as Endangered under the EPBC Act.

4.2 Threatened Ecological Communities

4.2.1 EPBC Act 1999

Five Critically Endangered Ecological Communities (CEEC) listed under the EPBC Act were identified as potentially occurring within the locality of the study area as part of the EPBC Protected Matters Search Tool, including:

- Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland;
- White Box-Yellow Box-Blakely's Red Gum grassy woodland and derived native grassland;
- Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions;
- Grey Box (*Eucalyptus microcarpa*) grassy woodlands and derived native grasslands of south-eastern Australia; and
- Weeping Myall Woodlands.

An assessment for likelihood of occurrence was conducted, and is included in **Appendix C**. Two EPBC Act listed TEC have been confirmed as occurring within the study area, as outlined below.

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

The following outlines the listing criteria to determine if a community is the Box-Gum Grassy Woodland and Derived Grassland under the EPBC Act Policy Statement.

'Is, or was previously, at least one of the most common overstorey species White Box, Yellow Box, or Blakely's Red Gum (or Western Grey Box or Coastal Grey Box in the Nandewar region)?'

There are no canopy trees within the grazed grasslands community that incorporates the core hole lease. Additionally, surrounding vegetation is not representative of the White Box, Yellow Box, Blakely's Red Gum Woodland, and it is unlikely that the grazed grasslands and core hole lease previously supported these species. Therefore, the core hole lease is not considered to be the EEC as it does not meet the above criteria.

However, woodland adjacent to a portion of the existing access track comprises White Box and Yellow Box. The following assessment applies to the Woodland only.

Does the patch have a predominantly native understorey?

A patch is defined as a continuous area containing the ecological community (areas of other ecological communities such as woodlands dominated by other species are not included in a patch). The patch is the larger of:

- An area that contains five or more trees in which no tree is greater than 75m from another tree; or
- The area over which the understorey is predominantly native.

For the purposes of this assessment, the patch is considered to be the tract of Woodland vegetation adjacent to the existing access track. This patch comprises a predominantly native understorey.

Is the patch 0.1ha or greater in size?

The defined patch is greater than 0.1ha.

Are there 12 or more native understorey species present (excluding grasses), with at least one important species?

Within the defined patch, there are 12 or more native understorey species present. Therefore, the woodland community is considered to be the listed TEC.

Outcomes

The results of the field survey determined that the core hole lease does not fit the EPBC Act Box-Gum Grassy Woodland and Derived Native Grassland criteria, as the patch is not considered to previously have supported White Box, Yellow Box or Blakely's Red Gum.

The woodland community adjacent to the access track is considered to be the Box-Gum Grassy Woodland and Derived Native Grassland, as the species composition and density is considered to meet the criteria outlined under the Policy Statement.

Weeping Myall Woodlands

The following outlines the listing criteria to determine if a community is the Weeping Myall Woodland under the EPBC Act Policy Statement Decision Flowchart:

Are there Weeping Myall trees on the property?

There are Weeping Myall trees within the vegetation community delineated as Weeping Myall Woodland on **Figure 4.1**.

Does the patch have a native understorey, where a patch is defined as a continuous area that entirely consists of an ecological community?

The patch is defined as the area extending up to 10 m beyond the drip line (the edge of the foliage canopy) of the outermost trees where the understorey criteria are satisfied. The patch of vegetation delineated as Weeping Myall Woodland comprises a predominantly native understorey that has been highly disturbed due to grazing.

Does the patch have at least 5% tree canopy cover or at least 25 dead or defoliated mature Weeping Myall trees per hectare?

Yes, the patch of vegetation delineated as Weeping Myall Woodland on **Figure 4.1** comprises at least 5% tree canopy cover.

Is the tree canopy dominated (at least 50%) by living, dead or defoliated Weeping Myall trees?

While scattered Bimble Box and Boonery occur in this community, Weeping Myall is the dominant canopy species.

Is the patch 0.5 hectares or greater in size?

Yes, the patches identified as Weeping Myall Woodland on **Figure 4.1** are greater than 0.5ha in size.

Does the patch have more than two layers of regenerating Weeping Myall present?

The Weeping Myall Woodland does not have two layers of regenerating Weeping Myall present, as Weeping Myall is not present as a secondary canopy, or within the shrub layer.

Is the tallest layer of living, dead or defoliated Weeping Myall trees at least 4 metres tall and of the vegetative cover present (shrub layer and ground cover), is at least 50% composed of native species?

The tallest layer of Weeping Myall within the woodland community is at least 4m tall, with an average height of 10m. At least 50% of the ground cover is comprised of native species. The Weeping Myall Woodland is therefore considered to be the listed TEC.

Outcomes

The results of the field survey determined that the Weeping Myall Woodland outlined on **Figure 4.1** is considered to meet the criteria outlined under the Policy Statement for the Weeping Myall Woodland TEC.

4.2.2 TSC Act

Nine EEC listed within the TSC Act were identified as potentially occurring within the study area, based on known or predicted communities occurring in the Liverpool Plains Catchment Management Area Sub-region (**Appendix C**). An assessment for likelihood of occurrence was conducted for each listed community, and is included in **Appendix C**. Two TSC Act EEC have been confirmed as occurring within the study area, as outlined below.

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland

Under the TSC Act, White Box - Yellow Box - Blakely's Red Gum Woodland EEC can exist in a number of states. Intact stands that contain diverse upper and mid-storeys and ground layers are rare. Modified states include the following:

- Areas where the main tree species are present ranging from an open woodland formation to a forest structure, and the ground layer is predominantly composed of exotic species; and
- Subject sites where the trees have been removed and only the grassy groundlayer and some herbs remain.

Identification guidelines have been provided for this community (NPWS 2002). The vegetation in the subject site has been assessed against these guidelines in **Table 4.2**.

Table 4.1 TSC Act Box Gum Woodland Listing Criteria

Criteria	Assessment
Is the subject site in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands or NSW South Western Slopes Bioregions?	The subject site is located within the Nandewar Bioregion.
Are there native species in the understorey? In the absence of native species, is the subject site likely to respond to assisted natural regeneration?	All vegetation communities in the study area support native species in the understorey.
Does the subject site have trees? If the subject site is treeless, is it likely to have supported White Box, Yellow Box or Blakely's Red Gum prior to clearing?	The core hole lease is treeless. Furthermore, it is unlikely to have previously supported White Box, Yellow Box or Blakely's Red Gum prior to clearing as it appears to have previously supported a Weeping Myall community. A portion of woodland occurring adjacent to the existing access track comprises White Box and Yellow Box.
Are, or where White Box, Yellow Box or Blakely's Red Gum, or a combination of these species present?	The core hole lease is not considered to have previously supported these species. It is therefore not considered to be the listed Box Gum Woodland. A portion of woodland occurring adjacent to the existing access track comprises White Box and Yellow Box.
Is the understorey of the subject site predominantly grassy?	Within the vegetation community that supports White Box and Yellow Box, the ground cover is predominantly grassy. It is therefore considered to be the listed community.

The results of the field survey determined that the core hole lease does not fit the NSW Scientific Committee Final Determination of this EEC, as it is unlikely that the core hole lease previously supported White Box, Yellow Box, or Blakely's Red Gum, given the dominance of Weeping Myall Woodland in the surrounding areas.

The woodland adjacent to the access track is considered to fit the NSW Scientific Committee Final Determination of this EEC, as it currently supports White Box and Yellow Box. Additionally, it has a predominantly grassy understorey. This community is therefore considered to be White Box – Yellow Box – Blakely's Red Gum Woodland.

Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes Bioregions

The NSW Scientific Committee determination of the Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South western Slopes bioregions lists this community as an EEC. The final determination outlines that this species is located on red-brown earths and heavy textured grey and brown alluvial soils within a climatic belt receiving between 375 and 500 mm mean annual rainfall. The structure of the community varies from low woodland and low open woodland to low sparse woodland or open shrubland, depending on site quality and disturbance history. The tree layer grows up to a height of about 10 metres and invariably includes *Acacia pendula* (Weeping Myall or Boree) as one of the dominant species or the only tree species present. The understorey includes an open layer of chenopod shrubs and other woody plant species and an open to continuous groundcover of grasses and herbs.

It is considered that the Weeping Myall Woodland occurring adjacent to the proposed core hole lease is representative of the listed EEC, as described by the NSW Scientific Committees Final Determination.

4.3 Threatened Flora Species

4.3.1 EPBC Act

A Protected Matters Search for the study area identified nine threatened flora species listed under the EPBC Act that potentially occur in the locality. An assessment of likelihood of occurrence was completed for each species, and is included in **Appendix B**. The assessment identified that the study area provides suitable habitat for the following flora species:

- Bluegrass (*Dichanthium setosum*);
- Finger Panic Grass (*Digitaria porrecta*);
- Leek-orchid (*Prasophyllum sp. Wybong*);
- Cobar Greenhood Orchid (*Pterostylis cobarensis*);
- Austral Toadflax (*Thesium australe*); and
- *Tylophora linearis*.

Targeted searches did not confirm the presence of any threatened flora species within the study area.

4.3.2 TSC Act

The results of the DECCW wildlife atlas database search revealed eight threatened flora species potentially occur within the locality. An assessment of likelihood of occurrence was completed for each species, and is included in **Appendix B**. The assessment identified that the study area provides suitable habitat for the following flora species:

- Bluegrass;
- Finger Panic Grass;
- Scant Pomaderris (*Pomaderris queenslandica*);
- Austral Toadflax (*Thesium australe*); and
- *Tylophora linearis*.

Targeted searches did not confirm the presence of any threatened flora species within the study area.

4.4 Weeds

Two listed noxious weeds were identified in the study area, namely Prickly Pear and African Boxthorn. Additionally, Noogoora Burr is known to occur on the property. Under the provisions of the *Noxious Weeds Act 1993*, Prickly Pears (except *Opuntia ficus-indica*) and African Boxthorn are classed as Class 4 weeds. This means that the growth and spread of the plant must be controlled according to the measure specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed.

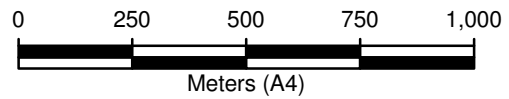
Numerous environmental weeds were identified across the study area, particularly Saffron Thistle and Tall Fleabane (*Conyza sumatrensis*).



Legend

- Indicative Study Area
- Box-Gum Woodland
- Myall

AERIAL PHOTOGRAPHY
The aerial photography used in this plan has not been rectified.
The image has been overlaid as a best fit on the boundaries shown and position is approximate only.



Project Manager	BD
Compiled by	HR
Map Projection	MGAz56
Map Datum	GDA94
File Reference	PR107872.mxd
Sheet Number	1 of 1

Client	Santos QNT Pty Ltd
Title	Figure 4.1 Vegetation Communities Goran South 1

RPS			
SCALE (A4)	DATE	DRAWING NO.	ISSUE
1:16,596	07/06/2011	PR107872-1	1

5.0 Fauna

5.1 Habitat Values

Two habitats were identified as occurring within the study area. These habitats provide a range of resources for native fauna species, as outlined below.

5.1.1 Woodland

Condition / Description

The study area includes areas of Eucalypt and Acacia woodland, primarily located adjacent to the existing and proposed access tracks. Additionally, stands of Acacia woodland occur throughout the study area. Mature eucalypts with hollows are common within this habitat type, and provide a breeding habitat for numerous native birds and mammals. This habitat type also provides foraging opportunities for a range of birds, mammals and reptiles.

Observed Fauna

A range of birds were observed utilising this habitat, including Torresian Crow (*Corvus orru*), Australasian Pipit (*Anthus novaeseelandiae*), Apostle Bird (*Struthidea cinerea*), Galah (*Eolophus roseicapilla*), Laughing Kookaburra (*Dacelo novaeguineae*), White-Winged Chough (*Corcorax melanorhamphos*) and Red-Rumped Parrot (*Psephotus haematonotus*, as well as a Frill-neck Lizard (*Chlamydosaurus kingii*). Additionally, Koala (*Phascolarctos cinereus*) scat was observed under White Box and Bimble Box across the study area.

5.1.2 Grazing Pasture

Condition / Description

The study area is dominated by grassy grazing paddocks that have been historically cleared to facilitate the current land use. These areas are heavily grazed, and comprise of native and introduced grasses. While no canopy vegetation occurs in this area, it is considered to provide foraging resources for a range of species, including birds, macropods and reptiles.

Observed Fauna

Fauna observed in this area was limited to generalist bird species such as Torresian Crow, Australian Magpie (*Cracticus tibicen*), and White-faced Heron (*Egretta novaehollandiae*). Additionally, evidence of Koala was identified in the study area, as discussed in **Section 5.3.2**.

5.2 Regional Context

The study area is located approximately 1.5km from the highest known level of Lake Goran. The lake is highly ephemeral, and when at capacity, is considered to provide a range of habitat resources, including breeding habitat for a variety of amphibians, reptiles and birds. This area also provides potential habitat for an array of migratory species and water birds. It is likely that species utilising Lake Goran may occasionally utilise the study area for foraging purposes.

The study area is largely isolated from tracts of remnant vegetation, however scattered stands of vegetation provide stepping stone connectivity to Goran State Forest.

5.3 Threatened Species

5.3.1 EPBC Act

Ten threatened fauna species listed under the EPBC Act were identified as potentially occurring in the site locale (10km buffer) using the EPBC Protected Matters Search Tool. An assessment of likelihood of occurrence was completed for each species based on habitat preference and known species distribution, and is included in **Appendix B**. The assessment identified that the study area provides suitable habitat for the following fauna species:

- Pink-tailed Legless Lizard (*Aprasia parapulchella*);
- Superb Parrot (*Polytelis swainsonii*);
- Regent Honeyeater (*Xanthomyza Phrygia*); and
- Swift Parrot (*Lathamus discolor*); and
- Greater Long-eared Bat (*Nyctophilus timoriensis*.)

Targeted searches did not confirm the presence of any EPBC listed species within the study area.

5.3.2 TSC Act

Forty-five threatened species were identified as potentially occurring within the site locale, based on the Curlew Atlas of NSW Wildlife records. An assessment of likelihood of occurrence was completed for each species based on habitat preference and known species distribution, and is included in **Appendix B**. The assessment identified that the study area provides suitable habitat for numerous listed species, including reptiles, mammals and birds (refer to **Appendix B**).

Targeted searches confirmed the presence of Koala on site, listed as Vulnerable under the TSC Act. No additional listed fauna species were observed on site. Koala is further discussed in **Section 6.3.2**.

5.4 Migratory Species

The EPBC Protected Matters Search Tool identified 13 migratory species as potentially occurring in the study area (**Appendix A**). An assessment of likelihood of occurrence was completed for each species based on habitat preference and known species distribution, and is included in **Appendix B**. The assessment confirmed that it is likely that several migratory species utilise the study area for foraging purposes, given its proximity to Lake Goran. Refer to assessment of likelihood of occurrence was completed for each species based on habitat preference and known species distribution, and is included in **Appendix B**.

Targeted searches did not confirm the presence of any EPBC migratory species within the study area.

5.5 Pests

While no pest fauna species were observed, it is likely that several pest species including Red Fox (*Vulpes vulpes*) and European Rabbit (*Oryctolagus cuniculus*) occur within the study area.

6.0 Ecological Impact Assessment

6.1 Potential Ecological Impacts

A range of short-term impacts are associated with the proposed activities, including impacts arising from vegetation removal, soil disturbances, and construction activities.

The potential impacts associated with the proposed activities are short-term and temporary. The proposed core hole lease is located within an area that has been heavily disturbed by intensive grazing. This area is in poor ecological condition, and of little habitat value due to the high levels of disturbance. As such, impacts are considered to be negligible.

The following sections outline the potential impacts identified, taking into consideration KTP's under the TSC and EPBC Acts.

6.1.1 Vegetation Removal

Clearing of disturbed ground covers will be required as part of construction. No canopy vegetation will be removed as part of the proposal

6.1.2 Introduction of Weeds and Feral Pest Species

The proposed activities have the potential to create favourable conditions for additional introduced weed species within the study area, which could potentially lead to an increase of existing weed populations. This is most likely to occur where soil disturbance is to occur.

All plant and machinery will be washed down and cleaned of any foreign soil and seed prior to being transported onsite to prevent the potential spread of introduced weeds and pathogens.

Disturbance of surface soils along access roads/ tracks and where re-shaping/ re-levelling earthworks are proposed to occur may encourage weed growth. Weed species, especially those listed as noxious, should be removed from site or controlled by means of herbicide applications to help prevent or minimise their re-occurrence within the proposed activities footprints. Where practical these weeds should be removed from site or controlled by means of herbicide applications to help prevent or minimise their re-occurrence.

6.1.3 Potential Disturbances to Lake Goran

The proposed core hole lease is located within 1.5km of the highest known level of Lake Goran. Construction activities have the potential to impact upon Lake Goran, due to erosion and sedimentation, chemical spills, and runoff. Given that an Environmental Management Plan will be prepared for the site, it is unlikely that the proposed construction activities will have an impact upon Lake Goran.

6.1.4 Disruption of Breeding Cycle, Roosting and Sheltering Behaviour

The breeding cycle, roosting, sheltering and foraging behaviour for some species may potentially be impacted by the proposed activities due to additional noise, light, and vehicle traffic.

6.1.5 Noise

Noise pollution as a result of vehicles, machinery and drilling may deter native fauna from the study area. The proposed activities could affect the migration and dispersal ability of native fauna particularly in relation to noise and vehicular movements. The proposed activities may result in short term increased noise pollution which has the potential to temporarily disrupt the breeding cycle and the foraging and roosting behaviour of some native fauna species.

6.2 Matters of National Environmental Significance

An EPBC Act Protected Matters Search was undertaken using the online database to generate a list of those MNES on potentially occurring within the study area and surrounds. This data, combined with other local knowledge and records, was utilised to assess whether the proposed activities will have, or are likely to have a significant impact on MNES.

6.2.1 World Heritage Areas

The proposed activities are not in a World Heritage area, and are not in close proximity to any such area.

6.2.2 Wetlands Protected by International Treaty

The proposed activities are not upstream or in an area where there is any form of Ramsar Wetlands.

6.2.3 Nationally Listed Threatened Species, Migratory Species and Ecological Communities

As discussed in **Sections 4 & 5**, five threatened fauna species, six threatened flora species and two ecological communities were identified as potentially occurring, or occurring in the site locale. The likely level of impact on these species and ecological communities was assessed in Appendix C. While the assessment indicated that no significant impact is likely for each threatened species and community, an assessment under the *EPBC Act Policy Statement 1.1 - Significant Impact Guidelines Matters of National Environmental Significance* (DEWHA, 2009) has been conducted for the following TEC identified as occurring on site (**Appendix D**):

- White Box – Yellow Box, and Blakely's Red Gum Woodland and Derived Native Grasslands; and
- Weeping Myall Woodland.

The application of the assessment of significance concluded that there is not likely to be a significant impact on the above communities arising from the proposed activities.

6.3 NSW State Significance

6.3.1 TSC Act

Section 5A of the EP&A Act lists seven factors that must be taken into account in the determination of the significance of potential impacts proposed activities on 'threatened species, populations or ecological communities (or their habitats)' listed under the TSC Act. The Assessment of Significance (7-part test) is used to determine whether activities are 'likely' to cause 'a significant impact' on threatened biota and thus whether a Species Impact Statement (SIS) is required.

As discussed in **Sections 4 & 5**, numerous threatened fauna species, five threatened flora species and two ecological communities were identified as potentially occurring, or occurring in the site locale. The likely level of impact on these species and ecological communities was assessed in **Appendix C**. While the assessment indicated that no significant impact is likely for each threatened species and community, a 7-part test of significance has been conducted for the following species and communities identified as occurring on site (**Appendix D**):

- White Box – Yellow Box and Blakely's Red Gum Woodland;
- Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes Bioregions; and
- Koala.

The application of the 7-part test concluded that there is not likely to be a significant impact on the above species or communities arising from the proposed activities.

6.3.2 Koala

Gunnedah LGA is listed in the *State Environmental Planning Policy No. 44 – Koala Habitat Protection* (SEPP 44), Schedule 1 as an LGA where this policy applies. Schedule 2 of SEPP 44 lists 10 tree species that are considered indicators of 'Potential Koala Habitat'. The presence of any of the species listed on a site proposed for development triggers the requirement for an assessment for 'Potential Koala Habitat'. SEPP 44 defines potential Koala Habitat as:

"areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component".

While White Box and Bimble Box are present across the property, and constitute 15% of the total number of trees in the upper canopy in the Eucalypt Woodland community, the proposed core hole lease does not include any canopy trees. The proposed core hole lease is therefore not considered to provide potential Koala habitat.

The access track traverses an area of White Box – Yellow Box Woodland, which is considered to be suitable Koala habitat. While the proposed activity will not result in the removal or interference of canopy trees, an Environmental Management Plan (EMP) has been prepared for the site. The EMP outlines site specific mitigation measures to prevent potential impacts on the local Koala population.

7.0 Impact Mitigation and Management

7.1 Introduction

In order to minimise potential ecological impacts resulting from the proposed activity, the location and design of the proposed core hole lease and associated infrastructure, and identification of appropriate mitigation measures has been undertaken in accordance with the 'avoid – minimise – mitigate – offset' hierarchy:

- Avoiding the impact altogether by relocating the proposed activity, or parts of an activity;
- Minimising impacts by restricting the magnitude of the proposed activity and its implementation;
- Mitigating the impact of the activity by appropriately managing the proposed activity, and rehabilitating, or restoring the affected environment; and
- Offsetting the impacts.

Avoid

The core hole lease has been located within an area of highly disturbed grassland, that is considered to be of low ecological value due to continual intensive grazing, and historical clearing. The core hole lease has been located to avoid areas of higher ecological significance, including areas considered to be TEC and EEC. The location of the core hole lease avoids canopy trees.

The proposed access track has largely been located along existing access tracks to avoid the need for additional clearing of native vegetation communities. Where additional access tracks require construction, they have been sited within disturbed grazing lands to avoid clearing canopy vegetation.

The core hole has been located to avoid impacts on the nearby Lake Goran.

Minimise

The disturbance area will be minimised to reduce unnecessary clearing and earthworks. Additionally, the disturbance area will be appropriately demarcated to ensure machinery is limited to the designated disturbance area. Access tracks have been largely located along existing access tracks to minimise disturbances. Additional clearing for the access track will result in the clearing of disturbed grasslands only. Vehicle speeds along the access track will be limited to minimise dust generation.

Weed management procedures will be implemented to prevent the spread of weeds both on and off site. Where vehicles and machinery are moving between the site and weed free areas, wash down procedures will be implemented. In particular, Noogoora Burr, a Class 4 declared noxious weed should be appropriately controlled within the proposal footprint and along the proposed access road and tracks prior to the construction stage.

To minimise impacts on Lake Goran, all liquids (fuel, oil, cleaning agents, drilling liquids etc) will be stored appropriately and disposed of at suitably licensed facilities. Spill management procedures will be implemented as required. Rubbish will be collected and removed from the site to ensure it does not enter Lake Goran or other surrounding areas.

Mitigate

An EMP has been prepared for the proposed activity, outlining a range of mitigation measures, including Koala management measures. As outlined in the EMP, weed monitoring will occur throughout the construction phase, and weed removal will be carried out as necessary.

The extent of disturbance will be clearly demarcated to ensure all machinery is limited to the disturbance area. Where the access track is adjacent to canopy vegetation, the access track will be clearly demarcated to ensure no accidental damage to canopy trees occurs.

Following construction of the core hole, the disturbance area will be appropriately rehabilitated to meet landholder requirements. Given that the core hole lease is currently used for grazing, it will be re-instated to natural grassland to provide site stability. No weed species will be used to rehabilitate the well lease.

Offset

Due to the proposed activities being short-term and the level of impacts being temporary and minimal in extent, as well as the recommended mitigation measures to rehabilitate the activity site, offsets are not required.

8.0 Conclusion

Santos is proposing to construct an exploration core hole, known as Goran South 1 within PEL 1, Gunnedah Basin. The proposed well lease is located within an agricultural property which has been disturbed due to intensive grazing, and historical land management practices.

Two TSC Act and EPBC Act listed communities occur across the property, White Box - Yellow Box - Blakely's Red Gum Woodland and Derived Native Grasslands, and Weeping Myall Woodland. However, the proposed core hole lease has been located within an area that is not commensurate with either community. The core hole lease has been selected as it is of low ecological value, due to intensive grazing and selective clearing. The core hole lease is void of canopy vegetation, and consists of disturbed ground covers, including weeds.

Access to the core hole lease is predominantly along existing access tracks. The existing access track is located within an area of White Box – Yellow Box – Blakely's Red Gum Woodland, however no widening of this portion of the track will be required. Construction of approximately 1500m of new access track will be required. While Weeping Myall occurs adjacent to the proposed access track location, it has been located to avoid all canopy vegetation. The new access track will be located in areas that comprise of disturbed grassland vegetation only. As such, minimal disturbances are expected to arise from the access track.

The well lease and access tracks have been located to minimise impacts on Lake Goran, a nationally significant wetland that supports a range of migratory species.

The proposed well lease has been selected and designed in accordance with the 'avoid – minimise – mitigate – offset' hierarchy to minimise impacts on White Box - Yellow Box - Blakely's Red Gum Woodland and Weeping Myall Woodland. The proposed well lease and new access track are highly disturbed, and predominantly cleared of vegetation. No canopy vegetation occurs within the proposed lease or within the new access track disturbance area.

No threatened flora species listed under the TSC Act and/or EPBC Act were identified as occurring within the well lease or access tracks. Two Class 4 noxious weeds, Prickly Pear and African Boxthorn, were recorded in the study area during the pre-clearance survey. Additionally, Noogoora Burr is known to occur on the property.

Woodland adjacent to the existing access track and proposed new access track, is considered to provide potential suitable marginal habitat to support several listed threatened species. Additionally, Koala scats were observed in this area. However, the proposed well lease does not comprise suitable habitat resources to support these listed species.

The potential direct and indirect impacts that may be associated with the proposal are considered to be minimal. A range of mitigation and management measures have been identified, to minimise potential indirect ecological impacts. No significant impact on the White Box - Yellow Box - Blakely's Red Gum Woodland or Weeping Myall Woodland will occur as a result of the proposed activity.

9.0 References

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Appendix A to the Ecological Assessment

EPBC Protected Matters Report



Australian Government

Department of Sustainability, Environment,
Water, Population and Communities

EPBC Act Protected Matters Report: Coordinates

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information about the EPBC Act including significance guidelines, forms and application process details can be found at <http://www.environment.gov.au/epbc/assessmentsapprovals/index.html>

Report created: 19/08/11 14:42:45

[Summary](#)

[Details](#)

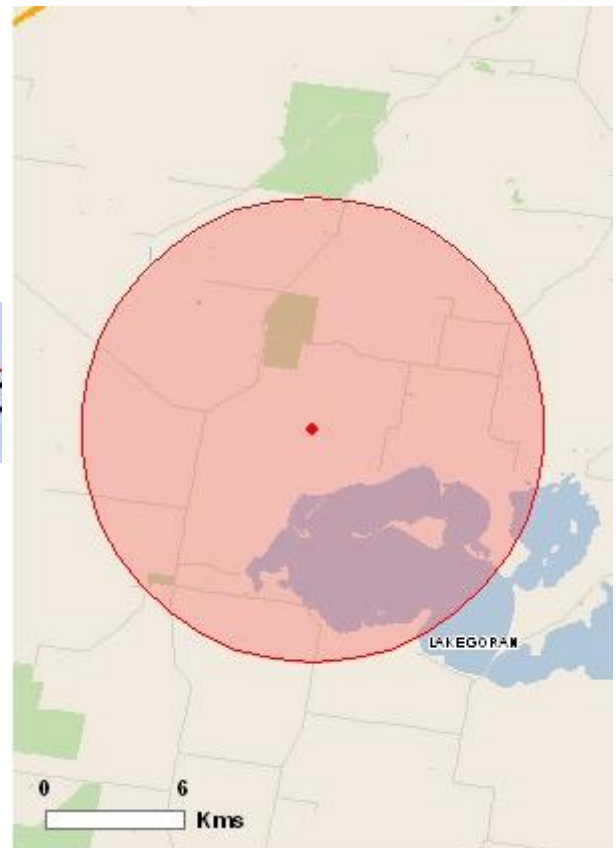
[Matters of NES](#)

[Other matters protected by
the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



This map may contain data which are
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Australia), ©PSMA 2010

[Coordinates](#)

Buffer: 10.0Km

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see <http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html>.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Significance (Ramsar Wetlands):	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	5
Threatened Species:	19
Migratory Species:	11

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage/index.html>

Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at <http://www.environment.gov.au/epbc/permits/index.html>.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	9
Whales and Other Cetaceans:	None

Critical Habitats:	None
Commonwealth Reserves:	None

Report Summary for Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	None
State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	9
Nationally Important Wetlands:	1

Details

Matters of National Environmental Significance

Threatened Ecological Communities [\[Resource Information \]](#)

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Critically Endangered	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community may occur within area
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered	Community may occur within area
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community may occur within area
Weeping Myall Woodlands	Endangered	Community may occur within area

Threatened Species [\[Resource Information \]](#)

Name	Status	Type of Presence
BIRDS		
Anthochaera phrygia		
Regent Honeyeater [82338]	Endangered	Species or species habitat may occur within area
Lathamus discolor		
Swift Parrot [744]	Endangered	Species or species habitat may occur within area
Polytelis swainsonii		
Superb Parrot [738]	Vulnerable	Species or species habitat may occur within area
Rostratula australis		

Australian Painted Snipe [77037]	Vulnerable	Species or species habitat may occur within area
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FISH

[Maccullochella peelii peelii](#)

Murray Cod, Cod, Goodoo [68443]	Vulnerable	Species or species habitat may occur within area
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FROGS

[Litoria booroolongensis](#)

Booroolong Frog [1844]	Endangered	Species or species habitat may occur within area
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MAMMALS

[Chalinolobus dwyeri](#)

Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may occur within area
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[Dasyurus maculatus maculatus \(SE mainland population\)](#)

Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
--	------------	--

[Nyctophilus timoriensis \(South-eastern form\)](#)

Greater Long-eared Bat, South-eastern Long-eared Bat [66888]	Vulnerable	Species or species habitat may occur within area
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[Petrogale penicillata](#)

Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area
------------------------------------	------------	--

PLANTS

[Digitaria porrecta](#)

Finger Panic Grass [12768]	Endangered	Species or species habitat likely to occur within area
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[Euphrasia arguta](#)

[4325]	Critically Endangered	Species or species habitat may occur within area
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[Philothea ericifolia](#)

[64942]	Vulnerable	Species or species habitat likely to occur within area
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[Prasophyllum sp. Wybong \(C.Phelps ORG 5269\)](#)

a leek-orchid [81964]	Critically Endangered	Species or species habitat may occur within area
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[Pterostylis cobarensis](#)

Cobar Greenhood Orchid [12993]	Vulnerable	Species or species habitat likely to occur within area
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[Swainsona murrayana](#)

Slender Darling-pea, Slender Swainson, Murray Swainson-pea [6765]	Vulnerable	Species or species habitat likely to occur within area
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[Thesium australe](#)

Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area
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[Tylophora linearis](#)

[55231]	Endangered	Species or species habitat likely to occur within area
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REPTILES

[Underwoodisaurus sphyrurus](#)

Border Thick-tailed Gecko
[1660]

Vulnerable

Species or species habitat likely to occur within area

Migratory Species

[[Resource Information](#)]

Name

Status

Type of Presence

Migratory Marine Birds

[Apus pacificus](#)

Fork-tailed Swift [678]

Species or species habitat may occur within area

[Ardea alba](#)

Great Egret, White Egret
[59541]

Species or species habitat may occur within area

[Ardea ibis](#)

Cattle Egret [59542]

Species or species habitat may occur within area

Migratory Terrestrial Species

[Haliaeetus leucogaster](#)

White-bellied Sea-Eagle [943]

Species or species habitat likely to occur within area

[Hirundapus caudacutus](#)

White-throated Needletail [682]

Species or species habitat may occur within area

[Merops ornatus](#)

Rainbow Bee-eater [670]

Species or species habitat may occur within area

[Xanthomyza phrygia](#)

Regent Honeyeater [430]

Endangered*

Species or species habitat may occur within area

Migratory Wetlands Species

[Ardea alba](#)

Great Egret, White Egret
[59541]

Species or species habitat may occur within area

[Ardea ibis](#)

Cattle Egret [59542]

Species or species habitat may occur within area

[Gallinago hardwickii](#)

Latham's Snipe, Japanese Snipe
[863]

Species or species habitat may occur within area

[Rostratula benghalensis s. lat.](#)

Painted Snipe [889]

Vulnerable*

Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species

[[Resource Information](#)]

Name

Status

Type of Presence

Birds

[Apus pacificus](#)

Fork-tailed Swift [678]

Species or species habitat may occur within area

[Ardea alba](#)

Great Egret, White Egret
[59541]

Species or species habitat may occur within area

[Ardea ibis](#)

Cattle Egret [59542]

Species or species habitat may occur within area

[Gallinago hardwickii](#)

Latham's Snipe, Japanese Snipe
[863]

Species or species habitat may occur within area

[Haliaeetus leucogaster](#)

White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus		
White-throated Needletail [682]		Species or species habitat may occur within area
Lathamus discolor		
Swift Parrot [744]	Endangered	Species or species habitat may occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Rostratula benghalensis s. lat.		
Painted Snipe [889]	Vulnerable*	Species or species habitat may occur within area

Extra Information

State and Territory Reserves [[Resource Information](#)]

Wondoba, NSW

Invasive Species [[Resource Information](#)]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.

Name	Status	Type of Presence
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Mammals

[Felis catus](#)

Cat, House Cat, Domestic Cat [19]	Species or species habitat likely to occur within area
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[Oryctolagus cuniculus](#)

Rabbit, European Rabbit [128]	Species or species habitat likely to occur within area
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[Sus scrofa](#)

Pig [6]	Species or species habitat likely to occur within area
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[Vulpes vulpes](#)

Red Fox, Fox [18]	Species or species habitat likely to occur within area
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Plants

[Lycium ferocissimum](#)

African Boxthorn, Boxthorn [19235]	Species or species habitat may occur within area
------------------------------------	--

[Pinus radiata](#)

Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]	Species or species habitat may occur within area
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[Rubus fruticosus aggregate](#)

Blackberry, European Blackberry [68406]	Species or species habitat likely to occur within area
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[Salix spp. except S.babylonica, S.x calodendron & S.x reichardtiji](#)

Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]	Species or species habitat likely to occur within area
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[Tamarix aphylla](#)

Athel Pine, Athel Tree,	Species or species habitat likely to occur within area
-------------------------	--

Tamarisk, Athel Tamarisk,
Athel Tamarix, Desert
Tamarisk, Flowering Cypress,
Salt Cedar [16018]

Nationally Important Wetlands

[Resource Information]

[Lake Goran, NSW](#)

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites;
- seals which have only been mapped for breeding sites near the Australian continent.

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-31.21371 150.13041

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Department of Environment, Climate Change and Water, New South Wales](#)
- [-Department of Sustainability and Environment, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment and Natural Resources, South Australia](#)
- [-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts](#)
- [-Environmental and Resource Management, Queensland](#)
- [-Department of Environment and Conservation, Western Australia](#)
- [-Department of the Environment, Climate Change, Energy and Water](#)
- [-Birds Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-SA Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Atherton and Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [-State Forests of NSW](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

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Last updated: Thursday, 16-Sep-2010 09:13:25 EST

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Appendix B to the Ecological Assessment

Site Flora Species List

Family Name	Scientific Name	Common Name
ASTERACEAE	<i>Carthamus lanatus</i> *	Saffron Thistle
BRASSICACEAE	<i>Capsella bursa-pastoris</i> *	Shepherds Prse
CASURINACEAE	<i>Casuarina cristata</i>	Belah
CHENOPODIACEAE	<i>Sclerolaena muricata</i>	Black Rolypoly
CHENOPODIACEAE	<i>Sclerolaena birchii</i> *	Galvanised Burr
CUPRESSACEAE	<i>Callitris glaucophylla</i>	White Cypress
CYPERACEAE	<i>Gahnia aspera</i>	Rough Saw-Sedge
FABACEAE	<i>Acacia pendula</i>	Weeping Myall
LORANTHACEAE	<i>Amyema quandang</i>	Grey Mistletoe
MYRTACEAE	<i>Eucalyptus populnea</i>	Bimble Box
MYRTACEAE	<i>Eucalyptus melliodora</i>	Yellow Box
POACEAE	<i>Aristida vagans</i>	Three-awn Speargrass
POACEAE	<i>Austrostipa aristiglumis</i>	Plains Grass
POACEAE	<i>Austrostipa scabra</i>	Rough Speargrass
POACEAE	<i>Austrostipa verticillata</i>	Slender Bamboo Grass
POACEAE	<i>Digitaria didactyla</i>	Blue Couch Grass
RUTACEAE	<i>Geijera parviflora</i>	Wilga
SOLANACEAE	<i>Lycium ferocissimum</i> *	African Boxthorn

* denotes introduced species.

Appendix C to the Ecological Assessment

Assessment of Likelihood of Occurrence, and Potential Level of Impact

Those threatened flora and fauna species (listed under the *TSC Act* and the *EPBC Act*) that have been gazetted / recorded from within the locality have been considered in the following tables. EEC's and Endangered Populations known from the broader area have also been addressed. Each species / community / population is considered for its potential to occur within the study area and the likely level of impact as a result of the proposed activities. The following tables deal with each species / community / population separately and identifies the ecological parameters of significance associated with the proposed activities.

'Species' or 'EEC / Population' – Lists each threatened species / EEC / population known from the vicinity of the site. The status of each threatened species under the *TSC Act* and *EPBC Act* is also provided.

'Habitat' – Provides a brief account of the species / community / population and the preferred habitat attributes required for the existence / survival of each species / community / population.

'Likelihood of Occurrence' – Assesses the likelihood of each species / community / population to occur within the site in terms of the aforementioned habitat description and taking into account local habitat preferences, results of recent field investigations, data gained from various sources and previously gained knowledge via fieldwork undertaken within other ecological assessments in the locality.

'Potential for Impact' – Through consideration of the likely level / significance of impacts to each species / community / population that would result from the proposed activities, taking into account both short and long-term impacts, a decision has been made whether further assessment is required. This assessment is largely based on the chance of occurrence of each species / community with due recognition to other parameters such as home range, habitat use, connectivity etc. It also considers the scope of the proposed activities.

Likelihood of Occurrence of Threatened Ecological Communities within the Study Area, and Potential Likely Level of Impact

Ecological Community	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
EPBC Act - White Box-Yellow Box-Blakely's Red Gum grassy woodland and derived native grassland TSC Act - White Box Yellow Box Blakely's Red Gum Woodland	EEC	CE	White Box Yellow Box Blakely's Red Gum Woodland (commonly referred to as Box-Gum Woodland) is an open woodland community (sometimes occurring as a forest formation) , in which the most obvious species are one or more of the following: White Box <i>Eucalyptus albens</i>, Yellow Box <i>E. melliodora</i> and Blakely's Red Gum <i>E. blakelyi</i>. Intact sites contain a high diversity of plant species, including the main tree species, additional tree species, some shrub species, several climbing plant species, many grasses and a very high diversity of herbs. Box-Gum Woodland is found from the Queensland border in the north, to the Victorian border in the south. It occurs in the tablelands and western slopes of NSW.	This ecological community is known to occur adjacent to the existing access track. Refer to Figure 4.1, and Section 4.	Considered unlikely to be adversely affected by the proposed activities, as no clearing is required along the existing access track. Given that this species is known to occur on site, an AoS has been conducted, and is included in Appendix D .
TSC Act - Native Vegetation on Cracking Clay Soils of the Liverpool Plains EPBC Act – Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland	EEC	CE	Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland commonly occur in the Darling Downs of southern Queensland and the Liverpool Plains and Moree Plains of northern NSW. Species composition can change yearly and seasonally in response to rainfall, temperature, fire, grazing pressure and management. This community is typically dominated by tussock grasses in the genera <i>Austrodanthonia</i>, <i>Austrostipa</i>,	This community was not identified in the study area. While species from the listed genera occur within study area, the soils are not considered to be suitable to be classified as this community.	Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area. An AoS for this community is not required.

			<i>Bothriochloa</i>, <i>Chloris</i>, <i>Enteropogon</i>, or <i>Themeda</i>, with occurrences of other herbaceous plants such as native daisies, orchids, lilies and other wildflowers. The shrub cover is typically a very minor component of the grassland. A tree canopy is typically absent. The ecological community generally occurs on flat to low slopes, of no more than 5 percent (or less than 1 degree) inclination. The community is mainly associated with fine textured, often cracking clay soils derived from either basalt or alluvium.		
TSC Act - Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions EPBC Act - Grey Box (<i>Eucalyptus microcarpa</i>) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	EEC	E	Inland Grey Box Woodland includes those woodlands in which the most characteristic tree species, <i>Eucalyptus microcarpa</i> (Inland Grey Box), is often found in association with <i>E. populnea</i> subsp. <i>bimbil</i> (Bimble or Poplar Box), <i>Callitris glaucophylla</i> (White Cypress Pine), <i>Brachychiton populneus</i> (Kurrajong), <i>Allocasuarina luehmannii</i> (Bulloak) or <i>E. melliodora</i> (Yellow Box), and sometimes with <i>E. albens</i> (White Box). The community generally occurs as an open woodland 15–25 m tall but in some locations the overstorey may be absent as a result of past clearing or thinning, leaving only an understorey. Inland Grey Box Woodland occurs predominately within the Riverina and South West Slopes regions of NSW down to the Victorian border. This community also extends across the slopes and plains in Central and Northern NSW up to the Queensland	This ecological community was not identified in the study area.	Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area. An AoS for this community is not required.

			Border.		
TSC Act - Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions EPBC Act - Weeping Myall Woodlands	EEC	E	This ecological community is scattered across the eastern parts of the alluvial plains of the Murray-Darling river system. Typically, it occurs on redbrown earths and heavy textured grey and brown alluvial soils within a climatic belt receiving between 375 and 500 mm mean annual rainfall. The structure of the community varies from low woodland and low open woodland to low sparse woodland or open shrubland, depending on site quality and disturbance history. The tree layer grows up to a height of about 10 metres and invariably includes <i>Acacia pendula</i> (Weeping Myall or Boree) as one of the dominant species or the only tree species present. This EEC is known from parts of the Local Government Areas of Berrigan, Bland, Bogan, Carrathool, Conargo, Coolamon, Coonamble, Corowa, Forbes, Gilgandra, Griffith, Gwydir, Inverell, Jerilderee, Lachlan, Leeton, Lockhart, Moree Plains, Murray, Murrumbidgee, Narrabri, Narranderra, Narromine, Parkes, Urana, Wagga Wagga and Warren, and but may occur elsewhere in these bioregions.	This ecological community is known to occur adjacent to the proposed access track. Refer to Figure 4.1, and Section 4.	Considered unlikely to be adversely affected by the proposed activities, as the access track has been located to ensure no clearing of this community. Given that this species is known to occur on site, an AoS has been conducted, and is included in Appendix D.
TSC Act - Artesian Springs Ecological Community	EEC	E	Naturally restricted to the artesian springs of the Great Artesian Basin in north-western NSW. The springs occur where artesian water emerges at the surface through fault-lines in the overlying rock and produce mounds from the salts and sediments as the water evaporates. The vegetation within the community frequently	This ecological community was not identified in the study area.	Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area. An AoS for this community is not required.

			consists of sedges or similar vegetation, however, trees and shrubs, may be adjacent to the springs or nearby. Occurs at the edges of the Great Artesian Basin. Mostly found in Queensland and South Australia, however, a few occur in the Mulga Lands, Darling Riverine Plains and Cobar Peneplain Bioregions of New South Wales.		
TSC Act - Oonline (<i>Cadellia pentastylis</i>) community in the Nandewar and Brigalow Belt South bioregion	EEC	-	The Ooline community is an unusual and distinctive forest community with the canopy dominated by the tree Ooline (<i>Cadellia pentastylis</i>). Other canopy species include White Box (<i>Eucalyptus albens</i>), Ironbarks (<i>E. beyeriana</i> and <i>E. melanophloia</i>), Dirty Gum (<i>E. chloroclada</i>), Narrow-leaved Grey Box (<i>E. pilligaensis</i>), Green Mallee (<i>E. viridis</i>) and White Cypress Pine (<i>Callitris glaucophylla</i>). The understorey is made up of a range of shrubs such as Wattles and grasses. Extensively cleared and now known from only seven main locations on the North West Slopes in NSW, between Narrabri and the Queensland border, and also in Queensland.	This ecological community was not identified in the study area.	Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area. An AoS for this community is not required.
TSC Act - Carbeen Open Forest community in the Darling Riverine Plains and Brigalow Belt South Bioregions	EEC	-	This was previously an open forest community of flora and fauna that may now exist as woodland or as remnant trees. Characteristic tree species are Carbeen (<i>Corymbia tessellaris</i>) and White Cypress-pine (<i>Callitris glaucophylla</i>). Associated trees include <i>Corymbia dolichocarpa</i>, <i>Eucalyptus populnea</i>, <i>E.</i>	This ecological community was not identified in the study area.	Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area. An AoS for this community is not required.

			<i>camaldulensis</i> , <i>Casuarina cristata</i> and <i>Allocasuarina leuhmannii</i> . Found on riverine plains of the Meehi, Gwydir, MacIntyre and Barwon Rivers and in small remnants farther south.		
TSC Act - Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions	EEC	-	Tall woodland or open forest dominated by Fuzzy Box <i>Eucalyptus conica</i> , often with Grey Box <i>Eucalyptus microcarpa</i> , Yellow Box <i>Eucalyptus melliodora</i> , or Kurrajong <i>Brachychiton populneus</i> . Buloke <i>Allocasuarina leuhmannii</i> is common in places. Shrubs are generally sparse, and the groundcover moderately dense, although this will vary with season. Alluvial soils of the South West Slopes, Brigalow Belt South and Darling Riverine Plains Bioregions. Mainly in the Dubbo-Narromine- Parkes-Forbes area.	This ecological community was not identified in the study area.	Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area. An AoS for this community is not required.
TSC Act - Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions	EEC	CE	A low, dense form of dry rainforest generally less than 10 m high, made up of vines and rainforest trees as well as some shrubs. This community often stands out as a bright green against surrounding woodland due to many species having bright-coloured leaves. The main canopy is dominated by rainforest species such as Red Olive Plum (<i>Cassine australis</i> var. <i>angustifolia</i>), Wilga (<i>Geijera parvifolia</i>) Native Olive (<i>Notelaea microcarpa</i> var. <i>microcarpa</i>) and Peach Bush (<i>Ehretia membranifolia</i>), with taller eucalypts and cypress pines from surrounding woodland vegetation emerging above the main canopy.	This ecological community was not identified in the study area.	Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area. An AoS for this community is not required.

			A scattered distribution near Gunnedah, Barraba, Bingara and north of Wialda on the NSW North West Slopes and Plains, and also in Queensland.		
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Likelihood of Occurrence of Threatened Flora Species within the Study Area, and Potential Likely Level of Impact

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Flora						
<i>Cadellia pentastylis</i>	Ooline	V	V	Forms a closed or open canopy mixing with Eucalypt and Cypress Pine species with a typical soil profile of sandy loam surface layer, grading from a light clay to medium clay with depth.	Surveys did not record this species within the study area. Unlikely due to lack of suitable habitat and high disturbance.	Detailed flora surveys were conducted within the study area, and no individuals were observed. The proposed activities will not result in the removal of this species. Therefore, further assessment under an Assessment of Significance (AoS) for this species is not required.
<i>Cyperus conicus</i>	-	V	-	Mostly found in open woodlands dominated by sandy soils. Prefer to grown near waterholes or the banks of waterbodies in which sandy soils may also be found.	Surveys did not record this species within the study area. Unlikely due to lack of suitable habitat. No sandy soils are present on site.	No potential habitat is present in the study area, and thus this species is unlikely to be affected by the proposed activities. Therefore a further assessment of Assessment of Significance (AoS) for this species is not required.
<i>Dichanthium setosum</i>	Bluegrass	V	V	Found in moderately disturbed areas such as cleared woodland, grassy roadside remnants, grazed land and highly disturbed pasture on heavy basaltic black soils and stony red-brown hard setting loam with clay subsoil.	Possible. Suitable habitat occurs in the study area. Surveys did not record this species within the study area.	Considered unlikely to be adversely affected by the proposed activities due to the minimal disturbances proposed. Therefore AoS for this species is not required.
<i>Digitaria porrecta</i>	Finger Panic Grass	E	E	Occurs in grasslands and in undulating woodlands and open forests with an underlying basaltic geology.	Possible. Suitable habitat occurs in the study area. Surveys did not record this species within the study	Considered unlikely to be adversely affected by the proposed activities due to the minimal disturbances

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
					area.	proposed. Therefore AoS for this species is not required.
<i>Euphrasia arguta</i>	-	-	CE	Mostly seen occupying elevated grasslands within close proximity to rivers.	Surveys did not record this species within the study area. Unlikely to occur within the proposed core hole lease due to lack of suitable habitat.	No potential habitat is present in the study area, and thus this species is unlikely to be affected by the proposed activities. Therefore a further assessment of Assessment of Significance (AoS) for this species is not required.
<i>Philotheca ericifolia</i>	-	V	V	Grows mostly in dry sclerophyll forest and heath on damp sandy flats and gullies.	Unlikely to occur within the core hole lease due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat within the core hole lease, therefore AoS for this species is not required.
<i>Pomaderris queenslandica</i>	Scant Pomaderris	E		Generally found occupying sheltered woodlands or moist eucalypt woodlands that are comprised of a dense understorey and in close proximity to a waterbody.	Possible. Suitable habitat occurs in the study area. The core hole lease does not provide suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat within the core hole lease, therefore AoS for this species is not required.
<i>Prasophyllum sp. Wybong</i>	A Leek-orchid	-	CE	Generally found in shrubby and grassy habitats in dry to wet soil. It is known to occur in open Eucalypt woodland and grassland.	Possible. Suitable habitat occurs in the study area. The core hole lease does not provide suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat within the core hole lease, therefore AoS for this species is not required.
<i>Pterostylis cobarensis</i>	Cobar Greenhood Orchid	V	V	Found in Eucalypt woodlands, open mallee or <i>Callitris</i> shrublands on low or stony ridges and slopes in skeletal sandy-loam soils.	Unlikely due to highly modified nature of the core hole lease.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat within the core hole lease, therefore AoS for this species is not required.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
<i>Swainsona murrayana</i>	Slender Darling-pea	V	V	Known to occur on clay-based soils in a variety of vegetation types, including Bladder Saltbush, Black Box and grassland communities on level plains, floodplains and depressions. It is often found with <i>Maireana</i> species.	Unlikely due to highly modified nature of the core hole lease.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat within the core hole lease, therefore AoS for this species is not required.
<i>Thesium australe</i>	Austral Toadflax	V	V	Occurs in grasslands or grassy woodlands and is often found in damp subject sites in association with Kangaroo Grass.	Possible. Suitable habitat occurs in the study area. Surveys did not record this species within the study area.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat within the core hole Lease, therefore AoS for this species is not required.
<i>Tylophora linearis</i>	-	V	E	Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry Eucalypt and/or <i>Callitris</i> woodlands.	Possible. Suitable habitat occurs in the study area. The core hole lease does not provide suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat within the core hole lease, therefore AoS for this species is not required.

Likelihood of Occurrence of Threatened Fauna Species within the Study Area, and Potential Likely Level of Impact

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Fish						
<i>Maccullochella peelii peelii</i>	Murray Cod	-	V	Found in clear rocky streams to slow flowing, turbid rivers and billabongs. Usually found near large rocks, snags, overhanging vegetation and other woody structures.	May utilise Lake Goran, however it is unlikely to utilise the core hole lease due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the core hole lease, therefore AoS for this species is not required.
Amphibians						
<i>Litoria booroolongensis</i>	Booroolong Frog	E	E	Found along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses.	Suitable habitat occurs in fringing wetland vegetation to Lake Goran, unlikely to utilise core hole lease due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the core hole lease, therefore AoS for this species is not required.
Reptiles						
<i>Aprasia parapulchella</i>	Pink-tailed Legless Lizard	V	V	Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass (<i>Themeda australis</i>). Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks. Commonly found beneath small, partially-embedded rocks and appear to spend considerable time in burrows below these rocks.	Possible. Suitable habitat occurs in the study area, however the core hole lease is not considered to provide suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the core hole lease. Therefore AoS for this species is not required.
<i>Hoplocephalus bitorquatus</i>	Pale-headed Snake	V	-	Found mainly in dry Eucalypt forests and woodlands, Cypress woodland and occasionally in rainforest or moist	Possible. Suitable habitat occurs in the study area, however the core hole	Considered unlikely to be adversely affected by the proposed activities due to the

				Eucalypt forest. Favours streamside areas, particularly in drier habitats.	lease is not considered to provide suitable habitat.	lack of suitable habitat within the core hole lease. Therefore AoS for this species is not required
<i>Underwoodisaurus sphyrurus</i>	Border Thick-tailed Gecko	V	V	Favours forest and woodland areas on steep rocky or scree slopes, with boulders, rock slabs, fallen timber and deep leaf litter.	Habitat in the study area is not suitable to support this species.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required.
Aves						
<i>Anseranas semipalmata</i>	Magpie Goose	V		Depending upon the level of maturity adults are seen occupying floodplains and moist grasslands as opposed to juveniles which are seen in moist habitats further inland.	Possible. Habitat in the study area provides marginal foraging habitat for this species.	Considered unlikely to be adversely affected by the proposed activities due to the minimal nature of the proposal. Therefore, an AoS for this species is not required.
<i>Anthochaera phrygia</i>	Regent Honeyeater	E	E, M	Inhabits dry open forest and woodland, particularly Box-Ironbark woodland and open riparian forests of River She-oak.	Suitable habitat occurs in the open woodland adjacent to the study area, however no suitable habitat occurs within the well lease.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the well lease. While suitable habitat occurs in adjacent areas, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required.
<i>Apus pacificus</i>	Fork-tailed Swift	-	M	Aerial over open country, from semi-deserts to coasts, islands and sometimes over forests and cities.	Possible flyover species.	Considered unlikely to be adversely affected by the proposed activities due to the low likelihood of the species occurring on the site, therefore AoS for this species is not required.
<i>Ardea alba</i>	Great Egret	-	M	Prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp	Known to utilise Lake Goran. Grazing lands in the study area may provide	The proposed activities will result in minimal impact on this species' habitat. Construction

				grasslands.	suitable foraging habitat.	activities will not directly affect Lake Goran. Additionally, given the minimal clearing proposed, the activity is not considered to significantly impact on foraging habitat. Therefore, an AoS has not been prepared for this species.
<i>Ardea ibis</i>	Cattle Egret	-	M	Found in grasslands, woodlands, wetlands, pastures and croplands, especially where drainage is poor.	Known to utilise Lake Goran. Grazing lands in the study area may provide suitable foraging habitat.	The proposed activities will result in minimal impact on this species' habitat. Construction activities will not directly affect Lake Goran. Additionally, given the minimal clearing proposed, the activity is not considered to significantly impact on foraging habitat. Therefore, an AoS has not been prepared for this species.
<i>Calyptorhynchus lathamii</i>	Glossy-Black Cockatoo	V	-	She-oaks, in forests, woodlands, timbered watercourses, in eucalypt and native cypress, Brigalow scrub.	Possible. Habitat trees occur in the study area, however no suitable habitat occurs in the core hole lease.	Considered unlikely to be adversely affected by the proposed activities, as no impacts are anticipated on suitable habitat. Therefore AoS for this species is not required.
<i>Climacteris picumnus</i>	Brown Treecreeper	V	-	Found in Eucalypt woodlands and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked Eucalypts, usually with a grassy understorey.	Suitable habitat occurs in the study area, however no suitable habitat occurs within the well lease.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the well lease. While suitable habitat occurs in the study area, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required.
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V		Inhabits eucalypt forests and woodlands, especially those containing	Suitable habitat occurs in the study area, however no	Considered unlikely to be adversely affected by the

				rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	suitable habitat occurs within the well lease.	proposed activities due to the lack of suitable habitat within the well lease. While suitable habitat occurs in the study area, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required.
<i>Gallinago hardwickii</i>	Latham's Snipe	-	M	Soft wet ground or shallow water with tussocks with other green or dead growth, wet parts of paddocks, seepage below dams, irrigated areas, scrub or open woodland from sea level to alpine bogs over 2000m, samphire on salt marshes, mangrove fringes	Likely to utilise Lake Goran, unlikely to utilise the core hole lease due to lack of suitable habitat.	The proposed activities will result in minimal impact on this species' habitat. Construction activities will not directly affect Lake Goran, the only potential habitat in the vicinity. Therefore, AoS for this species is not required.
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	Forages primarily in the canopy of open Eucalypt forest and woodland. Riparian habitats are particularly used, due to higher soil fertility. Also found in isolated flowering trees in open country, e.g. paddocks and roadside remnants.	Suitable habitat occurs in the study area, however no suitable habitat occurs within the well lease.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the well lease. While suitable habitat occurs in the study area, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required.
<i>Grantiella picta</i>	Painted Honeyeater	V	-	Inhabits Boree, Brigalow and Box-Gum woodlands and Box-Ironbark forests, feeding on the fruits of mistletoes growing on woodland Eucalypts and Acacias.	Suitable habitat occurs in the study area, however no suitable habitat occurs within the well lease.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the well lease. While suitable habitat occurs in the study area, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required.
<i>Hamirostra melanosternon</i>	Black-breasted Buzzard	V	-	Lives in a range of habitats, especially along timbered watercourses which is	Suitable habitat occurs in the study area. The core	Considered unlikely to be adversely affected by the

				the preferred breeding habitat. Also hunts over grasslands and sparsely timbered woodlands.	hole lease may provide foraging habitat for this species.	proposed activities given the minimal disturbances proposed. Therefore, AoS for this species is not required.
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	-	M	Habitat characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea). Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, forest (including rainforest) and even urban areas.	Likely to utilise Lake Goran, unlikely to utilise the core hole lease due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities given the minimal disturbances proposed. Therefore, AoS for this species is not required.
<i>Hieraaetus morphnoides</i>	Little Eagle	V	-	Occupies open eucalypt forest, woodland or open woodland. She oak or acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.	Suitable habitat occurs in the study area. The core hole lease may provide foraging habitat for this species.	Considered unlikely to be adversely affected by the proposed activities given the minimal disturbances proposed. Therefore, AoS for this species is not required.
<i>Hirundapus caudacutus</i>	White-throated Needletail	-	M	Almost exclusively aerial most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy.	Possible flyover species. Unlikely to utilise the core hole lease due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required.
<i>Lathamus discolor</i>	Swift Parrot	E	E	Migrates to south-east Australia between March and October. Occurs in areas where Eucalypts are flowering profusely or where there are abundant lerp infestations.	Suitable habitat occurs in the study area, however no suitable habitat occurs within the well lease.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the well lease. While suitable habitat occurs in the study area, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required.
<i>Lophoictinia isura</i>	Square-tailed Kite	V	-	Found in a variety of habitats including dry woodlands and open forests. Shows a particular preference for	Suitable habitat occurs in the study area. The core hole lease may provide	Considered unlikely to be adversely affected by the proposed activities given the

				timbered watercourses.	foraging habitat for this species.	minimal disturbances proposed. Therefore, AoS for this species is not required.
<i>Melanodryas cucullata</i>	Hooded Robin	V	-	Prefers lightly wooded country and structurally diverse habitats, usually open Eucalypt woodland, Acacia scrub and mallee, often in or near clearings or open areas.	Suitable habitat occurs in the study area. The core hole lease may provide foraging habitat for this species.	Considered unlikely to be adversely affected by the proposed activities given the minimal disturbances proposed. Therefore, AoS for this species is not required.
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater	V	-	Occupies mostly upper levels of drier open forests or woodlands dominated by Box or ironbark Eucalypts. Also inhabits open forests of smooth-barked Gums, stringy barks, ironbarks and tea-trees.	Suitable habitat occurs in the study area. The core hole lease may provide foraging habitat for this species.	Considered unlikely to be adversely affected by the proposed activities given the minimal disturbances proposed. Therefore, AoS for this species is not required.
<i>Merops ornatus</i>	Rainbow Bee-eater	-	M	Occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation.	Suitable habitat occurs in the study area. The core hole lease may provide foraging habitat for this species.	Considered unlikely to be adversely affected by the proposed activities given the minimal disturbances proposed. Therefore, AoS for this species is not required.
<i>Neophema pulchella</i>	Turquoise Parrot	V	-	Lives on edges of Eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	Suitable habitat occurs in the study area. The core hole lease may provide foraging habitat for this species.	Considered unlikely to be adversely affected by the proposed activities given the minimal disturbances proposed. Therefore, AoS for this species is not required.
<i>Ninox connivens</i>	Barking Owl	V	-	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. Roosts in shaded portions of tree canopies, with tall midstorey species, such as Acacia and Casuarina species.	Suitable habitat occurs in the study area. The core hole lease may provide foraging habitat for this species.	Considered unlikely to be adversely affected by the proposed activities given the minimal disturbances proposed. Therefore, AoS for this species is not required.
<i>Polytelis swainsonii</i>	Superb Parrot	V	V	Found in Box-Gum, Box-Cypress-pine and Boree woodlands and River Red Gum forest. Nests in small colonies in the hollows of large trees, mainly in tall	Suitable habitat occurs in the study area. The core hole lease may provide foraging habitat for this	Considered unlikely to be adversely affected by the proposed activities given the minimal disturbances

				riparian River Red Gum forest or woodland.	species.	proposed. Therefore, AoS for this species is not required.
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler	V	-	Inhabits open Box-Gum woodlands on the slopes, Box-Cypress pine and open Box woodlands on alluvial plains.	Suitable habitat occurs in the study area. The core hole lease may provide foraging habitat for this species.	Considered unlikely to be adversely affected by the proposed activities given the minimal disturbances proposed. Therefore, AoS for this species is not required.
<i>Pyrrholaemus sagittatus</i>	Speckled Warbler	V	-	Lives in a wide range of Eucalypt dominated communities that have a grassy understorey and often on rocky ridges or in gullies.	Possible. Suitable habitat occurs in woodland habitat within the study area. The core hole lease does not provide suitable habitat for this species.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the core hole lease, and minimal impacts anticipated on woodland habitats in the study area. Therefore AoS for this species is not required.
<i>Rostratula australis</i>	Australian Painted Snipe	E	V	Inhabits shallow terrestrial freshwater wetlands, including temporary and permanent lakes, swamps and claypans.	Likely to utilise Lake Goran, unlikely to utilise the core hole lease due to lack of suitable habitat	The proposed activities will result in minimal impact on this species' habitat. Construction activities will not directly affect Lake Goran, the only potential habitat in the vicinity. However, as it is possible that this species utilised Lake Goran, an AoS for this species is not considered necessary.
<i>Rostratula benghalensis</i>	Painted Snipe	-	M	Inhabits inland and coastal shallow freshwater wetlands, occurring in both ephemeral and permanent wetlands, particularly where there is grass. Individuals have been spotted in artificial dams, sewage ponds and waterlogged grasslands.	Unlikely to occur within the study area due to species distribution.	Considered unlikely to be adversely affected by the proposed activities, therefore AoS for this species is not required.
<i>Stagonopleura guttata</i>	Diamond Firetail	V	-	Found in grassy eucalypt woodlands, including Box-Gum woodlands and Snow Gum woodlands. Often found in	Possible. Suitable habitat occurs in woodland habitat within the study area. The	Considered unlikely to be adversely affected by the proposed activities due to the

				riparian areas and sometimes in lightly wooded farmland.	core hole lease does not provide suitable habitat for this species.	lack of suitable habitat within the core hole lease, and minimal impacts anticipated on woodland habitats in the study area. Therefore AoS for this species is not required.
<i>Stictonetta naevosa</i>	Freckled Duck	V	-	Primarily occurs in south-eastern and south-western Australia (Pizzey and Knight, 2007), however the species occasionally occurs in coastal NSW and Victoria, particularly during drought. Breeds in large temporary swamps created by floods in the Bulloo and Lake Eyre basins and the Murray-Darling system. Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. May also utilise lakes, reservoirs, farm dams and sewage ponds (DEC, 2007). During drier times, the Freckled Duck moves to more permanent waters such as lakes, reservoirs, farm dams and sewerage ponds (Pizzey and Knight, 2007).	Likely to utilise Lake Goran, unlikely to utilise the core hole site due to lack of suitable habitat.	The proposed activities will result in minimal impact on this species' habitat. Construction activities will not directly affect Lake Goran, the only potential habitat in the vicinity. Therefore, an AoS for this species is not required..
<i>Tyto novaehollandiae</i>	Masked Owl	V	-	Roosts and breeds in moist Eucalypt forested gullies, using large tree hollows or sometimes caves for nesting. Lives in dry Eucalypt forests and woodlands.	Possible. Suitable habitat occurs in woodland habitat within the study area. The core hole lease does not provide suitable habitat for this species.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the core hole lease, and minimal impacts anticipated on woodland habitats in the study area. Therefore AoS for this species is not required.
Mammals						
<i>Aepyprymnus rufescens</i>	Rufous Bettong	V		Patchy distribution from Cooktown, Queensland, to north-eastern NSW. Rufous Bettongs inhabit a variety of	Unlikely due to lack of suitable habitat in the	Considered unlikely to be adversely affected by the proposed activities due to the

				forests from tall, moist eucalypt forest to open woodland, with a tussock grass understorey. A dense cover of tall native grasses is the preferred shelter (DEC, 2007).	study area.	lack of suitable habitat within the study area; therefore an AoS for this species is not required.
<i>Bettongia penicillata penicillata</i>	Brush-tailed Bettong (South-East Mainland)	EX	-	The Brush-tailed Bettong (south-east mainland) was associated with grassland, heath and sclerophyll woodland (AMMSG 1996). Other accounts record the subspecies from open eucalypt forest with low woody scrub, tussock grass and occasional bare patches (Flannery 1990a).	N/A	N/A
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V	-	Found in a broad range of habitats from rainforest to sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum dreys or thickets of vegetation. The Eastern Pygmy-possum is found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania (DEC, 2005)	Possible. Suitable habitat occurs in woodland habitat within the study area. The core hole lease does not provide suitable habitat for this species.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the core hole lease, and minimal impacts anticipated on woodland habitats in the study area. Therefore AoS for this species is not required.
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Roosts in caves, crevices in cliffs, old mine workings and disused Fairy Martin (<i>Hirundo ariel</i>) nests, frequenting dry open forest and woodland close to these features.	Possible. Suitable habitat occurs in woodland habitat within the study area. The core hole lease does not provide suitable habitat for this species.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the core hole lease, and minimal impacts anticipated on woodland habitats in the study area. Therefore AoS for this species is not required.

<i>Chalinolobus picatus</i>	Little Pied Bat	V	-	Occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress-pine forest, mallee and Bimbil box. Roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings.	Possible. Suitable habitat occurs in woodland habitat within the study area. The core hole lease does not provide suitable habitat for this species.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the core hole lease, and minimal impacts anticipated on woodland habitats in the study area. Therefore AoS for this species is not required.
<i>Conilurus albipes</i>	White-footed Tree Rat	PE	-	The White-footed Rabbit-rat was known to inhabit open forest woodlands and grassy ecosystems in Victoria (Seebeck & Menkhorst 2000). Habitat information is not known for other states in which the species occurred. Gould observed the species sleeping in the hollow limbs of prostrate trees, or in hollow branches of large <i>Eucalypts</i> near the ground.	N/A	N/A
<i>Dasyurus geoffroii</i>	Western Quoll	E	V	Most kinds of wooded habitat including eucalypt forest, dry woodland and mallee shrubland.	Unlikely due to lack of suitable habitat. In the study area.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required.
<i>Dasyurus maculatus maculatus</i>	Spotted-tail Quoll	V	E	Recorded in a wide range of habitat types including dry and moist sclerophyll forests and woodlands, rainforest, coastal heathland, and riparian forest. Found in shelters and dens in small caves, fallen logs with large hollows and tree hollows.	Unlikely due to lack of suitable habitat. In the study area.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required.
<i>Lagorchestes leporides</i>	Eastern Hare-wallaby	PE	EX	Little is known about this species, but it appears to have inhabited open grassland plains.	N/A	N/A
<i>Macropus dorsalis</i>	Black-striped Wallaby	E	-	Preferred habitat is characterised by dense woody or shrubby vegetation	Possible. Suitable habitat occurs in woodland habitat	Considered unlikely to be adversely affected by the

				that must occur near a more open, grassy area to provide suitable habitat.	within the study area, that is adjacent to grassy foraging areas.	proposed activities, given the minimal clearing proposed within grassy habitat. Therefore AoS for this species is not required.
<i>Nyctophilus timoriensis</i>	Greater Long-eared Bat	V	V	Commonly roosts in crevices, hollows and under loose bark in Box / Ironbark / Cypress Pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland.	Possible. Suitable habitat occurs in woodland habitat within the study area. The core hole lease does not provide suitable habitat for this species.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the core hole lease, and minimal impacts anticipated on woodland habitats in the study area. Therefore AoS for this species is not required.
<i>Onychogalea fraenata</i>	Bridled Nailtail Wallaby	E	-	Preferred habitat is a narrow band of transitional vegetation that separates dense Acacia scrub from open grassy Eucalypt woodland.	Unlikely. Outside of known distribution.	Considered unlikely to be adversely affected by the proposed activities due to the low likelihood of the species occurring in the study area, therefore AoS for this species is not required.
<i>Petaurus australis</i>	Yellow-bellied Glider	V	V	The Yellow-bellied Glider is found in tall mature Eucalypt Forest and they feed on a range of sources including winter-flowering Eucalypts which provide nectar and pollen (NPWS, 2000; Readers Digest 1997). They also feed upon the sap of Eucalypts in which they chew V-shaped incisions to collect the sap. Yellow-bellied Gliders den in large tree hollows (NPWS, 2000).	Possible. Suitable habitat occurs in woodland habitat within the study area. The core hole lease does not provide suitable habitat for this species.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the core hole lease, and minimal impacts anticipated on woodland habitats in the study area. Therefore AoS for this species is not required.
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas.	Possible. Suitable habitat occurs in woodland habitat within the study area. The core hole lease does not provide suitable habitat for this species.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the core hole lease, and minimal impacts anticipated on woodland habitats in the study

						area. Therefore AoS for this species is not required.
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	Occupies rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges.	Unlikely due to lack of suitable habitat. In the study area.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required.
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	V	-	The Brush-tailed Phascogale has a patchy distribution around the coast of mainland Australia (NPWS, 1999). The Brush-tailed Phascogale is a largely arboreal species that primarily occurs in dry forests and woodlands with an open or sparse ground cover of herbs, grasses shrubs and leaf litter and a moderate density of trees and shrubs in the midstratum (NPWS, 2000; NPWS, 1999; Soderquist 1995). Old growth forest is usually required within an individual's home range, which has been recorded to be up to 100 ha for males and 20-60 ha for females however, recent studies in high quality habitat have demonstrated that animals have home ranges as small as 2.3 -8.0 ha for females (SFNSW; 1995; NPWS; 1999; van der Ree et. al. 2001). This species feeds upon invertebrates such as spiders, beetles and cockroaches, and occasionally small vertebrates. Nectar from flowering eucalypts is also an important dietary component (NPWS, 2000). The Brush-tailed Phascogale is dependent on tree hollows for breeding and shelter, and may utilise numerous hollows within its home range (NPWS, 2000; NPWS, 1999). This species generally prefers	Possible. Suitable habitat occurs in woodland habitat within the study area. The core hole lease does not provide suitable habitat for this species.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the core hole lease, and minimal impacts anticipated on woodland habitats in the study area. Therefore AoS for this species is not required.

				hollows that are 25-40 mm wide (Ayers et al., 1996).		
Phascolarctos cinereus	Koala	V	-	Inhabits Eucalypt woodlands and forests, spending most of their time in trees. Feeds on the foliage of more than 70 Eucalypt and 30 non-Eucalypt species.	Known to occur in woodland habitat on site, as Koala scat has been identified under numerous Eucalypt trees. The core hole lease is not considered to provide suitable habitat for this species.	While this species is known to occur within the study area, potential impacts on this species are considered to be low. The core hole does not provide habitat or movement opportunities for this species. While primary food trees occur adjacent to the study area, minimal impacts are proposed to this area. While the potential impacts are considered to be low, given the known presence within the study area, an AoS for this species has been prepared (Appendix D).
<i>Pseudomys australis</i>	Plains Rat	E	V	Primarily found in stone-covered plains and mod slopes with boulders, small stones and gilgais. Associated vegetation is predominantly chenopod as well as ephemeral plants.	Unlikely due to lack of suitable habitat. In the study area.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required.
<i>Pseudomys gouldii</i>	Gould's Mouse	E	-	It is a poorly known species. Animals are reported to have preferred sandhills and plains, and to make burrows under bushes in loose soil (Dixon 2008).	Unlikely due to lack of suitable habitat. In the study area.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required.
<i>Pseudomys pilligaensis</i>	Pilliga Mouse	V	V	In habits sparse grasslands with low-nutrient deep sands. The largest abundances were found in gullies recently burnt and with a distinct understorey and canopy cover of bloodwoods and acacias.	Unlikely due to lack of suitable habitat in the study area.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area; therefore an AoS for this species is not

						required.
<i>Rattus villosissimus</i>	Long-haired Rat	V	-	Sustained in mesic, densely vegetated sites. During plagues can be found in virtually all inland habitats. Following extended periods of above average rainfall or flood this species can breed rapidly. Resulting populations disperse widely, then die away abruptly as food is depleted and water evaporates. Predators rely on these rat plagues for their own rapid reproduction.	Unlikely due to lack of suitable habitat. In the study area.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required.
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail-bat	V	-	Roosts in tree hollows and buildings. If there are no trees, they are known to occupy mammal burrows.	Possible. Suitable habitat occurs in woodland habitat within the study area. The core hole lease does not provide suitable habitat for this species.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the core hole lease, and minimal impacts anticipated on woodland habitats in the study area. Therefore AoS for this species is not required.
<i>Sminthopsis macroura</i>	Stripe-faced Dunnart	V	-	Sustained along drainage lines within native dry grasslands dominated by dry shrubs. In these dry areas cracks in the dirt, rocks or tussocks of grass are used as a sheltering mechanism.	Unlikely due to lack of suitable habitat in the study area.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area; therefore an AoS for this species is not required.
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	V	-	Generally distributed among a broad band associated within both sides of the Great Dividing Range from Cape York to Kempsey (DEC, 2007). Some records further south including within the Great Lakes, Lake Macquarie and Cessnock LGA's (DEC, 2007a).	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required.

Sources: EPBC Act Protected Matters Search Tool (Department of Sustainability, Environment, Water, Population, and Community, 2011), Atlas of Wildlife, Map Sheet 8935 – Curlewis (NSW Office of Environment and Heritage, 2011)

Key: CE: Critically Endangered, E: Endangered, V: Vulnerable, EEC: Endangered Ecological Community; PE/EX: Presumed Extinct, M: Migratory **Bold:** Known to occur

Appendix D to the Ecological Assessment

Assessment of Significance / 7-Part Test

EPBC Act Assessment of Significance

Approach

An assessment of whether the proposed activities will have, or are likely to have a significant impact on listed threatened species or listed migratory species under the EPBC Act has been carried out in accordance with the EPBC Act and *EPBC Act Policy Statement 1.1 - Significant Impact Guidelines Matters of National Environmental Significance* (DEWHA, 2009). The DEWHA (2009) guidelines require proponents to self-assess as to whether or the action is likely to have a significant impact on MNES. Where impacts on MNES are likely, then an assessment of the significance of those impacts must be performed.

There are two EEC listed under the EPBC Act that were positively recorded in the locality. An assessment of significance for each community has been conducted, and is included below.

White Box Yellow Box Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands

White Box Yellow Box Blakely's Red Gum Woodland Grassy Woodland and derived Native Grasslands (Box Gum Woodland) is found on relatively fertile soils on the tablelands and western slopes of NSW and generally occurs between the 400 and 800 mm isohyets extending from the western slopes, at an altitude of c. 170m to c. 1200 m, on the northern tablelands. In NSW, the community occurs within the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands and NSW South Western Slopes Bioregions. Less than 5% of this community remains in good condition, and much of this occurs in small, isolated patches within the NSW Liverpool Plains region.

Significant Impact Criteria

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

a) Reduce the extent of an ecological community;

This ecological community will not be reduced in extent, as no clearing within the Box Gum woodland is required. While this community is located adjacent to an existing access track, no widening on the access track is proposed.

The extent of the ecological community will therefore not be reduced over the medium to long-term.

b) Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;

No clearing of this community is proposed. This community has been fragmented, given the location of the existing access track throughout the Box Gum Woodland. As the existing access track is proposed for use, the activity will not result in additional fragmentation of this community.

c) Adversely affect habitat critical to the survival of an ecological community;

Past disturbances associated with land clearing for agriculture have already significantly impacted the extent of this community in the study area. The use of the existing access track is unlikely to further affect habitats critical to the survival of the ecological community.

d) Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;

The proposed activities will not impact abiotic factors necessary for the survival of the Box Woodland.

e) Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;

The impacts to the community will be limited to edge effects associated with the use of the existing access track, such as erosion and the potential for weed infestation. While mitigation measures will be implemented to ensure impacts are limited, it is noted that these areas do not contain species that are unique to the community within the same patch. Utilising the access track will not affect the diversity or overall functionality of the community.

f) Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

-- assisting invasive species, that are harmful to the listed ecological community, to become established, or

Guidelines will be put in place prevent the spread and invasion of weeds into this community occurring adjacent to the access tracks and may reduce the presence of such weeds already present.

-- causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community; or

The proposed activities will not cause regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community.

g) Interfere with the recovery of an ecological community.

The OEH (2010) has prepared a (draft) national recovery plan for this CEEC. The primary objective of the recovery plan is to minimise the risk of extinction of this CEEC through:

- Achieving no net loss in extent and condition of the ecological community throughout its geographic distribution;
- Increasing protection of sites in good condition;
- Increasing landscape functionality of the ecological community through management and restoration of degraded sites;
- Increasing transitional areas around remnants and linkages between remnants; and

- Bringing about enduring changes in participating land manager attitudes and behaviors towards environmental protection and sustainable land management practices to increase extent, integrity and function of Box-Gum Grassy Woodland.

Only a very small proportion of this CEEC in the locality would be temporarily impacted due to edge effects.

Conclusion

Based on consideration of the above factors it is concluded that the proposed activities are unlikely to have a significant impact on the White Box Yellow Box Blakely's Red Gum Woodland.

Weeping Myall Woodlands

Weeping Myall Woodlands are mostly found on relatively heavy clay soils among depositional landforms of the South-Western part of the Hunter River Valley floor in NSW.

The woodlands are known to occur in two forms; shrubby and open grass woodland or woodland with a sparse understorey of shrubs and an open ground cover of grasses and forbs. The Weeping Myall is primarily the sole dominant species of the overstorey with an occasionally different canopy species scattered amongst this ecological community.

Significant Impact Criteria

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

a) Reduce the extent of an ecological community;

This ecological community will not be reduced in extent, as no clearing within the Weeping Myall Woodland is required. This community is located adjacent to a proposed access track which has been located in an area to avoid there need to clear in this vegetation community.

The extent of the ecological community will therefore not be reduced.

b) Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;

No clearing of this community is proposed. This community has already been fragmented, due to historical land clearing for agricultural practices. The proposed access track and resulting activities will not result in additional fragmentation of this community.

c) Adversely affect habitat critical to the survival of an ecological community;

Past disturbances associated with land clearing for agriculture have already significantly impacted the extent of this community in the study area. The proposed access track is unlikely to further affect habitats critical to the survival of the ecological community.

d) Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;

The proposed activities will not impact abiotic factors necessary for the survival of the Weeping Myall Woodland.

e) Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;

The impacts to the community will be limited to the proposed access tracks. These areas do not contain species that are unique to the community within the same patch and temporarily removing or suppressing these species will not affect the diversity or overall functionality of the community.

f) Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

-- assisting invasive species, that are harmful to the listed ecological community, to become established, or

Guidelines will be put in place to prevent the spread and invasion of weeds into this community occurring adjacent to the core hole lease and proposed access track and may reduce the presence of such weeds already present in the study area.

-- causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community; or

The proposed activities will not cause regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community.

g) Interfere with the recovery of an ecological community.

There is no draft recovery plan compiled for the Weeping Myall Woodland.

Conclusion

Based on consideration of the above factors it is concluded that the proposed activities are unlikely to have a significant impact on the Weeping Myall Woodland.

7-Part Test

Approach

Part 1, Section 5A of the EP&A Act lists seven factors that must be taken into account in the determination of the significance of potential impacts of proposed activities on 'threatened species, populations or ecological communities or their habitats' (threatened biota) listed under the TSC Act. The so-called '7-part test' is used to determine whether proposed activities are 'likely' to impose 'a significant effect' on threatened biota and thus whether a Species Impact Statement (SIS) is required to be produced.

The significance of the impacts on Koala, and two EEC have been assessed in the sections below.

Koala (Phascolarctos cinereus)

The Koala is widespread, found in sclerophyll forest and woodland on foothills and plains on both sides of the Great Dividing Range from about Chillagoe in northern Queensland to Mount Lofty Ranges in South Australia. The distribution extends inland to Desert Uplands of central Queensland and along riverine forests in central NSW and north-central Victoria. Koalas are arboreal, agile climbers and spend most of their time in trees. They are inactive for 20 hours per day. Koalas feed on the foliage of more than 70 Eucalypt and 30 non-Eucalypt species.

7-Part Test Criteria

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 proposed activities are unlikely to have an adverse effect on the life cycle of the Koala. While evidence of Koala usage was observed within the study area, no canopy trees occur within the core hole lease. Additionally, no canopy vegetation will be disturbed along the proposed access tracks. Subsequently, Koala habitat on site will not be affected by the proposed activities.

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 applicable.

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 applicable.

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

No canopy trees will be removed and no surrounding habitat suitable for Koalas will be removed or modified as a result of the proposed activity.

(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

The proposed core hole lease is currently void of native canopy vegetation, and is primarily dominated by a highly disturbed gassy understorey. It is not considered to be contributing to a movement corridor. No areas of adjacent Koala habitat are likely to become fragmented or isolated as a result of the proposed activity.

(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.

Evidence of Koala usage was observed under several Eucalypt trees in the study area, however no canopy trees occur within the core hole lease. Therefore the grassland to be removed or modified is not likely to be important for the long-term survival of the Koala, as it does not provide an important habitat resource for the Koala.

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

The vegetation within the core hole lease is not considered to provide critical habitat for the Koala, as it is lacking mature canopy vegetation. While mature eucalypts, including known Koala food trees occur adjacent to the proposed access track, this Koala habitat will not be impacted by the proposed activities.

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

The OEH (2008) has prepared an Approved Recovery Plan for the Koala. The primary objective of the recovery plan is to minimise the risk of extinction of this species. Specific objectives include:

- To conserve Koalas in their existing habitat;
- To rehabilitate and restore Koala habitat and populations;
- To develop a better understanding of the conservation biology of Koalas;

- To ensure that the community has access to factual information about the distribution, conservation and management of Koalas at a national, state and local scale;
- To manage captive, sick or injured Koalas and orphaned wild Koalas to ensure consistent and high standards of care;
- To manage overbrowsing to prevent both Koala starvation and ecosystem damage in discrete patches of habitat; and
- To coordinate, promote the implementation, and monitor the effectiveness of the NSW Koala Recovery Plan across NSW.

The proposed activities will result in the temporary disturbance grassland only. No canopy trees will be cleared within the core hole lease, or along the proposed access track. Furthermore, mitigation measures such as enforced speed limits will be implemented as part of construction works. Koalas are unlikely to be affected by the proposed activities.

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

There are currently 35 key threatening processes (KTP's) listed under the TSC Act. The most relevant KTP to this activity is the clearing of native vegetation, which is listed as a KTP under TSC and EPBC Acts.

Clearing of native vegetation - The proposed activities will result in the temporary disturbance of approximately grassland habitat only. The loss of grassland is unavoidable in light of the objectives of the proposed activities, however is unlikely to result in impacts upon Koalas, particularly given that no canopy vegetation is to be removed. No mature canopy vegetation in areas adjacent to the core hole lease will be removed.

Conclusion

Based on the consideration of the above factors, the proposed activities are not likely to significantly affect the listed Vulnerable Koala or its habitats.

White Box Yellow Box Blakely's Red Gum Woodland

White Box Yellow Box Blakely's Red Gum Woodland is found on relatively fertile soils on the tablelands and western slopes of NSW and generally occurs between the 400 and 800 mm isohyets extending from the western slopes, at an altitude of c. 170m to c. 1200 m, on the northern tablelands. The community occurs within the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands and NSW South Western Slopes Bioregions.

7-Part Test Criteria

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.

Not applicable.

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 applicable.

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.

Given that this EEC will not be cleared as part of the proposal, it is considered unlikely to have an adverse impact on the extent of the ecological community. While vegetation adjacent to the access track may be indirectly impacted due to edge effects such as weeds, it is unlikely to substantially modify the composition of the EEC.

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 EEC is located adjacent to the existing access track. No removal of this EEC is proposed as part of this application. It is unlikely to result in increased fragmentation or isolation of this community.

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

No critical habitat is registered for this EEC.

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

The DECCW (2010) has prepared a (draft) national recovery plan for this EEC. The primary objective of the recovery plan is to minimise the risk of extinction of this EEC through:

- ▶ *Achieving no net loss in extent and condition of the ecological community throughout its geographic distribution;*
- ▶ *Increasing protection of sites in good condition;*
- ▶ *Increasing landscape functionality of the ecological community through management and restoration of degraded sites;*
- ▶ *Increasing transitional areas around remnants and linkages between remnants; and*
- ▶ *Bringing about enduring changes in participating land manager attitudes and behaviours towards environmental protection and sustainable land management practices to increase extent, integrity and function of Box-Gum Grassy Woodland.*

The proposal ensures no net loss in extent or condition, as no clearing within this community is proposed. Agricultural land use prevents any opportunities to provide linkages between isolated patches of this EEC.

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

The development would contribute to the operation of one Key Threatening Processes (KTPs) is of relevance to White Box Yellow Box Blakely's Red Gum Woodland:

Invasion of native plant communities by exotic perennial grasses - Based on the above considerations, the development would not result in a significant increase in the operation of any KTPs of relevance to White Box Yellow Box Blakely's Red Gum Woodland.

Conclusion

Based on the consideration of the above factors, the development is not likely to result in a significant effect on the local occurrence of White Box Yellow Box Blakely's Red Gum Woodland.

Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions

Weeping Myall Woodlands tend to occur along the alluvial plains of the Murray-Darling river system. The community has a preference of red-brown earths and heavy clay soils rarely associated with drainage. Its composition and structure occurs in different forms from; low open woodland, open shrubland, low sparse woodland or low woodland. This variable community may also depend upon the extent of clearing and grazing pressures.

7-Part Test Criteria

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.

Not applicable.

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 applicable.

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.

The EEC will not be cleared for the proposed activities to be undertaken and therefore the local occurrence is not likely to be placed at risk of extinction. No Weeping Myall will be cleared as part of this proposal. It is not likely to significantly modify the composition of this EEC.

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 Weeping Myall Woodland occurring in the study area will not be removed as part of this proposal. The proposal will not result in the additional fragmentation of this community.

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

No critical habitat is registered for this EEC.

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

There is no draft recovery plan compiled for the Myall Woodland.

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

The development would contribute to the operation of the following Key Threatening Processes (KTPs) is of relevance to the Myall Woodland:

- Invasion of native plant communities by exotic perennial grasses - Based on the above considerations, the development would not result in a significant increase in the operation of any KTPs of relevance to Weeping Myall Woodland.

Conclusion

Based on the consideration of the above factors, the development is not likely to result in a significant effect on the local occurrence of the Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions.

Appendix B

Noise Assessment

prepared by Heggies (now SLR)



HEGGIES

REPORT 20-2014-R3

Revision 2

Santos Drill Rig Noise Assessment

PREPARED FOR

URS

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29 APRIL 2009

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1 INTRODUCTION

Heggies Pty Ltd (Heggies) has been engaged by URS Australia Pty Ltd (URS) on behalf of Santos Ltd (Santos) to undertake noise and lighting assessments for the drill rigs operating in the Gunnedah Basin.

This report presents the results from:

- Ambient noise monitoring conducted at Wisemans 1 and Stoney Creek 1 which are located on the Gunnedah Basin, New South Wales. The two (2) monitoring locations are representative of flat/ open plains (Wisemans 1) and woodlands (Stoney Creek 1). Both attended and unattended noise measurements have been performed in order to accurately document the existing background noise environment.
- Based on the existing background noise environment the appropriate noise criteria have been determined.
- Attended noise measurements have been performed to determine sound power levels (SWL) for the dominant noise sources during operation of drill rigs McD 29, McD 33, MDC 105 and Atlas Rig 1.
- Noise emission predictions including noise contour plots and offset distances at which the noise criteria is predicted to be achieved using the calculated SWLs for the drill rigs.

2 TECHNICAL NOISE INFORMATION

2.1 Standard Noise Indices

This report makes reference to certain noise level descriptors, in particular the LA90, LAeq, LA10 and LMax noise levels.

The LAeq is essentially the average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound over the same measurement period.

The LA90 noise level is the A-weighted sound pressure level exceeded 90% of a given measurement period and is representative of the average minimum background sound level (in the absence of the source under consideration), or simply the “background” level.

The LA10 is the A-weighted sound pressure level exceeded 10% of a given measurement period.

The LMax noise level is the maximum A-weighted noise level associated with site activity.

The LMax,adj T noise level is the average of the maximum noise levels during time period T adjusted for tonality and impulsiveness.

The relationship between the LAeq and the LA90 is in general less than 1 dBA for steady state noise sources (ie generators and normal drilling operation).



2.2 Typical Noise Levels

Table 1 presents examples of typical noise levels

Table 1 Typical Noise Levels

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130 120 110	Threshold of pain Heavy rock concert Grinding on steel	Intolerable Extremely noisy
100 90	Loud car horn at 3 m Construction site with pneumatic hammering	Very noisy
80 70	Kerb side of busy street Loud radio or television	Loud
60 50	Department store General Office	Moderate to Quiet
40 30	Inside private office Inside bedroom	Quiet to Very quiet
20	Unoccupied recording studio	Almost silent

2.3 A-Weighting or dBA Noise Levels

The overall level of a sound is usually expressed in terms of dBA, as is the case in Australian Standard AS 1055 Acoustics – *Description and measurement of environmental noise*, which is measured using the “A-weighting” filter incorporated in sound level meters. These filters have a frequency response corresponding approximately to that of human hearing. People’s hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound.

Different sources having the same dBA level generally sound about equally as loud, although the perceived loudness can also be affected by the character of the sound (eg the loudness of human speech and a distant motorbike may be perceived differently, although they are of the same dBA level).

2.4 Sensitivity of People to Noise Level Changes

A change of up to 3 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness.



3 DETERMINING EXISTING AMBIENT NOISE LEVELS

In order to characterise the existing noise environment, long-term unattended ambient noise monitoring was undertaken from 9 March to 23 March at two (2) locations typical of the terrain in the Murrurundi/Gunnedah of NSW. These noise monitoring locations were located in areas with the following type of terrain:

- Wisemans 1 – flat/ open plains; and
- Stoney Creek 1 – woodlands.

The noise monitoring locations are shown in **Figure 1**.

Figure 1 Ambient Noise Monitoring Locations on the Gunnedah Basin

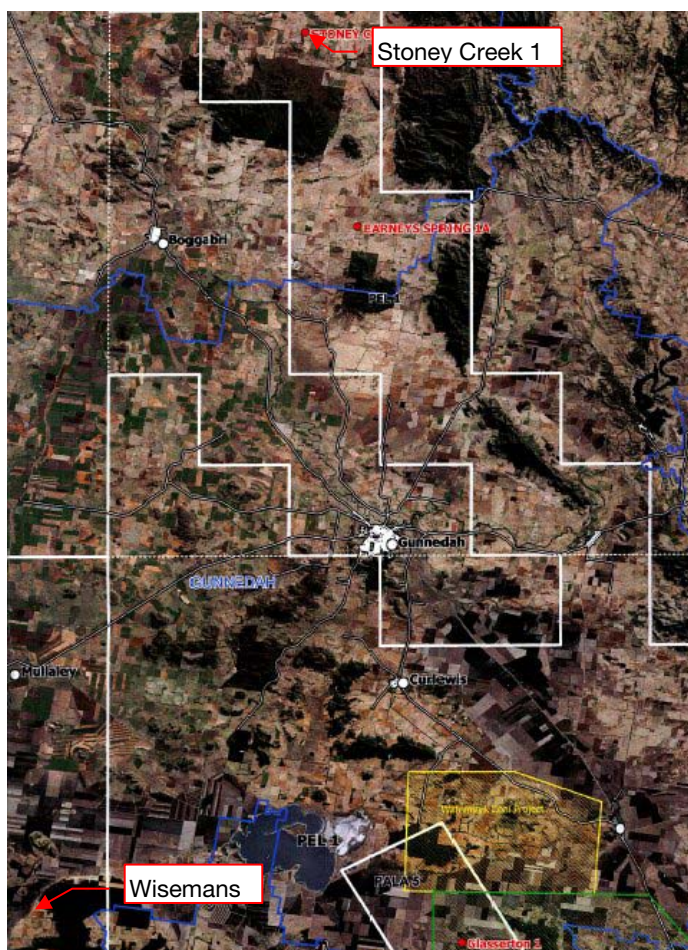


Table 2 summarises the noise monitoring location details.



Table 2 Ambient Noise Monitoring Locations

Noise monitoring Location	Comments	Photo
Wisemans 1	Logger located next to a sorghum field and a paddock with cattle to the side.	
Stoney Creek 1	Logger located in an unused paddock. With cattle paddock to the side.	

Attended noise measurements were also conducted at the site to confirm background noise levels and to observe typical noise sources associated with the ambient noise environment during the daytime, evening and night-time periods. The attended noise measurements were conducted for one 15 minute period during each of the day (7.00 am to 6.00 pm), evening (6.00 pm to 10.00 pm) and night (10.00 pm to 7.00 am) time periods at both Wisemans 1 and Stoney Creek 1 (ie six 15 minute attended noise measurements were undertaken). The attended noise measurements were conducted on the 9, 10 and 23 March 2009.

15-minute weather data over the noise monitoring period was sourced via a remote weather station setup near the unattended logger at Wisemans 1. The weather conditions on 9 to 11 March were windy (above 5 m/s) and these days have been excluded from the measurements results. For the monitoring period 12 to 21 March the weather conditions were generally fine, with temperatures ranging from 15°C to 30°C, with calm to moderate breezes (below 5 m/s) blowing generally from the south, east and west. Some minor rainfall was recorded during the monitoring period these periods have been excluded from the measurement results. The weather conditions during the remainder of the monitoring period are considered to be suitable for background noise measurements.



Graphs showing the statistical noise levels and weather data measured at Wisemans 1 and Stoney Creek 1 over the whole monitoring period are presented in **Appendix A** and **Appendix B** for each 24-hour period. The graphs show various statistical noise levels, including the background (LA90) noise level.

3.1 Instrumentation

The long term unattended monitoring was undertaken using two (2) Acoustic Research Laboratories (ARL) EL-316 Environmental Noise Loggers programmed to record various statistical noise levels including the background (LA90) noise level. The logger was checked for calibration before and after the survey with a Rion NC-73 Sound Level Calibrator and no significant drift (greater than 0.5 dBA) in calibration was detected.

ARL EL-316 Noise Loggers are NATA certified Type 1 meters. It is common practice to use Type 1 (or 2) noise loggers for measuring background noise levels. The noise floor of EL-316 loggers is around 19 dBA.

Attended measurements were undertaken using a SVAN 948 Sound Level Meter. This unit is a Type 1 Sound Level Meter. The SVAN was checked for calibration before and after each set of noise measurements using a Rion NC-73 Sound Level Calibrator and no significant drift in calibration signal level was observed.

All items of acoustic instrumentation employed during the noise monitoring were set to 'Fast' response in accordance with the relevant Australian Standards. All items of acoustic instrumentation employed during the noise measurement surveys were designed to comply with AS 1259.2 *Sound Level Meters* and carry current calibration certificates.

3.2 Noise Monitoring Results

3.2.1 Unattended Noise Monitoring

The unattended ambient noise measurements were used to determine the "Rating Background Level" (RBL) for the daytime (7.00 am to 6.00 pm), evening (6.00 pm to 10.00 pm) and night-time (10.00 pm to 7.00 am) periods at Wisemans 1 and Stoney Creek 1. The RBL is the median of the 90th percentile of the background (LA90) noise levels in each assessment period (day, evening and night) over the duration of the monitoring period.

For the purpose of determining the applicable noise criteria the New South Wales (NSW) 'Industrial Noise Policy' (INP) states that where a rating background noise level of less than 30 dBA is measured, the rating background noise level is set to the threshold level of 30 dBA. **Table 3** summarises the measured RBLs for Wisemans 1 and Stoney Creek 1.

Table 3 Measured Ratings Background Levels

Monitoring Location	Rating Background Level (dBA)		
	Day ¹	Evening ¹	Night ¹
Wisemans 1	(27) 30 ²	32	33
Stoney Creek 1	(26) 30 ²	34	(23) 30 ²

Note 1: Daytime: 0700 to 1800 hours (Monday to Saturday), or 0800 to 1800 hours (Sundays and public holidays).
Evening: 1800 to 2200 hours. Night-time: the remaining periods

Note 2: Numbers within brackets are the actual measured RBL's. Where the rating background level is less than 30 dBA, it is set to 30 dBA.

The elevated ambient noise levels in the evening and night-time at Wisemans 1 and in the evening at Stoney Creek 1 are due to noise from insects which are typical of the ambient noise environment during the summer season.



3.2.2 Attended Ambient Noise Measurements

Attended measurements were undertaken in order to confirm background noise levels and to observe typical noise sources associated with the ambient noise environment. The results of these measurements are summarised in **Table 4**.

Table 4 Attended Measurement Results – Day, Evening and Night-Time Periods

Monitoring Location	Date	Time (end of 15 min period)	Measured Noise Level (dBA)			Comments
			LA90 ¹	LAeq ²	LA10 ³	
Wisemans 1	9/03/09	5:25pm	42	46	49	Wind speed above 5 m/s. Wind generated noise in grass, trees and sorghum dominant. Noise from insects present, but lower than wind generated noise.
	10/03/09	2:45pm	37	44	46	Wind speed approximately 5 m/s. Wind generated noise in grass and sorghum dominant. Some occasional bird noise.
	10/03/09	7:05pm	43	48	51	Windy and gusty above 5 m/s. Wind generated noise in grass, trees and sorghum dominant. Noise from insects present, but lower than wind generated noise.
	10/03/09	11:20pm	33	37	38	Light breeze, wind speed less than 5 m/s. Insect noise dominant.
Stoney Creek 1	9/03/09	8:25pm	38	44	46	Wind speed approximately 5 m/s (wind gusts of above 5 m/s). Wind generated noise in grass and trees dominant. Some occasional insect noise.
	23/03/09	4:30pm	26	38	41	In general wind speed of much less than 5 m/s (wind gust of approximately 5 m/s). Bird chipping and occasional insect dominant noise source. 2 car passbys generated less than 35 dBA.
	24/03/09	0:45am	23	36	30	No wind. Distant Insect noise dominant. Car passby.

- 1 The LA90 is the noise level exceeded for 90% of the sample period. This noise level is described as the background level.
 - 2 The LAeq is the A-weighted equivalent noise level. It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.
 - 3 The LA10 is the noise level exceed for 10% of the sample period. This is commonly referred to as the average maximum noise level.
- Note: Daytime: 7.00am to 6.00pm (Monday to Saturday), or 8.00am to 6.00pm (Sundays and public holidays). Evening: 6.00pm to 10.00pm. Night-time: 10.00pm to 7.00am.

The attended measurements and observations summarised in **Table 4** shows that, in the absence of wind noise, insects and birds noise dominates the ambient noise environment at both Wisemans 1 and Stoney Creek 1.



3.3 Predicted Ambient Noise Levels for the Winter Period

The most significant seasonal influence on noise levels is due to the presence (or otherwise) of insect noise (usually most prevalent during the summer months) and from the prevailing weather conditions. On review of the measured RBLs in **Table 3**, the statistical noise plots (**Appendix A** and **Appendix B**), the 1/3 octave attended measurements and operator notes in **Table 4**, the measured RBLs have been adjusted to predict the likely ambient noise level for the winter period (excluding insect noise). The predicted RBLs for the winter season are shown in **Table 5**.

Table 5 Predicted Rating Background Level for the Winter Season

Monitoring Location	Rating Background Level (dBA)		
	Day ¹	Evening ¹	Night ¹
Wisemans 1	(27) 30 ²	(27) 30 ²	(28) 30 ²
Stoney Creek 1	(26) 30 ²	(26) 30 ²	(23) 30 ²

Note 1: Daytime: 0700 to 1800 hours (Monday to Saturday), or 0800 to 1800 hours (Sundays and public holidays).
Evening: 1800 to 2200 hours. Night-time: the remaining periods

Note 2: Where the rating background level is less than 30 dBA, it is set to 30 dBA.

4 NOISE CRITERIA

The New South Wales (NSW) 'Industrial Noise Policy' (INP) outlines industrial noise criteria in two categories, an intrusive criterion and an amenity criterion. These criteria will be used in assessing the noise impacts associated with the operating drill rigs and are summarised below.

4.1 Intrusive Criterion

L_{Aeq}(15 minute) should not exceed the RBL by more than 5 dBA. **Table 6** presents a summary of the time specific intrusive criteria, based on the RBL's in **Table 3**.

Table 6 Location and Time Specific Intrusive Criteria – Summer Season

Background Noise Monitoring Location	Day ¹ L _{Aeq} (15minute) (dBA)	Evening ¹ L _{Aeq} (15minute) (dBA)	Night ¹ L _{Aeq} (15minute) (dBA)
Wisemans 1	35	37	38
Stoney Creek 1	35	39	35

Note 1: Daytime: 0700 to 1800 hours (Monday to Saturday), or 0800 to 1800 hours (Sundays and public holidays).
Evening: 1800 to 2200 hours. Night-time: the remaining periods



4.2 Amenity Criteria

Table 7 Summary of Relevant Amenity Criteria¹

Type of Receiver	Indicative Noise Amenity Area	Time of Day ²	Recommended LAeq Noise Level, dBA	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
	Suburban	Day	55	60
		Evening	45	50
		Night	40	45

Note 1: Sourced from Table 2.1 in the NSW INP

Note 2: Daytime: 0700 to 1800 hours (Monday to Saturday), or 0800 to 1800 hours (Sundays and public holidays).
Evening: 1800 to 2200 hours. Night-time: the remaining periods.

The noise criteria in **Table 6** and **Table 7**, shows that the intrusive noise criterion is the limiting criterion and will represent the operational noise criterion for this project. The limiting intrusive noise criterion for the project is 35 dBA LAeq(15 minute) for both open/flat plains and woodland terrain areas.

4.3 Accounting for Annoying Noise Characteristics

The INP refers to 'Modifying factor' adjustments. 'Modifying factor' adjustments should be applied if the noise characteristics include:

- Tonal noise
- Low-frequency noise
- Impulsive noise
- Intermittent noise

Low frequency noise was observed during the site visits to the investigated drill rigs. The noise emission from these drill rigs has therefore been assessed against the relevant noise criterion, applying the low frequency 'modifying factor' adjustments where appropriate.

'Modifying factor' adjustments are applied for low frequency noise when the difference between the C-weighted level and the A-weighted level is more than 15 dB. If the noise is of low frequency character (ie dBC-dBA >15 dB) a penalty of 5 dB is to be added to the measured/predicted noise level before comparison with the applicable intrusive or amenity criteria. This is equivalent to reducing the noise criteria (which has been done for this assessment to allow for a simple presentation of the measured/predicted noise levels).

5 ATTENDED SOURCE NOISE MEASUREMENTS

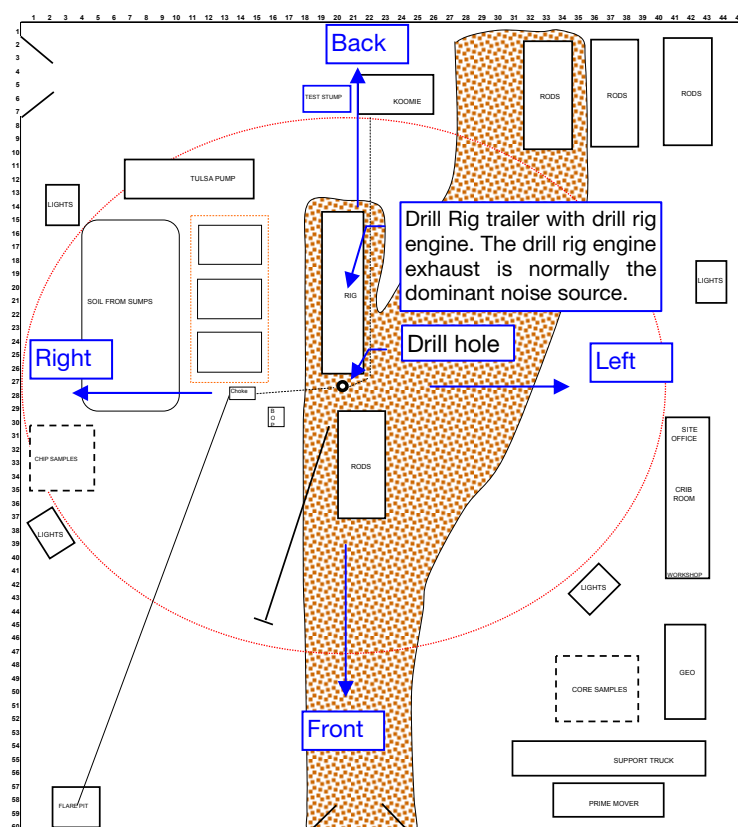
Attended near-field source noise measurements at two (2) drill rigs operating in the Gunnedah Basin and two (2) drill rigs operating in the Roma/Fairview area have been performed to determine sound power levels (SWL) for noise prediction purposes. Where possible individual noise sources (ie drill rig, drill rig engine exhaust, generators, pumps) have been identified and the noise emission from these individual plant items were measured.



The attended noise measurements were carried out with a SVAN 948 Type 1 Sound Level Meter (S/N 8895) that was checked for calibration before the measurement using a Rion NC 73 Calibrator. The Sound Level Meter was designed to comply with the requirements of AS IEC 61672.1 2004 *Electroacoustics - Sound Level Meters* and carried a current manufacturer calibration certificate.

A nominal site plan for the drill rigs is shown in **Figure 2**. The orientation and indicated directions shown on **Figure 2** have been used for presentation of the determined SWLs and predicted noise emission levels.

Figure 2 Typical Drill Site Plan



5.1 Drill Rig McD 33

Attended near-field source noise measurements were performed for the drill rig McD 33 at Drill Site Maroo 1 on 10 March 2009 and Drill Site Slacksmith 1 on 24 March 2009. The determined SWLs are presented in **Table 8**.

Table 8 Determined SWL for Plant Items at Drill Rig McD 33

Plant Item	Operation	SWL dBA	Direction of Noise Emission
Drill engine exhaust dominant source (RPM 750)	Drillstring testing operation	105	Main source emission to the sides of the drill rig trailer with engine
Drill engine exhaust dominant source (RPM 1700)	High RPM with no load	110	Main source emission to the sides of the drill rig trailer with engine



Plant Item	Operation	SWL dBA	Direction of Noise Emission
Trailer KOOMIE, compressor, genset	Both the “white generator” and the green hydraulic pump in operation	93	
Generator QAS20	Normal operation	85	
Generator Allight P14E25	Normal operation	85	
Light Tower Diesel generator	Normal operation	94	Main source emission from exhaust in direction of light (towards centre of drill site)
Tulsa pump, Diesel motor and charge pump	Pumping water from and back to the sump	105	

5.2 Drill Rig McD 29

Attended near-field source noise measurements were performed for the drill rig McD 29 at Drill Site Glasserton 1 on 24 March 2009. The determined SWLs are presented in **Table 9**.

Table 9 Determined SWL for Plant Items at Drill Rig McD 29

Plant Item	Operation	SWL dBA	Direction of Noise Emission
Drill engine exhaust dominant source (RPM 800)	Core drilling operation	111	Main source emission to the front of the drill hole
Generator QAS20	Normal operation	85	
Generator Genelite P14E25	Normal operation	84	

5.3 Drill Rig MDC 105

Attended near-field source noise measurements were performed for the drill rig MDC 105 at Drill Site Blythe Down 1 in Roma on 6 April 2009. The determined SWLs are presented in **Table 10**.

Table 10 Determined SWL for Plant Items at Drill Rig MDC 105

Plant Item	Operation	SWL dBA	Direction of Noise Emission
Drill engine exhaust dominant source	Core drilling operation	108	Main source emission to the sides of the drill rig trailer with engine
Mud Pump PEQ 179	Normal operation	111	
Generator Allight P14E2S	Normal operation	87	
Generator Allight P11E2S	Normal operation	82	
Light Tower Diesel generator	Normal operation	104	Main source emission from engine exhaust, normally perpendicularly to the direction of light.

5.4 Drill Rig Atlas 1

Attended near-field source noise measurements were performed for the drill rig Atlas 1 at Drill Site Fairview 83_OB3 on 7 April 2009. The determined SWLs are presented in **Table 11**.

**Table 11 Determined SWL for Plant Items at Drill Rig Atlas 1**

Plant Item	Operation	SWL dBA	Direction of Noise Emission
Drill engine exhaust dominant source	Core drilling operation	111	Main source emission to the sides and back of the drill rig trailer with engine
Mud Pump (pump PZ7 and motor Caterpillar 3408)	Normal operation	113	
Rig Generator Allight P275HE2	Normal operation	94	
Generator Allight P30E1	Normal operation	87	
Sykes Pump	Normal operation	101	
Light Tower Diesel generator	Normal operation	98	Main source emission from engine exhaust, normally perpendicularly to the direction of light.

6 NOISE PREDICTIONS/ ASSESSMENT

All noise predictions for this project have been carried out utilising the CONCAWE prediction methodology within SoundPLAN. The CONCAWE prediction method is specially designed for large industrial facilities and incorporates the influence of distance attenuation, ground absorption, air absorption and shielding attenuation, as well as meteorological conditions, including wind effects.

Noise levels have been calculated for both neutral and “worst case” weather conditions. The “worst case” weather conditions used to assess the effect of adverse meteorological conditions on noise propagation is shown in **Table 12** below. The parameters in **Table 12** are considered typical of neutral and “worst case” weather in regards to noise propagation.

Table 12 Weather Conditions – Neutral and “Worst Case”

Parameter	Neutral Weather	“Worst Case” Weather
Temperature	10°C	10°C
Humidity	70%	90%
Pasquill Stability Category	D	F (simulates temperature inversion conditions)
Wind Speed	0 m/s	2 m/s (source to receiver)

The determined SWLs, location of noise sources and the directivities (noise emission in different directions) in **Section 5** have been used to predict noise emission levels at various offset distances for each of the operational drill rigs. The predictions include noise emissions from the diesel generators in the light towers which would be operating if night works were being undertaken.

6.1 Drill Rig McD 29 and McD 33

Noise contour plots for the different drill rig operations, modelled for neutral and “worst case” weather conditions, are presented in **Appendix C** for the 2 existing drill rigs (ie McD 29 and McD 33) operating in the Gunnedah area. The predicted noise emissions in **Table 13** and the offset distances at which the noise criteria are predicted to be achieved (shown in **Table 14**) assume propagation over flat, soft ground (ie open grassland) to a typical receiver.



Table 13 Predicted Noise Levels at Various Offset Distances – Drill Rig McD 29 and McD 33

Drill Rig and Operation	Weather Condition	Direction	Predicted Noise Level at Buffer Distance (LAeq dBA)						
			50m	100m	250m	500m	1,000 m	2,000 m	5,000 m
Drillstring testing operation McD 33	Neutral	Front	57	49	39	30	20	10	<10
		Left	57	50	39	31	22	12	<10
		Back	61	53	41	32	22	12	<10
		Right	60	53	42	33	23	13	<10
Drillstring testing operation McD 33	Worst Case	Front	57	50	42	33	24	14	<10
		Left	57	51	42	34	26	16	<10
		Back	61	54	44	36	27	16	<10
		Right	60	54	45	37	27	17	<10
Core drilling operation McD 29	Neutral	Front	65	59	48	39	30	19	<10
		Left	58	56	45	37	27	17	<10
		Back	62	55	44	35	25	15	<10
		Right	62	55	44	35	26	16	<10
Core drilling operation McD 29	Worst Case	Front	66	59	51	43	33	23	<10
		Left	58	56	48	40	31	20	<10
		Back	63	56	47	39	29	19	<10
		Right	62	55	47	39	29	19	<10
Open hole drilling operation McD 33	Neutral	Front	60	54	43	34	25	16	<10
		Left	59	55	43	35	26	17	<10
		Back	66	58	46	36	27	18	<10
		Right	64	57	45	36	26	16	<10
Open hole drilling operation McD 33	Worst Case	Front	61	55	47	39	31	22	<10
		Left	60	56	47	39	31	23	<10
		Back	67	59	49	41	32	23	<10
		Right	65	58	49	40	31	21	<10

It is noted that the predicted noise levels at distances greater than 1,000m would be similar to, or below, background noise levels observed in rural areas of the Gunnedah Basin.

The character of the noise source has been considered when assessing the relevant intrusive noise criteria. A penalty of 5 dB has been applied to the noise criteria to account for the low frequency character of the noise source (ie the difference between C-weighted and A-weighted is more than 15 dB as outlined in **Section 4.3**). A column showing the result of the low frequency assessment is shown in **Table 14**, the relevant intrusive noise criteria (reduced by 5 dB where necessary) shows.

Table 14 shows the predicted offset distances in each direction for the different drilling operations. The highlighted distances are the predicted offset distance required to achieve the noise criteria for all drilling operations at drill rigs McD 29 and McD 33.



Table 14 Predicted Offset Distances to Achieve the Noise Criteria – Drill Rig McD 29 and McD 33

Drill Rig and Operation	Noise Contour Map in Appendix C	Weather Condition	Low Frequency Assessment Difference (dBC – dBA)	Relevant Intrusive Criterion (LAeq dBA)	Offset Buffer Distance (m)			
					Front	Left	Back	Right
Drillstring testing operation McD 33	Map 1	Neutral	22 <u>>15</u>	30 ¹	475	580	565	630
Core drilling operation McD 29	Map 2	Neutral	22 <u>>15</u>	30 ¹	975	790	690	800
Open hole drilling operation McD 33	Map 3	Neutral	22 <u>>15</u>	30 ¹	730	780	820	780
Drillstring testing operation McD 33	Map 4	Worst Case	21 <u>>15</u>	30 ¹	650	775	760	830
Core drilling operation McD 29	Map 5	Worst Case	21 <u>>15</u>	30 ¹	1250 ²	1015	915	1050
Open hole drilling operation McD 33	Map 6	Worst Case	19 <u>>15</u>	30 ¹	1100	1160 ²	1220 ²	1110 ²

Note 1: If the difference between the C-weighted and A-weighted noise level is more than 15 dB, the intrusive noise criterion is reduced by 5 dB to account for noise of low frequency character (as outlined in **Section 4.3**).

Note 2: Highlighted shows the predicted distance in each direction required to achieve the noise criteria for all drilling operations at drill rigs McD 29 and McD 33 (currently operating in the Gunnedah Basin).

6.2 Drill Rig MDC 105 and Atlas 1

Noise contour plots for the different drill rig operations, modelled for neutral and “worst case” weather conditions, are presented in **Appendix D** for the two drill rigs, MDC 105 and Atlas 1, operating in the Roma/Fairview area. The predicted noise emissions in **Table 15** and the offset distances at which the noise criteria are predicted to be achieved (shown in **Table 16**) assume propagation over flat, soft ground (ie open grassland) to a typical receiver.

Table 15 Predicted Noise Levels at Various Offset Distances – Drill Rig MDC 105 and Atlas 1

Drill Rig and Operation	Weather Condition	Direction	Predicted Noise Level at Buffer Distance (LAeq dBA)						
			50m	100m	250m	500m	1,000 m	2,000 m	5,000 m
Core drilling operation MDC 105	Neutral	Front	65	58	46	36	26	16	<10
		Left	67	60	49	38	28	18	<10
		Back	64	57	45	36	26	16	<10
		Right	63	58	47	37	27	17	<10



Drill Rig and Operation	Weather Condition	Direction	Predicted Noise Level at Buffer Distance (LAeq dBA)						
			50m	100m	250m	500m	1,000 m	2,000 m	5,000 m
Core drilling operation MDC 105	Worst Case	Front	66	58	49	40	31	21	<10
		Left	68	61	52	42	33	23	<10
		Back	64	58	48	40	31	21	<10
		Right	63	59	50	41	32	22	<10
Drilling operation including the mud pump MDC 105	Neutral	Front	67	60	48	39	29	19	<10
		Left	67	62	51	41	32	21	<10
		Back	68	60	48	39	29	19	<10
		Right	66	60	49	39	30	19	<10
Drilling operation including the mud pump MDC 105	Worst Case	Front	68	61	52	43	34	24	<10
		Left	68	62	55	46	37	27	<10
		Back	69	61	52	43	34	24	<10
		Right	67	61	52	44	35	25	<10
Core drilling operation Atlas Rig 1	Neutral	Front	67	50	48	38	29	18	<10
		Left	69	63	51	42	32	21	<10
		Back	69	63	51	42	32	21	<10
		Right	72	63	51	42	32	21	<10
Core drilling operation Atlas Rig 1	Worst Case	Front	68	50	50	42	33	23	<10
		Left	70	63	54	46	37	26	<10
		Back	69	63	54	46	37	26	<10
		Right	72	63	54	46	37	26	<10
Drilling operation including the mud pump Atlas Rig 1	Neutral	Front	71	55	53	44	34	23	<10
		Left	72	66	55	45	35	25	<10
		Back	73	66	55	45	35	25	<10
		Right	75	67	55	45	35	25	<10
Drilling operation including the mud pump Atlas Rig 1	Worst Case	Front	73	56	55	48	39	29	11
		Left	73	67	57	49	40	30	12
		Back	74	67	57	49	40	30	12
		Right	75	67	57	49	40	30	12

It is noted that the predicted noise levels at distances greater than 1,000m to 2,000m would be similar to, or below, background noise levels observed in rural areas of the Gunnedah Basin.

The character of the noise source has been considered when assessing the relevant intrusive noise criteria. A penalty of 5 dB has been applied to the noise criteria to account for the low frequency character of the noise source (ie the difference between C-weighted and A-weighted is more than 15 dB as outlined in **Section 4.3**). A column showing the result of the low frequency assessment is shown in **Table 16**, the relevant intrusive noise criteria (reduced by 5 dB where necessary) shows.



Table 16 shows the predicted offset distances and directivities for the different drilling operations. The highlighted distances are the predicted offset distance required to achieve the noise criteria for all drilling operations at the two drill rigs, MCD 105 and Atlas Rig 1, currently operating in the Roma/Fairview area. **Table 16** shows that Atlas Rig 1 is the noisiest of all measured drill rigs. It is also the drill rig that requires the largest drill site (in terms of area).

Table 16 Predicted Offset Distances to Achieve the Noise Criteria – Drill Rig MDC 105 and Atlas 1

Drill Rig and Operation	Noise Contour Map in Appendix D	Weather Condition	Low Frequency Assessment Difference (dBC – dBA)	Relevant Intrusive Criterion (LAeq dBA)	Offset Buffer Distance (m)			
					Front	Left	Back	Right
Core drilling operation MDC 105	Map 1	Neutral	16 <u>>15</u>	30 ¹	755	860	745	850
Drilling operation including the mud pump MDC 105	Map 2	Neutral	14 < 15	35	660	760	640	680
Core drilling operation Atlas Rig 1	Map 3	Neutral	10 < 15	35	620	810	815	800
Drilling operation including the mud pump Atlas Rig 1	Map 4	Neutral	9 < 15	35	900	1010	1010	1025
Core drilling operation MDC 105	Map 5	Worst Case	15 <u>>15</u>	30 ¹	1055	1215	1055	1210
Drilling operation including the mud pump MDC 105	Map 6	Worst Case	13 < 15	35	950	1140	930	980
Core drilling operation Atlas Rig 1	Map 7	Worst Case	9 < 15	35	840	1100	1110	1100
Drilling operation including the mud pump Atlas Rig 1	Map 8	Worst Case	7 < 15	35	1280²	1410²	1410²	1400²

Note 1: If the difference between the C-weighted and A-weighted noise level is more than 15 dB, the intrusive noise criterion is reduced by 5 dB to account for noise of low frequency character (as outlined in **Section 4.3**).

Note 2: Highlighted shows predicted distance in each direction required to achieve the noise criteria for all drilling operations at drill rigs MDC 105 and Atlas Rig 1 (currently operating in the Roma/Fairview area).



6.3 Noise Attenuation due to Meteorology, Topography and Vegetation

6.3.1 Meteorological Effects

As previously noted, the predicted noise level emissions in **Table 13** and **Table 15** are based on neutral weather and “worst case” weather conditions as presented in **Table 12**. The resulting change in predicted levels due to “worst case” weather is summarised in **Table 17**.

Table 17 Increase in Noise Levels due to “Worst Case” Weather Conditions

	Increase in Predicted Noise Level at Offset Distance (dBA)					
	50m	100m	250m	500m	1,000m	2,000m
Change due to adverse weather	0	1	3	4	4	5

Note: Increase above predicted noise level for neutral weather conditions.

Appendix D of the NSW’s INP provides guidance on estimating the increase in noise levels due to temperature inversion conditions. The increase in noise levels was estimated using similar modelling parameters as those nominated above for “worst case” weather conditions. The increase in noise levels (nominated in NSW INP) due to temperature inversion conditions is estimated to be between 1 dBA and 6.5 dBA depending on the distance from the noise source and the change in temperature (increase for temperature inversions) with respect to height above ground. The increase in noise level due to temperature inversion conditions, nominated in the NSW INP (1 dBA to 6.5 dBA) is consistent with the increase in noise levels from the “worst case” weather condition (0 dBA to 5 dBA) shown in **Table 17**.

Table 17 shows that sensitive receivers located at 250m or more from a drill rig operation would experience a noticeable change in noise levels as a result of adverse weather conditions (up to distances where noise is no longer audible).

6.3.2 Topographical Effects

As previously stated, the predictions in **Table 13** to **Table 16** assume propagation over flat, soft ground (ie open grassland) to a typical receiver.

Local topography can dramatically affect the propagation of noise, especially if the drilling operation is conducted in an area with steep terrain. The extent of change in noise levels due to topographical effects would be dependant on the level of shielding provided (which would be very much site specific). The actual degree of noise attenuation due to topographical shielding is a function of the frequency spectrum of the noise and the length of the diffracted noise path compared to the direct noise path.

Noise attenuation due to topographical shielding typically ranges from 5 dBA if line-of-sight between the noise source and receiver location is just obscured, and up to approximately 15 dBA where the topography provides optimal sheilding of the sound transmission path.

It is noted that during “worst case” weather conditions, noise attenuation due to topographical shielding would be less than that expected during “neutral” weather conditions.

6.3.3 Vegetation and Forest Effects

Dense forest vegetation increases the amount of sound absorption along the noise propagation path. For the vegetation to have an effect on the noise propagation the height of vegetation must be above 2 metres (low scrub/bush would not attenuate the noise more than normal absorbing soft ground ie grass) and dense (unable to see through the vegetation even a short distances). The increased sound absorption of typical forest vegetation is estimated to be between 0.05 to 0.1 dBA per metre of propagation distance (ie approximately 5 to 10 dBA over 100 metres in dense forest).



7 CONCLUSION

Background noise monitoring has been performed for two (2) locations representative of open/flat plains (Wisemans 1) and woodland (Stoney Creek 1) terrain areas respectively. The results show presence of bird and insect noise as well as wind noise in grass, sorghum and trees (low breeze less than 5 m/s).

For the purpose of determining the applicable noise criteria the NSW INP states that where a rating background noise level of less than 30 dBA is measured, the rating background noise level is set to the threshold level of 30 dBA. The limiting rating background noise level for both open/flat plains and woodland terrain areas were set to the threshold level of 30 dBA.

The noise emissions from drill rigs McD 29, McD 33 and to some extent MDC 105 were identified as having low frequency noise characteristics. The NSW INP specifies a penalty of 5 dB if the noise is of low frequency character (ie dBC – dBA > 15 dB).

Therefore the limiting intrusive noise criterion has been reduced to **30 dBA LAeq(15 minute)** for drill rigs McD 29, McD 33 and to some extent MDC 105 for where the noise emission has been identified as having low frequency character.

The limiting intrusive noise criterion for the Atlas Rig 1 is **35 dBA LAeq(15 minute)**

Noise emission levels and offset distances at which the intrusive noise criterion is predicted to be achieved for the different drill rigs and drilling operations are presented in **Table 13** to **Table 16**. A summary of the offset distances required to achieve the relevant intrusive noise criteria is summarised in **Section 7.1** and **Section 7.2**.

7.1 Noise Emissions for McD 29, McD 33 and MDC 105

It was found that for the 2 drill rigs currently operating in the Gunnedah Basin, the noisiest drilling operation was the core drilling. For the core drilling the direction in front of the drill hole is emitting more noise than to the sides and backwards. For worst case weather conditions and core drilling operations, offset distances of up to **1250 metres** were found to be required to achieve the relevant intrusive noise criterion.

For the current drill site layout the open hole drilling operation (including the Tulsa mud pump) radiates more noise backwards and to the sides. For worst case weather conditions and open hole drilling operations, offset distances of up to **1220 metres** were found to be required to achieve the relevant intrusive noise criterion.

The MDC 105 drill rig has very similar noise emission levels to the McD 29 and McD 33. The noise emission from MDC 105 was also identified as having low frequency characteristics. However, when the mud pump was added to the noise sources the overall noise emission from MDC 105 was not identified as having low frequency characteristics. For worst case weather conditions a maximum offset distance of **1215 metres** was found to be required to achieve the relevant intrusive noise criterion. The maximum noise emission was measured to the left of the drilling operations almost 200 metres more offset distance required in comparison to the other three directions.

The offset distance required in each direction to achieve the relevant intrusive noise criteria for all drilling operations at drill rig McD 29, McD 33 and MDC 105 is summarised in **Table 18**.



Table 18 Predicted Offset Distances to Achieve the Noise Criteria for All Drilling Operations – Drill Rig McD 29, McD 33 and MDC 105

Drill Rig	Weather Condition ¹	Offset Buffer Distance (m)			
		Front	Left	Back	Right
McD 29 and McD 33	Neutral	975	790	820	800
	Worst Case	1250	1160	1220	1110
MDC 105	Neutral	755	860	745	850
	Worst Case	1055	1215	1055	1210

Note 1: See discussion in **Section 6.3.1**. Neutral and “Worst Case” weather conditions defined in **Table 12**.

For the drill rigs McD 29, McD 33 and MDC 105, an optimally placed drill site in the woodland with significant (if not dense) forest vegetation and topography obscuring line-of-sight between noise sources and the noise sensitive receiver, would result in an offset distance of approximately **600 metres** being required to achieve the relevant intrusive noise criterion (as detailed discussed below in **Section 7.3**).

7.2 Noise Emissions Atlas Rig 1

Atlas Rig 1 is the loudest of all measured drill rigs, but does not have low frequency characteristics. The maximum noise emission was measured to the sides and back of the drill rig. For worst case weather conditions and drilling operations including the mud pump, an offset distance of up to **1410 metres** was found to be required to achieve the relevant intrusive noise criterion.

The offset distance required in each direction to achieve the relevant intrusive noise criteria for all drilling operations at drill rig McD 29, McD 33 and MDC 105 is summarised in **Table 19**.

Table 19 Predicted Offset Distances to Achieve the Noise Criteria for All Drilling Operations – Atlas Rig 1

Drill Rig	Weather Condition ¹	Offset Buffer Distance (m)			
		Front	Left	Back	Right
Atlas Rig 1	Neutral	900	1010	1010	1025
	Worst Case	1280	1410	1410	1400

Note 1: See discussion in **Section 6.3.1**. Neutral and “Worst Case” weather conditions defined in **Table 12**.

For the Atlas Rig 1, an optimally placed drill site in the woodland with significant (if not dense) forest vegetation and topography obscuring line-of-sight between noise sources and the noise sensitive receiver, would result in an offset distance of approximately **700 metres** being required to achieve the relevant intrusive noise criterion (as detailed discussed below in **Section 7.3**).

7.3 Noise Attenuation due to Meteorology, Topography and Vegetation

There are several mitigation measures that can be applied to screen and direct the noise emission away from noise sensitive receivers as well as using the natural topography and vegetation to reduce the noise impacts.

With dense forest vegetation between the drill rig and the nearest noise sensitive receiver there will be increased noise propagation attenuation as outlined in **Section 6.3.3**. The dense forest vegetation will not only increase the attenuation, but also disrupt the steady down wind (wind from source to receiver) that is a characteristic of the adverse weather conditions. Typical dense forest vegetation in the woodlands thus has the potential to halve the required offset distances presented in **Table 13** to **Table 16** for worst case weather.



Furthermore using natural topographical shielding (or man-made earth mounds from the mud sumps etc) to shield the drill rigs from the nearest noise sensitive receivers has the potential to attenuate the noise emission by 5 dBA if line-of-sight between the noise source (drill rig engine exhaust typically at 3.5m height) and receiver location is just obscured, and by up to 15 dBA where the topography provides optimal blocking of the sound transmission path.

For the drill rigs McD 29, McD 33 and MDC 105, an optimally placed drill site in the woodland with significant (if not dense) forest vegetation and topography obscuring line-of-sight between noise sources and the noise sensitive receiver, would result in an offset distance of approximately **600 metres** being required to achieve the relevant intrusive noise criterion.

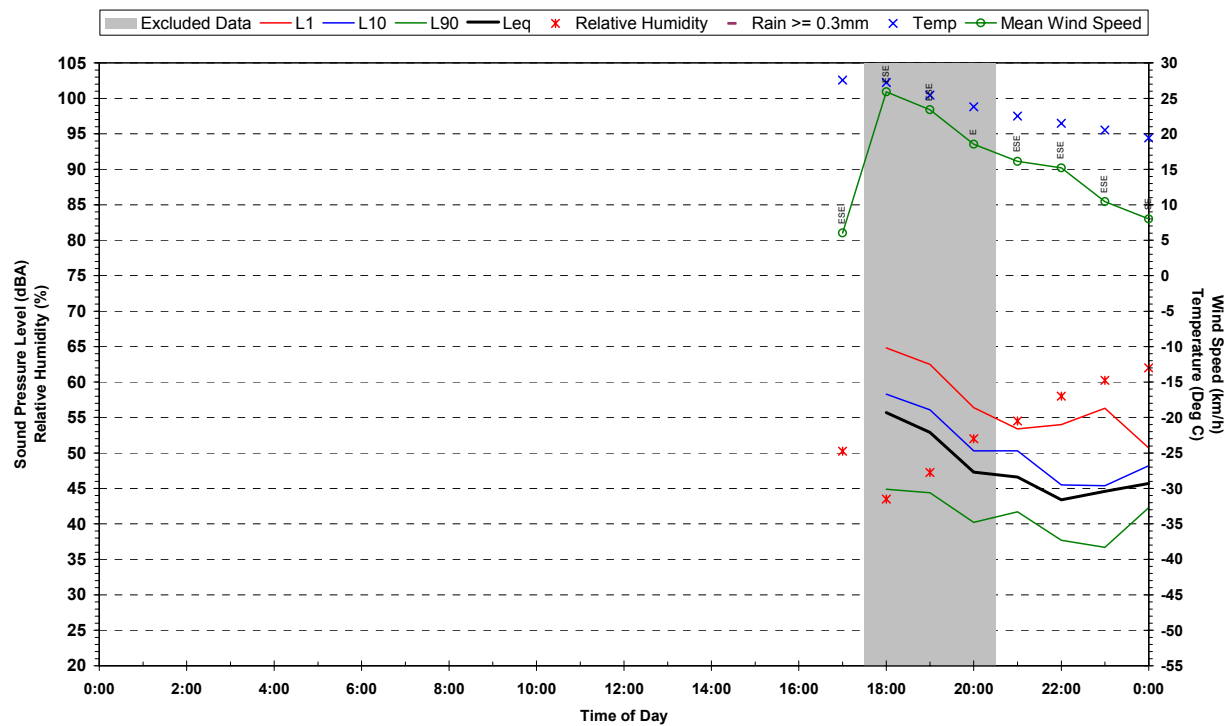
Atlas Rig 1 is louder and has the dominant noise source (ie the drill rig engine exhaust) located approximately 1m higher than the other three drill rigs (ie 4.5m height). Atlas Rig 1 optimally placed in the woodland with significant (if not dense) forest vegetation and topography obscuring line-of-sight between noise sources and the noise sensitive receiver would result in an offset distance of approximately **700 metres** being required to achieve the relevant intrusive noise criterion. Since the noise source is located higher than the other three drill rigs, obscuring line-of-sight between noise source and receiver will require significantly more elevation from the topography.

There are also other mitigation measures which could be incorporated closer to the noise sources (ie drill rig engine exhaust and mud pump) that would enable additional noise attenuation to be provided to the noise sensitive receiver. These noise mitigation measures may include:

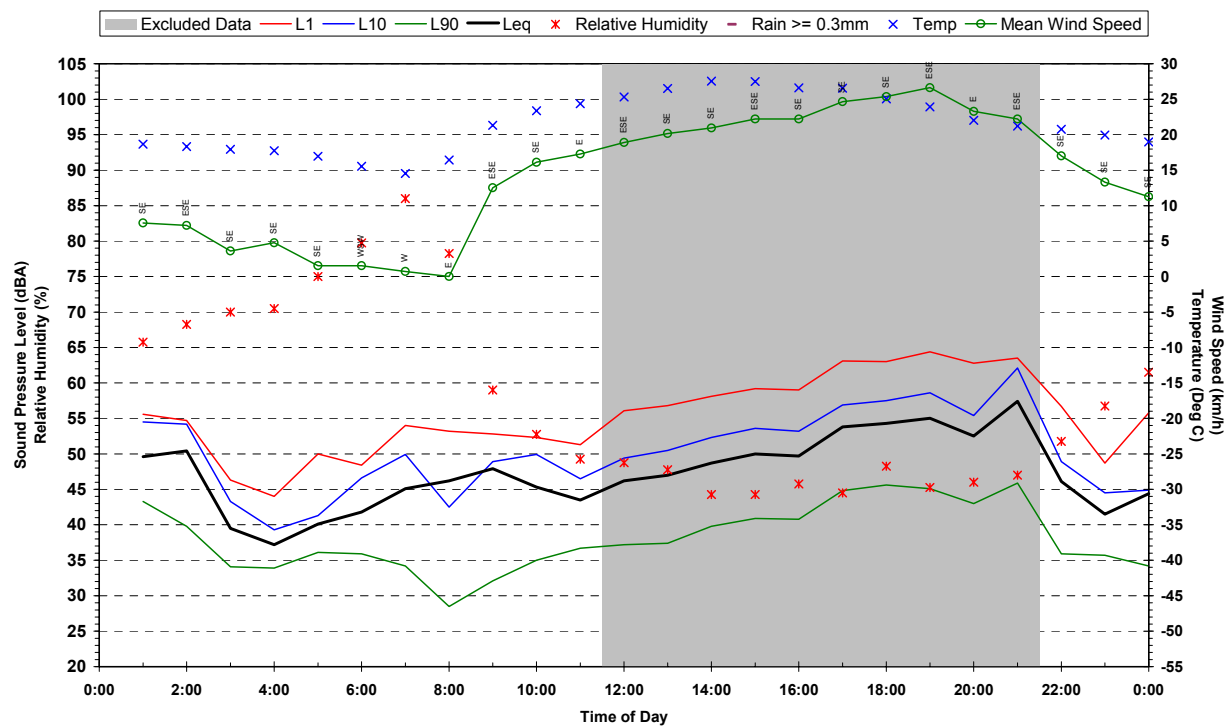
- Engine exhaust silencers
- Screening of engine exhausts

UNATTENDED NOISE MONITORING AT WISEMANS – STATISTICAL NOISE PLOTS

Statistical Ambient Noise Levels
20-2014 - GLNG - Wisemans - Monday 9 March 2009

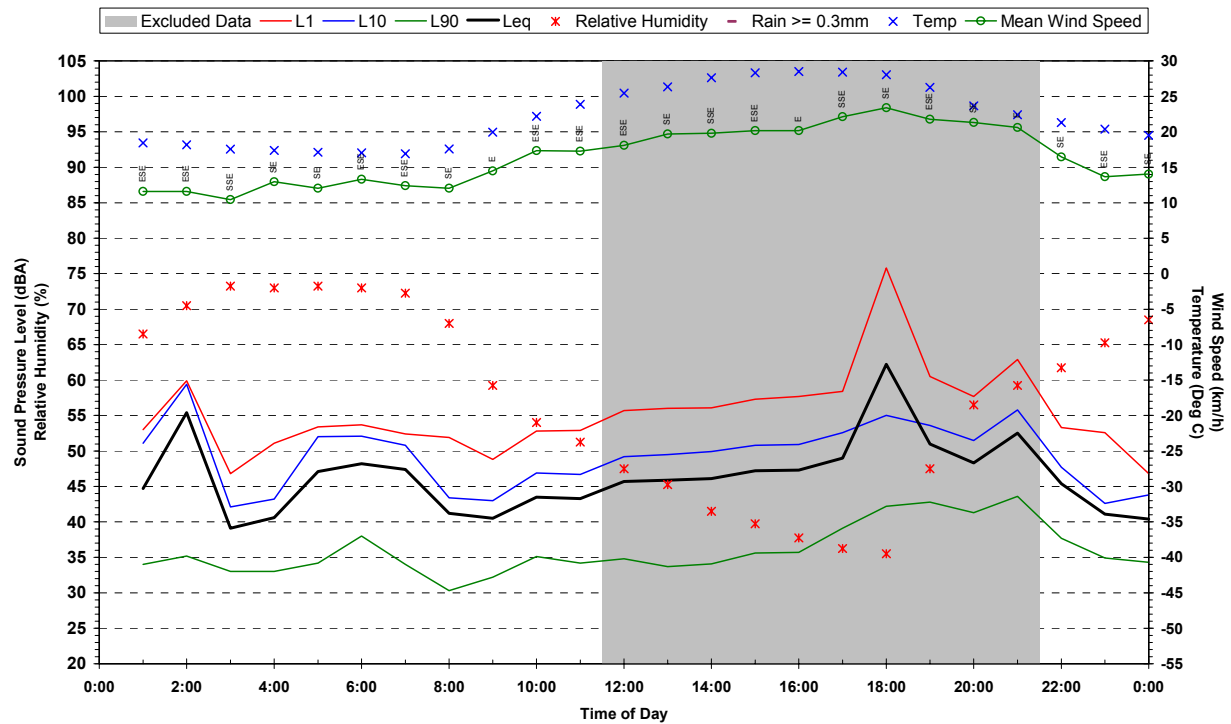


Statistical Ambient Noise Levels
20-2014 - GLNG - Wisemans - Tuesday 10 March 2009

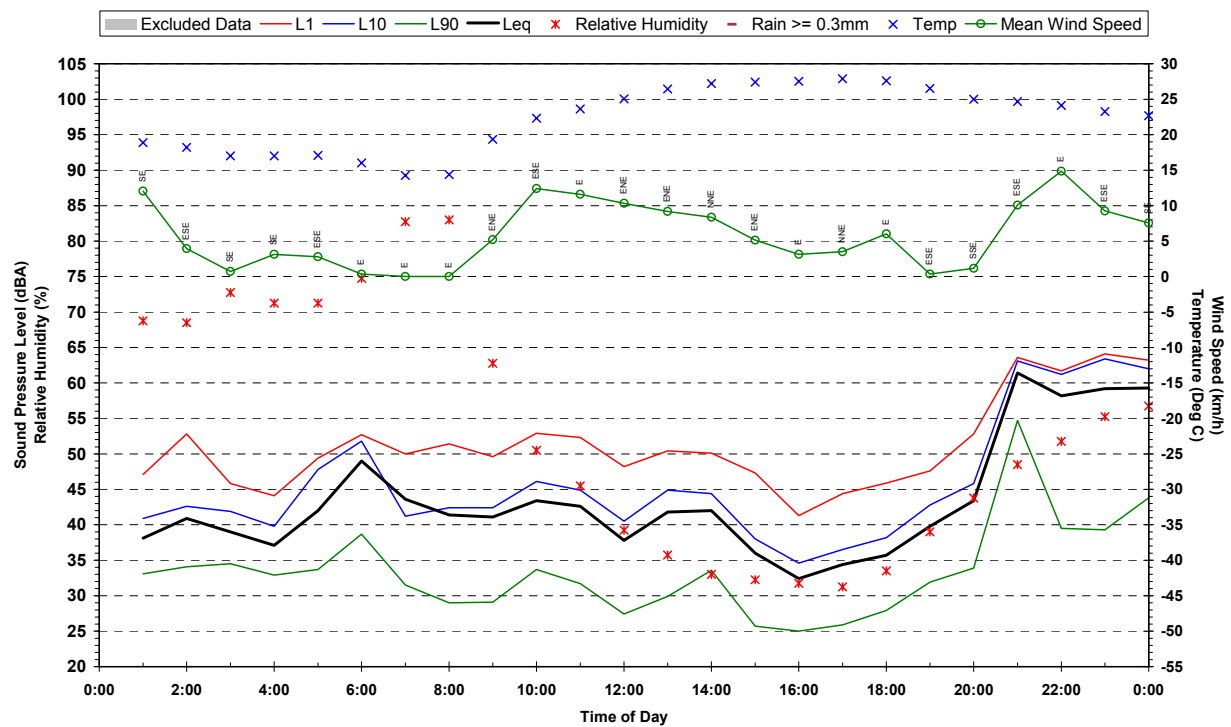


UNATTENDED NOISE MONITORING AT WISEMANS – STATISTICAL NOISE PLOTS

Statistical Ambient Noise Levels
20-2014 - GLNG - Wisemans - Wednesday 11 March 2009

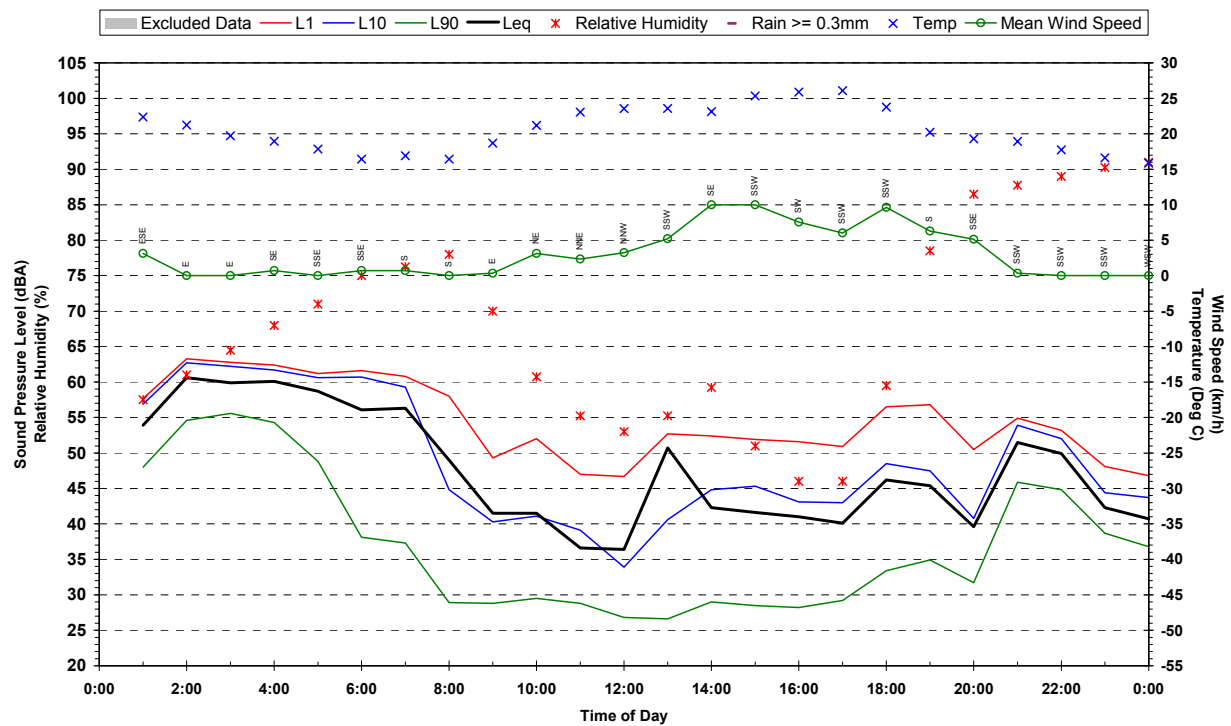


Statistical Ambient Noise Levels
20-2014 - GLNG - Wisemans - Thursday 12 March 2009

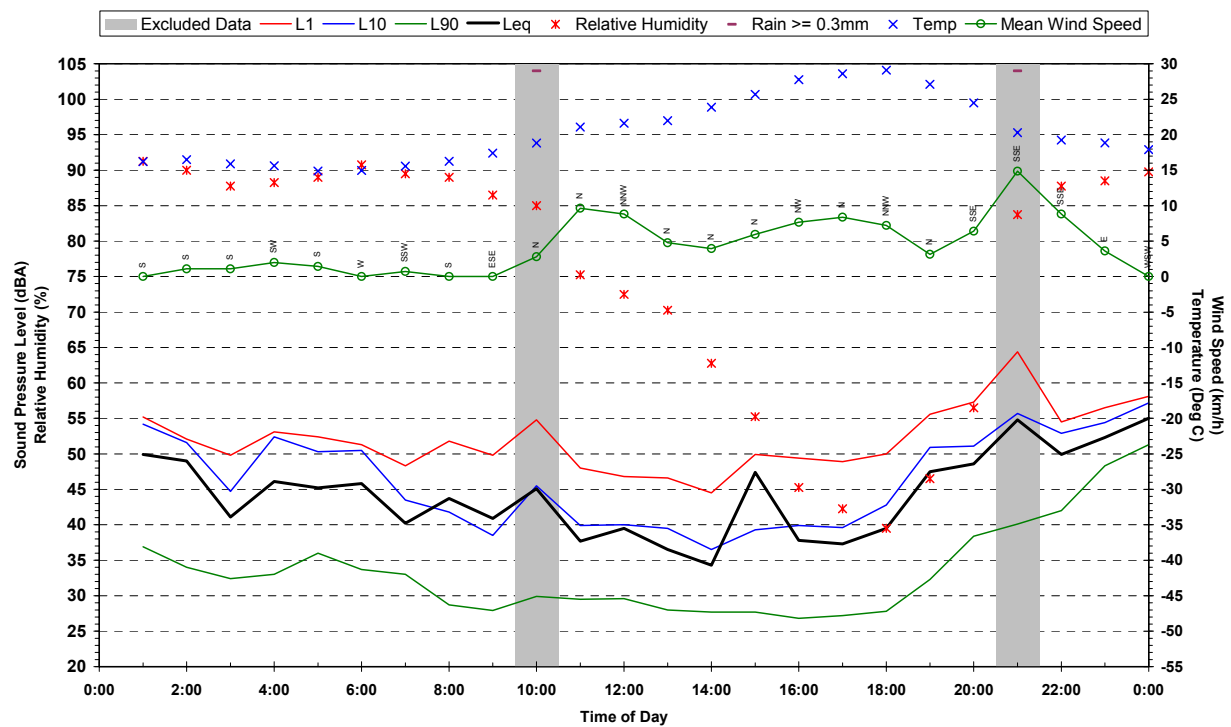


UNATTENDED NOISE MONITORING AT WISEMANS – STATISTICAL NOISE PLOTS

Statistical Ambient Noise Levels
20-2014 - GLNG - Wisemans - Friday 13 March 2009

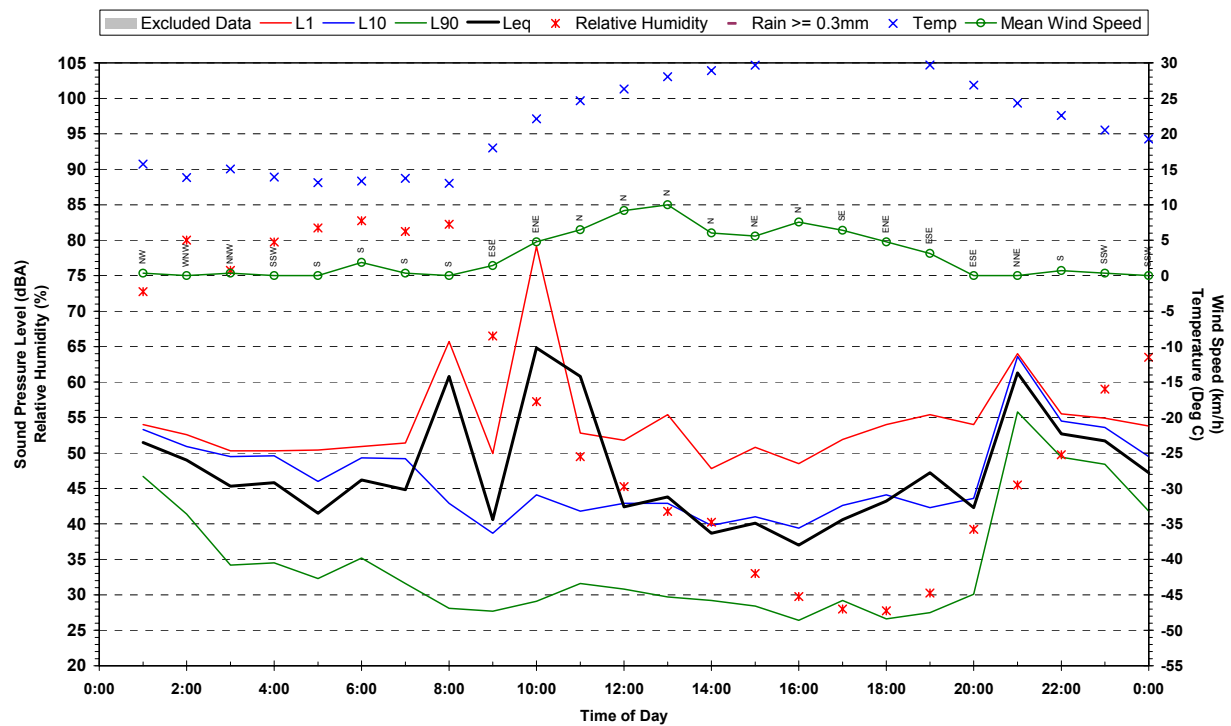


Statistical Ambient Noise Levels
20-2014 - GLNG - Wisemans - Saturday 14 March 2009

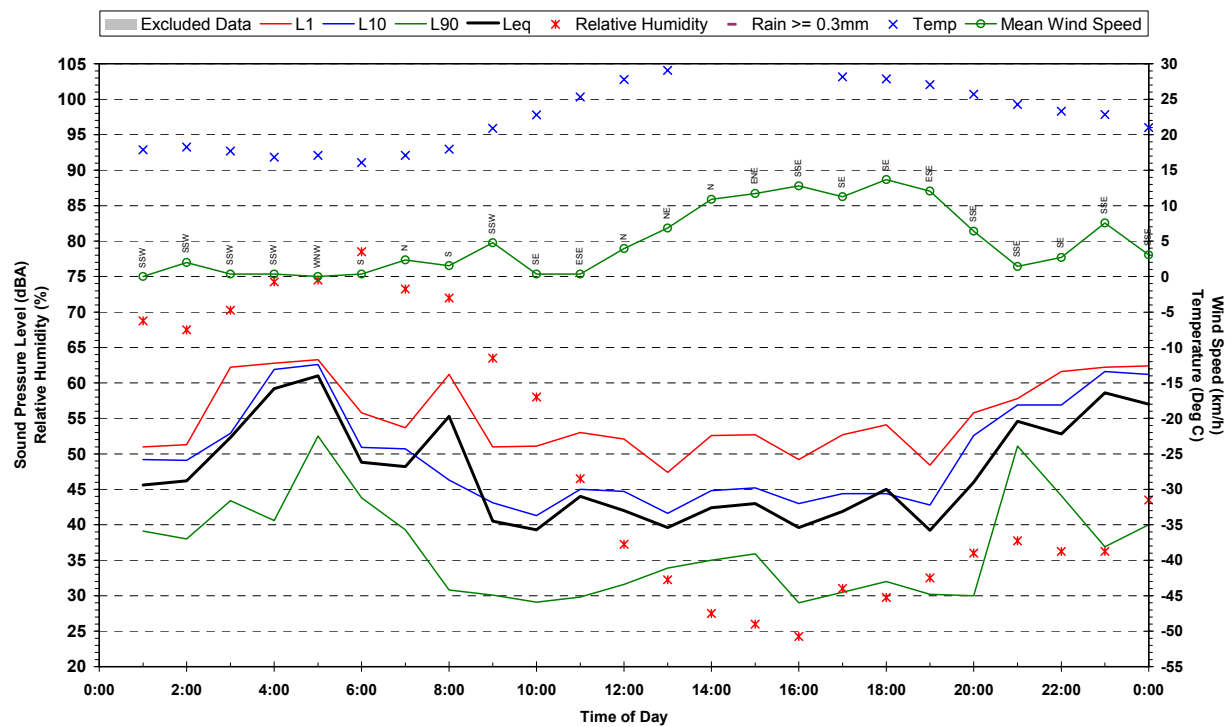


UNATTENDED NOISE MONITORING AT WISEMANS – STATISTICAL NOISE PLOTS

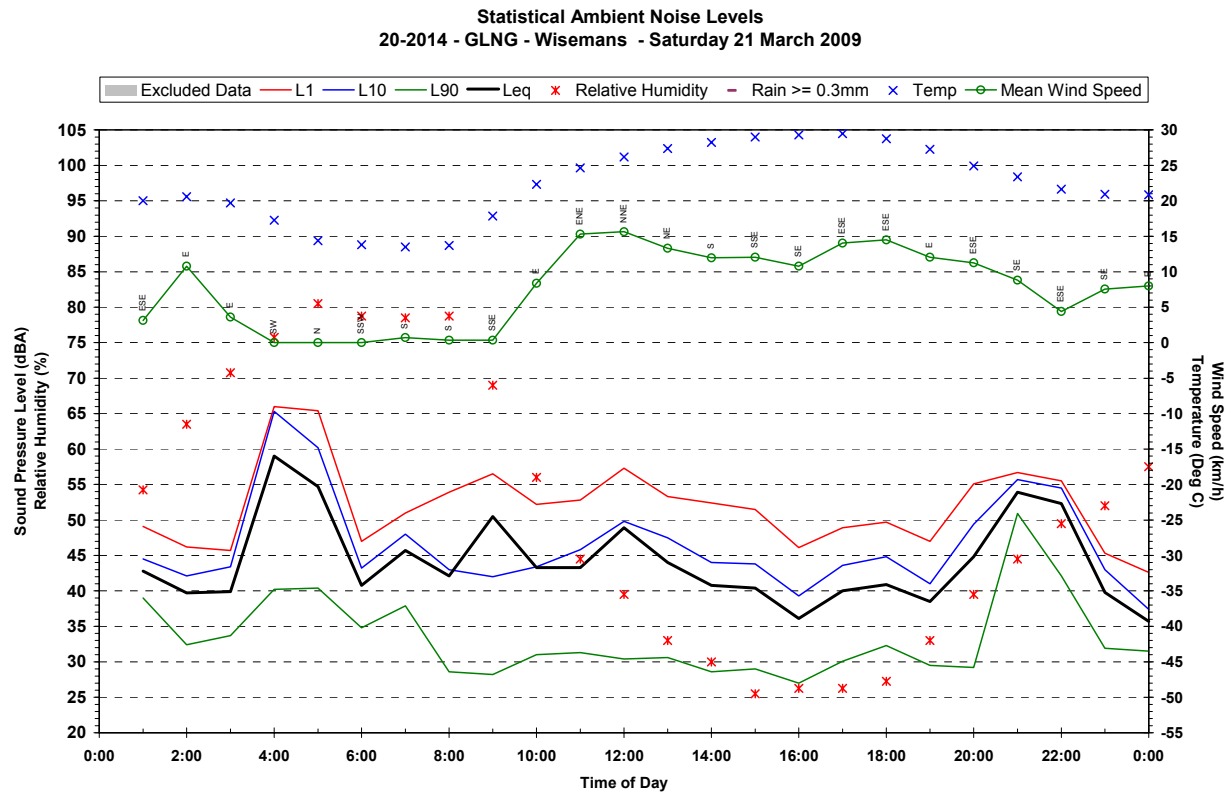
Statistical Ambient Noise Levels
20-2014 - GLNG - Wisemans - Thursday 19 March 2009



Statistical Ambient Noise Levels
20-2014 - GLNG - Wisemans - Friday 20 March 2009



UNATTENDED NOISE MONITORING AT WISEMANS – STATISTICAL NOISE PLOTS



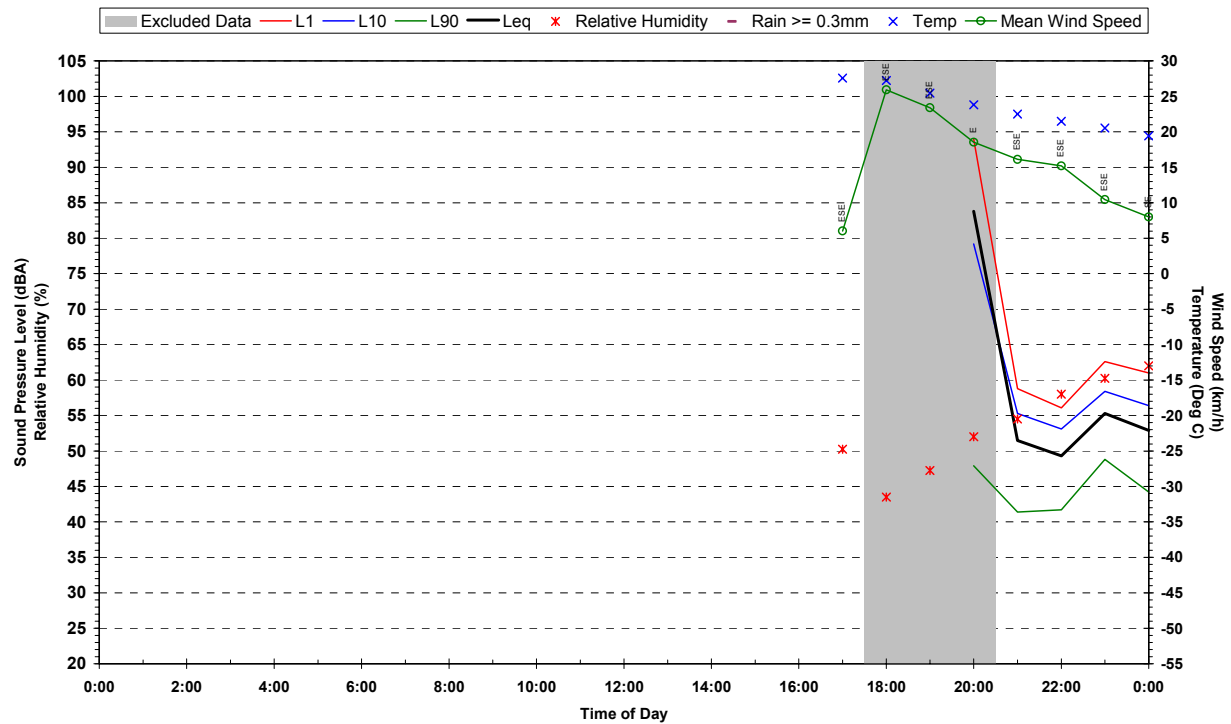
Appendix B

Report 20-2014-R3

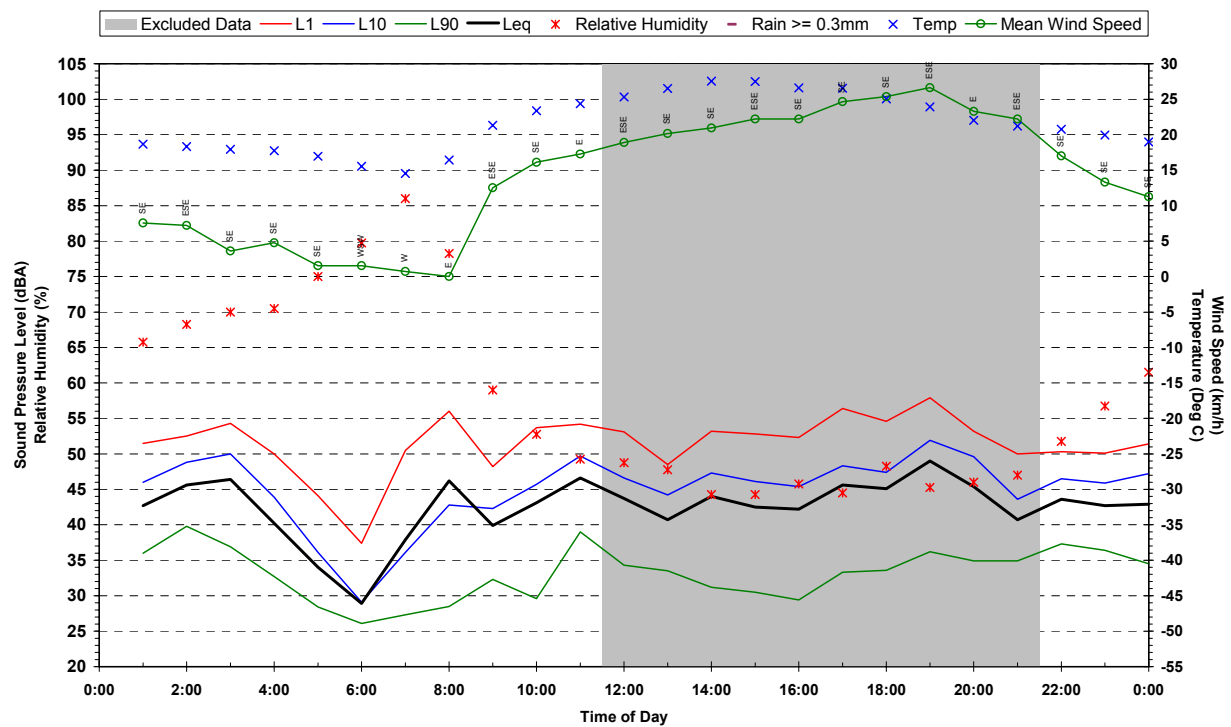
Page 1 of 1

UNATTENDED NOISE MONITORING AT STONEY CREEK 1 – STATISTICAL NOISE PLOTS

Statistical Ambient Noise Levels
20-2014 - GLNG - Stoney Creek 1 - Monday 9 March 2009

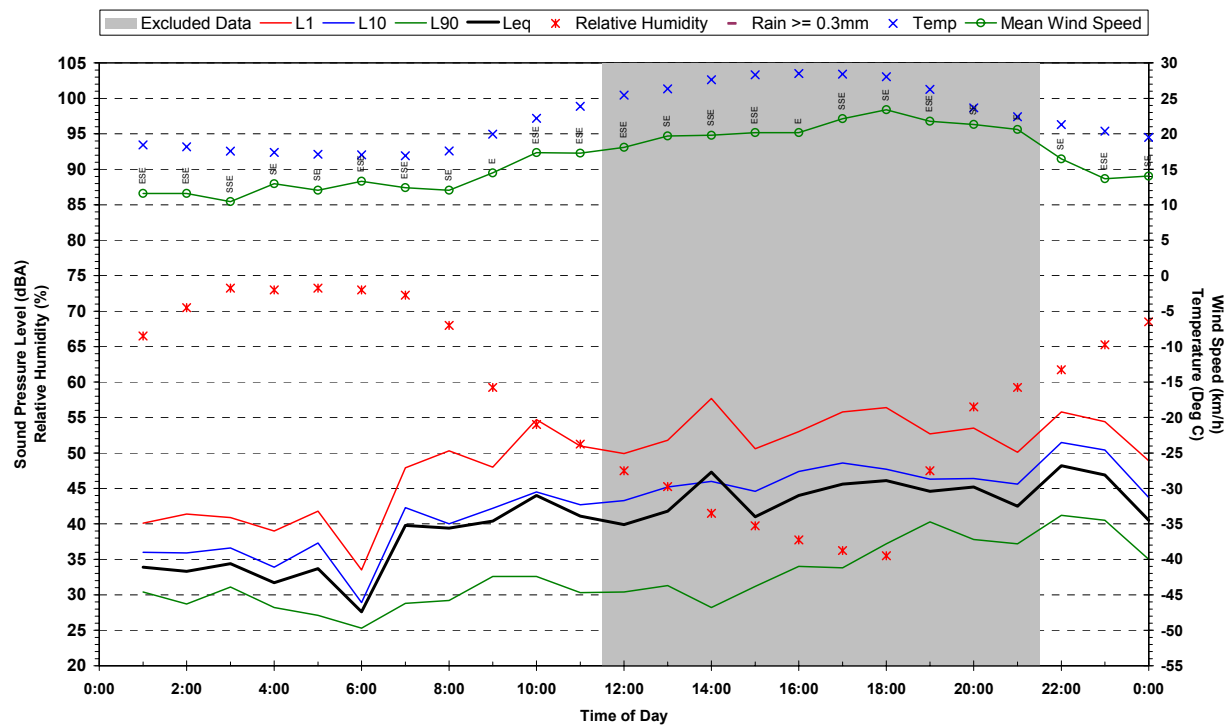


Statistical Ambient Noise Levels
20-2014 - GLNG - Stoney Creek 1 - Tuesday 10 March 2009

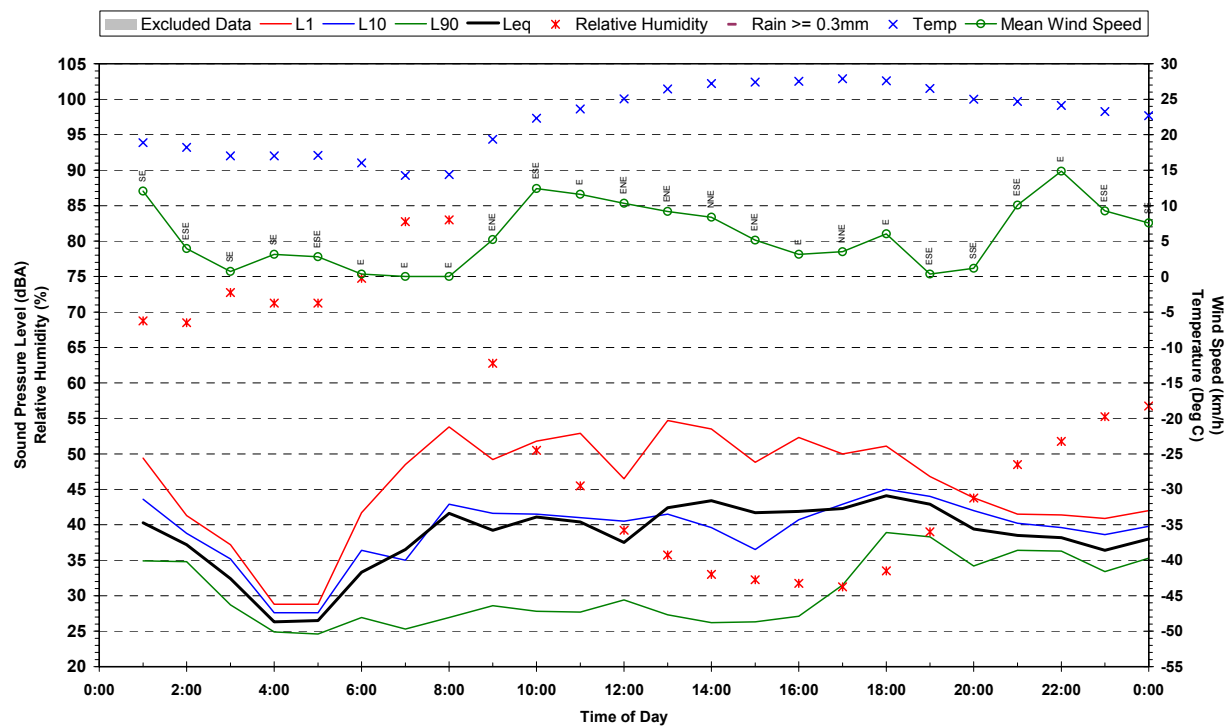


UNATTENDED NOISE MONITORING AT STONEY CREEK 1 – STATISTICAL NOISE PLOTS

Statistical Ambient Noise Levels
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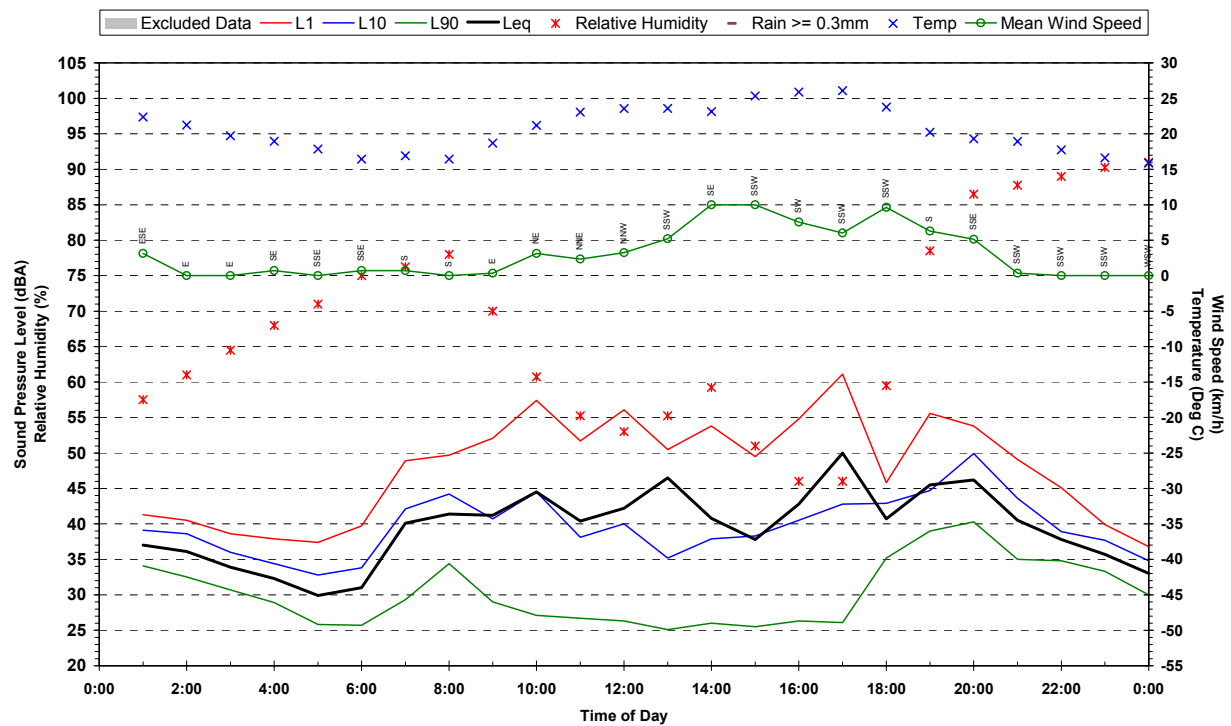


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20-2014 - GLNG - Stoney Creek 1 - Thursday 12 March 2009

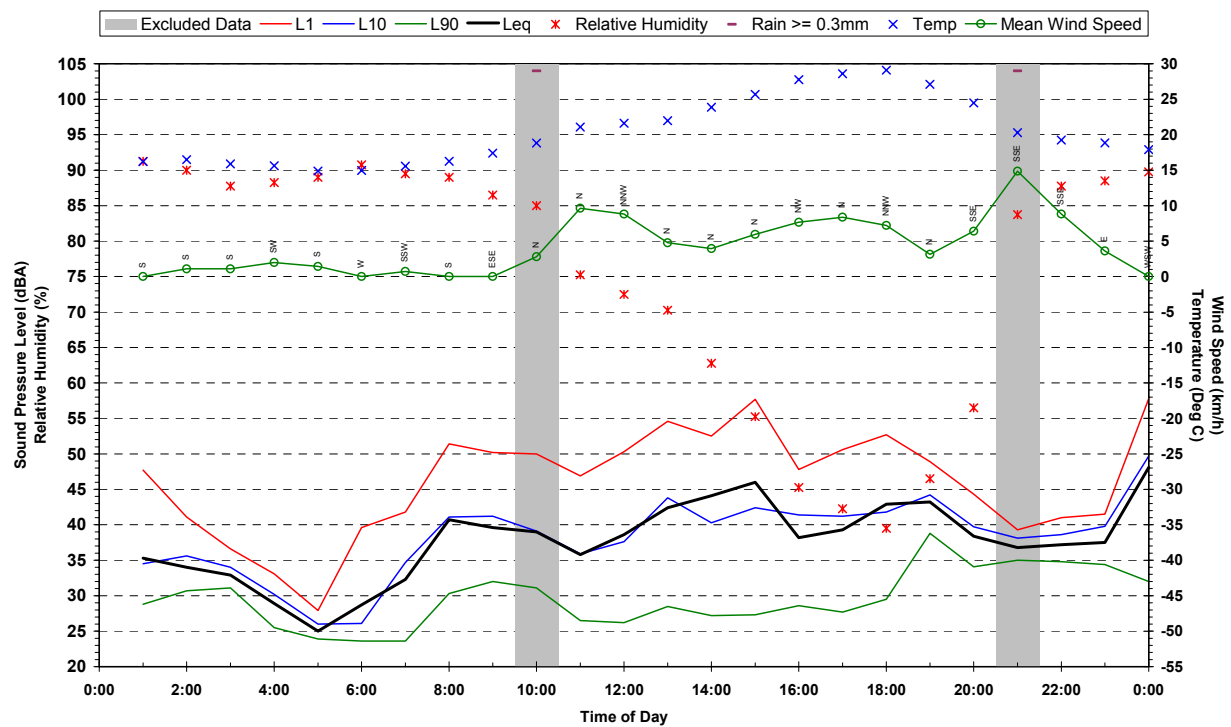


UNATTENDED NOISE MONITORING AT STONEY CREEK 1 – STATISTICAL NOISE PLOTS

Statistical Ambient Noise Levels
20-2014 - GLNG - Stoney Creek 1 - Friday 13 March 2009

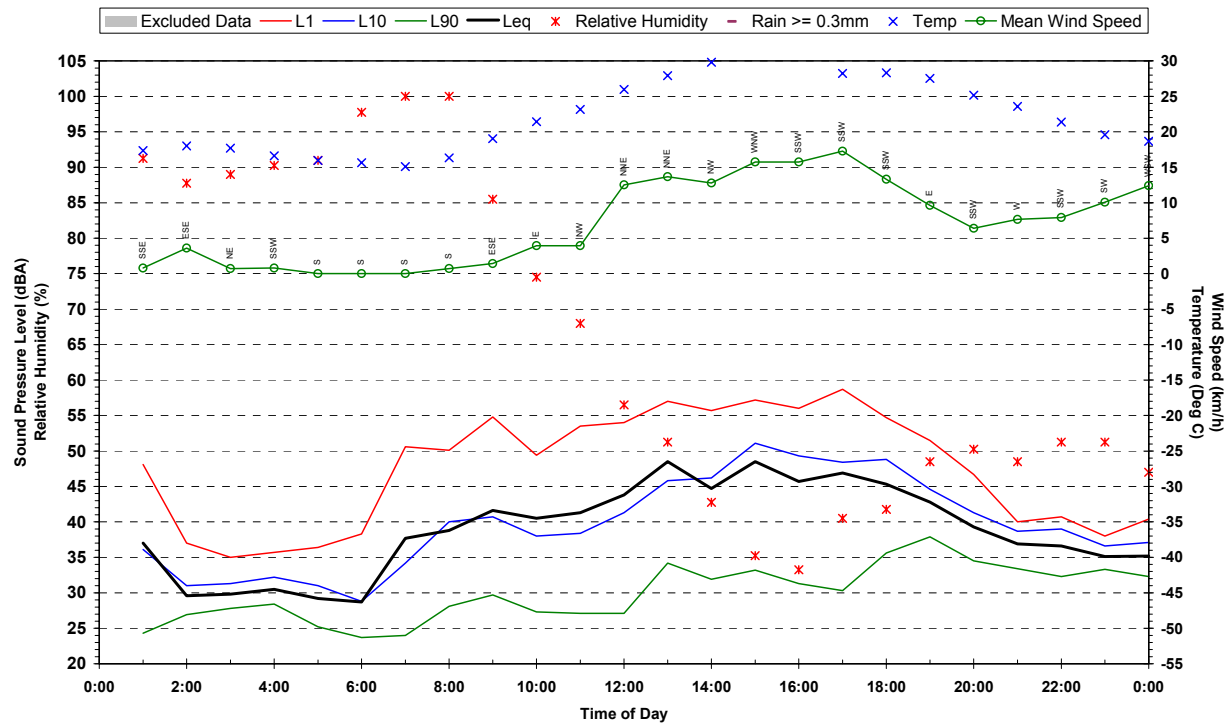


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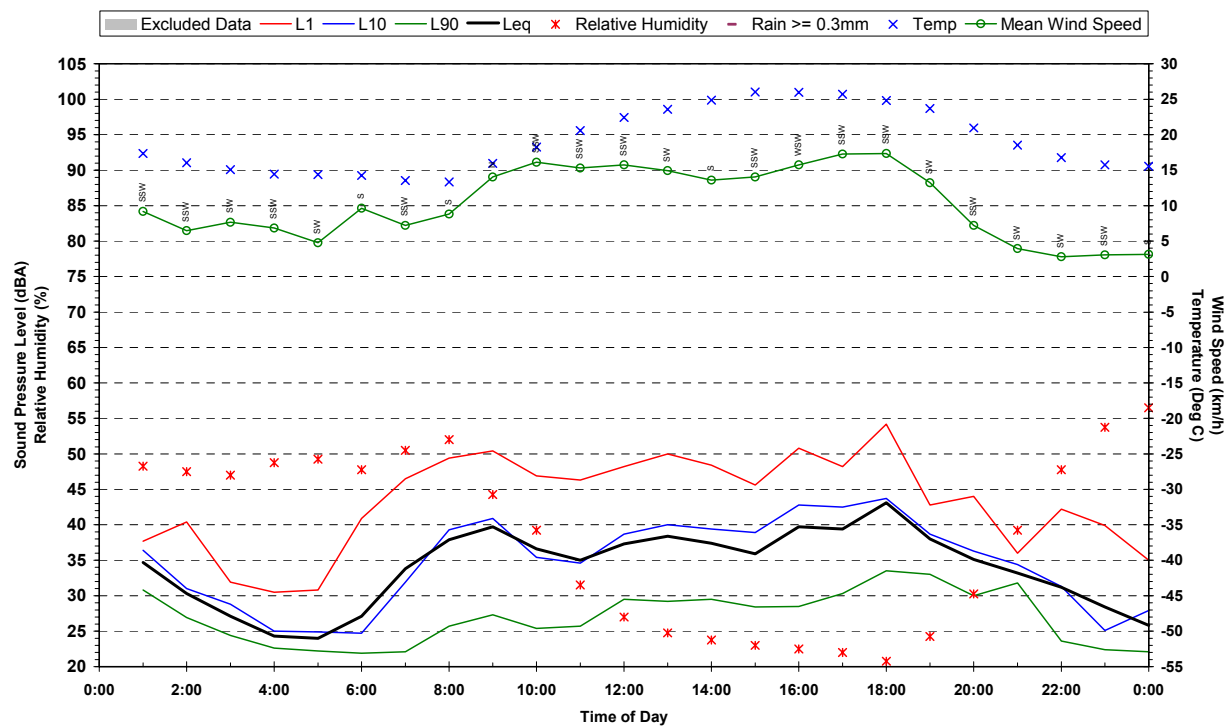


UNATTENDED NOISE MONITORING AT STONEY CREEK 1 – STATISTICAL NOISE PLOTS

Statistical Ambient Noise Levels
20-2014 - GLNG - Stoney Creek 1 - Sunday 15 March 2009

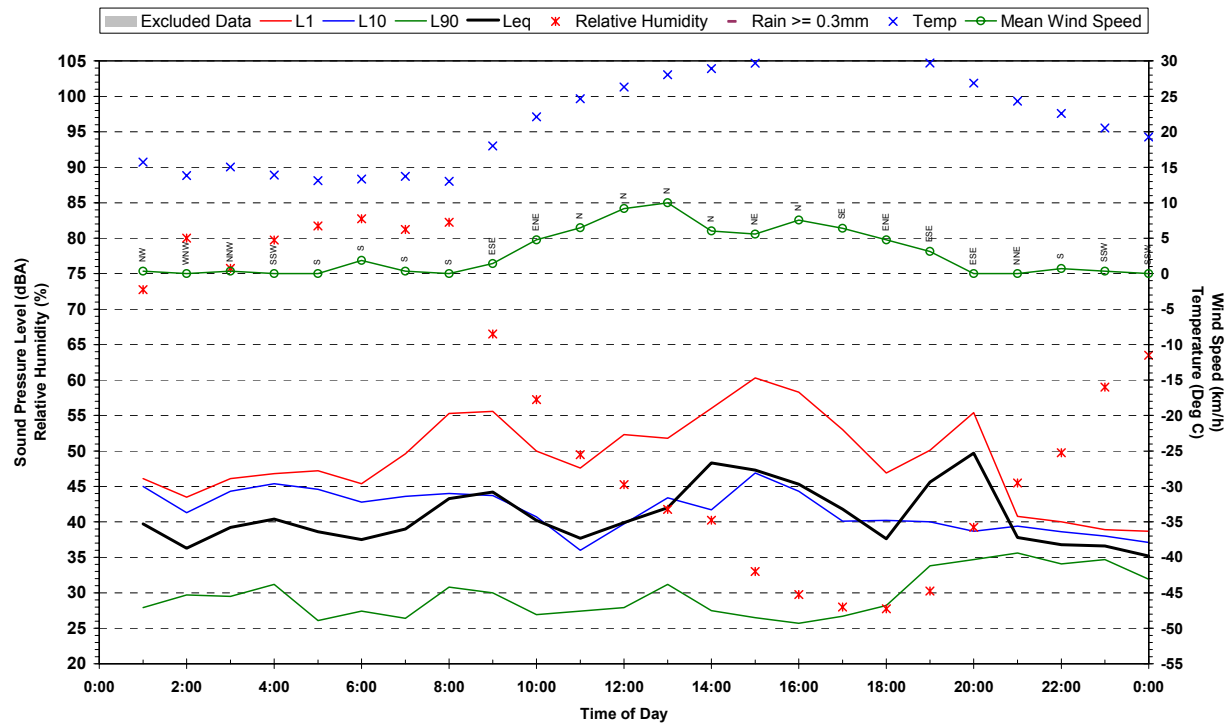


Statistical Ambient Noise Levels
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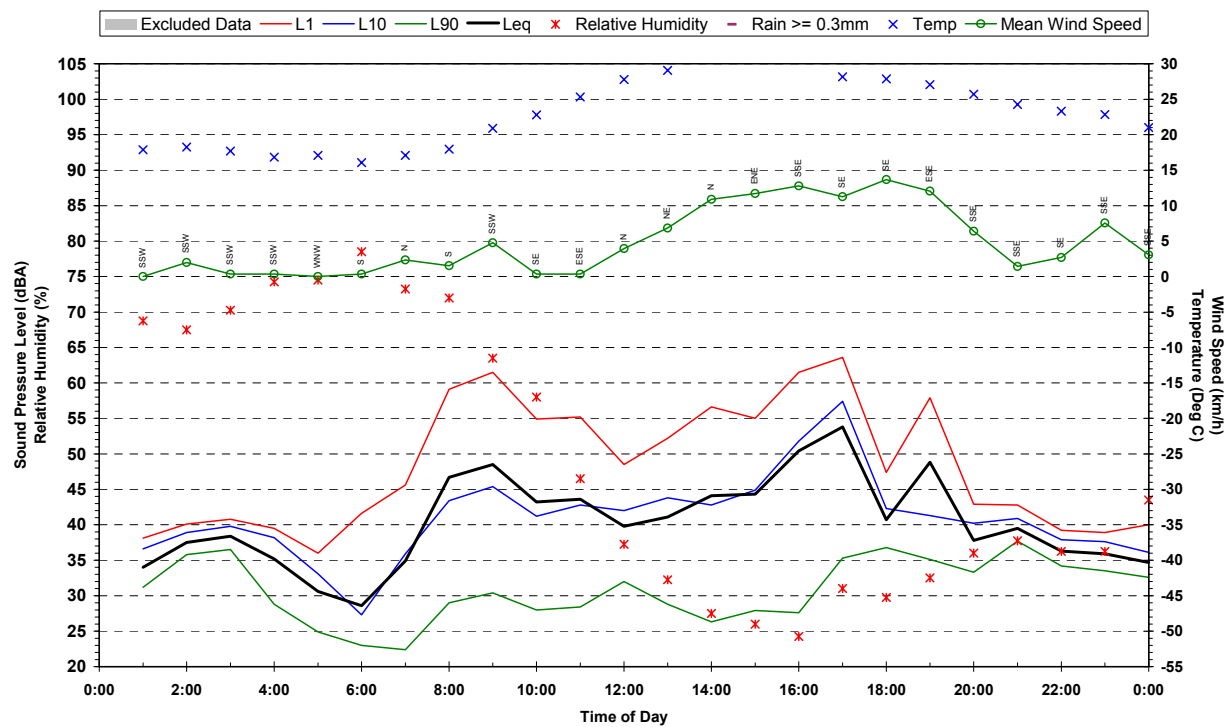


UNATTENDED NOISE MONITORING AT STONEY CREEK 1 – STATISTICAL NOISE PLOTS

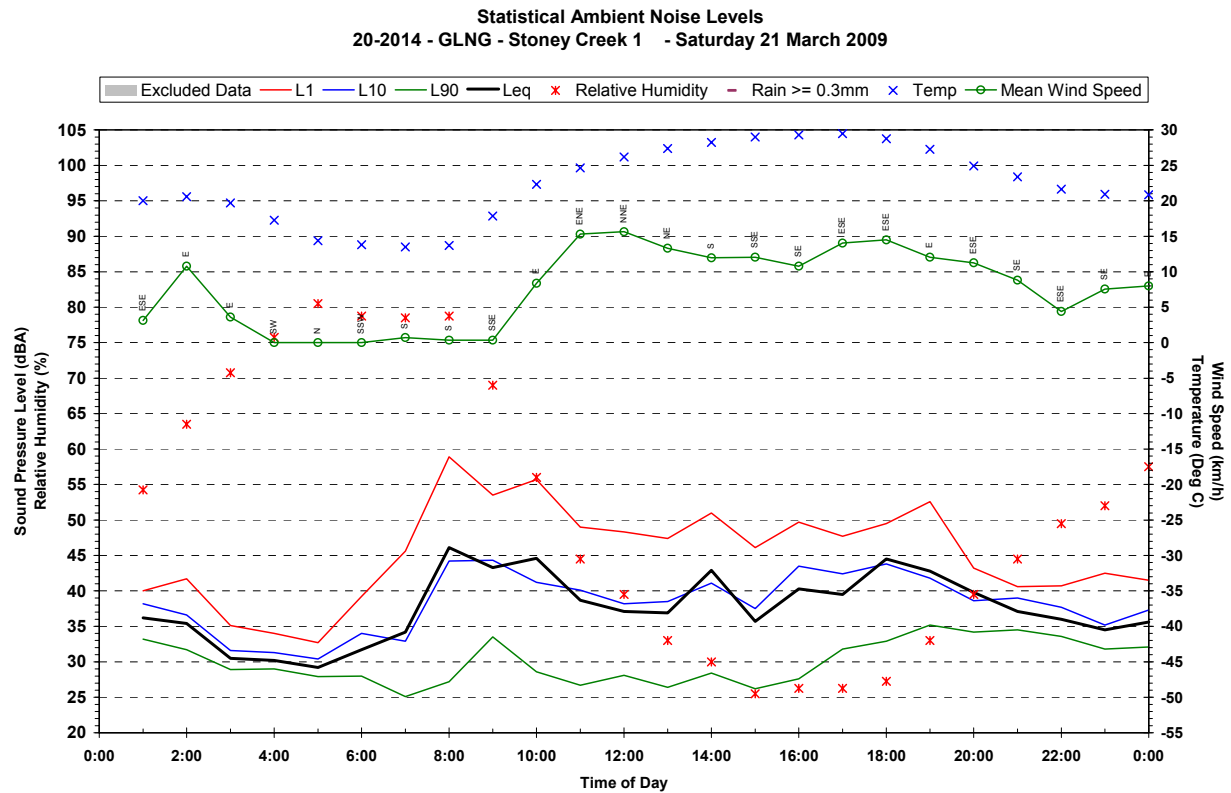
Statistical Ambient Noise Levels
20-2014 - GLNG - Stoney Creek 1 - Thursday 19 March 2009

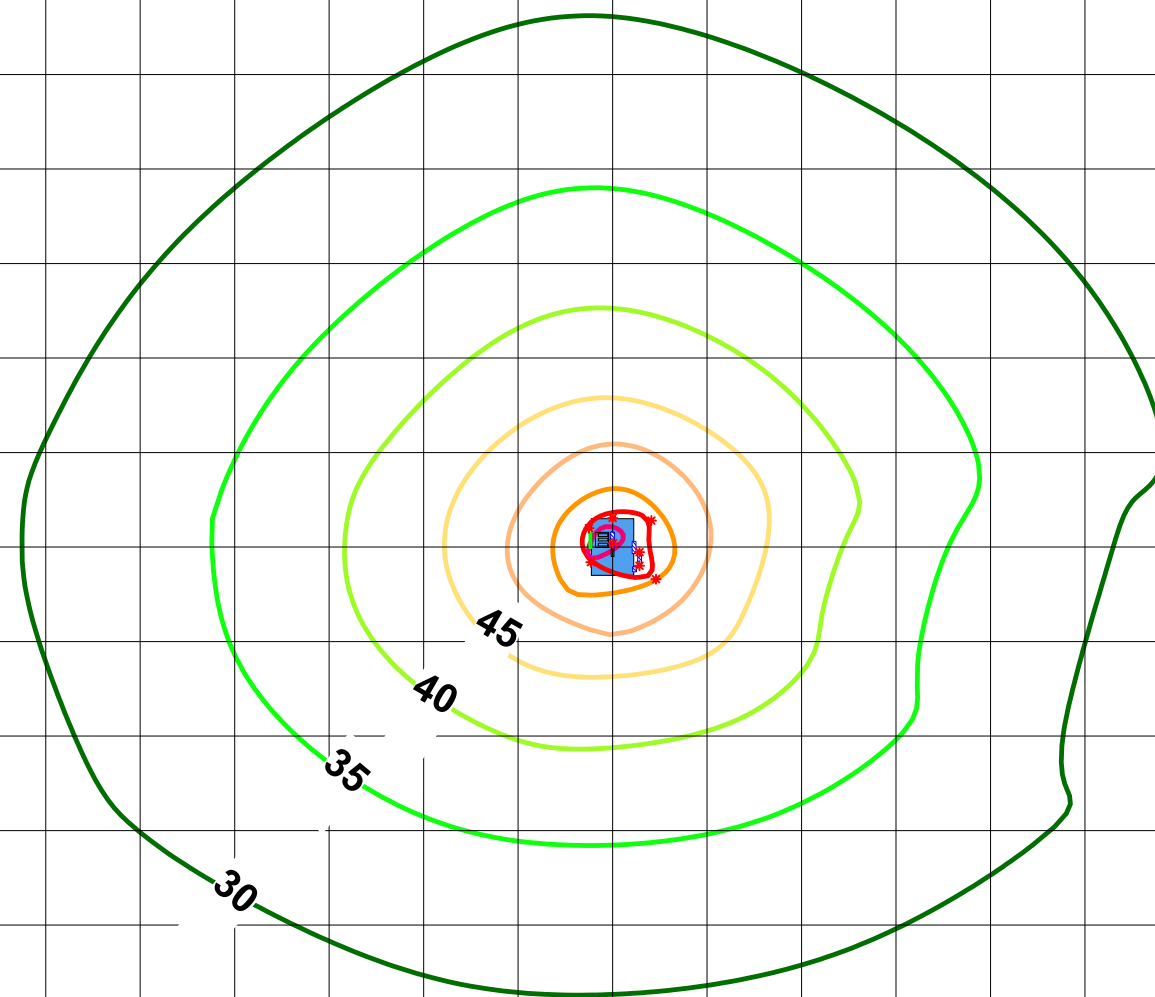
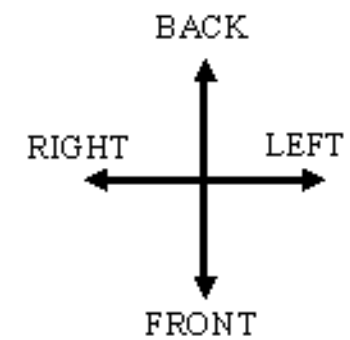


Statistical Ambient Noise Levels
20-2014 - GLNG - Stoney Creek 1 - Friday 20 March 2009



UNATTENDED NOISE MONITORING AT STONEY CREEK 1 – STATISTICAL NOISE PLOTS

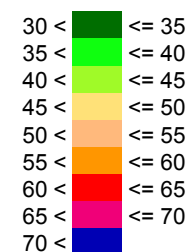




Project specific intrusive
noise criterion 30 dBA LAeq
5 dB penalty for low frequency
noise has been applied.

Grid sections
100x100m

LAeq (dBA)



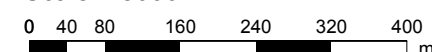
Legend

- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

Note:

Predictions at 1.5m above
ground and assumes
"Neutral" weather

Scale 1:8000



20-2014-R3 SANTOS DRILL RIG (LAeq) Noise Contours

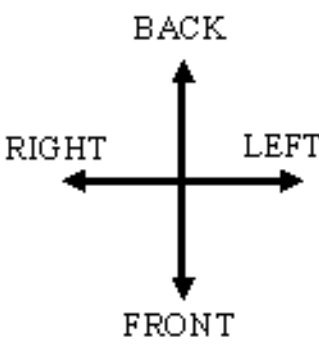
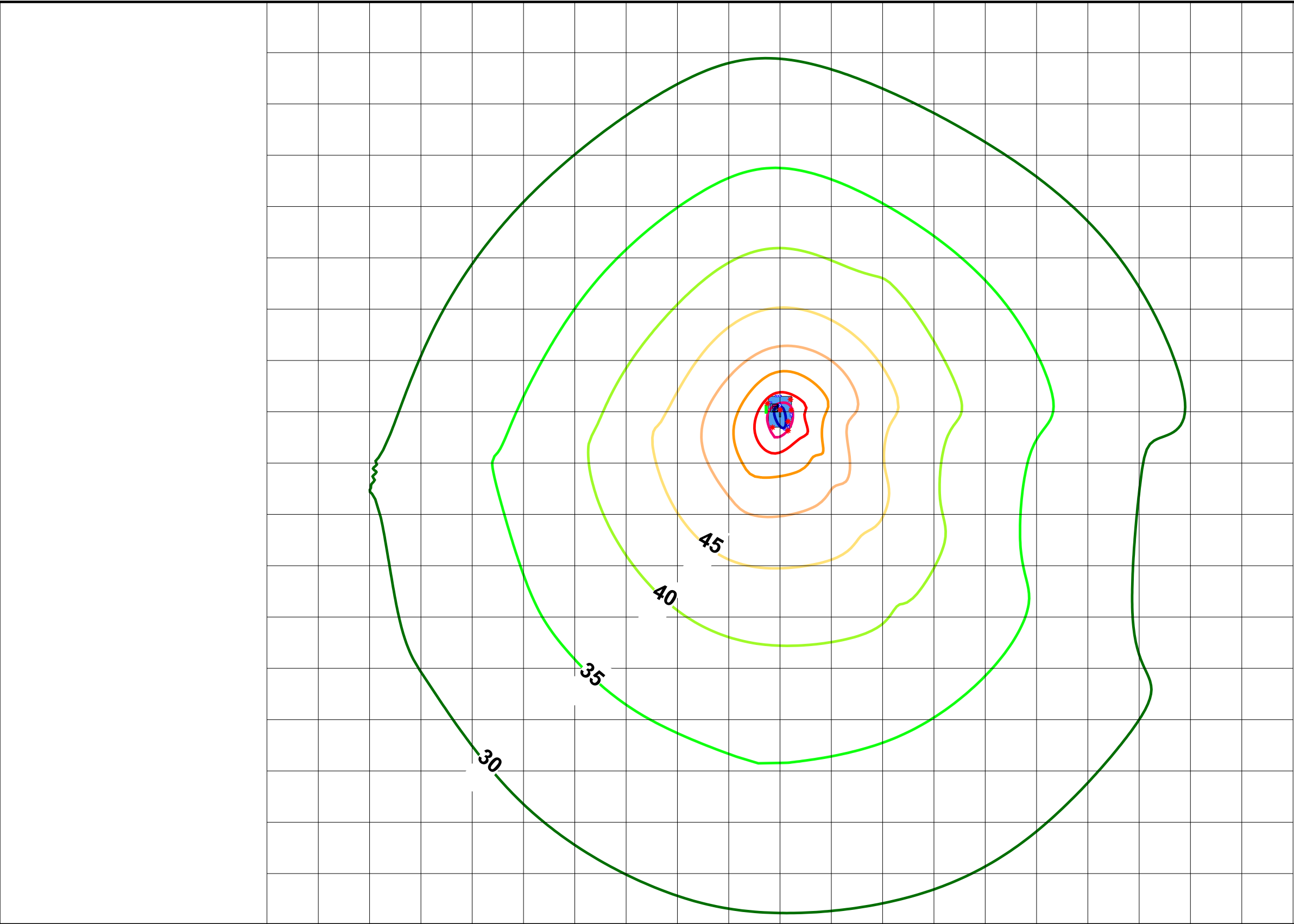
	Name	Date
Prepared	HM	2/04/09
Checked	MC	2/04/09
Authorised	MC	2/04/09

Appendix C Map 1

Predicted Noise Contours (LAeq)
Drill Rig McD 33
Drillstring testing operation



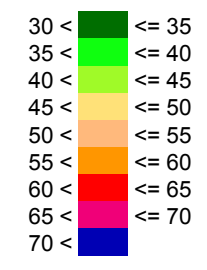
HEGGIES



Project specific intrusive noise criterion 30 dBA LAeq
5 dB penalty for low frequency noise has been applied.

Grid sections
100x100m

LAeq (dBA)

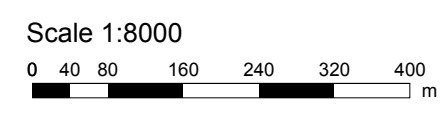


Legend

- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

Note:

Predictions at 1.5m above ground and assumes "Neutral" weather



20-2014-R3 SANTOS DRILL RIG (LAeq) Noise Contours

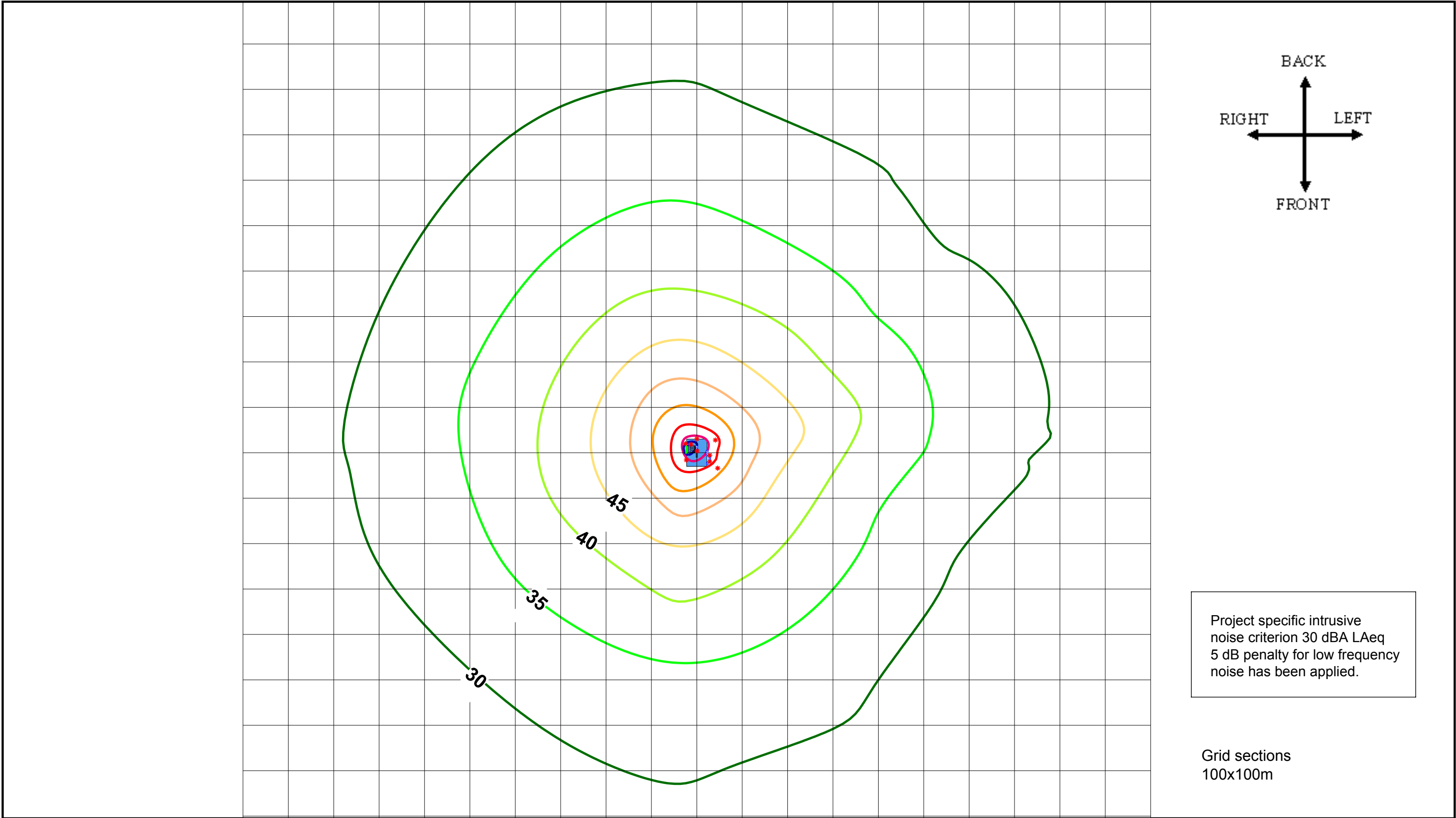
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Appendix C Map 2

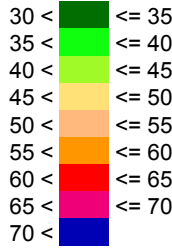
Predicted Noise Contours (LAeq)
Drill Rig McD 29
Core drilling operation



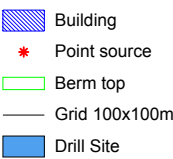
HEGGIES



LAeq (dBA)



Legend



Note:

Predictions at 1.5m above ground and assumes "Neutral" weather



**20-2014-R3
SANTOS DRILL RIG
(LAeq) Noise Contours**

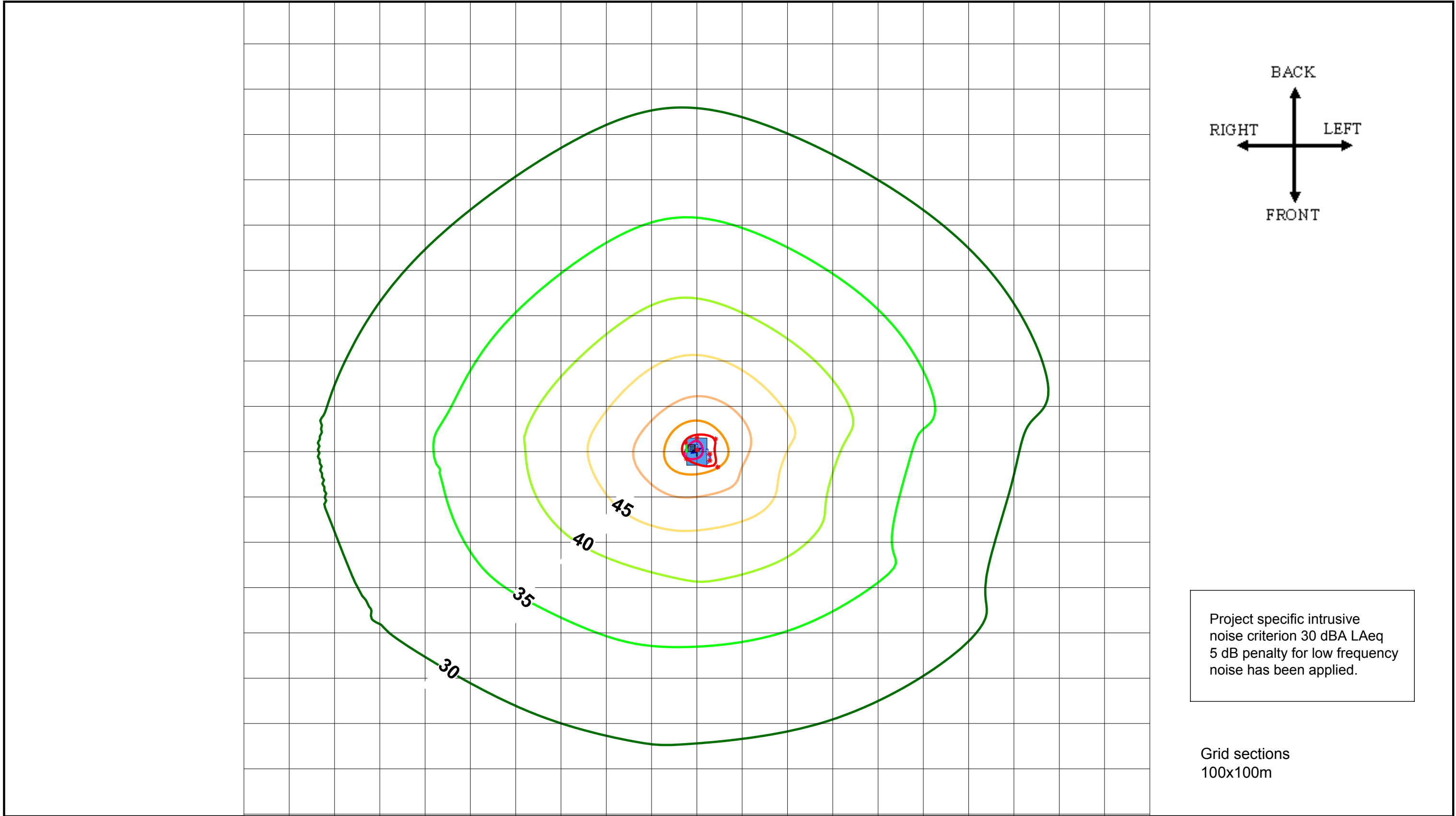
	Name	Date
Prepared	HM	2/04/09
Checked	MC	2/04/09
Authorised	MC	2/04/09

**Appendix C
Map 3**

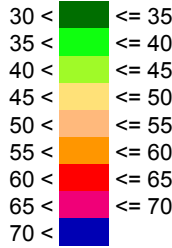
Predicted Noise Contours (LAeq)
Drill Rig McD 33
Open hole drilling operation



HEGGIES



LAeq (dBA)



Legend

- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

Note:

Predictions at 1.5m above ground and assumes "Worst Case" weather



20-2014-R3
SANTOS DRILL RIG
(LAeq) Noise Contours

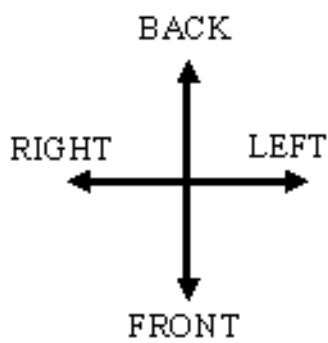
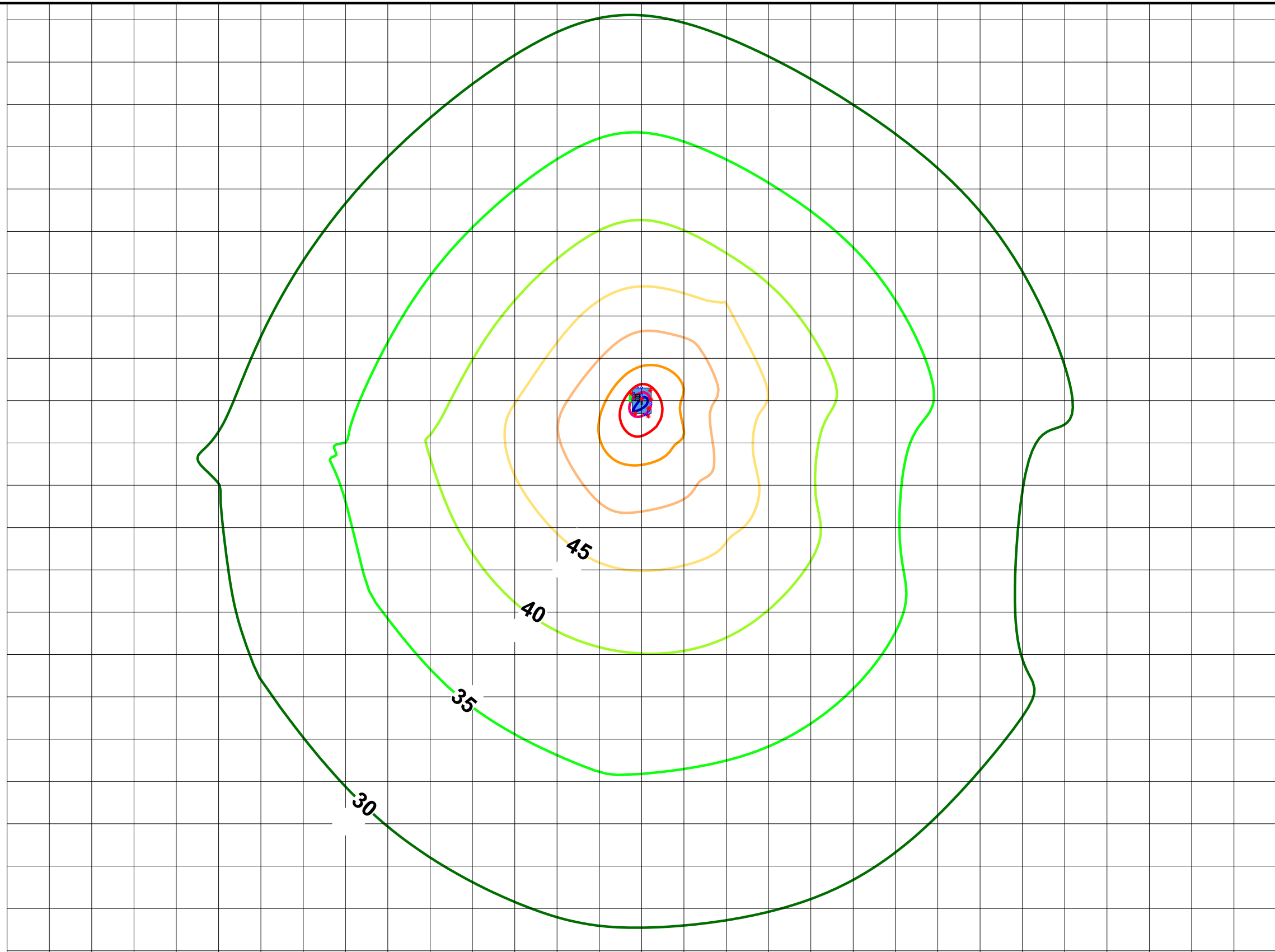
	Name	Date
Prepared	HM	2/04/09
Checked	MC	2/04/09
Authorised	MC	2/04/09

Appendix C
Map 4

Predicted Noise Contours (LAeq)
Drill Rig McD 33
Drillstring testing operation



HEGGIES



Project specific intrusive noise criterion 30 dBA LAeq
5 dB penalty for low frequency noise has been applied.

Grid sections
100x100m

LAeq (dBA)

30 <	<= 35
35 <	<= 40
40 <	<= 45
45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	<= 65
65 <	<= 70
70 <	

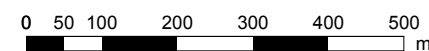
Legend

- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

Note:

Predictions at 1.5m above ground and assumes "Worst Case" weather

Scale 1:10000



20-2014-R3 SANTOS DRILL RIG (LAeq) Noise Contours

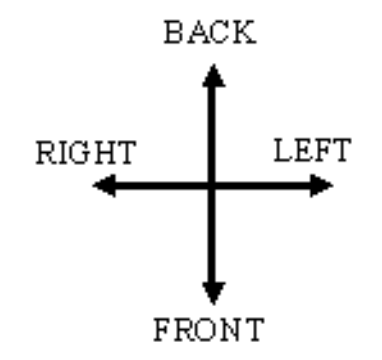
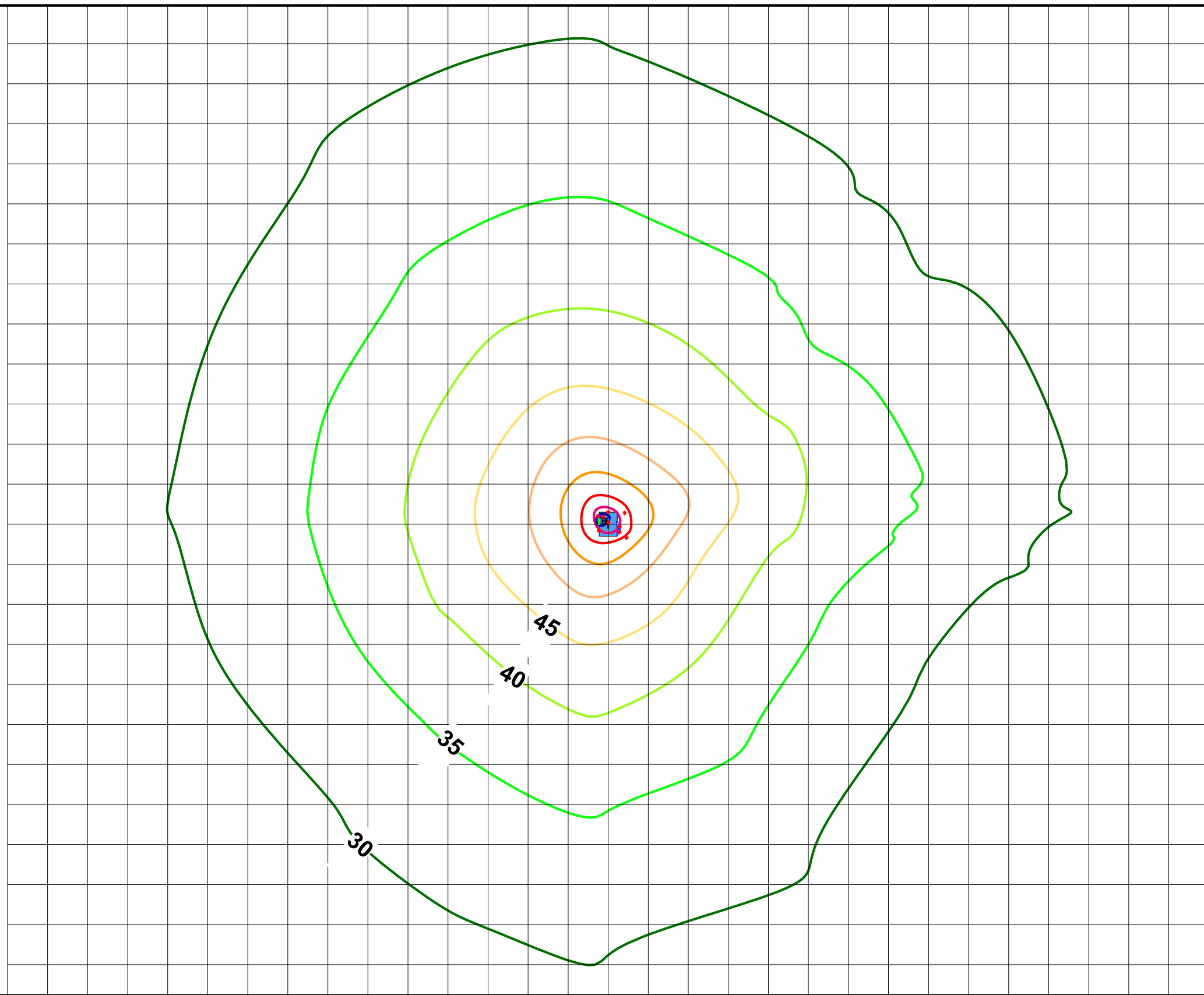
	Name	Date
Prepared	HM	2/04/09
Checked	MC	2/04/09
Authorised	MC	2/04/09

Appendix C Map 5

Predicted Noise Contours (LAeq)
Drill Rig McD 29
Core drilling operation



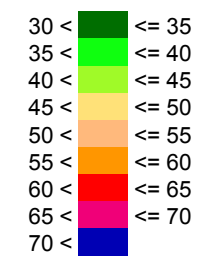
HEGGIES



Project specific intrusive noise criterion 30 dBA LAeq
5 dB penalty for low frequency noise has been applied.

Grid sections
100x100m

LAeq (dBA)

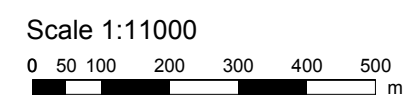


Legend

- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

Note:

Predictions at 1.5m above ground and assumes "Worst Case" weather



20-2014-R3 SANTOS DRILL RIG (LAeq) Noise Contours

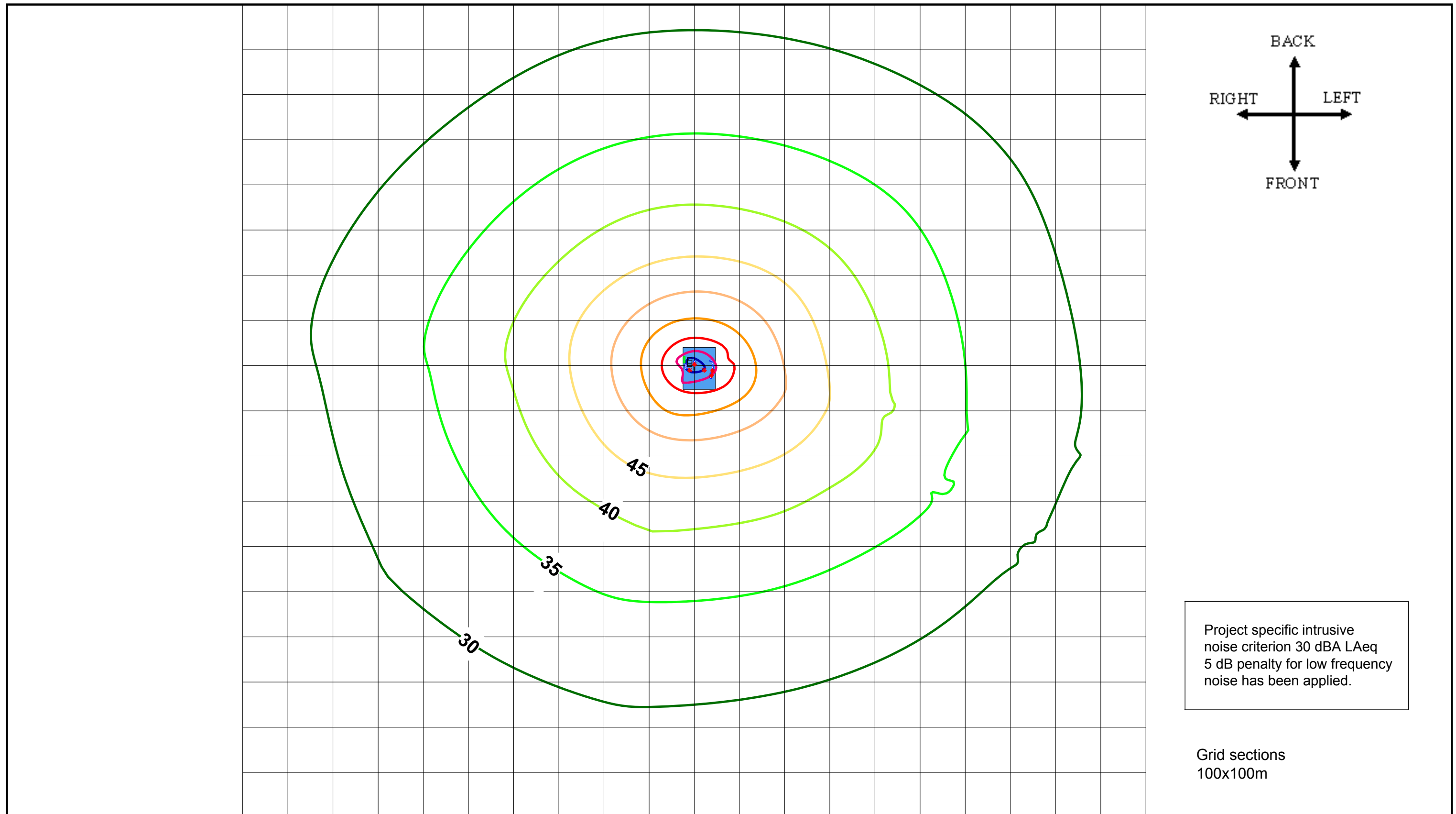
	Name	Date
Prepared	HM	2/04/09
Checked	MC	2/04/09
Authorised	MC	2/04/09

Appendix C Map 6

Predicted Noise Contours (LAeq)
Drill Rig McD 33
Open hole drilling operation



HEGGIES



LAeq (dBA)

30 <	<= 35
35 <	<= 40
40 <	<= 45
45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	<= 65
65 <	<= 70
70 <	

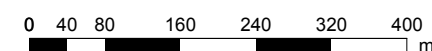
Legend

- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

Note:

Predictions at 1.5m above ground and assumes "Neutral" weather

Scale 1:8000



**20-2014-R3
SANTOS DRILL RIG
(LAeq) Noise Contours**

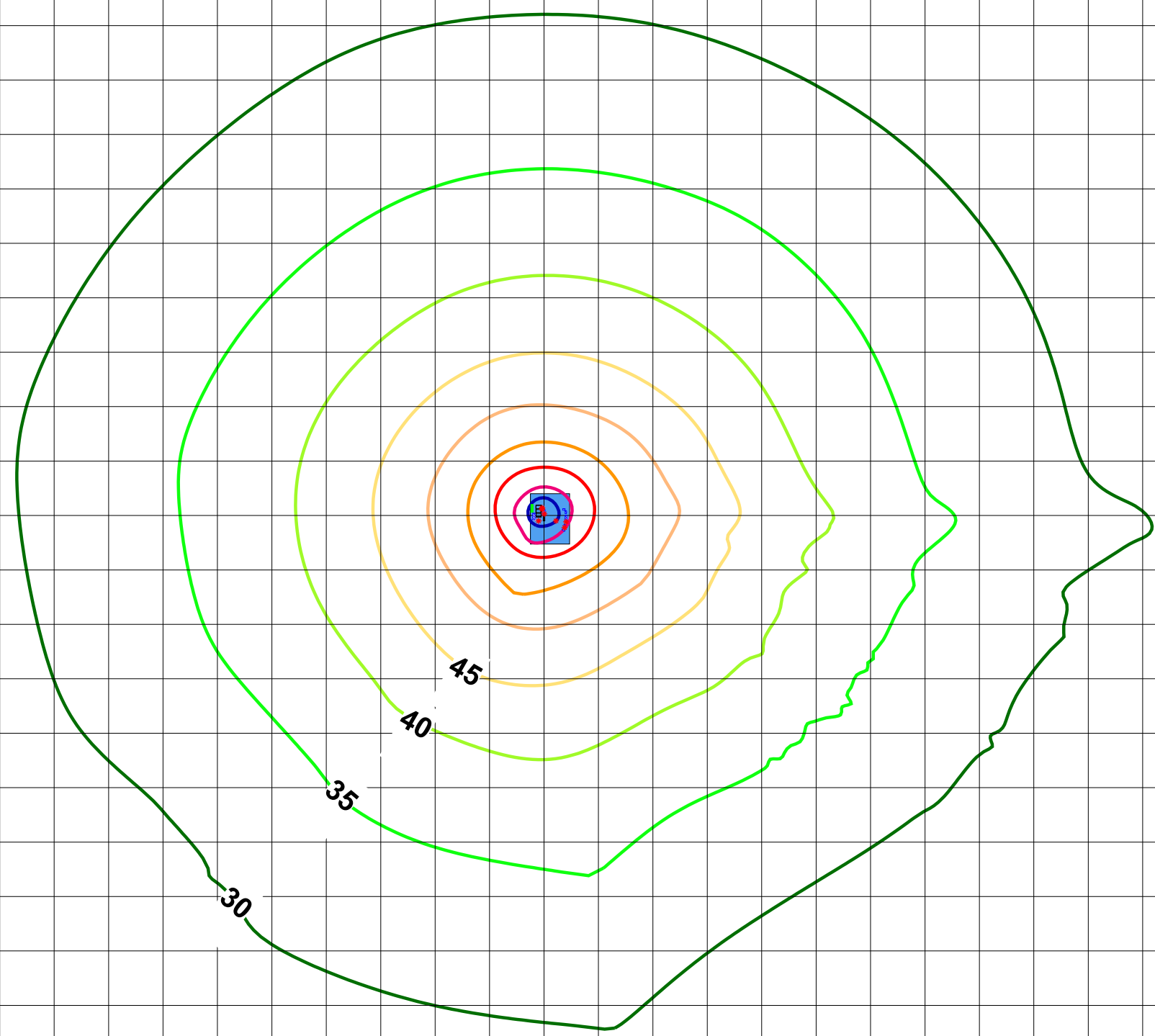
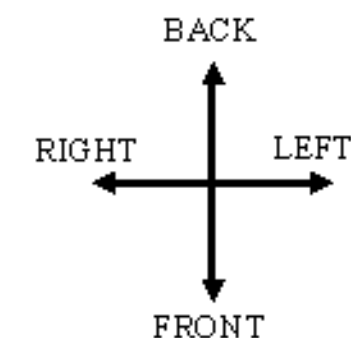
	Name	Date
Prepared	HM	16/04/09
Checked	MC	16/04/09
Authorised	MC	17/04/09

**Appendix D
Map 1**

Predicted Noise Contours (LAeq)
Drill Rig MDC 105
Core drilling operation



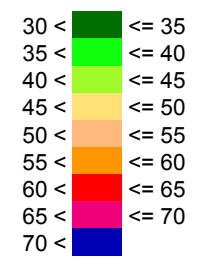
HEGGIES



Project specific intrusive noise criterion 35 dBA LAeq

Grid sections 100x100m

L_{Aeq} (dBA)

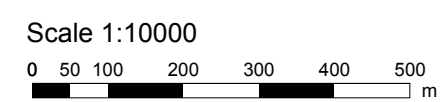


Legend

- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

Note:

Predictions at 1.5m above ground and assumes "Neutral" weather



20-2014-R3
SANTOS DRILL RIG
(L_{Aeq}) Noise Contours

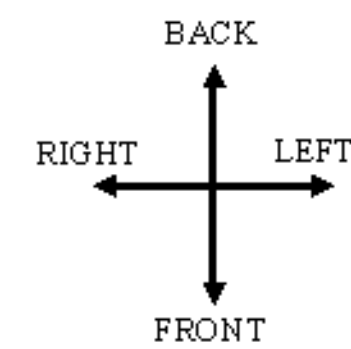
	Name	Date
Prepared	HM	16/04/09
Checked	MC	16/04/09
Authorised	MC	17/04/09

Appendix D
Map 2

Predicted Noise Contours (L_{Aeq})
Drill Rig MDC 105
Drilling operation including the mud pump

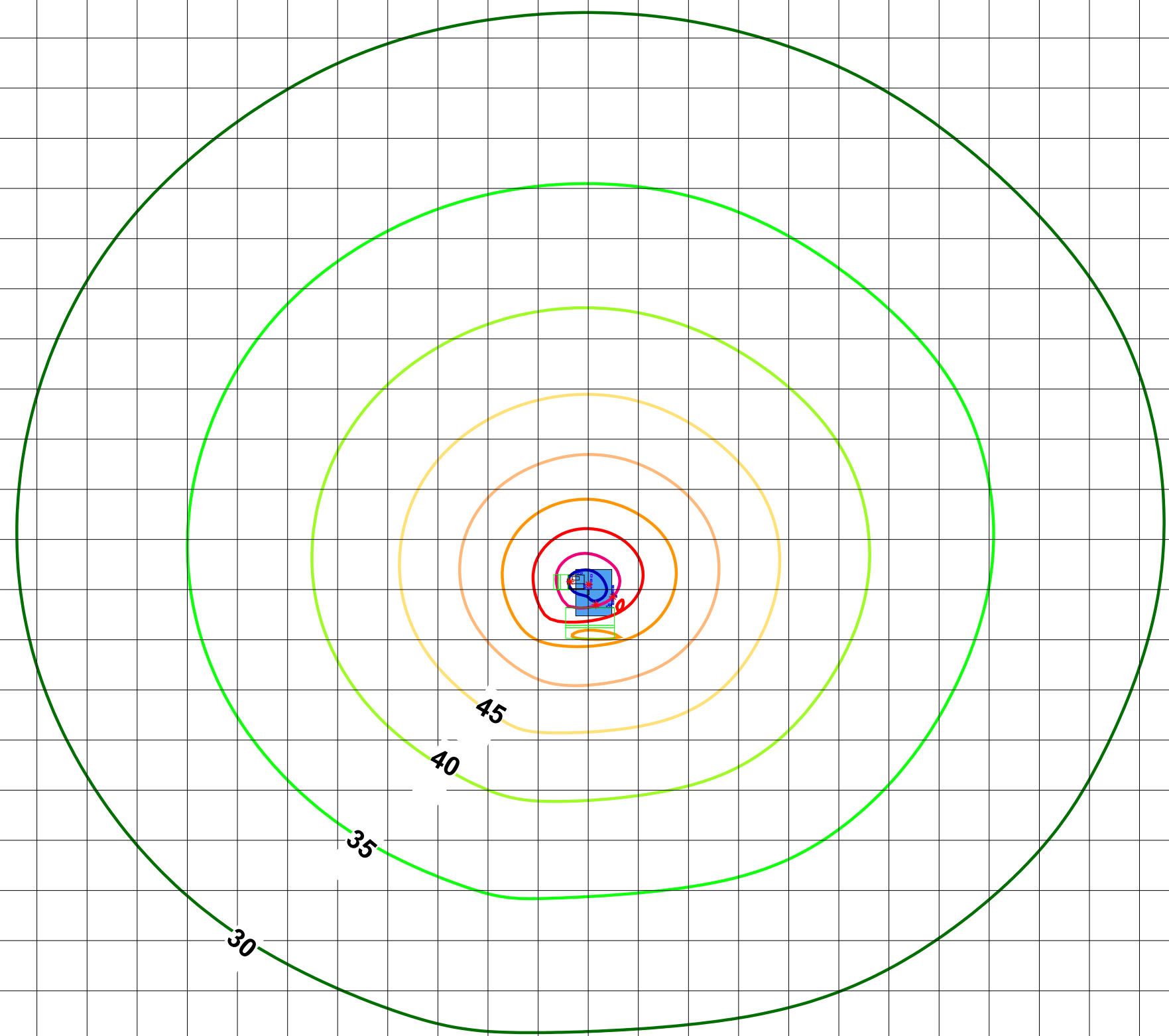


HEGGIES

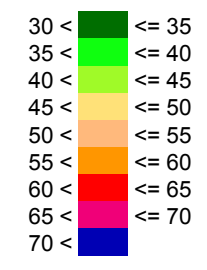


Project specific intrusive
noise criterion 35 dBA LAeq

Grid sections
100x100m



LAeq (dBA)

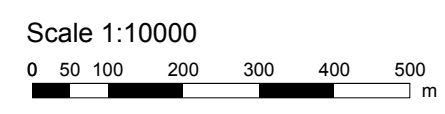


Legend

- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

Note:

Predictions at 1.5m above
ground and assumes
"Neutral" weather



20-2014-R3 SANTOS DRILL RIG (LAeq) Noise Contours

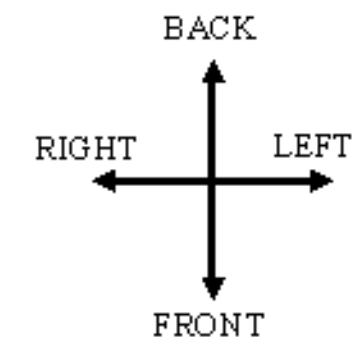
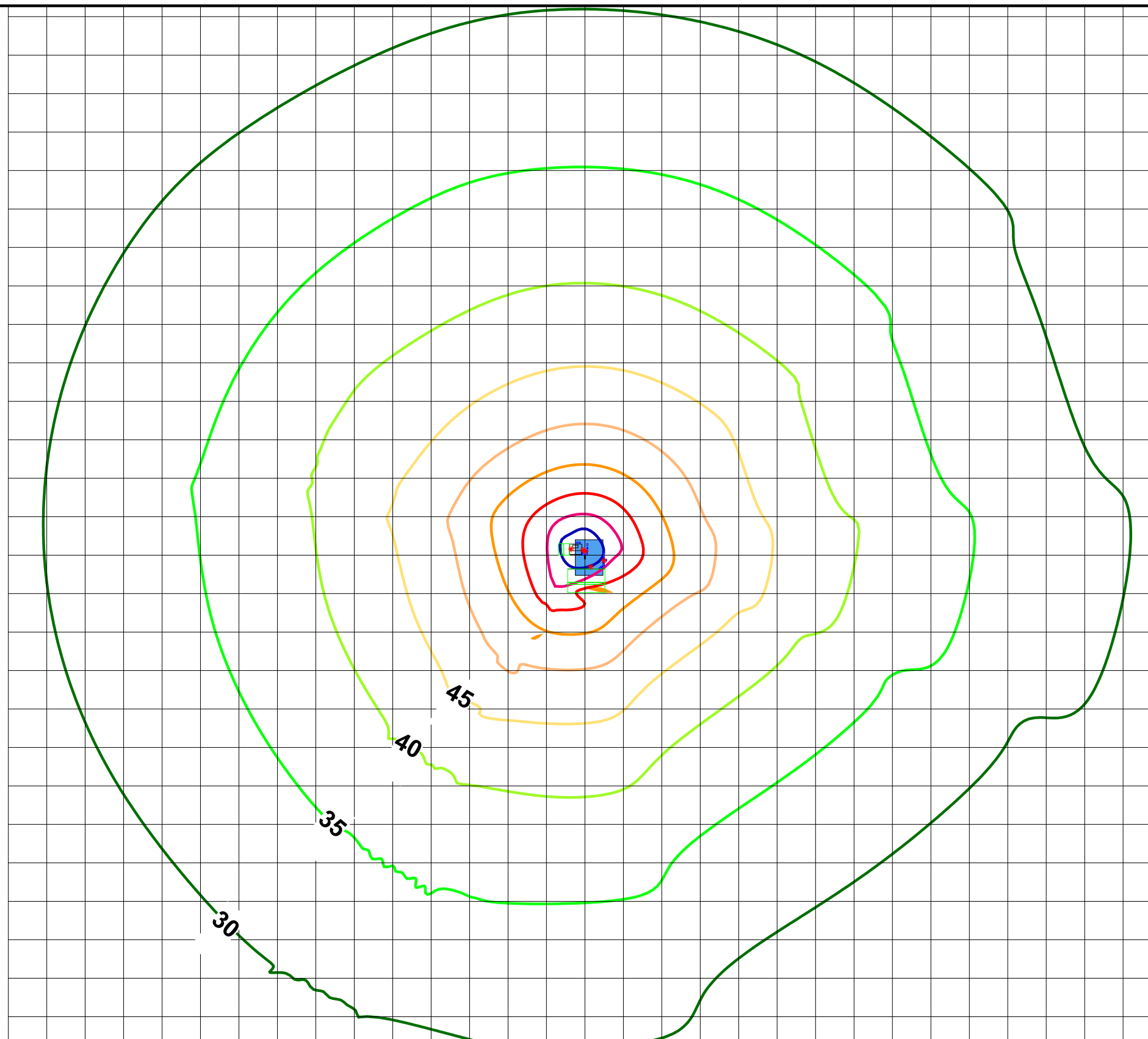
	Name	Date
Prepared	HM	17/04/09
Checked	MC	17/04/09
Authorised	MC	17/04/09

Appendix D Map 3

Predicted Noise Contours (LAeq)
Drill Rig Atlas 1
Core drilling operation



HEGGIES



Project specific intrusive
noise criterion 35 dBA LAeq

Grid sections
100x100m

LAeq (dBA)

30 <	<= 35
35 <	<= 40
40 <	<= 45
45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	<= 65
65 <	<= 70
70 <	

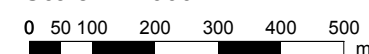
Legend

- Building
- * Point source
- Berm top
- Grid 100x100m
- Drill Site

Note:

Predictions at 1.5m above
ground and assumes
"Neutral" weather

Scale 1:12000



20-2014-R3 SANTOS DRILL RIG (LAeq) Noise Contours

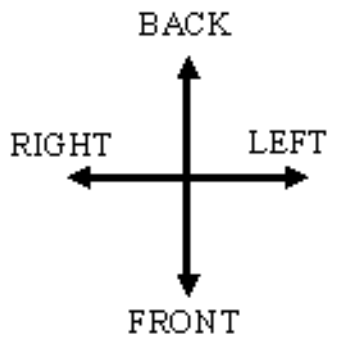
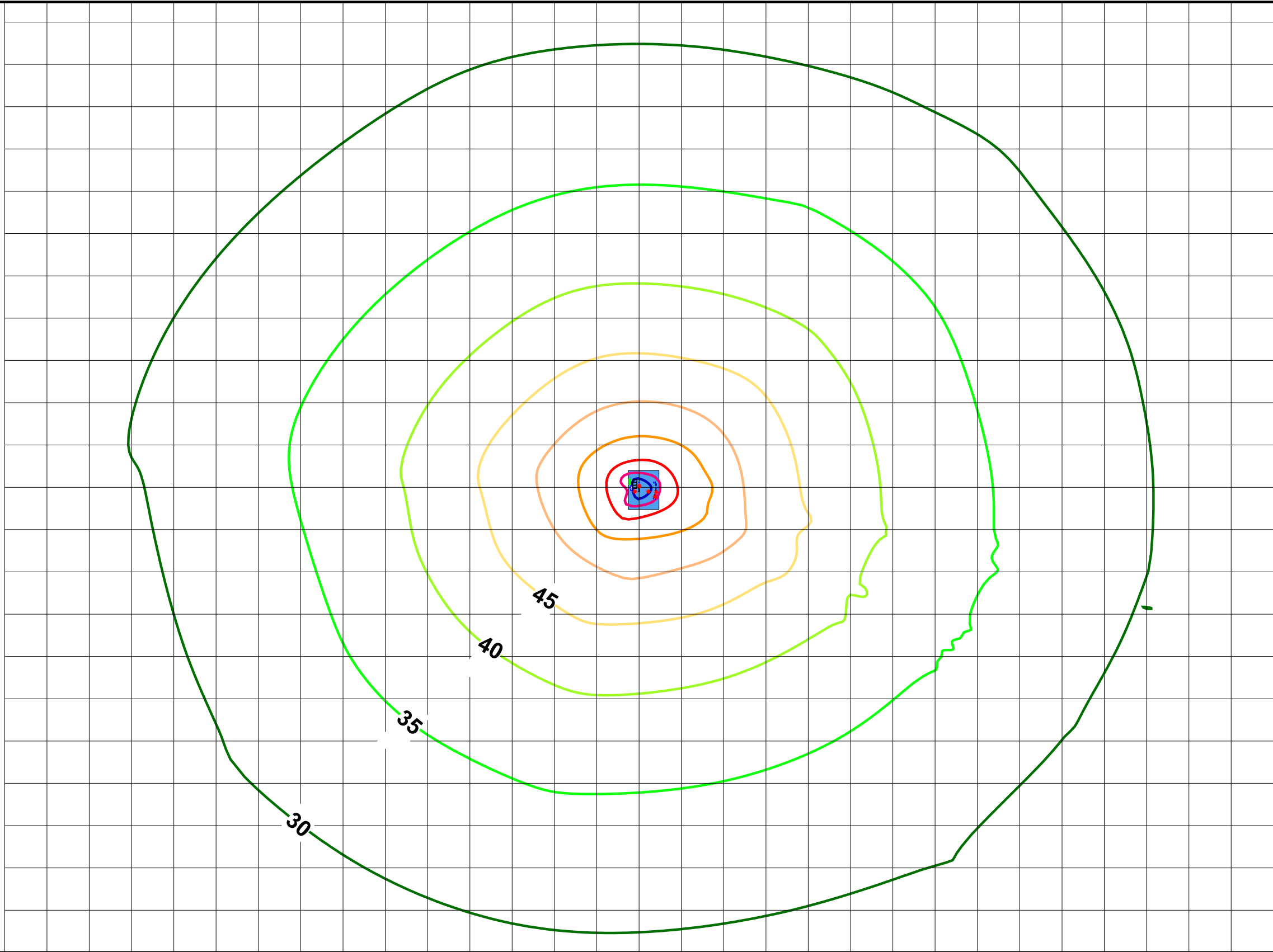
	Name	Date
Prepared	HM	17/04/09
Checked	MC	17/04/09
Authorised	MC	17/04/09

Appendix D Map 4

Predicted Noise Contours (LAeq)
Drill Rig Atlas 1
Drilling operation including the mud pump



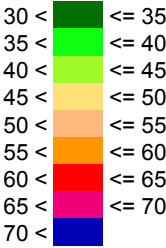
HEGGIES



Project specific intrusive noise criterion 30 dBA LAeq
5 dB penalty for low frequency noise has been applied.

Grid sections
100x100m

LAeq (dBA)

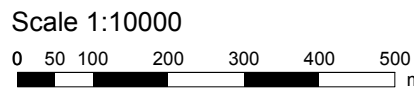


Legend

- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

Note:

Predictions at 1.5m above ground and assumes "Worst case" weather



20-2014-R3
SANTOS DRILL RIG
(LAeq) Noise Contours

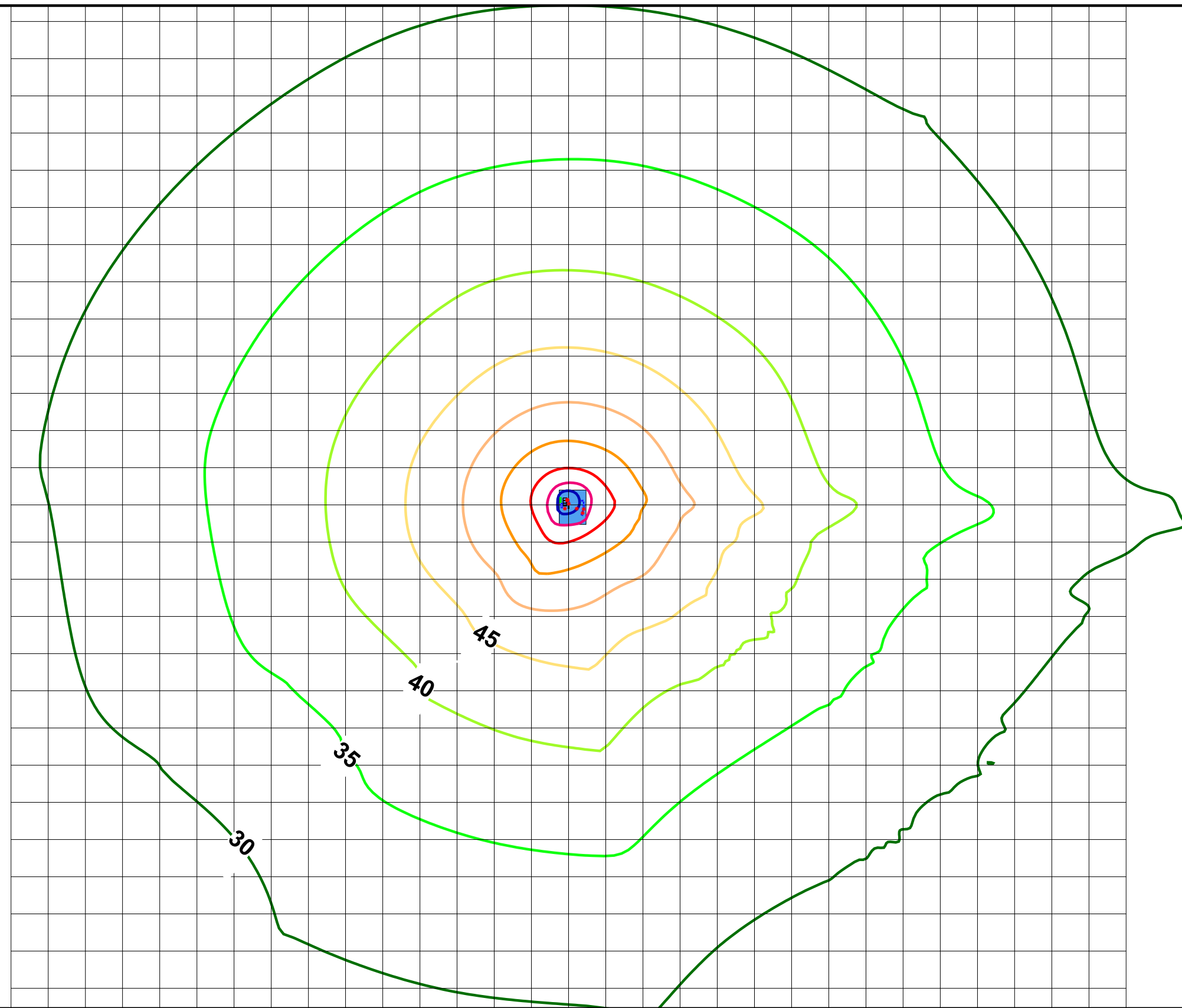
	Name	Date
Prepared	HM	16/04/09
Checked	MC	16/04/09
Authorised	MC	17/04/09

Appendix D
Map 5

Predicted Noise Contours (LAeq)
Drill Rig MDC 105
Core drilling operation



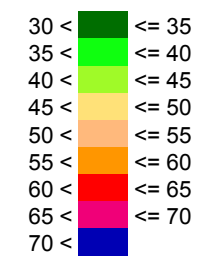
HEGGIES



Project specific intrusive noise criterion 35 dBA LAeq

Grid sections 100x100m

LAeq (dBA)

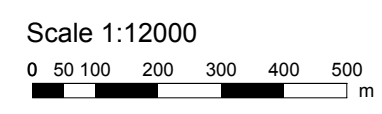


Legend

- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

Note:

Predictions at 1.5m above ground and assumes "Worst case" weather



20-2014-R3 SANTOS DRILL RIG (LAeq) Noise Contours

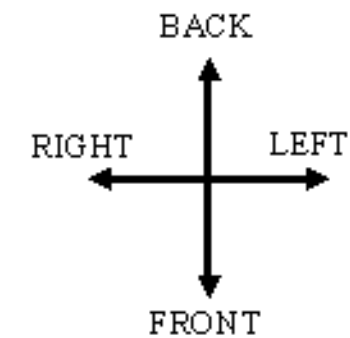
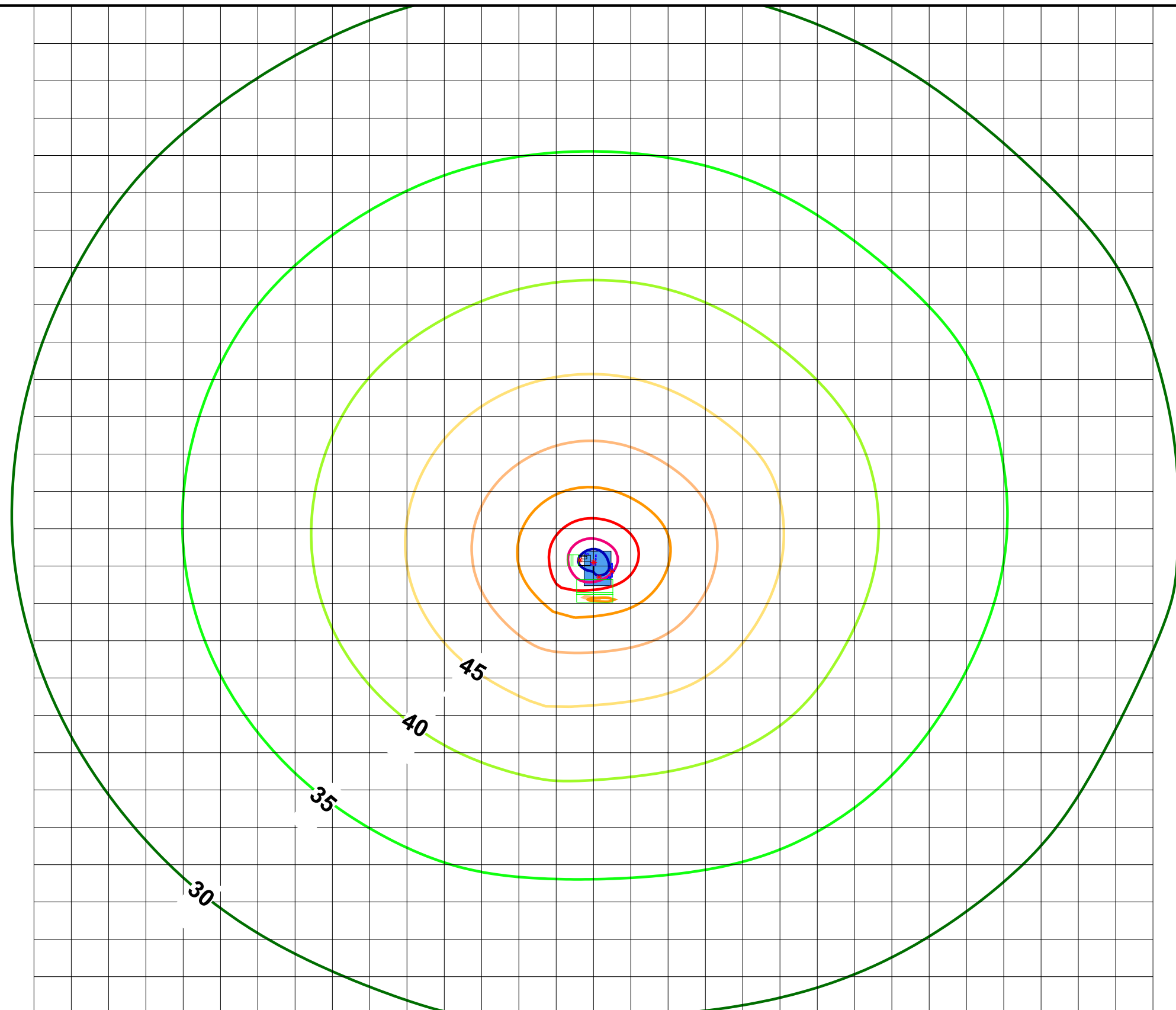
	Name	Date
Prepared	HM	16/04/09
Checked	MC	16/04/09
Authorised	MC	17/04/09

Appendix D Map 6

Predicted Noise Contours (LAeq)
Drill Rig MDC 105
Drilling operation including the mud pump



HEGGIES



Project specific intrusive
noise criterion 35 dBA LAeq

Grid sections
100x100m

LAeq (dBA)

30 <	<= 35
35 <	<= 40
40 <	<= 45
45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	<= 65
65 <	<= 70
70 <	

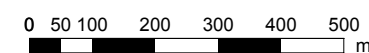
Legend

- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

Note:

Predictions at 1.5m above
ground and assumes
"Worst case" weather

Scale 1:12000



20-2014-R3 SANTOS DRILL RIG (LAeq) Noise Contours

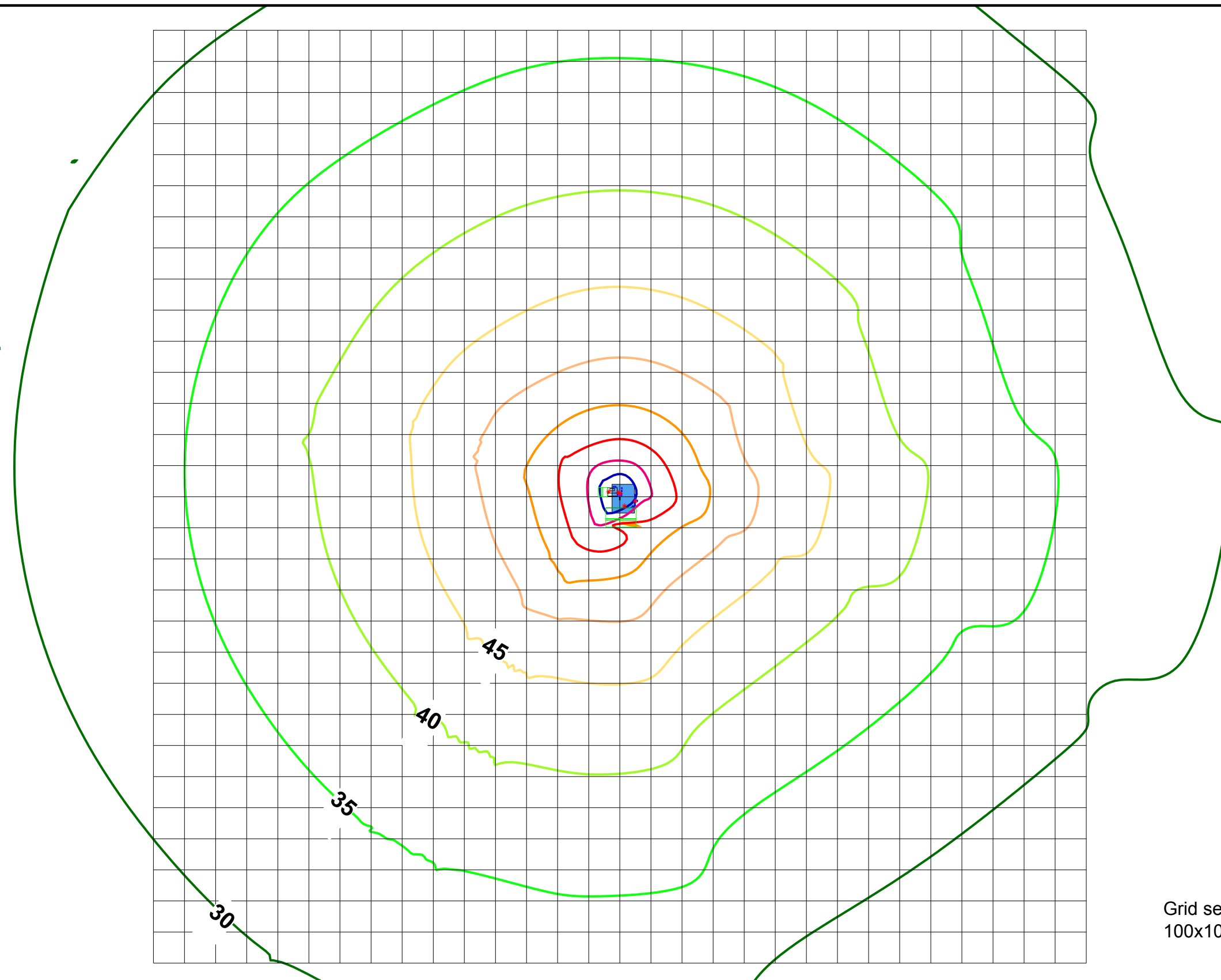
	Name	Date
Prepared	HM	17/04/09
Checked	MC	17/04/09
Authorised	MC	17/04/09

Appendix D Map 7

Predicted Noise Contours (LAeq)
Drill Rig Atlas 1
Core drilling operation



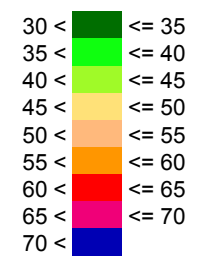
HEGGIES



Project specific intrusive
noise criterion 35 dBA LAeq

Grid sections
100x100m

LAeq (dBA)

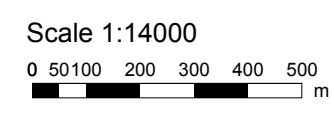


Legend

- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

Note:

Predictions at 1.5m above
ground and assumes
"Worst case" weather



20-2014-R3 SANTOS DRILL RIG (LAeq) Noise Contours

	Name	Date
Prepared	HM	17/04/09
Checked	MC	17/04/09
Authorised	MC	17/04/09

Appendix D Map 8

Predicted Noise Contours (LAeq)
Drill Rig Atlas 1
Drilling operation including the mud pump



HEGGIES

Appendix C

Aboriginal Heritage Due Diligence Report

prepared by RPS



Aboriginal Heritage Due Diligence Report

**Goran South I Core Hole
Lake Goran, NSW**

Prepared by:

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Report No: PR108963

Version/Date: Final October 2011

Document Status

Version	Purpose of Document	Orig	Review	Review Date	Format Review	Approval	Issue Date
<i>Draft A</i>	<i>Draft for Client Review</i>	<i>DF</i>	<i>DR</i>	<i>26.8.2011</i>	<i>BJ 26.8.11</i>	<i>DR</i>	<i>26.8.11</i>
<i>Final</i>	<i>Final Report</i>	<i>DF</i>	<i>GG</i>	<i>5.10.11</i>	<i>BJ 5.10.11</i>	<i>G Goode</i>	<i>5.10.11</i>

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Executive Summary

RPS has been engaged by Santos QNT Pty Limited to prepare an Aboriginal Heritage Due Diligence Report for Lake Goran. The purpose of a due diligence report is to demonstrate that reasonable and practicable measures were taken to prevent harm to Aboriginal objects or places.

The project area (Figure 1-1) is located near Lake Goran in the Gunnedah Local Government Area (LGA). It is located approximately 28 km south west of the town of Gunnedah, and comprises a privately owned field approximately 2.5 km north west of the high water mark of the ephemeral Lake Goran. It is proposed that a single core hole be drilled in the project area for the purposes of coal seam gas exploration.

As part of the due diligence investigation, RPS undertook a desktop review of the environmental and archaeological contexts of the project area, including an analysis of the landscape surrounding the project area, a review of prior archaeological investigations and a search of the Office of Environment and Heritage (OEH) Aboriginal Heritage Information Management Systems (AHIMS) database. That search showed a total of 19 previously recorded sites within 10km of the proposed core hole location. The most common site identified was scarred/modified trees.

A site inspection was also conducted. As a result of the desktop study and site inspection, it was concluded that there were no archaeological constraints to the drilling of the core hole. The following general recommendations were also made:

Recommendation 1

Vehicle access is to remain within existing tracks where possible in order to minimise potential impacts on surrounding vegetation and reduce erosion.

Recommendation 2

All relevant Santos QNT Pty Limited staff and subcontractors should be made aware of their statutory obligations for heritage under the *National Parks & Wildlife Act 1974* (NSW) and the *Heritage Act 1977* (NSW) which may be implemented as a heritage induction.

Recommendation 3

If Aboriginal site/s are identified in the project area during works, then all works in the area should cease, the area be cordoned off and contact made with OEH Enviroline 131 555, a suitably qualified archaeologist and the relevant Aboriginal stakeholders, so that it can be adequately assessed and managed.

Recommendation 4

In the event that skeletal remains are uncovered, work must cease immediately in that area and the proponent, Santos QNT Pty Limited, will need to contact the NSW Police Coroner to determine if the material is of Aboriginal origin. If determined to be Aboriginal, they must then contact OEH Enviroline 131 555 and relevant Aboriginal stakeholders in order to determine an action plan for the management of the skeletal remains prior to works re-commencing.

Recommendation 5

If during the course of development works, significant European cultural heritage material is uncovered, work should cease in that area immediately. OEH should be notified and works only recommence when an appropriate and approved management strategy instigated.

Terms & Abbreviations

Abbreviation	Meaning
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
DECCW	Department of Environment, Climate Change and Water
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
LALC	Local Aboriginal Land Council
LGA	Local Government Authority
NPW Act	<i>National Parks & Wildlife Act 1974</i>
NPWS	National Parks and Wildlife Service
OEH	Office of Environment & Heritage (NSW)

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Appendices

APPENDIX 1- ABORIGINAL HERITAGE DUE DILIGENCE REPORT

Legislative Requirements

APPENDIX 2 – ABORIGINAL HERITAGE DUE DILIGENCE REPORT

AHIMS Results

I Introduction

RPS has been engaged by Santos QNT Pty Limited to prepare an Aboriginal Heritage Due Diligence Report for the area surrounding a proposed core hole to be located near Lake Goran. The purpose of a due diligence report is to demonstrate that reasonable and practicable measures were taken to prevent harm to an Aboriginal object or place. This report has considered the relevant environmental and archaeological information, landforms, disturbances and the nature of the proposed activity in addition to formulating appropriate recommendations.

1.1 The Project Area

The project area is located near Lake Goran in the Gunnedah Local Government Area (LGA). It is located approximately 28 km south west of the town of Gunnedah, and comprises a privately owned field approximately 2.5 km north west of the high water mark of the ephemeral Lake Goran (Figure 1-1).

The field is currently utilised for grazing, and vegetation has been cleared. According to the current landowner, the block has also been used in the past for cropping.

1.2 Proposed Works

Santos QNT Pty Limited is a major Australian oil and gas exploration and production company, with interests both in Australia and overseas. It is the holder of Petroleum Exploration Licence 1 which covers the project area. It is proposed that a single core hole be drilled in the project area for the purposes of coal seam gas exploration, to be known as Goran South 1.

1.3 Legislative Context

The following overview of the legal framework is provided solely for information purposes for the client, it should not be interpreted as legal advice. RPS will not be liable for any actions taken by any person, body or group as a result of this general overview, and recommend that specific legal advice be obtained from a qualified legal practitioner prior to any action being taken as a result of the summary below.

Aboriginal heritage (places, sites and objects) within NSW are protected by the *National Parks and Wildlife Act 1974*. Although there are other Acts protecting and managing cultural heritage in New South Wales (see Appendix 1), the due diligence procedure is only available to projects applicable under this Act.

1.3.1 National Parks & Wildlife Act 1974

Aboriginal heritage (places, sites and objects) within NSW are protected by the *National Parks and Wildlife Act 1974*. Although there are other Acts protecting and managing

cultural heritage in New South Wales (see Appendix 1), the due diligence procedure is only available to projects applicable under this Act.

The NSW Government is working towards stand alone legislation to protect Aboriginal cultural heritage which will be a significant reform for NSW. The first stage of this work has been completed and includes significant changes to the primary state legislation relating to Aboriginal cultural heritage in NSW, the *National Parks and Wildlife Act 1974* (NPW Act). The legislation is now overseen by the Office of Environment and Heritage (OEH) (formerly DECCW) as part of the NSW Department of Premier and Cabinet.

Changes to the NPW Act were made effective on 1 October 2010 and include:

- increased penalties for Aboriginal heritage offences, in some cases from \$22,000 up to \$1.1 million in the case of companies who do not comply with the legislation;
- ensuring companies or individuals cannot claim 'no knowledge' in cases of serious harm to Aboriginal heritage places and objects by creating new strict liability offences under the Act;
- introducing remediation provisions to ensure people who illegally harm significant Aboriginal sites are forced to repair the damage, without need for a court order;
- unification of Aboriginal heritage permits into a single, more flexible permit; and
- strengthened offences around breaches of Aboriginal heritage permit conditions.

Along with new offences summarised above, there are new defences that have been introduced which will apply where a person harms an Aboriginal object without knowing what it was and without a permit from OEH. One of these defences is the 'due diligence' defence (s87(2)), which states that if a person or company has exercised due diligence to ascertain that no Aboriginal object was likely to be harmed as a result of the activities proposed for the site, then liability from prosecution under the NPW Act 1974 will be removed or mitigated if it transpires that an object was harmed. As a consequence of this provision, OEH released a publication entitled *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales 2010*. This publication sets out a minimum benchmark for acceptable due diligence investigations to be followed. These investigations include:

- the carrying out of a search of the Aboriginal Heritage Information Management System (AHIMS) database to ensure there are no registered sites within the project area;
- a review of previous archaeological investigations in the project area; and
- an assessment of the relevant landscape features and visual inspection to determine whether there are Aboriginal objects present within the project area or that they are likely.

One of the benefits of the due diligence provisions are that they provide a simplified process for investigating the Aboriginal archaeological context of an area without the need for an Aboriginal Heritage Impact Permit (AHIP). Aboriginal consultation is also not required for an investigation under due diligence. However, if the due diligence

investigation shows that the activities proposed for the area are likely to harm objects or likely objects within the landscape, then an AHIP will be required with full consultation.

Further details on the relevant legislative Acts are provided in Appendix 1.

1.4 Aboriginal Community Consultation

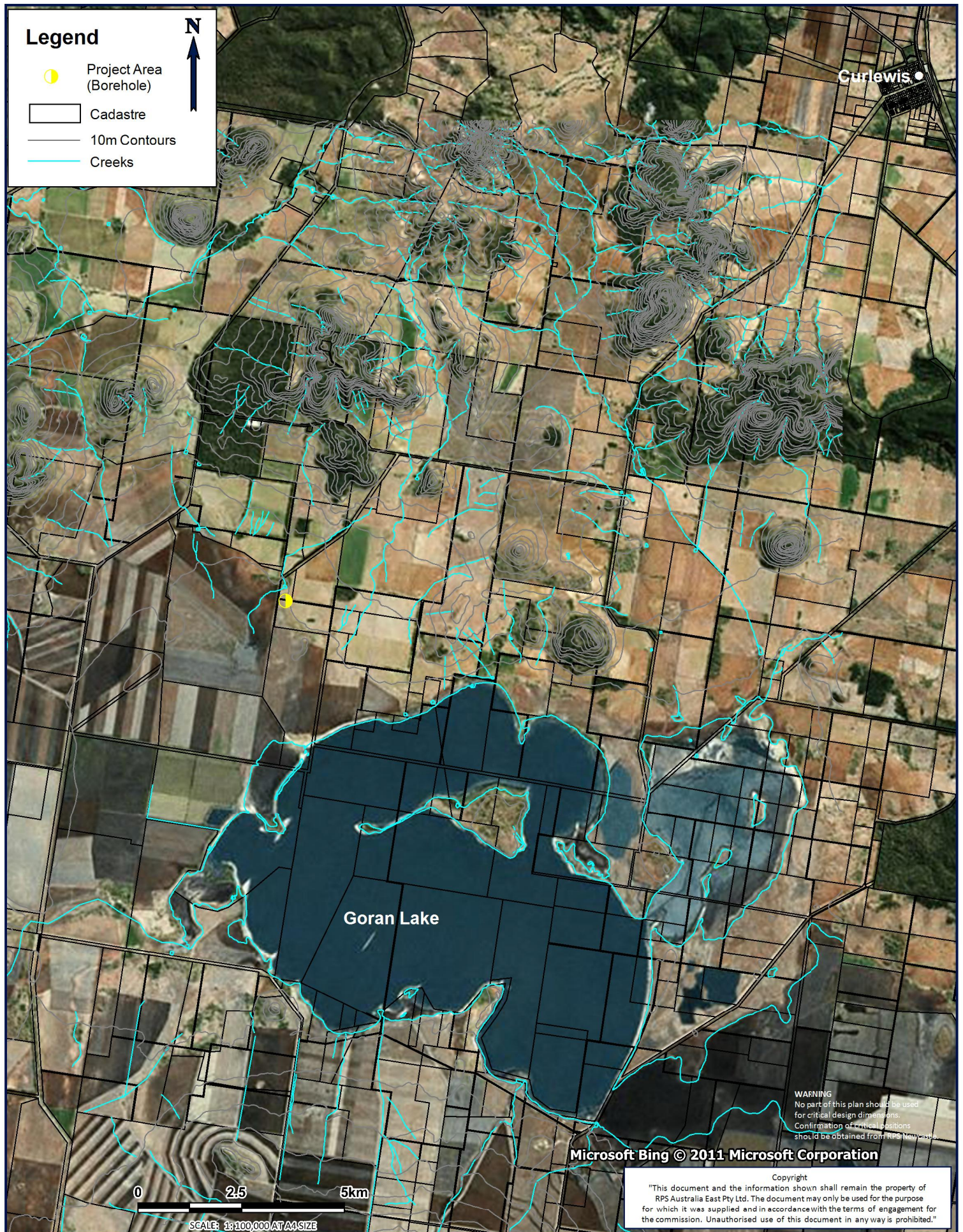
As mentioned above, due diligence inspection relates to the physical identification of Aboriginal objects. Community consultation is only required once Aboriginal objects have been detected and an AHIP is deemed necessary. Section 5.2 of the 2010 Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW specifically states that:

‘Consultation with the Aboriginal community is not a formal requirement of the due diligence process’ (2010:3)

Further details on the relevant legislative Acts are provided in Appendix 1.

1.5 Authorship and Acknowledgements

This report was prepared by Deborah Farina, Archaeologist, with assistance from Ali Byrne, Graduate Archaeologist and reviewed by Gillian Goode, Senior Archaeologist, all of RPS.



TITLE: FIGURE 1-1: PROJECT AREA

LOCATION: GORAN LAKE

DATUM: N/A
PROJECTION: MGA ZONE 56(GDA 94)

DATE: 12/8/2011
PURPOSE: REF

LAYOUT REF: J:\JOBS\108K\108963 Goran South REF\Drafting\Archaeology\MapInfo Workspaces
VERSION (PLAN BY): A A4 (DF-NW)

CLIENT: SANTOS LIMITED
JOB REF: 108963

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2 Environmental and Heritage Context

Aboriginal heritage due diligence requires that available knowledge and information is considered. The purpose of reviewing the relevant environmental and heritage information is to assist in identifying whether Aboriginal sites or places are present within the project area.

2.1 Local Environment

An understanding of environmental context is important for the predictive modelling of Aboriginal sites, as well as, for their interpretation. The local environment provided natural resources for Aboriginal people, such as, stone (for manufacturing stone tools), food and medicines, wood and bark (for implements such as shields, spears, canoes, bowls, shelters, amongst others), as well as, areas for camping and other activities. The nature of Aboriginal occupation and resource procurement is related to the local environment and it therefore needs to be considered as part of the cultural heritage assessment process.

2.2 Geology and soils

The project area is located within the Gunnedah Basin, which extends from Belatta in the north (approximately 40 km north of Narrabri) to the Liverpool Ranges in the south. The Gunnedah basin was formed in the late Carboniferous to early Permian and covers an area of 15,000 km².

The dominant geology of the project area is quaternary alluvium which is common in areas of inundation (Banks 1995:3). It chiefly comprises clay, silt, sand and gravel. There are also small areas of basalt and dolerite which form part of the Jurassic Garrawilla Volcanics. The Triassic Digby Beds of the Narrabeen Group include the Digby Conglomerate comprising two formations, one predominantly quartzose and quartz lithic sandstone, silty sandstone and mudstone, and the other made up of polymictic conglomerate, lithic and quartz lithic sandstone and mudstone.

The soils of the Liverpool Plains area are rich, alluvial soils. They are thought to be one of the most productive and resilient soils in the country, as evidenced by the extensive agricultural industries dominating land use in the region. There are four major soil landscapes within the vicinity of the project area: the Booloocooroo, Leslie's Road, Lake Goran and Lochaber.

The project area is predominantly within the Booloocooroo soil landscape, comprising very deep (>150cm) red-brown Earths, Red Earths, Red Podzolic soils, Black Duplex soils and Brown Clays. The A₁ horizon is a hardsetting, dark-brown clay loam fine sandy soil, through to a massive bright brown silty clay B horizon. Both are moderately permeable, hardsetting and earthy (Banks 1995:85).

The Leslie's Road soil landscape is located adjacent to the project area and is described as predominantly grey clays with black earths and brown clays. It is chiefly found in the Goran Basin and Mullaley Hills. Due to periodic waterlogging it is a water erosion and salinity hazard, with low wet-bearing strength (Banks 1995:97).

The other two soil landscapes, Goran Lake and Lochaber, occur nearby in small concentrations. Goran Lake is a lacustrine landscape, with associated lunettes and beaches which form undulating to rolling rises on the lake margins. The grey clay soils are predominantly very deep (>300cm) with a probable depth of Quaternary alluvium across the lake of 40m to >100m. Lochaber is described as an aeolian landscape of moderately deep (<100cm) grey clays, with moderately deep black earths occurring on the youngest lunettes and brown clays occurring in patches across the landscape (Banks 1995:148, 157).

2.3 Topography and hydrology

The project area is situated on the Liverpool Plains in north western New South Wales. The Breeza topographic map (89352N) shows the project area to be on flat to gently undulating land, within 1.5km of the high water mark of Lake Goran. Slopes are generally 0-3% with local relief at <3m.

The closest water source is Lake Goran, a natural ephemeral lake with its high water mark located approximately 2.5 km to the south east of the proposed core hole. Other nearby permanent water courses include the Mooki River, located approximately 15km to the east and Cox's Creek approximately 33 km to the west. The Namoi River is slightly north of Gunnedah, approximately 30 km to the north and a series of creeks and gullies are located approximately 15 km to the south.

Flooding is therefore an issue for much of the Gunnedah Shire, particularly at times when water levels of both the Namoi and Mooki Rivers are high. Flooding is irregular, with floods having been recorded in every month of the year. More severe floods have been recorded in the months of January, February, June and July, which also appears to coincide with the hottest and coldest months in the year (Shire of Gunnedah 2009:6).

2.4 Flora and fauna

Vegetation in the vicinity of the project area is currently cleared grassland, chiefly used for agricultural purposes. However, in its natural state the Gunnedah area is likely to have comprised dry sclerophyll forests and tall or savannah Woodland, containing species such as *Eucalyptus albens* (white box), *E. populnea* (bimble box), *E. camaldulensis* (river red gum), *E. pilligaensis* (pilliga box), *Acacia pendula* (myall), *Geijera parviflora* (wilga), *Angaphora floribunda* (rough-barked apple), *Heterodendron oleifolium* (rosewood) and *Casuarina cristata* (belah)(Banks 1995:84).

These vegetation communities often supported extensive faunal resources such as koala, kangaroo (red and grey), dingoes, possums, echidna, as well as a variety of birds, lizards

and bats (O'Rourke 2005:30-32). Indeed, due to its visible and relatively high koala population, Gunnedah promotes itself as the "Koala Capital of the World" (Shire of Gunnedah 2009:2).

The threatened species list for the Gunnedah area lists 71 species of flora and fauna considered as vulnerable or endangered. Most of the threatened species on the list are birds, possibly due to the large-scale clearance of vegetation from agriculture and mining (Department of Environment and Climate Change undated).

2.5 Climate

The climate in the Gunnedah area is within the mild temperate climate zone, characterised by warm, wet summers and cool to cold dry winters. The warmest months are December to February, with January recording the highest average maximum temperate at 31.9°C. The coolest months are June and July, with July recording the lowest average minimum temperate at 4.7°C (BOM, 2011).

Rainfall is highest during the summer months, with January recording the highest average monthly rainfall at 84.9 mm. July records the lowest average monthly rainfall at 35.8 mm.

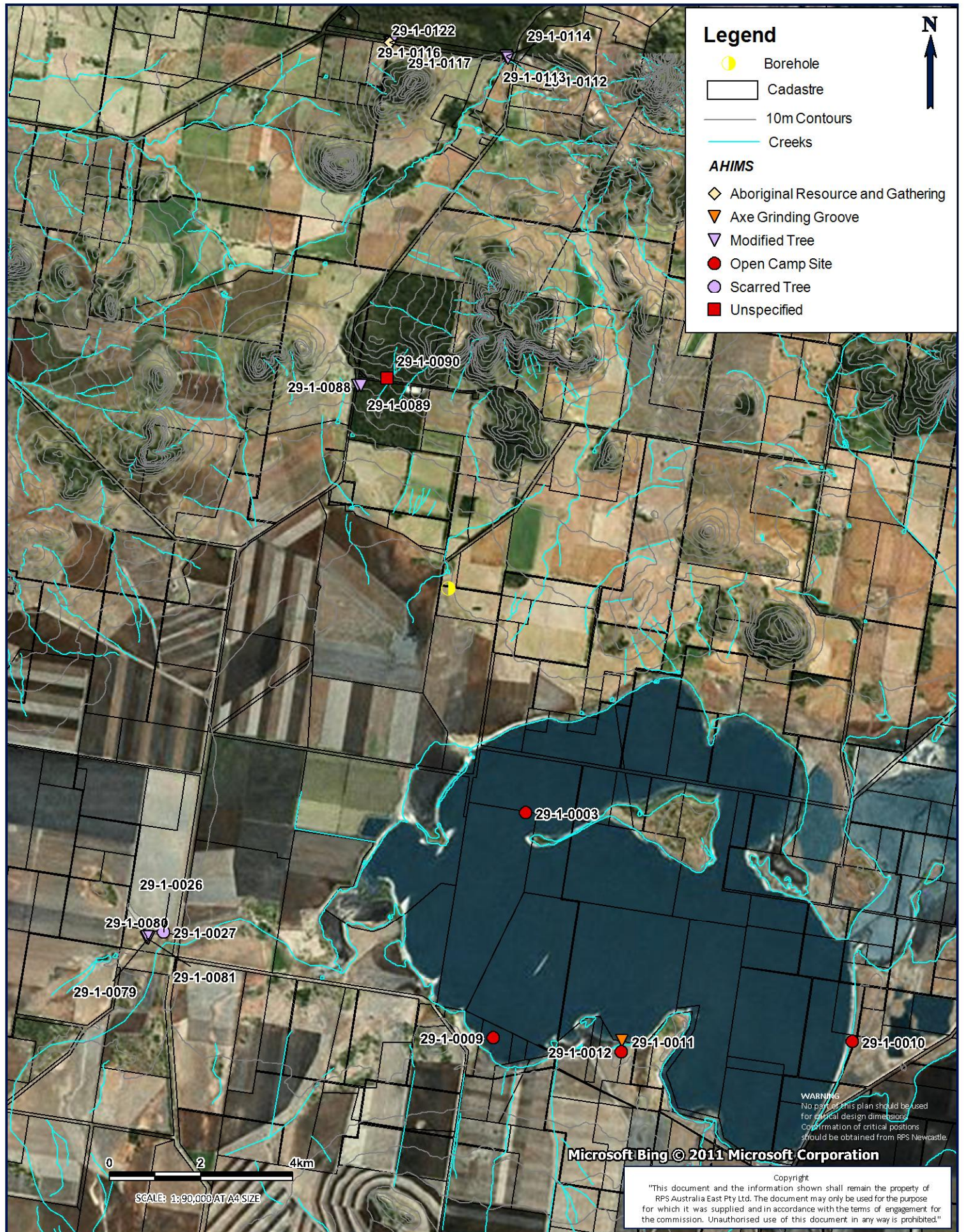
2.6 Aboriginal Heritage Information Management System (AHIMS)

A search was undertaken on 10 August 2011 of the OEH Aboriginal Heritage Information Management System (AHIMS) (Table 2-1 and Figure 2-1). The search results indicated that there are 19 previously recorded Aboriginal sites within a 10 km radius of the project area.

Table 2-1: Summary of AHIMS Results

Site Type	Frequency	Percent
Modified/scarred trees	12	63.16%
Artefact scatter	5	26.32%
Axe grinding groove	1	5.26%
Aboriginal resource & gathering	1	5.26%
TOTAL	19	100.00%

As can be seen from Table 2-1, modified/scarred trees are the dominant site type within the vicinity of the project area, followed by artefact scatters and smaller quantities of axe grinding grooves and Aboriginal resource & gathering sites. The density of artefacts in the scatters is small, with three being the highest number recorded at any one site (see Appendix 2). Very few of these sites are located within the vicinity of the project area. An earlier AHIMS search of a 2km radius of the core hole site showed that there were no sites located within this distance, and only four sites were identified in a 4km radius search.



TITLE: FIGURE 2-1: PROJECT AREA WITH AHIMS

LOCATION: GORAN LAKE

DATUM: N/A
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 12/8/2011
PURPOSE: REF

LAYOUT REF: J:\JOBS\1081\108963 Goran South REF\Drafting\Archaeology\MapInfo Workspaces
VERSION (PLAN BY): A4 (DF-NW)

CLIENT: SANTOS LIMITED
JOB REF: 108963

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2.7 Historic Records of Aboriginal occupation

It is important to acknowledge that early historical documents were produced for a number of reasons and thus may contain inaccuracies and/or bias in their reporting of events or other aspects of Aboriginal culture (L'Oste Brown 1998). Nonetheless, some historical documents provide important information and insights into local Aboriginal customs and material culture at the time of non-Indigenous settlement and occupation of region. For example, in the late 19th century, Police Sgt P J Ewing of Gunnedah recorded the memoirs of “Old” Joe Bungaree, an Aboriginal living in Gunnedah at the time. The “Ewing papers” offer a valuable insight to the life of one of the Kamilaroi’s greatest leaders, known as “Red Kangaroo”, as well as pre contact information regarding the Kamilaroi (O'Rourke 2005).

2.7.1 Pre contact

The Gunnedah area was home to the Kamilaroi/Gamilaraay people, whose country included land around the Barwon, Gwydir and Namoi Rivers. Their country extended to the Great Dividing Range in the east, west to Walgett, north to Nindigully, Queensland and south to the Goulburn River north of Mudgee (Tindale 1974).

It is estimated that there were approximately 10,000 Kamilaroi-speaking people in the region prior to European contact (O'Rourke 2005:34). The population would have been made up of approximately 50-60 smaller groups, who would also have been made up of even smaller familial groups or clans. By 1851, the Aboriginal population across the Liverpool Plain estimated by the Aborigines Commission Report as “about 1,000” (O'Rourke 2005:83).

Ethnographic data provided by “Old” Joe Bungaree state men were dressed in “girdles” made of woven animal hair and carried tools with them, either for hunting or for war. These included spears, woomeras, shields, boomerangs, waddies, nulla-nullas and tomahawks. Women carried yam sticks, hardwood sticks approximately 1.5m long, used to dig for roots and tubers. They would also carry large woven bags called “game packs” and small plaited bags known as “dilly bags”. The dilly bag contained small necessities, such as needles of fish bone, kangaroo or emu bone, wood, sewing threads of hair, bark, animal sinew, tying cords of animal hide, flint knives, tinder, clay balls (wetted for dressing wounds) and grinding stones (O'Rourke 2005:114-115).

Kamilaroi names were generally tripartite, with one being a “section” name, one a matri-clan or totem name, and a personal name. For example, the hero warrior “Red Kangaroo” was partially named in Kamilaroi *Gambu Gannuuru* – *Gambu* being his section name, inherited from his maternal grandmother, *Gannuuru* meaning “red kangaroo” being his totem name inherited from his mother and his personal name which is now lost, but would have been acquired or ascribed to him when he was a baby. His kin, both actual and assigned, would likely have called him “brother”, “uncle” or “cousin”, whilst others outside of his kin would have refer to him neutrally as “Gambu” or “Gannuuru” (O'Rourke 2005:115-116).

Gambu Gannuuru (*Red Kangaroo* in English) was one of the great warriors of the Gunnedah people. He was variously referred to as a “chief”, a “war chief” or “head man”. It is believed he lived before the time of the “great flood”, which was thought to have occurred around 1750. He was described as being exceptionally tall and broad, with a loud, booming voice. Shortly after being initiated when he was around 15 or 16 years old, he killed two Narrabri raiders. At the age of 17, he led a raiding party to Coonabarabran and captured two wives named Naroo and Nareen. He became a leader at around the age of 19 after fighting the existing leader to the death, killing him with a special “V” shaped shield. As well as being a fierce warrior, he was a strong dancer, being described whilst a teenager as “the strongest dancer and the most active of all” (O’Rourke, 2005:154).

In his prime, Gambu Gannuuru is said to have led wars against the Barraba-Bingara (the “Walleri or Gwydir blacks”), Bundarra, Coonabarabran, Goonoo Goonoo, Kingstown, Manilla, Narrabri, Quirindi, Terry Hie Hie and Walgett groups. However, by the time he was 40, he had negotiated peace with the Goonoo Goonoo and Manilla people, combining the forces to defeat the Kingstown-Bundarra people. Gambu Gannuuru defeated the Kingstown-Bundarra leader, Kibbi, with a spear (O’Rourke, 2005:155).

The Gunnedah people enjoyed an era of strength and prosperity at this time, with Gambu Gannuuru even leading the combined groups on a raid to New England. He is said to have died approximately “twenty moons before the great flood”, which has been estimated at around 1745 (O’Rourke, 2005:155). He was said to have been buried in a seated position under a mound, with a carved tree marking his grave, near the present day Abbott Street, Gunnedah (O’Rourke, 2005).

2.7.2 Post contact

It is thought that the area was named “Gunnedah” from the Kamilaroi meaning “place of white stones”. “Old” Joe Bungaree, one of the last full-blooded Kamilaroi men in the Gunnedah area, said that it was so named because of the white stones that were found in the soil in the area. A cattle station run by the employees of Jack Johnson was named Gunnedah in around 1835, and the area around it became known as such between then and 1848. A township grew around a place called “Johnson’s Woolshed”, but its post office was not named “Gunnedah” until 1859 (O’Rourke 2005:42) (Oxley 1820).

John Oxley in 1818 was the first European to explore the Liverpool Plains. He named the area the “Liverpool Plains” after Lord Liverpool, describing it as “beautiful and fertile”. Oxley notes that three native fires were observed, stating that the Liverpool Plains generally appeared to be “thinly inhabited” (Oxley 1820).

European settlers began arriving in the area in the 1830s. Initially, relations between the Kamilaroi and Europeans were cordial. However, competition for resources and lack of communication between the two groups led to conflict on both sides. As most pastoral runs were situated on watercourses, Aboriginal groups gradually moved from traditional watering places. Cattle were often speared in retaliation and additional conflicts arose

when male relatives sought revenge for their wives being “borrowed” by the colonists which resulted in ongoing clashes between pastoralists and the Aboriginal groups (O'Rourke 2005:61).

It was considered that the real decimation of the Kamilaroi was caused by disease, in particular, smallpox, tuberculosis, measles and influenza. Other effects of disease included malnutrition and low birth rates due to alcoholism and venereal diseases. In 1789 a smallpox epidemic swept through the colony and is thought to have claimed the lives of at least a third of the Aboriginal population of New South Wales. In 1830-31, another smallpox outbreak was noted in the Namoi Valley killing many Kamilaroi, including the leader of the Boggabri people (O'Rourke 2005:67).

A mound was excavated towards the end of the 19th Century that may have been the grave of Gambu Gunnuuru and the area was known locally to be an Aboriginal burial ground.

According to recent census data, there are 978 (7.6%) Aboriginal people living in the Gunnedah Shire. Approximately half are resident in Gunnedah town, and the remainder in other parts of the shire. One village in the south of the Shire, Walhollow, is an Aboriginal community settlement with an established school, shop, administrative office and health clinic (Shire of Gunnedah 2009:18).

2.8 Regional Archaeological Literature Review

Griffiths, T (1993). An Investigation of Fibre Optic Cable Route from Wandoba Exchange to Red Bob's Exchange, South of Gunnedah

This investigation was conducted on behalf of Telecom Australia ahead of the proposed installation of fibre optic cable between the Wandoba Exchange and Red Bob's exchange, a distance of approximately 12 km, and approximately 5 km to the west of Lake Goran. Portions of that survey lie to the immediate west of the current project area.

The survey transects generally followed road easements of Wandoba Road, and Red Bob's Road. Some of the route crossed ploughed fields. Ground visibility was described as very good.

A total of four sites along the Red Bob's Road transect were identified. The sites were all scarred trees and all of the scars were consistent with those made for coolamons. Three of the trees were yellow box, whilst one was a grey gum. All four were identified within 30m of the easement. Scarred trees 1 and 2 were designated “Probable” scarred trees, whilst scarred trees 3 and 4 were designated “Definite”.

As all of the trees were outside of the impact zone for the cable route, no further action was recommended. All trees were marked with orange tape to facilitate identification of the trees during the installation of the fibre optic cable. It was recommended that the sites be monitored during installation to ensure the trees would not be damaged.

Archaeological Surveys & Reports Pty Ltd (2007). Aboriginal Heritage Assessment – Sunnyside Coal Project, via Gunnedah.

This investigation was conducted on behalf of the Namoi Mining Pty Limited, ahead of a proposed mining program at the “Sunnyside” property, approximately 15 km west of Gunnedah. The project entailed the construction of a coal transport route through several properties to the Oxley Highway. The scope of works included identifying any constraints to an open cut mining facility. The study area totalled approximately 231 hectares.

A pedestrian survey was conducted in conjunction with representatives of local Aboriginal groups by walking transects across the project area. It was observed that the northern floodplain area was under new pasture inhibiting visibility; consequently it was decided to inspect the edges of the pasture where some exposure still existed. A total of four sites were identified, comprising an axe grinding groove, two isolated finds and an artefact scatter. The sites were identified on the slopes, saddle and ridge of the hills within the study area. It was concluded that the predictive model supported the outcomes of the survey.

All of the sites fell outside of the impact zone of the proposed works. However, it was recommended that as the axe grinding groove may still be indirectly impacted by mining activities, either by fly rock (from blasting) or vibration, that in addition to protecting the surface of the axe grinding grooves with hay bales, that a geotechnical expert be consulted to investigate the potential for damage to the grooves by any blasting.

RPS (2010). Cultural Heritage Survey and Assessment: Rocglen Mine Extension Project

This investigation was conducted on behalf of Whitehaven Coal Ltd ahead of a proposed extension of the Rocglen Mine. The project area comprised 460ha, and was located approximately 25km north of Gunnedah. The investigation consisted of indigenous and European heritage.

A pedestrian survey was conducted in conjunction with representatives of local Aboriginal groups by walking transects across the project area. A total of three sites were identified as a result of the survey, being an isolated find and two artefact scatters. Of the artefact scatters, one contained three flaked pieces of mudstone, chert and grey silcrete, whilst the other scatter contained two flaked pieces of greenstone and chert. The isolated find was a chalcedony flake with a banded quartz vein. Both artefact scatters were considered to be in a highly disturbed context and were not *in situ*. As such it was recommended that archaeological excavations not take place at these sites although one of the Aboriginal community groups recommended that subsurface investigations be undertaken. It was noted that the isolated find was located at the base of a tree, and it was acknowledged that the artefact may have been pushed to the surface by the tree roots.

No European heritage items were identified. In addition, it was noted that a survey by Appleton in 2007 of an adjacent block identified two scarred trees that were relatively undisturbed and in good condition. No scarred trees were observed during this survey.

It was concluded from previous environmental and archaeological investigations together with the survey results that the area had been used for camping and resource gathering.

2.9 Synthesis of Environmental and Archaeological Context

A review of the environmental context indicated that the project area would probably have been a suitable place for habitation by Aboriginal groups. The rich soil would likely have allowed diverse plant and animal life, there were abundant water supplies and source rocks of mudstone and basalt would have been suitable raw materials for the manufacture of stone tools used to harness and exploit those resources.

However, this is not borne out by the relatively low number of registered sites within the vicinity of the project area. This apparent bias may be explained by the destructive nature of the agricultural pursuits dominating the landscape since European contact, or it may simply be a case of limited archaeological investigations having been conducted in the area. However, it could also be that other areas nearby were more favourable habitation sites, with the area in the vicinity of the project area limited to short-term or transitory habitation.

A review of previous archaeological investigations shows a consistency between the sites identified regionally and those identified locally. Scarred trees are the dominant site type in both cases. However, potential for carved or scarred trees will depend on the retention of suitable mature age trees in a disturbed landscape. Previous land clearing associated with the surrounding developments and the varied effects of erosion and vegetation growth could have displaced these and other site types. In addition, these factors may have affected site integrity and reduced the possibility for *in situ* cultural material to be identified or located.

3 Site Visit and Field Results

The site visit was undertaken to comply with due diligence requirement that a visual inspection of the project area is conducted. The results of the site visit are reported below.

3.1 Field Results

There have been two archaeological due diligence inspections that have taken place for this project. The first took place in clear sunny conditions on Friday August 5th, 2011 by Darrell Rigby, Cultural Heritage Manager, RPS, and the second on Tuesday 23 August 2011 by Deborah Farina, Archaeologist for RPS. The second site visit was in response to the proposed relocation of the core hole (such proposal was later abandoned).

Access to the site is along existing farm tracks and crossing through several gate ways. No vegetation needs to be removed along the access tracks. The nearest permanent water source is at Red Bob's Gully which is approximately six kilometres distant.

Goran South 1 presents as a single flat landscape unit with no discernable features (Plate 1). All vegetation has been cleared, consistent with agricultural use of the locality and the proposed core hole location is best described as a cleared open paddock, surrounded by other cleared open paddocks (Plate 2). Some native grasses are apparent offering a sparse coverage of the ground surface. Consequently ground visibility was excellent for visual identification of potential Aboriginal material. Whilst exposures may have represented 5-10% of the overall location, visibility was excellent at better than 70%.

Previous disturbance had occurred in the vicinity of the proposed Goran South 1 core hole in the form of a dam and drainage culvert immediately to the south south west (Plate 3). The dam and its environs were investigated for signs of Aboriginal cultural material, but none was found. There is evidence of sporadic occurrences of jasper and quartzite cobbles of varying size (5-10cm) across the project area, (2-3 per 5m²) all of which were heavily flawed and considered unsuitable as a knapping source (Plate 5). Evidence of previous ploughing was apparent from remnant furrows in the paddock at varying intervals.

3.2 Conclusion of Field Results

Given that there were no mature trees, no stone outcropping, no overhangs or rocky shelters, no sandstone nor any other discernible landform feature or environmental resource suitable for Aboriginal exploitation or occupation, it is highly unlikely that the proposed core hole at Goran South 1 would impact on or harm Aboriginal cultural heritage or material items. The archaeological field survey identified no Aboriginal material at risk of impact from the proposed works.

An area exceeding the core hole footprint was assessed for the purposes of due diligence and included areas likely to undergo modification during drilling works, proposed access routes to the drill locations and turning circles for vehicles.

The proposed core hole was not situated close to known cultural heritage sites. There was no evidence of any Aboriginal artefacts at the core hole location or along the proposed core hole access track; therefore it is considered that there is no impediment for work for the proposed drilling programme to proceed at the proposed core hole locations investigated in this report.

The proposed core hole was positioned in a highly modified landform. As such, any core hole works undertaken in this location meets the low impact activity criteria under the (National Parks and Wildlife Service NSW 2009) and described in Section 7.5 of the *NSW DECCW 2010 Due Diligence Code of Practice for the protection of Aboriginal Objects in NSW*.

No Aboriginal or European Cultural Heritage sites were identified at the core hole location inspected during the course of the archaeological survey. As such no archaeological constraints apply to the proposed drilling within the bounds of the drilling footprint at the core hole location.

4 Conclusions and Recommendations

This report has considered the available environmental and archaeological information for the project area, the land condition, as well as, the nature of the proposed activities. The following management recommendations have been formulated with consideration to all available information.

Recommendation 1

Vehicle access is to remain within existing tracks where possible in order to minimise potential impacts on surrounding vegetation and reduce erosion.

Recommendation 2

All relevant Santos QNT Pty Limited staff and subcontractors should be made aware of their statutory obligations for heritage under the *National Parks & Wildlife Act 1974* (NSW) and the *Heritage Act 1977* (NSW) which may be implemented as a heritage induction.

Recommendation 3

If Aboriginal site/s are identified in the project area during works, then all works in the area should cease, the area be cordoned off and contact made with OEH Enviroline 131 555, a suitably qualified archaeologist and the relevant Aboriginal stakeholders, so that it can be adequately assessed and managed.

Recommendation 4

In the event that skeletal remains are uncovered, work must cease immediately in that area and the proponent, Santos QNT Pty Limited, will need to contact the NSW Police Coroner to determine if the material is of Aboriginal origin. If determined to be Aboriginal, they must then contact OEH Enviroline 131 555 and relevant Aboriginal stakeholders in order to determine an action plan for the management of the skeletal remains prior to works re-commencing.

Recommendation 5

If, during the course of development works, significant European cultural heritage material is uncovered, work should cease in that area immediately. OEH should be notified and works only recommence when an appropriate and approved management strategy instigated.

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6 Plates



Plate 1: Core hole location, looking west (western site limit marked by tree in upper right of frame)



Plate 2: Project area, looking south west



Plate 3: Project area, looking north



Plate 4: Project area, looking south-east



Plate 5: Examples of pebbles located in topsoil



Plate 6: Peg marking core hole location at centre of project area



Plate 7: Core hole location

Appendix I - Aboriginal Heritage Due Diligence Report

Legislative Requirements

Summary of Statutory Controls

The following overview of the legal framework is provided solely for information purposes for the client, it should not be interpreted as legal advice. RPS will not be liable for any actions taken by any person, body or group as a result of this general overview, and recommend that specific legal advice be obtained from a qualified legal practitioner prior to any action being taken as a result of the summary below.

COMMONWEALTH

Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (ATSIHIP Act Amendment 2006)

The purpose of this Act is to preserve and protect all heritage places of particular significance to Aboriginal and Torres Strait Islander people. This Act applies to all sites and objects across Australia and in Australian waters (s4).

It would appear that the intention of this Act is to provide national baseline protection for Aboriginal places and objects where State legislation is absent. It is not to exclude or limit State laws (s7(1)). Should State legislation cover a matter already covered in the Commonwealth legislation, and a person contravenes that matter, that person may be prosecuted under either Act, but not both (s7(3)).

The Act provides for the preservation and protection of all Aboriginal objects and places from injury and/or desecration. A place is construed to be injured or desecrated if it is not treated consistently with the manner of Aboriginal tradition or is or likely to be adversely affected (s3).

Australian Heritage Commission Act 1975

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 those places. Places maintained in the register are those which are significant in terms of their association with particular community or social groups and they may be included for social, cultural or spiritual reasons. The Act does not include specific protective clauses.

The Australian Heritage Council Act (2003) together with *The Environment Protection and Biodiversity Conservation Act (1999, amended)* includes a National Heritage List of places of National heritage significance, maintains a Commonwealth Heritage List of heritage places owned or managed by the Commonwealth and ongoing management of the Register of the National Estate.

STATE

It is incumbent on any land manager to adhere to state legislative requirements that protect Aboriginal Cultural heritage. The relevant legislation in NSW includes but is not limited to the summary below.

National Parks and Wildlife Act 1974 (NPW ACT)

The NPW Act provides statutory protection for all Aboriginal heritage, places and objects (not being a handicraft made for sale), with penalties levied for breaches of the Act. This legislation is overseen by the Office of Environment and Heritage (OEH), and specifically the Director-General of OEH. Part 6 of this Act is the relevant part concerned with Aboriginal objects and places, with Section 86 and Section 90 being the most pertinent. In 2010, this Act was substantially amended, particularly with respect to Aboriginal cultural heritage requirements. Relevant sections include:

Section 86

This section now lists four major offences:

- (1) A person must not harm an object that the person knows is an Aboriginal object;
- (2) A person must not harm an Aboriginal object;
- (3) For the purposes of s86, “circumstances of aggravation” include:
 - (a) The offence being committed during the course of a commercial activity; or
 - (b) That the offence was the second or subsequent offence committed by the person;
- (4) A person must not harm or desecrate an Aboriginal place.

Offences under s86 (2) and (4) are now strict liability offences, ie, knowledge that the object or place harmed was an Aboriginal object or place needs to be proven. Penalties for all offences under Part 6 of this Act have also been substantially increased, depending on the nature and severity of the offence.

Section 87

This section now provides defences to the offences of s86. These offences chiefly consist of having an appropriate Aboriginal Heritage Impact Permit (AHIP), not contravening the conditions of the AHIP or demonstrating that due diligence was exercised prior to the alleged offence.

Section 87A & 87B

These sections provide exemptions from the operation of s86; Section 87A for authorities such as the Rural Fire Service, State Emergency Services and officers of the National Parks & Wildlife Service in the performance of their duties, and s87B for Aboriginal people performing traditional activities.

Section 89A

If a person knows of the location of an Aboriginal object or place that has not been previously registered and does not advise the Director-General of that object or place within a reasonable period of time, then that person is guilty of an offence under this Section of the Act.

Section 90

This section authorises the Director-General to issue an AHIP.

Section 90A-90R

These sections govern the requirements relating to applying for an AHIP. In addition to the amendments to the Act, OEHL have issued three new policy documents clarifying OEHL's requirements with regards to Aboriginal archaeological investigations: *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010*, *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* and *Code of Practice for Archaeological Investigations in NSW*. The Consultation Requirements formalise the consultation with Aboriginal community groups into four main stages, and includes details regarding the parties required to be consulted, advertisements inviting Aboriginal community groups to participate in the consultation process, requirements regarding the provision of methodologies, draft and final reports to the Aboriginal stakeholders and timetables for the four stages. The Due Diligence Code of Practice sets out the minimum requirements for investigation, with particular regard as to whether an AHIP is required. The Code of Practice for Archaeological Investigation sets out the minimum requirements for archaeological investigation of Aboriginal sites.

Aboriginal Heritage Impact Permits (AHIP)

OEHL encourages consultation with relevant Aboriginal stakeholders for all Aboriginal Heritage Assessments. However, if an Aboriginal Heritage Impact Permit (AHIP) is required for an Aboriginal site, then specific OEHL guidelines are triggered for Aboriginal consultation.

Aboriginal Cultural Heritage Consultation Requirements for Proponents

In 2010, the *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (ACHCR's) were issued by OEHL (12th April 2010). These consultation requirements replace the previously issued *Interim Community Consultation Requirements* (ICCR) for Applicants (Dec 2004). These guidelines apply to all AHIP applications prepared after 12th April 2010; for projects commenced prior to 12th April 2010, transitional arrangements have been stipulated in a supporting document, Questions and Answers 2: Transitional Arrangements.

The ACHCR's 2010, include a four stage Aboriginal consultation process and stipulate specific timeframes for each stage. Stage 1 requires that Aboriginal people who hold cultural information are identified, notified and invited to register an expression of interest in the assessment. Stage 1 includes the identification of Aboriginal people who may have an interest in the project area and hold information relevant to determining the cultural significance of Aboriginal objects or places. This identification process should draw on reasonable sources of information including: the relevant OEHL EPRG regional office, the relevant Local Aboriginal Land Council(s), the Registrar of Aboriginal Owners, *Aboriginal Land Rights Act 1983*, the Native Title Tribunal, Native Title Services Corporation Limited, the relevant local council(s), and the relevant catchment management authority. The identification process should also include an advertisement placed in a local

newspaper circulating in the general location of the project area. Aboriginal organisations and/or individuals identified should be notified of the project and invited to register an expression of interest (EoI) for Aboriginal consultation. Once a list of Aboriginal stakeholders has been compiled from the EoI's, they need to be consulted in accordance with ACHCR's Stages 2, 3 and 4.

For projects commenced before the 12th April 2010, Section 1 (Q1) of the transitional arrangements indicates that if Aboriginal consultation was commenced prior to the 12th April 2010 (including advertising and notification of stakeholders) then consultation is to be continued under the previous ICCR guidelines.

Interim Community Consultation Requirements (ICCR) for Applicants (Dec 2004) required a three stage process of which timeframes were stipulated for specific components. Stage 1 required the notification and registration of interests. Notification included an advertisement in a local print media, in addition to contacting the Local Aboriginal Land Council(s), the registrar of Aboriginal Owners, Native Title Services, local council(s) and the Department of Environment and Conservation. Stage 1 also required the invitation for expressions of interest (EoI) to be sent to interested Aboriginal parties and an Aboriginal stakeholder list compiled. Stage 2 required the preparation of an assessment design to be sent to the Aboriginal stakeholders for comment and review. Stage 3 required that the assessment report be provided to registered Aboriginal stakeholders for review and comment.

Environmental Planning & Assessment Act 1979 (EP&A Act)

This Act regulates a system of environmental planning and assessment for New South Wales. Land use planning requires that environmental impacts are considered, including the impact on cultural heritage and specifically Aboriginal heritage. Within the *EP&A Act*, Parts 3, 4 and 5 relate to Aboriginal heritage.

Part 3 regulates the preparation of planning policies and plans. Part 4 governs the manner in which consent authorities determine development applications and outlines those that require an environmental impact statement. Part 5 regulates government agencies that act as determining authorities for activities conducted by that agency or by authority from the agency. The National Parks & Wildlife Service is a Part 5 authority under the *EP&A Act*.

In brief, the *NPW Act* provides protection for Aboriginal objects or places, while the *EP&A Act* ensures that Aboriginal cultural heritage is properly assessed in land use planning and development.

Heritage Act 1977

This Act 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. Although Aboriginal heritage sites and objects are primarily protected by the *National Parks & Wildlife Act* (1974, as amended), if an Aboriginal site, object or place is of great significance, it may be protected by a heritage order issued by the Minister subject to advice by the Heritage Council.

Other legislation of relevance to Aboriginal cultural heritage in NSW includes the *NSW Local Government Act (1993)*. Local planning instruments also contain provisions relating to indigenous heritage and development conditions of consent.

Appendix 2 – Aboriginal Heritage Due Diligence Report

AHIMS Results

Deborah Farina
Accounts Payable Fortitude Valley PO Box 237
Brisbane New South Wales 4006

Date: 10 August 2011

Attention: Deborah Farina

Email: deborah.farina@rpsgroup.com.au

Dear Sir or Madam:

**AHIMS Web Service search for the following area at Datum :GDA, Zone : 56, Eastings : 216549 - 236549,
Northings : 6533226 - 6553226 with a Buffer of 200 meters. conducted by Deborah Farina on 10 August 2011**

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

19	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the [NSW Government Gazette \(http://www.nsw.gov.au/gazette\)](http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref Number : 108963

Client Service ID : 48565

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
29-1-0011	Goran Hokey Pokey	AGD	56	229900	6534700	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	344
	<u>Contact</u>	<u>Recorders</u>		P.W Greenwood				<u>Permits</u>		
29-1-0088	BBS; Red Chief LALC; Goran SF 2	AGD	56	224716	6546763	Open site	Valid	Modified Tree (Carved or Scarred) : 1		99031
	<u>Contact</u>	<u>Recorders</u>		Archaeological Surveys & Salvage ,Red Cheif LALC - BBS Survey Team				<u>Permits</u>		
29-1-0089	BBS; Red Chief LALC; Goran SF ST 1	AGD	56	224650	6546763	Open site	Valid	Modified Tree (Carved or Scarred) : 1		99031
	<u>Contact</u>	<u>Recorders</u>		Archaeological Surveys & Salvage ,Red Cheif LALC - BBS Survey Team				<u>Permits</u>		
29-1-0081	BBS; Walhallow LALC; Red Bobs 1	AGD	56	220976	6536387	Open site	Valid	Modified Tree (Carved or Scarred) : 1		98931
	<u>Contact</u>	<u>Recorders</u>		Archaeological Surveys & Salvage ,Walhallow LALC - BBS survey team				<u>Permits</u>		
29-1-0114	Wondoba Scar tree 4	AGD	56	227279	6552969	Open site	Valid	Modified Tree (Carved or Scarred) : 1		
	<u>Contact</u> Searle	<u>Recorders</u>		Mr.Leonard Talbott				<u>Permits</u>		
29-1-0009	Howes Hill;	AGD	56	227500	6534700	Open site	Valid	Artefact : -	Open Camp Site	
	<u>Contact</u>	<u>Recorders</u>		P.W Greenwood				<u>Permits</u>		
29-1-0012	Hokey Pokey Lake Goran	AGD	56	229900	6534500	Open site	Valid	Artefact : -	Open Camp Site	344
	<u>Contact</u>	<u>Recorders</u>		Van Hoen				<u>Permits</u>		
29-1-0027	Red Bob's Scarred tree 4;RB 4;	AGD	56	221290	6536500	Open site	Valid	Modified Tree (Carved or Scarred) : -	Scarred Tree	2734
	<u>Contact</u>	<u>Recorders</u>		Tom Griffiths				<u>Permits</u>		
29-1-0113	Wondoba Scar Tree 3	AGD	56	227261	6552958	Open site	Valid	Modified Tree (Carved or Scarred) : 1		
	<u>Contact</u> Searle	<u>Recorders</u>		Mr.Trent Colley				<u>Permits</u>		
29-1-0003	Goran Lake;	AGD	56	228000	6538900	Open site	Valid	Artefact : -	Open Camp Site	
	<u>Contact</u>	<u>Recorders</u>		Quirindi District Historical Society				<u>Permits</u>		
29-1-0010	Goran Lake;	AGD	56	234200	6534800	Open site	Valid	Artefact : -	Open Camp Site	
	<u>Contact</u>	<u>Recorders</u>		Mr.Peter Greenwood				<u>Permits</u>		
29-1-0117	Wondoba Scar tree 7	AGD	56	225084	6553162	Open site	Valid	Modified Tree (Carved or Scarred) : 1		
	<u>Contact</u> Searle	<u>Recorders</u>		Mr.Peter Beale				<u>Permits</u>		
29-1-0079	BBS; Walhallow LALC; Red Bobs 3	AGD	56	221006	6536373	Open site	Valid	Modified Tree (Carved or Scarred) : 1		98931
	<u>Contact</u>	<u>Recorders</u>		Archaeological Surveys & Salvage ,Walhallow LALC - BBS survey team				<u>Permits</u>		
29-1-0026	Red Bob's Scarred tree 3;RB 3;	AGD	56	221290	6536490	Open site	Valid	Modified Tree (Carved or Scarred) : -	Scarred Tree	2734

Report generated by AHIMS Web Service on 10/08/2011 for Deborah Farina for the following area at Datum :GDA, Zone : 56, Eastings : 216549 - 236549, Northings : 6533226 - 6553226 with a Buffer of 200 meters.Additional Info : Develop predictive model for due diligence investigation. Number of Aboriginal sites and Aboriginal objects found is 19

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref Number : 108963

Client Service ID : 48565

<u>SiteID</u>	<u>SiteName</u>	<u>Datum</u>	<u>Zone</u>	<u>Easting</u>	<u>Northing</u>	<u>Context</u>	<u>Site Status</u>	<u>SiteFeatures</u>	<u>SiteTypes</u>	<u>Reports</u>
	<u>Contact</u>	<u>Recorders</u>	Tom Griffiths					<u>Permits</u>		
29-1-0116	Wondoba Scar tree 6	AGD	56	225112	6553147	Open site	Valid	Modified Tree (Carved or Scarred) : 1		
	<u>Contact</u> Searle	<u>Recorders</u>	Mr.Leonard Talbott,Mr.Peter Beale					<u>Permits</u>		
29-1-0112	Wondoba Scar Tree 2	AGD	56	227298	6552922	Open site	Valid	Modified Tree (Carved or Scarred) : 1		
	<u>Contact</u> Searle	<u>Recorders</u>	Mr.Peter Beale					<u>Permits</u>		
29-1-0122	Wondoba Resource 1	AGD	56	225080	6553165	Open site	Valid	Aboriginal Resource and Gathering : 10		
	<u>Contact</u> Searle	<u>Recorders</u>	Mr.Peter Beale					<u>Permits</u>		
29-1-0090	BBS; Red Chief LALC; Goran SF 1	AGD	56	225202	6546912	Open site	Valid	Artefact : 3		99031
	<u>Contact</u>	<u>Recorders</u>	Archaeological Surveys & Salvage ,Red Cheif LALC - BBS Survey Team					<u>Permits</u>		
29-1-0080	BBS; Walhallow LALC; Red Bobs 2	AGD	56	220989	6536401	Open site	Valid	Modified Tree (Carved or Scarred) : 1		98931
	<u>Contact</u>	<u>Recorders</u>	Archaeological Surveys & Salvage ,Walhallow LALC - BBS survey team					<u>Permits</u>		

Report generated by AHIMS Web Service on 10/08/2011 for Deborah Farina for the following area at Datum :GDA, Zone : 56, Eastings : 216549 - 236549, Northings : 6533226 - 6553226 with a Buffer of 200 meters.Additional Info : Develop predictive model for due diligence investigation. Number of Aboriginal sites and Aboriginal objects found is 19

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Appendix D

Core Hole Design

prepared by Santos

WELL NAME:		Goran South 1					
WELL TYPE:		CSG CHIP HOLE					
LICENCE		NSW PEL 1					
RIG		Lucas Rig 13 (McD 29)					
Metres MD (RT)	Group	Lithology	Tops & Target TVD (m GL)	P & A	Well Schematic		
100		Quaternary Alluvium	46.9 m	12"	10-3/4" ~6 m		
		Deriah Formation	100.9 m		8-1/2"	7" Casing	
200	BLACK JACK GROUP	Trinkey Formation	219 m	6-1/8" Hole Size	4-1/2" Casing		
300		Wallala Formation	259.2m				
400		Volcanic Intrusive	385.5m				
		Clare Sandstone	389.5 m				
		Benelabri Formation	406.5 m				
		Hoskissons C.M	415.2 m				
500		Arkarula Formation	435 m			99 / 96 mm hole	TOC ~ 700 m
600		Pamboola Formation	510.4 m				
	Watermark Formation	652.2 m					
700	Porcupine Formation	808 m	4-1/2" to ~750 m				
800	Maules Creek Fm	818 m					
	Maules Creek Coal Member	913.6 m					
900	BELLATA GROUP	Boggabri Volcanics	933.6 m	TD at 933.6 m GL in Boggabri Volcanics.			
1000		TD					
1100							

Appendix E

Advice on Lake Goran Flood Levels

prepared by RPS Aquaterra

Our Ref: S160/002a
Date: 15 August 2011

Belinda Lewis
Senior Planner,
RPS
Level 12,
92 Pitt Street, Sydney
NSW 2001

Dear Ms Lewis,

RE: LAKE GORAN FLOOD LEVELS

This letter confirms that RPS Aquaterra recently (July, 2011) investigated the historical variations in surface elevations of Lake Goran. The investigation was carried out with a view to understanding the water levels reached during large floods and the likelihood of such events occurring.

The assessment was based on information received from:

- NSW Office of Water (NOW);
- Inland Flood Unit, Office of Environment and Heritage in Tamworth; and
- Bureau of Meteorology;
- A review of work conducted by other consultants (Most relevant is: Bewsher Consulting, 1995, *Hydrological Study of Lake Goran*, prepared for Department of Water Resources)

The most relevant information included rainfall records from Gunnedah (1881 to 2010) and measured lake levels (1974 to 2005).

The dimensions of the lake as well as graphical plots of simulated lake levels for the period 1881 to 1992 were obtained from the above report by Bewsher (1995). Monitoring conducted subsequent to the Bewsher report has provided a further thirteen years of lake level information (till 2005) and an additional 18 years of rainfall information (till 2010). These records were processed and included in statistical analyses as part of our investigation.

Some of the main features of the lake and key findings of our study and reviews are as follows:

- The Bewsher Report described the lake as having a surface area of 8,800 Ha and a volume of 123 GL;
- The area surrounding the lake is generally low lying and forms part of the Liverpool Plains. The water level and the surface area of the lake vary considerably in response to rainfall and catchment runoff as a result of very gentle topographical gradients. When full, large volumes of water are needed to obtain small increments in water levels and the accompanying increase in surface area is substantial;
- The nominal full supply level of the lake is 296.4 m AHD according to the Bewsher report;
- The probability of the lake spilling is about 14% based on the period of measured lake levels (1974 to 2005);
- The highest recorded lake level during the period of monitoring is 296.79 m AHD. The probability of occurrence of this event is 2%, based on the period of lake level monitoring; and
- The highest observed lake level within the 112 years of simulated results presented in the Bewsher Report was about 296.85 m AHD in 1890. The probability of this occurring as deduced from the occurrence of rainfall amounts between 1880 and 2010 is about 0.5% or 1:200 years.

Should you require further information please feel free to contact the undersigned.

Yours sincerely
RPS Aquaterra

Craig Schultz

Craig Schultz
Senior Principal Hydrologist

Ed Neilan

Ed Neilan
Managing Director

Appendix F

Environmental Management Plan

prepared by RPS



Environmental Management Plan

**Goran South I Core Hole – PEL I,
Gunnedah Basin**

Prepared by:

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Report Number: 107106-2_EMP
Version / Date: Final, Revision 0 / October 2011

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In preparing this report we have made certain assumptions. We have assumed that all information and documents provided to us by the Client or as a result of a specific request or enquiry were complete, accurate and up-to-date. Where we have obtained information from a government register or database, we have assumed that the information is accurate. Where an assumption has been made, we have not made any independent investigations with respect to the matters the subject of that assumption. We are not aware of any reason why any of the assumptions are incorrect.

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Document Status

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1.0 Introduction

Santos QNT Pty Ltd (Santos) as operator for and on behalf of the titleholders is proposing to undertake drilling activities at the Goran South 1 location in the Gunnedah Basin. The purpose of this is to assess the coal seam gas resource within Petroleum Exploration Licence No. 1 (PEL 1).

RPS was engaged to prepare this Environmental Management Plan (EMP) to accompany the Review of Environmental Factors (REF) for the proposed activities to be submitted to the Department of Industry and Investment in accordance with the Environmental Planning and Assessment Act 1979 (NSW). RPS has also prepared an ecological assessment (EA). Terms used in the REF and the EA have the same meaning in this EMP.

1.1 Description of the Action

1.1.1 Introduction

Santos proposes to undertake drilling activities to assess the coal seam gas potential of the Gunnedah Basin in PEL 1.

The proposed activity is to conduct drilling at the Goran 1 location at the property known as 'Boenery Park' in order to obtain information on coal depths, seam thickness, continuity and permeability. Coal seams of a particular interest will be cored for gas composition testing. Drill stem testing (DST) or equivalent downhole evaluation is also planned to be undertaken on coal seams to collect pressure and permeability information.

In summary, the process involves:

- preparation of lease access tracks utilising existing access tracks with minor improvements;
- preparation of a level drill pad (also referred to as "well lease area");
- placement of a drilling rig and ancillary equipment at the well lease;
- drilling of the core hole;
- collection and analysis of drill core;
- conduct well testing and wireline logging (as required);
- plugging and abandonment of the well including suspension of steel casing over mineable coal seams (as required);
- removal of equipment and imported materials and the rehabilitation of the site; and
- rehabilitation of the site in line with legislative and landholder requirements.

Due to the type of drilling activity proposed, associated water from the targeted coal seams is not anticipated to be lifted.

Santos has negotiated an access, compensation and rehabilitation agreement with the affected landowner in respect to land access, compensation and rehabilitation. A scouting survey has been

undertaken in consultation with the relevant landholder prior to drilling taking place to locate the site with an emphasis on minimisation of impacts on the environment and property operations.

1.1.2 Site preparation and Equipment

Various works will be required in order to prepare the site for the proposed drilling, including preparation of the well lease, access track improvements and construction as well as positioning the drill rig and associated temporary buildings and equipment on the site. The major equipment used on site will be a drilling rig and associated temporary buildings. These works are summarised further in this section. Figure 3.1 and Figure 3.2 of the REF illustrate the proposed site layout for the well lease and access tracks.

During site preparation, there will be some soil disturbance as a level drill pad will need to be constructed at the well lease. Associated lined drilling sumps and a flare pit will also be constructed on site. The area to be disturbed for drilling activity is outlined in **Table 1.1**.

Table 1.1 Areas of disturbance & cut and fill for well leases

Well Lease	Pad Area	Pad Level
Goran South 1	86m x 69m with an overall area of disturbance of approximately 6,000m ² .	Cut and fill will be required to establish a pad level at approximately RL 296.55m AHD
Access Track	New track 5m wide, approximately 1500m long = 7500m ² . Some minor filling required at various locations on access track	Following existing site levels, with some filling and piping required in isolated locations.

Well Lease Construction

- Civil works equipment will be moved to site including bulldozer, excavator, grader, roller, water trucks, other trucks and support and light vehicles.
- Portable amenities will be located on site during construction.
- Any topsoil will be stripped and stockpiled.
- Required sumps will be excavated and lined with impermeable plastic sheeting.
- The lease area will be graded, rolled and otherwise constructed per Figure 3.1 of the REF;
- Required sumps will be excavated and lined with impermeable plastic sheeting. Sump and erosion control is shown per Figure 3.2 of the REF;
- A 10-3/4" steel conductor casing will be pre-installed at approximately 6m depth by the civil works crews ahead of the rig arriving on site.
- The lease will be fenced with appropriate fencing to manage livestock movements

Access Track Improvements and Construction

Access to the "Boenery Park" property is via existing, good quality roads. The only works required to these roads may be grading to ensure a good quality surface is maintained. There will need to be some

additional works to ensure all weather access through the property to the well lease, as illustrated on Figure 3.3 of the REF.

The following is a list of the detailed works involved.

- Existing 1500m of track to be topped with 100mm road base.
- New 1500m long x 5m wide access track to be prepared using 100mm road base.
- Track is to be constructed to allow wet weather access. This will require piping and some minor filling in parts as identified on Figure 3.3 of the REF.
- Sensitive vegetation (Weeping Myall) located along the northern boundary of Lot 28 will be avoided by offsetting the track 10m from the drip-line of the trees.

Drill Rig Positioning & Operation

- Equipment will enter/exit the site via the main access gate shown in Figure 3.2 of the REF. This will include generator units, lighting towers, site offices, stores and other various buildings and equipment required for the duration of drilling.
- Moving and rigging up/down of equipment (i.e. installation and dismantling of rig equipment) is expected to take up to 3 days per site (3 per rig up, 3 per rig down).

Ancillary equipment will be required on site during the course of the drilling activities, including wireline trucks, cementing trucks and service company vehicles, these vehicles will exit and enter the site as required.

1.1.3 Drilling Activities

The well site will have a specific well design ensuring compliance with relevant legislation. The specific well design is provided in **Appendix D** of the REF.

A nominal 10-3/4" (273mm) cemented conductor is to be installed by the lease builder to approximately 6 m below ground level. A surface hole of 8-1/2" (216mm) will be rotary drilled to approximately 100mRT, where a 7" (178mm) surface casing will be landed and cemented to the surface. The main hole of 6-1/8" (156mm) will be drilled from the 7" (178mm) casing shoe to total depth of approximately 934mRT (20m into the Boggabri Volcanics) based on the pre-drill geological prognosis. DSTs or equivalent downhole evaluations may be conducted over selected Late and Early Permian Coals with testing to be performed in accordance with legislative requirements.

On penetrating target coal seams, coal cores will be collected and sampled for gas content and composition to evaluate local variations in coal seam permeability and composition. Any testing will be performed in accordance with legislative requirements.

The closest offset wells to the proposed activities are Goran Lake 1 (2.9km), Howes Hill 1 (5.4km) and Goran 1 (6.5km).

Once the well has reached the total depth, geophysical wire-line logs will be run over the main section of the hole to identify major stratigraphic units, intersected coal seam depth and seam thickness. Further

DST or equivalent downhole evaluation may follow after completion of logging. Following logging and any post TD activities, the well will be fully plugged and abandoned with cement plugs from bottom to top. It is planned to cut and remove the 4-1/2" casing from approximately 50m above the casing shoe prior to setting cement plugs. A separate plug and abandon program will be issued at a later date. Approval is required for this abandonment program prior to abandonment operations commencing. The placement of cement plugs will effectively isolate the penetrated formations from each other and from the surface.

1.1.4 Abandonment and Rehabilitation

The well will be cemented, plugged and abandoned in accordance with regulatory requirements and rehabilitated following completion of activities within the allowed regulatory timeframe, unless needed for further exploration testing. In the case of plug and abandonment, the intermediate casing would be removed above the top of cement (where required and practicable) and a steel identification plate installed near the top of the hole > 1 metres below the surface.

Once the drilling and testing activities are complete, the disturbed area is proposed to be rehabilitated with appropriate mitigation measures and environmental safeguards implemented to minimise potential impacts. All rehabilitation works will be undertaken with maximum regard to environmental protection and rehabilitation, vegetation, subsoil and topsoil management, weed control, erosion and sedimentation management and revegetation in accordance with the relevant statutory requirements.

Revegetation & rehabilitation will be undertaken within the required regulatory timeframe (Section 4.3). All private tracks used during operations are generally returned to their pre-operations state or to a condition agreed by the landholder.

1.1.5 Duration

Drilling activities are temporary. The drilling of the core hole well is expected to occur over a 56 day period not including lease build, or site restoration. There will be 14 days of lease construction activities prior to drilling the well. Rehabilitation activities of 30 days following the drilling of the well will be additional to this period.

This equates to a total of approximately 70 days of construction and drilling and 30 days of rehabilitation, as outlined in **Table 1.2**.

Table 1.2 Duration of drilling and site activities

Activity	Expected Duration
Lease Build	14 days
Drilling	56 days
Rehabilitation	30 days

1.1.6 Staff and Hours of Operation

The number of employees present on the site at any one time is expected to be up to 20 persons. It is not proposed to provide a workers camp on the site, with off-shift drilling crews to be located in nearby accommodation with travel to and from site to be provided.

The hours of operation during the drilling and work over will be on a 24-hour a day, 7 days a week basis as negotiated with the landholder. Hours of operation during lease construction and rehabilitation will be on a 12-hour a basis between 6am and 6pm. During drilling personnel movements to and from site will be minimised outside of a single shift change per day but may be necessary due to emergency situations or specific activities (e.g. crews and service companies entering and leaving site to conduct specific activities).

1.1.7 Chemicals

A number of chemicals are planned to be utilised to facilitate the efficient and safe drilling of the wells in line with best oilfield practice. These chemicals are typical of those generally used in oilfield activities. These chemicals will be used either to deliver the wells as planned or will be held in contingency to handle unplanned scenarios (e.g. stuck pipe, excessive mud losses etc.). The Material Safety Data Sheet (MSDS) information for all of these chemicals can be found on the Santos web site (<http://www.santos.com/exploration-acreage/gunnedah-basin-gas/fact-sheets-msds.aspx>). The fluids are water based (not synthetic or oil based) and recycled for reuse as much as possible during the drilling process. A list of chemicals are included in the REF.

1.1.8 Justification of Activity

Drilling of the Goran South 1 well is a necessary step in the ongoing exploration of the hydrocarbon potential in PEL 1, which to date has undergone limited petroleum exploration. Discovery and appraisal of coal seam gas resources in the area has the potential to increase the state's reserves and revenue from gas and underpin future exploration or production in the region.

The proposed activities consist of drilling a well, wireline geophysical logging, drill stem tests, casing and cementing using steel casing strings. These procedures are required to define and identify commercially valuable reserves of coal seam gas.

1.1.9 Alternatives

There is limited previous drilling in this area of the Gunnedah Basin that is sufficiently deep for the purposes of petroleum exploration. The proposed exploration hole drilling operation is essential to gain accurate gas composition and detailed stratigraphic data. Due to the highly specialised nature of the proposed works, drill cutting sampling and testing is the only feasible method available to obtain reliable and accurate gas composition and permeability data for the local coal resource. Geophysical methods available (e.g. seismic), which could be applied to exploration would show the structure of the basin but would not provide the ability to sample and analyse the stratigraphy of the Gunnedah Basin to quantify coal seam gas potential.

The location of the exploration holes is a substantial factor in the evaluation of the potential coal seam gas resource. The initial location of the core hole was carefully considered by the project team, in consultation with specialist consultants and agricultural operators and taking into account the underlying geology, the existing environment and the current land use at each location.

The selection of the proposed core hole site located on privately owned land has been based upon the ecological protection principles of avoidance and harm minimisation. The site has been selected to avoid and/or minimise potential ecological impacts and in particular those to Goran Lake. The well lease site selection process identified areas where historical disturbances had modified the natural condition and where zero or minimal vegetation clearing, tree removal and earthworks would be required to establish the well lease and associated infrastructure, including the access track.

The site was located in consultation with the landholder and with the assistance of a scouting party comprised of Santos' Project Representatives, Cultural Heritage Officers and Lease Construction Experts. Third party surveyors and Ecologists were also consulted to assist in positioning of the well lease as part of the scouting process.

Once all known constraints were identified on the site, this information was used to delineate areas to be avoided in the initial location identification process. This included areas which would require unnecessary intrusion on sensitive ecological communities.

The final area identified for the exploration hole operations have been determined to avoid existing constraints as much as is practical. By undertaking the site identification methodology outlined above, the evaluation of sites for the drilling program was undertaken using an adaptive management approach, where constraints were identified, verified in the field and avoided. The resulting exploration hole location area is considered the most appropriate location both from a resource investigation perspective and to minimise any potential environmental impacts

1.2 Site Particulars

1.2.1 Regional Location

The study area is located approximately 18km south west of Curlewis, in the Brigalow Belt South IBRA Bioregion and Liverpool Plains IBRA Subregion. The study area is within the Gunnedah Shire Council Local Government Area (LGA).

The study area is located to the north of Lake Goran, a nationally Important Wetland (NSW005), mapped by the Office of Environment and Heritage (OEH) as a Freshwater Wetland. A number of State Forests are located within proximity to the Boenery Park property. For instance, the Goran State Forest is located approximately 5km south of the study area, while the Brezza State Forest is situated 12km west of the potential core hole site. The Trinkey State Forest can also be found approximately 13km to the south west of the site.

1.2.2 Study Area Description

The study area is limited to approximately 25ha surrounding the proposed core hole lease, and the proposed access tracks. The majority of the study area is comprised of grazing land, and is largely cleared of native vegetation communities. While the proposed core hole lease is located within highly disturbed grazing land, vegetation adjacent to the existing and proposed access track include Acacia and Eucalypt Woodland communities.

I.2.3 Topography

The topography of the subject site is relatively flat to gently undulating land, and within 1.5km of the high water mark of Lake Goran. Slopes are generally 0-3% with local relief at <3m, as shown in Figure 2.5 of the REF. Elevation across the property ranges between approximately 300m Australian Height Datum (AHD) at the north of the site and no less the 290 AHD at the south of the site.

I.2.4 Climate

The Bureau of Meteorology (BoM) weather station considered to be most representative of the subject locality was Quirindi Post Office. The local climate is temperate with a slight dominance of summer rainfall. The average daily maximum temperature is around 24.6°C, while the average daily minimum temperature is around 8.9°C (BoM, 2011). Long-term mean annual rainfall for the locality is 684.3 mm and is known to range between 337.7 mm (lowest record 1919) to 1,149 mm (highest record 1921).

As shown in **Table 1.3**, mean temperature records indicate the warmest month is January and the coolest month is July. January receives the greatest rainfall and April the least. Notably, very little variation occurs throughout an average year.

Table 1.3 Climate Statistics from Quirindi Post Office BoM Weather Station

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Max Temp (°C)	32.2	31.3	29.3	24.9	20.5	16.6	15.9	17.9	21.5	25.2	28.4	31.2
Mean Min Temp (°C)	16.4	16.1	13.5	8.9	5.1	2.8	1.6	2.4	5.0	8.7	11.9	14.8
Mean Rainfall (mm)	80.7	65.5	53.1	42.1	44.4	51.3	48.5	45.4	46.6	60.7	64.8	80.9

2.0 Environmental Management Plan

2.1 Purpose

This EMP has been prepared to ensure that the proposed activities are undertaken in accordance with relevant legislation, policies and guidelines. The mitigation measures outlined within this EMP are designed to ensure that the impact upon the environment are minimised, and that any impacts that do occur are managed appropriately.

2.2 Objectives

The objective of this EMP is to:

- Ensure cultural heritage sites are not impacted unnecessarily by land disturbance;
- Avoid sites of known scientific and natural significance;
- Minimise or where possible avoids clearance of native trees and shrubs;
- Minimise risks to wildlife and stock;
- Avoid the introduction or spread of pest plants and animals and implement control measures as necessary;
- Minimise disturbance and avoid contamination to soil;
- Include erosion control measures in vulnerable locations;
- Ensure that noise and dust issues are adequately dealt with in order to minimise likely impacts upon the surrounding environments;
- Optimise (in order of most to least preferable) waste avoidance, reduction, reuse, recycling, treatment and disposal;
- Provide adequate measures in relation to bushfire protection and ignition that may affect the surrounding environments; and
- Facilitate rehabilitation and/or restoration and consider post-construction land use.

2.3 Responsibilities

Responsibility for the environmental management will be structured and be both broad-based company policy related and individually assigned. While designated individuals will be responsible for certain aspects of the construction and decommissioning activities, all staff will be responsible for environmental management to a certain extent.

The following information provides a summary of each of the defined roles.

2.3.1 Project Manager

During the Goran South 1 activities, the Project Execution Manager is responsible for the overall execution of the activities and will ensure appropriate environmental management and compliance throughout the project execution activities.

2.3.2 Drilling Contractor

During drilling operations and within the drilling lease areas, the Drilling Rig Manager is the on-site person responsible for ensuring appropriate environmental management and compliance. Overall responsibility for ensuring drilling activity environmental management and compliance falls with the Santos CSG Drilling and Completions Environmental Advisor following site approval.

2.3.3 Civil Works Contractor

During civil works activities, the responsibility for environmental management and compliance rests with the Santos Construction Supervisor. The Site Supervisor provided by the Civil Works Contractor is responsible for any immediate actions required to ensure on-site environmental management and compliance only in the on-site absence of the Santos Construction Supervisor and is responsible for timely reporting of any issues directly to the Santos Construction Supervisor.

2.3.4 Environmental Advisor / Auditor

The Santos Environmental Advisor is the field-based person responsible for advising the Drilling Contractor and Civil Works and other relevant parties on the requirements of the EMP to ensure that the requirements are implemented.

Such personnel need to be appropriately qualified and undertake activities such as the following:

- Inspecting construction works on a regular basis to ensure compliance with relevant requirements;
- Maintaining a written and photographic record of the construction activities for reference;
- Identifying potential problem areas and ensuring that they are treated adequately;
- Advising all construction staff on their environmental responsibilities;
- Reporting situations of non-compliance to the Santos Project Manager;
- Ensuring sensitive areas previously identified by studies (such as threatened plants or heritage items) are flagged out and that personnel are informed of their significance; and
- Monitoring environmental performance of the construction activities.

2.3.5 Heritage Supervisor

The Santos Heritage Supervisor will be consulted as required. They may be required to monitor the protection of Aboriginal artefacts or European heritage. They are also required to flag items of significance for construction workers to avoid.

2.3.6 Supervising Ecologist

The Supervising Ecologist is required to monitor all vegetation clearing and pruning activities to ensure vegetation and fauna management procedures are implemented. The Supervising Ecologist is to provide advice during the site rehabilitation and monitor revegetation. They are also required to prepare or provide input into required reporting.

2.3.7 Project Liaison

The Santos Project Liaison manager is responsible for regular and ongoing communication as required to external parties. The Santos Project Liaison manager is responsible for ensuring any public complaints are effectively managed.

2.4 Procedures

Procedures need to be put in place to ensure that there are set standards and management requirements that need to be considered. This EMP outlines procedures in Construction Management and Decommissioning Management sections as to what procedures are, in relation to each environmental issue. No Operational Management phase has been developed for the site as drilling operations are considered under Construction Management.

2.5 Training and Awareness

Training and awareness is an integral part of the protection of the environment and the implementation of an EMP. A comprehensive environmental training program will encompass inductions, job specific training, and environmental awareness programs.

2.5.1 Induction

Santos has a comprehensive, multi level induction program. All contractors and personnel will complete the Santos Level 1 induction as the basis of completing any works for the company and covers company values, policies, Environment Health and Safety Management System (EHSMS) and other core information.

The Gunnedah Level 2 induction covers EHS matters that are specific to the NSW and the local area in which the company operates, minimum standards and expectations.

The Site Level 3 is an on-site induction specific to a smaller area of work, such as a drill site or a pilot well site. Conditions and requirements for this site are covered in this induction.

2.5.2 Job Specific Training

Santos operators and staff undertake competency based training, in line with the requirements of their role. These are assessed periodically and identified gaps addressed in a training and development plan for each individual.

All Santos personnel and contractors are required to have a working knowledge of the Santos EHS MS, site specific conditions relating to works being completed on site.

2.5.3 Environmental Awareness

Prior to a scope of work commencing on a Santos site, an 'icebreaker' is held with all relevant parties to the work scope. Environmental conditions associated with the works in addition to any health and safety issues are identified and discussed in detail. Toolbox meetings are held at the start of each day where these requirements are refreshed to ensure that all persons on site are aware of the requirements and have opportunity to discuss concerns in an open forum.

2.6 Communication

Regular and ongoing communication will be required to inform external parties as to the progress and success of the environmental aspects of the activity. The primary point of contact will be the appointed project liaison person. External parties are likely to include:

- Landholders;
- Business;
- Local, State and Federal government;
- NSW Farmers Association;
- Namoi Catchment Management Authority;
- Utilities operators;
- Local Aboriginal Land Councils; and
- Special interest and activist groups.

2.7 Documentation and Reporting

A record of the implementation and results of the EMP is an important tool to enable internal and external authorities to check the procedures and the monitoring results. Assessment of compliance with statutory authorities, success in achieving objectives, any environmental outcomes and their significance and the effectiveness of the EMP will be documented.

Documentation and recording is proposed to include:

- Records of induction and training attendees;
- Inspection reports;
- Non-compliance reports;
- Accident or incident reports; and
- Audit result reports.

2.8 Review and Improvement

Given the short-term nature of the proposal, a review and improvement process is not required. However, in the event of a notable environmental incident, the EMP will be updated to reflect any required changes to management practises.

3.0 Construction Management

3.1 Overview

The construction phase incorporates the following activities:

- Construction of new and upgrade of existing access tracks;
- Preparation of a level drill pad (also referred to as “well lease area”);
- Placement of a drilling rig and ancillary equipment at the well lease;
- Drilling of the core hole;
- Collection and analysis of drill core;
- Conduct well testing and wireline logging (as required);

The sections below outline environmental issues and management actions to be implemented throughout the construction phase.

3.2 Vegetation Management

3.2.1 Overview

A White Box-Yellow Box Woodland, a Weeping Myall Woodland and a Grazed Grassland community were identified in the ecological assessment conducted by RPS. Due to recent cropping the core hole lease area is highly disturbed and does not constitute any community listed in the EPBC Act or the TSC Act.

The White Box-Yellow Box Woodland is located adjacent to the existing access track as a linear patch. This moderately disturbed community corresponds with the Endangered Ecological Community (EEC) known as White Box – Yellow Box – Blakely’s Red Gum Woodland, which is listed under the schedules of the TSC Act. It is also federally listed under the Threatened Ecological Community (TEC) known here as the White Box – Yellow Box – Blakely’s Red Gum Woodland and Derived Native Grasslands. Moreover, this community is critically endangered according to the EPBC Act.

The Weeping Myall Woodland is located adjacent to the proposed access track and in isolated stands throughout the investigation site, though not within the proposed core hole lease area. This community corresponds with the ECC known as the Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion, which is listed under the Schedules of the TSC Act. Furthermore, this community is considered endangered under the EPBC Act, though is classified as the Weeping Myall Woodland under this Act.

3.2.2 Environmental Issues

The potential impacts associated with the proposed activities are short-term and temporary. The physical ground disturbance will be minimised to the actual rig platform including rod rack and transfer area. The remaining rig infrastructure will be placed on grade or elevated on blocks, bricks or timber to reduce the amount of ground disturbance.

The core hole is located entirely within an area of heavily disturbed cropped grassland. Clearing of the core hole area will include the removal of exotic ground cover species, as well as minimal native grasses. The proposed upgrading and extension of the existing access track is not likely to have any direct effect to local faunal communities as no canopy trees will be removed during construction. Potential indirect ecological impacts associated with the proposed activity include dust generation, soil erosion, weed invasion, and transportation of weeds off site.

3.2.3 Management Measures

A variety of management measures will be adapted to minimise the likelihood and magnitude of environmental impacts:

- All liquids (fuel, oil, cleaning agents, drilling liquids etc) will be stored appropriately and disposed of at suitably licensed facilities;
- Spill management procedures will be implemented as required;
- Rubbish will be collected and removed from the site to ensure it does not enter surrounding areas;
- Appropriate erosion and sediment control will be installed;
- The disturbance area will be minimised to reduce unnecessary clearing and earthworks. Additionally, the disturbance area around the lease will be appropriately fenced to ensure machinery is limited to the designated disturbance area;
- Vehicle speeds will be limited to reduce dust generation;
- Where access tracks are required, they will be located along existing track routes. Additional clearing will result in the clearing of disturbed grasslands only;
- Weed management procedures will be implemented to prevent the spread of weeds both on and off site;
- Where vehicles and machinery are moving between the site and weed free areas, wash down procedures will be implemented;
- Following drilling of the core hole and plug and abandonment, the disturbance area will be appropriately rehabilitated to meet landholder requirements. Given that the core hole lease is currently used for grazing, it will be re-instated to natural grassland to provide site stability; and
- No weed species will be used to rehabilitate the core hole site.

3.3 Fauna Management

3.3.1 Overview

Due to historic land management practices the core hole area is considered to be of low value for fauna, however the ground cover may still provide limited foraging resources and shelter for a range of species, including birds, macropods and reptiles. Canopy trees are evident adjacent to the existing access track and proposed extension. Mature eucalypts with hollows are common in a White Box-Yellow Box Woodland, and may provide breeding habitat for numerous native birds and mammals including Koalas

(*Phascolarctos cinereus*). This community may also provide foraging opportunities for a range of birds, mammals and reptiles. No canopy trees are proposed for removal during the construction phase, however construction activities have the potential to impact upon fauna populations, such as reptiles and Koala, through vehicle strike, noise, dust and light pollution.

The adjacent wetland area and Lake Goran provide a range of habitat resources, including breeding habitat for a variety of amphibians, reptiles and birds. This area provides potential habitat for an array of migratory species and water birds, and considered to be of high ecological value. Furthermore Lake Goran is listed as wetland of national significance at a federal level.

3.3.2 Environmental Issues

Evidence of Koala usage (scats) was observed under White Box and Bimble Box tress across the study site. As outlined in Section 3.2 (Vegetation Management) a White Box-Yellow Box Woodland is located adjacent to the existing access track. The scattered canopy is comprised of White Box (*Eucalyptus albens*), Yellow Box (*Eucalyptus melliodora*), White Cypress Pine (*Callitris glaucophylla*), Belah (*Casuarina cristata*), and Bimble Box (*Eucalyptus populnea*).

In NSW the White Box and Bimble Box have been identified as significant contributors to the diet of Koalas under Schedule 2 of the *State Environmental Planning Policy No. 44 – Koala Habitat Protection* (SEPP 44). Furthermore White Cypress Pine and Bimble Box were identified by Smith (1992) as favoured food trees for Koala populations in the Gunnedah region and the study indicated that Koalas' utilise road side vegetation as movement passages and hence it is likely that a transient population utilise the study area.

As no Koala habitat trees will be cleared, the impacts to Koala populations are considered minimal. However, noise and light pollution as a result of vehicle, machinery and drilling as well as vehicle traffic may deter native fauna from utilising the study area and immediate surrounding areas (potentially Lake Goran) as habitat. The proposed activities could temporarily impact the migration, breeding cycle, roosting, sheltering, foraging behaviour and dispersal ability of some species particularly the Koala in relation to noise and vehicular movements.

Construction activities also have the potential to impact upon Lake Goran, as well as migratory species utilising Lake Goran, due to erosion and sedimentation, chemical spills, runoff, and dust.

3.3.3 Management Measures

The following fauna management measures are to be implemented throughout the construction phase for the protection of local fauna in particular the Koala:

- Well leases areas to be clearly fenced using temporary fauna exclusion fencing prior to vegetation clearing commencing;
- Construction equipment and vehicles will be stored within designated work areas, and not within areas of adjacent habitat;

- All construction vehicles/machinery are to use the designated access tracks, and follow the speed limits; and
- All access tracks within the activity site will be speed limited to a maximum of 20km/h to reduce the collision with Koalas and other fauna.
- Designated Koala warning signs will be installed along the access tracks;
- No domestic pets (including dogs or cats) allowed on site during construction;
- If injured or sick Koalas are encountered by site personnel within the activity site, the Site Manager or supervising ecologist will contact the local Wildlife Information, Rescue and Education Service;
- Following abandonment of the well leases, a report will be prepared by the Site Manager, with input from the fauna supervising ecologist outlining:
 - » The number and location of Koalas recorded across the activity site;
 - » The number and location of Koala injuries or mortalities within the activity site, and on access roads use for the action;
 - » Confirmation that the measures undertaken to protect Koalas in the area have been adequately implemented and maintained; and
 - » A summary of the rehabilitation carried out within each of the well leases.
- Erosion and sediment control measures and noise mitigation measures will be carried out to ensure impacts upon migratory species utilising Lake Goran are minimised.

3.4 Aboriginal Cultural Heritage Management

3.4.1 Environmental Issues

The site, including all lease pads and access tracks were inspected by RPS and a Santos' cultural heritage officer in August 2011. No items of significance were identified and no features likely to contain archaeological deposits were found.

3.4.2 Management Measures

To limit any potential impact on any unknown Aboriginal sites or objects the following measures are proposed:

- All relevant Santos staff and subcontractors should be made aware of their statutory obligations for heritage under NSW NPW Act (1974) and the NSW Heritage Act (1977), which may be implemented as a heritage induction;
- Minimise impact to areas outside the area of operation through appropriate on-site induction of all employees and contractors attending site;
- Vehicle access is to remain within existing tracks where possible in order to minimise potential impacts on surrounding vegetation and reduce erosion;

- In the event that any vegetation clearing is required to allow large machinery access to a given area, soil disturbance shall be kept to a minimum. Subject to ecological constraints, it is preferable for vegetation to be cut with a chain saw rather than bulldozed, and trees and bushes shall be cut at their base just above ground level where possible;
- If works fall outside of the areas inspected for the purposes of the cultural heritage assessment or access routes are altered those areas must be further investigated by a qualified archaeologist.
- If Aboriginal site/s are identified in the project area during works, then all works in the area should cease, the area cordoned off and contact made with OEH Enviroline 131 555, a suitably qualified archaeologist and the relevant Aboriginal stakeholders, so that it can be adequately assessed and managed; and
- In the event that skeletal remains are uncovered, work must cease immediately in that area and the proponent, Santos Limited, will need to contact the NSW Police Coroner to determine if the material is of Aboriginal origin. If determined to be Aboriginal, they must then contact OEH Enviroline 131 555 and relevant Aboriginal stakeholders in order to determine an action plan for the management of the skeletal remains prior to works re-commencing.

3.5 European Cultural Heritage Management

3.5.1 Environmental Issues

There are no items of heritage significance listed as occurring on the subject site in either the Gunnedah LEP 1998 or on the NSW State Heritage Register. A number of items of local and State heritage significance were recorded as occurring within the Gunnedah Local Government Area, however these are not located in close proximity to the subject site.

Four sites within the Gunnedah LGA are listed on the Commonwealth Register of National Estate, however none of these are on the subject site.

3.5.2 Management Measures

It is considered that the potential impacts associated with other cultural heritage can be appropriately managed if the mitigation measures presented below are implemented:

- All relevant staff will be made aware of their statutory obligations for heritage under NSW NPW Act (1974) and the NSW Heritage Act (1977), which may be implemented as a heritage induction; and
- If, during the course of development works, significant European cultural heritage material is uncovered, work should cease in that area immediately. OEH should be notified and works only recommence when an appropriate and approved management strategy instigated.

3.6 Access

3.6.1 Overview

Access to the “Boenery Park” property is via existing, good quality roads. The only works required to these roads may be grading to ensure a good quality surface is maintained. There will need to be some additional works to ensure all weather access through the property to the well lease, as illustrated on Figure 3.3 of REF.

The following is a list of the detailed works involved.

- Existing 1500m of track indicated in Figure 3.3 of the REF to be topped with 100mm road base;
- New 1500m long x 5m wide access track indicated on Figure 3.3 of the REF to be prepared using 100mm road base;
- Track is to be constructed to allow wet weather access. This will require piping and some minor filling in parts as identified on Figure 3.3 of the REF;
- Sensitive vegetation (Weeping Myall) located along the northern boundary of Lot 28 will be avoided by offsetting the track 10m from the drip-line of the trees; and
- Environmental Issues.

3.6.2 Environmental Issues

The following environmental issues have been identified as key issues potentially arising from the construction of access tracks:

- Soil compaction, erosion and sediment release to land and water;
- Incursion of disease, weeds, vermin or destructive influences to the site;
- Temporary disruption to landholders; and
- Degradation of existing road infrastructure.

3.6.3 Management Measures

The following management measures will be implemented throughout the construction of access tracks:

- Topsoil will be removed prior to surface preparation and stockpiled within designated work areas for resspreading during restoration;
- During the creation of access tracks, erosion or sediment release will be controlled adequately; and
- Appropriate measures will be employed to prevent surface damage to public roads (e.g. limiting dirt track access during wet weather and protecting bitumen surfaces where tracked machinery is required to cross roads).

The following measures will be implemented throughout the construction phase to ensure access tracks are appropriately utilised:

- Access tracks will be speed limited to 20km/h; and
- Vehicle parking will be restricted to designated areas.

3.7 Grading

3.7.1 Overview

Due to the proposed activities, the lease area will be graded and rolled, and regrading and widening of the existing track will also be required. Furthermore, the proposed access track will require grading.

3.7.2 Environmental Issues

The following issues have been identified as key issues potentially arising from grading:

- Soil erosion and sediment release;
- Soil mixing, compaction and topsoil loss; and
- Increased potential for the spread of weeds and pathogens.

3.7.3 Management Measures

The following management measures will be implemented throughout the construction phase:

- Graded soil will be stockpiled separately from other materials (e.g. vegetation), where it can be readily recovered for respreading and where it will not be lost through wind or water erosion or other means;
- Graded soil shall not be stockpiled where it has the potential to result in sedimentation or acidification of land; and
- Topsoil containment measures (e.g. berms and sediment fencing) will be used as necessary.

3.8 Waste Management

3.8.1 Overview

Drill cuttings and some general site operations waste will be produced as part of the proposed drilling operations. Any solvents, oils and other general waste would need to be managed in an appropriate manner to avoid health risks and contamination of land and waterways.

3.8.2 Management Measures

The following management measures will be implemented throughout the construction phase:

- A general Waste Management Strategy based upon the principles of reduce, reuse and recycling shall be implemented;

-
- A specific Site Waste Management Plan for drilling activities shall be prepared and implemented by the drilling contractor;
 - All staff and contractors shall be made aware of waste management procedures during induction;
 - Appropriate waste containers shall be provided on the site;
 - Any waste generated is to be disposed of in an appropriate manner in accordance with relevant standards and guidelines;
 - Spills of waste material shall be dealt with in a prompt and thorough manner, and reported to the appropriate authority if necessary;
 - General refuse shall be collected and transported to an approved recycling or disposal site;
 - Onsite waste disposal is prohibited; and
 - Hazardous waste shall be managed in accordance with existing guidelines and standards.

3.9 Contaminated Land

3.9.1 Overview

The location's history of agriculture suggests that the area is unlikely to have been previously contaminated

3.9.2 Environmental Issues

The drilling operation will pose minimal impact on the soils. No soil is proposed to be removed from the site. On the completion of drilling all excavated material would be backfilled. Based upon the history of the locations and the minimal impact to site soils during operations, land contamination issues are considered to be minimal for the proposed activity.

3.9.3 Management Measures

The following mitigation measures are proposed to reduce the risk of soil contamination:

- A spill kit will be provided for clean up spills of diesel, lubricants, oil etc;
- Any spills or leaks will be cleaned up immediately;
- Daily pre-start inspection of plant and equipment will be undertaken to identify any maintenance requirements;
- All potential contaminants will be stored, handled, used and disposed of in accordance with the MSDS;
- All wastes (other than drill cuttings and sump fluid) will be removed from the site as required;
- Drilling fluids will be contained in sumps or above-ground tanks;
- On-site storage of fuel and lubricants will be minimised;
- Sumps will be adequately maintained;

- Sumps will have overflow capacity in case of heavy rain; and
- Any soil that becomes contaminated through contact with drilling fluids, fuels, or lubricants will be removed from the site and disposed of at an appropriate licensed disposal facility.

3.10 Erosion and Sediment Control

3.10.1 Overview

The proposed activities will involve earthworks within a defined footprint for the installation of temporary infrastructure and upgrading and extension of the track. There is still potential risk for soil erosion to occur resulting in sediment transport to local water ways including Lake Goran. The use of previously disturbed areas (i.e. existing access tracks) and the selection of level or gently sloping sites will minimise the disturbance footprint of the exploration.

3.10.2 Environmental Issues

The following are considered to be the key environmental issues in relation to erosion and sediment control for the construction phase:

- Loss of topsoil and sub-soils;
- Potential risk for soil erosion to occur resulting in sediment transport to Lake Goran.
- Reduced potential for rehabilitation success; and
- Long term stability of disturbed areas.

It is considered that the potential impacts can be appropriately managed if the mitigation measures presented below are implemented.

3.10.3 Management Measures

The erosion and sediment control measures are proposed as follows:

- Any displaced soil gathered during operations will be stockpiled within the compound. This soil is to be used as backfill at the conclusion of drilling operations;
- Existing ground cover will be maintained where possible;
- Entry/exit points will be stabilised to the work area or any high traffic areas;
- Sediment fences will be installed at the downstream limit of the disturbance area; and
- The disturbed area will be rehabilitated upon completion of activities.

3.11 Noise Control

3.11.1 Overview

The site is located in an agricultural area where the existing noise levels are relatively low. The nearest residence is approximately 1.85km to the north east of the site. This residence is associated with the landholder's property.

3.11.2 Environmental Issues

Drilling activities are temporary and noise will be generated by the construction of the lease and track infrastructure for a duration of approximately 14 days, drilling over approximately 56 days and rehabilitation for approximately 30 days. Drilling activities will be 24 hours per day 7 days per week with lease and track construction activities to be conducted over a 12 hour day shift. The majority of the noise will be associated with the operation of the drill rig.

3.11.3 Management Measures

To minimise the potential impacts on noise the following actions will be implemented:

- Santos will ensure that any community issues of concern will be met with a prompt response;
- Santos will undertake to refine on site noise mitigation measures and plant operating procedures where practical;
- Landholder notification will be given prior to commencement of drilling; and
- Equipment will be maintained so that noise levels remain constant.

3.12 Air Quality

3.12.1 Overview

The existing air quality of the locality is typical of a rural area with the majority of air emissions and pollutants arising from existing agricultural activities including stock grazing, land clearing and soil preparation, sowing and harvesting of crops, vehicle and heavy machinery movements; bushfires and burn-offs.

3.12.2 Environmental Issues

The potential for the activity to introduce additional air emissions would arise from the following sources:

- Vehicle movements to and from the site;
- Construction and rehabilitation of the proposed access tracks and well leases;
- Drilling and testing of the wells;
- Operation of plant (i.e. temporary power generation); and

- Flaring of gas.

The inclusion of a flare pit is a safety precaution associated with the drilling activities to minimise potential risk to personnel or plant on the site so that any gas that is encountered during drilling can safely flare in accordance with Santos' established process for flaring.

The air emissions associated with the proposal will be dust and greenhouse gases.

The dust generated by drilling and ancillary equipment travelling to and from the site would vary depending on road and weather conditions. The access track is in good condition and is proposed to be gravelled prior to the commencement of drilling activities. Vehicle movement would be very slow and therefore minimal dust would be generated. In the context of the surrounding agricultural activities this will not be a significant issue.

As the proposed activities are associated with exploration, potential contributions to greenhouse gases, for the duration of the activities, are confined to:

- The operation of diesel fuelled vehicular traffic;
- Plant including the drilling rig;
- Flaring in the event of an emergency; and
- Site power generation.

Collectively these represent minimal emissions when compared with the agricultural activities that take place throughout the region. It is considered that the potential impacts associated with air emissions can be appropriately managed if the mitigation measures presented below are implemented.

3.12.3 Management Measures

To minimise impacts on air quality the following actions will be undertaken:

- Access tracks are to be gravelled and maintained in a compacted state;
- Land disturbance areas are to be minimised; and
- Slow speed restrictions will be enforced on internal site access tracks.

3.13 Weed Control

3.13.1 Overview

The proposed activities have the potential to create favourable conditions for additional introduced weed species within the study area, which could potentially lead to an increase of existing weed populations. This is most likely to occur where soil disturbance is to occur.

3.13.2 Environmental Issues

Noogoora Burr, a Class 4 noxious weed, was identified on the investigation site along with numerous environmental weeds. Gunnedah Shire Council is the local control authority (LCA) for noxious weeds that occur in the local government area (LGA).

Key environmental issues associated with weed control include:

- The spread of weed species on and off site; and
- Potential for unsustainable rehabilitation.

3.13.3 Management Measures

The *Noxious Weeds Act 1993* states that the growth and spread of Class 4 noxious weeds must be controlled. Landowners and occupiers are responsible for the control of noxious weeds according to their Class as specified in the Act. The following weed management procedures will be implemented to prevent the spread of weeds both on and off site:

- Noogoora Burr, a Class 4 declared noxious weed will be appropriately controlled within the proposal footprint and along the proposed access road and tracks prior to the construction stage;
- Weed monitoring will occur throughout the construction phase, and weed removal will be carried out as necessary;
- Where vehicles and machinery are moving between the site and weed free areas, wash down procedures must be implemented;
- All cleared weed species will be stockpiled separately, and removed off site. Weed material is not to be re-used as part of site rehabilitation;
- If practical, clearing will commence in areas of low weed infestation, and move towards areas of high weed infestation; and
- Weed infestations identified by the supervising ecologist within and adjacent to access tracks and well leased will be eradicated by hand, with non-residual herbicide, or mechanical removal. Appropriate weed removal techniques are outlined in **Table 3.1**.

Table 3.1: Weed Removal Techniques

Weed Type	Removal Technique	Method
Woody Weeds	Cut and Paint	▪ Make a horizontal cut through the stem close to the ground using secateurs, loppers or a bush saw; and ▪ Immediately apply herbicide to the exposed flat stump surface.
	Stem Injection	▪ At the base of the tree drill holes at a 45 degree angle into the sapwood; ▪ Fill each hole with herbicide immediately; and ▪ Repeat the process at 5 cm intervals around the tree.
	Frilling or Chipping	▪ At the base of the tree make a cut into the sapwood with a chisel or axe;

Weed Type	Removal Technique	Method
		- Fill each cut with herbicide immediately; and - Repeat the process at 5 cm intervals around the tree.
Small Plants	Hand removal	- Remove any seeds or fruits and carefully place into a bag; - Grasp stem at ground level, rock plant backwards and forwards to loosen roots and pull out; and - Tap the roots to dislodge any soil, replace disturbed soil and pat down.
Vines and Scramblers	Hand removal	- Take hold of one runner and pull towards yourself; - Check points of resistance where fibrous roots grow from the nodes; - Cut roots with a knife or dig out with a trowel and continue to follow the runner; - The major root systems need to be removed manually or scrape/cut and painted with herbicide; and - Any reproductive parts need to be bagged.
	Stem Scraping	- Scrape 15 to 30 cm of the stem with a knife to reach the layer below the bark/outer layer; and - Immediately apply herbicide along the length of the scrape.
Weeds with Underground Reproductive Structures	Hand removal	- Remove and bag seeds or fruits; - Push a narrow trowel or knife into the ground beside the tap root, carefully loosen the soil and repeat this step around the taproot; - Grasp the stem at ground level, rock plant backwards and forwards and gently pull removing the plant; and - Tap the roots to dislodge soil, replace disturbed soil and pat down.
	Crowning	- Remove and bag stems with seed or fruit; - Grasp the leaves or stems together so the base of the plant is visible; - Insert the knife or lever at an angle close to the crown; - Cut through all the roots around the crown; and - Remove and bag the crown.
	Stem Swiping	- Remove any seed or fruit and bag; and - Using an herbicide applicator, swipe the stems/leaves.

3.14 Disease Control

3.14.1 Overview

Disease control is required due to the potential for particular plant / soil diseases to be spread, particularly *Phytophthora*. *Phytophthora* can be spread via unregulated exposure and movement of soils between areas of construction. Measures will therefore be implemented to avoid such disease facilitation from occurring.

3.14.2 Environmental Issues

The following are key environmental issues in relation to disease control:

- Damage to native vegetation possibly leading to death;

- Loss of biodiversity; and
- Poor regeneration.

3.14.3 Management Measures

A variety of management measures will be adapted to minimise and control disease on the site:

- If machinery is transported from an area of confirmed infection to the site, stringent wash down must be completed before leaving the area, removing all soil and vegetative material from cabins, trays, and under carriages;
- Construction personnel will be trained adequately in pest management and hygiene procedures; and
- All machinery to be clean of foreign soil and propagative matter to avoid the importation of *Phytophthora*.

3.15 Bushfire Prevention

3.15.1 Overview

Bushfire prevention needs to be considered as there is the potential for bushfires to ignite as a result of the construction activities. This can occur as a result of vehicles operating in dry flammable areas, conducting construction activities, and as a result of equipment such as petrol-driven pumps and generators.

3.15.2 Environmental Issues

The following key environmental issues are associated with bushfires:

- Damage to, or loss of, flora, fauna and habitat;
- Impacts to primary industry production; and
- Damage to, or loss of, third party infrastructure.

3.15.3 Management Measures

The following measures will be implemented throughout the construction phase:

- Clearing all flammable material from around potential fire ignition sources;
- Ensuring flammable materials are cleared from the immediate vicinity of field equipment which may pose a potential fire hazard e.g. petrol driven pumps, generators;
- Maintenance and operation of all machinery so as to comply with relevant fire safety standards thus minimising fire risk; and
- Machinery and vehicles not in use will be parked in areas free of flammable material and vegetation (e.g. not parked over shrubs, tall grass or cleared vegetation residue).

Fire response preparation measures will be implemented throughout the construction phase, including:

- Storage of appropriate fire fighting equipment in accordance with the requirements of the relevant State Fire Protection Regulations. Equipment will be of the required standard and be inspected and well maintained throughout the construction phase;
- Equipping construction machinery and vehicles with fire fighting equipment at the appropriate times in accordance with the relevant Fire Protection Regulations; and
- Construction workforce bushfire education and training will be undertaken as appropriate detailing fire prevention and safety, personnel responsibilities and basic fire suppression.

3.16 Groundwater

3.16.1 Overview

The groundwater at the Goran South core hole site and surrounding areas consist of both alluvial and hard rock aquifers. Alluvial aquifers are generally those that are closer to the surface and associated with more porous soil and rock materials. The consolidated formations (e.g. hard rock aquifers) of the Gunnedah Basin comprise interbedded coals, sandstone and siltstones and are not considered major groundwater sources.

The target CSG bearing formations for this proposal are the Permian coals of the Black Jack Group (Hoskissons Coal). Other bores completed within the Black Jack Group have water levels between 10 and 16m below ground level. The aquifers of the Black Jack Group are low yielding with two bores indicating a yield of approximately 1 litre per second.

Due to the type of activity proposed, water from the targeted coal seams is not anticipated to be lifted.

3.16.2 Environmental Issues

Potential impacts on groundwater may arise from the drilling process, where cross-contamination of groundwater from drilling fluids can occur. This will be prevented through the casing and completion of the well in accordance with regulatory requirements.

There is also the potential impact of seepage of drilling mud, drilling additives and/or hydrocarbons (oils/lubricants etc) to shallow groundwater beneath the rig and core hole site.

3.16.3 Management Measures

To minimise impacts on groundwater, the following mitigation measures are proposed:

- The drilling installation of the core hole will be undertaken in accordance with good industry practices; and
- Monitoring of private groundwater bores within a 2km radius (with landholder permission) will be undertaken before drilling commences, to more clearly establish baseline conditions and then

continue monitoring on a regular basis throughout the duration of all drilling activities. It is proposed that monitoring will include water level and water quality (electrical conductivity) observations.

In order to manage/prevent the risk of any seepage of drilling fluids to shallow groundwater, it is recommended that, the drilling sumps should be lined (with an appropriate impermeable material) and that all drilling fluids are completely removed from site prior to site rehabilitation.

In addition to the above, the natural existence of shallow subsurface alluvium (which contains relatively impermeable clays) will further minimize potential water quality risks associated with possible partial failure of these mitigation measures. These clays will tend to hold any contaminant in the near surface zone above the water table.

3.17 Surface Water

3.17.1 Overview

The subject site is located in the Goran sub-catchment. Goran sub-catchment comprises an area of 590km² with elevations ranging from 680m on Coolanbilla Mountain to 300m within Goran Lake. Lake Goran spills to the east into the Mooki River. Recharge under Lake Goran has also been estimated at approximately 6mm per year.

The proposed well lease is located above the flood level of the lake. Water for drilling operations will be sourced from Council or another licensed provider.

3.17.2 Environmental Issues

There is the potential for the proposed activities to impact on the surface water quality of Lake Goran located adjacent to the site through sedimentation and site run-off. There is also the potential for chemicals and fuels from operational areas to come in contact with surface waters.

It is considered that the potential impacts associated with surface water can be appropriately managed if the mitigation measures presented below are implemented.

3.17.3 Management Measures

Proposed measures to protect surface waters include:

- Contaminated waters will be contained and where necessary disposed of at an appropriate facility;
- Drilling fluids will be contained on site and not discharged to surrounding watercourses. Over-balanced drill techniques to be utilised to prevent formation fluid from rising through the well to the surface;
- Excessive fluid losses will be cured by LCM (cellulose material such as sawdust) to ensure most fluids return to the surface;
- Sediment fences and traps will be installed so as to prevent soil loss or sedimentation;

-
- Fuel and lubricants will be stored on site only when necessary and maintained off site whenever possible;
 - All areas storing or handling fuel, fuel using equipment, and chemicals will be bunded in accordance with Australian Standard 1940 – 2004; The Storage and Handling of Flammable and Combustible Liquids;
 - The maintenance and cleaning of vehicles and other equipment or plant will be carried out in areas from where the resultant contaminants cannot be released into any waters;
 - Wastewater removed from site will be managed by a contractor licensed to carry and handle water;
 - Where applicable maintenance of roads, drains, bund walls, contour and diversion banks to occur. All drainage structures will be maintained for the life of the development;
 - Disturbed land will be rehabilitated to pre-operational quality or better, to minimise sediment erosion; and
 - During rehabilitation, diversion banks and ripping along the contour will be completed to prevent the concentration and momentum of water flow as required.

3.18 Chemical and Hazardous Substances Management

3.18.1 Overview

The drilling operations would generally only use chemicals such as drilling fluids/agents, fuels, and lubricants. While these substances are not considered highly hazardous, there is still the potential risk of fire and pollution to land, water and air, if an accidental spillage was to occur.

3.18.2 Management Measures

The following measures will be implemented throughout the construction phase:

- Site operations to adhere to the Occupational Health and Safety Act 2000 and the protection of the Environment Operations Act 1997;
- Any storage of Flammable and Combustible Liquids shall be stored and handled in accordance with the Australian Standards AS1940:2004; The storage and handling of flammable and combustible liquids; and
- Disposal of all waste (including fuels, chemicals and LCM) off-site in accordance with relevant regulations.

4.0 Decommissioning

Site decommissioning includes the following:

- Plugging and abandonment of the well including cut and removal of intermediate casing to avoid (as much as is possible) suspension of steel casing over mineable coal seams (as required);
- Removal of equipment and imported materials from the site; and
- Full rehabilitation of the site in line with legislative and landholder requirements.

4.1 Pilot Well Plug & Abandonment

Following bore logging and any post total depth activities, the well will be cemented, plugged and abandoned in accordance with regulatory requirements and rehabilitated following completion of activities within the allowed regulatory timeframe, unless needed for further exploration testing. In the case of plug and abandonment, the intermediate casing would be removed above the top of cement (where required and practicable) and a steel identification plate installed near the top of the hole greater than one metre below the surface.

4.2 Equipment Removal

All equipment and imported materials will be removed off site under the following management procedures:

- All site equipment will be removed using existing access tracks to minimise weed spread and further disturbances;
- All fencing and erosion and sediment control devices will be pulled down and taken off site;
- All holes and drains will be backfilled to ground level, stockpiles to be levelled or removed off site; and
- All wastes removed off site and disposed off at the appropriate facility.

4.3 Site Rehabilitation

The proposed rehabilitation and revegetation of the well lease site and access track will reinstate native ground covers. Given the current land use is grazing, the disturbed areas will be re-seeded with native grasses and will coincide with landholder requirements, being re-instated as grazing pasture or natural grasslands. No weed species will be used to rehabilitate the well lease.

4.3.1 Timing and Objectives

The operations are temporary in nature, with a duration of approximately 70 days. Revegetation and rehabilitation will be undertaken within the required regulatory timeframe. Rehabilitation will aim to:

- Ensure a stable landform is maintained;

- All private tracks used during operations are generally returned to their pre-operations state or to a condition agreed by the landholder; and
- Re-instate the site to a stable landform that is representative of the pre-clearing vegetation condition and composition, or better.

4.3.2 Species Schedule

The desired rehabilitation species have been identified in **Table 4.1**. These species are native species representative of the existing community. These species should be added to a hydromulch mix and sprayed over the well lease area.

Table 4.1: Rehabilitation Species Selection

Scientific Name	Common Name	Type
<i>Austrostipa aristiglumis</i>	Plains Grass	Seed
<i>Aristida ramosa</i>	Purple Wiregrass	Seed
<i>Austrostipa scabra subsp. scabra</i>	Speargrass	Seed
<i>Austrostipa verticillata</i>	Slender Bamboo Grass	Seed
<i>Chloris truncata</i>	Windmill Grass	Seed
<i>Bothriochloa decipiens</i>	Pitted Bluegrass	Seed

4.3.3 Rehabilitation Performance Criteria, Monitoring and Actions

To determine the success of rehabilitation efforts a number of performance criteria for the site have been developed in **Table 4.2**. This table also identifies rehabilitation actions to be implemented and monitoring requirements to evaluate rehabilitation success.

Table 4.2: Rehabilitation Management Schedule

Rehabilitation Management Schedule		
Performance Criteria	Rehabilitation is considered finalised when the performance criteria outlined below are met. Where these criteria have not been met by the end of the assessable period, further monitoring and maintenance will be required until success is achieved.	
	Performance Criteria	Success verification
		2 months following rehab 1 Year following rehab
	1. Evidence of ground cover (ground cover includes mulch, plants and habitat features)	≥60% ground cover ≥70% ground cover
	2. Correct species used	Evidence of native species generation ≥90% of ground cover is native species
	3. Minimal presence of declared pest plants	≤30% declared weed cover ≤10% declared weed cover
	4. Minimal signs of subsidence or erosion	Landform reshaped and topsoil respread. Seeding completed. Erosion and sediment control measures in place. Minimal evidence of erosion. Stable and self-sufficient landform.
Timing	Rehabilitation Actions	Responsibility
Upon Decommissioning	- Erosion and sediment control measures are implemented to reduce runoff and disturbances prior to rehabilitation; and - Control weeds present on site.	Santos
Within 6 months of decommissioning	- Control weeds present on site; - Respread topsoil; - Spray and maintain hydromulch as per revegetation contractors requirements; and - Ensure erosion and sediment control measures are implemented as required.	Santos
Timing	Monitoring Tasks	Responsibility
60 days since rehabilitation	- Survey undertaken by ecologist to verify 60 day performance criteria. Surveys to document rehabilitation success with site data and photo monitoring; and - Review rehabilitation success and investigate areas that have been unsuccessful.	Santos & Ecologist
1 year since rehabilitation	- Survey undertaken by ecologist to verify 1 year performance criteria. Surveys to document rehabilitation success with site data and photo monitoring; and - Review rehabilitation success and investigate areas that have been unsuccessful.	Santos & Ecologist
Timing	Corrective Procedures	Responsibility
Following each monitoring event	- Reinstate erosion & sediment controls as required (e.g. jute matting, mulch, sediment fencing in areas suffering erosion); - Treat declared weed species and manage spread of other	Santos

Rehabilitation Management Schedule		
	weeds; and Review rehabilitation success and investigate areas that have been unsuccessful.	
Timing	Reporting	Responsibility
Following each monitoring event or as required by site approval.	Report identifying results of monitoring events with assessment against each performance criteria.	Santos & Ecologist

5.0 Reporting

One final report is required for the project. This report will discuss the sites construction and decommissioning activities as well as rehabilitation success. The report is to include an assessment of compliance with statutory authorities, success in achieving objectives, and any environmental outcomes. The report will be completed within 6 months of decommissioning, and kept by Santos QNT Pty Ltd. Where required, additional maintenance requirements will be outlined within this report.