NSW GOVERNMENT | Public Works Advisory

Water Monitoring Strategy for Coal Basins in NSW – New Groundwater Monitoring Bores in the Gunnedah Basin

Review of Environmental Factors

Report Number: ISR18059

October 2018

Prepared for Department of Industry

Lands and Water Division

NSW GOVERNMENT | Department of Industry

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Cover photo source: DoI - Water, 2017

Declaration

This Review of Environmental Factors (REF) has been prepared by Public Works Advisory (a division of the Department of Finance, Services and Innovation) on behalf of the Lands and Water Division, Water Branch, Department of Industry (DoI - Water). The report presents the assessment of potential impacts that may result from the implementation of the Water Monitoring Framework project in the Gunnedah Basin, comprising the installation of twenty (20) groundwater monitoring bores at eleven (11) prioritised sites.

DoI - Water is a public authority and a determining authority as defined in the *Environmental Planning & Assessment Act 1979* (EP&A Act). The proposal satisfies the definition of an activity under the Act, and as such DoI - Water must assess and consider the environmental impacts of the proposal before determining whether to proceed.

This REF has been prepared in accordance with Sections 5.5 and 5.7 of the EP&A Act and Clause 228 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Reg). This REF provides a true and fair assessment of the proposed activity in relation to its likely effects on the environment. Notwithstanding further biodiversity assessments that are required, it addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposed activity.

On the basis of the information presented in this REF (noting that further assessment is required for Site 1D Pilliga West to confirm potential biodiversity impacts on vulnerable species) it is concluded that:

(1) The proposed activity is not likely to have a significant impact on the environment and therefore an Environmental Impact Statement is not required.

(2) The proposed activity is not likely to significantly affect threatened species, populations, ecological communities, or critical habitat. Therefore, a Biodiversity Development Assessment Report or Species Impact Statement (SIS) is not required.

(3) The proposed Activity is not likely to affect any Commonwealth land, is not being carried out on Commonwealth land, or significantly affects any Matters of National Environmental Significance.

The proposed activity is recommended for approval subject to:

- Further assessment of potential biodiversity impacts at Site 1D Pilliga West, in relation to potential Pilliga Mouse habitat, undertaken in accordance with the requirements of the NSW *Biodiversity Conservation Act 2016* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*;
- Implementation of measures to avoid, minimise or manage environmental impacts in this REF.

Author & Qualifications	Rasha Haymour, GC EnvP
Author Designation	Environmental Scientist/Planner
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Designation	Senior Environmental Scientist
Organisation	Public Works Advisory, Department of Finance, Services and Innovation
Signature	
Date	17/10/2018

Verification and Determination

Verifier

I have examined this REF and the Declaration by Rasha Haymour (the author) and accept the report on behalf of DoI - Water.

Name	Doug Trudeau
Designation	Lead Water Resources Officer
Organisation	Department of Industry, Lands and Water Division
Signature	[redacted]

Determination

I accept the report and determine that the activity may proceed.

Name	Lynn Tamsitt
Designation	Director, Water Science
Organisation	Department of Industry, Lands and Water Division
Signature	[redacted]

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List of Abbreviations

Abbreviation	Description
CEMP	Construction Environmental Management Plan
CSG	CSG
DoI - Water	Department of Industry, Lands and Water Division, Water Branch
DPI	NSW Department of Primary Industries
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Reg	*Environmental Planning and Assessment Regulation 2000*
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GDE	Groundwater Dependent Ecosystem
GW	Groundwater
LEP	Local Environmental Plan
LGA	Local Government Area
NPW Act	*National Parks and Wildlife Act 1974*
OEH	Office of Environment and Heritage
POEO Act	*Protection of The Environment Operations Act 1997*
REF	Review of Environmental Factors
SEPP	State Environmental Planning Policy
TMP	Traffic Management Plan
WM Act	*Water Management Act 2000*
WMP	Waste Management Plan
WSP	Water Sharing Plan

1 Introduction

1.1 Background and Context

1.1.1 Water Monitoring Strategy for NSW Coal Basins

DoI - Water has developed a Water Monitoring Strategy for Coal Basins in NSW involving Water Monitoring Expansion (the project). This Strategy describes actions proposed to enhance water monitoring in the NSW coal basins. It addresses the recommendations of the NSW Chief Scientist and Engineer relating to the NSW Government's commitment to invest in better monitoring and more accessible information.

The Water Monitoring Expansion project includes two components:

- Expanding groundwater monitoring by drilling new groundwater monitoring bores in the deeper strata of NSW coal basins; and
- Expanding groundwater level and quality monitoring programs into coal basins with current or potential new coal and Coal Seam Gas (CSG) development.

A number of catchments within the NSW coal basins were identified to locate bores required for the monitoring network expansion as part of this project. The coal basin target areas are displayed in Figure 1-1.

1.1.2 Activities in Gunnedah Basin

The Gunnedah Basin has a history of coal and conventional petroleum exploration and coal mining, and more recently the basin's potential CSG targets have attracted much interest in the area. Economic coal deposits are located mainly within the Maules Creek sub-basin of the Gunnedah Basin, where the Maules Creek Formation and the Black Jack Group host numerous coal seams varying in thickness and quality.

Coal is mined in the central and eastern parts of the Gunnedah Basin using mainly open-cut methods, although one underground mine is in operation.

There are currently eight operating coal mines in the Namoi subregion. Seven of these are open-cut (Maules Creek, Boggabri, Tarrawonga, Rocglen, Werris Creek, Whitehaven, and Blue Vale (Vickery)) and the eighth is an underground mine (Narrabri). CSG is extracted commercially for use within a local privately owned powerplant near Narrabri. CSG production is proposed from the Narrabri Gas Project being investigated by Santos and is currently going through the approval process.

The geological Gunnedah Basin is the subject of six current CSG developments in various stages of exploration and appraisal. The principal seams for CSG exploration in the Gunnedah Basin are the Hoskissons Coal, which lies within the Late Permian Black Jack Group, and the Early Permian coal seams of the Maules Creek Formation, located towards the base of the Bohena Trough.

Most of the Gunnedah Basin is underlain by petroleum exploration licences, with the exception of one tenement at the western extent of the basin. Current CSG exploration developments are concentrated in the Gunnedah Basin, which is only present in the central eastern part of the Basin. According to the MinView database, 175 CSG-related wells have been drilled in the Gunnedah Basin. The majority of wells are located to the south and south-west of Narrabri.

1.2 Proposal Overview and Objectives

This REF is being prepared to support the expansion of the groundwater monitoring network into the Gunnedah Basin, and comprises the installation and operation of twenty (20) bores at eleven (11) sites that would enable DoI - Water to establish a water monitoring network throughout the Basin. A regional view of the proposed bore site locations is shown in Figure 1-2. Site-specific details are shown in Table 1-1, while, maps and photographs are provided in Appendix A.

The main objectives of the proposal are to enable DoI - Water to understand existing groundwater resources, as well as to understand the impact of present and future changes in regional groundwater resources influenced by mining and other natural resource extraction industries likely to occur in the Gunnedah Basin region.

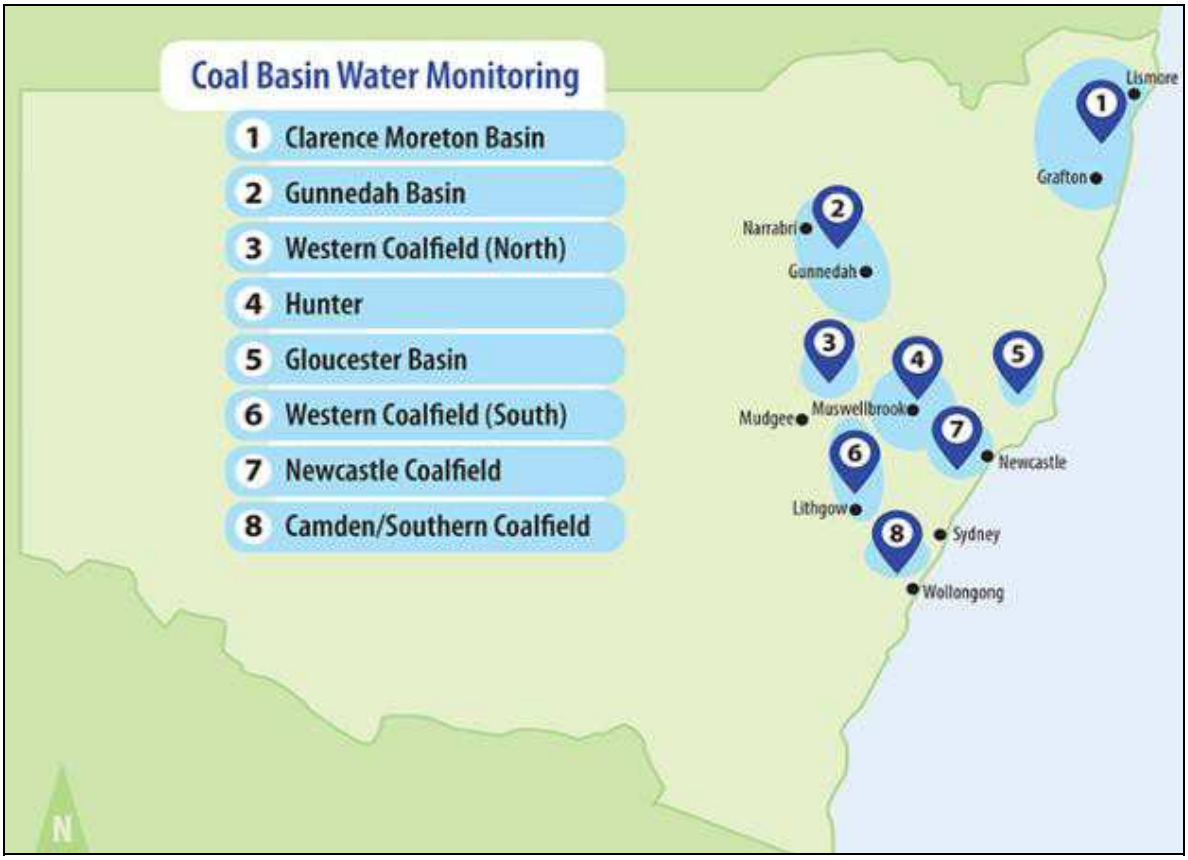

Figure 1-1: Coal basins in NSW targeted by the Strategy

Source: DoI - Water Website, accessed 2018.

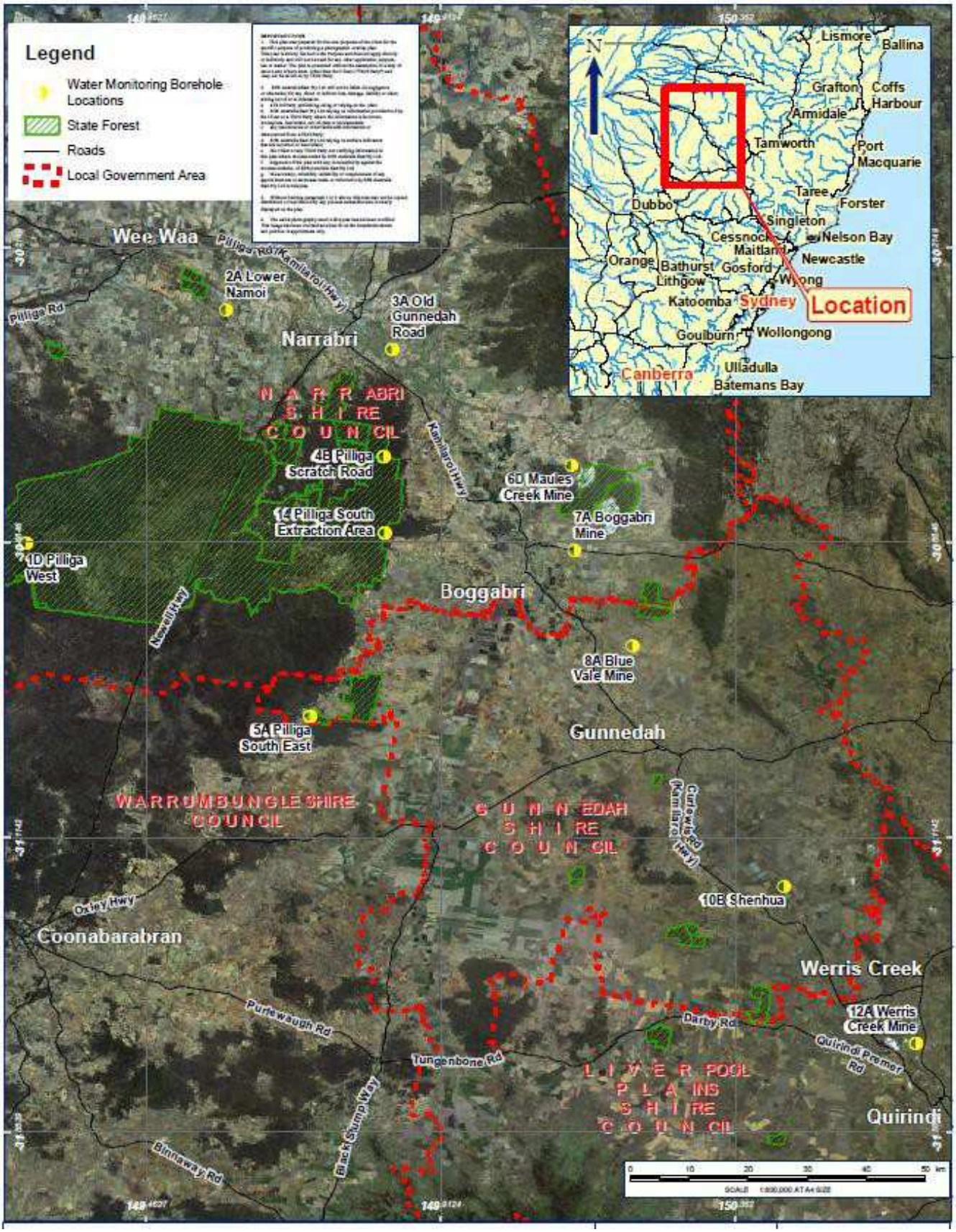

Figure 1-2: Locations of the Proposed Bore Sites in the Gunnedah Basin

Source: RPS Australia, 2018

Table 1-1: Details for Each Bore Location

Site	Depth	Target Layer	Lot & DP	Co-ordinates		LGA	Land Ownership
				Longitude	Latitude		
1D Pilliga West	Shallow, 190m	Shallow Pilliga Sandstone	State land	149.27951	-30.66452	Narrabri	Forestry Corporation of NSW
	Medium, 380m	Napperby / Digby - On ridge above Hoskissions Seam					
2A Lower Namoi	Shallow, 170m	Shallow Pilliga Sandstone	-	149.58385	-30.30837	Narrabri	Council
3A Old Gunnedah Road	Shallow, 160m	Shallow Pilliga Sandstone	7001//DP1029804	149.83846	-30.36817	Narrabri	DoI - Water Managed by Rural Lands Protection Board
	Medium, 380m	Napperby/ Digby - On ridge above Hoskissions Seam					
4B Pilliga Scratch Road	Shallow, 120m	Shallow Pilliga Sandstone	State land	149.82580	-30.53250	Narrabri	Forestry Corporation of NSW
	Medium, 400m	Napperby / Digby - On ridge above Hoskissions Seam					
	Deep, 620m	Porcupine Fm - above Maules Creek Fm					
5A Pilliga South	Shallow, 120m	Shallow Pilliga Sandstone	State land	149.71300	-30.92857	Gunnedah	Forestry

Site	Depth	Target Layer	Lot & DP	Co-ordinates		LGA	Land Ownership
				Longitude	Latitude		
East	Medium, 430m	Within Hoskissons seam					Corporation of NSW
	Deep, 540m	Within Maules Creek seam					
6D Maules Creek Mine	Shallow, 120m	Shallow within basement adjacent to Maules Creek alluv	7003//DP1114719	150.11223	-30.54532	Narrabri	DoI - Water Managed by Rural Lands Protection Board
7A Boggabri Mine	Shallow, 120m	Shallow within basement adjacent to alluvium	164//DP754926	150.11694	-30.67542	Narrabri	DoI - Water Managed by Rural Lands Protection Board
8A Blue Vale Mine	Shallow, 140m	Shallow within basement adjacent to alluvium	2//DP1034512	150.20571	-30.82108	Gunnedah	DoI - Water Managed by Rural Lands Protection Board
10B Shenhua	Shallow, 120m	Porcupine Fm - above basement	7300//DP1143103	150.43616	-31.18795	Gunnedah	DoI - Water Managed by Rural Lands Protection Board

Site	Depth	Target Layer	Lot & DP	Co-ordinates		LGA	Land Ownership
				Longitude	Latitude		
12A Werris Creek Mine	Shallow, 65m	Alluvium	Road corridor	150.63788	-31.42853	Liverpool Plains	Council
	Shallow, 100m	Shallow hard rock				Liverpool Plains	Council
14 Pilliga South Extraction Area	Shallow, 90m	Shallow Pilliga S/S NCCC	State land	149.82722	-30.64756	Narrabri	Forestry Corporation of NSW
	Medium, 360m	Within Hoskisson Seam for baseline NCCC					
	Deep, 495m	Within Maules Creek Seam for baseline NCCC					

2 Statutory Considerations

This section presents the statutory planning and strategic policy context for the proposal.

2.1 Environmental Planning Instruments

The sites assessed in this REF fall across three local government areas, being Gunnedah, Liverpool Plains and Narrabri (see Figure 1-2 above). The respective environmental planning instruments that apply in each LGA are described below.

2.1.1 Gunnedah Local Environmental Plan 2012

There are three sites in the Gunnedah LGA, being Sites 5A Shallow, Medium & Deep, Site 8A Blue Vale Mine and Site 10B Shenhua. These sites are subject to the provisions of the Gunnedah Local Environmental Plan 2012, including the following land zonings and permissibility:

- RU1 – Primary Production (Sites 8A Blue Vale Mine, 10B Shenhua) – Permitted with consent
- RU3 – Forestry (Sites 5A Shallow, Medium & Deep) - Prohibited

However, as discussed in Section 2.1.4 below, *State Environmental Planning Policy (Infrastructure) 2007* is the relevant environmental planning instrument for the proposal and allows water monitoring stations to proceed on any land without the need to obtain development consent.

In addition, clause 5.12 of the Gunnedah LEP 2012 states that the LEP *does not restrict or prohibit, or enable the restriction or prohibition of, the carrying out of any development, by or on behalf of a public authority, that is permitted to be carried out with or without development consent, or that is exempt development, under State Environmental Planning Policy (Infrastructure) 2007*.

2.1.2 Liverpool Plains Local Environmental Plan 2011

There is one site in the Liverpool Plains LGA, being Site 12A Werris Creek Mine Shallow & Shallow (refer Figure 1-2). This site is subject to the provisions of the Liverpool Plains LEP 2011 and is zoned Zone RU1 – Primary Production. The proposed bores are permitted with consent in this zone under the LEP.

However, as discussed in Section 2.1.4 below, *State Environmental Planning Policy Infrastructure (SEPP (Infrastructure) 2007) 2007* is the relevant environmental planning instrument for the proposal and allows water monitoring stations to proceed on any land without the need to obtain development consent.

In addition, clause 5.12 of the Liverpool Plains LEP 2011 states that the LEP *does not restrict or prohibit, or enable the restriction or prohibition of, the carrying out of any development, by or on behalf of a public authority, that is permitted to be carried out with or without development consent, or that is exempt development, under State Environmental Planning Policy (Infrastructure) 2007.*

2.1.3 Narrabri Local Environmental Plan 2012

There are seven sites in the Narrabri LGA, being:

- Site 1D Pilliga West

- Site 2A Lower Namoi
- Sites 3A Old Gunnedah Road
- Site 4B Pilliga Scratch Road
- Site 6D Maules Creek Mine
- Site 7A Boggabri Mine
- Site 14 Pilliga South Extraction Area

These are shown in Figure 1-2 above.

These sites are subject to the provisions of the Narrabri Local Environmental Plan 2012, including the following land zonings and permissibility:

- RU1 – Primary Production (Site 2A Lower Namoi, Sites 3A Shallow and Medium, Site 6D Maules Creek Mine, Site 7A) - Prohibited
- RU3 – Forestry (Sites 1D Pilliga West Shallow and Medium, Sites 4B Pilliga Scratch Road Shallow, Medium and Deep, Sites 14 Pilliga South Extraction Area Shallow, Medium and Deep) - Prohibited

However, as discussed in Section 2.1.4 below, *State Environmental Planning Policy Infrastructure (SEPP (Infrastructure) 2007) 2007* is the relevant environmental planning instrument for the proposal and allows water monitoring stations to proceed on any land without the need to obtain development consent.

In addition, clause 5.12 of the Narrabri LEP 2012 states that it *does not restrict or prohibit, or enable the restriction or prohibition of, the carrying out of any development, by or on behalf of a public authority, that is permitted to be carried out with or without development consent, or that is exempt development, under SEPP (Infrastructure) 2007*.

2.1.4 State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 (SEPP (Infrastructure) 2007) aims to assist in the effective delivery of public infrastructure by improving certainty and regulatory efficiency. It provides a clear definition of environmental assessment and approval process for public infrastructure and services facilities.

Clause 92 (2) of the SEPP (Infrastructure) 2007 states that development for the purpose of a monitoring station may be carried out by or on behalf of a public authority without consent on any land. Monitoring Station *means a facility operated for the principal purpose of monitoring weather, noise, air, water, groundwater or environmental impacts*. The proposed water monitoring bores meet the definition of a monitoring station and can therefore proceed without the need to obtain development consent.

2.1.5 State Environmental Planning Policy No 44 - Koala Habitat Protection

SEPP 44 applies to land identified as potential koala habitat and core koala habitat within LGAs listed in Schedule 1 of the SEPP, including Gunnedah and Narrabri.

Under this SEPP, potential koala habitat is defined under the SEPP 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 means 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. SEPP 44 requires preparation of a Plan of Management for core Koala habitat but does not strictly apply to activities approved under Parts 5 or 5.1 of the EP&A Act.

The installation of groundwater bores is not anticipated to remove trees or disturb SEPP 44 Koala populations or habitat. However, if track and construction pads require an area of more than 1 hectare and have the potential to affect core Koala habitat, further assessment should be undertaken in accordance with the *Biodiversity Conservation Act 2016* and in consideration of the objectives of SEPP 44.

2.2 NSW Legislation

2.2.1 Environmental Planning and Assessment Act 1979

The EP&A Act provides a framework for environmental planning and assessment in NSW. As detailed in Section 2.1.4, SEPP (Infrastructure) 2007 removes the requirement to obtain development consent for water monitoring stations and therefore the project would be assessed under Part 5 of the EP&A Act. This REF has been prepared to meet the requirements under Section 5.5 of the EP&A Act, which requires that the proponent take into account to the fullest extent possible all matters affecting or likely to affect the environment due to the proposed activity.

Clause 228 of the EP&A Reg provides guidance on how to determine whether an activity would have a significant impact on the environment. An assessment of the proposed works against the matters listed in Clause 228 is provided in Appendix B. Based on the assessment presented in this REF, it has been determined that the proposal is unlikely to significantly affect the environment and therefore the preparation of an EIS in accordance with Section 5.7 of the EP&A Act is not required.

DoI - Water would be the determining authority for the works. All other agencies with an approval role are also taken to be determining authorities and are considered to have undertaken this role through the provision of the relevant approval.

Ecologically Sustainable Development Principles (ESD)

The encouragement of ecologically sustainable development (ESD) is one of the Objects of the EP&A Act. The principles of ESD are:

The reasons justifying the carrying out of the development or activity in the manner proposed, having regard to biophysical, economic and social considerations, including the following principles of ecologically sustainable development:

(a) the precautionary principle, namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

In the application of the precautionary principle, public and private decisions should be guided by:

a) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and

b) an assessment of the risk-weighted consequences of various options,

(b) inter-generational equity, namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations,

(c) conservation of biological diversity and ecological integrity, namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration,

(d) improved valuation, pricing and incentive mechanisms, namely, that environmental factors should be included in the valuation of assets and services, such as:

(i) polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,

(ii) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,

(iii) environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structures, including market mechanisms that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

The proposed development is considered to be consistent with these principles. The monitoring bores would improve scientific knowledge and understanding of the impact extractive industries and mining have on groundwater in the Gunnedah Basin. Environmental safeguards would be implemented during construction works to prevent long term and irreversible environmental degradation in accordance with the precautionary principle and inter-generational integrity. The proposed development would not impact on biological diversity and ecological integrity at the bore sites, as the proposed bores are planned for cleared areas requiring minimal vegetation disturbance.

2.2.2 Water Management Act 2000 and Water Act 1912

The object of the *Water Management Act 2000* (WM Act) is the sustainable and integrated management of the State's water for the benefit of both present and future generations. The *Water Management Act 2000* is the main piece of water legislation for NSW ensuring secure access of water for users and that water is provided for the environment.

As the groundwater monitoring bores are for the purpose of *taking of water from or by means of an exempt monitoring bore for the purposes of measuring water levels, water pressure or water quality*, they do not require Water Access or Water Use approval, in accordance with clauses 18(1) and 31(1) of the *Water Management (General) Regulation 2011*.

Furthermore, the groundwater monitoring bores do not require a licence under the *Water Act 1912* as they are being installed for DoI - Water, as a statutory representative of the Crown. However, the bores must be registered with DoI - Water by the completion and submission of a bore construction report (known as a “Form A”). This is a requirement for all water bores drilled in NSW.

Water Sharing Plans

Groundwater within NSW is managed under Water Sharing Plans (WSP). These WSP includes rules for protecting the environment, water extractions, managing licence holders' water accounts and water trading in the plan area. Inland areas will soon be managed under Water Resource Plans once approved by the Murray Darling Basin Authority.

Groundwater contained within the Gunnedah Basin is managed under the *Water Sharing Plan for the NSW Murray – Darling Basin Porous Rock Groundwater Sources 2011*, and within this is managed under the Gunnedah - Oxley Basin MDB Groundwater Source.

Adjacent water sources are the NSW Great Artesian Basin Groundwater Sources and the Upper and Lower Namoi Groundwater Sources.

A schematic is provided in Figure 2-1 showing the relationship between these water sources (CDM Smith, 2014).

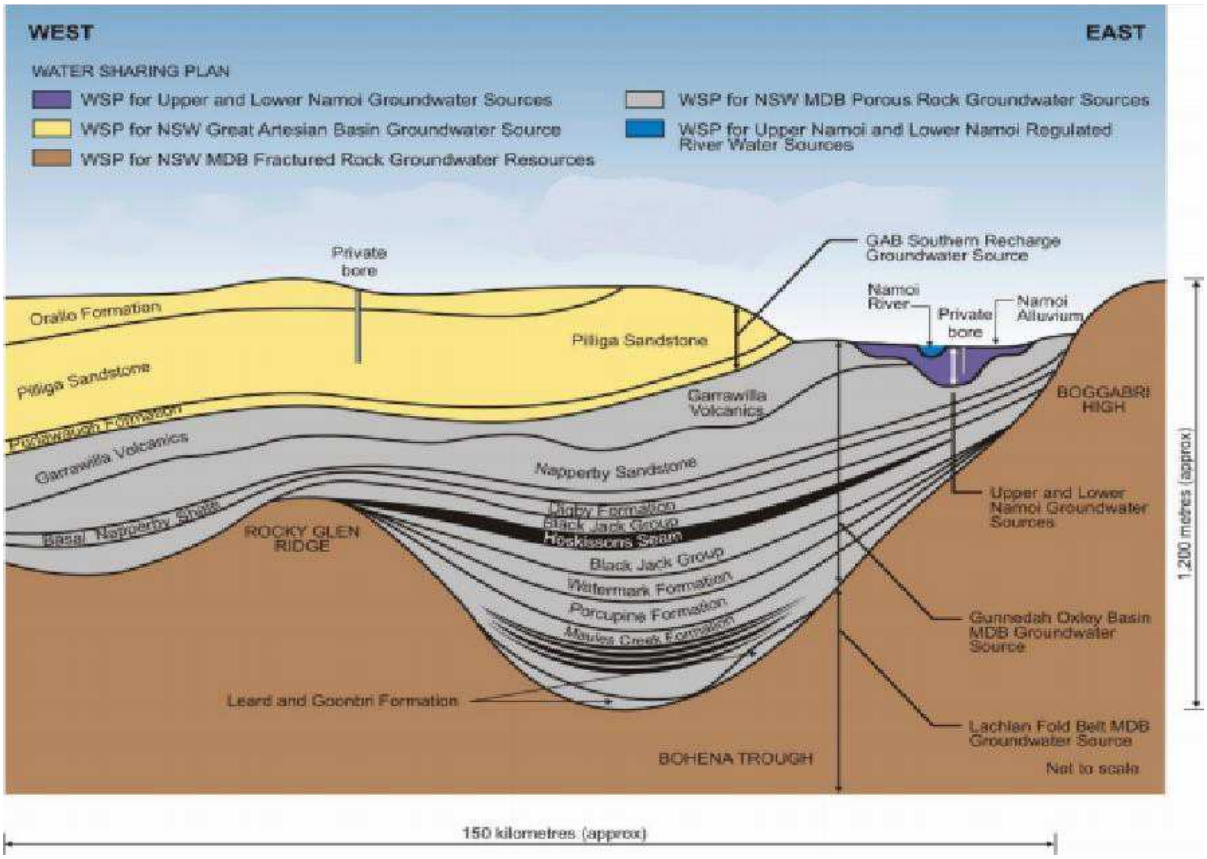

Figure 2-1: Relationship of Water Sources associated with the Gunnedah Basin

Source: CDM Smith, 2014

2.2.3 Roads Act 1993

Two of the bore sites are located within road reserves, being the sites at 12A Werris Creek Mine and 2A Lower Namoi. Liverpool Plains Shire Council and Narrabri Shire Council are the appropriate roads authorities for these road reserves, respectively.

Section 138 of the *Roads Act 1993* states that a person must not erect a structure or carry out a work in, on or over a public road, unless the appropriate roads authority has given consent.

2.2.4 Protection of the Environment Operations Act 1997

The NSW Environment Protection Authority (EPA) is responsible for the administration of the *Protection of the Environment Operations Act 1997* (POEO Act). The POEO Act regulates air, noise, land and water pollution.

Activities listed under Schedule 1 of the POEO Act are scheduled activities that require an environment protection licence. The proposal does not constitute a scheduled activity listed under Schedule 1 of the POEO Act and therefore an environment protection licence is not required.

Section 120 of the POEO Act makes it an offence to pollute waters. It is considered that the construction and operation of the water monitoring bores can be carried out without causing water pollution and therefore a licence would not be required.

2.2.5 Protection of the Environment Operations (Waste) Regulation 2014

The *Protection of the Environment Operations (Waste) Regulation 2014* sets out the provisions with regards to non-licensed waste activities and non-licensed waste transporting, in relation to the way in which waste must be stored, transported, and the reporting and record-keeping requirements. The proposed works (in particular aspects such as removal of spoil) would be undertaken to be consistent with the requirements of this regulation.

2.2.6 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BCA) commenced on 26 August 2017. The biodiversity conservation and land management reforms repeal several existing Acts, in particular the *Native Vegetation Act 2003*, *Threatened Species Conservation Act 1995,* the *Nature Conservation Trust Act 2001* and the animal and plant provisions of the *National Parks and Wildlife Act 1974*.

The BCA specifies the requirements for biodiversity assessment for applications for development consent under Part 4, environmental assessment of an activity under Part 5, or approval of State significant infrastructure under Part 5.1, of the *Environmental Planning and Assessment Act 1979*. For Part 5 assessment, the proponent of an activity that is likely to significantly affect threatened species would have the option of providing a biodiversity development assessment report or a Species Impact Statement.

Given the relatively minimal disturbance required to construct the bores and the short-term nature of the bore installation works, the proposed water monitoring bores are not predicted to have a significant impact on a threatened species, populations, ecological communities or their habitats. Therefore, a biodiversity development assessment report would not be required in accordance with the *Biodiversity Conservation Act 2016* (see section 4.9).

2.2.7 National Parks and Wildlife Act 1974

The National Parks and Wildlife Act 1974 (NPW Act) provides for the statutory protection of Aboriginal cultural heritage places, objects and features. One of the objects of the NPW Act is the conservation of places, objects and features of significance to Aboriginal people (Section 2A). The NPW Act provides for the management of both Aboriginal Objects and Aboriginal Places.

Aboriginal Objects and Aboriginal Places are protected under Part 6 of the NPW Act and there are legislative penalties if a person harms or desecrates an Aboriginal Place or Object

(s. 86). Harm to an Aboriginal Place or Object includes any act or omission that destroys, defaces or damages the object or place, or, in relation to an Aboriginal object, moves the object from the land on which it had been situated.

However, harm to an Aboriginal Object that is 'trivial or negligible' does not constitute an offence. Also, it is a defence against prosecution for unintentionally harming Aboriginal Objects if due diligence had been exercised to determine that no Aboriginal object would be harmed, or the harm or desecration was authorised by an Aboriginal heritage impact permit (AHIP).

Clause 80B of the *National Parks and Wildlife Regulation 2009* removes the need to follow the due diligence process for the following specifically defined low impact activities. This clause states that it is a defence to a prosecution for an offence under section 86 (2) of the *National Parks and Wildlife Act 1974* if the defendant establishes that the act or omission concerned was work for the construction and maintenance of ground water monitoring bores on land that has been disturbed. For the purposes of this clause, land is disturbed if it has been the subject of human activity that has changed the land's surface, being changes that remain clear and observable.

In accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (DECCW, 2009), examples of activities that may have disturbed land include the following:

(a) soil ploughing,

(b) construction of rural infrastructure (such as dams and fences),

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

(d) clearing of vegetation,

(e) construction of buildings and the erection of other structures,

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

(g) substantial grazing involving the construction of rural infrastructure,

(h) construction of earthworks associated with anything referred to in paragraphs (a)-(g).

This defence does not apply to situations where an Aboriginal object is known to occur and does not authorise harm to known Aboriginal objects.

A Due Diligence Aboriginal Heritage Assessment undertaken for the proposal by RPS Australia (July 2018), identified that there were no known or previously unidentified Aboriginal objects present at any of the bores sites. The assessment concluded that no further assessment or an AHIP would be required for the proposed works.

2.2.8 Crown Land Management Act 2016

The *Crown Land Management Act 2016* commenced on 1 July 2018 and is administered by DoI – Lands & Water. It repealed the *Crown Lands Act 1989* and implements reforms identified through the comprehensive review of Crown land management and follows over four years of engagement with the community on the future of Crown land.

A number of the proposed bore sites are located on Crown land managed by Local Land Services (the former Rural Lands Protection Board). Under Section 9.2 of this Act it is an offence to erect a structure, clear or dig up Crown land without a lawful authority. However, as works would be undertaken by or on behalf of DoI - Water, the works are considered to have a lawful authority. North West Local Land Services have not raised any objection to the bores on the basis that they do not impede the safe movement of walking stock through the area.

2.2.9 Forestry Act 2012

The *Forestry Act 2012* provides for the dedication, management and use of State forests and other Crown-timber land for forestry and other purposes. The Act constitutes and specifies the objectives and functions for the Forestry Corporation of New South Wales as a statutory State-owned body. Under Section 60 of this Act, Forestry Permits may be issued for non-forestry purposes.

The following bore sites are located within State Forests:

- Sites 1D Pilliga West – Denobolue State Forest;
- Sites 4B Pilliga Scratch Road - Jacks Forest State Forest;
- Sites 5A Pilliga South East – Kerringle State Forest; and
- Sites 14 Pilliga South Extraction Area – Pilliga East State Forest.

The REF has considered the potential scenic and visual amenity impacts values of the proposed bores (see Section 4.14).

2.2.10 Rural Fires Act 1997

Lands throughout the Gunnedah, Liverpool and Narrabri LGAs are identified as bushfire prone land. The bore sites identified as bushfire prone land are listed in Section 4.12.

The proposed groundwater monitoring bores do not require approval from the NSW Rural Fire Service (RFS) under the *Rural Fires Act 1997*.

Nevertheless, to ensure protection of the monitoring station asset, the installation of above ground infrastructure within bushfire prone lands should consider the any bushfire risks at the site.

2.3 Commonwealth Legislation

2.3.1 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides for Commonwealth involvement in development assessment and approval in circumstances where there exist 'matters of national environmental significance'. Matters of national environmental significance include:

- World heritage properties.
- National heritage places.
- Wetlands of international importance.
- Nationally threatened species and ecological communities.
- Migratory species.

- Commonwealth marine areas.
- The Great Barrier Reef Marine Park.
- Nuclear actions (including uranium mining).
- A water resource, in relation to coal seam gas development and large coal mining development.

The development is not anticipated to adversely impact on any matters of national environmental significance (see Section 4.9 for threatened flora and fauna considerations). Therefore, referral to the Commonwealth Department of Environment and Energy is not required.

The installation of the groundwater monitoring bores would assist in protecting a matter of national environmental significance, being a water resource, in relation to coal seam gas development and large coal mining development.

2.4 Summary of Approvals

Table 2-1: Summary of Approvals

Agency	Requirements	Reference
DoI - Water	Determination of the proposal	Pt 5, s5.5 and 5.7 of EP&A Act
Forestry Corporation of NSW	Approval to conduct works in a State Forest (permit)	s60 Forest Permit
Narrabri Shire Council	Landowner consent Approval to undertake works within a Road Reserve	N/A s138 of the *Roads Act 1993*
Liverpool Plains Shire Council	Landowner consent Approval to undertake works within a Road Reserve	N/A s138 of the *Roads Act 1993*

2.5 Agency Consultation

A number of agencies were consulted as part of the preparation of this REF. Table 2-2 provides a summary of the responses received and identifies how those comments have been addressed by the REF. Copies of all responses are provided in Appendix C.

Table 2-2: Summary of Agency Consultation

Agency	Comment / Issue Raised	How Addressed in REF
Gunnedah Shire Council	Council would like to see an additional monitoring bore installed in closer proximity to the Gunnedah town water supply bores to monitor any potential effect on water quality from the proposed Shenhua mine. It is noted that the site and location 10B Shenhua is located in close proximity to the proposed mine site and we are concerned there could be potential contamination caused which may not be detected due to the close proximity. An additional monitoring bore slightly upstream from Gunnedah would provide a good base line for water quality data prior to the commencement of the proposed mine.	There are numerous existing monitoring bores in the area around Gunnedah's town water supply and therefore no additional bores are considered necessary in the area suggested.
Liverpool Plains Shire Council	Council has no immediate objections or concerns regarding the placement of additional new bore(s) in the location suggested from an environmental perspective based on the high level information currently available. Consideration would, however, need to be given to infrastructure placement from a traffic safety/road infrastructure perspective once further detail is available. Approvals would also be required to be obtained from Council under the *Roads Act 1993* (in its capacity as the roads authority) prior to the commencement of any works. It would be Council's expectation at this juncture that a similar Agreement(s) would be entered into with Council as currently in place with Whitehaven Coal. Council suggested that the proposal may take advantage of one or both of the two (2) bores already in existence on Paynes/Wadwells Roads which are in the same general location. To that end Council provided a history of the Agreements already in place with Werris Creek Coal under the current monitoring regime. Any alterations to the terms and conditions of the access agreement of existing bores will require further consultation with Council.	Section 4.3 Section 2.2.3 DoI - Water do not intend to utilise existing bores for the proposed monitoring.
Narrabri Shire Council	Narrabri Shire Council supports the project. For the site located within Council's road reserve, DoI - Water is required to lodge a Section 138 application with Council, ensure the bore to be placed within 5 meters from the road boundary and provide Council with public liability currency of not less than $20 million.	Noted Sections 2.2.3 and 2.4

Agency	Comment / Issue Raised	How Addressed in REF
Forestry Corporation of NSW	Forestry Corporation of NSW (FCNSW) acknowledges the request to access State forests for the purposes of monitoring bore construction and maintenance. Section 60 (1) *Forestry Act* 2012 requires the authority of a Forest Permit to conduct these activities within State forests. The nature and cost of a Forest Permit is determined by the type of activity and timeframe of access. The following information will be required for the purposes of providing a Forest Permit for the activity: 1) Provide full corporate details of the entity that is intending to sign the Forest Permit. If the applicant is a "Pty Ltd" entity please provide the ABN; 2) A letter of authority setting out the extent by which a consultant company, if any, has authority to undertake negotiations on your organisation's behalf; 3) A synopsis of the activities proposed to be undertaken within State forests; 4) The proposed timeframe of the activities including start and finish dates; 5) An estimate dollar value of the proposed activities; 6) A detailed description of any infrastructure proposed to be placed on or remain within State forests; 7) Copies of location maps, digital spatial data and any diagrams or photographs identifying the extent of the proposed activities on and adjacent to State forests, including identified vehicle access routes across State forests; 8) A copy of any statutory approvals issued in favour of DoI - Water in relation to the activities proposed on State forests; and Confirmation that DoI - Water will reimburse FCNSW reasonable legal costs arising from or incurred in relation to the preparation and issuing of the Forest Permit.	Section 2.2.9 DoI – Water to provide Sections 1 and 3 Section 3.4.4 To be provided in permit application Sections 1 and 3 Section 1 and Appendix A. Access routes are described in Section 4.3. DoI – Water to provide
Local Land Services (LLS) - North West Region	North West LLS have no objection to the request to access Crown land managed by LLS, with the provision that groundworks do not impede the safe movement of walking stock through the area.	Section 4.3

3 Description of the Proposal

This section provides a description of the proposal that is assessed in this REF.

3.1 Site Selection

A methodology has been developed for identifying, prioritising and selecting the location of new groundwater monitoring points. It is documented in the report on *Water Monitoring Strategy for Coal Basins in NSW Monitoring Point Selection – Gunnedah Basin* (DoI - Water, 2018) and addresses the following:

1. Background to the development of the Strategy to expand water monitoring in the NSW coal basins and the areas targeted;
2. Statements of monitoring network purpose, objectives and scope;
3. Identification of data and information needed to characterise coal basins and inform monitoring point selection;
4. Discussion on potential impacting activities, impact pathways and processes, sensitive receptors and how this informs monitoring needs and options; and
5. Site selection and prioritisation process.

3.1.1 Target Drilling Depths

Geological modelling was used to analyse the likely depths that formations could be found at all potential monitoring locations. The usefulness and reliability of the model for that purpose is variable according to the location and formations being targeted.

For each identified potential monitoring bore site, the geological model produced a stratigraphic sequence which was then used to assist in interpretation and the decision making around what formation to target and the likely depth of the new monitoring point.

3.1.2 Site Selection Criteria

Criteria have been developed to guide, assess and prioritise the siting of new groundwater monitoring bores. These are:

- data gaps;
- existing monitoring;
- surface geology;
- core of coal seams;
- resource activity;
- inter-aquifer connectivity;
- sensitive receptors;
- active use area;
- water quality; and modelling characterisation.

The sites selected are those which have met as many criteria as possible, constrained by practical considerations such as site access and land ownership.

3.2 Scope of Works

The proposal assessed in this REF comprises of the construction and operation of twenty (20) bores at eleven (11) distinct locations, ranging from depths of 65 to 620 m (see Table 1-1). The bores form part of a larger program of works that would enable DoI - Water to establish a water monitoring network throughout the coal basins of NSW. The bores will be established to monitor groundwater pressure and quality.

3.2.1 Bore Design

Generic bore designs will be provided to the Drilling Contractor, who would develop these generic designs into a detailed design for each bore

Bore designs are to comply with the design and construction specifications of the *Code of Practice for CSG Well Integrity* (Code of Practice), or the *Minimum Construction Requirements for Water Bores in Australia* (MCRWA) (National Uniform Drillers Licensing Committee, 2012) (referred to collectively henceforth as "the standards"). The bores shall be constructed based on generic designs for water monitoring bores as per the standards (see Figure 3-3 and Figure 3-4). The typical site set up for water monitoring bores constructed to the MCRWA and the Code of Practice are shown in Figure 3-3 and Figure 3-4 respectively.

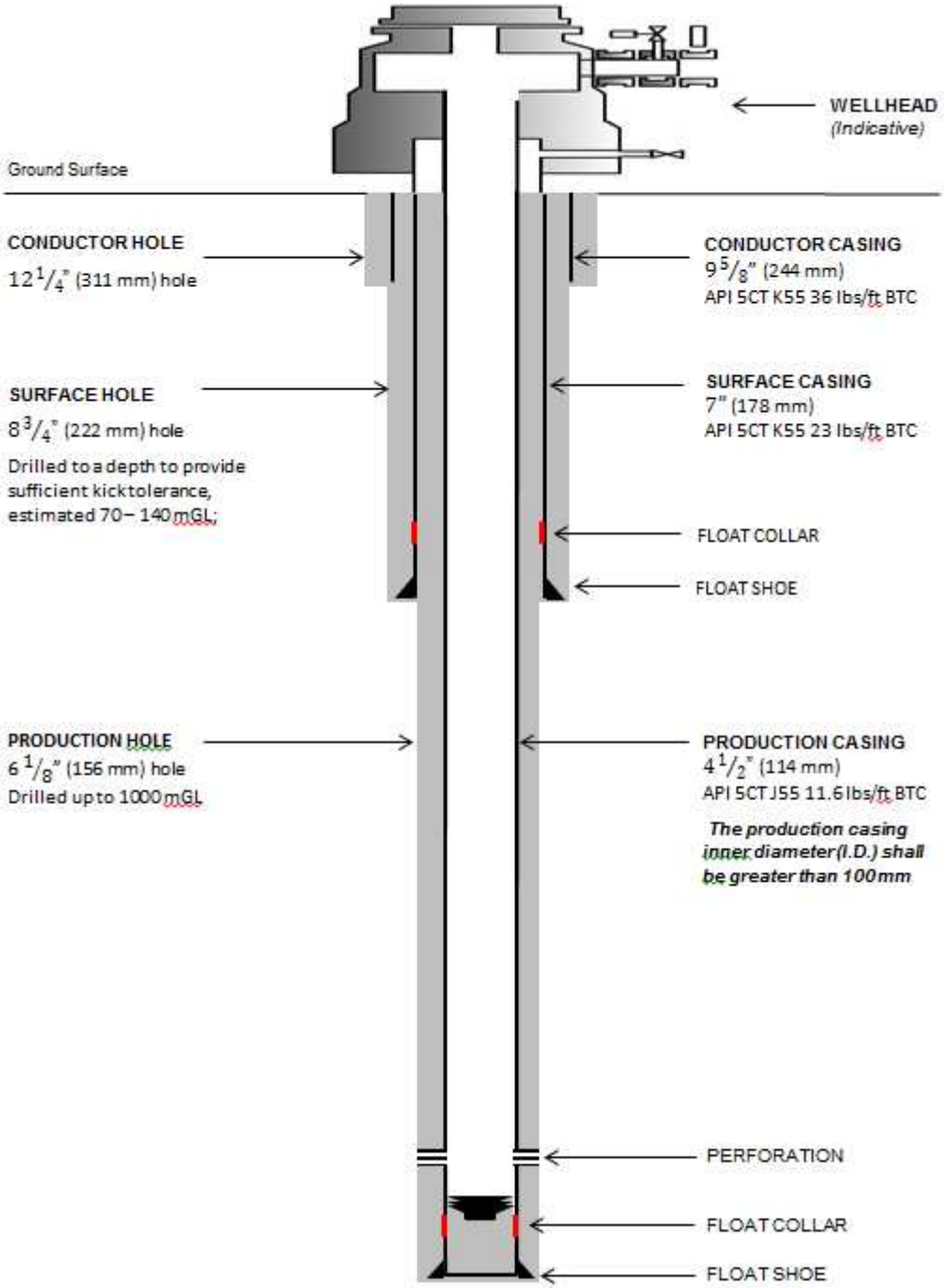

Figure 3-1: Bore Schematic for bore constructed to the *Code of Practice for CSG Well Integrity* (Code of Practice)

Source: DoI - Water, Technical Specifications- Southern Coalfield, 2017

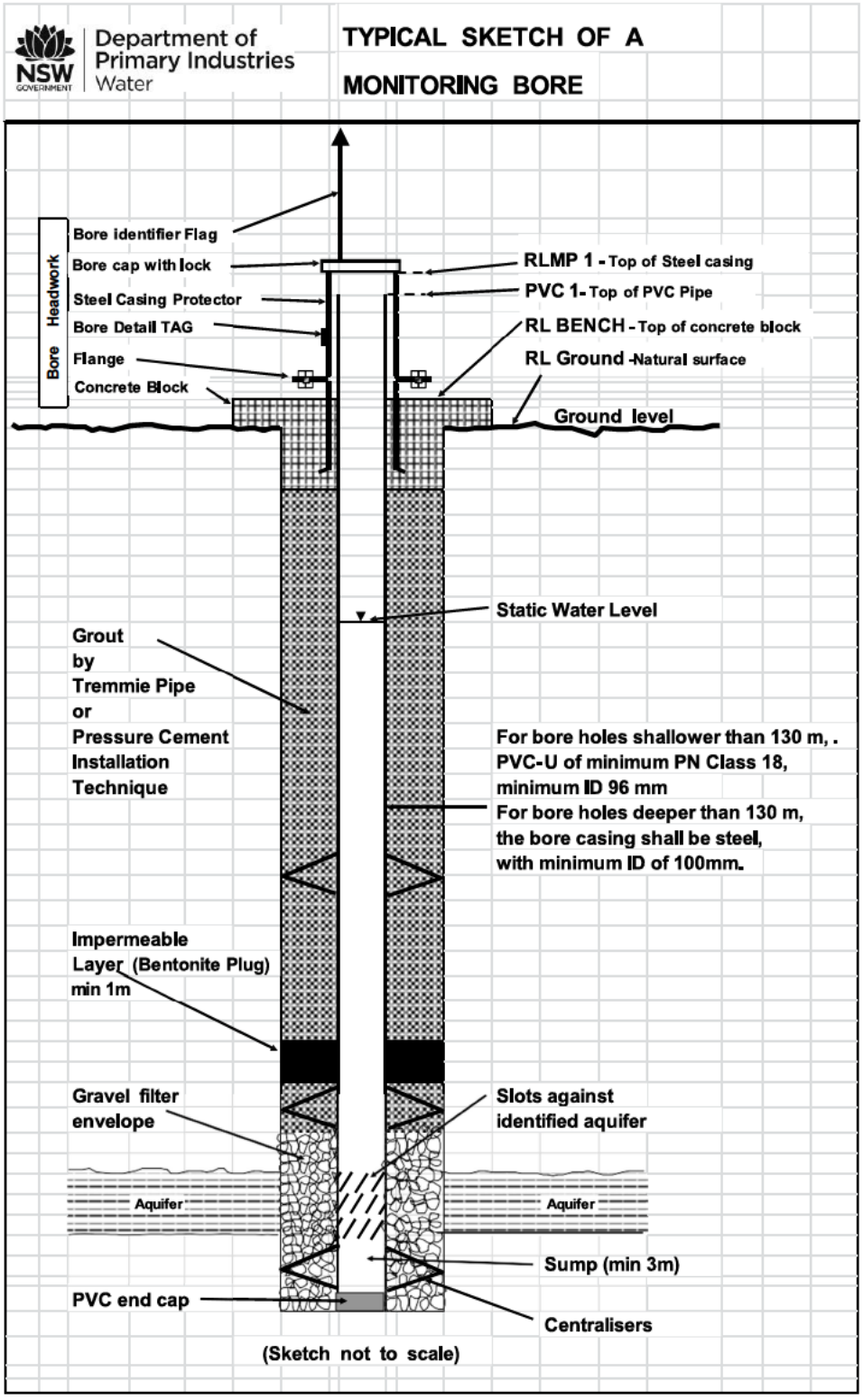

Figure 3-2 Bore Schematic for bore constructed to the Minimum Construction Requirements for Water Bores in Australia

Source, *DoI - Water, Southern Coal Fields Technical Specs*

Figure 3-3: Typical site set up for water monitoring bore constructed to Minimum Construction Requirements for Water Bores in Australia

Source: DoI - Water, 2017

Figure 3-4: Typical site set up for water monitoring bore constructed to NSW Code of Practice for CSG Well Integrity

Source: DoI - Water, 2018

3.3 Summary of Works

The main components of the proposal are summarised as follows:

- Drilling each borehole using truck mounted drilling rig (the exact methodology would be nominated by the successful drilling contractor).
- Development of each groundwater monitoring bore utilising methods considered most suitable for the bore and geological conditions encountered. Water sampling and analysis would be undertaken following the completion of the bore development.
- Installation of water sampling and hydrometric monitoring equipment
- Undertake post completion monitoring for each bore every three months for the first year after the completion of the bore development.
- Monitoring bores would be utilised in perpetuity. Monitoring frequency or target parameters may be adjusted depending on the results being observed.

3.3.1 Drilling and Bore Development

The purpose of the drilling operation is to drill fit for purpose bores, in a manner such that safety risks to personnel and the risk of environmental damage is reduced to as low as reasonably practicable. Fit for purpose with respect to the required drilling operations means drilling the bore in a manner that:

- facilitates the production of high quality geological logs, wireline logs, drilling cuttings and core return (if applicable);
- intersects the required geological formations;
- reaches the required bottom hole position;
- facilitates the installation of bore casing and fit for purpose bore cementation; and
- facilitates the production of high quality level or pressure data and representative formation water samples.

Design, drilling, construction, maintenance and decommissioning of water bores anywhere in Australia is governed by the standards. DoI - Water is responsible for the management of and access to groundwater. Approval to construct a bore and extract groundwater is governed by the WM Act, which 'recommends' that all water bores be constructed to meet the minimum construction requirements.

The monitoring bores would be equipped and used for taking water samples and/or monitoring water levels. They would be low water yield construction but provide for accurate water quality sampling and water level measurements from a particular zone of interest in an aquifer.

Care would be taken during drilling operations and in selecting the drilling method and materials used in bore construction. It is essential to ensure that no contaminants are introduced that may affect the monitoring or sampling results. The driller would be responsible for design of the drilling process to ensure bores:

- protect the groundwater resource from contamination;
- maintain aquifer pressures and quality; and

- isolate the targeted production zone from other formations.

Drilling Method

There is the potential that mud rotary drilling, air drilling, cable tool or other drill methods may be used. Construction to the Code of Practice involves mud rotary drilling. The type of drilling method used will be determined by the contractor and will be dependent on the nature of each location.

Mud rotary drilling involves a special mix of clay and water being forced down the drill hole turning a rotary bit, with rock chips returning in the "mud" slurry. With mud rotary drilling, all sediment and water will be controlled above ground using a mud recycling tank with back up reserve tanks for additional drill mud cuttings and water.

Bores constructed to the Code of Practice by the mud rotary method include a small flare pit that may be installed away from the well head to mitigate against the event of a gas or fluid leak and to allow flaring of any gas for safety reasons. There will also be a two-inch pipeline from the drill site to the flare pit. The flare pit generally is lined and pits 2 m x 2 m and 0.6 m deep are not uncommon. This pit will also be backfilled and rehabilitated upon completion of the drilling. The details of the required type of drilling method used will be determined by the contractor.

Air rotary drilling is similar to mud rotary, except that the mud pump is to be replaced by a compressor assembly (which includes a cooling system, air receiver and unloading system). Air is forced through the drilling pipe and into the rotary drill bit.

An air compressor and lined pits are required. The pits retain the excess water produced during drilling before it is disposed. The site layout may also include a mud tank only used if large quantities of wastewater are encountered.

A cable tool rig has a smaller footprint than conventional rotary drilling rigs as the mud systems are not required. Figure 3-5 and Figure 3-6 show typical site layouts for mud drilling and air drilling. The precise arrangement of equipment onsite will be dependent on the nature of each site and space available.

Fuel for all drilling methods will be located up gradient, remote from the active drilling area in a bunded area and separate to the process water capture and sediment treatment area.

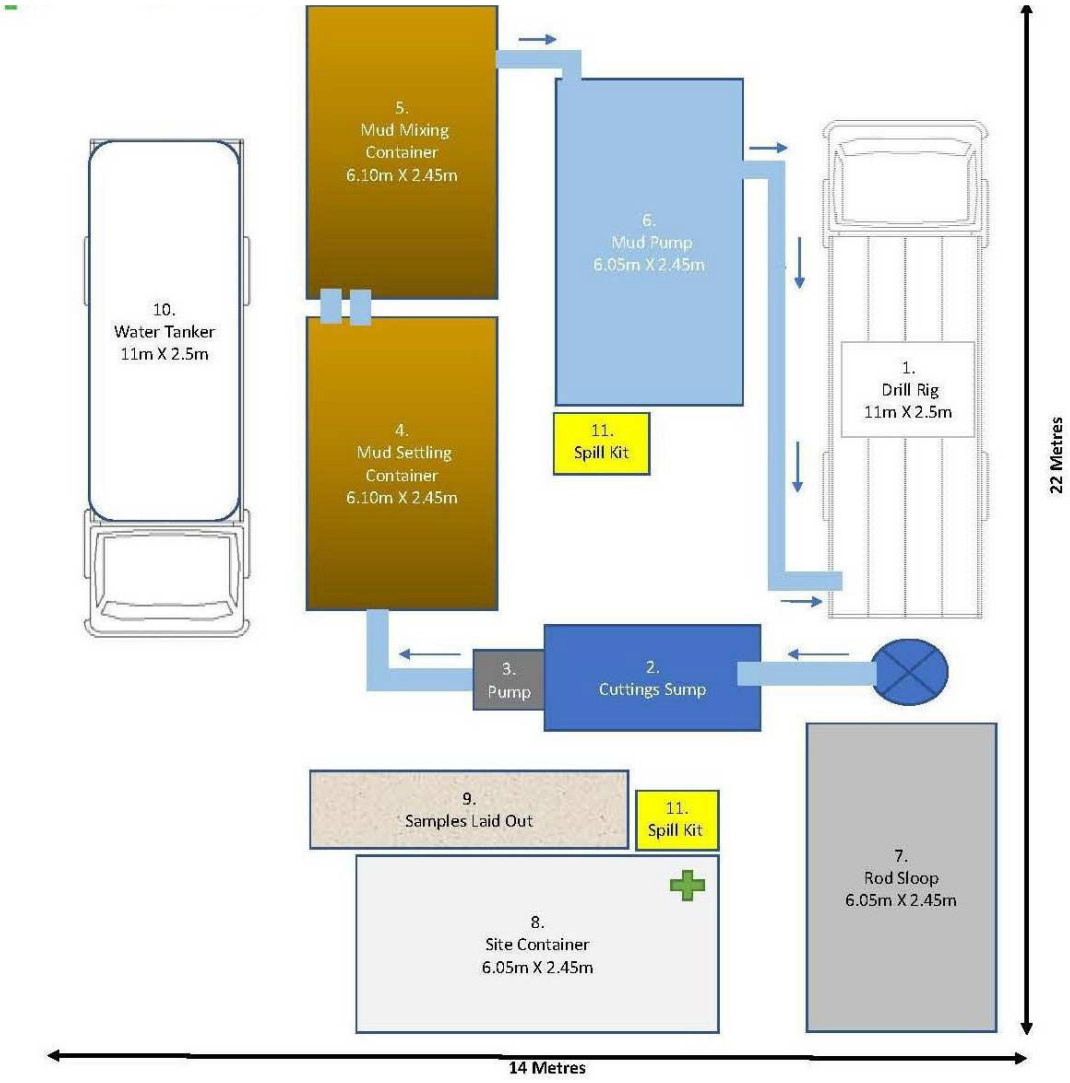

Figure 3-5: Generic Mud Rotary Site (Southern Coal Fields Technical Specification)

Source: DoI - Water, 2018

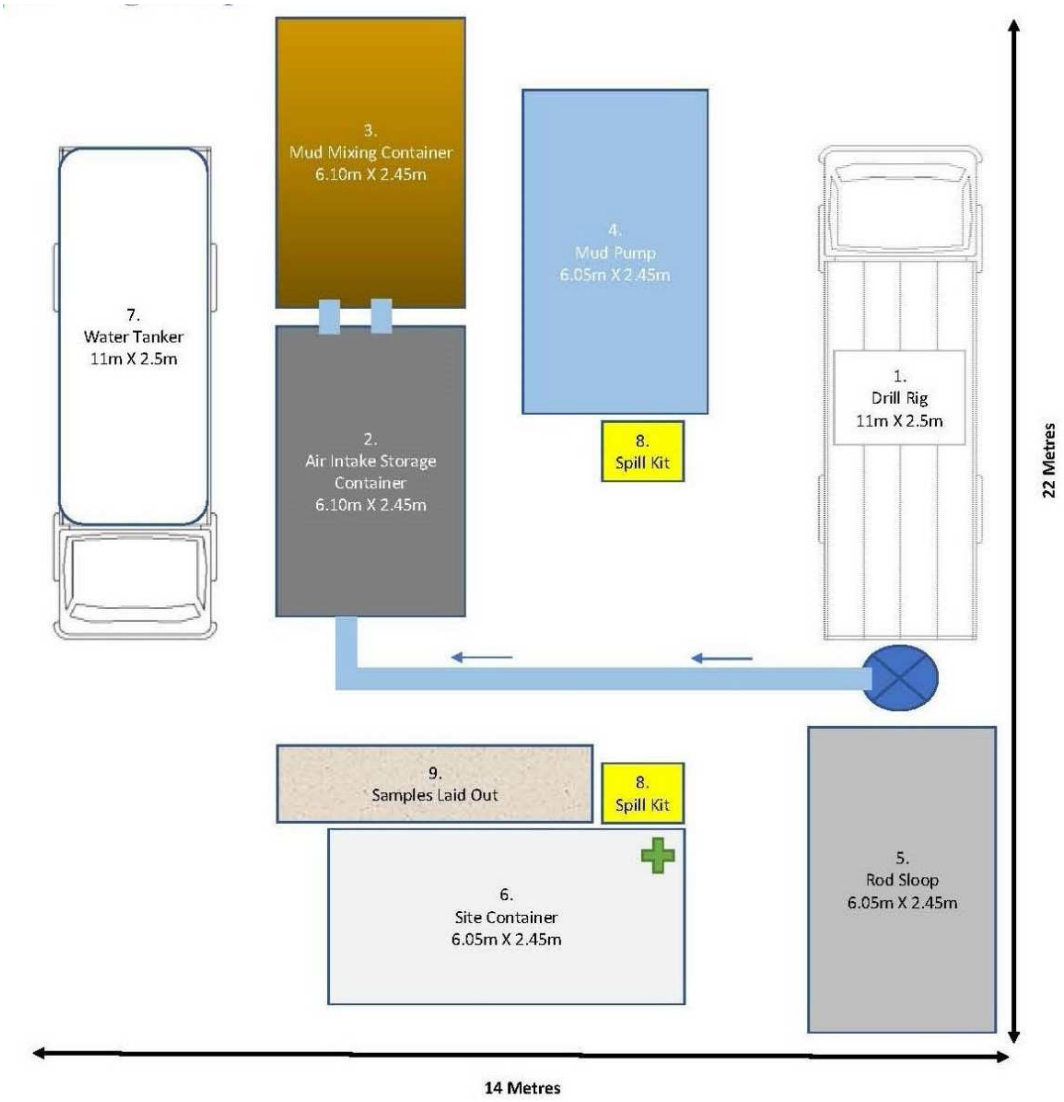

Figure 3-6: Generic Air Rotary Site (Southern Coal Fields Technical Specification)

Source: DoI - Water, 2018

Drilling Fluid

The type of drilling fluid to be used will be determined by the contractor and will be dependent on the nature of each location. No drilling fluids are permitted to ground, and no unlined cellars and mud pits are to be used. Fluid containment is to be designed by the contractor, such that seepage of fluid shall not be possible. At completion, containment vessels are to be emptied of all drilling cuttings and the cuttings disposed of off-site at a facility appropriately licenced to receive such wastes. The contractor will maintain a register of all waste removed from site.

The drilling fluid used for the bore installation is to incorporate the following requirements:

- The drilling fluid must adhere to the standards.
- The drilling fluid that is used to install groundwater pressure and/or quality monitoring bores (either the single or multi-zone generic bore designs):
  - Shall minimise the use of organic matter (e.g. starches) to reduce bacteria growth in the completed bore.

  - Shall minimise the use of sulphates to reduce bacteria growth in the completed bore. Sulphates should not be used as a component of the primary drilling fluid (e.g. potassium sulphate) but may be used as a contingency material (e.g. barite – barium sulphate).

- The contractor may also use contingency materials (i.e. kill mud, lost circulation material). All materials are to be handled in accordance with their Safety Data Sheets (SDS), which are to accompany all material brought on to site.
- Safety Data Sheets (SDS) for all drilling fluids and contingency materials shall be included in the winning contractor's WHS management plan.
- The contractor shall maintain a register of the location where water used on site was sourced. The register shall include volume, source and date taken.

3.4 Construction Methodology

The proposal would be executed under a design and construct contract, with exact construction methodology being determined by the successful construction contractor.

The following section describes the predicted construction methodology for the purposes of assessing the environmental impacts of the proposed works. The following methodology has been developed based on the preliminary concept design and experience with similar water monitoring construction projects.

The various steps the driller will take in constructing bores is as follows;

- Prepare site plan identifying the location of vehicle parking areas, site facilities, erosion and sediment controls;
- Erect temporary fencing around drill site (area fenced a function of the site) to provide security and prevent unnecessary disturbance and damage to surrounding vegetation by vehicles and construction activities;
- Clear leaf matter and any small vegetation from within the work area, to reduce the fire hazard. This material would be stored for rehabilitation of the site following drilling completion;
- Establish the need to construct a working platform on which to base the drilling rig;
- No unlined cellars and mud pits are to be used;
- Arrange down-gradient silt fencing and tanks to manage drilling water;
- Move drill rig onto bore site together with the support vehicles, compressor and necessary equipment. The plant and equipment brought onto each site would have been cleaned offsite to avoid introducing soil and weeds and drilling rig disinfected to avoid aquifer bacterial contamination;
- Commence drilling process, to the required depth for each bore site. During drilling, the bore would produce 'chips' of alluvial material and sandstone, which would be raised to the surface by air and fluid pressure or mechanically with the cable tool;
- Drilling fluids are circulated down hole to remove drilling cuttings produced in the drilling process. Drill fluids are circulated through onsite tanks to remove the drill

cuttings. Periodically the fluids in the tanks will be removed when drill cutting content affects the drilling process. Water generated during drilling would be diverted to a holding tank for disposal off-site. No water would be discharged directly to ground or into a waterway;

- Conduct geophysical investigations prior the installation of the casing;
- Conduct down-hole geophysical logging to the full depth;
- For the Code of Practice, install a casing to the base of the hole, and pressure grout the annulus between the casing and the borehole to prevent migration of water between formations;
- For the Code of Practice, perforate the steel casing to intersect the target formation and enable sampling and monitoring of the target water bearing layer;
- For MCRWA, install casing with screen or slotted casing and sump.
- For MCRWA, emplace gravel pack, bentonite seal, and cement to surface.
- Develop and clean hole by pumping or air lifting techniques;
- Collect water sample;
- Ensure all headworks are fitted;
- Reinstate site to grade and remove drilling rig and equipment off site; and
- Install fencing around the bore to prevent unauthorised access. The fencing would contain signage indicating that the bore is part of the NSW Government state-wide network of monitoring bores managed by DoI - Water.

3.4.1 Site Rehabilitation

The rehabilitation of drilling sites would be undertaken following completion of the monitoring bores installation. This shall include:

- the removal of any waste and drilling debris;
- the backfilling of any pits or excavations that may have been constructed for sediment control;
- the removal of any silt fences or security fencing;
- reinstatement of stockpiled topsoil; and
- the spreading of mulch, chip bark or other natural materials as required to encourage revegetation.

3.4.2 Materials and Construction Equipment

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

- Mobile drilling rig;
- Bobcat or small dozer to clear vegetation;
- Small trucks carrying construction materials, and large trucks to transport excavated material from each site;

- For mud drilling: mud recycling system to clean muds
- Blow out preventer cellar and flare pit;
- Mud, water, fuel, and sediment tanks;
- Site office (optional);
- Compressor, concrete vibrator, concrete mixer;
- Passenger vehicles to transport construction workers;
- Chemical storage area;
- Top soil and sediment storage area; and
- Temporary toilet.

3.4.3 Working Hours

It is proposed to maximise working hours during bore installation to minimise the duration of construction. This may involve working seven days per week, either between 6am and 8pm or 24 hours per day at most of the bores sites. It is noted that these hours are outside the standard working hours listed in the *Interim Construction Noise Guideline* (DECC, 2009). However, non-standard working hours are proposed to minimise risks associated with leaving bores open and unattended, with these risks including bore collapse and escape of gas.

3.4.4 Construction Timeframe

The exact times taken to drill each bore would vary depending on the encountered subsurface conditions, however each bore is expected to be drilled, constructed and developed within approximately two to three weeks of mobilisation to site.

Works are expected to commence in 2018 subject to the finalisation of landowner agreements. Completion is expected by early March 2019.

3.5 Construction Environmental Management

Construction of the proposed works would be undertaken in accordance with a Construction Environmental Management Plan (CEMP) that would be prepared by the construction contractor/s and approved by Public Works Advisory on behalf of DoI - Water prior to commencement. The CEMP would incorporate all of the mitigation measures identified in this REF as well as any conditions of approval and any other licence or approval conditions. The CEMP would also incorporate an emergency response plan in case of a pollution incident, a complaints handling procedure and a 24 hour telephone contact number. The complete list of the mitigation measures recommended in this REF is provided in Section 5.

3.6 Operational Requirements

Operation of the monitoring bores and water depth (pressure) would be monitored by WaterNSW through telemetered equipment.

The operation of the monitoring bores would be unobtrusive, with post-construction activities to comprise water sampling, laboratory testing and maintenance of bores and equipment.

Water samples would be taken periodically (initially expect to be every three months) but this frequency may be adjusted in response to observations. Water sampling would be undertaken with minimum disturbance of the water within the casing. A small amount of purge water generated during sampling might be discharged onto the ground near to the bores depending on the method used, however it is expected to be of relatively good quality and unlikely to have an environmental impact.

Samples extracted from the bore would be sent to laboratory for testing under appropriate collection and handling procedures and within the necessary timeframes.

Maintenance of bores and equipment and water sampling would be undertaken through scheduled visits and within specific timeframes.

4 Environmental Assessment

This section identifies and characterises the likely potential impacts associated with the construction and operation of the proposed works.

4.1 Assessment Methodology

The key objectives of this assessment are to:

- Identify those facets of the environment likely to be affected by the proposal during both construction and operation;
- Identify the sensitivity of the site;
- Identify and characterise the associated impacts; and
- Identify and evaluate feasible mitigation measures for the identified impacts.

Environmental issues of potential relevance to the proposal include:

- Land use;
- Access and traffic;
- Noise and vibration;
- Air quality;
- Geology
- Groundwater
- Topography, soils and surface water;
- Flora and fauna;
- Aboriginal archaeology;
- Historic heritage;
- Natural events;
- Utilities and infrastructure;
- Waste management; and
- Visual amenity;

4.2 Location and Land Use

The selected bore sites in the Gunnedah Basin are subject to a variety of land uses, including parklands, natural reserves, rural developments, road infrastructure, agricultural land uses and extraction activities. Land use at each site is described in Table 4-1. Generally, the proposed bore sites are situated within a heavily altered landscape with primary factors for land modification being determined by past and present anthropogenic activities including land clearing, the establishment of farms, construction of roads, dams and rural and urban residential development. Extensive farm land areas including pasture lands for livestock grazing and ploughed fields occur within the general area with remnant bushlands of limited areas along the majority of the Kamilaroi and Newell highways. The nearby Pilliga National Park and Nature Reserve was never used for agricultural or pastoral activities and so has predominantly native vegetation remaining.

Table 4-1: Site Land Use and Access

Site	Description and Land Use	Access	Nearest Sensitive Receiver (e.g. residence)
1D Pilliga West	Parkland, Pilliga National Park	Country Line Road	No dwellings identified nearby
2A Lower Namoi	Farm land, 12 kilometres south of the Kamilaroi Highway	Cisro Road	Rural homestead 1.8 km away
3A Old Gunnedah Road	Farm land, 5 kilometres north-east of the Kamilaroi Highway	Old Gunnedah Road	Rural homestead 300m away
4B Pilliga Scratch Road	Parkland, Pilliga Conservation Park	Scratch Road	Rural homestead 3.8 km away
6D Maules Creek Mine	Farm land, 12 kilometres north-east of the Kamilaroi Highway	Sisson Road	Rural homestead 1.7 km away
5A Pilliga South East	Farm land, 13 kilometres south-west of the Kamilaroi Highway	Kirringle Road	Rural homestead 1.5 km away
7A Boggabri Mine	Farm land, 10 kilometres north-east of the Kamilaroi Highway, along Rangari Road.	Rangari Road	Rural homestead 1 km away
8A Blue Vale Mine	Farm land, 8 kilometres north-east of the Kamilaroi Highway	Blue Vale Road	Rural homestead 2.3 km away
10B Shenhua	Farm land, 6 kilometres north of the Kamilaroi Highway	Pullaming Road	Rural homestead 1.6 km away
12A Werris Creek Mine	Farm land, 2.5 kilometres north-east of the Kamilaroi Highway	Paynes Road	Rural homestead 50 m away
14 Pilliga South Extraction Area	Park land, 10 kilometres west of the Newell Highway, along a previously constructed forestry access road	Caloola Road	Rural homestead 5 km away

4.2.1 Impact Assessment

The majority of the bore sites are located in relatively remote locations away from urban areas. Public access is generally available to all sites.

The proposed construction of the boreholes is not anticipated to have an impact on operations of the surrounding land, provided the mitigation measures listed below are properly implemented.

The construction works associated with the proposed bore installations may cause some temporary disruption to local roads, however these impacts are not anticipated to be significant, assuming implementation of the mitigation measures listed below. Impacts associated with traffic, noise and dust are discussed in more in detail in the following sections. Given the predominantly isolated nature of the construction areas, the proposed activity is unlikely to result in adverse impacts to the surrounding land use.

Fencing would be installed on sites co-inhabited by livestock (notably those managed by LLS) during construction and operation of the bores, to minimise any adverse impacts of the proposed works and ensure safe movement of livestock.

The impact on the surrounding land uses during the operation phase is predicted to be negligible, as the operations of the monitoring bores would be unobtrusive and undertaken mainly by WaterNSW through telemetered equipment. Water samples would be taken physically (initially expect to be every three months) but frequency may be adjusted in response to observations, and the impact of the sampling during operation is also considered to be negligible.

The impacts of the operational activities required post-installation are primarily related to traffic and access, groundwater, surface water and natural events and are discussed in the below sections of this REF.

4.2.2 Mitigation Measures

Pre-Construction

- All necessary approvals are to be obtained and access arrangements / agreements confirmed prior to commencement of construction activities (including site establishment, tree clearing, stockpiling etc.).
- Negotiations would be undertaken with affected landowners where access to private land is impacted (i.e. across driveway / access points). The outcomes of any access arrangements would be documented in a CEMP prior to construction commencing.
- Adjoining landowners should be notified about the proposed works at least 14 days prior to the commencement of works onsite.
- A Community Engagement Plan, or equivalent, would be prepared and implemented before work commences. This would include details of neighbours that need to be advised of the proposed works and how the notification would be undertaken.

Construction

- Ensure the necessary care and maintenance of property facilities and operations including fences, gates and stock. However, if any damage did occur to property it

would be restored to a condition equivalent to the original condition. Temporary fencing and gates would be installed where necessary to exclude animals (stock and ground dwelling native fauna) from the work sites. Any temporary fencing or gates no longer required would be removed at the completion of the works.

- Sufficient closure and or barricading of the area are to be in place for the duration of the construction works, to prevent unauthorised and public access.
- All areas impacted by the works are to be rehabilitated in accordance with a site-specific rehabilitation management plan.
- Adequate procedures to be established and detailed in the CEMP, including notification requirements to EPA, for incidents that cause material harm to the environment.

Post Construction and Operation

- Post construction rehabilitation/stabilisation is required to restore sites to the pre-construction condition.
- Adequate procedures must be established and detailed in the OEMP, including notification requirements to EPA, for incidents that cause material harm to the environment.

4.3 Access and Traffic

The majority of the proposed bore sites offer suitable access to accommodate a drilling rig and ancillary vehicles, however some sites have limited or constrained access. Access to site 5A may require closure of the road within the State Forest, and access to site 6D Maules Creek Mine would need to be via Maules Creek Mine. Minor works may be required to facilitate access, which would be made good upon completion of work. The main access road for each site is listed in Table 4-1. No new access roads would need to be constructed to access the bore sites.

4.3.1 Impact Assessment

Drilling and bore development would require a drilling rig and other ancillary vehicles, typically 3-5 light vehicles (e.g. four-wheel-drives or utilities). The drilling rig would be compliant with the Heavy Vehicle National Regulation (Mass, Dimensions and Loading).

No permanent access tracks would be constructed for any of the sites. Due to the unsealed nature and underlying soil conditions, there is the risk of damage if site access is not managed appropriately, especially in wet weather conditions. The safe movement of livestock is required to be maintained within Crown Land managed by LLS.

The contractor would be responsible for establishing strict conditions for access to prevent damaged to existing roads and ensure safe movement of livestock in consultation with the landowner/manager.

Given the generally rural and isolated nature of the sites and temporary duration of the proposed works, traffic impacts during construction are not considered significant. There would be a minor increase in vehicles utilising the local road networks for the purpose of delivering construction materials, equipment, removal of waste as well as the arrival and departure of construction workers. Access to each of the bore construction sites would be limited to construction workers for safety reasons.

Fencing would be installed on sites co-inhabited by livestock (notably those managed by LLS) during construction and operation of the bores, to minimise the adverse impacts of the proposed works and ensure safe movement of livestock.

Post construction, periodic bore maintenance and water sampling would be undertaken. Access to the bore sites would be based on scheduled visits and timeframes to avoid peak traffic periods. Therefore, any such traffic impacts are anticipated to be negligible.

4.3.2 Mitigation Measures

Pre-construction

- Consideration should be given to infrastructure placement from a traffic safety/road infrastructure perspective.

Construction

- A Traffic Management Plan (TMP) would be prepared by the chosen project contractor in accordance with:
    - *RMS Traffic Control at Work Sites Manual, Issued 2018, and*
    - *Australian Standard 1742.3 - 2009 Traffic Control for Works on Roads.*
- The TMP would detail appropriate construction traffic controls and management measures and all aspects would be implemented in co-ordination with the relevant local Councils and RMS. The TMP would include, but not be limited to, provisions for the following:
    - Predicted traffic movements,
    - Confirmation of traffic vehicle routes,
    - Onsite communication system and safe guards for ingress and egress,
    - Provisions and safeguards to notify local road users of construction works such as through signage,
    - Any changed traffic and access conditions (if required), and
    - Appropriate safety equipment and clothing such as the wearing of fluorescent safety vests.
- Where works are conducted on or adjacent to public roads and private access roads, appropriate traffic control procedures would be implemented. The work would be undertaken in a manner that allows the continued safe use of roadways.
- Where works are conducted on land co-inhibited by livestock, temporary fencing should be installed to ensure safe movement of livestock in the area.
- All access through, or work within property not owned by DoI – Water, would be undertaken with a minimum of inconvenience to the owner / occupier. Residences or associated buildings would not be entered, except under exceptional circumstances.
- All gates and barriers (not including those providing access to public areas) would be closed and locked at all times to prevent unauthorised access.

- Safe 24 hour all weather access must be retained for landowners for the duration of the project.
- Contractor would maintain security at each worksite for the duration of the project.

Post Construction and Operation

- Establish a procedure to ensure the ongoing maintenance of the internal on-site access roads and access points during the operation phase. This maintenance may include sedimentation and erosion control structures, where necessary.

4.4 Noise

The nearest sensitive noise receptors to the proposed borehole sites are listed in Table 4-1. Generally, the borehole sites are located within low noise background areas, surrounded by rural areas used for agricultural activities or mining.

4.4.1 Impact Assessment

Construction management levels for noise at residences are listed in Chapter 4 (Table 2) of the *Interim Construction Noise Guideline* (DECCW, 2009). The guideline states that construction works with duration of less than three weeks should be subject to a qualitative assessment of noise impacts. The works are predicted to take 2-3 weeks at each bore site and therefore a quantitative assessment has not been undertaken.

Standard constructions hours as listed in the *Interim Construction Noise Guideline* (DECCW, 2009) are unlikely to be strictly adhered to, for the reasons outlined in Section 3.4.3. Continuous drilling, if adopted by the contractor, would occur over 24 hours for approximately one week and all other construction work would generally occur in normal daytime hours (7am to 6pm Monday to Saturday). Overall, noise impact resulting from the works are not expected to be significant given there are limited residences or other sensitive noise receptors in the vicinity of the majority of sites. It is noted however that rural homesteads may be located within 50m and 300m of sites 12A Werris Creek Mine and 3A Old Gunnedah Road, respectively, and therefore 24-hour work would not be appropriate in these locations. In addition, the potential use of State Forests for passive recreational activities may restrict works in those locations to times when such activities are less likely to occur; however this would be subject to confirmation with the Forestry Corporation of NSW as part of the Forestry Permit application process.

Given the short duration of the proposed works and the proper implementation of the mitigation measures listed in Section 4.4.2, any noise impacts are considered unlikely to be significant.

4.4.2 Mitigation Measures

Construction

- All employees, contractors and subcontractors are to receive a project induction. The environmental component may also be covered in toolbox meetings and should include:
    - all relevant project specific and standard noise mitigation measures as detailed in a project specific construction noise and vibration management plan prepared by the contractor;

  - relevant licence and approval conditions;
  - permissible hours of work;
  - any limitations on high noise generating activities;
  - location of nearest sensitive receivers;
  - construction employee parking areas;
  - designated loading / unloading areas and procedures;
  - site opening / closing times (including deliveries); and
  - environmental incident procedures.
- Avoid unnecessary shouting or loud stereos / radios on site.
- Noise monitoring should be considered for the duration of the works.
- Wherever possible, vehicles, plant and equipment would be switched off when not in use.
- The impact of noise on known sensitive noise receivers would be minimised by implementing measures such as appropriate positioning of plant on the site and scheduling noisier activities to less sensitive periods.
- Work generating high noise levels should be scheduled during less sensitive time periods if practicable.
- Use quieter and less noise emitting construction methods where feasible and reasonable.
- All plant and equipment to be appropriately maintained to ensure optimum running conditions, with periodic monitoring.
- Plan traffic flow, parking and loading / unloading areas to minimise reversing movements within the site.
- Where reasonable and feasible, use structures to shield residential receivers from noise such as:
  - site shed placement;
  - earth bunds;
  - temporary or mobile noise screens (where practicable);
  - enclosures to shield fixed noise sources such as pumps, compressors, fans etc. (where practicable); and
  - consideration of site topography when situating plant.
- Where vibration is found to be excessive, management measures should be implemented to ensure vibration compliance is achieved. Management measures may include modification of construction methods such as using smaller equipment, establishment of safe buffer zones as far as practicable within the site constraints, and if considered feasible, time restrictions for the most excessive vibration activities. Time restrictions are to be negotiated with affected receivers.

- Where construction activity occurs in close proximity to sensitive receivers, vibration testing of actual equipment on site would be carried out prior to their commencement of site operation to determine acceptable buffer distances, as far as practicable within the site constraints, to the nearest affected receiver locations.
- Dilapidation surveys should be conducted at all buildings within close proximity of the construction works. These surveys are used to address potential community concerns that perceived vibration may have caused damage to property.
- Works would be limited those hours listed in the *Interim Construction Noise Guideline* (DECC, 2009) where there is the potential for noise generated outside those hours, particularly works at night, to impact on residences or other sensitive receivers.

4.5 Air Quality

Air quality is expected to be good due to the rural environment surrounding the bore sites. The main factors influencing local air quality are:

- Movement of vehicles and trucks;
- Windborne dust during dry periods, particularly from bare areas; and
- Annual pollen dumps from local vegetation.

4.5.1 Impact Assessment

The main impact to air quality during construction is expected to arise from the generation of airborne localised dust associated with earthworks and from trucks transporting materials to and around the work sites on unsealed roads. This is not anticipated to cause notable adverse environmental impacts unless the weather is particularly windy. Dust emission would be minimised by minimising the construction footprint and the area of vegetation removed. No water carts or watering would be used for dust control due to the scarcity of local water and the remote location.

Air quality would be affected by emissions generated from construction vehicles and equipment. These emissions would be minor and temporary, therefore it considered unlikely that they would contribute to a permanent detectable reduction in local air quality.

Given the short time frame of the proposed works, as well as the implementation of the recommended mitigation measures, potential air quality impacts would not be significant.

4.5.2 Mitigation Measures

Pre-construction

- Vehicles and equipment are to be suitably serviced within the six-month period prior to commencement of construction activities and all necessary maintenance undertaken during the construction period. The excessive use of vehicles and powered construction equipment is to be avoided.

Construction

- All construction machinery is to be turned off when not in use to minimise emissions.

- All practicable and feasible measures would be taken to avoid raising excessive levels of dust.
- Appropriate measures to suppress dust would be implemented whenever dust is likely to be a problem.
- Hazardous material would be handled as per relevant guidelines to avoid potential air pollution.
- Any stockpiled spoil/fill is to be protected to minimise dust generation.
- Vehicles transporting spoil from the project sites are to be covered.

4.6 Geology

The regional area comprises three principal geological units; the New England Fold Belt in the east, the Gunnedah Basin centrally and the Surat Basin in the west (Schlumberger, 2012 [Schlumberger Water Services, 2012, *Namoi Catchment Water Study, Independent Expert Final Study Report*, prepared for Department of Trade and Investment, regional Infrastructure and Services, NSW). The proposed bore sites are located where geologic units of the Surat (Great Artesian Basin) overlie geologic units of the Gunnedah Basin.

The geologic units of the Surat Basin are described as containing up to 2.5 km of non-marine and marine Jurassic to Cretaceous aged siliciclastic with minor coal. The sequences are thinner toward the edges of the basin, including where drilling is proposed to take place under this program. The Surat is one of the Basins that make up the Great Artesian Basin (Geoscience Australia, 2012).

The Surat Basin geology principally consists of a sandstone layer laid down by continental erosion of higher ground during the Triassic, Jurassic and early Cretaceous periods. The sandstone was then covered by a layer of marine sedimentary rock shortly afterward, which formed a confining layer, thus trapping water in the sandstone aquifer (Geoscience Australia, 2012).

The geologic units of the Gunnedah Basin are described as “containing up to 1,200 m of marine and non-marine Permian and Triassic sediments within which the coal bearing strata of the Black Jack Formation and the Maules Creek Formation occur” (Tadros, 1993 Tadros, NZ (ed.) 1993, *The Gunnedah Basin, New South Wales, Geological Survey of New South Wales*, Memoir Geology 12). Both the Maules Creek Formation and the Black Jack Formation contain coal seams that historically have been targeted for coal mining and coal seam gas explorations (Green et al, 2011).

The stratigraphy of the Gunnedah Basin with associated depositional environment is shown in Figure 4-1.

The geologic units targeted at the eleven potential bore sites, as assessed by the geological modelling, are listed in Table 1-1.

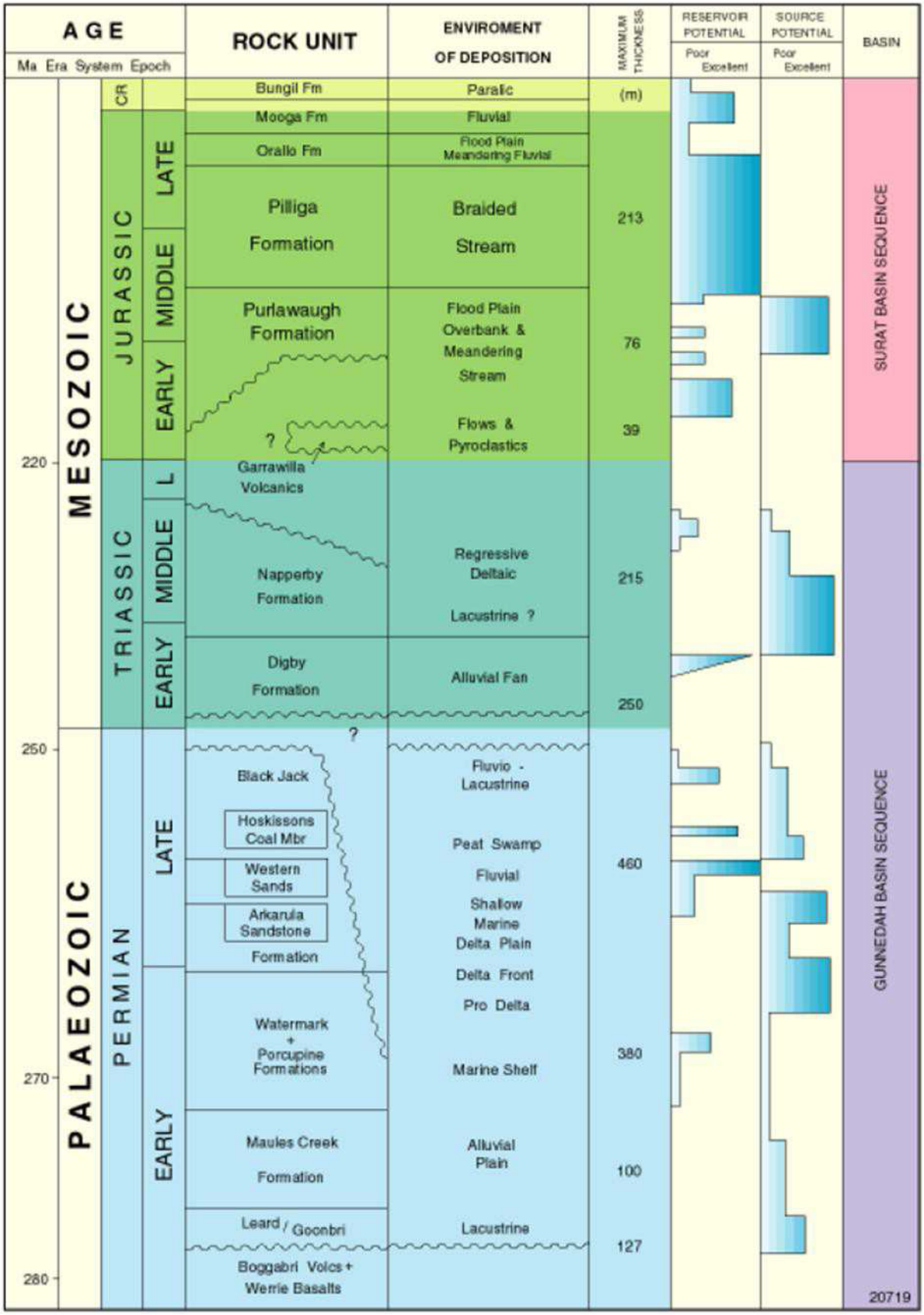

Figure 4-1: Stratigraphy of the Gunnedah Basin with Associated Depositional Environment

Source: DoI – Water, 2018

4.6.1 Impact Assessment

Drilling progress through the sandstone is anticipated to disrupt the strata in the immediate vicinity of the hole due to the grinding effect of the adopted drilling method. This would produce chips, which are raised to the surface, and fine sediment material which may cake the wall of the hole. This wall cake is temporary, as the construction of the monitoring installation would dislodge the fine sediment.

Overall, the impact on geology associated with construction of the proposed monitoring bores is anticipated to be confined to the strata of the immediate vicinity of the holes and would not have an impact on the geology of Gunnedah Basin.

4.6.2 Mitigation Measures

None required.

4.7 Groundwater

The groundwater bore locations assessed in this REF fall within the Namoi Sub-region of the Commonwealth Government's Bioregional Assessment Program and includes the Liverpool Plains and a large portion of the Namoi River Basin (see Figure 4-2).

High yielding aquifers containing good quality groundwater form in the alluvial sediments that make up the Upper and Lower Namoi Groundwater Sources. These are a valuable source of groundwater for irrigation and other requirements along the Namoi Valley. The Gunnedah Basin directly underlies the alluvium and outcrops in the eastern half of the region. To the west, the Gunnedah Basin dips under the sequences of the Great Artesian Basin (Surat Basin). The Lower Namoi Groundwater Source lies directly upon the GAB in the western half of the Namoi Region (see Figure 4-2).

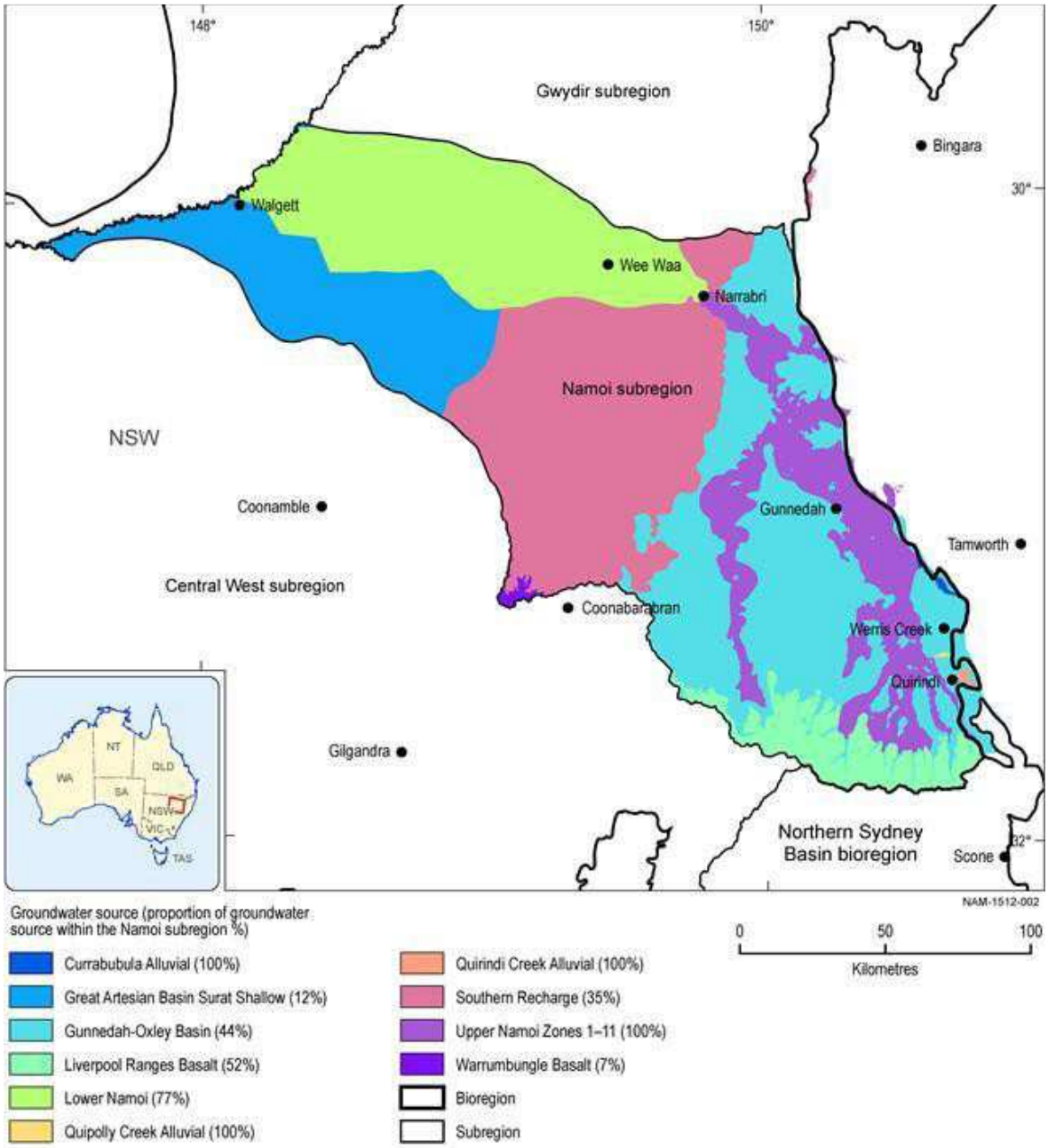

Figure 4-2: Groundwater Sources of the Namoi Subregion

Source: Commonwealth of Australia, 2016, Bioregional Assessment Programme http://www.bioregionalassessments.gov.au

Groundwater quality of the GAB generally has salinity of 500 to 1500 mg/L in the Lower Cretaceous-Jurassic aquifers. The groundwater is of a Na-HCO3-Cl type, and generally suitable for domestic, town supply and stock use. However, it is unsuitable for irrigation in most areas due to its high sodium adsorption ratio and having salinity mostly in the range of 250 to 1000 mg/L (NSW Government, Current Water Accounts and Water Quality-Namoi Subregion, 2016*).* Groundwater extraction from the GAB has historically been mainly for stock and domestic use.

Groundwater extraction and reliance from the Gunnedah Basin is itself very low However, there is high reliance on overlying and adjacent alluvial aquifers by users for basic rights and irrigation purposes. The alluvial systems of the Lower and Upper Namoi

have the highest reliance of groundwater extraction in the State. As such, the potential impacts from coal mining activities may propagate from the adjacent porous rock of the Gunnedah Basin through to the alluvium material potentially causing water level declines and water quality changes. Similarly, there is a high level of reliance on the Pilliga sandstone by stock and domestic bores. Whilst the Pilliga sandstone is a formation of the GAB, depressurisation from CSG depressurisation activities has the potential to cause falling water levels within the overlying Pilliga sandstone if not managed appropriately.

Groundwater Dependent Ecosystems (GDEs)

DoI - Water (DPIW, 2016) has mapped GDEs across some parts of NSW using various data sources as indirect indicators of groundwater use by vegetation and published scientific knowledge of communities that potentially have a reliance on groundwater. Data sources used in identifying potential groundwater dependent terrestrial and wetland ecosystems included existing vegetation mapping data sets, monitored real time groundwater level data for the shallowest water levels to create contours and remote sensing analysis of where vegetation might use a water source other than soil moisture. Using these data sources, the identification of potential GDEs was based on a number of probability matrices. These matrices were developed to allow the spatial model to provide outcomes that separated the vegetation into high, medium and low probability of being groundwater dependent.

The High Probability GDEs for the Gunnedah Basin area are shown in Figure 4-3. This indicates that, for areas within the Basin subject to coal mining between Gunnedah and Narrabri, there is minimal potential use of groundwater by vegetation, or there is either no vegetation detected/present via the remote sensing component. The mapped areas of High Probability GDEs in areas subject to coal mining are largely constrained to remanent riparian vegetation along surface water drainage system.

A review of the Bureau of Meteorology Groundwater Dependent Ecosystems Atlas in April 2018 identified the following potential for Groundwater Dependent Ecosystems (GDEs) specifically in relation to the proposed bore sites, as shown in Table 4-2.

Table 4-2: Groundwater Dependent Ecosystems

Site	Groundwater Dependent Ecosystems (GDE)
1D Pilliga West	Low potential for Terrestrial GDE (Narrow-Leaved Ironbark) recorded in the vicinity
2A Lower Namoi	Low potential Terrestrial GDE (Brigalow-Belah Open Forest) recorded in close proximity
3A Old Gunnedah Road	Moderate potential Terrestrial GDE (Poplar- Yellow Box) recorded in close proximity
4B Pilliga Scratch Road	Low potential Terrestrial GDE (White Bloodwood – Red Ironbark Woodland) recorded in close proximity
6D Maules Creek Mine	Low potential Terrestrial GDE (Narrow-Leaved Ironbark) recorded in close proximity
5A Pilliga South East	No GDE recorded in close proximity

Site	Groundwater Dependent Ecosystems (GDE)
7A Boggabri Mine	Moderate potential Terrestrial GDE (Poplar- Yellow Box) recorded in close proximity
8A Blue Vale Mine	Low potential Terrestrial GDE (Partly Derived Windmill Grass) recorded in close proximity
10B Shenhua	Low potential Terrestrial GDE (Liverpool Plains Grassland) recorded in close proximity
12A Werris Creek Mine	Low potential Terrestrial GDE (Blakely's Red Gum) recorded in close proximity
14 Pilliga South Extraction Area	Low potential Terrestrial GDE (White Bloodwood – Red Ironbark Woodland) recorded in the vicinity

4.7.1 Impact Assessment

The development of the completed bore induces circulation of groundwater through the walls of the hole which removes any fine sediment. Water extracted during this process is managed to prevent environmental impacts (see Section 3.3.1 for further details).

Post construction, any water extraction from the bores will only be undertaken for water quality sampling and aquifer testing purposes. The water within the bore casing will equilibrate with the groundwater in the surrounding strata. On the addition or removal of automatic data logging equipment, as well as when manual measurements are taken, there might be slight disturbance of the water within the casing, however this will be negligible and will not directly affect groundwater surrounding the bore.

Groundwater sampling would be conducted periodically. Groundwater pumped from the wells for sampling is expected to have low salinity and to be of good quality. There would be a minor disturbance to water within the casing and minor induced flow into the pipe of groundwater from the surrounding strata. In each instance, these disturbances will be transitory and of negligible impact on the aquifer as a whole.

4.7.2 Mitigation Measures

- Appropriate mitigation measures would be incorporated into the CEMP to manage groundwater encountered during construction, and would address the following:
  - Ensuring groundwater quality is not impacted during construction.
  - Appropriate treatment and monitoring regimes in the event that groundwater flows come to the surface, including diversion to a holding tank for disposal off-site. No water would be discharged directly to ground or into a waterway.

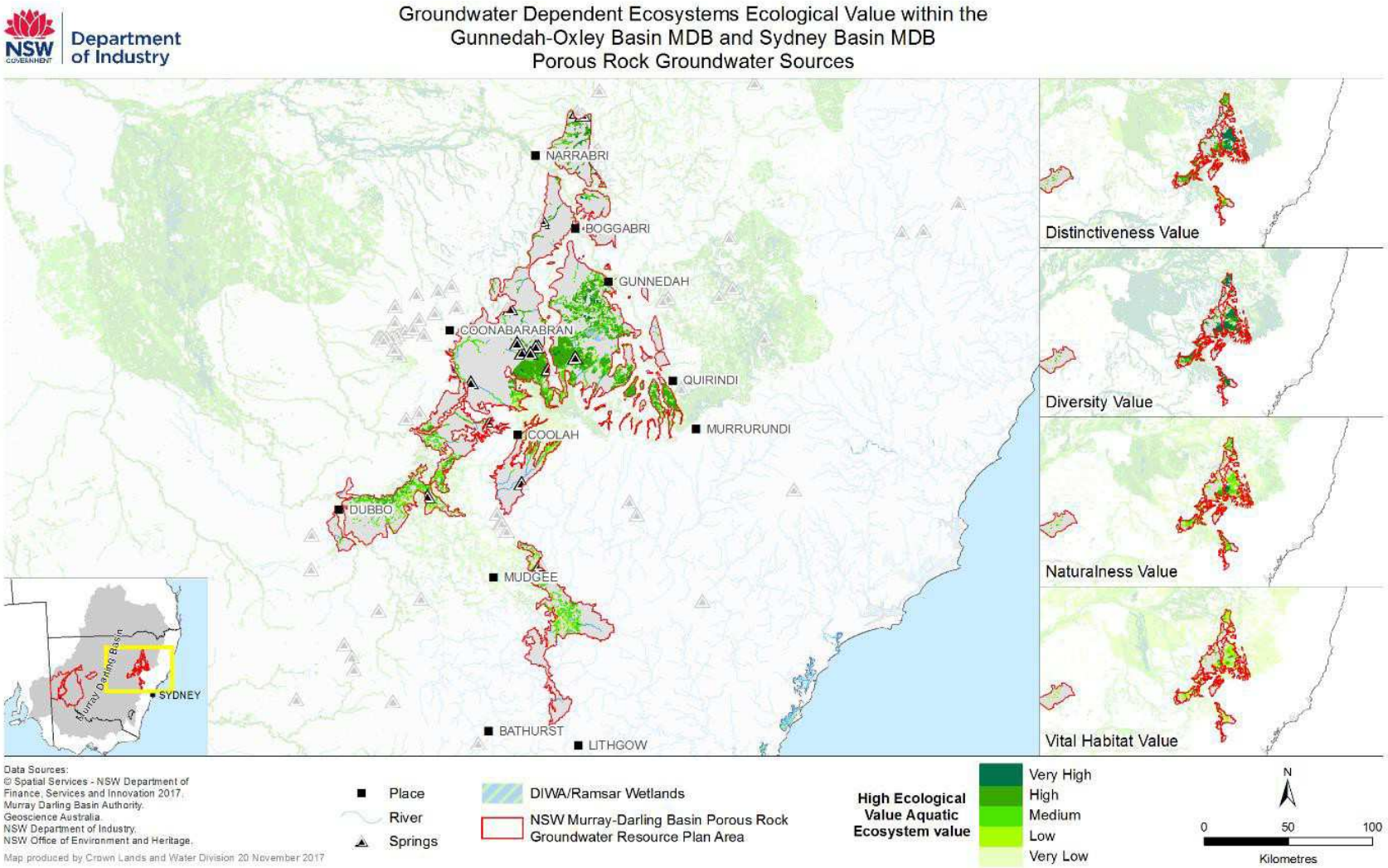

Figure 4-3: High Priority GDEs within the Gunnedah Basin

Source: DoI - Water, 2018

4.8 Topography, Soils and Surface Water

The following information regarding topography, soils and surface water is taken from the *Due Diligence Aboriginal Heritage Assessment* undertaken by RPS in June 2018 (see Appendix E).

Topography

The area containing the proposed borehole sites predominantly extends across a plain with occasional slopes and elevations, extending between 215 m Australian Height Datum (AHD) in the north and 450 m AHD in the south (NSW Land & Property Information 2016).

Soils

The proposed borehole locations predominantly extend across a region comprising of Early Permian, Permian and Middle Triassic period sedimentary rock and Cainozoic Era sedimentary deposits. The Permian sedimentary rock consists of sandstone, siltstone and mudstone. The Cainozoic Era sedimentary deposit consists of unconsolidated mud, silty sand and gravel of an uncertain age and origin (NSW Land & Property Information, 2016).

Table 4-3 lists the dominant soil landscapes across the borehole sites areas.

Table 4-3: Dominant Soil Landscapes

Soil Landscape	Dominant Soil Material	Description
Narrabri	A1 horizon	Dark brown (brownish black) (7.5YR 3/2) [moist] clay loam with moderate pedality (angular blocky, 20 - 50 mm, rough-faced peds), light clay, grey vertosol, no mottling.
	A1, A2 horizon	Dark brown (7.5YR 3/3) [moist] light medium clay with strong pedality (smooth-faced peds), few (1-10/10x10cm) roots (<1mm), few (1- 10/10x10cm) roots (1-2mm), field pH is 7.0.
	B1 horizon	Strong brown (brown) (7.5YR 4/6) [moist] medium clay with strong pedality (smooth-faced peds), field pH is 8.0
	A1, A2 horizon	Colour not recorded silty clay loam with weak pedality (sub-angular blocky, 5 - 10 mm), field pH is 5.5.
	A1 horizon	Very dark brown (brownish black) (10YR 2/2) [moist] sandy loam with massive structure (earthy), field pH is 5.5.
	B2 horizon	n/a
	B1, B2 horizon	n/a

Fullswood Road (fr) - Gunnedah	A1, A2 horizon	Hard setting dark clay loam (fine sand dominant) with intermittent fine sand clay loam and light sand clay loam. Coarse gravels (6-60 millimetres) common (10-20 per cent of deposit)
	A1 horizon	Hard setting dark brown silty clay loam. Rounded to coarse gravels (6- 60 millimetres) common (10-20 per cent of deposit).
	B2 horizon	Structured reddish-brown medium to heavy clay. Rounded to coarse gravels (6-60 millimetres) common (10-20 per cent of deposit).
	B1, B2 horizon	Brown medium clay with calcareous segregations. Rounded to coarse gravels (6-60 millimetres) common (10-20 per cent of deposit).
Dunover (do) - Werris Creek	A1, A2 horizon	Black to dark reddish brown (5YR 2/1 – 3/2) heavy clay; strong pedality, smooth-faced dense polyhedral peds (1 – 5 mm); field pH 7.0 – 10.0; coarse fragments are generally absent, absent to common (0 – 20%) soft medium calcareous segregations; surface is seasonally cracking and self-mulching; slowly permeable
	A1 horizon	Black to brownish black (5YR 1.7/1 – 3/1) heavy clay; strong pedality, smooth-faced dense prismatic peds (20 – 50 mm), slickensides and 45o shear planes present; field pH 8.5 – 10.0; coarse fragments generally absent
	B1 horizon	Dull reddish brown (5YR 4/3 – 5/3) heavy clay; strong pedality, smoothfaced dense prismatic peds (20 – 100 mm), lenticular (50 mm +) under moist conditions, prominent slickensides and 45o shear planes common; field pH 8.5 – 10.5; coarse fragments generally absent

Surface Water

The main surface water resource of the Namoi Sub-region is the Namoi River.

A detailed description of the topography, soils and hydrology at each of the 11 sites is provided in Table 4-4 below.

Table 4-4: Site Topography, Soils and Surface Water

Site	Topography, Soils and Surface Water
1D Pilliga West	The location is on a flat plain with low-growth shrubs associated with the Pilliga Scrub vegetation landscape, with occasional shallow depressions at intermittent areas and an ephemeral creek line. The soil comprised of yellow, sandy silt with gravel inclusions. There are some permanent and seasonal fresh water sources in the immediate vicinity of the borehole location.
2A Lower Namoi	The landform is a flat plain with intermittent areas of low and medium-growth shrubs and trees. The soil comprised of dry, yellow, sandy silt. There are very limited permanent fresh water sources in the immediate vicinity of the borehole location and limited seasonal water sources.
3A Old Gunnedah Road	The landform in this area is a flat plain. The soil comprised of yellow and red-yellow sandy silt with gravel associated with road construction. Vegetation was a mix of occasional mature eucalypts with an open area of grasses and intermittent small shrubs. There are very limited permanent fresh water sources in the immediate vicinity of the borehole location and limited seasonal water sources.
4B Pilliga Scratch Road	The landform comprised gently undulating plain, with intermittent areas of low and medium-growth shrubs and trees. The soil comprised of dry, yellow, sandy silt. There are very limited permanent fresh water sources in the immediate vicinity of the borehole location and limited seasonal water sources.
6D Maules Creek Mine	The soil comprised of yellow and red-yellow sandy silt with gravel associated with previous access road construction. There are very limited permanent fresh water sources in the immediate vicinity of the borehole location and limited seasonal water sources.
5A Pilliga South East	The landform in this area comprised mostly of a flat plain with occasional very gentle undulations, and juvenile eucalypts and shrubby understorey. The soil profile consisted of a reddish yellow-grey sandy silt, transitioning to a light-grey yellow silty loam at the vegetated areas. There are very limited permanent fresh water sources in the immediate vicinity of the borehole location and limited seasonal water sources.
7A Boggabri Mine	The location is a flat plain with very gentle undulations, intermittent groves of eucalypts, with an open area of grasses. The soil profile consisted of dark reddish-grey sandy silt with gravel intrusions. There are very limited permanent fresh water sources in the immediate vicinity of the borehole location and limited seasonal water sources.

Site	Topography, Soils and Surface Water
8A Blue Vale Mine	The landform in this area is mostly flat plain with extensive sheet wash erosion promoted by an absence of vegetation. The soil profile consisted of a dark yellow-grey sandy silty clay with small gravel intrusions. There are very limited permanent fresh water sources in the immediate vicinity of the borehole location and limited seasonal water sources.
10B Shenhua	The landform in this area is mostly flat plain with extensive sheet wash erosion promoted by an absence of vegetation. The soil profile consisted of dark reddish-grey sandy silty clay. There are very limited permanent fresh water sources in the immediate vicinity of the borehole location and limited seasonal water sources.
12A Werris Creek Mine	The landform in this area is mostly a flat plain with gentle undulations to the west and north. The soil comprised of yellow sandy silt with gravel inclusions. There are very limited permanent fresh water sources in the immediate vicinity of the borehole location and limited seasonal water sources.
14 Pilliga South Extraction Area	The landform in this area is a flat plain. The soil comprised of yellow and red-yellow sandy silt with gravel inclusions. Vegetation comprised juvenile eucalypts with a shrubby understory. There are very limited permanent fresh water sources in the immediate vicinity of the borehole location and limited seasonal water sources.

4.8.1 Impact Assessment

The construction of the proposed bores would result in ground disturbance due to the drilling works and monitoring bore installation and construction of associated infrastructure (e.g. drilling platform) (see Figure 3-3 and Figure 3-4 for the likely drill site arrangement).

There is potential for erosion and movements of excavated materials by wind and sediment laden runoff off-site through surface water. Erosion and sediment controls would be required during construction works as outlined in a CEMP, with measures surrounding each site, designed and implemented prior to commencement. Surface stabilisation (such as applying gravel) would be undertaken during and following the works to prevent any impacts off-site (such as sedimentation of drainage lines and waterbodies), throughout the period of disturbance. It should be noted that although mitigation measures to protect water quality have been listed in this REF, further details would be included in the CEMP for the works when the construction methodology is known.

The other main potential for sediment erosion to occur is through accessing the site under wet weather conditions. Provided the contractor implements appropriate protocols and management measures (see Section 4.8.2) the risk to degradation of the environment would be low.

The main potential for surface water quality impacts is through the movement of sediment laden water offsite during rainfall events in construction activities, at each site. Runoff from the earthworks has the potential to increase turbidity and nutrients entering the receiving waters, which when present in large volumes may have some ecological impacts. In addition, due to the nature of the works and the relatively remote locations of the sites, construction machinery would be kept at the site overnight, and as such there is a risk of a fuel spill. Given the limited permanent freshwater sources in the immediate vicinity of the works areas, the risk of adverse surface water quality impacts or flooding affecting construction works is assessed to be low. Any such impacts would not be significant due to the short duration of the proposed works and the implementation of the mitigation measures listed below.

The bore construction would require drilling fluid which is likely to consist of bentonite slurry. The slurry is required to transport the cuttings, cool the drill bit and to seal and support the drilled hole. Bentonite is naturally occurring clay which is self-sealing and is therefore suitable for preventing excessive sloughing from the walls of the borehole while drilling is occurring.

The use of drilling fluid could potentially result in soil erosion and waterway contamination if it is not contained onsite. Drilling fluid would be recirculated and because any loss of fluid would adversely affect drilling operations it would be immediately apparent to the drilling rig operators (via a loss in pressure and fluid ceasing to be pumped to the drill-head). Appropriate management measures would be implemented to ensure drill waters are appropriately recycled and contained onsite such as through the use of holding tanks.

Sandy silt-laden groundwater would be produced during drilling and could be potentially contaminated in comparison to surface water. However, any purged water generated would be diverted to a holding tank for disposal off-site. No water would be discharged directly to ground or into a waterway.

Each monitoring bore would be left capped and locked securely as detailed for each location and indicated in the project specification.

Following installation of the bores, periodic maintenance would be required to clean the bores of accumulated sediments. This would entail accessing the site by a four-wheel-drive vehicle with trailer-mounted air compressor or similar. The cleaning process would involve air lifting of the bores as described above to remove silt. All water generated by this process would be controlled to avoid discharge to any surface watercourses.

4.8.2 Mitigation Measures

Preconstruction

- Soil and water management measures would be detailed in the CEMP. This would include the site-specific measures to be implemented for all works areas, in accordance with the guidelines outlined in the 2004 Landcom publication *Managing Urban Stormwater: Soils and Construction, 4th edition* ("The Blue Book") and Volume 2a Installation of Services. These measures would need to be site specific and address the following issues to prevent erosion, sediment loss and water quality impacts:
    - Minimisation of disturbance to soil and water adjacent to, and within, all watercourses in the works area.
    - Identification of site specific sediment and erosion control measures wherever erosion is likely to occur.
    - No soil disturbance to occur in areas obviously prone to erosion or sediment runoff, such as steep slopes.
    - Silt fencing would be used at locations where erosion and sediment runoff could occur. Silt sausages and sandbags may also be installed as required to assist with this process.
    - Identification of any environmentally sensitive areas on or near construction sites to ensure runoff is diverted away from sensitive areas.
    - Requirements for vegetation clearing to be kept to a DoI - Water.
    - Retention of all surface runoff on-site and where possible stormwater from off site would be diverted around the construction site.
    - Location of construction compounds (at least 50 m from any drainage lines).
    - Location and management of stockpiles (such as locating stockpiles away from any drainage lines near the works areas).
    - All erosion and sediment controls would be regularly inspected, especially when rain is expected and directly after any rain events.
    - Water generated during drilling would be diverted to a holding tank for disposal off-site. No water would be discharged directly to ground or into a waterway.
- A drilling management plan / procedures should be developed as part of the CEMP to detail the appropriate management of drilling slurry so as to avoid off site impacts.
- A site-specific spill management plan would be prepared and include the following requirements:
    - Emergency spill kits are to be kept at the site (vehicle kits).

- Refuelling of machinery to be undertaken in a dedicated area within the construction compound appropriately protected as outlined in the spill management plan.
- Spill pallets would be used to store chemicals and capture small spills.
- Any chemicals and fuels are to be stored in a bunded area at least 50 m from any waterway or drainage line.
- Any hazardous materials on site to be stored in the compounds and within impervious and bunded enclosures capable of storing 120% of the volume of material stored there.
- Workers would be trained in the spill management plan and the use of the spill kits.

Construction

- Works would not be undertaken where there is the potential for degradation of the site and surrounding areas (including access tracks) due to heavy rainfall. Weather forecasts would be checked regularly to allow appropriate scheduling of construction works and securing of equipment and materials prior to a heavy rainfall event.
- All areas disturbed during the works would be protected by installing appropriate erosion and sedimentation control measures so that sediment-laden runoff does not enter any drainage line or wetland. Measures may include:
  - diverting any potential upslope runoff and stormwater away from the site;
  - installing temporary erosion control devices (e.g. sediment fencing, sand bags, sediment basins); and
  - temporary surface protection (e.g. surface mulching, geotextile / erosion control matting).
- Appropriate mitigation measures would be incorporated into the CEMP to manage groundwater encountered during construction, and would address the following:
  - Ensuring groundwater quality is not impacted during construction; and
  - Appropriate treatment and monitoring regimes in the event that groundwater flows come to the surface, including diversion to a holding tank for disposal off-site. No water would be discharged directly to ground or into a waterway.
- Drilling fluid would be comprised of freshwater, with the addition of approved muds, where required, to stabilise the hole.
- Tanks would be used instead of excavated sumps for drilling fluids.
- Drilling fluids and fines would be removed from site at the completion of drilling. No disposal of drilling fluids and slurry is to be undertaken within the catchment.
- Disposal of drilling fluids to be undertaken in a manner that would not cause pollution of waters as per Section 120 of the POEO Act.
- Concrete would not be mixed within 20 m of any natural or built drainage line or wetland. All concrete waste and any concrete washout would be contained and

removed for proper disposal off site. Washout of trucks would be undertaken off catchment wherever possible.

- Excavated spoil would be temporarily stockpiled on flat, cleared land to prevent impacts to vegetation and would be backfilled as soon as practicable.
- Any excess spoil would be removed off site at a licensed facility in accordance with relevant EPA requirements.

4.9 Flora and Fauna

The area of the proposed bore locations is situated within a heavily altered landscape with primary factors for land modification being determined by past and present anthropogenic activities including land clearing, the establishment of farms, construction of roads, dams and rural and urban residential development. Extensive farm-land areas including pasture lands for livestock grazing and ploughed fields occur with remnant bushlands of limited areas along the majority of the Kamilaroi and Newell highways. The Pilliga National Park and Nature Reserve was never used for non-Aboriginal agricultural or pastoral activities and so has predominantly native vegetation remaining (RPS, 2010).

The proposed bore sites are generally disturbed with extensive vegetation clearance, with those sites within State Forests exhibiting less disturbance and more remnant native vegetation.

Searches of threatened species registers was undertaken in July 2018 for all proposed bore sites. The searches included a 10 km radius and included searches on the both OEH Atlas of NSW Wildlife (BioNet) and EPBC Act of Protected Matters Search Tool (see Appendix D). The research results identified several endangered ecological community, threatened species or populations which may occur, or have previously been recorded, in the vicinity of the proposed bore locations (see Appendix D).

The proposed bore site 4B Pilliga Scratch Road is located in Pilliga Conservation Park, within close proximity to significant population of a native shrub species (*Motherumbah B. opponens* (Coolabah Bertya)), which is listed as a State and Commonwealth threatened plant species.

The Forestry Corporation of NSW has advised that Site 1D Pilliga West is located within a Pilliga Mouse Protection Area and is subject to a timber harvest exclusion. The Pilliga Mouse (*Pseudomys pilligaensis*) is listed as vulnerable under the NSW *Biodiversity Conservation Act* 2016 and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. Within the Pilliga region this species is largely restricted to low-nutrient deep sand soils which are recognised as supporting a distinctive vegetation type referred to as the Pilliga Scrub. The Pilliga Mouse is found in greatest abundance in recently burnt moist gullies, areas dominated by broombush and areas containing an understorey of kurricabah (*Acacia burrowii*) with a bloodwood (*Corymbia trachyphloia*) overstorey. A survey of the bore site for Pilliga Mouse habitat was not undertaken as part of this REF.

4.9.1.1 Impact Assessment

Generally, minimal vegetation is required to be removed at each bore site, particularly those which have been subject to previous disturbance and include cleared areas. Overall, the vegetation removal associated with the proposed borehole establishment and site

preparation works are likely to have negligible impact on the potential habitat available for any listed threatened species or ecological communities which may occur in the area.

The proposed monitoring bore at 4B Pilliga Scratch Road would be located in close proximity to an existing bore in this location. A REF was prepared by CH2M Hill in 2014 for that bore and included an assessment of the potential impact on the *Motherumbah B. opponens* (Coolabah Bertya) shrub species. That REF concluded that no impacts to this species are anticipated, as there is a sufficiently large cleared area adjacent to this habitat which can constitute the worksite. The monitoring bore proposed as part of the current program is located within the same area as the existing bore and is surrounded by a large cleared area that acts as a buffer to the threatened shrub species. Accordingly, any impact on *Motherumbah B. opponens* (Coolabah Bertya) is considered to be negligible.

The Forestry Corporation of NSW has advised that Site 1D Pilliga West is located within a Pilliga Mouse Protection Area and is subject to a timber harvest exclusion. It is not known whether the bore site itself contains habitat for the Pilliga Mouse. The bore site should be surveyed by an ecologist prior to carrying out any works on site to determine whether the site contains any Pilliga Mouse habitat, and if so, an assessment of impacts should be undertaken in accordance with the requirements of the NSW *Biodiversity Conservation Act 2016* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Notwithstanding further investigations and potential biodiversity assessment required at Site 1D Pilliga West, for the remaining sites it is not considered that any legislative assessments (i.e. reference to the EPBC Act's Significant Impact Guidelines or Part 7 of the BC Act [i.e. the five-part test]), regarding the impact of the proposal on any matter of conservation significance are required. This is due to the limited extent of work proposed, the generally modified character of the areas to be affected and their land use history. The undertaking of the proposed work would not fragment or isolate any areas of habitat, nor present any barriers to the breeding or dispersal requirements of any native species.

Given the short timeframe and minor footprint of the proposed works, and assuming the proper implementation of the recommended mitigation measures provided below, flora and fauna are considered unlikely to be impacted significantly by the proposal.

4.9.2 Mitigation Measures

Pre-construction

- Site 1D Pilliga West should be surveyed by an ecologist prior to carrying out any works on site to determine whether the site contains any Pilliga Mouse habitat, and if so, an assessment of impacts should be undertaken in accordance with the requirements of the NSW *Biodiversity Conservation Act 2016* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.
- Flora and fauna management during construction would be included in the Contractor's Environmental Management Plan (CEMP).
- Topsoil would be carefully removed and stored appropriately.
- The site would be inspected to check for noxious or environmental weeds before work commences. If weeds are present, appropriate control measures would be agreed

upon and implemented during the work. Any weeds that are removed from the site would be properly disposed of at an appropriately licensed waste facility.

Construction

- Implement appropriate tree protection measures for any trees which may be impacted prior to any works on the site.
- Do not place vehicles, machinery or stockpiles beneath canopies of trees.
- The construction footprint would be minimised, with the construction works area and traffic routes to be clearly defined prior to commencing work.
- Vegetation clearing would be kept to the minimum required to undertake the works.
- Topsoil would not be mixed with subsoil.
- Topsoil would be returned to the area from which it was stripped and not be mixed with topsoil from other areas.
- Details of wildlife carer to be kept readily available in the case of fauna being discovered or injured during site works.
- Where vegetation disturbance is required, the root ball of plants would be left intact to aid in rehabilitation and soil retention.
- Construction machinery (bulldozers, bobcats, trucks,) would be cleaned prior to entering the work site if the machinery is used off the hard stand or road areas and prior to leaving the site if operating in areas containing noxious weeds.
- Any fallen timber, dead wood and bush rock encountered in the impact area would be relocated to a suitable place nearby (a suitable place would be deemed as an area with similar characteristics as to where the log / dead wood / rock was originally located). These items would not be placed on top of existing habitat features.
- All workers would be made aware of potential threatened flora and fauna during works and understand the procedures if threatened fauna are detected (i.e. unexpected finds procedure).
- All personnel working at the 4B Pilliga Scratch Road site would be inducted to ensure they are familiar with Coolabah Bertya and the constraints it places on works.
- At the 4B Pilliga Scratch Road site, soil would be excavated and stockpiled in appropriate horizon layers and placed back in position at the cessation of the works, in the correct order, in accordance with industry standard soil conservation management. This will assist in maintaining the soil seedbank, and potential habitat for threatened plant species.
- Signage on fencing adjacent to known occurrence of Coolabah Bertya at 4B Pilliga Scratch Road would be installed. Signage would identify the approximate location of this listed species and deter site users from entry to the area.
- Newly exposed surfaces should be stabilised as soon as possible in order to reduce the potential for soil erosion and reformed to facilitate natural rehabilitation.

Operation

- At the completion of the monitoring program rehabilitation would be undertaken as soon as practicable.

4.10 Aboriginal Archaeology

A Due Diligence Aboriginal Heritage Assessment was undertaken by RPS in 2018. The assessment was undertaken in accordance with *the Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW*. The following is a summary of the assessment results, with the full report provided in Appendix E.

A search of the OEH administered Aboriginal Heritage Information Management System (AHIMS) identified 14 Aboriginal sites previously recorded in the vicinity of the proposed borehole locations. The highest number of sites are stone artefacts. However, the search identified no Aboriginal objects or places within the proposed borehole sites.

The results of the AHIMS search and the review of previous archaeological assessments indicate low to moderate potential for surface artefacts and low potential for culturally modified trees to be found in the area of the borehole locations. Prior land clearing practices throughout the area has limited the prevalence of scarred trees, however any vegetated area comprising mature trees may contain potential for these site types to occur. Areas close to water sources on flat ground are likely have a moderate to high probability of surface artefacts and Potential Archaeological Deposits have a potential presence in areas subject to minimal or no disturbance to the natural ground surface and subsurface.

No Aboriginal objects or places were identified during the archaeological pedestrian inspection of the 11 borehole locations. Ground surfaces, where visible, were inspected for stone artefacts but none were identified.

A search of the Register of Native Title Claims was undertaken to determine if any Native Title land claims have been issued or are in the process of determination. A claim was entered in 2012, NC2011/006 – the Gomeroi People. This claim has not yet been determined. RPS recommends land tenure mapping to determine location of boreholes relevant to vacant Crown Land on which determined Native Title can exist.

4.10.1 Impact Assessment

All 11 borehole locations demonstrated ground disturbance associated with establishing access roads, fencing, electricity easements, pastoral and farming practices, and sheet wash erosion promoted by previous vegetation clearance. Aboriginal heritage objects, predominantly stone artefacts are located within A1 and A2 horizon soils, above B1 horizon soils. Due to the eroded nature of the soil profiles across the all bore sites, no impacts to potential Aboriginal sites within these areas are anticipated.

Inconsistent water sources would not have been reliable sources of drinking water for past Aboriginal people and as such it is considered that use of these location types would likely have been transitory only.

It has been identified that all of the 11 borehole locations are considered to have low potential for unidentified Aboriginal objects to be present and low potential for subsurface Aboriginal objects. The few mature trees present were inspected for evidence of cultural scarring, but no such evidence was identified

Therefore, the assessment concluded that there are no identified Aboriginal objects in all of the bore sites area. Given the proper implementation of mitigation measures listed below, the impact on Aboriginal objects or sites is considered to be negligible and further assessment or an AHIP is not required for the proposed activity.

4.10.2 Mitigation Measures

Construction

- In view of the Native Title claim # NC2011/006, land tenure mapping of the proposed borehole locations should be undertaken to determine if their location falls within land where Native Title may exist.
- If any proposed borehole locations exist on land where Native Title may exist, consultation should be undertaken with the relevant Native Title Claimants.
- All relevant staff and contractors should be made aware of their statutory obligations for heritage under *the National Parks and Wildlife Act 1974* and *the Heritage Act 1977*, which may be implemented as a heritage induction.
- If unrecorded Aboriginal object/s are identified in the Project Area, then all works in the immediate area must cease and the area cordoned off. OEH must be notified on the Enviroline 131 555 so that the site can be adequately assessed and managed.
- In the unlikely event that human skeletal remains are identified, work must cease immediately in the vicinity of the remains and the area cordoned off. The proponent must contact the local NSW Police who will make an initial assessment as to whether the remains are part of a crime scene or, possible Aboriginal remains. If the remains are thought to be Aboriginal, OEH must be contacted on the Enviroline 131 555. An OEH officer will determine if the remains are Aboriginal or not. If the remains are identified as Aboriginal, a management plan must be developed in consultation with the relevant Aboriginal stakeholders before works recommence.

4.11 Historic Heritage

A Due Diligence Historic Heritage Assessment was undertaken by RPS in 2018. The following is a summary of the assessment results, with the full report provided in Appendix E

A search of the National Heritage Database, State Heritage Register and the Local Government Heritage Registers of Narrabri LEP 2012, Gunnedah LEP 2012 and Liverpool LEP 2011 identified no heritage listing within the proposed boreholes sites.

4.11.1 Impact Assessment

No impacts anticipated.

4.11.2 Mitigation Measures

- If, during the course of development works, suspected non-Aboriginal heritage material is uncovered, work should cease in that area immediately. The Heritage Branch, Office of Environment & Heritage (Enviroline 131 555) should be notified and works only recommence when an approved management strategy has been developed.

4.12 Natural Events

Several of the proposed bore sites are identified as bushfire prone land, these being:

- 1D Pilliga West
- 4B Pilliga Scratch Road
- 6D Maules Creek Mine
- 5A Pilliga South East
- 12A Werris Creek Mine
- 14 Pilliga South Extraction Area

4.12.1 Impact Assessment

During construction, any hot works such as welding pose a bushfire risk to those sites identified as bush fire prone.

Solar power is proposed for the telemetry equipment and therefore any bushfire risk from the provision of power to the sites is anticipated to be low. The presence of the bores is not predicted to have an impact on reducing the area required for fire fighters and other emergency services personnel to fight fires and undertake evacuation procedures.

For maintenance and water sampling during operation of the bores, weather conditions should be taken into consideration prior to undertaking such activities to minimise the risk to people from natural hazards such as bushfire, fallen timber, etc.

4.12.2 Mitigation Measures

Pre-construction

- The CEMP would include emergency evacuation plans for personnel, plant and equipment in the event of a bushfire or any other emergency.
- The CEMP would include hot work control procedures and containment measures on sites to carry out such works (when allowed).

Construction

- Construction workers are to be made aware of the location of the proposed works in bushfire prone land and the potential for bushfire risk.
- No hot works are to be undertaken on Total Fire Ban days.

4.13 Waste Management

The overall waste generated due to the proposal is anticipated to be low. The construction of the proposed monitoring bores would result in waste in the form of site waste such as excess spoil, cleared vegetation, drilling fluids, solid and liquid wastes, general building waste such as packaging, off cuts, excess materials and workers waste such as drinks containers, food scraps, etc. Portable toilets would be provided for workers at the construction site.

To ensure that environmental harm does not occur as a result of uncontrolled or inappropriate collection, transport and disposal the relevant provisions of the following legislation and regulation would be implemented:

- *Waste Avoidance and Resource Recovery Act 2001*
- *Protection of the Environment Operations Act 1997*

- *Protection of the Environment Operations (Waste) Regulation 2014*

4.13.1 Impact Assessment

The waste management and contamination control procedures and/or measures listed below would be implemented for the proposed works. It is assessed that waste can be adequately managed to avoid impact.

4.13.2 Mitigation Measures

Pre-construction

- The contractor undertaking the works would detail waste management procedures in a Waste Management Plan to be incorporated into the CEMP. The contractor is to assume responsibility for the appropriate disposal of any waste generated.

Construction

- Adequate procedures should be established and detailed in the CEMP, including notification requirements to EPA, for incidents that cause material harm to the environment. The CEMP would also follow the resource management hierarchy principles embodied in the *Waste Avoidance and Resource Recovery Act* 2001. Namely, to:
    - avoid unnecessary resource consumption;
    - recover resources (including reuse, reprocessing, recycling and energy recovery); and
    - dispose (as a last resort).
- All waste removed from the site would be classified and disposed of appropriately, and all non-recyclable waste would be disposed of at an appropriate licensed waste disposal facility.
- If any contaminated material is encountered during earthworks, work would cease, the site secured and a safe work method statement(s) and appropriate practices would be implemented. Any contaminated material would be classified first and then stored, transported and disposed of in accordance with EPA requirements at an EPA licensed waste facility.
- Cleared vegetation (devoid of weeds) would be left on site.

4.14 Visual Amenity

The majority of the proposed bore sites are located in rural and natural landscapes. Public visibility of the sites is varied, with Sites 3A Old Gunnedah Road, 7A and 8A Blue Vale Mine being highly visible locations. Sites 1D Pilliga West, 4B Pilliga Scratch Road, 5A Pilliga South East and 14 Pilliga South Extraction Area are located in State Forests, which have the potential for greater scenic and amenity values due to their potential use as passive recreational facilities.

4.14.1 Impact Assessment

There would be minor and temporary visual impacts during construction of the bores due to the presence of construction equipment.

Post-construction, the presence of the bores is not anticipated to have a significant visual impact. The bores are generally located in isolated rural landscapes, with similar and previous bore installations demonstrating minimal visual impacts on the landscape.

4.14.2 Mitigation Measures

Construction

- The clearing of vegetation would be kept to the minimum required for the works.
- Construction compounds and areas for the parking of vehicles and storing of equipment would be located in cleared areas wherever possible.

4.15 Utilities and Infrastructure

Existing utilities are located in the vicinity of Site 5A (telecommunications) and Site 10B Shenhua (overhead power and telecommunications).

4.15.1 Impact Assessment

Overall the works are considered unlikely to have an adverse impact on utilities and infrastructure. For those sites which include or are in close proximity to services, the bores would be installed so as to avoid any impacts of these.

4.15.2 Mitigation Measures

- Utilities and services which may be impacted by the proposal would be accurately located prior to commencement of works.
- Utility and service providers would be consulted prior to the commencement of and during construction works in the event that impacts on any utilities and services by the proposal are likely.
- Care shall be taken to ensure no disturbance of underground infrastructure (optic fibre cables, gas lines, water lines, etc.), or aboveground infrastructure (power lines, sealed road pavement, etc.).
- Any inadvertent damage to infrastructure as a result of the works is to be rectified in consultation with the infrastructure owner.

5 Environmental Management

5.1 Construction Management

Preparation of a Construction Environmental Management Plan (CEMP) is mandatory for all projects undertaken by or on behalf of government agencies or where funding is being provided by the government (NSW Government Code of Practice for Procurement, 2005).

The CEMP would be developed to ensure that appropriate environmental management practices are followed during a project's construction and/or operation. Public Works Advisory would review the CEMP for this proposal, which should include the following elements, as described in the Guideline for the Preparation of Environmental Management Plans (DIPNR, 2004):

Table 5-1: Construction Environmental Management Plan Structure

Background	Introduction Project Description EMP Context EMP Objectives Environmental Policy
Environmental Management	Environmental Management Structure and Responsibility Approval and Licensing Requirements Reporting Environmental Training Emergency Contacts and Response
Implementation	Risk Assessment Environmental Management Environmental Management Activities and Controls Environmental Management Plans and Maps Environmental Schedules
Monitor and Review	Environmental Monitoring Environmental Auditing Corrective Action EMP Review

The following compilation of mitigation measures is intended to assist in the preparation of the CEMP, to ensure that the relevant site-specific safeguards are implemented for the aspects of the environment listed below. It should be noted that this list is not comprehensive, with the CEMP to incorporate any additional measures required as part of determination of the project and conditions of any other approvals, permits or licenses

required for the proposal. The CEMP should also provide details on monitoring and verification for all identified mitigation measures.

5.2 Operational Management

Operational safeguards identified below are to be incorporated into an Operational Environmental Management Plan (OEMP) for the project.

5.3 Environmental Management Measures

The following details the environmental objectives during construction and the proposed mitigation to be included in the CEMP. This list is not definitive, and additional measures detailed as part of the determination of the project and conditions of any other approvals must also be included.

Operational safeguards are also listed for incorporation into an OEMP for the project.

Implementation of the mitigation measures outlined below would be undertaken during a number of phases of the project. These phases comprise:

1. Detailed design – refinement of the design details.
2. Pre-construction – prior to the contractor arriving on site to carry out the works.
3. Construction – during construction phase.
4. Operation – post construction.

5.3.1 Land Use

Objective

- Minimise impacts to surrounding land users during construction and operation.

Actions

Action/Phase	Responsibility
Pre-Construction	
All necessary approvals are to be obtained and access arrangements / agreements confirmed prior to commencement of construction activities (including site establishment, tree clearing, stockpiling etc.).	DoI - Water / Contractor
Negotiations would be undertaken with affected landowners where access to private land is impacted (i.e. across driveway / access points). The outcomes of any access arrangements would be documented in a CEMP prior to construction commencing.	DoI - Water / Contractor
Adjoining landowners should be notified about the proposed works at least 14 days prior to the commencement of works onsite.	Contractor
A Community Engagement Plan, or equivalent, would be prepared and implemented before work commences. This would include details of neighbours that need to be advised of the proposed works and how the notification would be undertaken.	Contractor

Action/Phase	Responsibility
Construction	
Ensure the necessary care and maintenance of property facilities and operations including fences, gates and stock. However, if any damage did occur to property it would be restored to a condition equivalent to the original condition.	Contractor
Sufficient closure and or barricading of the area are to be in place for the duration of the construction works, to prevent unauthorised access by the public and to exclude livestock from the works area. Temporary fencing and gates would be installed where necessary to exclude animals (stock and ground dwelling native fauna) from the work sites. Any temporary fencing or gates no longer required would be removed at the completion of the construction works.	Contractor
All areas impacted by the works are to be rehabilitated in accordance with a site-specific rehabilitation management plan.	Contractor
Adequate procedures must be established and detailed in the CEMP, including notification requirements to EPA, for incidents that cause material harm to the environment.	Contractor
Post Construction and Operation	
Fencing would be installed on sites co-inhabited by livestock (notably those managed by LLS) during construction and operation of the bores, to ensure safe movement of livestock.	DoI - Water/ Contractor
Post construction landscaping is to be undertaken when practicable.	Contractor
Adequate procedures must be established and detailed in the OEMP, including notification requirements to EPA, for incidents that cause material harm to the environment.	Contractor

5.3.2 Traffic & Access

Objectives

- Ensure that construction vehicles do not cause excessive inconvenience to road and pedestrian users.
- Ensure the safety of road users and construction personnel for the duration of works.
- Minimise the pollution impacts resulting from the use of vehicles during construction.

Actions

Action/Phase	Responsibility
Pre-construction	
Consideration should be given to infrastructure placement from a traffic safety/road infrastructure perspective.	Contractor
Construction	
A Traffic Management Plan (TMP) would be prepared by the chosen project contractor in accordance with: – *RMS Traffic Control at Work Sites Manual*, Issued 2018, and – *Australian Standard 1742.3 - 2009 Traffic Control for Works on Roads*.	Contractor
The TMP would detail appropriate construction traffic controls and management measures and all aspects would be implemented in co-ordination with the relevant local Councils and RMS. The TMP would include, but not be limited to, provisions for the following: – Predicted traffic movements, – Confirmation of traffic vehicle routes, – Onsite communication system and safe guards for ingress and egress, – Provisions and safeguards to notify local road users of construction works such as through signage, – Any changed traffic and access conditions (if required), and – Appropriate safety equipment and clothing such as the wearing of fluorescent safety vests.	Contractor
Where works are conducted on or adjacent to public roads and private access roads, appropriate traffic control procedures would be implemented. The work would be undertaken in a manner that allows the continued safe use of roadways.	Contractor
All access through, or work within private property would be undertaken with a DoI - Water of inconvenience to the owner / occupier. Residences or associated buildings would not be entered, except under exceptional circumstances.	Contractor
All gates and barriers (not including those providing access to public areas) would be closed and locked at all times to prevent unauthorised access.	Contractor
Safe 24 hour all weather access must be retained for landowners for the duration of the project.	Contractor
Contractor would maintain security at each worksite for the duration of the	Contractor

Action/Phase	Responsibility
project.	
Post Construction and Operation	
Establish a procedure to ensure the ongoing maintenance of the internal on-site access roads and access points during the operation phase. This maintenance may include sedimentation and erosion control structures, where necessary.	Contractor

5.3.3 Noise and Vibration

Objectives

- Compliance with relevant recommendations specified in the *Interim Construction Noise Guideline* (DECC, 2009).
- Avoidance / minimisation of noise impacts on nearby sensitive noise receivers.

Actions

Action/Phase	Responsibility
Construction	
All employees, contractors and subcontractors are to receive a project induction. The environmental component may also be covered in toolbox meetings and should include: – all relevant project specific and standard noise mitigation measures as detailed in a project specific construction noise and vibration management plan prepared by the contractor; – relevant licence and approval conditions; – permissible hours of work; – any limitations on high noise generating activities; – location of nearest sensitive receivers; – construction employee parking areas; – designated loading / unloading areas and procedures; – site opening / closing times (including deliveries); and – environmental incident procedures.	Contractor
Avoid unnecessary shouting or loud stereos / radios on site.	Contractor
Noise monitoring should be considered for the duration of the works.	Contractor
Wherever possible, vehicles, plant and equipment would be switched off when not in use.	Contractor

Action/Phase	Responsibility
The impact of noise on known sensitive noise receivers would be minimised by implementing measures such as appropriate positioning of plant on the site and scheduling noisier activities to less sensitive periods.	Contractor
Work generating high noise levels should be scheduled during less sensitive time periods if practicable.	Contractor
Use quieter and less noise emitting construction methods where feasible and reasonable.	Contractor
All plant and equipment to be appropriately maintained to ensure optimum running conditions, with periodic monitoring.	Contractor
Plan traffic flow, parking and loading / unloading areas to minimise reversing movements within the site.	Contractor
Where reasonable and feasible, use structures to shield residential receivers from noise such as: – site shed placement; – earth bunds; – temporary or mobile noise screens (where practicable); – enclosures to shield fixed noise sources such as pumps, compressors, fans etc. (where practicable); and – consideration of site topography when situating plant.	Contractor
Where vibration is found to be excessive, management measures should be implemented to ensure vibration compliance is achieved. Management measures may include modification of construction methods such as using smaller equipment, establishment of safe buffer zones as far as practicable within the site constraints, and if considered feasible, time restrictions for the most excessive vibration activities. Time restrictions are to be negotiated with affected receivers.	Contractor
Where construction activity occurs in close proximity to sensitive receivers, vibration testing of actual equipment on site would be carried out prior to their commencement of site operation to determine acceptable buffer distances, as far as practicable within the site constraints, to the nearest affected receiver locations.	Contractor
Dilapidation surveys should be conducted at all buildings within close proximity of the construction works. These surveys are used to address potential community concerns that perceived vibration may have caused damage to property.	Contractor
Works would be limited those hours listed in the *Interim Construction Noise Guideline* (DECC, 2009) where there is the potential for noise generated	Contractor

Action/Phase	Responsibility
outside those hours, particularly works at night, to impact on residences or other sensitive receivers.	

5.3.4 Air Quality

Objectives

- Minimisation of off-site dust nuisance to neighbouring landholders and the community.
- Minimisation of air quality impacts resulting from machinery and vehicle emissions.

Actions

Action/Phase	Responsibility
Pre-Construction	
Vehicles and equipment are to be suitably serviced within the six-month period prior to commencement of construction activities and all necessary maintenance undertaken during the construction period. The excessive use of vehicles and powered construction equipment is to be avoided.	Contractor
Construction	
All construction machinery is to be turned off when not in use to minimise emissions.	Contractor
All practicable and feasible measures would be taken to avoid raising excessive levels of dust.	Contractor
Appropriate measures to suppress dust would be implemented whenever dust is likely to be a problem.	Contractor
Hazardous material would be handled as per relevant guidelines to avoid potential air pollution.	Contractor
Any stockpiled spoil/fill is to be protected to minimise dust generation.	Contractor
Vehicles transporting spoil from the project sites are to be covered.	Contractor

5.3.5 Water Quality, Erosion and Sediment Control

Objectives

- To effectively manage sediment and erosion control during the construction stage of the project.
- Prevention / minimisation of impacts to nearby waterways during construction.

Actions

Action/Phase	Responsibility

Action/Phase	Responsibility
Pre-Construction	
Soil and water management measures would be detailed in the CEMP. This would include the site-specific measures to be implemented for all works areas, in accordance with the guidelines outlined in the 2004 Landcom publication *Managing Urban Stormwater: Soils and Construction, 4th edition* ("The Blue Book") and *Volume 2a Installation of Services*. These measures would need to be site specific and address the following issues to prevent erosion, sediment loss and water quality impacts: – Minimisation of disturbance to soil and water adjacent to, and within, all watercourses in the works area. – Identification of site specific sediment and erosion control measures wherever erosion is likely to occur. – No soil disturbance to occur in areas obviously prone to erosion or sediment runoff, such as steep slopes. – Silt fencing would be used at locations where erosion and sediment runoff could occur. Silt sausages and sandbags may also be installed as required to assist with this process. – Identification of any environmentally sensitive areas on or near construction sites to ensure runoff is diverted away from sensitive areas. – Requirements for vegetation clearing to be kept to a DoI - Water. – Retention of all surface runoff on-site and where possible stormwater from off site would be diverted around the construction site. – Location of construction compounds (at least 50 m from any drainage lines). – Location and management of stockpiles (such as locating stockpiles away from any drainage lines near the works areas). – All erosion and sediment controls would be regularly inspected, especially when rain is expected and directly after any rain events. – Water generated during drilling would be diverted to a holding tank for disposal off-site. No water would be discharged directly to ground or into a waterway.	Contractor
A drilling management plan / procedures should be developed as part of the CEMP to detail the appropriate management of drilling slurry so as to avoid off site impacts.	Contractor
A site-specific spill management plan would be prepared and include the following requirements: – Emergency spill kits are to be kept at the site (vehicle kits). – Refuelling of machinery to be undertaken in a dedicated area within	Contractor

Action/Phase	Responsibility
the construction compound appropriately protected as outlined in the spill management plan. – Spill pallets would be used to store chemicals and capture small spills. – Any chemicals and fuels are to be stored in a bunded area at least 50 m from any waterway or drainage line. – Any hazardous materials on site to be stored in the compounds and within impervious and bunded enclosures capable of storing 120% of the volume of material stored there. – Workers would be trained in the spill management plan and the use of the spill kits.	
Construction	
Works would not be undertaken where there is the potential for degradation of the site and surrounding areas (including access tracks) due to heavy rainfall. Weather forecasts would be checked regularly to allow appropriate scheduling of construction works and securing of equipment and materials prior to a heavy rainfall event.	Contractor
All areas disturbed during the works would be protected by installing appropriate erosion and sedimentation control measures so that sediment-laden runoff does not enter any drainage line. Measures may include: – diverting any potential upslope runoff and stormwater away from the site; – installing temporary erosion control devices (e.g. sediment fencing, sand bags, sediment basins); and – temporary surface protection (e.g. surface mulching, geotextile / erosion control matting).	Contractor
Appropriate mitigation measures would be incorporated into the CEMP to manage groundwater encountered during construction, and would address the following: – Ensuring groundwater quality is not impacted during construction; and – Appropriate treatment and monitoring regimes in the event that groundwater flows come to the surface, including diversion to a holding tank for disposal off-site. No water would be discharged directly to ground or into a waterway.	Contractor
Drilling fluid would be comprised of freshwater, with the addition of approved muds, where required, to stabilise the hole.	Contractor
Tanks would be used instead of excavated sumps for drilling fluids.	Contractor
Drilling fluids and fines would be removed from site at the completion of	Contractor

Action/Phase	Responsibility
drilling. No disposal of drilling fluids and slurry is to be undertaken within the catchment.	
Disposal of drilling fluids to be undertaken in a manner that would not cause pollution of waters as per Section 120 of the POEO Act.	Contractor
Concrete would not be mixed within 20 m of any natural or built drainage line or wetland. All concrete waste and any concrete washout would be contained and removed for proper disposal off site. Washout of trucks would be undertaken off catchment wherever possible.	Contractor
Excavated spoil would be temporarily stockpiled on flat, cleared land to prevent impacts to vegetation and backfilled as soon as practicable.	Contractor
Any excess spoil would be removed off site at a licensed facility in accordance with relevant OEH requirements.	Contractor
Potentially contaminated water being discharged or irrigated must be prevented from entering any nearby watercourses.	Contractor
Isolation of aquifers to prevent the mixing of water from different depths will be achieved by constructing the bores to the standards of the specifications.	Contractor

5.3.6 Flora and Fauna

Objectives

- Avoidance / minimisation of impacts to flora and fauna.
- Minimise clearing of vegetation.
- Avoid the introduction or spread of weeds during construction and post construction.

Actions

Action/Phase	Responsibility
Pre-construction	
Site 1D Pilliga West should be surveyed by an ecologist prior to carrying out any works on site to determine whether the site contains any Pilliga Mouse habitat, and if so, an assessment of impacts should be undertaken in accordance with the requirements of the NSW *Biodiversity Conservation Act 2016* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.	DoI - Water
Aspects of Flora and Fauna Management would be included in the Contractor's Environmental Management Plan (CEMP).	Contractor
Topsoil would be carefully removed and stored appropriately.	Contractor

Action/Phase	Responsibility
The site would be inspected to check for noxious or environmental weeds before work commences. If weeds are present, appropriate control measures would be agreed upon and implemented during the work. Any weeds that are removed from the site would be properly disposed of at an appropriately licensed waste facility.	Contractor
Construction	
Implement appropriate tree protection measures for any trees which may be impacted prior to any works on the site.	Contractor
Do not place vehicles, machinery or stockpiles beneath canopies of trees.	Contractor
The construction footprint would be minimised, with the construction works area and traffic routes to be clearly defined prior to commencing work.	Contractor
Vegetation clearing would be kept to the DoI - Water required to undertake the works.	Contractor
Topsoil would not be mixed with subsoil.	Contractor
Topsoil would be returned to the area from which it was stripped and not be mixed with topsoil from other areas.	Contractor
Details of wildlife carer to be kept readily available in the case of fauna being discovered or injured during site works.	Contractor
Where vegetation disturbance is required, the root ball of plants would be left intact to aid in rehabilitation and soil retention.	Contractor
Construction machinery (bulldozers, excavators, trucks, loaders and graders) would be cleaned prior to entering the work site if the machinery is used off the hard stand or road areas and prior to leaving the site if operating in areas containing noxious weeds.	Contractor
Any fallen timber, dead wood and bush rock encountered in the impact area would be relocated to a suitable place nearby (a suitable place would be deemed as an area with similar characteristics as to where the log / dead wood / rock was originally located). These items would not be placed on top of existing habitat features.	Contractor
All workers would be made aware of potential threatened flora and fauna during works and understand the procedures if threatened fauna are detected (i.e. unexpected finds procedure).	Contractor
Newly exposed surfaces should be stabilised as soon as possible in order to reduce the potential for soil erosion and reformed to facilitate natural rehabilitation.	Contractor

Action/Phase	Responsibility
All personnel working at the 4B Pilliga Scratch Road site would be inducted to ensure they are familiar with Coolabah Bertya and the constraints it places on works.	Contractor
At the 4B Pilliga Scratch Road site, soil would be excavated and stockpiled in appropriate horizon layers and placed back in position at the cessation of the works, in the correct order, in accordance with industry standard soil conservation management. It is hoped this will maintain the soil seedbank, and potential habitat for threatened plant species.	Contractor
Signage on fencing adjacent to known occurrence of Coolabah Bertya at the 4B Pilliga Scratch Road site would be installed. Signage would identify the approximate location of this listed species and deter site users from entry to the area.	Contractor
Operation	
At the completion of the monitoring program rehabilitation would be undertaken as soon as practicable.	DoI – Water

5.3.7 Aboriginal Heritage

Objective(s)

- Minimise potential to impact items and places of Aboriginal heritage due to the works.

Action(s)

Action/Phase	Responsibility
Construction	
In view of the Native Title claim # NC2011/006, land tenure mapping of the proposed borehole locations should be undertaken to determine if their location falls within land where Native Title may exist.	Contractor
If any proposed borehole locations exist on land where Native Title may exist, consultation should be undertaken with the relevant Native Title Claimants.	Contractor
All relevant staff and contractors should be made aware of their statutory obligations for heritage under *the National Parks and Wildlife Act 1974* and *the Heritage Act 1977*, which may be implemented as a heritage induction.	Contractor
If unrecorded Aboriginal object/s are identified in the Project Area, then all works in the immediate area must cease and the area cordoned off. OEH must be notified on the Enviroline 131 555 so that the site can be adequately assessed and managed.	Contractor

Action/Phase	Responsibility
In the unlikely event that human skeletal remains are identified, work must cease immediately in the vicinity of the remains and the area cordoned off. The proponent must contact the local NSW Police who will make an initial assessment as to whether the remains are part of a crime scene or, possible Aboriginal remains. If the remains are thought to be Aboriginal, OEH must be contacted on the Enviroline 131 555. An OEH officer will determine if the remains are Aboriginal or not. If the remains are identified as Aboriginal, a management plan must be developed in consultation with the relevant Aboriginal stakeholders before works recommence.	Contractor

5.3.8 Historic Heritage

Objective(s)

- Minimise potential to impact items and places of historic heritage due to the works.

Action(s)

Action/Phase	Responsibility
Pre-Construction	
If, during the course of development works, suspected historic cultural heritage material is uncovered (e.g. relics), work should cease in that area immediately. The Heritage Branch, OEH must be notified by ringing the Enviroline 131 555 and works only recommence when an approved management strategy has been developed.	Contractor

5.3.9 Natural Events

Objective(s)

- Minimise potential risk to construction workers and the public due to bushfire or other natural events.

Action(s)

Action/Phase	Responsibility
Pre-Construction	
The CEMP would include emergency evacuation plans for personnel, plant and equipment in the event of a bushfire or any other emergency.	Contractor
The CEMP would include hot work control procedures and containment measures on sites to carry out such works (when allowed).	Contractor
Construction	
Construction workers are to be made aware of the location of the proposed works in bushfire prone land and the potential for bushfire risk.	Contractor

Action/Phase	Responsibility
No hot works are to be undertaken on Total Fire Ban days.	Contractor

5.3.10 Waste Management

Objective(s)

- Compliance the provisions of the *Protection of the Environment Operations (Waste) Regulation 2014*.
- Maximise reuse / recycling of waste material and minimise waste disposed of to landfill.
- Minimise offsite impacts associated with spoil and waste generation.

Action(s)

Action/Phase	Responsibility
Pre-construction	
The contractor undertaking the works would detail waste management procedures in a Waste Management Plan to be incorporated into the CEMP. The contractor is to assume responsibility for the appropriate disposal of any waste generated.	Contractor
Construction	
Adequate procedures should be established and detailed in the CEMP, including notification requirements to EPA, for incidents that cause material harm to the environment. The CEMP would also follow the resource management hierarchy principles embodied in the *Waste Avoidance and Resource Recovery Act 2001*. Namely, to: – avoid unnecessary resource consumption; – recover resources (including reuse, reprocessing, recycling and energy recovery); and – dispose (as a last resort).	Contractor
All waste removed from the site would be classified and disposed of appropriately, and all non-recyclable waste would be disposed of at an appropriate licensed waste disposal facility.	Contractor
If any contaminated material is encountered during earthworks, work would cease, the site secured and a safe work method statement(s) and appropriate practices would be implemented. Any contaminated material would be classified first and then stored, transported and disposed of in accordance with EPA requirements at an EPA licensed waste facility.	Contractor
Cleared vegetation (devoid of weeds) would be left on site.	Contractor

5.3.11 Visual Amenity

Objective(s)

- Protect the visual amenity of the locality for the landholder.

Action(s)

Action/Phase	Responsibility
Construction	
Clearing of vegetation would be kept to the DoI - Water required for the works.	Contractor
Construction compounds and areas for the parking of vehicles and storing of equipment would be located in cleared areas wherever possible.	Contractor

5.3.12 Utilities & Infrastructure

Objective(s)

- Avoidance / minimisation of impacts on utilities and infrastructure.

Action(s)

Action/Phase	Responsibility
Pre-construction	
Utilities and services which may be impacted by the proposal would be accurately located prior to commencement of works.	Contractor / DoI - Water
Consult with utility and service providers prior to the commencement of and during construction works in the event that impacts on any utilities and services by the proposal are likely.	Contractor
Construction	
Care would be taken to ensure no disturbance of underground infrastructure (optic fibre cables, gas lines, water lines, etc.), or aboveground infrastructure (power lines, sealed road pavement, etc.).	Contractor
Any inadvertent damage to infrastructure as a result of the works is to be rectified in consultation with the infrastructure owner.	Contractor
Any inadvertent damage to infrastructure as a result of the works is to be rectified in consultation with the infrastructure owner.	Contractor / DoI - Water

6 Conclusions

The installation of twenty (20) groundwater monitoring bores at eleven (11) sites would enable DoI - Water to understand existing groundwater resources in the Gunnedah Basin, as well as understand the impact of present and future changes in regional groundwater resources influenced by mining and other natural resource extraction industries likely to occur in the Gunnedah Basin region.

The project would potentially cause short-term impacts such as increased noise and dust. However, these impacts are considered to be minor and temporary. Minimal vegetation clearing is proposed for the establishment of the bores. The development is considered to be a low impact activity for Aboriginal heritage impacts and a due diligence assessment did not identify the potential for Aboriginal items to be present at any of the sites.

Overall, given that the works are predominantly at single point locations, are readily accessible and would include aboveground headworks that have a small footprint, adverse impacts during the construction and operation phase of the proposal are considered to be minimal.

This REF has been prepared in accordance with Sections 5.5 and 5.7 of the *Environmental Planning and Assessment Act 1979* and Clause 228 of the *Environmental Planning and Assessment Regulation 2000.* Notwithstanding further biodiversity assessment that is required, this REF provides a true and fair assessment of the proposed activity in relation to its likely effects on the environment and addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposed activity.

On the basis of the information presented in this REF (noting that further assessment is required for Site 1D Pilliga West to confirm potential biodiversity impacts on vulnerable species) it is concluded that:

(1) The proposed activity is not likely to have a significant impact on the environment and therefore an Environmental Impact Statement is not required.

(2) The proposed activity is not likely to significantly affect threatened species, populations, ecological communities, or critical habitat. Therefore, a Biodiversity Development Assessment Report or Species Impact Statement (SIS) is not required.

(3) The proposed Activity is not likely to affect any Commonwealth land, is not being carried out on Commonwealth land, or significantly affects any Matters of National Environmental Significance.

The proposed activity is recommended for approval subject to:

- Further assessment of potential biodiversity impacts at Site 1D Pilliga West, in relation to potential Pilliga Mouse habitat, undertaken in accordance with the requirements of the NSW *Biodiversity Conservation Act 2016* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*;
- Implementation of measures to avoid, minimise or manage environmental impacts in this REF.

7 References

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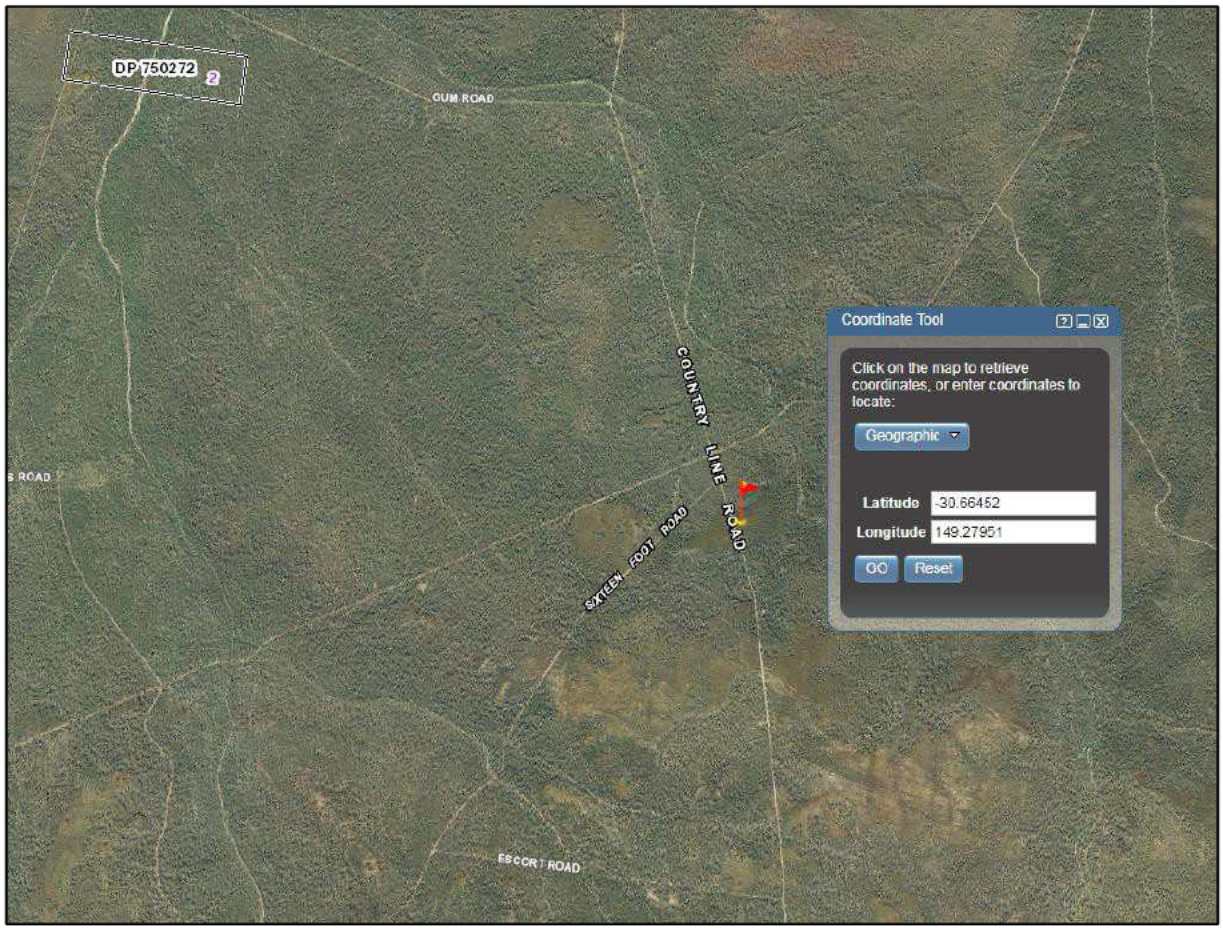
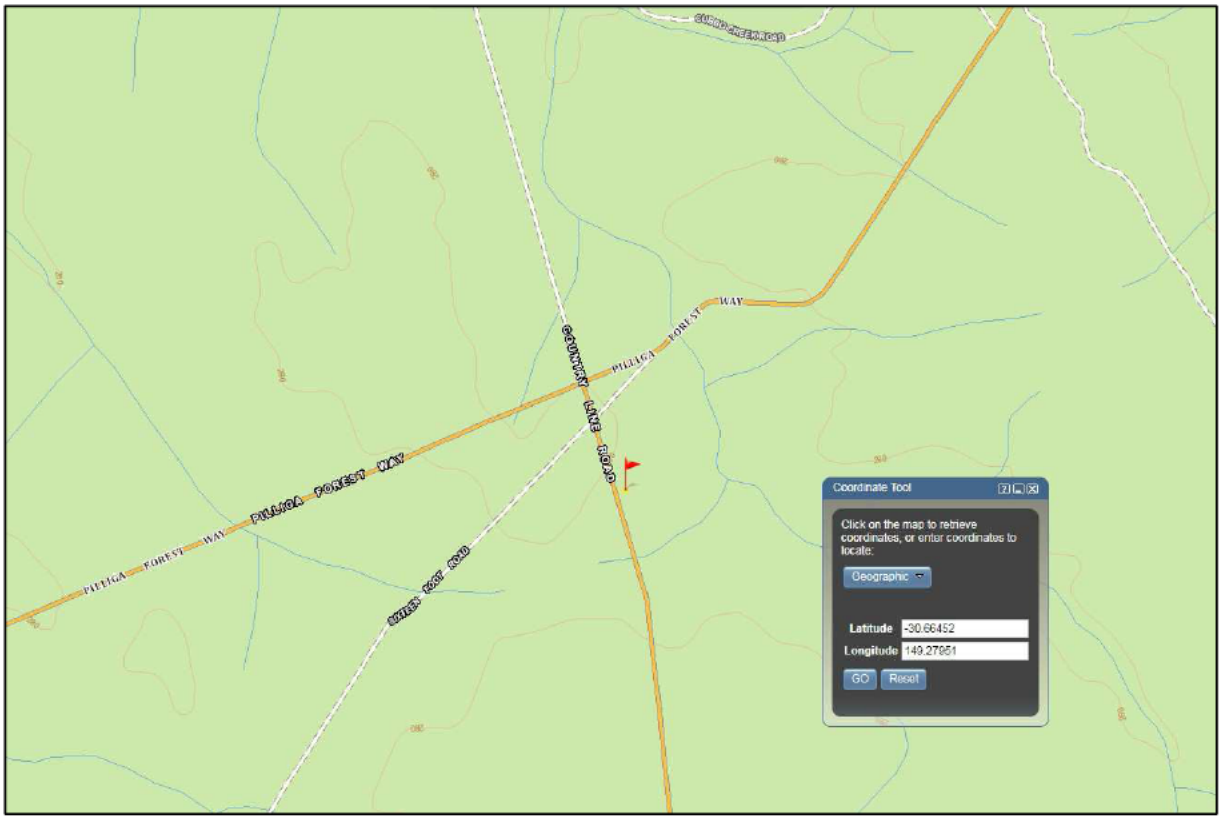
the Namoi subregion. Product 1.1 from the Northern Inland Catchments Bioregional Assessment. Department of the Environment, Bureau of Meteorology, CSIRO and Geoscience Australia, Australia.

Appendix A – Site Maps and Photographs

1D Pilliga West

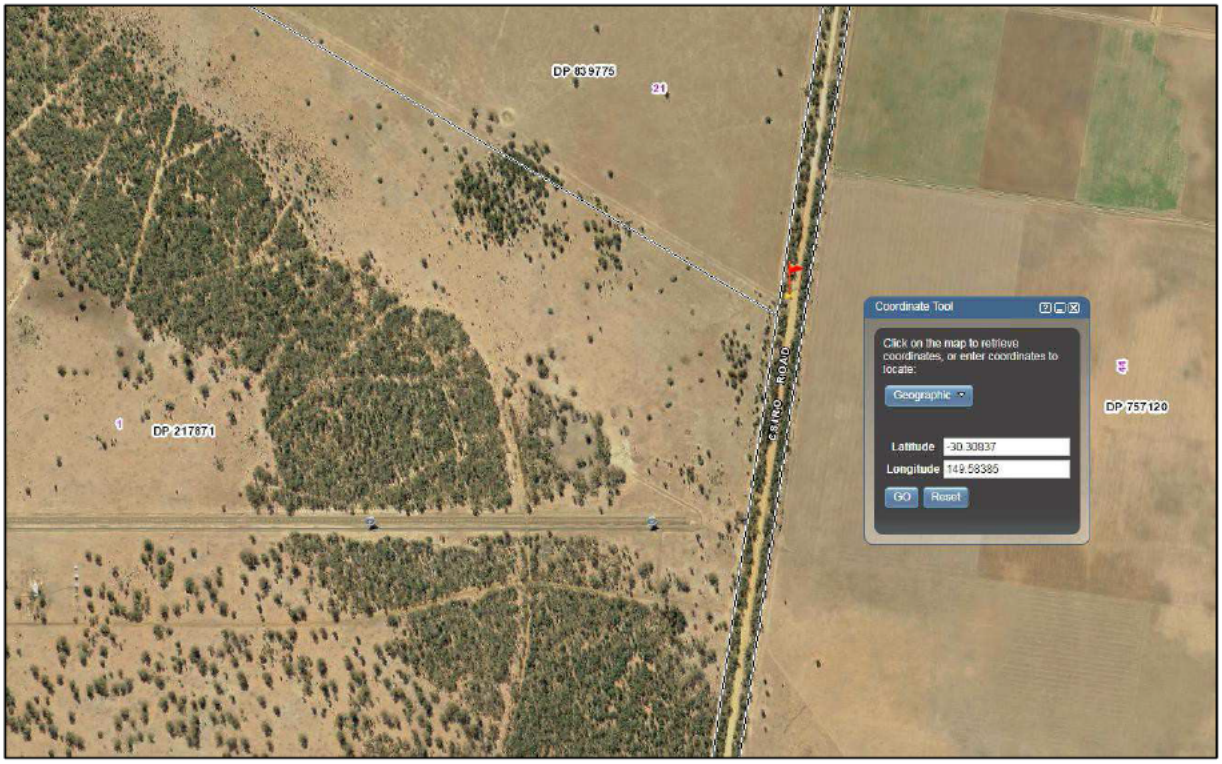


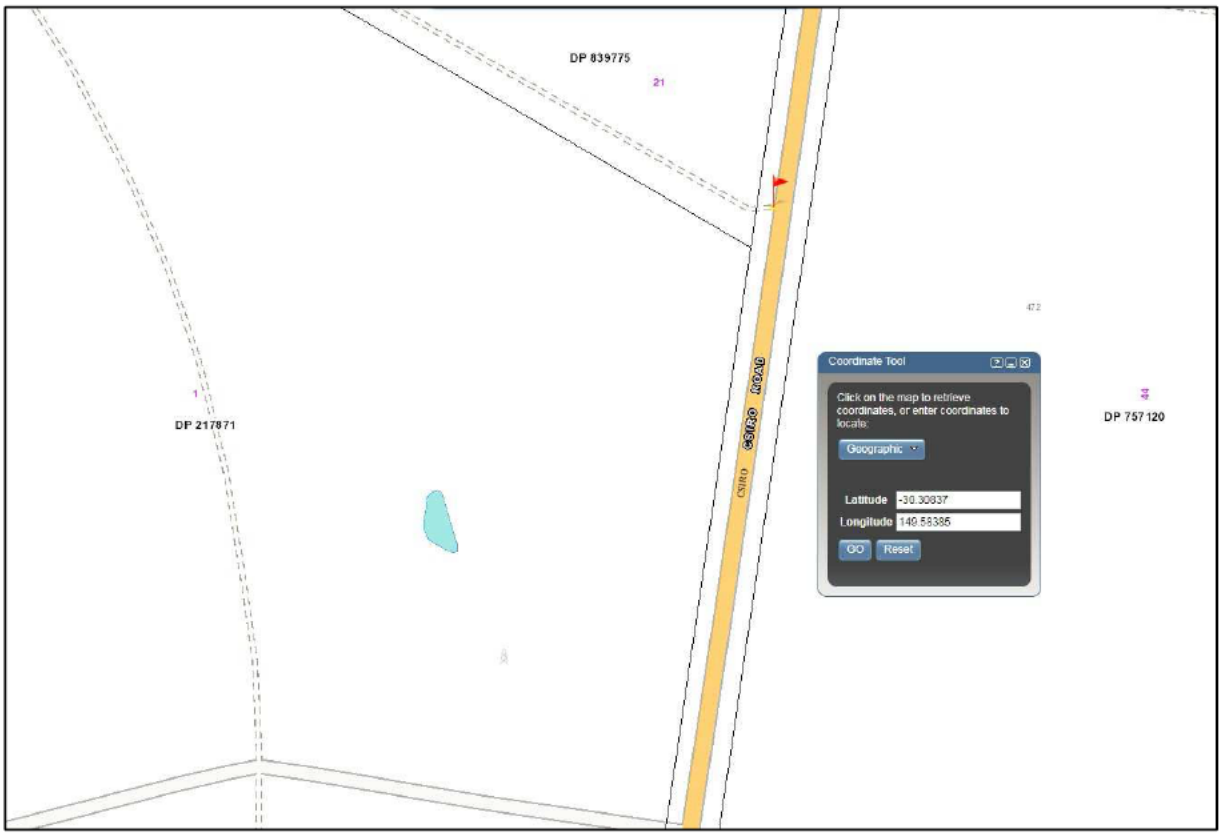


Source: SIX Maps, Accessed June 2018

Source: RPS, 2010

2A Lower Namoi

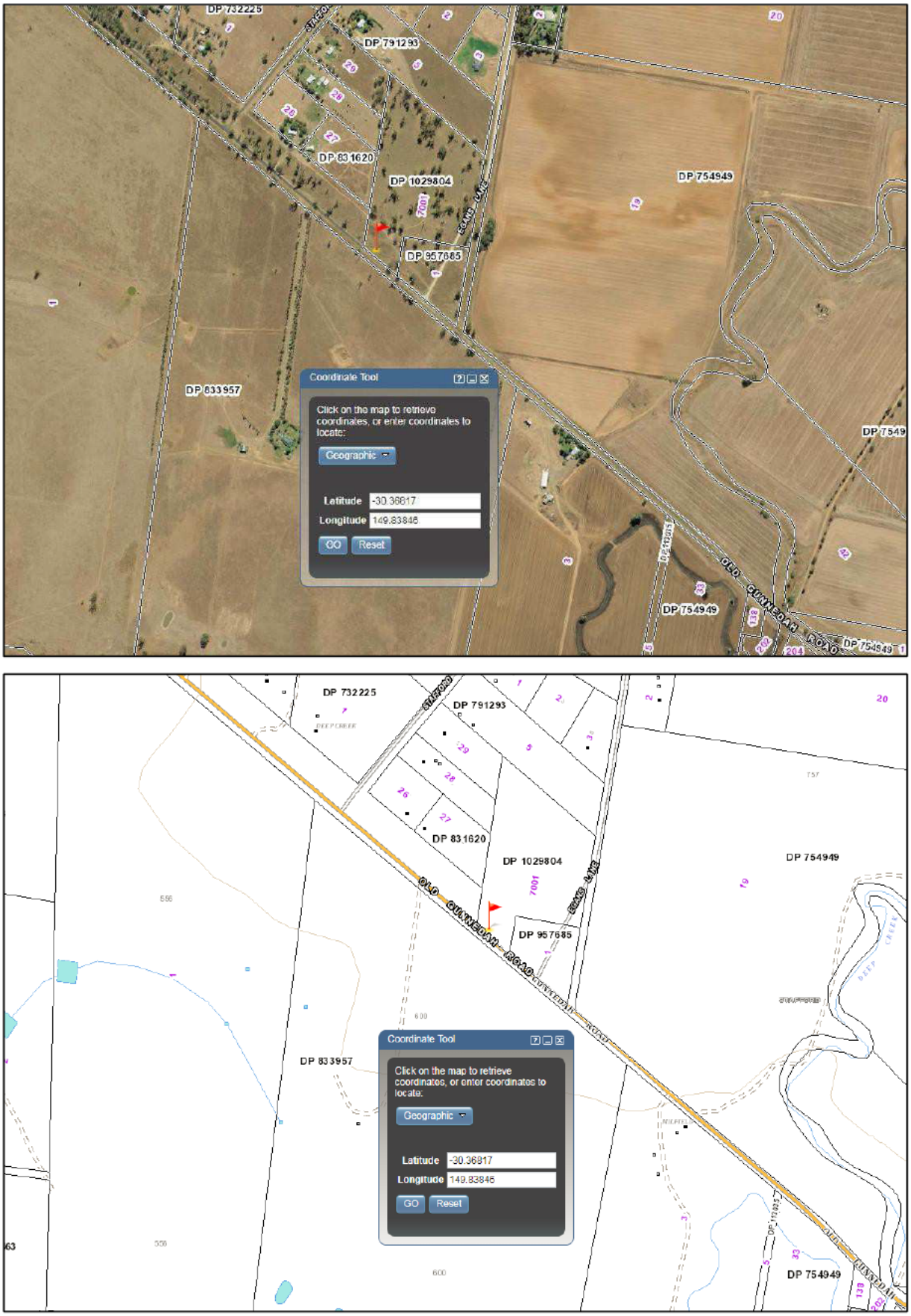




Source: SIX Maps, Accessed June 2018

Source: RPS, 2010

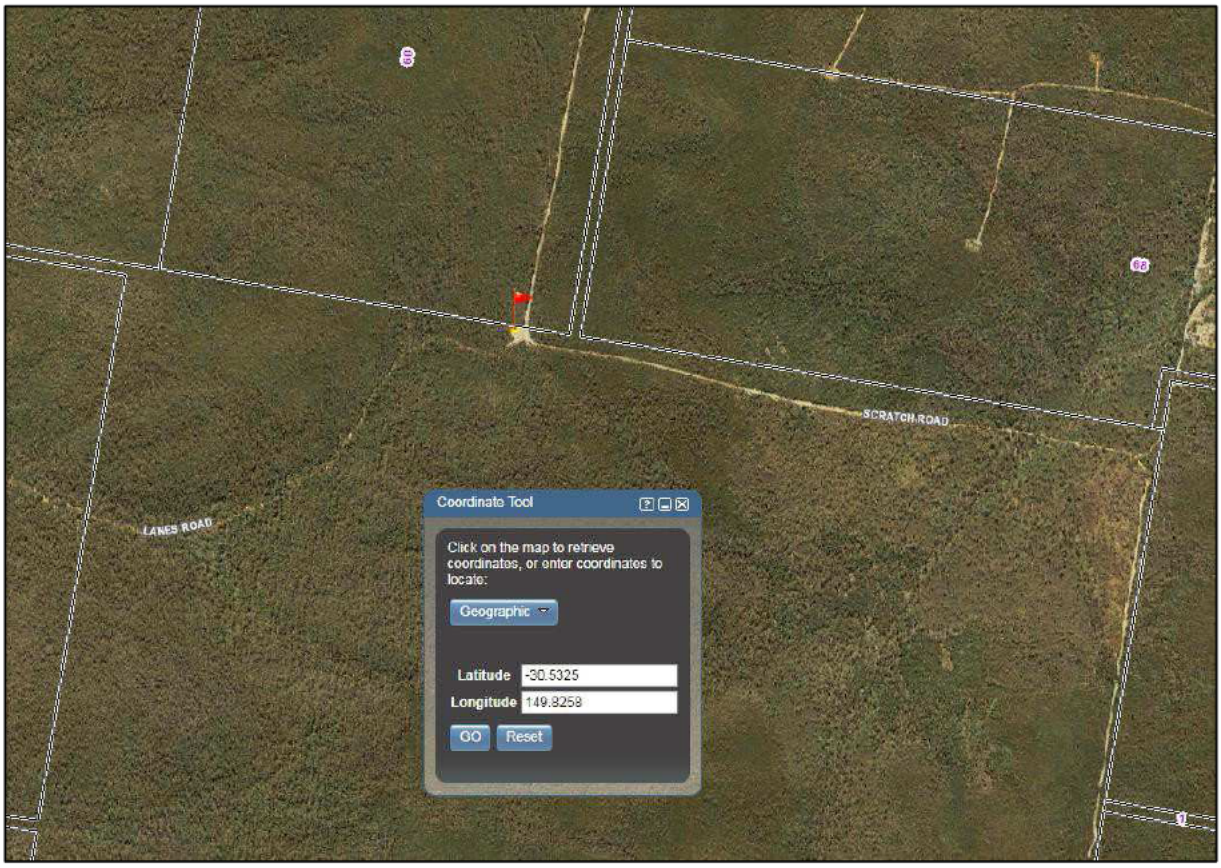
3A Old Gunnedah Road

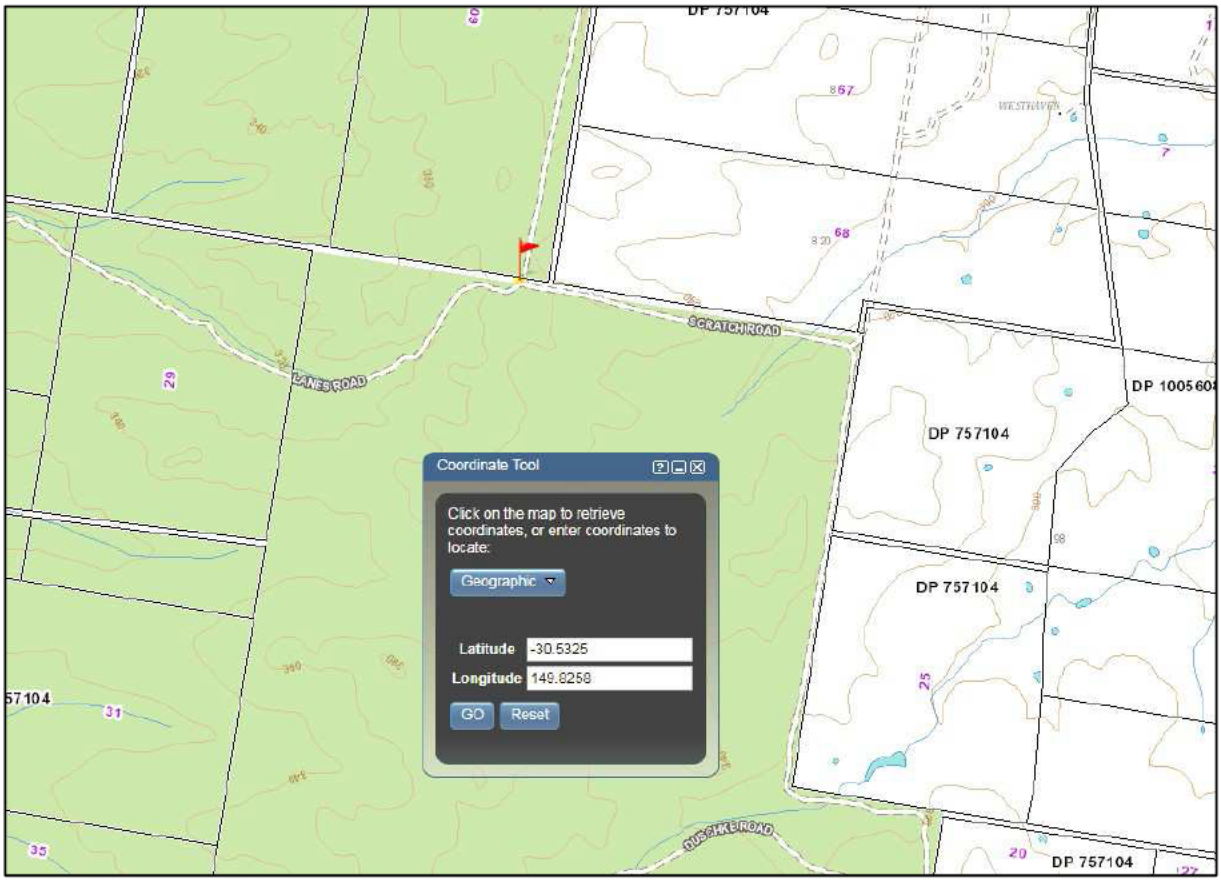


Source: SIX Maps, Accessed June 2018

Source: RPS, 2010

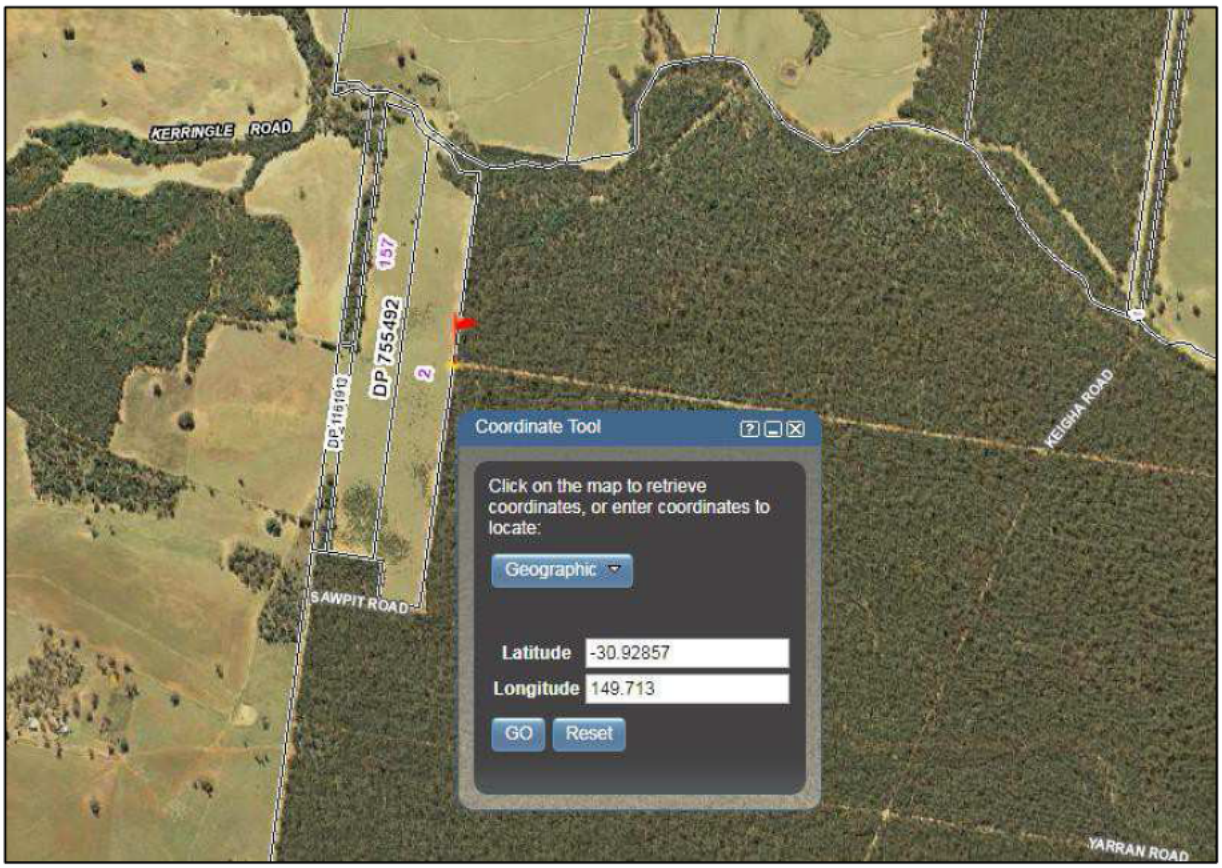
4B Pilliga Scratch Road

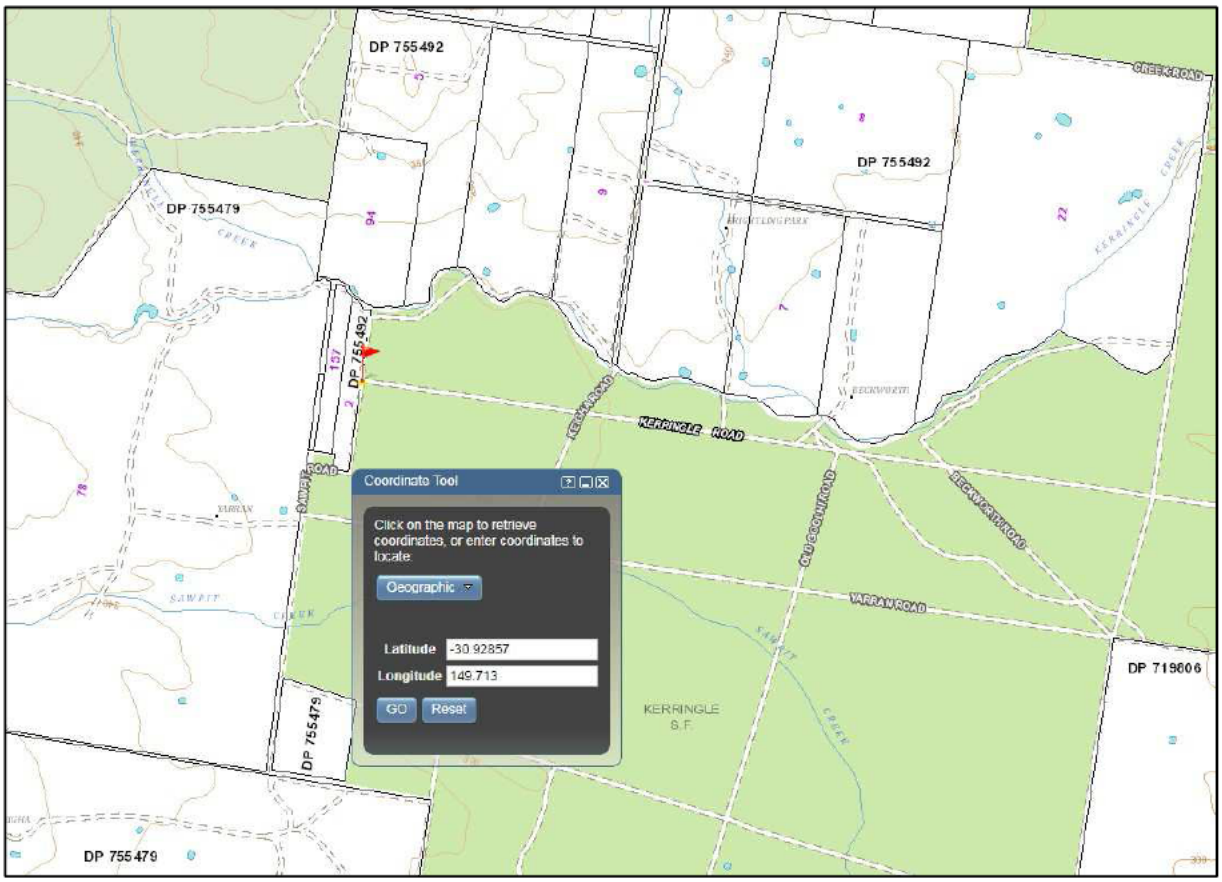




Source: RPS, 2010

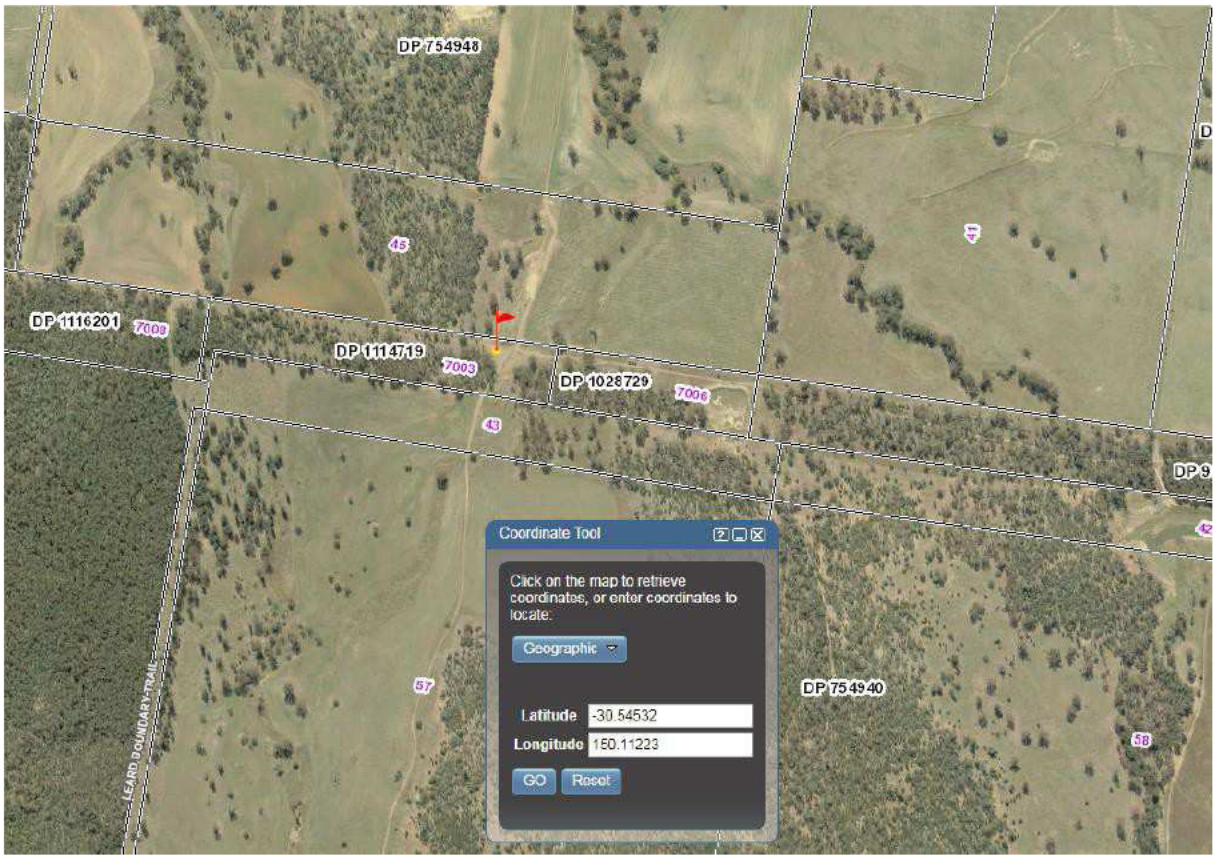
5A Pilliga South East

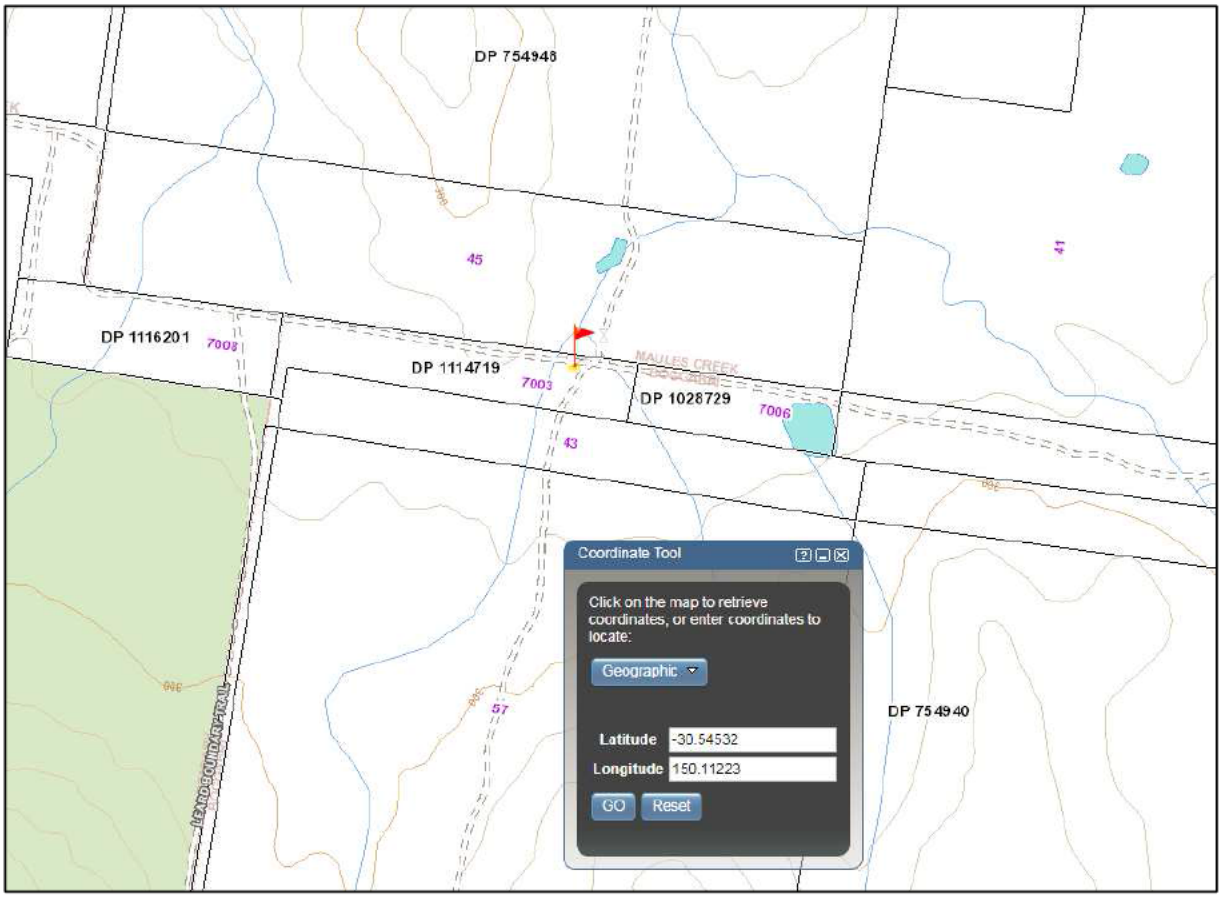




Source: RPS, 2010

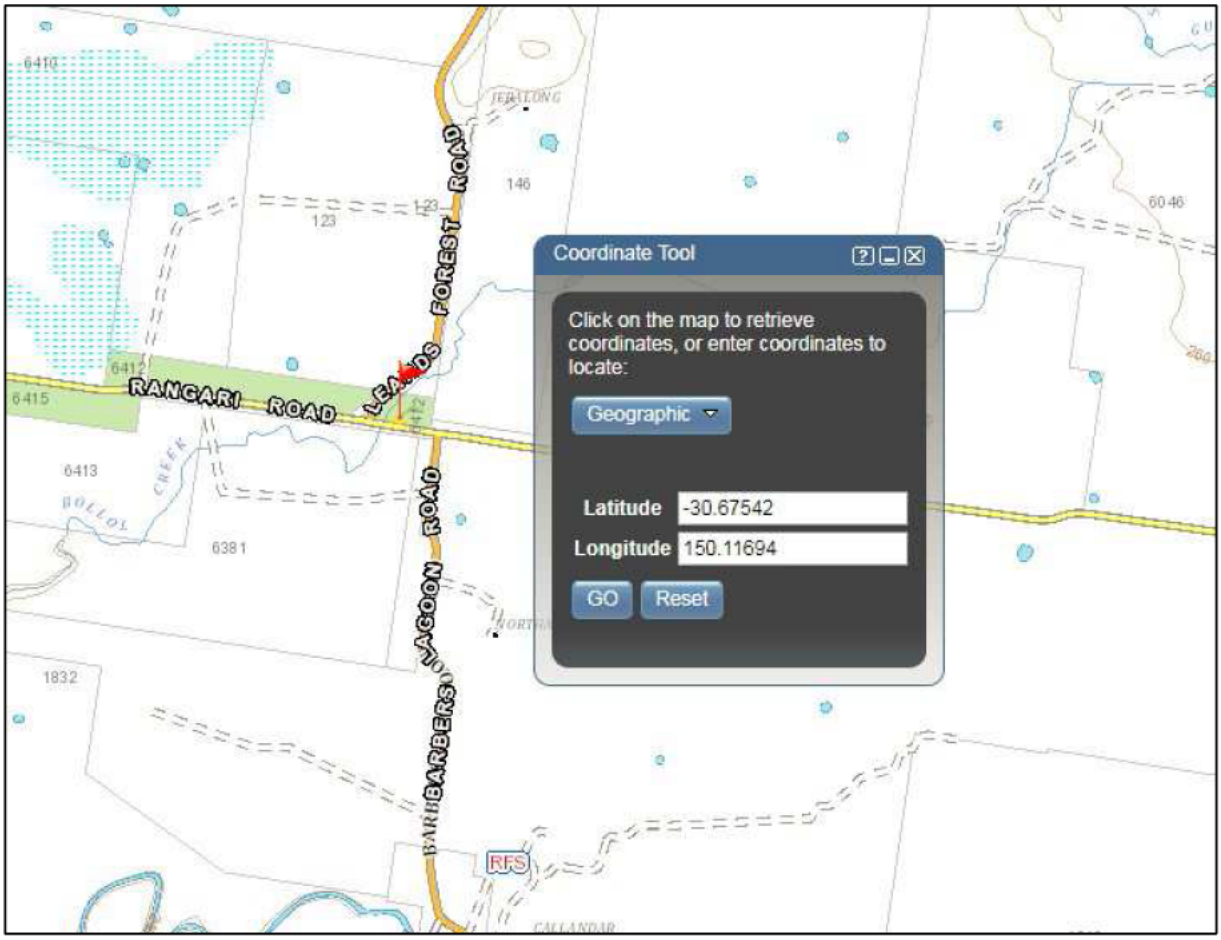
6D Maules Creek Mine





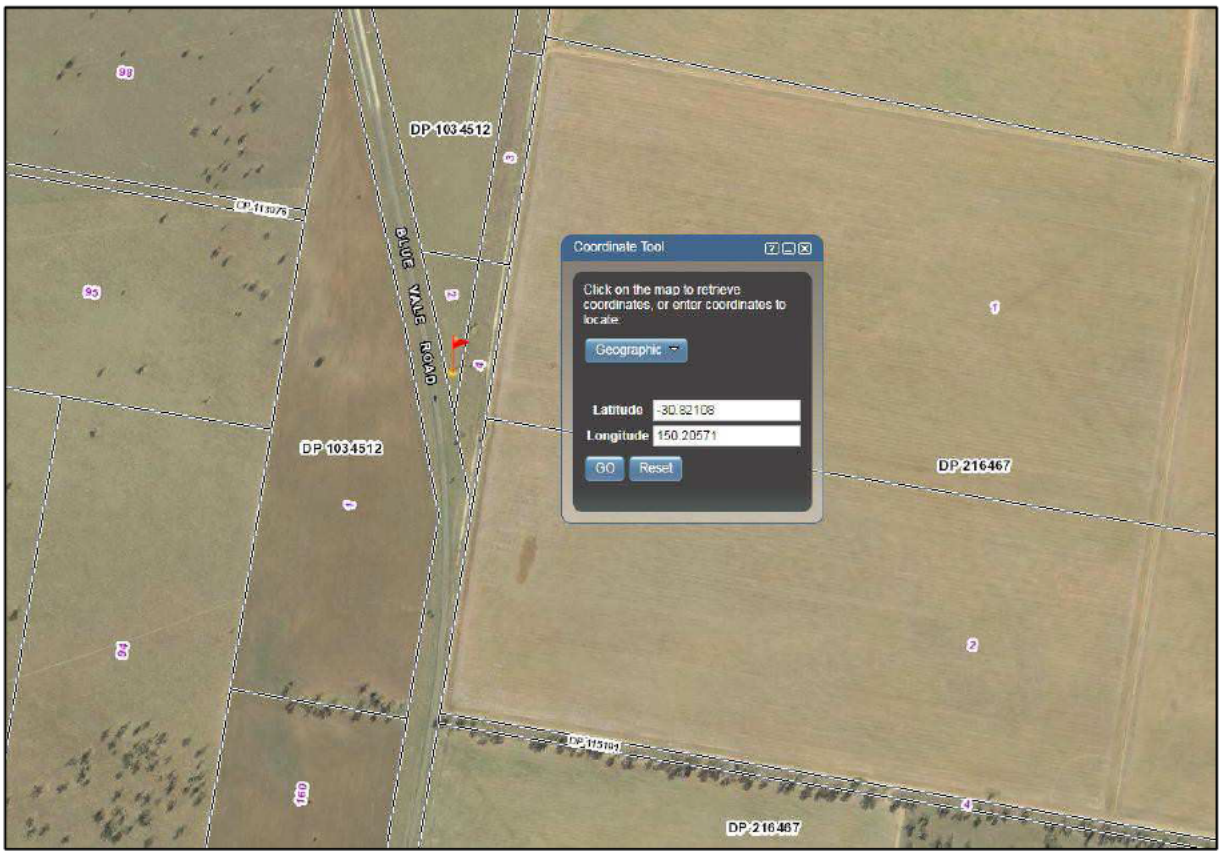
Source: RPS, 2010

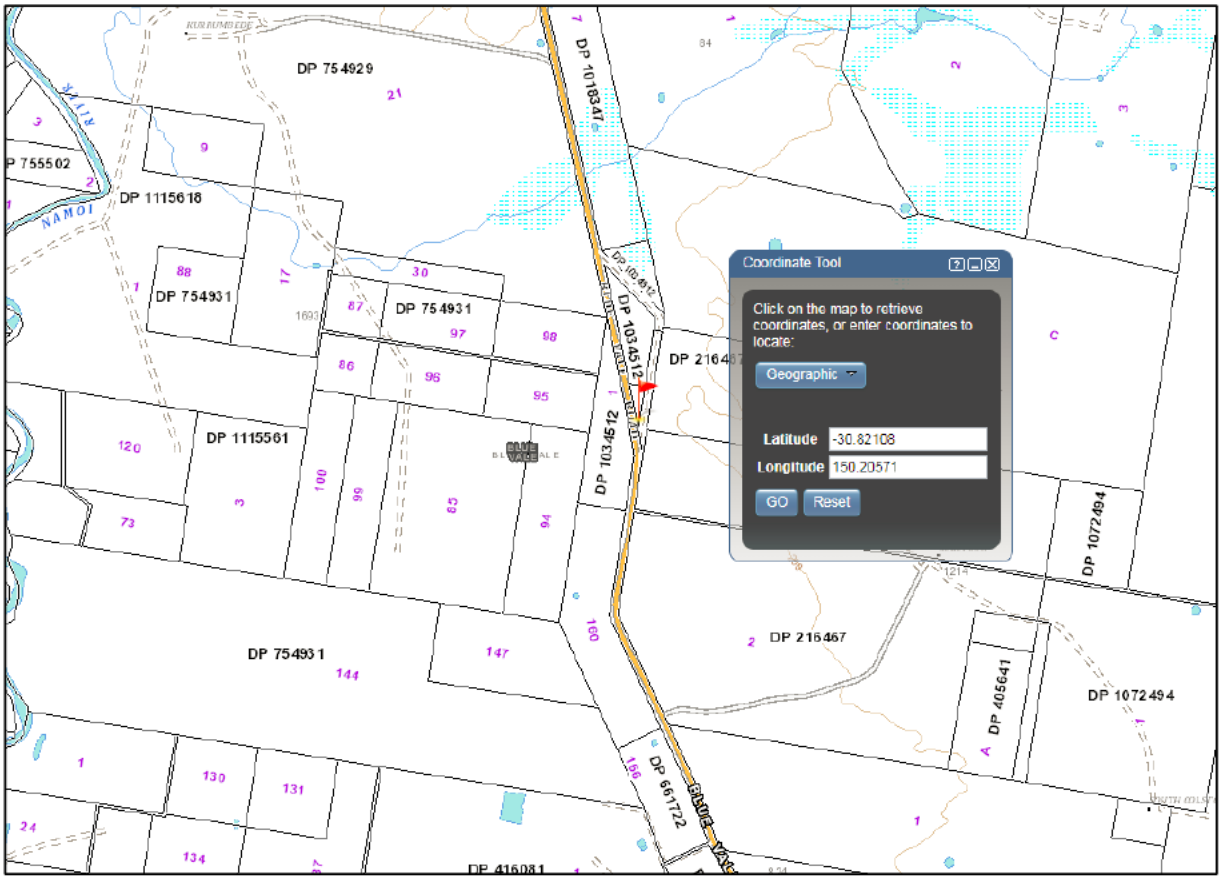
7A Boggabri Mine



Source: RPS, 2010

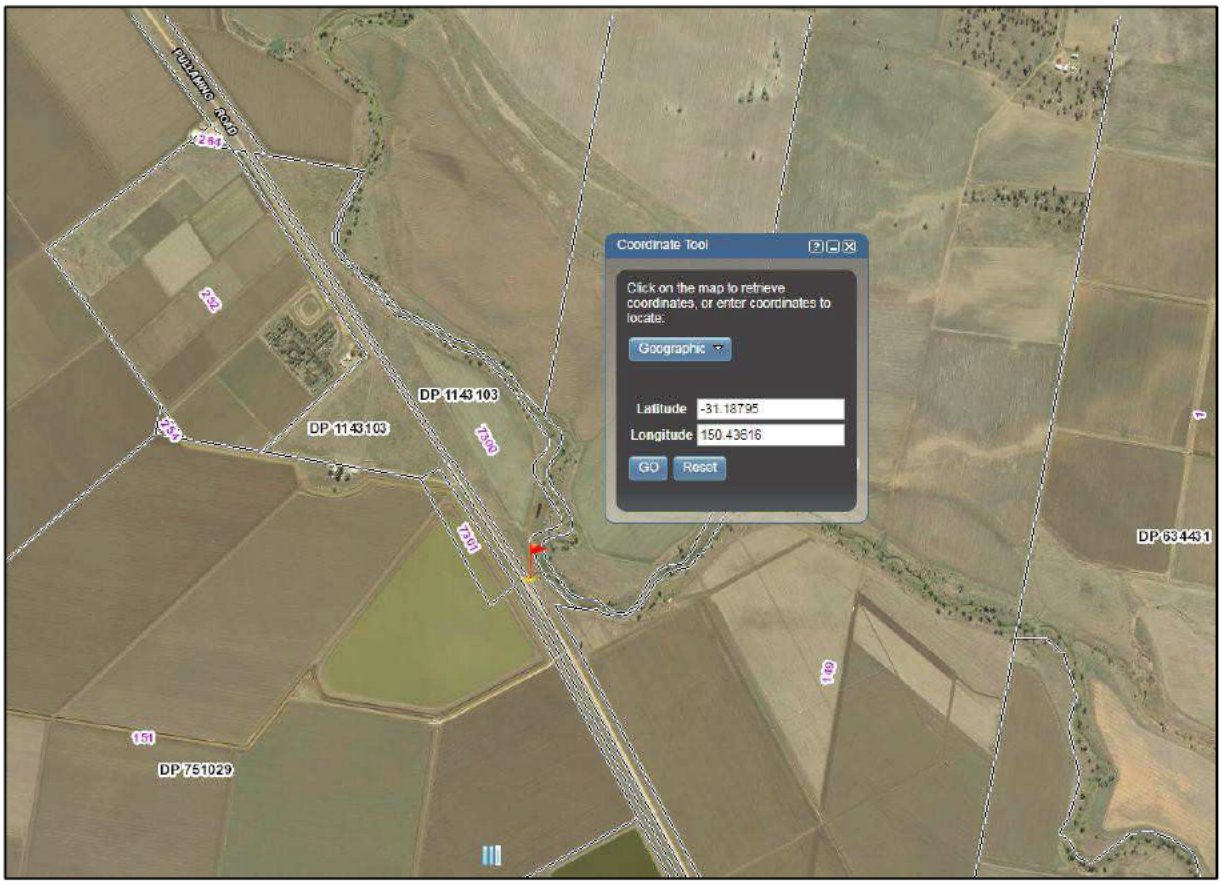
8A Blue Vale Mine

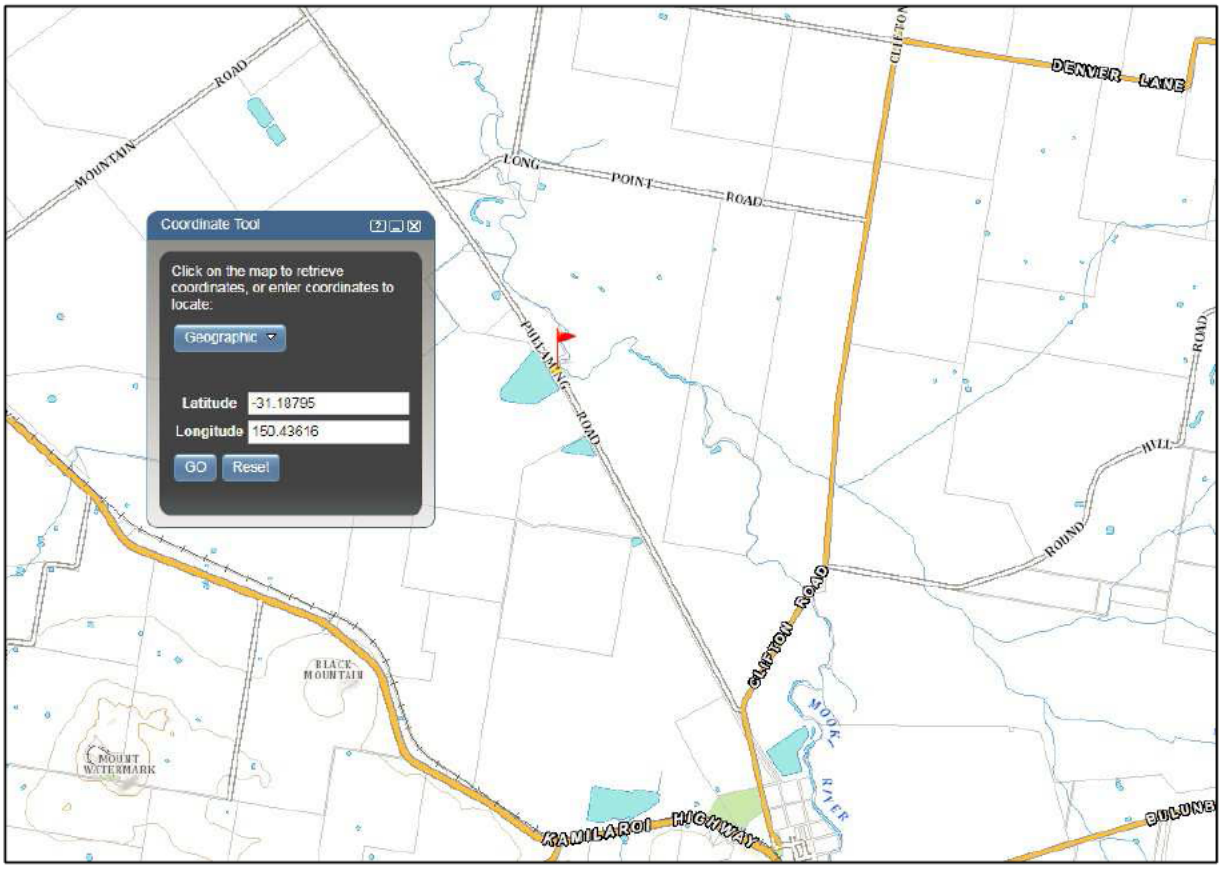




Source: RPS, 2010

10B Shenhua

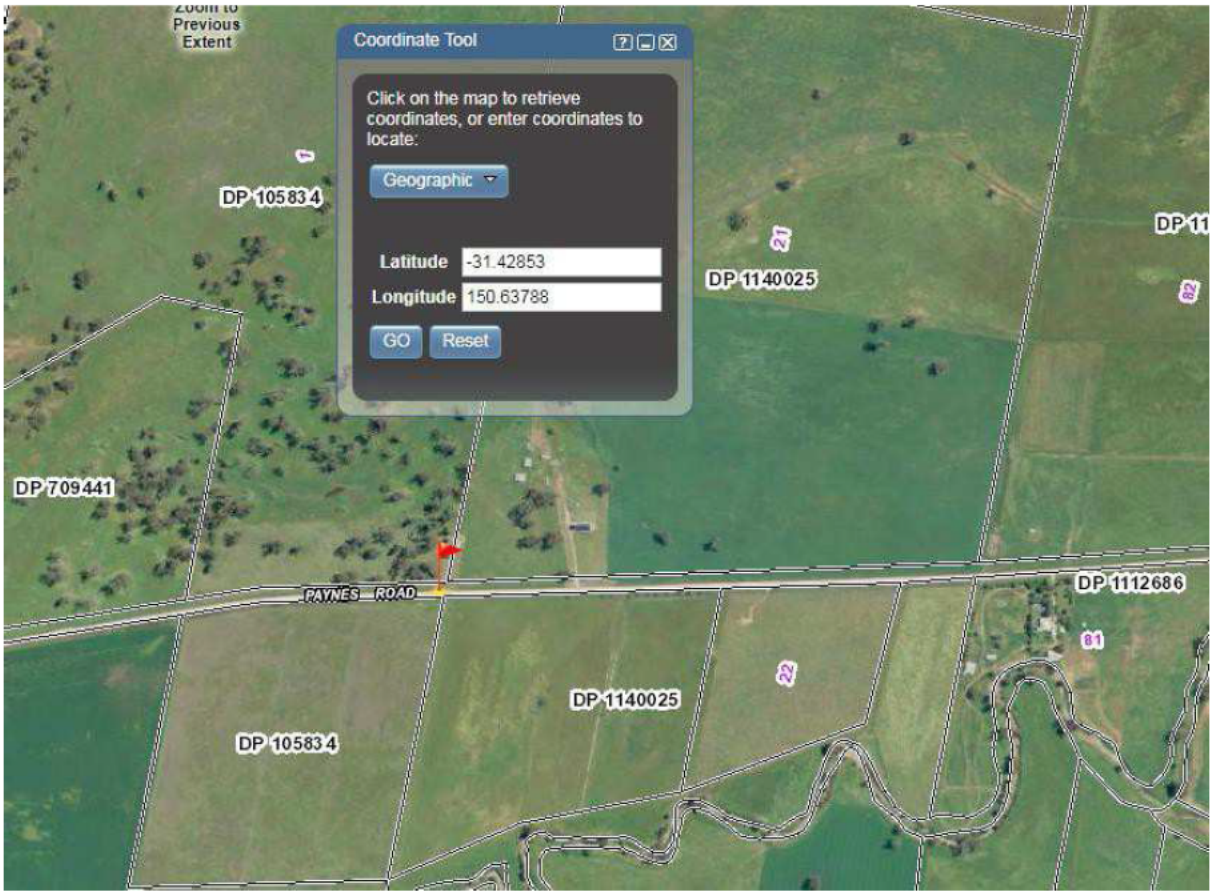


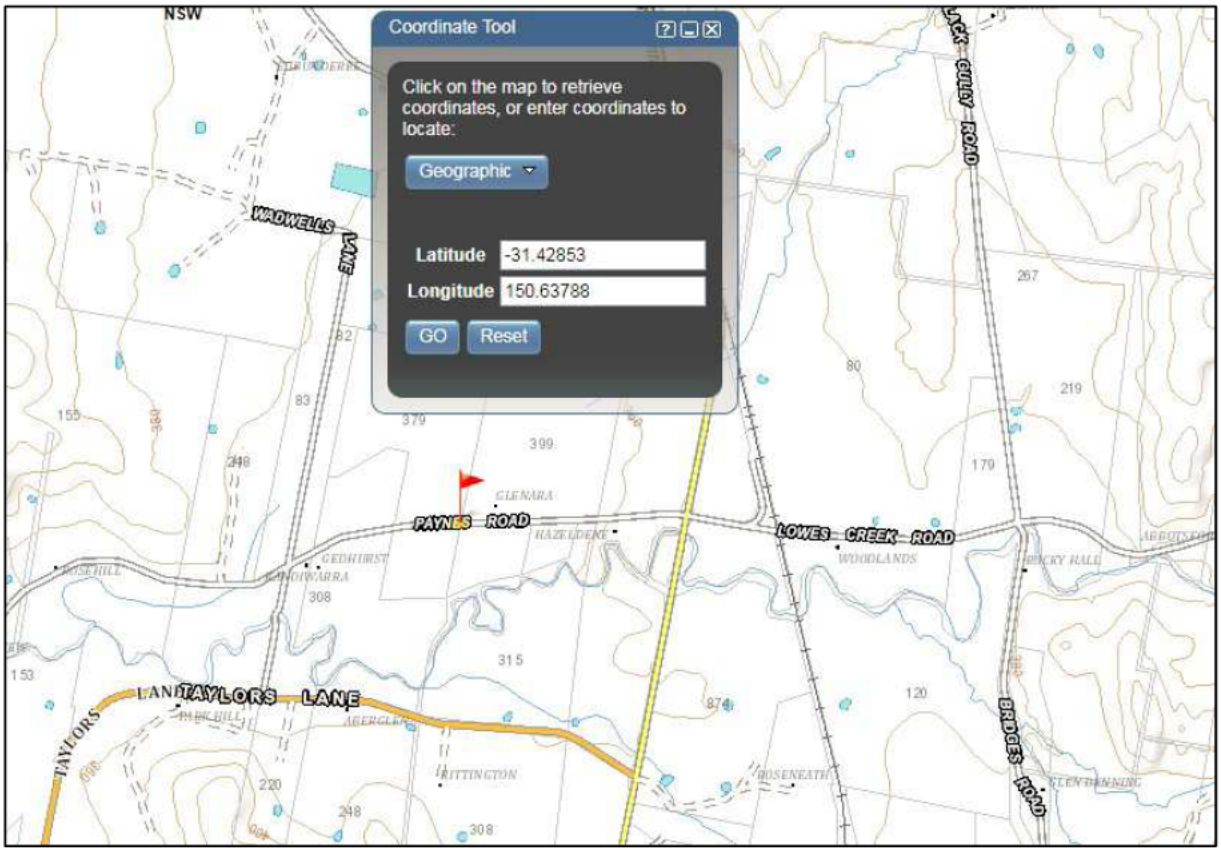


Source: SIX Maps, Accessed June 2018

Source: RPS, 2010

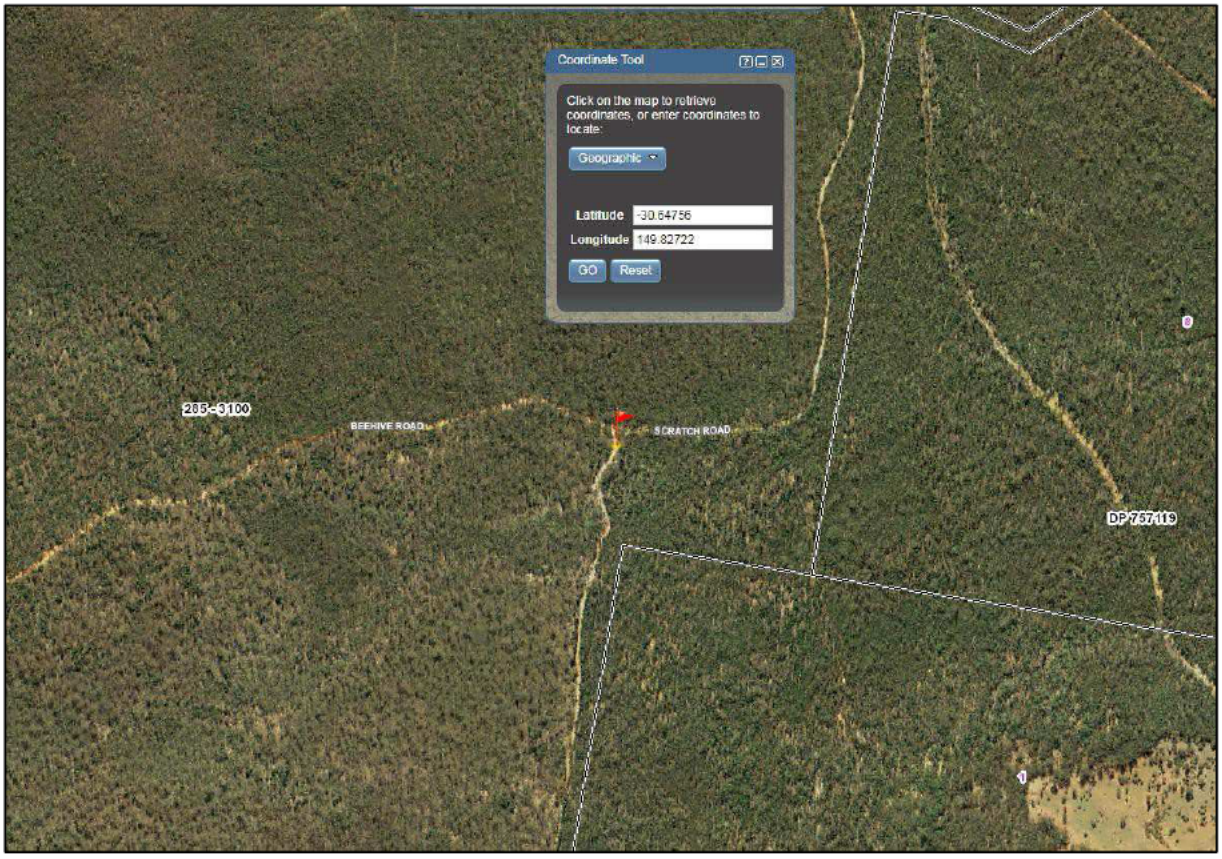
12A Werris Creek Mine

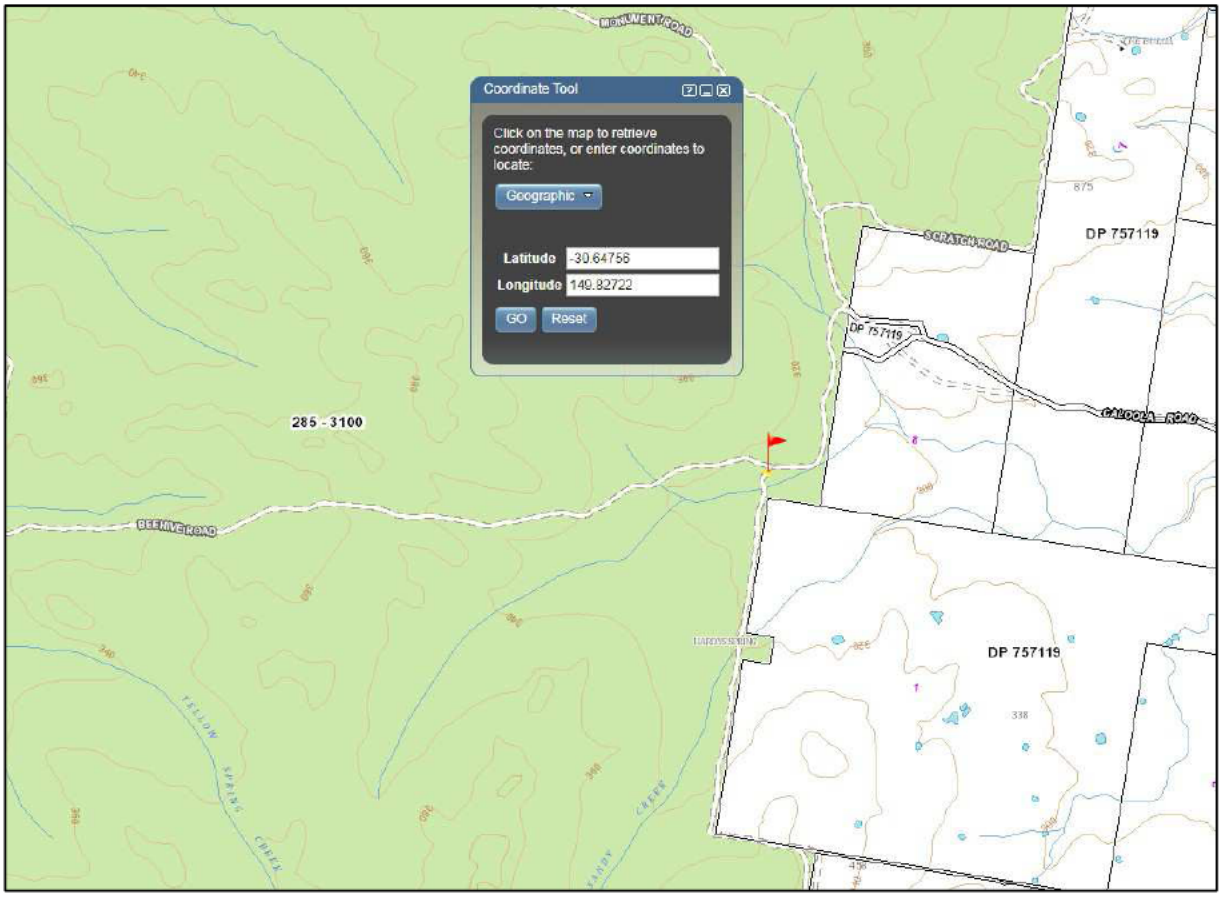




Source: RPS, 2010

14 Pilliga South Extraction Area





Source: RPS, 2010

Appendix B – Consideration of Clause 228

Clause 228 of the EP&A Regulation 2000 indicates, for purposes of Part 5 of the Act, the factors that must be taken into account when consideration is being given to the likely impact of an activity on the environment.

A determining authority is only required to consider the following matters where an EIS has been prepared for a Part 5 activity under the EP&A Act. However, the following information is provided to assist determining authorities in making determinations consistent with those made for an activity requiring preparation of an EIS.

The various factors and findings following the environmental assessment are presented below.

(a) Any environmental impact on a community,

There is the potential for some minor noise, dust and access impacts during construction, however any impacts would be minor and would not affect the community.

(b) Any transformation of a locality,

The proposed works are located within generally remote environments in rural areas. The new bores at each site would result in only a minor transformation of the locality.

(c) Any environmental impact on the ecosystems of the locality,

No significant impact to threatened species or ecological communities is anticipated. Measures have been proposed to ensure that any impacts are minor and temporary.

(d) Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality,

Construction works are on private property. The works would be temporary and would not preclude general use and enjoyment of the area or current use of land. The works would have minor impacts on the recreational use of the area.

(e) 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,

None identified.

(f) Any impact on the habitat of protected fauna (within the meaning of the National Parks and Wildlife Act 1974),

None identified.

(g) Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air,

None identified.

(h) Any long-term effects on the environment,

The proposal would result in a positive long-term impact in enhancing groundwater quality monitoring, improving the creation and dissemination of water information and knowledge products in the NSW coal basins.

(i) Any degradation of the quality of the environment,

Temporary degradation may occur during the works due to excavation and associated dust impacts. Measures have been proposed to ensure that any impacts are minor and temporary.

(j) Any risk to the safety of the environment,

None identified.

(k) Any reduction in the range of beneficial uses of the environment,

None identified.

(l) Any pollution of the environment,

No discharges are anticipated.

(m) Any environmental problems associated with the disposal of waste,

None identified.

(n) Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply,

None identified. Groundwater monitoring activities would be carried out in accordance with the water sharing plans applicable to the bore sites.

(o) Any cumulative environmental effect with other existing or likely future activities,

None identified.

(p) Any impact on coastal processes and coastal hazards, including those under projected climate change conditions.

Not relevant to this proposal.

Appendix C – Consultation Responses

Natassa Assargiotis

From: Sheridan - Kevin [redacted]
Sent: Thursday, 19 April 2018 2:38 PM
To: Natassa Assargiotis
Cc: Dataworks
Subject: Gunnedah Basin New Groundwater Monitoring Bores REF

Hi Natassa

I refer to your correspondence to Gunnedah Shire Council regarding the preparation of a REF for the proposed installation of up to 20 groundwater monitoring bores across the Gunnedah Basin.

Council is pleased to see this project proceed.

The only comment we make is we would like to see an additional monitoring bore installed in closer proximity to the Gunnedah town water supply bores to monitor any potential effect on water quality from the proposed Shenhua mine. We note the site and location 10B Shenhua is located in close proximity to the proposed mine site and we are concerned there could be potential contamination caused which may not be detected due to the close proximity. An additional monitor bore slightly upstream from Gunnedah would provide a good base line for water quality data prior to the commencement of the proposed mine.

Your favourable consideration of our request would be much appreciated

Kind regards

Kevin Sheridan | Manager Water Services | [redacted]
Websites
Administration: www.gunnedah.nsw.gov.au **Tourism**: www.visitgunnedah.com.au
Cinema: www.thecivic.com.au

Natassa Assargiotis

From: Donna Ausling [redacted]
Sent: Monday, 9 July 2018 1:26 PM
To: Natassa Assargiotis; Michelle Moodley
Cc: Alice Elsley; Warren Faulkner
Subject: FW: Proposed Gunnedah Basin Groundwater Monitoring Bore Network – REF Response - additional information 9 July 2018

Good afternoon Anastasia and Michelle

Thanks for your note.

By way of clarification, we were initially of the assumption that the proposal would take advantage of one or both of the two (2) bores already in existence on Paynes/Wadwells Roads which are in the same general location. Hence providing the history on the Agreements already in place with Werris Creek Coal under the current monitoring regime.

Council has no immediate objections or concerns regarding the placement of additional new bore(s) in the location suggested from an environmental perspective based on the high level information currently available. Consideration would, however, need to be given to infrastructure placement from a traffic safety/road infrastructure perspective once further detail is available. Approvals would also be required to be obtained from Council under the *Roads Act 1993* (in its capacity as the roads authority) prior to the commencement of any works. It would be Council's expectation at this juncture that a similar Agreement(s) would be entered into with Council as currently in place with Whitehaven Coal.

I trust that this advice provides the necessary clarification.

Should you require any additional information or assistance you are invited to contact the undersigned.

Kind regards

Donna Ausling
Director of Environmental and Economic Development Services | [redacted]

From: Sally Londero
Sent: Monday, 9 July 2018 9:01 AM
To: Donna Ausling
Subject: FW: Proposed Gunnedah Basin Groundwater Monitoring Bore Network – REF Response

Hi Donna,

Please see below reply email from Michelle.

Thanks

Sally Londero
Business Support Officer |
[redacted]

From: Natassa Assargiotis [redacted]]
Sent: Monday, 9 July 2018 8:47 AM
To: Sally Londero
Cc: Michelle Moodley
Subject: RE: Proposed Gunnedah Basin Groundwater Monitoring Bore Network – REF Response

Hi Sally

The letter from Donna appears to refer to existing bores, rather than new bores proposed by CL&W, unless I'm mistaken. I'm not sure how these existing bores are connected to the current proposal which was outlined in our letter to Council.

Should I speak to Donna directly to clarify this?

Thanks

Anastasia (Natassa) Assargiotis
Senior Environmental Scientist | Environment & Sustainability
[redacted]

Please consider the environment before printing this email

From: Sally Londero [redacted]
[redacted] 2018 10:35 AM
To: Natassa Assargiotis [redacted]

Cc: Michelle Moodley [redacted]
Subject: Proposed Gunnedah Basin Groundwater Monitoring Bore Network – REF Response

Good Morning,

Please find attached documents and signed letter from Donna Ausling – the Director of Environmental and Economic Development Services.

The original copy of the letter will also be posted to your nominated postal address.

Kind Regards,

Sally Londero
Business Support Officer | [redacted]

LIVERPOOL PLAINS SHIRE COUNCIL

Reference: dla: DLA 18/0095

Contact: Donna Ausling

6 July 2018

Attention: Anastasia Assargiotis
Public Works Advisory
[redacted]

Email: [redacted]

Dear Madam,

Re: Proposed Gunnedah Basin Groundwater Monitoring Bore Network - REF Response

Council wishes to acknowledge receipt of your letter dated 17 April 2018 regarding the above and apologises for the delay in providing a formal response.

It is noted that two (2) monitoring bores that are proposed to form part of the overall network are located within the Liverpool Plains Local Government Area.

In response, it appears that the subject bores are existing items of infrastructure. A more detailed map of the bore locations is enclosed along with copies of the existing Access Agreements that are in place with Whitehaven Coal for your information and records.

On this basis, Council has no detailed comments to provide in relation to the project at this time.

It should be noted that any alterations to the terms and conditions of the enclosed Access Agreements arising from the project will require further consultation with Council.

Thank you for the opportunity to provide comment and should you have any further questions in relation to this matter, please contact the undersigned on [redacted] or email [redacted]

Yours faithfully,

[redacted]

Donna Ausling
DIRECTOR OF ENVIRONMENTAL & ECONOMIC DEVELOPMENT SERVICES

[redacted]

NALG 2013 CATEGORY WINNER

Forestry Corporation of NSW ABN 43 141 857 613

[redacted]

Forestry Corporation

Doug Trudeau
Lead Water Resources Officer
NSW Department of Industry – Water
[redacted]

26 July 2018

Dear Doug,

RE: ACCESS TO STATE FOREST FOR MONITORING BORE CONSTRUCTION AND MAINTENANCE

Forestry Corporation of NSW (FCNSW) acknowledges your request to access State forests for the purposes of monitoring bore construction and maintenance.

Section 60 (1) *Forestry Act 2012* requires the authority of a Forest Permit to conduct these activities within State forests. The nature and cost of a Forest Permit is determined by the type of activity and timeframe of access.

In order to appropriately draft the Forest Permit for your activity, please address the queries listed in Attachment 1.

Yours Faithfully,

[redacted]

Jarod Dashwood
Forest Occupancy Supervisor
[redacted]

Attachment 1. FCNSW request for project details

1) Provide full corporate details of the entity that is intending to sign the Forest Permit. If the applicant is a "Pty Ltd" entity please provide the ABN;

2) A letter of authority setting out the extent by which a consultant company, if any, has authority to undertake negotiations on your organisation's behalf;

3) A synopsis of the activities proposed to be undertaken within State forests;

4) The proposed timeframe of your activities including start and finish dates;

5) An estimate dollar value of the proposed activities;

6) A detailed description of any infrastructure proposed to be placed on or remain within State forests;

7) Copies of location maps, digital spatial data and any diagrams or photographs identifying the extent of the proposed activities on and adjacent to State forests, including identified vehicle access routes across State forests;

8) A copy of any statutory approvals issued in favour of your organisation in relation to the activities proposed on State forests; and

9) Confirmation that your organisation will reimburse FCNSW reasonable legal costs arising from or incurred in relation to the preparation and issuing of the Forest Permit.

Natassa Assargiotis

From: Tan Vo <[redacted]
Sent: Friday, 20 July 2018 9:45 AM
To: Natassa Assargiotis
Subject: RE: Consultation - Gunnedah Basin New Groundwater Monitoring Bores - Review of Environmental Factors

Hi Natassa

They will need to lodge Sec 138 Application with Council, ensure the bore to be placed within 5 meters from the road boundary and provide Council with PL currency of not less than $20 mil.

Regards

Tan Vo
Manager Property Services
Narrabri Shire Council
[redacted]

From: Natassa Assargiotis <[redacted]
Sent: Thursday, 19 July 2018 5:32 PM
To: Tan Vo [redacted]
Subject: FW: Consultation - Gunnedah Basin New Groundwater Monitoring Bores - Review of Environmental Factors

Thanks Tan

Do you have any specific requirements for CL&W (i.e do they need to sign a formal agreement etc) that I should let them know about?

Regards,

Anastasia (Natassa) Assargiotis
Senior Environmental Scientist | Environment & Sustainability
[redacted]

PO Box N408, Grosvenor Place NSW 1220

[redacted]

Please consider the environment before printing this email

From: Tan Vo [redacted]
Sent: Wednesday, 18 July 2018 3:07 PM
To: Natassa Assargiotis [redacted]
Subject: RE: Consultation - Gunnedah Basin New Groundwater Monitoring Bores - Review of Environmental Factors

Hi Natasha

No issues with the bore in Council's road reserve. However, you should still consider consulting with the owners of land immediately adjoining this section of the road.
Regards

Tan Vo
Manager Property Services
[redacted]

From: Natassa Assargiotis [redacted]
Sent: Wednesday, 11 July 2018 4:13 PM
To: Tan Vo <[redacted]
[redacted] New Groundwater Monitoring Bores - Review of Environmental Factors

Hi Tan

Just following up regarding the below email to see if you have any comments for DoI – L&W in relation to the proposed groundwater bore?

Many thanks

Anastasia (Natassa) Assargiotis
Senior Environmental Scientist | Environment & Sustainability

Public Works Advisory | Department of Finance, Services and Innovation

Please consider the environment before printing this email

[redacted]

Please consider the environment before printing this email

From: Natassa Assargiotis
Sent: Tuesday, 19 June 2018 5:52 PM
To: Tan Vo [redacted]
Subject: RE: Consultation - Gunnedah Basin New Groundwater Monitoring Bores - Review of Environmental Factors

Hi Tan

Thanks for your email. The bore is actually in Council's road reserve *near* Lot 21 DP 839775 – my apologies, that should have been made more clear in the letter sent. The co-ordinates listed provide a more precise location of the bore.

Please let me know how this affects your response.

Regards,

Anastasia (Natassa) Assargiotis
Senior Environmental Scientist | Environment & Sustainability

[redacted]

Please consider the environment before printing thisemail

From: Tan Vo [redacted]
Sent: Tuesday, 19 June 2018 5:24 PM
To: Natassa Assargiotis <[redacted]
[redacted]ring Bores - Review of Environmental Factors

Hi Natassa

Great to speak with you this afternoon.

Thank you for your consultation on the Gunnedah Basin New Groundwater Monitoring Bores. In general Narrabri Shire Council supports your project.
Your list includes four (4) parcels of land located in Narrabri Shire LGA, which can be summarised as follows:

1. 2A Lower Namoi, Lot 21 DP 839775 owned by Council?
   Council's records show that this parcel of land is located at 475 CSIRO Road, Narrabri owned by Hugh David Lindsay Faris and Margaret Helen Faris (Not Council). Please consult with these owners accordingly.

2. 3A Old Gunnedah Road, Lot 7001 DP 1029804, owned by DOI?
   Council's records show that this parcel of land is located at 619 Old Gunnedah Road, Narrabri owned by State NSW (Crown Reserve R14528)

3. 6D Maules Creek Mine, Lot 7001 DP 1114719, owned by DOI?
   Council's records show that this parcel of land is located at 363 Trantham Road, Boggabri owned by State NSW (Crown Reserve R44336).

4. 7A Boggabri Mine, Lot 164 DP 754926, owned by DOI?
   Council's records show that this parcel of land is located at 6412 Rangari Road, Boggabri owned by State NSW (Crown Reserve R38561).

Hope the above helps.
Regards

Tan Vo
Manager Property Services
[redacted]

From: Natassa Assargiotis [redacted]
Sent: Tuesday, 17 April 2018 8:45 PM
To: Council <[redacted]
[redacted] Groundwater Monitoring Bores - Review of Environmental Factors

Dear Sir/Madam,

The NSW Department of Industry – Lands and Water (DoI – L&W) has engaged Public Works Advisory to prepare a Review of Environmental Factors (REF) for the proposed installation of up to 20 groundwater monitoring bores across the Gunnedah Basin, a number of which are located in the Narrabri Local Government Area and on land owned by Council. The purpose of the attached letter is to notify your organisation of the proposed works, and to provide the opportunity to comment on any matters that your organisation would like to see addressed in the REF and to identify if any additional approvals are required.

Regards,

Anastasia (Natassa) Assargiotis
Senior Environmental Scientist | Environment & Sustainability

Public Works Advisory | Department of Finance, Services and Innovation

[redacted]

Appendix D – Database Searches

Data from the BioNet BioNet Atlas website, which holds records from a number of custodians. The data are only indicative and cannot be considered a comprehensive inventory, and may contain errors and omissions. Species listed under the Sensitive Species Data Policy may have their locations denatured (^ rounded to 0.1Â°; ^^ rounded to 0.01Â°).
 Search criteria : Public Report of all Valid Records of Threatened (listed on TSC Act 1995) or Commonwealth listed Entities in selected area [North: -30.61 West: 149.23 East: 149.33 South: -30.71] returned a total of 89 records of 14 species.
Report generated on 4/07/2018 3:00 PM

Kingdom	Class	Family	Species Code	Scientific Name	Exotic	Common Name	NSW status	Comm. status	Records
Animalia	Aves	Megapodiidae	0007	*Leipoa ocellata*		Malleefowl	E1,P	V	1
Animalia	Aves	Burhinidae	0174	*Burhinus grallarius*		Bush Stone-curlew	E1,P		1
Animalia	Aves	Cacatuidae	0265	*^Calyptorhynchus lathami*		Glossy Black-Cockatoo	V,P,2		6
Animalia	Aves	Psittacidae	0302	*^^Neophema pulchella*		Turquoise Parrot	V,P,3		2
Animalia	Aves	Climacteridae	8127	*Climacteris picumnus victoriae*		Brown Treecreeper (eastern subspecies)	V,P		3
Animalia	Aves	Acanthizidae	0504	*Chthonicola sagittata*		Speckled Warbler	V,P		16
Animalia	Aves	Pomatostomidae	8388	*Pomatostomus temporalis temporalis*		Grey-crowned Babbler (eastern subspecies)	V,P		8
Animalia	Aves	Neosittidae	0549	*Daphoenositta chrysoptera*		Varied Sittella	V,P		3
Animalia	Aves	Artamidae	8519	*Artamus cyanopterus cyanopterus*		Dusky Woodswallow	V,P		2
Animalia	Mammalia	Phascolarctidae	1162	*Phascolarctos cinereus*		Koala	V,P	V	14
Animalia	Mammalia	Muridae	1473	*Pseudomys pilligaensis*		Pilliga Mouse	V,P	V	19
Plantae	Flora	Apocynaceae	9456	*Tylophora linearis*			V,P	E	7
Plantae	Flora	Polygalaceae	5260	*Polygala linariifolia*		Native Milkwort	E1,P		1
Plantae	Flora	Rutaceae	10585	*Philotheca ericifolia*			P	V	6

Australian Government

Department of the Environment and Energy

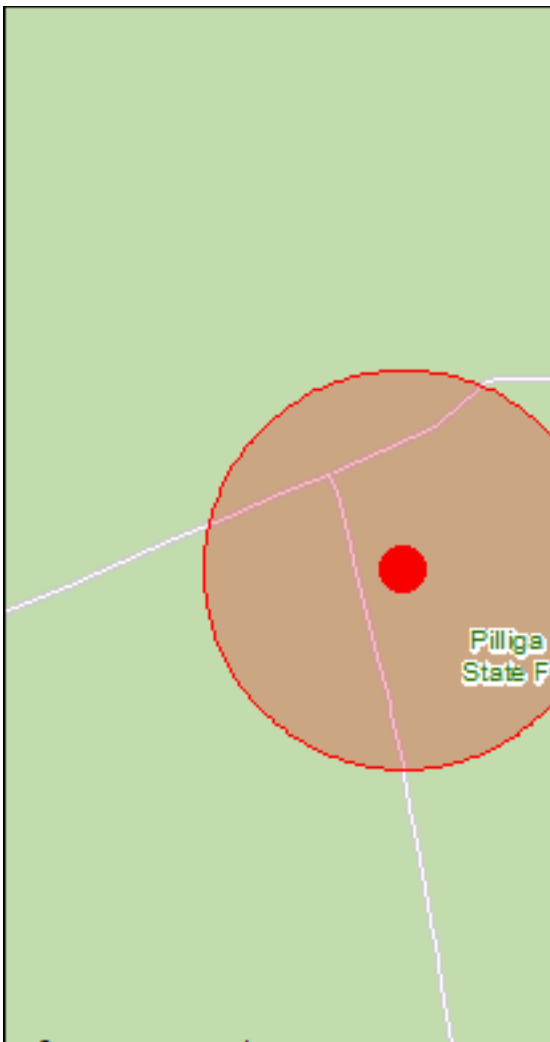
C Act Protected Matters Report

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

on the coverage of this report and qualifications on data supporting this report are cont
e end of the report.

is available about Environment Assessments and the EPBC Act including significance
application process details.

eated: 09/07/18 10:48:25



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f National Environmental Significance

the report summarises the matters of national environmental significance that may c
e area you nominated. Further information is available in the detail part of the report,
y scrolling or following the links below. If you are proposing to undertake an activity t
mpact on one or more matters of national environmental significance then you should
ive Guidelines on Significance.

tters Protected by the EPBC Act

the report summarises other matters protected under the Act that may relate to the area yo
ay be required for a proposed activity that significantly affects the environment on Commor
tion is outside the Commonwealth land, or the environment anywhere when the action is ta
alth land. Approval may also be required for the Commonwealth or Commonwealth agenc
on that is likely to have a significant impact on the environment anywhere.

Act protects the environment on Commonwealth land, the environment from the actions tak
alth land, and the environment from actions taken by Commonwealth agencies. As heritag
rt of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritag
alth Heritage place. Information on the new heritage laws can be found at
nvironment.gov.au/heritage

of National Environmental Significance

of International Importance (Ramsar) [Resource

	Proximity
ation wetland complex	900 - 1000k
	800 - 900km
g, and lakes alexandrina and albert wetland	1000 - 1100k

eatened Ecological Communities [Resource

ned ecological communities where the distribution is well known, maps are derived fr
e vegetation maps, remote sensing imagery and other sources. Where threatened ec
distributions are less well known, existing vegetation maps and point location data ar
licative distribution maps.

	Status	Type of Pres
Black Box Woodlands of the Darling ains and the Brigalow Belt South	Endangered	Community within area
Eucalyptus microcarpa) Grassy Woodlands d Native Grasslands of South-eastern	Endangered	Community within area
sslands on basalt and fine-textured alluvial rthern New South Wales and southern d	Critically Endangered	Community within area
yall Woodlands	Endangered	Community within area
Yellow Box-Blakely's Red Gum Grassy and Derived Native Grassland	Critically Endangered	Community within area

eatened Species [Resource

	Status	Type of Pres
a phrygia		
neyeater [82338]	Critically Endangered	Species or s

	Status	Type of Pres
		habitat may area
us dwyeri		
d Pied Bat, Large Pied Bat [183]	Vulnerable	Species or s may occur w
naculatus maculatus (SE mainland population)		
Quoll, Spotted-tail Quoll, Tiger neastern mainland population)	Endangered	Species or s may occur w
s corbeni		
ong-eared Bat, South-eastern Long- 83395]	Vulnerable	Species or s likely to occu
tos cinereus (combined populations of Qld, NSW and the ACT)		
bined populations of Queensland, Wales and the Australian Capital 35104]	Vulnerable	Species or s known to occ
s pilligaensis		
se, Poolkoo [99]	Vulnerable	Species or s known to occ
oliocephalus		
ed Flying-fox [186]	Vulnerable	Foraging, fee behaviour m area
procumbens		
	Vulnerable	Species or s likely to occu
m setosum		
14159]	Vulnerable	Species or s likely to occu
ericifolia		
	Vulnerable	Species or s known to occ

	Threatened	Type of Pres
anoleuca tcher [612]		Species or s known to occ
Vetlands Species		
leucos andpiper [59309]		Species or s may occur w
uminata d Sandpiper [874]		Species or s may occur w
uginea dpiper [856]	Critically Endangered	Species or s may occur w
lanotos ndpiper [858]		Species or s may occur w
ardwickii nipe, Japanese Snipe [863]		Species or s may occur w

tters Protected by the EPBC Act

rine Species [Resource

s listed under a different scientific name on the EPBC Act - Threatened Species list.

	Threatened	Type of Pres
leucos andpiper [59309]		Species or s may occur w
cus Swift [678]		Species or s likely to occu

	Threatened	Type of Pres
caudacutus ted Needletail [682]		Species or s likely to occu
atus ee-eater [670]		Species or s may occur w
ava gtail [644]		Species or s may occur w
anoleuca tcher [612]		Species or s known to occ
penghalensis (sensu lato) pe [889]	Endangered*	Species or s may occur w

ormation

Species [Resource

orted here are the 20 species of national significance (WoNS), along with other introd
nsidered by the States and Territories to pose a particularly significant threat to biodiv
ral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane T
Health Project, National Land and Water Resouces Audit, 2001.

	Status	Type of Pres

	Status	Type of Pres
		within area
s		
		Species or s likely to occu
Cat, Domestic Cat [19]		Species or s likely to occu
ensis e [127]		Species or s likely to occu
lus se [120]		Species or s likely to occu
s cuniculus opean Rabbit [128]		Species or s likely to occu
s Ship Rat [84]		Species or s likely to occu
		Species or s likely to occu
oes ox [18]		Species or s likely to occu
o. rs [82753]		Species or s likely to occu
ta e Monterey Pine, Insignis Pine		Species or s

t

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

esigned to assist in identifying the locations of places which may be relevant in determining obligations under the Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlan nportance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and liste munities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range o

listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where ing, the type of presence that can be determined from the data is indicated in general terms. People using this inf need to consider the qualifications below and may need to seek and consider other information sources.

ecological communities where the distribution is well known, maps are derived from recovery plans, State vegeta y and other sources. Where threatened ecological community distributions are less well known, existing vegetati re used to produce indicative distribution maps.

gratory and marine species distributions have been derived through a variety of methods. Where distributions are aps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) t escribed habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and

e information is available for species or large number of maps are required in a short time-frame, maps are derive l degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-h nually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribu early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution pping methods are used to update these distributions as time permits.

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

y and

pecies and ecological communities have not been mapped and do not appear in reports produced from this data

ed species listed as extinct or considered as vagrants

pecies and ecological communities that have only recently been listed

rrestrial species that overfly the Commonwealth marine area

y species that are very widespread, vagrant, or only occur in small numbers

wledgements

ase has been compiled from a range of data sources. The department acknowledges who have contributed valuable data and advice:

of Environment and Heritage, New South Wales
tment of Environment and Primary Industries, Victoria
tment of Primary Industries, Parks, Water and Environment, Tasmania
tment of Environment, Water and Natural Resources, South Australia
tment of Land and Resource Management, Northern Territory
tment of Environmental and Heritage Protection, Queensland
tment of Parks and Wildlife, Western Australia
nment and Planning Directorate, ACT
e Australia
lian Bird and Bat Banding Scheme
lian National Wildlife Collection
l history museums of Australia
m Victoria
lian Museum
Australian Museum
sland Museum
Zoological Collections of Australian Museums
sland Herbarium
al Herbarium of NSW
Botanic Gardens and National Herbarium of Victoria
anian Herbarium
Herbarium of South Australia
ern Territory Herbarium
rn Australian Herbarium
lian National Herbarium, Canberra
sity of New England
Biogeographic Information System
lian Government, Department of Defence
y Corporation, NSW
ience Australia
D
lian Tropical Herbarium, Cairns
Australia

Data from the BioNet BioNet Atlas website, which holds records from a number of custodians. The data are only indicative and cannot be considered a comprehensive inventory and may contain errors and omissions. Species listed under the Sensitive Species Data Policy may have their locations denatured (^ rounded to 0.1Â°; ^^ rounded to 0.01Â°). Copyright the State of NSW through the Office of Environment and Heritage. Search criteria : Public Report of all Valid Records of Threatened (listed on TSC Act 1995) or Commonwealth listed Entities in selected area [North: -30.27 West: 149.54 East: 149.64 South: -30.37] returned a total of 23 records of 11 species.
Report generated on 4/07/2018 3:15 PM

Kingdom	Class	Family	Species Code	Scientific Name	Exotic	Common Name	NSW status	Comm. status	Records
Animalia	Reptilia	Scincidae	2042	*Anomalopus mackayi*		Five-clawed Worm-skink	E1,P	V	1
Animalia	Reptilia	Elapidae	2675	*Hoplocephalus bitorquatus*		Pale-headed Snake	V,P		1
Animalia	Aves	Anseranatidae	0199	*Anseranas semipalmata*		Magpie Goose	V,P		1
Animalia	Aves	Accipitridae	0225	*Hieraaetus morphnoides*		Little Eagle	V,P		1
Animalia	Aves	Gruidae	0177	*Grus rubicunda*		Brolga	V,P		1
Animalia	Aves	Cacatuidae	0265	*^Calyptorhynchus lathami*		Glossy Black-Cockatoo	V,P,2		3
Animalia	Aves	Psittacidae	0277	*^^Polytelis swainsonii*		Superb Parrot	V,P,3	V	2
Animalia	Aves	Climacteridae	8127	*Climacteris picumnus victoriae*		Brown Treecreeper (eastern subspecies)	V,P		2
Animalia	Aves	Pomatostomidae	8388	*Pomatostomus temporalis temporalis*		Grey-crowned Babbler (eastern subspecies)	V,P		4
Animalia	Mammalia	Phascolarctidae	1162	*Phascolarctos cinereus*		Koala	V,P	V	6
Animalia	Mammalia	Macropodidae	1260	*Macropus dorsalis*		Black-striped Wallaby	E1,P		1

Australian Government

Department of the Environment and Energy

C Act Protected Matters Report

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

on the coverage of this report and qualifications on data supporting this report are cont
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application process details.

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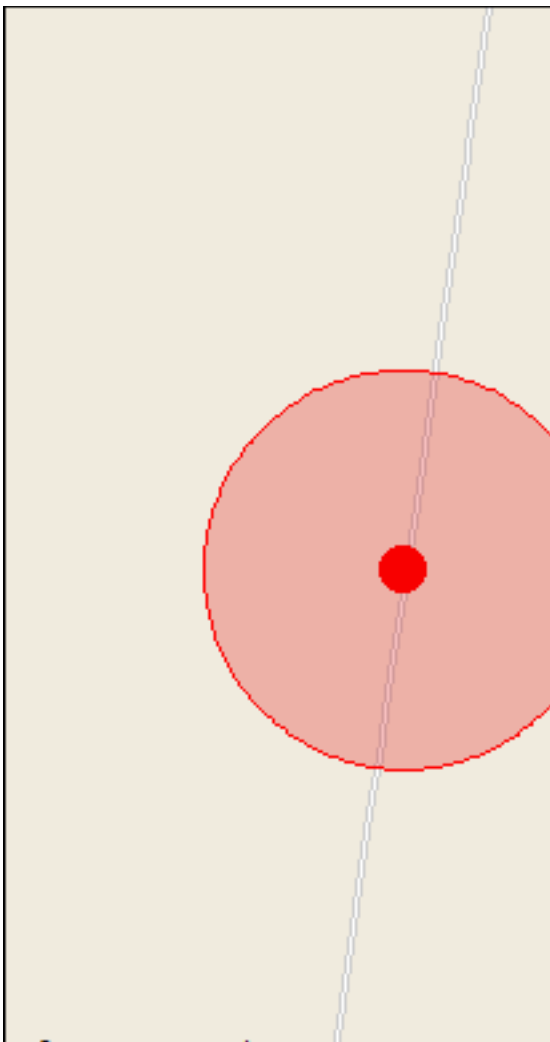

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f National Environmental Significance

the report summarises the matters of national environmental significance that may c
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mpact on one or more matters of national environmental significance then you should
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tters Protected by the EPBC Act

the report summarises other matters protected under the Act that may relate to the area yo
ay be required for a proposed activity that significantly affects the environment on Commor
tion is outside the Commonwealth land, or the environment anywhere when the action is ta
alth land. Approval may also be required for the Commonwealth or Commonwealth agenc
on that is likely to have a significant impact on the environment anywhere.

Act protects the environment on Commonwealth land, the environment from the actions tak
alth land, and the environment from actions taken by Commonwealth agencies. As heritag
rt of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritag
alth Heritage place. Information on the new heritage laws can be found at
nvironment.gov.au/heritage

of National Environmental Significance

of International Importance (Ramsar) [Resource

	Proximity
ation wetland complex	900 - 1000k
	900 - 1000k
g, and lakes alexandrina and albert wetland	1100 - 1200k

eatened Ecological Communities [Resource

ned ecological communities where the distribution is well known, maps are derived fr
e vegetation maps, remote sensing imagery and other sources. Where threatened ec
distributions are less well known, existing vegetation maps and point location data ar
licative distribution maps.

	Status	Type of Pres
Black Box Woodlands of the Darling ains and the Brigalow Belt South	Endangered	Community within area
Eucalyptus microcarpa) Grassy Woodlands d Native Grasslands of South-eastern	Endangered	Community within area
sslands on basalt and fine-textured alluvial rthern New South Wales and southern d	Critically Endangered	Community within area
yall Woodlands	Endangered	Community within area
Yellow Box-Blakely's Red Gum Grassy and Derived Native Grassland	Critically Endangered	Community within area

eatened Species [Resource

	Status	Type of Pres
a phrygia		
neyeater [82338]	Critically Endangered	Foraging, fe

	Status	Type of Pres
		habitat may area
us dwyeri		
d Pied Bat, Large Pied Bat [183]	Vulnerable	Species or s may occur w
s corbeni		
ong-eared Bat, South-eastern Long- 83395]	Vulnerable	Species or s likely to occu
tos cinereus (combined populations of Qld, NSW and the ACT)		
bined populations of Queensland, Wales and the Australian Capital 35104]	Vulnerable	Species or s known to occ
m setosum		
14159]	Vulnerable	Species or s likely to occu
s mackayi		
d Worm-skink, Long-legged Worm- 4]	Vulnerable	Species or s may occur w

ratory Species [Resource

s listed under a different scientific name on the EPBC Act - Threatened Species list.

	Threatened	Type of Pres
Marine Birds		
cus		
Swift [678]		Species or s likely to occu
errestrial Species		
caudacutus		
ted Needletail [682]		Species or s may occur w

tters Protected by the EPBC Act

vealth Land [Resource

onwealth area listed below may indicate the presence of Commonwealth land in this
bility of the data source, all proposals should be checked as to whether it impacts on
ealth area, before making a definitive decision. Contact the State or Territory governr
for further information.

ealth Land - Commonwealth Scientific & Industrial Research Organisation

rine Species [Resource

s listed under a different scientific name on the EPBC Act - Threatened Species list.

	Threatened	Type of Pres
leucos		
andpiper [59309]		Species or s may occur w
cus		
Swift [678]		Species or s likely to occu
, White Egret [59541]		Species or s likely to occu
t [59542]		Species or s may occur w
minata		
d Sandpiper [874]		Species or s may occur w
uginea		
dpiper [856]	Critically Endangered	Species or s may occur w
lanotos		

ormation

Species [Resource

orted here are the 20 species of national significance (WoNS), along with other introd
nsidered by the States and Territories to pose a particularly significant threat to biodiv
ral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane T
Health Project, National Land and Water Resouces Audit, 2001.

	Status	Type of Pres
s tristis		
yna, Indian Myna [387]		Species or s likely to occu
ensis		
6]		Species or s likely to occu
hynchos		
4]		Species or s likely to occu
via		

	Status	Type of Pres
s		
		Species or s likely to occu
Cat, Domestic Cat [19]		Species or s likely to occu
ensis e [127]		Species or s likely to occu
lus se [120]		Species or s likely to occu
s cuniculus opean Rabbit [128]		Species or s likely to occu
s Ship Rat [84]		Species or s likely to occu
		Species or s likely to occu
es ox [18]		Species or s likely to occu
cissimum thorn, Boxthorn [19235]		Species or s likely to occu
o. rs [82753]		Species or s likely to occu

t

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

esigned to assist in identifying the locations of places which may be relevant in determining obligations under the Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlan nportance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and liste munities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range o

listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where ing, the type of presence that can be determined from the data is indicated in general terms. People using this inf need to consider the qualifications below and may need to seek and consider other information sources.

ecological communities where the distribution is well known, maps are derived from recovery plans, State vegeta y and other sources. Where threatened ecological community distributions are less well known, existing vegetati re used to produce indicative distribution maps.

gratory and marine species distributions have been derived through a variety of methods. Where distributions are aps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) t escribed habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and

e information is available for species or large number of maps are required in a short time-frame, maps are derive l degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-h nually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribu early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution pping methods are used to update these distributions as time permits.

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

y and

pecies and ecological communities have not been mapped and do not appear in reports produced from this data

ed species listed as extinct or considered as vagrants

pecies and ecological communities that have only recently been listed

rrestrial species that overfly the Commonwealth marine area

y species that are very widespread, vagrant, or only occur in small numbers

wledgements

ase has been compiled from a range of data sources. The department acknowledges who have contributed valuable data and advice:

of Environment and Heritage, New South Wales
tment of Environment and Primary Industries, Victoria
tment of Primary Industries, Parks, Water and Environment, Tasmania
tment of Environment, Water and Natural Resources, South Australia
tment of Land and Resource Management, Northern Territory
tment of Environmental and Heritage Protection, Queensland
tment of Parks and Wildlife, Western Australia
nment and Planning Directorate, ACT
e Australia
lian Bird and Bat Banding Scheme
lian National Wildlife Collection
l history museums of Australia
m Victoria
lian Museum
Australian Museum
sland Museum
Zoological Collections of Australian Museums
sland Herbarium
al Herbarium of NSW
Botanic Gardens and National Herbarium of Victoria
anian Herbarium
Herbarium of South Australia
ern Territory Herbarium
rn Australian Herbarium
lian National Herbarium, Canberra
sity of New England
Biogeographic Information System
lian Government, Department of Defence
y Corporation, NSW
ience Australia
O
lian Tropical Herbarium, Cairns
Australia

Data from the BioNet BioNet Atlas website, which holds records from a number of custodians. The data are only indicative and cannot be considered a comprehens inventory, and may contain errors and omissions. Species listed under the Sensitive Species Data Policy may have their locations denatured (^ rounded to 0.1Â°; ^^ rounded to 0.01Â°). Copyright the State of NSW through the Office of Environment and Heritage. Search criteria : Public Report of all Valid Records of Threatened (listed on TSC Act 1995) or Commonwealth listed Entities in selected area [North: -30.32 West: 149.79 East: 149.89 South: -30.42] returned a total of 45 records of 1 species.
Report generated on 4/07/2018 3:10PM

Kingdom	Class	Family	Species Code	Scientific Name	Exotic	Common Name	NSW status	Comm. status	Records
Animalia	Reptilia	Elapidae	2675	*Hoplocephalus bitorquatus*		Pale-headed Snake	V,P		2
Animalia	Aves	Accipitridae	0218	*Circus assimilis*		Spotted Harrier	V,P		2
Animalia	Aves	Cacatuidae	0265	*^Calyptorhynchus lathami*		Glossy Black-Cockatoo	V,P,2		2
Animalia	Aves	Psittacidae	0260	*Glossopsitta pusilla*		Little Lorikeet	V,P		2
Animalia	Aves	Psittacidae	0277	*^^Polytelis swainsonii*		Superb Parrot	V,P,3	V	1
Animalia	Aves	Strigidae	0246	*^^Ninox connivens*		Barking Owl	V,P,3		1
Animalia	Aves	Tytonidae	0252	*^^Tyto longimembris*		Eastern Grass Owl	V,P,3		2
Animalia	Aves	Climacteridae	8127	*Climacteris picumnus victoriae*		Brown Treecreeper (eastern subspecies)	V,P		1
Animalia	Aves	Acanthizidae	0504	*Chthonicola sagittata*		Speckled Warbler	V,P		14

Animalia	Aves	Pomatostomidae	8388	*Pomatostomus temporalis temporalis*	Grey-crowned Babbler (eastern subspecies)	V,P		7
Animalia	Aves	Neosittidae	0549	*Daphoenositta chrysoptera*	Varied Sittella	V,P		5
Animalia	Aves	Artamidae	8519	*Artamus cyanopterus cyanopterus*	Dusky Woodswallow	V,P		1
Animalia	Mammalia	Phascolarctidae	1162	*Phascolarctos cinereus*	Koala	V,P	V	2
Animalia	Mammalia	Emballonuridae	1321	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	V,P		2
Plantae	Flora	Brassicaceae	1816	*Lepidium aschersonii*	Spiny Peppercress	V,P	V	1

Australian Government

Department of the Environment and Energy

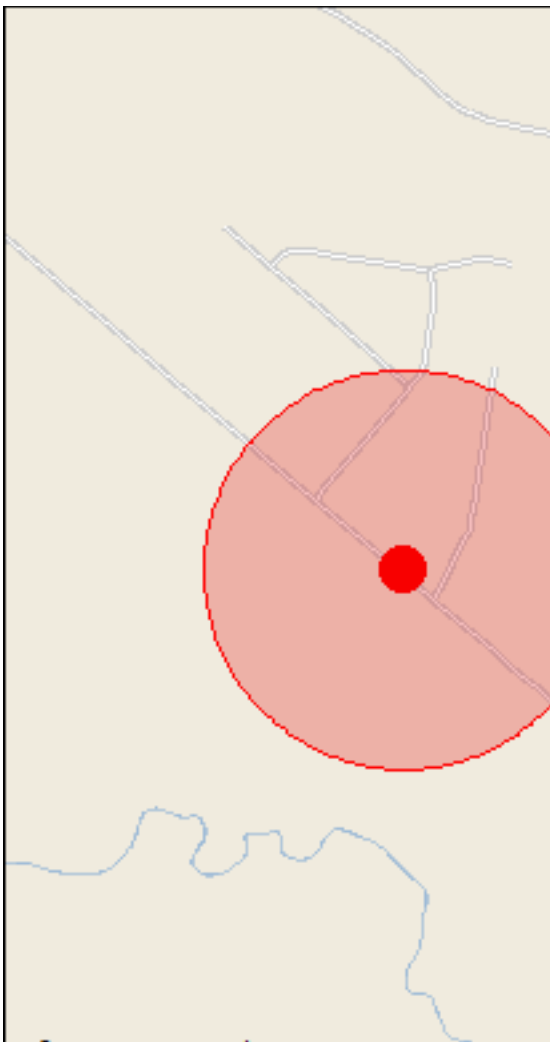
C Act Protected Matters Report

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

on the coverage of this report and qualifications on data supporting this report are cont
e end of the report.

is available about Environment Assessments and the EPBC Act including significance
application process details.

eated: 09/07/18 12:08:56



ary

the report summarises the matters of national environmental significance that may o
e area you nominated. Further information is available in the detail part of the report,
y scrolling or following the links below. If you are proposing to undertake an activity t
mpact on one or more matters of national environmental significance then you should
ive Guidelines on Significance.

the report summarises other matters protected under the Act that may relate to the area yo
ay be required for a proposed activity that significantly affects the environment on Commor
tion is outside the Commonwealth land, or the environment anywhere when the action is ta
alth land. Approval may also be required for the Commonwealth or Commonwealth agenc
on that is likely to have a significant impact on the environment anywhere.

Act protects the environment on Commonwealth land, the environment from the actions tak
alth land, and the environment from actions taken by Commonwealth agencies. As heritag
rt of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritag
alth Heritage place. Information on the new heritage laws can be found at
nvironment.gov.au/heritage

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