Review of Environmental Factors

Proposed Boreholes within A232 and ML1331 at Airly Mine, Capertee

Prepared by:

RPS AUSTRALIA EAST PTY LTD

241 Denison Street
Broadmeadow NSW 2292

T: +61 2 4940 4200
F: +61 2 4961 6794
E: newcastle@rpsgroup.com.au

Prepared for:

CENTENNIAL AIRLY PTY LIMITED

PO Box 92
Lithgow NSW 2790

T: +61 2 6359 2107
E: sam.price@centennialcoal.com.au
W: www.centennialcoal.com.au

Client Manager: Darrell Rigby
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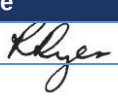
Rob Dwyer		15-04-16

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Executive Summary

Overview

Airly Mine is an underground coal mine located on the northern fringe of the western coal fields of New South Wales, approximately 40 kilometres northwest of Lithgow and approximately 4.5 kilometres north of the village of Capertree. Airly Mine is operated by Centennial Airly Pty Ltd (Centennial Airly) a company wholly owned by Centennial Coal Company Limited.

Centennial Airly proposes to drill seven boreholes as well as install a V-notch weir used for water monitoring at Airly Mine. The purpose of the proposed activity is to install groundwater monitoring sites and to provide geological information for the mine's geological model. The boreholes are located within the life of mine operation area for Airly Mine and within the Mugii Murum-ban State Conservation Area. The proposed activity area is accessed via existing tracks from Glen Davis Road.

Under State Environmental Planning Policy (SEPP) (Mining, Petroleum Production and Extractive Industries) 2007 (the Mining SEPP) development for the purposes of mineral exploration may be carried out without development consent. The proposed activity is to be assessed under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This Review of Environmental Factors (REF) has been completed to address the requirements of Part 5 of the EP&A Act and to assist NSW Department of Trade and Investment, Regional Infrastructure and Services (DTIRIS) with their consideration of the conditions of A232.

Proposed activity

The proposed activity comprises:

- Site preparation and drilling of seven boreholes ARP11, ARP12, ARP13, ARP13SP ARP14, ARP15 and ARP15SP within borehole compounds of approximately 450m^2, installation of a V-notch Weir and upgrading of existing tracks and re-opening of small sections of disused access tracks leading to the boreholes and V-notch weir;
- Collection of geotechnical data;
- Partial rehabilitation following the collection of geotechnical data;
- Installation of piezometers for groundwater monitoring;
- Collection of groundwater monitoring data over an anticipated duration of approximately 20 years; and
- Decommissioning and full rehabilitation following the useful life of the groundwater monitoring bores.

Borehole locations were chosen to minimise land disturbance and vegetation clearance. As a result minimal soil disturbance and vegetation clearance is required for the proposed activity.

Justification

The objectives of the proposed activity are:

- To determine the position, quality, thickness and extent of the coal resource for inclusion in the mines geological model for the purposes of mine planning;
- To obtain geotechnical data on the strata associated with the coal seam for mine design purposes; and
- To obtain baseline data and continue monitoring groundwater as part of Airly Mine's water monitoring program.

The activity is necessary to determine the potential coal resource in the area and to provide sufficient baseline groundwater data to inform any future applications by Centennial Airly.

Key potential environmental impacts

Soil

- There is potential for soil erosion from wind and from runoff water. However, the area of disturbance is small and there would be a very small gradient/slope of the terrain with sediment retention fencing installed at each site.
- Fuels and oil would be used during the proposed activity. Any drilling muds used would be biodegradable to avoid the risk of soil (and water) contamination. Mitigation measures to minimise and manage the risk of spills are identified.
- Soil would be removed during excavations and mitigation measures to ensure its re-use for rehabilitation are identified.
- Impacts associated with soil profile inversion and soil compaction would be mitigated.

Surface and groundwater

- Cross contamination of aquifers would be avoided through the proposed drilling methodology and mitigation measures.
- Changes to groundwater levels are not expected.
- Biodegradable drilling mud and fuels and oils would be used during the proposed activity. The risk of seepage of drilling fluids or hydrocarbons to water resources would be managed.

Hazardous substances

- Risks associated with transport, use and storage of hazardous substances will be managed.

Waste

- The management of wastes, including its transport will comply with relevant legislation and guidelines.

Air quality

- There are three residential properties within proximity of the proposed activity area, two of which are owned by Centennial. These could potentially be affected by dust during the construction process. Dust also has potential to affect the environment of the SCA and those using the immediate area for recreation. During construction, dust would be minimised.
- Emissions from vehicle and plant exhausts would be very low.
- Any odour emissions are likely to be minor.

Noise

- Potential construction noise impacts to three residential properties and those using the immediate area for recreation would be managed through mitigation measures such as prior notification of the residents of two properties, best practice measures and a complaints handling procedure.

Flora and fauna

- Whilst the proposed borehole compounds have been selected to minimise vegetation impacts, there would be potential losses of:
  - approximately 0.225 hectares native vegetation due to the borehole compounds and 0.31 ha

associated with track upgrading (existing tracks and disused access tracks)

- Vegetation disturbance will be minimised and the proposed activity area will be rehabilitated.
- Vegetation removal will be avoided where possible. Where vegetation removal is unavoidable, it will be kept to a minimum. No hollow bearing trees and/or mature trees are expected to be removed.
- There would not be a significant impact upon any listed threatened ecological communities or any listed threatened species.
- The potential risk of vehicles and machinery bringing materials onto the sites that may cause the distribution of weed species or introduce pathogens would be managed. Appropriate measures such as vehicle and machinery cleaning protocols will be employed to ensure that vehicles and machinery working within the proposed activity area do not bring materials (soils, weeds or pathogens etc.) onto the sites that may cause the distribution of weed species.

Community

- Minor increases in traffic along Glen Davis Road and on the tracks to the proposed activity area are unlikely to result in traffic delays or road safety issues.
- During construction, there are potential impacts on those using this part of the SCA for recreation such as noise, dust, traffic, visual effects and the introduction of a hazard.
- During construction, there would be temporary impacts associated with the recreational, heritage and conservation values of the SCA.

Economic

- Provision of temporary construction work for approximately five contractors (in addition to existing Centennial staff) and purchasing of material supplies.

Public safety

- Potential hazards to recreational users of this part of the Mugii Murum-ban SCA will be managed.
- There is a risk of bushfire and this risk will be managed.

Visual or scenic landscape

- During construction, the works would be visible within the Mugii Murum-ban SCA. This may temporarily detract from the scenic qualities of the land.

Use, wastage, destruction or depletion of natural resources including water, fuels, timber, or extractive materials?

Quantities of fuel used in the activity will not be significant.

- The proposed activity is not likely to involve the significant use, wastage, destruction or depletion of natural resources.
- The proposed activity is unlikely to affect the use of, or the community's ability to use, natural resources such as the Mugii Murum-ban SCA.

Agriculture

- The proposed activity area is not within land used for agricultural purposes. No reduction in agricultural land will occur.
- Very low traffic generation is unlikely to cause impacts on agricultural businesses from delays on Glen Davis Road.

- No impact on any water supply services or processing facilities required for agricultural enterprises.
- Risks associated with spills of fuels and oils and potentially contaminating water and soil would be mitigated.

Aboriginal heritage

- No Aboriginal objects, sites or culturally modified trees were identified within the borehole compounds or within 5m either side of the access tracks. One Aboriginal site is located 20m from Borehole ARP11 and mitigation would be implemented for its protection.
- In the event of Aboriginal objects being identified during the proposed activity, mitigation measures are identified.

Historic cultural heritage

- No non-Aboriginal heritage items and places were recorded within or in close proximity to the proposed activity area.
- In the event of non-Aboriginal heritage material being identified during the proposed activity, mitigation measures would be implemented.

Cultural landscape

- The proposed activity area is within an SCA and beyond this, the nearest cultural landscape is the Greater Blue Mountains Area. Impacts to this area are not likely to be significant due to the distance and scale of the activity.

Cumulative effects

- There are existing monitoring bores at Airly Mine and both activities would contribute to the collection of groundwater data to inform any future mining related development in the area.
- Community concern about environmental impacts and employment associated with the general increase in mining related activities in the wider area. This would be addressed through ongoing community consultation.

Conclusion

The proposed activity is minor in scale and potential impacts are mainly associated with the construction stage that would be temporary lasting approximately three months (weather permitting). The borehole compounds will be initially rehabilitated following drilling with only the piezometer headworks remaining at each site until decommissioning in approximately 20 years time upon which each site will be fully rehabilitated. The borehole compounds were selected to minimise vegetation and land impacts. Clearing along all existing tracks and all disused access tracks that will be utilised by the activity will be kept to a minimum. The V-notch weir is not expected to alter the flow of water within Genowlan Creek as it is designed with the intention to monitor natural flows.

The potential impacts are considered low providing the mitigation measures identified in this REF are implemented.

1.0 Introduction

1.1 Background and summary of the activity

Airly Mine is an underground coal mine located on the northern fringe of the western coal fields of New South Wales, approximately 40 kilometres northwest of Lithgow and approximately 4.5 kilometres northeast of the township Capertee. Airly Mine is operated by Centennial Airly Pty Ltd (Centennial Airly) a company wholly owned by Centennial Coal Company Pty Limited.

This Review of Environmental Factors (REF) has been prepared for a proposed n program that involves the drilling of seven boreholes to the north east of the Airly Mine pit top. The REF has been prepared in accordance with Clause 228 of the Environmental Planning and Assessment Regulation 2000 and provides consideration of the environmental impact of the proposed works as required by Section 111 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Centennial Airly proposes to drill seven boreholes, install a V-notch weir used for water monitoring, upgrading of existing tracks and re-opening of small sections of disused access tracks leading to the exploration boreholes and V-notch weir (collectively referred to herein as the proposed activity), at Airly Mine. The purpose of the proposed activity is to install groundwater monitoring sites and to provide geological information for the mine's geological model. The boreholes are located within the life of mine operation area for Airly Mine and within the Mugii Murum-ban State Conservation Area as identified in **Figure 1**.

Under the Mining State Environmental Planning Policy (SEPP) development for the purposes of mineral exploration may be carried out without development consent. The proposed activity is a Category 3 activity under A232 and ML1331. Therefore, it is to be assessed under Part 5 of the EP&A Act and such activities require a REF prepared in accordance with Department guidelines. This REF has been prepared in accordance with ESG2: Environmental Impact Assessment Guidelines, for exploration, mining and petroleum activities subject to Part 5 of the Environmental Planning and Assessment Act 1979 (EP&A Act), a resource document from the Department of Trade and Investment, Regional Infrastructure and Services (DTIRIS).

This REF has been prepared utilising information where appropriate from the following specialist studies:

- Flora and Fauna Assessment as contained in **Appendix 1.** This Assessment includes the consideration of upgrading of existing tracks and the re-opening of disused access tracks**;**
- Water Impact Assessment as contained in **Appendix 2**; and
- Aboriginal Due Diligence Assessment as contained in **Appendix 3**. This Assessment includes the consideration of upgrading of existing tracks and the re-opening of disused access tracks**.**

The REF also been completed to:

- Assist DTIRIS with their consideration of the conditions of A232 and ML1331;
- Provide supplementary documentation to assist the Office of Environment and Heritage to grant a Determination Notice for the proposed activity; and
- Accompany a surface disturbance notice to DTIRIS.

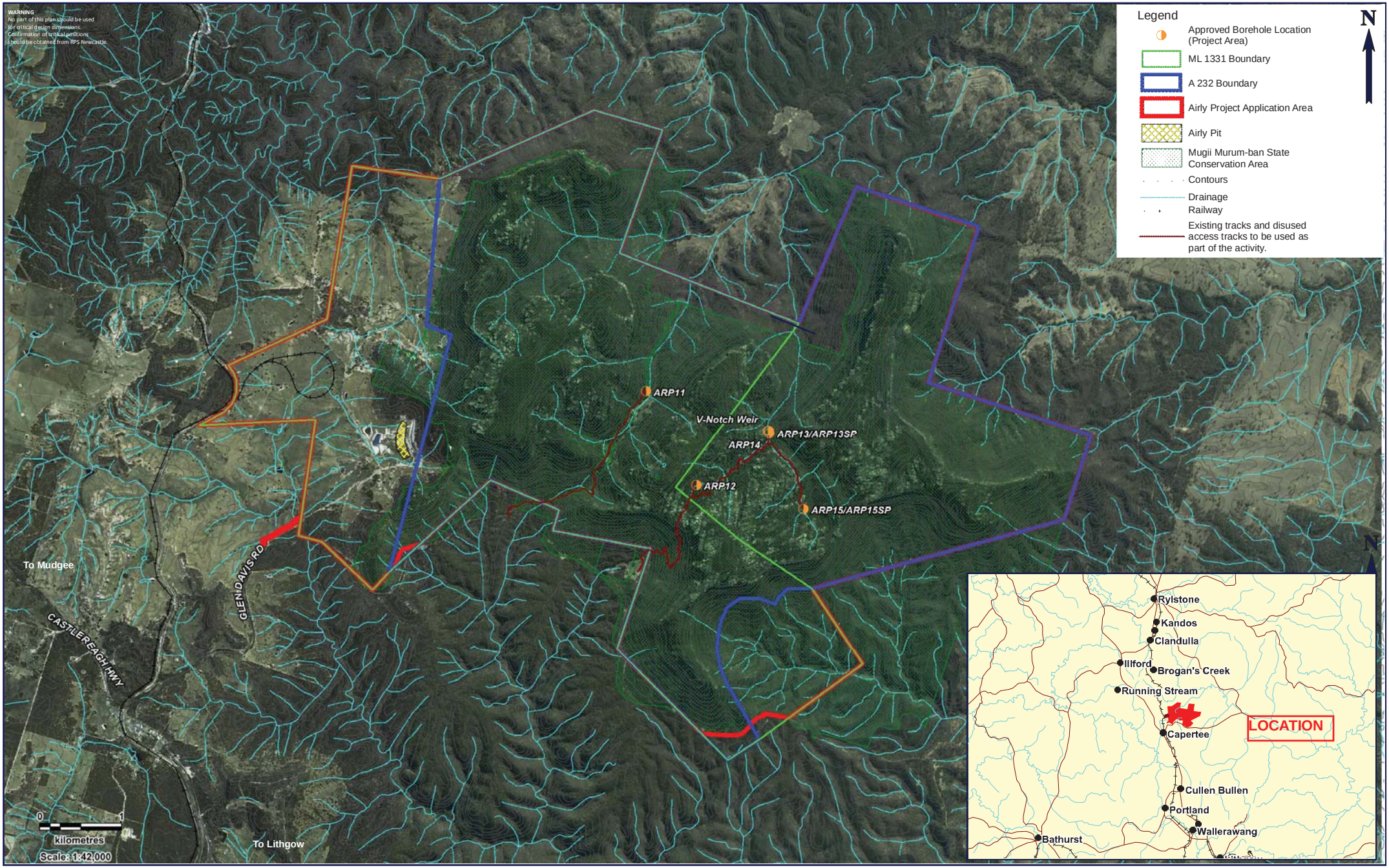
1.2 Structure of this REF

The structure of the REF is as follows:

- **Section 1** – Introduces the proposed activity.
- **Section 2** – Describes the proposed activity, consultation undertaken, justification of the activity,

alternatives and the mitigation strategy.

- **Section 3** – Describes the site.
- **Section 4** – Describes the existing environment.
- **Section 5** – Discusses the relevant planning legislation.
- **Section 6** – Assesses the potential environmental impacts of the proposed activity and identifies mitigation measures.
- **Section 7** – Provides a summary of the impacts and includes an assessment of the proposed activity against clause 228 of the *Environmental Planning and Assessment Regulation 2000*;
- **Section 8** – Statement of commitments
- **Section 9** – Concludes the REF.



TITLE: Figure 1: Locality

LOCATION: Airly

DATUM: (GDA 94)
PROJECTION: MGA Zone 56

DATE: 19/04/2016
PURPOSE: REF

LAYOUT REF: J:\JOBS\Centennial\All Jobs\123266 Airly Boreholes REF\10 - Drafting\MapInfo Workspace\Planning
VERSION (PLAN BY): D A3 (RD-NW)

CLIENT: Centennial Coal
JOB REF: 123266

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au

2.0 The proposed activity

2.1 Summary of the activity

Details of the proposed activity are provided in **Table 1**.

Table 1 Details of the proposed activity

Item	Details
Authorisation/title number	A232 and ML1331
Title Holder	Centennial Airly Pty Ltd
Proponent and Operator	Centennial Airly Pty Ltd
Activity Type	Coal exploration and groundwater monitoring boreholes
Activity Scope	Construction of seven boreholes (ARP11, ARP12, ARP13, ARP13SP, ARP14, ARP15 and ARP15SP) for geological and geotechnical investigation of the potential coal resource and groundwater monitoring. Install a V-notch weir into a small stream. Upgrading of existing tracks (only where absolutely necessary) and re-opening of small sections of disused access tracks leading to ARP13/ARP13SP, ARP14 and ARP15/ARP15SP. Clearing will be done predominately by hand. In some instances and only where necessary a small excavator may be required to ensure safe access is provided. Where ever possible clearing will be minimised and Five borehole compounds with an impact area of 450 m^2. Upgrading of existing sections of tracks and reopening of overgrown tracks, as identified in **Figure2**, will be carried out in a manner consistent with the principles set out in Erosion and Sediment Controls - A Field Guide for Erosion and Sediment Control Maintenance Practices on Unsealed Roads (OEH / NSW NPWS April 2010) to ensure appropriate control of water and sediment to ensure appropriate vegetation management in these areas.. Potential ground disturbance and vegetation clearing will be approximately 0.54 hectares (ha) (5 compounds and upgrading of access tracks where required). Geotechnical sampling, via use of track mounted drill rig, followed by partial rehabilitation of the borehole compounds. Installation of piezometers and undertaking of groundwater monitoring over an anticipated 20 year period. Vehicle / pedestrian access to the seven boreholes will be on a monthly basis. Decommissioning and full rehabilitation.
Activity location	Airly Mine, Capertee
Activity duration	Three months for the construction of the boreholes commencing in quarter 1 2016. Approximately 20 years for the operation of the piezometers for groundwater monitoring
Type of approval being sought	EP&A Act, Part 5

2.2 The proposed activity area

References to 'the proposed activity area' mean the seven boreholes, five compounds and the associated tracks to ARP13/ARP13SP, ARP14 and ARP15/ARP15SP that may be subject to minor upgrades to enable better vehicular access to the borehole compounds. The proposed activity area is illustrated in **Figure 2**.

2.3 Regional Location

Airly Mine is located 4.5km northeast of the township of Capertee and 40 km northwest of the City of Lithgow in the NSW Western Coalfield.

The proposed activity area is located within Authorisation Area 232. Additionally, borehole ARP11 is situated within Mining Lease ML1331. The proposed activity area is within the Lithgow Local Government Area (LGA). **Figure 1** illustrates the location of the proposed activity area in the context of the above mentioned.

2.4 Stakeholder consultation

Representatives from Centennial Airly met with NSW National Parks and Wildlife Service (NSW NPWS) on the 3rd June 2014 and on the 24th June 2014. On the 3rd June a meeting was held at the NPWS Rylstone Depot to outline the proposed 2014 exploration drilling program to be undertaken. On the 24th June a site inspection of the proposed drill sites was undertaken.

Representatives from Centennial Airly met with Environment Inspectors from DTIRIS and inspected the proposed drill sites on Genowlan Mountain on the 8th September 2014.

2.5 Justification of activity

The objectives of the proposed activity are:

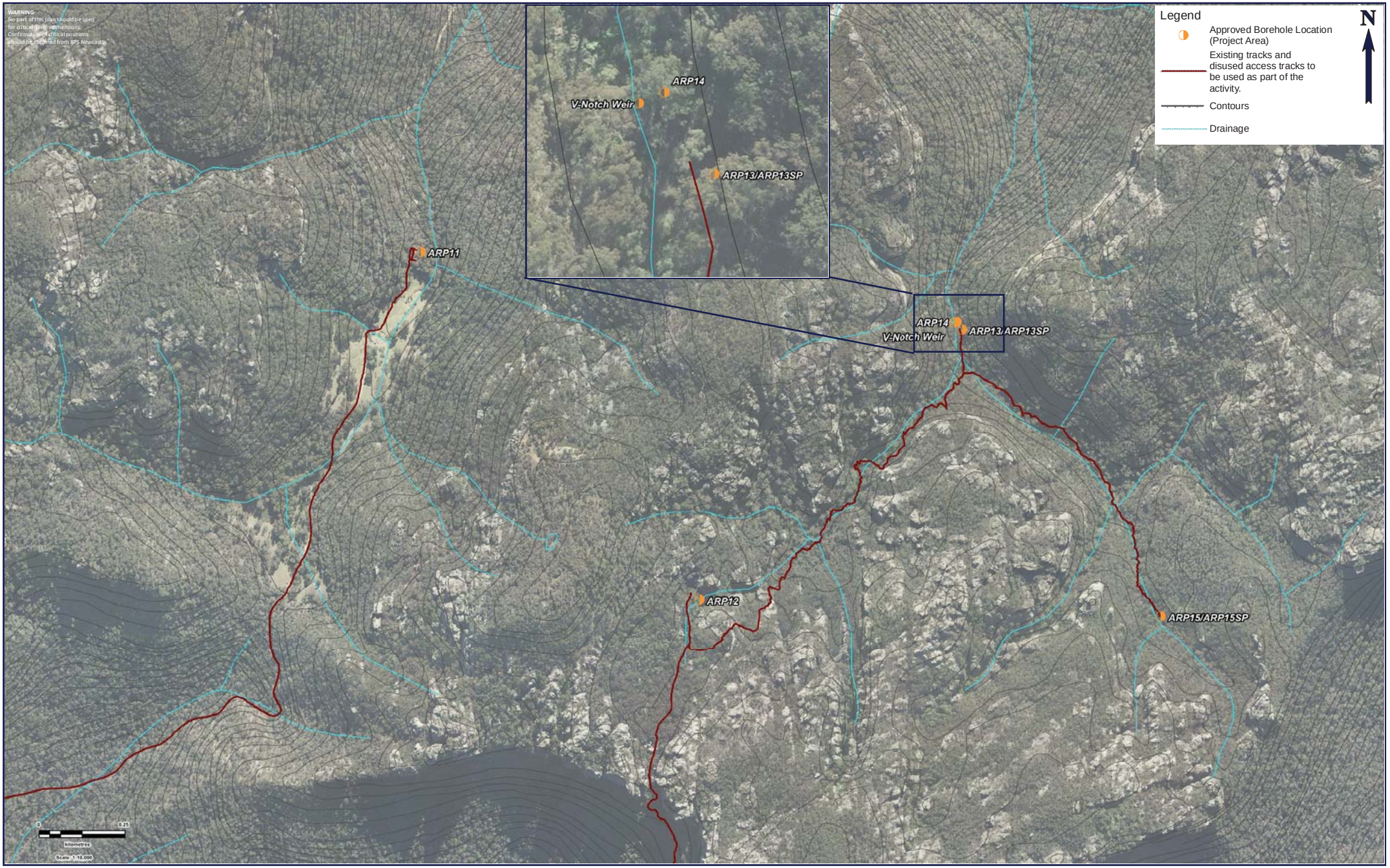
- To determine the position, quality, thickness and extent of the coal resource for inclusion in the mines geological model for the purposes of mine planning;
- To obtain geotechnical data on the strata associated with the coal seam for mine design purposes;
- To obtain baseline data on and continue monitoring groundwater as part of Centennial Airly's water monitoring program.

The proposed activity is necessary to determine the potential coal resource in the area and to provide sufficient baseline groundwater data to inform any future applications by Centennial Airly.

2.6 Analysis of alternatives

The following types of alternatives were considered:

- Alternative methods of obtaining data;
- Alternative locations; and
- Alternative sites.



TITLE: Figure 2: Project Area

LOCATION: Airly

DATUM: (GDA 94)
PROJECTION: MGA Zone 56

DATE: 19/04/2016
PURPOSE: REF

LAYOUT REF: J:\JOBS\Centennial\All Jobs\123266 Airly Boreholes REF\10 - Drafting\MapInfo Workspace\Planning
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241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au

2.6.2 Alternative methods of obtaining data

In order to obtain the geotechnical and groundwater data sought there are no other feasible methods.

2.6.3 Alternative locations

The boreholes need to be located to target potential aquifer recharge areas and therefore alternative locations were not considered further.

2.6.4 Alternative sites

The boreholes need to be located in a manner that is sufficiently spaced in order to monitor the different areas within the lease and authorisation area. Potentially suitable sites that would require a high proportion of disturbance to vegetation and soil were rejected in favour of those that would minimise such disturbance.

The borehole locations have been selected to utilise existing tracks leading from Glen Davis Road and to minimise land disturbance and vegetation clearing requirements. Drill sites ARP11 and ARP12 will be accessed completely via existing tracks. These tracks have been used previously at Airly Mine to provide access to drill rigs. Minor clearing of overgrown tracks will be required to access drill sites ARP13/ARP13SP, ARP14 and ARP15/ARP15SP.

2.7 Description of the activity

The proposed program primarily consists of constructing seven boreholes (ARP11, ARP12, ARP13,, ARP13SP, ARP14, ARP15 and ARP15SP). It is noted that an additional borehole known as ARP15A has been assessed in a number of the specialist reports appended to this REF however this site is no longer required.

The seven boreholes are proposed to investigate the location, depth, quality and thickness of the coal seam within the Authorisation Area A232. Following drilling, these boreholes will be equipped with piezometers used to monitor groundwater over approximately the next 20 years, after which they will be decommissioned and the borehole sites fully rehabilitated. A V-notch Weir is also proposed to be situated within Genowlan Creek near sites ARP13 and ARP14 to monitor water flow and detect any flow changes as a result of potential subsidence from underground mining.

The activity includes the upgrading of existing access tracks. There may also be a requirement to regrade rough sections of existing tracks and existing berms to allow equipment to travel along the tracks. The berms will be reinstated by Centennial Airly to the original grades at completion of the works. The activity also includes reopening of the final ~170m of track to access ARP13/ARP13SP and ARP14 and the V-Notch Weir, and the final ~450m of track to access ARP15/ARP15SP. Existing overgrown tracks lead to these sites.

This REF, including the Flora and Fauna Assessment and Aboriginal Due Diligence Assessment contained within, has considered a 5 metre wide potential area of impact along all existing tracks and all disused access tracks proposed for reuse. Clearing will be done predominately by hand. In some instances and only where necessary a small excavator may be required to ensure safe access is provided. Wherever possible, clearing will be minimised. A low level of impact is expected due to the methodology used for accessing and drilling the proposed bores. The boreholes will be drilled by a track mounted drill rig. The proposed bores are located within previously cleared areas adjacent to existing or disused tracks to minimise the removal of vegetation. In addition, where necessary, the drill rig will be guided around any trees or vegetation in order to access the proposed borehole sites. This will further minimise the impacts to local vegetation and the habitats within.

Water for drilling will be taken from existing water courses wherever possible. In order to minimise the impacts to natural flows during borehole construction, water will be gradually pumped at a rate which minimises the impacts to natural water flows.

2.7.1 Borehole locations

The locations of the seven proposed boreholes and V-notch weir are identified in **Figure 2**. The boreholes will be drilled and once the geotechnical data has been obtained, piezometers for groundwater monitoring will be installed.

2.7.2 Site preparation

The proposed activity area will be accessed via existing tracks leading from Glen Davis Road. Borehole ARP11 is located adjacent to an existing track and does not require track works for access. Access tracks into the remaining sites need to be regraded to enable vehicular access. Boreholes ARP13, ARP13SP, ARP14, ARP15 and ARP15SP are located along an overgrown existing track. There will be a requirement to reopen the final ~170m of track to access ARP13, ARP13SP and ARP14 and the V-Notch Weir, and the final ~450m of track to access ARP15 and ARP15SP. There may also be a requirement to regrade rough sections of track and existing berms along the tracks to allow equipment to travel along the tracks, the berms will be reinstated to the original grades at completion of the works. Subsequently, this track upgrading work will need to be undertaken prior to the construction of the boreholes to enable vehicular access. Assuming a maximum width of 5m (likely to be less), reopening of overgrown tracks required for access and use of existing tracks currently in use, requires the removal of approximately 0.31 ha of vegetation. An assessment of the impact of vegetation removal is contained in Section 6 of this REF.

The compound for each of the seven boreholes will have a maximum area of 450 m^2. This comprises a total area of approximately 0.225 hectares, noting that only one compound is required for boreholes ARP13 and ARP13SP and likewise only one compound is required for boreholes ARP15 and ARP15SP.. Locations for boreholes have been selected so that they have minimal slope and therefore surface run off is not expected. Where necessary, drainage will be implemented to ensure the working area remains free of excess water. Above ground tanks to capture and recirculate water and drilling mud will be used at each drill site.

Borehole locations were chosen adjacent to existing and former tracks to minimise land disturbance and vegetation clearance. Minimal soil disturbance and vegetation clearance is required for the borehole compounds.

2.7.3 Drilling rig and equipment

The main plant and equipment to be used during drilling activities will be:

- Track mounted drill rig;
- Track mounted drill rig carrier;
- Truck mounted water carrier;
- 4WD mounted water carrier;
- Helicopter;
- Light vehicles;
- Bulldozer (if required); and
- Grader (if required).

2.7.4 Borehole construction

The boreholes will be constructed in accordance with the Minimum Construction Requirements for Water Bores in Australia (ADIA, 2012).

The seven boreholes will be installed using a track mounted drilling rig using rotary mud drilling. Drilling will involve the use of mud, also known as drilling fluid, pumped down through the drill pipe and out through nozzles in the drill bit. Potential water sources for drilling use are identified in Section 2.7.6.

The mud circulates continuously to remove drill cuttings and also serves to cool and lubricate the drill bit. Water and drill cuttings brought to the surface will be collected in above-ground tanks to allow sediments to settle out of the solution. Recovered water / mud will be recirculated down the drilling rods.

A biodegradable bentonite clay-based mud will be used for rotary mud drilling.

At the completion of drilling, each borehole will be flushed to remove any remaining drilling mud from the walls of the borehole and the location of the borehole will surveyed. Following geophysical logging, standpipes and vibrating wire piezometers (VWPs) will be installed. All aquifers and permeable zones, other than the targeted zone, shall be adequately sealed to prevent aquifer interconnection between zones of different pressure and water quality. All waste, including drill cuttings, will be removed from the site for disposal at the completion of drilling.

Boreholes ARP11, ARP12 and ARP14 will be constructed as standpipes using a 50 mm class 18 threaded PVC with factory slotted PVC screen. Bore screens of length 3 – 6 metres will be placed at the bottom of boreholes, with the bores extended to the surface using PVC casing. A gravel pack will be placed in the annulus adjacent to the screen and above the screen with a bentonite seal placed above the gravel pack. The remaining bore annulus will be backfilled to near surface with bentonite and/or cement and a concrete collar will be placed at the surface. The standpipes will be completed with a lockable steel monument cover.

Borehole ARP13 will be drilled to the Devonian strata to a depth of approximately 305 m below ground level. A VWP will be installed within this hole to monitor piezometric height in the Shoalhaven Group and the Devonian strata located beneath the Lithgow Seam.

Borehole ARP13SP will be drilled adjacent to ARP13 and to a depth of approximately 90 m below ground level. A stand pipe piezometer will be installed to monitor water quality within the Lithgow seam. A gravel pack will be placed in the annulus adjacent to the PVC screen and above the screen with a bentonite seal placed above and below the gravel pack. The remaining bore annulus will be backfilled to near surface with bentonite and/or cement and a concrete collar will be placed at the surface. The standpipe will be completed with a lockable steel monument cover.

Borehole ARP15 will be drilled to the Devonian strata to a depth of approximately 365 m below ground level. A VWP will be installed within this hole to monitor potential change in piezometric height in the Permian strata as a result of proposed mining and piezometric height in the Shoalhaven Group and the Devonian strata located beneath the Lithgow Seam.

Borehole ARP15SP will be drilled adjacent to ARP15 and to a depth of approximately 42 m below ground level. A stand pipe piezometer will be installed to monitor potential future drawdown in the Triassic Narrabeen Sandstone. A gravel pack will be placed in the annulus adjacent to the PVC screen and above the screen with a bentonite seal placed above and below the gravel pack. The remaining bore annulus will be backfilled to near surface with bentonite and/or cement and a concrete collar will be placed at the surface. The standpipe will be completed with a lockable steel monument cover. A typical layout of the borehole compound is shown in **Figure 3**.

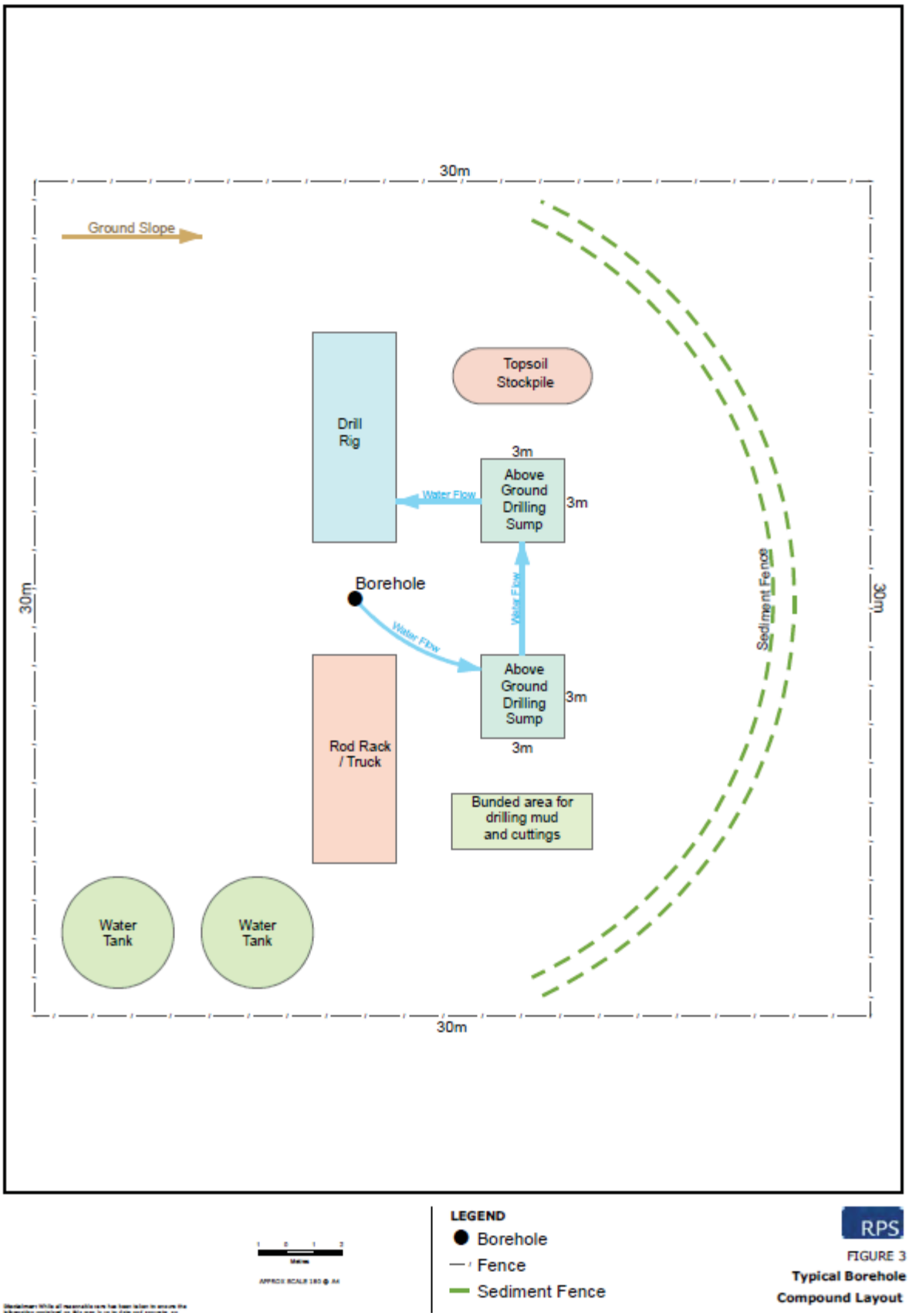


Figure 3 Typical borehole compound layout

Vented water pressure transducers will be installed in each standpipe to continuously measure groundwater levels. A data logger will be secured within the monument cover of each standpipe to record these groundwater levels. Data loggers will also be installed within the monument covers of ARP13 and ARP15 to continuously record piezometric head measurements from the VWPs.

2.7.5 V-notch weir construction

A V-notch weir is proposed to be constructed on Genowlan Creek within Lot 7002 DP1058210. The proposed construction will involve the installation of a 2cm thick timber and metal plate (with V-notch) across the width of the creek. The plate will be fixed to the creek bed and banks using cement to seal off any openings and to fix the plate to the creek bed. A device will be attached to the V-notch which will measure the water level in the V-notch. A data logger, sensor, wiring, solar panel and reference gauge will be installed at the monitoring location. The data logger will be installed within an instrument cabinet that will be fitted to a pole with a solar panel attached. A modem and aerial is also proposed to be installed if an adequate signal can be achieved. A typical V-notch weir is shown in the **Figure 4** below.

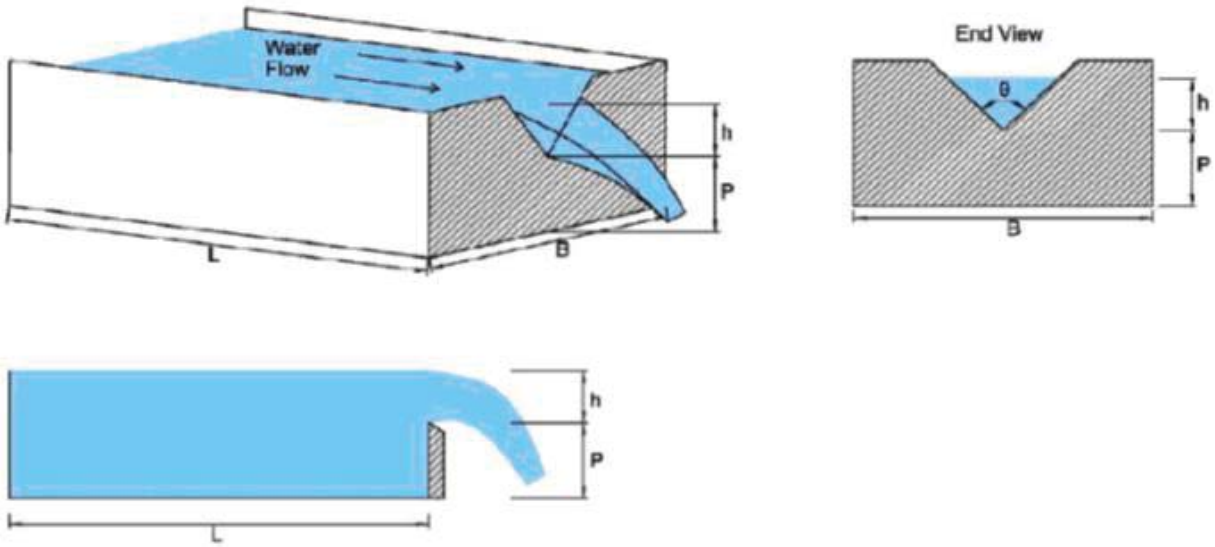


Figure 4 Typical V-Notch Weir

The proposed weir will be installed using the following general rules:

- A weir should be set at right angles to the direction of flow in a channel that is straight for a distance upstream from the weir at least ten times the length of the weir crest.
- The crest and sides of the weir should be straight and sharp-edged. Each side of the V-notch weir should make a 45 ° angle with a vertical line through the vertex of the notch.
- The channel upstream should be large enough to allow the water to approach the weir in a smooth stream, free from eddies.
- Avoid restrictions in the channel below the weir that would cause submergence. The crest must be placed higher than the maximum downstream water surface to allow air to enter below the nape.

Ongoing maintenance of the weir will largely involve the clearing of sediment and debris from behind the weir. Trees and sticks may also block the notch at times and would be removed as soon as possible.

The monitoring infrastructure will remain in place for as long is considered necessary by Centennial Airly to ensure that sufficient baseline information is obtained. When sufficient data is obtained, the infrastructure will be removed from the watercourses.

Given the minor nature of the works, rehabilitation works will be insignificant. Specifically, the walls of the weir on either side of the V-Notch would be removed by gradually lowering their height so that the water stored behind the weir is gradually released downstream.

2.7.6 Site water requirements

Based on previous bore construction at Airly Mine, it is expected that approximately 400,000 – 600,000 L (0.4 – 0.6 ML) of water will be required to drill the seven proposed boreholes. Water sources for each location are detailed in **Table 2**.

Table 2 Water sources for drilling at Airly Mine

Borehole	Water sources	Approximate volume required (ML)
ARP11	Gap Creek dam located at 'Rock Bottom' or dam at Airly Mine.	<0.002
ARP12	Genowlan Creek or in the event of insufficient flows the historic diamond creek mine.	<0.002
ARP13 and ARP13SP	Genowlan Creek or in the event of insufficient flows the historic diamond creek mine	<0.23
ARP14	Genowlan Creek or in the event of insufficient flows the historic diamond creek mine .	<0.002
ARP15 and ARP15SP	Genowlan Creek or in the event of insufficient flows the historic diamond creek mine	<0.31

At each borehole location, clean water will be stored in above-ground tanks for drilling-related activities.

The preferred water supply for ARP11 is the existing dam on Gap Creek located in the cleared area to the south of ARP11 locally known as 'Rock Bottom'. The dam is located on the existing access track from Glen Davis Road. Water from the dam will be transported by vehicle to drill site ARP11 or will be pumped from the dam using polyethylene pipe to the drill site by laying the pipe along the edge of the existing track. Should the dam be dry or contain an insufficient volume of water at the time of drilling, water will be sourced from the Airly Mine surface facilities area and transported to drill site ARP11 by helicopter or by a vehicle.

The preferred supply of water to ARP12, ARP15 and ARP15SP is to pump at a slow sustainable rate from Genowlan Creek using a polyethylene pipe to storage tanks located at the drill site. This method minimises subsequent environmental damage and personnel safety concerns caused by vehicle and helicopter movements. If in the event that Genowlan Creek has insufficient flows water will be sourced from an existing dam at the historic diamond creek mine. The dam is located on an existing access track leading to the northwest from ARP12. Water from the dam will be transported to ARP12 and ARP15 by helicopter.

Similarly Airly Mine proposes to source water for ARP13, ARP13SP and ARP14 from Genowlan Creek at the Oasis Surface Water Monitoring Station. A slow sustainable rate from the creek will be pumped directly to each drill site by polyethylene pipe. Anecdotal information suggests that creek baseflow at this location is approximately 200,000 L/day on average and it is estimated that less than 200,000 L will be required. It is therefore considered that there will be a sufficient volume of water available to supply the drilling operations at ARP13, ARP13SP and ARP14. If in the event that Genowlan Creek has insufficient flows water will be sourced from an existing dam at the historic diamond creek mine. Water from the dam will be transported to ARP13, ARP13SP and ARP14 by helicopter.

Sediment dams at Airly Mine may also be used to supply water for the drilling program as a back up if required. Prior water quality testing of this source of water will be carried out to ensure the water is suitable for the intended purpose.

2.7.7 Borehole completion and rehabilitation

Once the piezometers have been installed, the rest of the drill pads will be partially rehabilitated to their pre-operational state. Drilling fluids will be removed from the borehole compounds and rehabilitation will follow best practice management principles which may include grading, replacing topsoil, reseeding disturbed ground and controlling weeds. Rehabilitation will be done in consultation with the land owner being NSW National Parks and Wildlife Service.

The heads of the piezometers will remain in place during their useful life. Decommissioning and full rehabilitation of the boreholes, including filling and capping with concrete, will be undertaken during the mine closure process. Filling and capping may require the use of a small excavator for carrying of material to the sites.

2.7.8 Sampling and testing

The purpose of the activity is to drill boreholes to first obtain information about the potential coal resources and then use the boreholes as groundwater monitoring bores. Groundwater will not be extracted.

The data loggers will need to be downloaded from each piezometer periodically (it is currently anticipated that data will be downloaded every month). This will involve a member of staff driving to each to take the reading.

Up to ten workers will be required for the construction of the boreholes. The hours of construction will be:

- 7.00am to 6.00pm Monday to Friday and Saturday 8.00 am to 1 pm.

During operation of the piezometers, personnel members of staff will travel to the piezometers to take readings, collect groundwater samples or inspect the sites.

2.7.9 Timing and duration

Activities are anticipated to commence in quarter 2 of 2016. Drilling of boreholes ARP13 and ARP15 will take approximately four weeks each once the drill sites have been prepared. Drilling of boreholes ARP11, ARP12, ARP13SP, ARP14 and ARP15SP will take approximately 2 days each once the drill sites have been prepared. All the proposed boreholes will be constructed and partially rehabilitated within three months (weather permitting).

The boreholes are currently anticipated to be operational for groundwater monitoring for approximately 20 years. The boreholes will be accessed for ongoing monitoring purposes via remote sensing and will also be accessed on foot and via vehicle. This will occur on a monthly basis. Vehicle access to ARP13/ARP13SP, ARP14 and ARP15/ARP15SP will be minimised where ever possible during construction. After establishment of ARP13/ARP13SP, ARP14 and ARP15/ARP15SP ongoing access to these sites will be by foot.

Borehole site rehabilitation will commence following completion of construction of the boreholes, and full rehabilitation will be undertaken following the useful life of the piezometers.

2.8 Mitigation strategy

Centennial has a Pollution Incident Response Management Plan that is implemented for Airly Mine. This identifies the key actions to minimise the occurrence of a pollution incident and manage a pollution incident if one occurs.

The proposed activity will be carried out in accordance with the mitigation measures and statement of commitments provided in Sections 6 and 8 of this REF.

Strategies for the protection of water sources, managing wastes and noise are identified in Section 6.

2.9 Access arrangements

Under the *Mining Act 1992* (Mining Act), access arrangements are to be agreed in writing between the title holder and each landholder. The landholder is the NPWS who will provide approval for the proposed activity through the granting of a determination notice.

2.10 Other approval requirements

The need for other approvals, licenses and further assessments and documentation is outlined in Section 5.

The following will be required:

- Prior to drilling, a monitoring bore licence application will need to be lodged with the NSW Office of Water under Part 5 of the *Water Act 1912*.
- Water access licenses as appropriate if required.
- Approval in the form of a Determination Notice under the NP&W Act.
- Surface Disturbance Notice form under A232 and ML1331.

3.0 The Site

The borehole sites are within the Mugii Murum-ban State Conservation Area, occurring between 4.9km and 6.7km north-east of the Airly Mine entrance as illustrated in **Figure 1**.

The proposed activity area comprises compounds within which the bores will be located and the area of existing tracks requiring upgrading in order to allow the drill rig to reach the site. Existing track regrading will occur at all sites except for ARP11which is located in a low lying gully at the base of Mt Airly. The weir location is proposed to be situated within a third order tributary of Genowlan Creek.

Coordinates of the boreholes are provided in **Table 3**.

Table 3 Details of the proposed activity

Monitoring Site.	Description	
	Easting	Northing
ARP11	224172	6333539
ARP12	224980	6332531
ARP13 and ARP13SP	225744	6333312
ARP14	225728	6333335
ARP15 and ARP15SP	226319	6332480
V-notch Weir	225721	6333332

Site photographs of the proposed borehole locations are provided in **Plates 1** to **5**.

Plate 1 View of proposed borehole ARP11

Plate 2 View of proposed borehole ARP12

Plate 3 View of proposed borehole ARP13/ARP13SP

Plate 4 View of proposed borehole ARP14

Plate 5 View of proposed borehole ARP15/ARP15SP

Photographs of the access to the proposed V Notch weir site, the site itself and a typical example of a V Notch weir are provided in **Plates 6** to **9**.

Plate 6 V-notch access way

Plate 7 V-notch Weir location view to the west and showing creek line

Plate 8 V-notch Weir location view inside creek line

Plate 9 V-notch Weir example

4.0 The Existing Environment

4.1 General description

4.1.1 Climate and weather

The Bureau of Meteorology (BoM) weather station considered to be most representative of the proposed activity area is Running Stream (Brooklyn) for rainfall and Lithgow (Cooerwull) for temperature. As shown in **Table 4** the highest rainfall is during the summer months. Based on maximum and minimum mean temperature records the warmest month is January and the coolest month is June.

Table 4 Climate Data (Source: BoM)

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Max Temp (°C)	27.8	25.4	23	19.2	16.4	12.4	10.9	14.2	18	21.8	26	25.9
Mean Min Temp (°C)	12.1	12.1	8.3	5.5	0.7	-0.7	-0.4	-0.2	3.3	5.4	8.6	9.9
Mean Rainfall (mm)	82.3	80.2	69.5	60.3	62	69.3	69.1	70.6	62.4	72.7	76.4	78.9

4.1.2 Topography and hydrology

The proposed activity area is approximately 650 metres to 1000 metres Australian Height Datum (AHD). The surrounding area forms part of the Mugii Murum-ban State Conservation Area and is dominated by narrow valleys, narrow and deep incised drainage lines, narrow spurs and crests, steep sandstone escarpments and pagoda formations.

Gap Creek and Genowlan Creek traverse the proposed activity area and drain to the north. Gap Creek is approximately 50 metres east of borehole location ARP11. Genowlan creek and associated first order tributaries are situated approximately 20 metres from Borehole locations ARP12, ARP13/ARP13SP, ARP14 and ARP15/ARP15SP and the V-notch Weir; which is proposed to be installed within the creek line.

4.1.3 Vegetation

A Flora and Fauna Assessment has been undertaken for the proposed activity and is contained in **Appendix 1**. The Assessment included consultation with regional mapping – "Vegetation of the Western Blue Mountains" (VWBM) (DEC 2006) in conjunction with ground-truthing and identified two vegetation assemblages associated with the proposed sites as follows:

- MU 3 Hillslope Talus Mountain Gum – Brown Stringybark – Grey gum – Broad-leaved Hickory Moist Forest at sites ARP11, ARP13, ARP13SP, ARP14, ARP15, ARP15SP; and
- MU 4 Sheltered Gully Brown Barrel Ferny Forest, a community that occurred at ste ARP12;

Neither of these communities is listed as being threatened under the TSC Act or the EPBC Act.

4.1.4 Geology

The proposed activity area is located within the southern part of the Western Coalfield of NSW, on the western edge of the Sydney Basin. The area is underlain by Triassic sandstone of the Narrabeen Group, which is underlain by the Illawarra Coal Measures.

Sandstone of the Triassic Narrabeen Group outcrops throughout the plateau and cliffs of Mount Airly and Genowlan Mountain, with small areas of Tertiary basalt outcrop at the higher elevations. The Triassic strata are up to 200 m thick. The Permian Illawarra Coal Measures outcrop around the Triassic formations at lower

elevations, including the zone between Mount Airly and Genowlan Mountain. The Lithgow Seam, within the lower Illawarra Coal Measures, is the currently mined coal seam at Airly Mine. The seam outcrops completely within the vicinity of the proposed activity area and is therefore disconnected to the areas of occurrence of this seam located several kilometres to the south and north-west.

The depth of cover above the Lithgow Seam ranges from less than 20 m in areas of outcrop and in the Gap Creek area, up to approximately 310 m. The seam dips gradually to the east at about 1 degree. The average thickness of the Permian overburden is 105 m.

Inter-bedded siltstone and sandstone of the older Shoalhaven Group outcrop across the Airly Mine surface facilities area and beyond the Study Area. Older Devonian rocks also outcrop beyond the proposed activity area in areas of lower elevation.

Based on high resolution aeromagnetic and radiometric data (SKR, 2012), the basement (or pre-Permian) and shallow geology is characterised by a number of north-west, north-east and north-south trending fault and joint features. SKR (2012) also reports that igneous intrusions are not pervasive in the area.

4.1.5 Soil

The proposed activity area is situated on the geological landscapes of the Narrabeen group and Illawarra Coal Measures. Narrabeen group is characterised by sandstone, claystone, siltstone and Widden Brook Conglomerate and is part of the Clifton Subgroup. Illawarra Coal Measures are characterised by shale, sandstone, conglomerate and chert with coal and torbanite seams.

The borehole locations and weir are situated across two soil landscapes. Borehole locations ARP11, ARP13/ARP13SP, ARP14 and ARP15/ARP15SP and the V-notch Weir are located on the Hassans Walls soil landscape and borehole location ARP12 is located on the Warragamba soil landscape.

The Hassans Walls soil landscape is typically shallow (0cm to 20cm in depth) and may occur over two horizons (A^1 and A^2). A^1 horizon consists of brownish black loamy sand (hw1). A^2 horizon comprises of greyish yellow brown sand (hw2). The underlying subsoils (B^1 and B^2 horizon) may occur at 20cm to 100cm in depth. The subsoils consist of bright yellowish brown pedal clay (hw3) and light grey medium clay (hw4) (King 1993:52-55).

The Warragamba comprises shallow topsoil which occurs over two horizons (A^1 and A^2). A^1 horizon consists of brownish black loamy sand topsoil (wb1) and A^2 horizon comprises of very dark reddish brown clayey sand (wb2). The underlying subsoil consists of pedal clay and occurs as subsoil which varies from dull brown, yellowish brown and reddish brown in colour (wb3) (King 1993:63-65).

4.1.6 Existing land uses

Land use surrounding the proposed activity area includes rural residential, grazing land, coal mining, recreation activities, commercial forestry and nature conservation. The majority of the proposed activity area consists of rugged unpopulated bushland including the Mugii Murum-ban State Conservation Area. An operational limestone mine, Excelsior Limestone Mine, is located 5 km north-west of the surface facilities area at Airly Mine. Historically, oil shale mining was an important land use in the region, with mining for diamonds and gold also occurring in the past.

The western regions of the proposed activity area consist of cleared agricultural land used primarily for grazing of stock as well as the Airly Mine surface facilities area. Those portions of the proposed activity area not within the Mugii-Murum-ban State Conservation Area is land owned by Centennial Airly. Glen Davis

Road, the Airly Mine Access Road and Torbane Road pass through the south-western corner of the proposed activity area.

The Gardens of Stone National Park and Wollemi National Park are both within the vicinity of Airly Mine. Both these protected areas, along with the Blue Mountains, Yengo, Nattai, Kanangra-Boyd and Thirlmere Lakes National Parks and the Jenolan Karst Conservation Reserve, make up the Greater Blue Mountains World Heritage Area.

4.1.7 Availability of services

No services are required for the proposed activity.

4.2 Description of surface and groundwater sources

4.2.1 Surface Water

The proposed activity area lies within the Capertee River catchment, which is part of the Greater Hawkesbury/Nepean catchment. The Capertee River flows in a south-east direction to its confluence with the Wolgan River to form the Colo River, which ultimately contributes to the Hawkesbury River and Broken Bay.

The proposed activity area includes the following four major creek systems:

- Airly Creek system;
- Emu Swamp Creek system;
- Gap Creek and Genowlan Creek system; and
- Torbane Creek and Oaky Creek system.

The Airly Creek system drains the southern part of the proposed activity area and joins the Capertee River approximately 17 km north-east of the surface facilities area at Airly Mine.

Surface runoff from a small area in the north-east of the proposed activity area drains to Emu Swamp Creek, which flows in a north-east direction and joins the Capertee River approximately 10 km downstream.

Surface runoff from the northern section of the proposed activity area drains into Gap Creek and Genowlan Creek. The two creeks, which are groundwater fed in parts, drain northward for approximately 2 km before converging into the greater Genowlan Creek. The surface water features locally referred to as ‘The Grotto’ and the ‘Oasis’ are located on the upper reaches of Genowlan Creek. Genowlan Creek continues to drain in a north easterly direction until its confluence with the Capertee River approximately 8 km downstream. All proposed drilling activities will occur within the Genowlan Creek catchment.

The Torbane-Oaky Creek sub-catchment drains the north-west region of the proposed activity area. Torbane Creek rises in the north-west of the proposed activity area and flows in a north-west direction and joins Oaky Creek approximately 2 km downstream of the proposed activity area boundary. A small northwest portion of the proposed activity area drains directly to an unnamed tributary of the Capertee River.

Airly Creek enters the Gardens of Stone Nation Park immediately south of the proposed activity area before joining the Capertee River. All other watercourses within the proposed activity area also drain into the Capertee River, which enters the Wollemi National Park downstream of Airly Mine approximately 35 km east of the proposed activity area.

All of the creeks within the proposed activity area are ephemeral. Generally, these watercourses flow for relatively brief periods following significant rainfall events. Flows within Airly Creek, Oaky Creek, Coco Creek and Genowlan Creek become perennial outside the proposed activity area.

4.2.2 Groundwater

The local groundwater sources within the proposed activity area are generally low yielding and predominantly within the Quaternary alluvium, weathered and/or fractured sandstone and coal seams that occur within Mount Airly and Genowlan Mountain. They are classified as 'less productive' in accordance with the criteria specified in the NSW Aquifer Interference Policy (i.e. the yield is typically less than 5 L/s and/or the total dissolved solids concentration is typically greater than 1,500 mg/L).

The regional groundwater sources occur within the Shoalhaven Group below the target coal seam, as well as within the underlying Devonian rocks.

4.2.2.1 Local groundwater sources

Alluvium

The alluvium throughout the proposed activity area forms an unconfined shallow aquifer with groundwater ranging in depth from less than 1 m to over 5 m below ground level (bgl) and aquifer thickness generally less than 12 m.

The alluvium associated with Gap Creek and Genowlan Creek is generally a silty sand material and recharged from rainfall as well as inter-aquifer flow from adjacent (primarily Permian) strata. Alluvial groundwater discharges to the connected streams.

It is understood that areas of Gap Creek and Genowlan Creek are fed relatively consistently by rainfall-based flows which emerge from the Quaternary colluvium and alluvium. Although the source for this recharge is rainfall-based, anecdotal evidence infers that these rainfall-based flows are held in the Quaternary Strata and released slowly into the reaches of Genowlan Creek above the 'Grotto' and the 'Oasis' areas, as well as in certain reaches of Gap Creek. Flows in the Grotto and Gap Creek vary with rainfall seasonality, whereas anecdotally the flows through the Oasis are persistent and vary from approximately 2.2 L/s in average conditions to 1 L/s during drought.

Groundwater Dependent Ecosystems (GDEs) are likely to occur within the shallow alluvial aquifer zones where groundwater levels are shallow and exist as moist sheltered gully forests. They are unlikely to be entirely groundwater dependent and are termed 'facultative' ecosystems. The GDEs that may exist within the proposed activity area are not listed as high priority GDEs in the WSP.

Porous and fractured rock

The local porous and fractured rock groundwater sources include the Narrabeen Sandstone and coal seams of the Illawarra Coal Measures. These sources are recharged by rainfall via fractures within overlaying strata and seep out of the side of the mountains or directly into watercourses. With the majority of discharge from these sources being to seepage areas, there is minimal inter-aquifer flow to underlying regional groundwater sources.

Piezometric pressure within the local porous and fractured rock groundwater sources is generally low, reflecting the extensive groundwater seepage/drainage area across the slopes of Mount Airly and Genowlan Mountain. Piezometric contours generally follow the dip of the strata to the east – northeast. There is a downward vertical hydraulic gradient across the strata from the Narrabeen Sandstone to the Illawarra Coal Measures.

4.2.2.2 Regional groundwater sources

The upper regional groundwater source occurs within siltstone and sandstone of the Shoalhaven Group. According to the Western Coalfield (Southern Part) Regional Geology 1:100,000 map (NSW Department of Mineral Resources, Edition 1 1992), this rock formation was deposited in a marine environment and therefore the groundwater is highly brackish to saline. The recharge area is predominantly to the west of the Study Area where the Shoalhaven Group outcrops. Groundwater flow is generally to the east.

The lower regional groundwater source occurs within Devonian metamorphic strata containing shale, sandstone and limestone. The groundwater is slightly brackish and therefore has a lower salt content than the Shoalhaven Group and it is less sulfate dominant. Recharge areas occur to the north, south and east of the Study Area and groundwater flow is generally to the east.

Registered bores

There are no registered bores recorded in the NSW Groundwater Bore Database that are located within the Study Area. The majority of registered domestic and stock bores in the vicinity of the Study Area are located to the east of the Study Area and extract groundwater from the lower regional groundwater source (sandstone and conglomerate formations). Bore yields are generally less than 2.5 L/s and the majority of these bores are utilised under basic landholder rights.

4.3 Description of threatened species, populations and ecological communities

4.3.1 Flora

Flora surveys were undertaken as part of the Flora and Fauna Assessment contained in **Appendix 1.**

As stated in Section 4.1.3 two vegetation assemblages were identified within the proposed activity area and are described as follows.

MU 3 Hillslope Talus Mountain Gum – Brown Stringybark – Grey gum – Broad-leaved Hickory Moist Forest

Plate 10 shows a representation of the above vegetation community.

Plate 10 MU 3 Hillslope Talus Mountain Gum – Brown Stringybark – Grey gum – Broad-leaved Hickory Moist Forest

Description:	Structurally this vegetation is a moderately tall forest, usually with an open shrub layer (although *Acacia falciformis* can dominate some sites). Similarly the ground layer can vary from sparse to well covered.
Canopy Layer:	12 to 30 m – 30% PFC. Dominated by *E. cypellocarpa* with *E. punctata* and *E. polyanthemos* also common.
Shrub Layer:	1 to 4 m – 2 to 25% PFC. The shrub layer varies from sparse to well developed (in more protected areas) and can include species characteristic of dry sites (e.g. *Acrotriche rigida*) and also species such as *Indigofera australis* that favour more moist sites
Ground Layer:	0 to 1 m – 30% PFC. A high diversity of herbs and forbs dominated the ground layer, *Pteridium esculentum* was dominant.
Classification:	This vegetation community is not commensurate with any Endangered Ecological Community listed under the TSC Act or EPBC Act.

MU 4 Sheltered Gully Brown Barrel Ferny Forest

Plate 11 displays the above vegetation community.

Plate 11 MU 4 Sheltered Gully Brown Barrel Ferny Forest

Description:	This vegetation is typically a very tall forest and can include a number of vegetation strata. Occurs in deep protected gullies.
Canopy Layer:	10 to 16 m – 20 to 30% PFC. Dominant species included: *E. fastigata* and/or *E. cypellocarpa.* There is frequently also a lower tree layer of species generally associated with depauperate rainforest or wet gullies (*Myrsine howittana*; *Elaeocarpus reticulatus*).
Shrub Layer:	2 to 4 m – 5 to 25% PFC. Dominant shrub species are ferns including large tree ferns and sometimes *Todea barbara*.
Ground Layer:	0 to 1.5 m – variable 40 to 80% PFC. Ferns and herb species that prefer moist sites dominate the ground layer, but some grass species (*Microlaena stipoides*; *Entolasia marginata*) also occur in the ground layer.
Classification:	This vegetation community is not commensurate with any Endangered Ecological Community listed under the TSC Act or EPBC Act.

None of the vegetation communities described above have been listed under the TSC Act 1995 or EPBC Act 1999. Additionally, proposed clearing within each vegetation community has been strategically positioned to be within previously cleared areas and/or adjacent to existing or disused tracks to limit vegetation disturbance. Where necessary, the drill rig will be guided around any trees or vegetation in order to access the proposed sites. This will further minimise the impacts to vegetation within these communities.

4.3.1.2 Significant Flora

A list of potentially occurring significant flora species from the locality (10km radius) and those that were deemed to have potential to occur within the sites due to habitat attributes, was compiled by the Flora and Fauna Assessment. The list included threatened species and ecological communities listed under the TSC Act 1995, along with those species listed on the EPBC Act 1999 and any other species deemed to be of local importance. Where suitable habitat for potentially occurring significant flora species was found on a site, targeted surveys were conducted.

No threatened flora were detected within any of the sites or associated access tracks.

4.3.2 Fauna

4.3.2.1 Fauna habitat

Habitat occurring at each of the proposed sites varied from dry sclerophyll, open forest habitat (sites ARP11, ARP13/ARP13SP ARP14 and ARP15/ARP15SP) to a more sheltered, wet sclerophyll forest habitat (site ARP12).

No hollows were detected within the sites, however hollows are likely to be prevalent in the immediate surrounding area. Suitable habitat occurs across forested areas for ground-dwelling mammals including the threatened Spotted-tailed Quoll (*Dasyurus maculatus*) as well as threatened woodland bird species including the Scarlet Robin (*Petroica boodang*), Varied Sittella (*Daphoenositta chrysoptera*) and Flame Robin (*Petroica phoenicea*). Common amphibians are likely to utilise the stream and associated habitats adjacent to ARP13 and ARP14, with potential for Red-crowned Toadlets to also occur.

4.3.2.2 Fauna species

No mammal species were recorded within the proposed sites, although it is most likely that the proposed sites represent part of the home range of a larger number of common mammal species.

There is potential for threatened mammal species to occur within the dense understory at sites ARP12 and ARP15/ARP15SP where the accumulation of forest debris and litter presents foraging and shelter opportunities for small mammals and their prey. A mature canopy and shrub layer at these sites also represents good foraging and sheltering habitat for arboreal mammal species and insectivorous bats. However this potential is diminished within the more open forest of sites ARP11, ARP13/ARP13SP and ARP14.

Bird species recorded within the vicinity of the proposed sites were limited to common woodland and forest species.

The wet sclerophyll forest at site 12 provides favoured summer habitat for the threatened Gang-gang Cockatoo (*Callocephalon fimbriatum*), whilst the forested areas at the remaining sites provide potential habitat for threatened woodland species including the Scarlet Robin (*Petroica boodang*) and Brown Treecreeper (*Climacteris picumnus victoriae*).

4.4 Description of Aboriginal cultural heritage values

An Aboriginal archaeological due diligence investigation was undertaken for the proposed activity in accordance with the Due Diligence Code of Practice for the protection of Aboriginal Objects in New South Wales 2010. The Aboriginal Due Diligence Assessment is contained in **Appendix 3**. This investigation included a desktop review of the environmental and archaeological contexts of the site and surrounding

area, a search of the Aboriginal Heritage Information Management Systems (AHIMS) database maintained by OEH and a visual inspection on 25 July and 28 August 2014 respectively.

The AHIMS revealed that Aboriginal site AHIMS#45-1-2765 (an artefact scatter) is approximately 20 metres to the northwest of proposed borehole location ARP11.

4.5 Native title claims, indigenous land use agreements and joint management arrangements

A search of the National Native Title Tribunal registers showed no applications or determinations of native title covering the proposed activity area. There are also no registered Indigenous Land Use Agreements or Joint Management arrangements over the proposed activity area.

4.6 Description of historic cultural or natural heritage values

Non-Indigenous heritage items and places are recorded in a number of ways including statutory and non-statutory registers. Federal designations include the National Heritage List and the Commonwealth Heritage List (CHL), both of which are maintained by the Department of Sustainability, Environment, Water, Population and Communities and are available to an online database, the Australian Heritage Database. Places of state significance are included on the State Heritage Register (SHR) maintained by the Heritage Branch and available on an online database, the NSW Heritage Inventory. Places of local significance are included in heritage schedules in local environmental plans (LEPs).

4.7 National Heritage

The National Heritage List is the lead statutory document for the protection of heritage places considered to have national importance. This list comprises Aboriginal, natural and historic places that are of outstanding national heritage significance to Australia. Listed places are protected under the EPBC Act.

A search of the National Heritage List undertaken on 3 October 2014 indicates that there is one item within the Lithgow LGA on the National Heritage List, being “The Greater Blue Mountains Area – Additional Values” as a place of national natural heritage. It includes the Wollemi, Blue Mountains, Yengo, Nattai, Kanangra-Boyd, Gardens of Stone and Thirlmere Lakes National Parks and the Jenolan Caves Karst Reserve. There are no items in the proposed activity area on the National Heritage List.

Previously the Register of the National Estate was the primary register for listing nationally significant heritage places. While the Register of the National Estate still exists in archival form, items can no longer be registered. Since February 2012 the Register no longer has statutory status. However, the Minister is still required to consider the Register when making some decisions under the EPBC Act. The Register of the National Estate was searched on 24 October 2012 and the results contain 11 heritage sites within the Lithgow LGA, however, no items are within the proposed activity area. The closest item on the Register of National Estate is the Bernina Private Cemetery located approximately three kilometres to the west of the proposed activity area.

4.8 State Heritage

Heritage items in NSW may be registered as significant at the state or local level. The Heritage Council has developed a set of seven criteria to help determine whether a heritage item is of State or local significance to the people of NSW. Items are assessed by the Heritage Council of NSW and if deemed eligible for listing i.e. are State significant, they are referred to the Minister for Heritage for Listing on the SHR, a statutory register of heritage items created by the NSW *Heritage Act 1977*.

Some heritage places and items that do not reach the threshold for listing on the State Heritage Register may be of heritage significance within a local government area. These places are listed by local council under their LEP and would be included on the NSW Heritage Inventory database.

The NSW Heritage Inventory database is maintained by the NSW Heritage Branch and lists items that have been identified as of State and local heritage value throughout NSW.

A search of the State Heritage Register on 3 October 2014 revealed no items of State Heritage Significance in the vicinity of the proposed activity area.

4.9 Section 170 Registers

Under s170 of the *Heritage Act 1977,* State Government Agencies are required to keep a list of heritage items maintained by that agency. These are known as s170 Registers. Searches of these registers were undertaken on 3 October 2014, with two items identified in the vicinity of the proposed activity area as identified in **Table 5**. The proposed activity will not impact on the heritage significance of the items listed below.

Table 5 Items on the s170 Register within the vicinity of the proposed activity area

Item	Address	Relevant Agency	Significance
Capertee Police Station	Mudgee Road, Captertee	NSW Police Service	State
Capertee Railway station	Capertee	Australian Rail Track Corporation	State

Source: State Heritage Inventory

4.10 Local Heritage

In relation to historic heritage, the proposed activity area is within the Project Application Area for the Airly Mine Extension Project. As part of the environmental assessment of the Airly Mine Extension Project a Cultural Heritage Impact Assessment was prepared (RPS, 2014). The Cultural Heritage Impact Assessment identified that the area subject of the Airly Mine Extension Project contains the Airly shale mining complex (37 items) and remnants of the Torbane processing site. The Airly shale mining complex sits wholly inside the Mugii Murum-ban State Conservation Area owned and managed by the NPWS. It is understood that NPWS is developing a Draft Plan of Management that Centennial Airly will comply with where relevant. The Torbane processing site is on Centennial Airly owned land.

The Cultural Heritage Impact Assessment noted that the Airly shale mining complex will be undermined using partial extraction mining methods, the mining occurs at depth resulting in a predicted level of between 0 and 10 millimetres of subsidence. As such, the Cultural Heritage Impact Assessment states there will be no impact on the remnant structures. The Torbane retorts area will not be undermined at all, thus ensuring no impact will occur at that location either. The installation of seven boreholes and a V-notch weir are in locations that do not contain identified historic items and therefore there are no known impacts arising from the construction of the boreholes and the V-notch weir.

5.0 Planning Context

5.1 Mining Act 1992

The objects of the *Mining Act 1992* (Mining Act) are:

- To recognise and foster the significant social and economic benefits to New South Wales that result from the efficient development of mineral resources, and
- To provide an integrated framework for the effective regulation of authorisations for prospecting and mining operations, and
- To provide a framework for compensation to landholders for loss or damage resulting from such operations, and
- To ensure an appropriate return to the State from mineral resources, and
- To require the payment of security to provide for the rehabilitation of mine sites, and
- To ensure effective rehabilitation of disturbed land and water, and
- To ensure mineral resources are identified and developed in ways that minimise impacts on the environment.'

The proposed activity will be undertaken within A232 granted under the Mining Act. The proposed activity falls under Category 3. This is because the activity will involve non-intensive drilling involving no more than moderate site preparation and is within or adjacent to a Sensitive Area (Mugii Murum-ban SCA).

Condition 2 of A232 states that prospecting operations listed as categories 2 or 3 or surface disturbing prospecting operations not listed in categories 1, 2 or 3 require prior notification on a Surface Disturbance Notice form to DTIRIS. Approval by DTIRIS requires assessment and determination under Part 5 of the EP&A Act. For Category 3 activities an REF must be prepared and must accompany the Surface Disturbance Notice. An REF is to be prepared in accordance with DTIRIS guidelines.

Other conditions specified in A232 include those relating to the preparation of Environmental Management Plans, heritage, flora and fauna, water, drilling methodology and rehabilitation. The proposed activities will need to comply with the conditions of A232.

Under clause 140, the holder of a prospecting title must not carry out prospecting operations except in accordance with an access arrangement to be agreed in writing between the title holder and each landholder. The landholder is the NPWS and whilst NPWS has been notified of the proposed activity access arrangements agreed in writing will be obtained by Centennial Airly prior to the commencement of activities.

5.2 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) provides the legislation relating to planning and development in NSW. Development is assessed under Part 5 if the relevant environmental instruments provide that the development does not require development consent and is not exempt development and the development is either carried out by a determining authority or requires the approval of the determining authority. Under Part 5, Clause 111 – Duty to consider environmental impact, '*a determining authority in its consideration of an activity shall, notwithstanding any other provisions of this Act or the provisions of any other Act or of any instrument made under this or any other Act, examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity*.'

Additionally, Clause 228 of the *Environmental Planning and Assessment Regulation 2000* provides details of supplementary factors that must be taken into account concerning the impact of an activity on the environment. These include specific or general guidelines for the activity or if no guidelines exist, the Regulation lists a general set of factors to consider. Clause 228 factors are addressed in Section 7.2 of this REF.

The proposed activity falls within the Lithgow LGA. The site is zoned rural 1 (a) under the *Lithgow Local Environmental Plan 1994* as discussed further in Section 5.13 of this REF. The proposed activity is permissible with development consent under the LEP however the Mining SEPP removes the requirement for development consent from the LGA. Clause 6 of the Mining SEPP provides that development for the purposes of mineral exploration may be carried out without development consent. This has the effect that the proposed activity is required to be assessed under Part 5 of the EP&A Act.

A determining authority, for the purposes of this activity, is defined in Part 5 to include a public authority whose approval is required before an activity may be carried out. The Department of Trade and Investment, Regional Infrastructure and Services is the determining authority for the proposed activity for the purposes of Part 5 of the EP&A Act.

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

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

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

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

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

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

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

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

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

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

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

This REF has been prepared to assist the determining authority in meeting the obligations of Section 111 of the EP&A Act. The proposed activity is not likely to significantly affect the environment or threatened species, populations or ecological communities or their habitats.

5.3 State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

The Mining SEPP applies to the proposed activity. In recognition of the importance to NSW of mining, petroleum production and extractive industries, the Mining SEPP aims to:

- Provide for the proper management and development of mineral, petroleum and extractive material resources for the purpose of promoting the social and economic welfare of the State, and
- Facilitate the orderly and economic use and development of land containing mineral, petroleum and extractive material resources, and
- To establish appropriate planning controls to encourage ecologically sustainable development through the environmental assessment, and sustainable management, of development of mineral, petroleum and extractive material resources.

As referred to in Section 5.2, Clause 6 of the Mining SEPP provides that development for the purposes of mineral exploration may be carried out without development consent.

Clause 10 of the Mining SEPP lists development that is exempt from approval under the EP&A Act.

Clause 10(1) applies to development that is on land that:

(a) is not within an environmentally sensitive area of State significance, or

(b) is within a state conservation area but is not land referred to in paragraphs (a)–(e) or (g)–(i) of the definition of environmentally sensitive area of State significance.

None of the land subject to the activity is land that is referred to in the above paragraphs and therefore the proposed activity meets this criterion for exempt development.

Clause 10(2) states:

Development for any of the following purposes is exempt development if it is of minimal environmental impact:

(a) the construction, maintenance and use of equipment for the monitoring of weather, noise, air, groundwater or subsidence

(b) *low intensity activities associated with mineral exploration or petroleum exploration, including the following:*

i geological mapping and airbourne surveying

ii sampling and coring using hand-held equipment

iii geophysical (but not seismic) surveying and downhole logging

iv accessing of areas by vehicle that does not involve the construction of an access way such as a track or road.

The activity which comprises drilling seven boreholes with a hydraulic drill and constructing a V-notch weir is not considered to meet the definition of exempt development under the provisions of the Mining SEPP 2007. Therefore, it is not exempt for approval under the EP&A Act.

5.4 State Environmental Planning Policy (State and Regional Development) 2011

Under the State and Regional Development SEPP, development is considered to be State significant development under the EP&A Act if:

(a) The development on the land concerned is, by the operation of an environmental planning instrument, not permissible without development consent under Part 4 of the Act, and

(b) The development is specified in Schedule 1 or 2.

Schedule 1 identifies the types of projects that are State Significant Development (SSD). This includes Mining (Schedule 1, 5):

(1) Development for the purpose of mining that:

a. Is coal or mineral sands mining, or

b. Is in an environmentally sensitive area of State significance, or

c. Has a capital investment value of more than $30 million.

(2) Extracting a bulk sample as part of resource appraisal of more than 20,000 tonnes of coal or any mineral ore.

(3) Development for the purpose of mining related works (including primary processing plants or facilities for storage, loading or transporting any mineral, ore or waste material) that:

a. Is ancillary to or an extension of another State significant development project, or

b. Has a capital investment value of more than $30 million.

(4) Development for the purpose of underground coal gasification.

The Mining SEPP provides that development for the purpose of mineral exploration may be carried out without development consent. In Schedule 1 of the State and Regional Development SEPP, in relation to (1), the proposed activity comprises exploration and groundwater monitoring only and does not constitute 'development for the purpose of mining'. In relation to (2), less than 20,000 tonnes of coal will be extracted

during the exploration. In relation to (3), the proposed activity does not constitute development for the purpose of mining related works that is ancillary to another State significant development or has a capital investment value of more than $30 million. Based upon these criteria the proposed activity is not SSD.

5.5 Environmental Protection and Biodiversity Conservation Act 1999

The EPBC Act identifies Matters of National Environmental Significance (MNES) and contains schedules of threatened species and Ecologically Endangered Communities (EECs) to which it affords protection. The EPBC Act requires the Commonwealth Minister for the Environment to approve actions which may have an impact on matters of national environmental significance. MNES include:

- World heritage areas;
- National heritage places;
- Wetlands of national importance;
- Commonwealth listed threatened species;
- Commonwealth listed migratory birds;
- Commonwealth marine area;
- Commonwealth land;
- Nuclear actions; and
- A water resource, in relation to coal seam gas development and large coal mining development.

MNES may be referred to the Department of Environment (DoE) by a proponent for consideration if any threatened species or EECs are potentially going to be impacted by the proposed activity. Impacts constituting a controlled action upon any MNES that have not been referred to DoE may be referred by a third party and may be subject to prosecution where the proposed action has not been previously assessed by DOE.

An EPBC Act protected matters search has been undertaken and the results are reported in Section 6 of this REF.

An assessment of MNES is provided in the Flora and Fauna Assessment contained in **Appendix 1**. The proposed activity is not expected to have any significant impact on any MNES provided the mitigation measures set out in Section 6 and the Flora and Fauna assessment contained in **Appendix 1** are implemented. Therefore a referral under the provisions of the EPBC Act is not necessary for this proposal.

5.6 Threatened Species Conservation Act 1995 and Fisheries Management Act 1994

The TSC Act and *Fisheries Management Act 1994* are NSW environmental legislative instruments that contain schedules of species and EECs, which are afforded threatened status and require consideration with regard to possible impacts as a consequence of a proposed action. Under the current legislative requirements of Section 5A of the EP&A Act each threatened species or EEC that may be affected by a proposed action is subject to the seven-part test of significance.

A Flora and Fauna Assessment has been undertaken for the proposed activity and is contained in **Appendix 1**. The Flora and Fauna Assessment included consideration of 5 metre wide potential area of impact along all existing tracks and all disused access tracks proposed for use. Following consideration of the survey results, available habitat and the minimal required vegetation removal, 14 threatened fauna species were

considered to have potential to be impact upon. These species were afforded further consideration via Section 5A of the EP&A Act 1979 (Seven-Part Test of Significance). The results of this assessment found that the threatened species considered are unlikely to be significantly impacted upon by the proposed works. Additionally, assessment of Matters of National Environmental Significance found that no impacts are expected under the EPBC Act.

5.7 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) aims to protect and reduce degradation of the environment. The POEO Act examines issues such as air quality, pollution, waste, water quality and noise. The Act also prescribes 'activities' in which a license must be issued by OEH. These 'activities' include certain size industrial, mining and agricultural developments.

Clause 5 and Schedule 1 of the POEO Act pertain to works that are identified as 'scheduled activity'. The proposed works and monitoring is not identified as a 'scheduled activity' and therefore the proposal does not require an environmental protection license.

Due to the small areas to be disturbed within the proposed works areas, as well as the low level of disturbance to habitats, the proposed works are considered highly unlikely to result in adverse impacts upon locally occurring threatened species or communities.

5.8 National Parks & Wildlife Act 1974

Aboriginal heritage (places, sites and objects) within NSW are protected by the NP&W Act. Although there are other Acts protecting and managing cultural heritage in NSW, the due diligence procedure is only available to projects applicable under this Act. Further detail is provided in the Aboriginal Due Diligence Assessment contained in **Appendix 3**.

One of the benefits of the due diligence provisions are that they provide a simplified process for investigating the Aboriginal archaeological context of an area without the need for an Aboriginal Heritage Impact Permit (AHIP). Aboriginal consultation is also not required for an investigation under due diligence. However, if the due diligence investigation shows that the activities proposed for the area are likely to harm objects or likely objects within the landscape, then an AHIP will be required with full consultation.

There are nine Aboriginal sites in the vicinity of the proposed boreholes with one location occurring 20m from a proposed borehole location. In order to limit potential impact on these and any unknown Aboriginal sites or objects, mitigation measures are identified by the Aboriginal Due Diligence Assessment.

For those sites located within an SCA, approval from OEH is required. This REF will be provided to the authority as supporting documentation to the Determination Notice.

Section 30G of the NP&W Act sets out management principles in relation to an SCA and sub clause (2)(c) provides for the undertaking of uses permitted under other provisions of the NP&W Act including mining permitted under Section 47J.

Section 47J, together with Section 47H provide for the existing mining interests subject to A232 which predates the declaration of this land as an SCA in March 2011.

5.9 Heritage Act 1977

The *Heritage Act 1997* main objective is to conserve the environmental heritage of the State of NSW. "Environmental heritage" is defined to include places, buildings, works, artefacts, moveable objects, and

precincts, of State or local heritage significance. Under the Act, it is an offence to disturb an item of heritage significance without the consent of the Heritage Council.

There are no items of environmental heritage within the vicinity of the proposed activity and the proposal will therefore have no environmental heritage impact.

5.10 Water Act 1912 and Water Management Act 2000

The *Water Act 1912* (Water Act) and WMA are the key pieces of legislation regulating access and impacts to surface and groundwater resources in NSW. Where a water sharing plan is in place, the WMA governs the issuing of water access licences (WALs) and water management and activity approvals. The following Water Sharing Plans under the WMA applicable to the proposed activity area are:

- Water Sharing Plan for Greater metropolitan region unregulated river water sources.
- Water Sharing Plan for Greater metropolitan region groundwater sources.

Under part 5 of the Water Act, a monitoring bore license application will need to be lodged with the NSW Office of Water prior to the commencement of drilling.

Section 91 of the WMA details the requirements for controlled activity approval to carry out work on waterfront land, which includes the bed of any river, lake or estuary and any land within 40 m of its high water mark. Clause 39 of the Water Management (General) Regulation 2011 exempt activities carried out in accordance with any lease or licence under the Mining Act 1992. Thus, controlled activity approvals will not be required for the drilling and construction of the proposed boreholes. However, it remains an offence to harm waterfront land when carrying out an exempt controlled activity.

5.11 Aquifer Interference Policy

Under the recent Aquifer Interference Policy (NOW, 2012), the drilling of monitoring bores and wells that are required by a development consent under Part 4 or an approval under Part 5.1 of the EP&A Act are defined as minimal impact aquifer interference activities and do not require licensing. This assumes that the boreholes are constructed and decommissioned in accordance with standards equivalent to the Minimum Construction Requirements for Water Bores in Australia. Specific details are required to be recorded and provided on request by NOW.

Stage 1 of the Aquifer Interference Regulation commenced on 30 June 2011 and specifies the requirement to hold a WAL if more than 3 ML per year of water is taken during coal exploration. Clause 18 of the Water Management (General) Regulation 2011 exempt certain activities from the requirement of a WAL, including the taking of water for prospecting or fossicking activities approved under the Mining Act 1992 up to a maximum of 3 ML per year of water.

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

SEPP 44 aims '*to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline'*.

The proposed activity area is located within Greater Lithgow LGA which is listed within Schedule 1 of SEPP 44 – 'Koala Habitat Protection'. Therefore SEPP 44 applies to the land.

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

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

Core koala habitat is defined as:

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

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

Schedule 2 of SEPP 44 lists ten tree species that are considered indicators of 'Potential Koala Habitat'. The presence of any of the species listed on a site proposed for development triggers the requirement for an assessment for 'Potential Koala Habitat'.

The Flora and Fauna assessment contained in **Appendix 1** states that all sites are within the Mugii Murum-ban State Conservation Area. SEPP 44 does not apply to lands reserved under the *National Parks and Wildlife Act 1974* of which the Mugii Murum-ban State Conservation Area falls within. Therefore, SEPP 44 is not applicable.

5.13 Zoning

Whilst the land subject of the proposed activity is contained within a State Conservation Area it is also zoned Rural 1(a) under the Lithgow LEP 1994. The objectives of zone are as follows:

To promote the proper management and utilisation of natural resources by:

(a) protecting, enhancing and conserving;

- *i. Rural land, in particular prime crop and pasture land, in a manner which sustains its efficient and effective agricultural production potential;*
- *ii. Soil, by controlling and locating development in accordance with soil capability;*
- *iii. Forests of existing and potential commercial value for timber production;*
- *iv. Valuable deposits of minerals, coal and extractive materials, by controlling the location of development for other purposes in order to ensure the efficient extraction of those deposits;*
- *v. Trees and other environmentally sensitive areas, where the conservation of the vegetation is significant for scenic amenity or natural wildlife habitat or is likely to control land degradation;*
- *vi. Water resources for use in the public interest, preventing the pollution of water supply catchment and major water storages;*
- *vii. Localities of significance for nature conservation, including places with rare plants, wetlands and significant wildlife habitat; and*
- *viii. Items of heritage significance.*

(b) preventing the unjustified development of prime crop and pasture land for purposes other than agriculture;

(c) Facilitating farm adjustments;

(d) Minimising the cost to the community of:

- *i. Fragmented and isolated development of rural land; and*
- *ii. Providing, extending and maintaining public amenities and services;*

(e) Providing land for other non-agricultural purposes, in accordance with the need for that development; and

(f) Providing for the separation of conflicting land uses.

Whilst under the Mining SEPP, the LEP does not apply to the proposed activity, consideration has been given to the zoning under the LEP. The siting of the boreholes and identified mitigation measures will minimise impacts to soil, trees, vegetation, water resources, nature conservation and heritage.

5.14 Licenses and Approvals Required

This REF has been prepared to assess the potential impacts of the proposed activity to address the requirements of Part 5 of the EP&A Act and assist DTIRIS in their consideration of the proposal's compliance with the conditions of A232.

This REF will also be provided as supporting documentation to the Determination Notice required under the NP&W Act as the proposed activity area is within Mugii Murum-ban SCA and a Surface Disturbance Notice form under Condition 2 of A232.

A monitoring bore licence is required under the *Water Act 1912* as discussed in Section 5.10. Appropriate water licensing for the extraction of water will also need to be obtained by Centennial Airly prior to any water extraction.

Under the Mining Act, access arrangements agreed in writing with the NPWS will be obtained by Centennial Airly prior to the commencement of activities.

6.0 Impact Assessment

6.1 Introduction

This section of the REF addresses the potential environmental impacts from the proposed activity and identifies mitigation measures. It addresses the types of impacts identified in the ESG2 guidelines and categorises them, by taking into account the guidance, as follows:

- Negligible
- Low adverse
- Medium adverse
- High adverse
- Positive

6.2 Assessment of physical and chemical impacts

6.2.1 Is the proposed activity likely to impact on soil quality or soil stability?

6.2.1.1 Potential impacts

During the establishment of the borehole compounds, the upgrading of the existing tracks and re-opening of disused access tracks there is potential for adverse impacts to the soil resources due to:

- Soil erosion.
- Chemical spills (such as diesel spill during refuelling plant).
- Soil removal.
- Soil profile inversion.
- Soil compaction.

Some of the existing tracks within the activity area are located on steeper land. Soils may be exposed within the areas of ground disturbance that could lead to erosion from wind. Bare soil allows the velocity of run-off waters to increase also leading to erosion. Given the small area of disturbance and the commitment to best management practises (such as the Erosion and Sediment Controls - A Field Guide for Erosion and Sediment Control Maintenance Practices on Unsealed Roads (OEH / NSW NPWS April 2010).the impacts are likely to be negligible.

Fuels and oil will be used during the proposed activity. Any drilling muds used will be biodegradable to avoid the risk of soil (and water) contamination. Mitigation measures to minimise and manage the risk of spills are identified further within this REF.

Soil will be removed during excavations and measures to ensure its re-use for rehabilitation. Soil profile inversion and soil compaction may occur as a result of the proposed activity.

The risk of adverse impact to the soil resource is considered low with the implementation of standard construction site environmental and engineering controls which are identified in Section 6.2.1.2.

6.2.1.2 Mitigation

Mitigation measures involving the employment of good drilling practises in accordance with *Construction Requirements for Water Bores in Australia (ADIA, 2012)* are identified in Section 6.2.2.2. In addition, the following measures are identified:

- Excess soil generated during site preparation activities will be stockpiled at each borehole compound and used as backfill for rehabilitation.
- No soil will be removed from the proposed activity area unless it is contaminated in which case it will be taken to a suitably licensed waste facility.
- Erosion and sediment controls will be implemented where necessary during site preparation, including the borehole compounds and track upgrades, in accordance with best management practises (such as the Erosion and Sediment Controls - A Field Guide for Erosion and Sediment Control Maintenance Practices on Unsealed Roads (OEH / NSW NPWS April 2010).
- The quantity of chemicals, fuels and oils stored at the proposed activity area will be minimised where practicable.
- All chemicals, fuels and oils stored at the proposed activity area will be kept in appropriately secured, bunded storage in accordance with the relevant Materials Safety Data Sheets (MSDS).
- An MSDS register of all chemicals used or stored at the proposed activity area will be maintained.
- Maintenance of vehicles, plant and equipment will occur off site at an appropriately licensed facility unless considered appropriate to conduct such maintenance at the drill site.
- A spill kit will be provided and site workers/contractors trained in its use. Any spills or leaks will be contained and cleaned up immediately using the spill kit. Contaminated material such as soil or absorbent materials will be placed in a bag and removed from the proposed activity area for disposal at a suitably licensed waste facility.
- Plant and equipment will be maintained and inspected on a daily basis.
- Drilling fluids will be contained in above ground tanks that have overflow capacity in case of heavy rain. These will be inspected regularly and maintained.
- All chemicals, fuels and oils will be removed at the completion of drilling.
- Disturbed areas will be rehabilitated in accordance with condition 27 of A232. Partial rehabilitation will be undertaken following drilling and once the geotechnical testing has been undertaken and full rehabilitation once the groundwater monitoring bores have completed their useful life.

6.2.1.3 Potential impact category

With the implementation of the mitigation measures identified, potential impacts are likely to be negligible to low adverse.

6.2.2 Is the activity likely to affect a waterbody, watercourse or wetland or natural drainage system?

A Water Impact Assessment for the proposed activity has been undertaken by GHD. The full report is provided in **Appendix 2**. A summary of the potential impacts and the specific mitigation measures from the Water Impact Assessment is provided in Section 6.2.2.1 and Section 6.2.2.2.

6.2.2.1 Potential impacts

Due to the localised nature and duration of the drilling and borehole construction works, it is expected that mitigation measures to be implemented will prevent any significant impacts on surface water and groundwater sources.

In relation to surface water sources all proposed drilling sites are in close proximity to watercourses associated with Gap Creek or Genowlan Creek. Potential impacts of the construction and operation of the boreholes on these surface water sources are as follows:

- Contamination of surface water sources due to fuel, oil or chemical spills;
- Soil erosion from disturbed areas (i.e. drill sites and new tracks) and sedimentation of surface water sources;
- Contamination of surface water sources due to the discharge of recirculating drilling water;
- Temporary changes to catchment flows due to the placement of the work pad; and
- Temporary reduction in flows in Genowlan Creek due to extraction to supply water for drilling.

In relation to groundwater sources potential impacts of the construction and operation of the boreholes on groundwater sources are as follows:

- Contamination of aquifers from the introduced water supply, drilling chemicals or surface water runoff directly entering the borehole;
- Cross-contamination of aquifers through vertical connection between aquifers of different head or groundwater quality;
- Contamination of aquifers from contaminated drilling rods; and
- Localised depressurisation of alluvial aquifers and/or porous and fractured rock groundwater sources.

6.2.2.2 Mitigation measures

Specific mitigation measures to address the potential impacts identified in the previous section are as follows.

Surface water sources

In relation to contamination of surface water sources due to fuel, oil or chemical spills:

- All required chemicals, fuels and other materials will be stored and managed appropriately in bunded areas;
- Refuelling activities will be undertaken off site where possible;
- All vehicles and plant will be checked for leaks prior to coming on site;
- Appropriate spill kits will be available on site at all times with personnel appropriately trained in the use of spill kits;
- All waste and unwanted materials will be removed off site at the completion of works to prevent uncontrolled discharges during rainfall events. Waste will be managed and disposed in accordance with the requirements of state and local authorities; and
- MSDS and manufacturer's recommendations will be available on the drill site for all drilling fluid products used. These will list instructions for handling, use, potential hazards and any disposal requirements for the product or container.

In relation to soil erosion from disturbed areas (i.e. drill sites and new tracks) and sedimentation of surface water sources:

- Erosion and sediment control measures will be installed as necessary prior to the commencement of any earthworks, including construction of new access tracks and drill sites. Measures will be consistent with the principles set out in Erosion and Sediment Controls - A Field Guide for Erosion and Sediment Control Maintenance Practices on Unsealed Roads (OEH / NSW NPWS April 2010).;
- Sediment and erosion control measures will be routinely inspected and maintained appropriately;
- Steep gradients will be avoided for access tracks and drill sites where possible in the vicinity of surface water sources;
- Sediment fences will be installed to prevent soil erosion and sediment laden runoff from areas where earthworks have been undertaken. Sediment fences will be removed by Centennial Airly once disturbed areas are restored as close as practical to pre-drilling conditions;
- The areas to be disturbed will be minimised and exposed areas covered to provide a stable surface where possible;
- Clean catchment runoff will be diverted around the disturbed areas by the use of diversion drains, sand bags, sediment fences and other control measures to direct water into natural bushland areas;
- Drilling and construction operations will be limited to dry weather conditions as far as practical;
- Vehicle and machinery movement will be confined to clearly defined access routes, tracks and work areas and
- At the completion of construction, all disturbed areas will be restored as close as practical to its pre-drilling conditions, including pre-drilling drainage patterns.

In relation to contamination of surface water sources due to the discharge of recirculating drilling water:

- All waste and unwanted materials, including drill cuttings, drilling water and mud, purged groundwater and other materials, will be contained on site in appropriately sized above-ground storage containers.
- Storage containers and pipelines will be routinely inspected and maintained appropriately. Storage containers will be covered overnight in case of rainfall.
- Steep gradients will be avoided for drill sites where possible in the vicinity of surface water sources.
- Drilling and construction operations will be limited to dry weather conditions as far as practical.
- All waste and unwanted materials will be removed off site at the completion of works to prevent uncontrolled discharges during rainfall events. Waste will be managed and disposed in accordance with the requirements of state and local authorities.

In relation to temporary changes to catchment flows due to the placement of the work pad:

- Steep gradients will be avoided for clean water runoff diversions where possible.
- Drilling and construction operations will be limited to dry weather conditions as far as practical.
- The areas to be disturbed will be minimised and exposed areas covered to provide a stable surface where possible.
- At the completion of construction, all disturbed areas will be restored as close as practical to its pre-drilling conditions, including pre-drilling drainage patterns.

In relation to temporary reduction in flows in Genowlan Creek due to extraction to supply water for drilling:

- Avoid oversupply of water for drilling activities and maximise the use of recirculated drilling water.

Groundwater sources

In relation to contamination of aquifers from the introduced water supply, drilling chemicals or surface water runoff directly entering the borehole:

- Drilling and bore construction will be undertaken in accordance with the *Minimum Construction Requirements for Water Bores in Australia (ADIA, 2012).*
- Only non-toxic, biodegradable drilling mud or fluid additives will be used.
- All bores will be positioned so that the headworks can be protected from frequent flooding and surface water drainage.
- The bores will be sealed appropriately to ground surface to prevent the ingress of surface water into the bore.

In relation to cross-contamination of aquifers through vertical connection between aquifers of different head or groundwater quality:

- Drilling and bore construction will be undertaken in accordance with the *Minimum Construction Requirements for Water Bores in Australia (ADIA, 2012).*
- Bores will be constructed by a NSW licensed water bore driller.
- All bores will be appropriately sealed to protect groundwater sources against contamination. In bores that intercept multiple groundwater sources, there will also be a seal (bentonite and/or cement) between the aquifers and permeable zones to prevent intermixing, flow and contamination.

In relation to contamination of aquifers from contaminated drilling rods:

- Drilling and bore construction will be undertaken in accordance with the *Minimum Construction Requirements for Water Bores in Australia (ADIA, 2012).*
- Bores will be constructed by a NSW licensed water bore driller.
- The driller will verify that the drilling rods are clean prior to use.

In relation to localised depressurisation of alluvial aquifers and/or porous and fractured rock groundwater sources:

- Solid casing will be installed into the borehole, or the hole will be grouted, as soon as possible after drilling to minimise groundwater inflows into the hole.

With the implementation of the mitigation measures identified, potential impacts are likely to be negligible to low adverse due to the minor residual risk of seepage of drilling fluids or hydrocarbons.

6.2.3 Is the activity likely to affect coastal processes and coastal hazards, including those under projected climate change conditions?

The proposed activity area is not near the coast or likely to affect coastal processes.

6.2.4 Does the proposed activity involve the use, storage or transport of hazardous substances or the use or generation of chemicals which may build up residues in the environment?

6.2.4.1 Potential impacts

Chemicals (such as oils and lubricants) and hazardous substances may be used and stored at the borehole compounds during drilling activities and transported to and from the proposed activity area.

6.2.4.2 Mitigation measures

Mitigation measures comprising the management of chemicals, hydrocarbons and other hazardous substances are addressed in Section 6.2.1.2 in addition:

- Chemicals and potentially hazardous substances will be used and stored according to regulatory requirements including the *Work Health and Safety Act 2011*.
- Any dangerous goods will be transported according to regulatory requirements under the *Dangerous Goods (Road and Rail Transport) Act 2008*.

6.2.4.3 Potential impact category

With the implementation of the mitigation measures identified, potential impacts are likely to be negligible to low adverse.

6.2.5 Does the activity involve the generation or disposal of gaseous, liquid or solid wastes or emissions?

6.2.5.1 Potential impacts

The following waste streams may be generated by the proposed activities:

- Materials from the upgrading of tracks.
- Vegetation.
- Drilling mud (biodegradable).
- Chemical, fuels and oil containers.
- General site waste such as packaging materials.
- Domestic wastes.
- Contaminated soil and materials (such as soil that has been subject to a spill and any absorbent materials used for a spill).

Potential impacts associated with the generation and disposal of these wastes include:

- Odours caused by improper storage or treatment of putrescibles waste.
- Leaching of pollutants into groundwater, surface water and soil.
- Pollution or contamination of water or land due to illegal dumping of waste and/or a lack of suitable containment of waste.
- Littering of the area due to a lack of suitable containment of waste.

Emissions of dust and greenhouse gases are addressed in Section 6.2.6.

6.2.5.2 Mitigation measures

- Drill cuttings will be tested for their suitability for reuse on site for rehabilitation. Testing will be in accordance with Australian Standard 1141 Methods of Sampling and Testing Aggregates. Drill cuttings that qualify as excavated natural material will be reused on site for rehabilitation. Those that exceed the limits set by the excavated material exemption will be transported and disposed of at an appropriately licensed waste management facility.
- The management of waste, including its transport will comply with the POEO Act and POEO (Waste) Regulation.
- Appropriate waste receptacles will be provided at the borehole compounds and track upgrading areas for

the disposal of domestic wastes.

- Waste materials will be separated, classified and managed in accordance with the Waste Classification Guidelines Part 1: Classifying Waste (DECCW 2009).
- All wastes will be removed from the borehole compounds and the track upgrading areas at the completion of drilling for disposal at an appropriately licensed waste management facility.
- All staff and contractors will be made aware of waste management procedures.
- Chemical, fuel and oil containers will be managed according to the MSDS or manufacturers' directions to avoid potential impacts to the environment or human health.

6.2.5.3 Potential impact category

With the implementation of the mitigation measures identified, potential impacts are likely to be negligible to low adverse.

6.2.6 Will the activity involve the emission of dust, odours, noise, vibration, or radiation in the proximity of residential/urban areas or other sensitive locations?

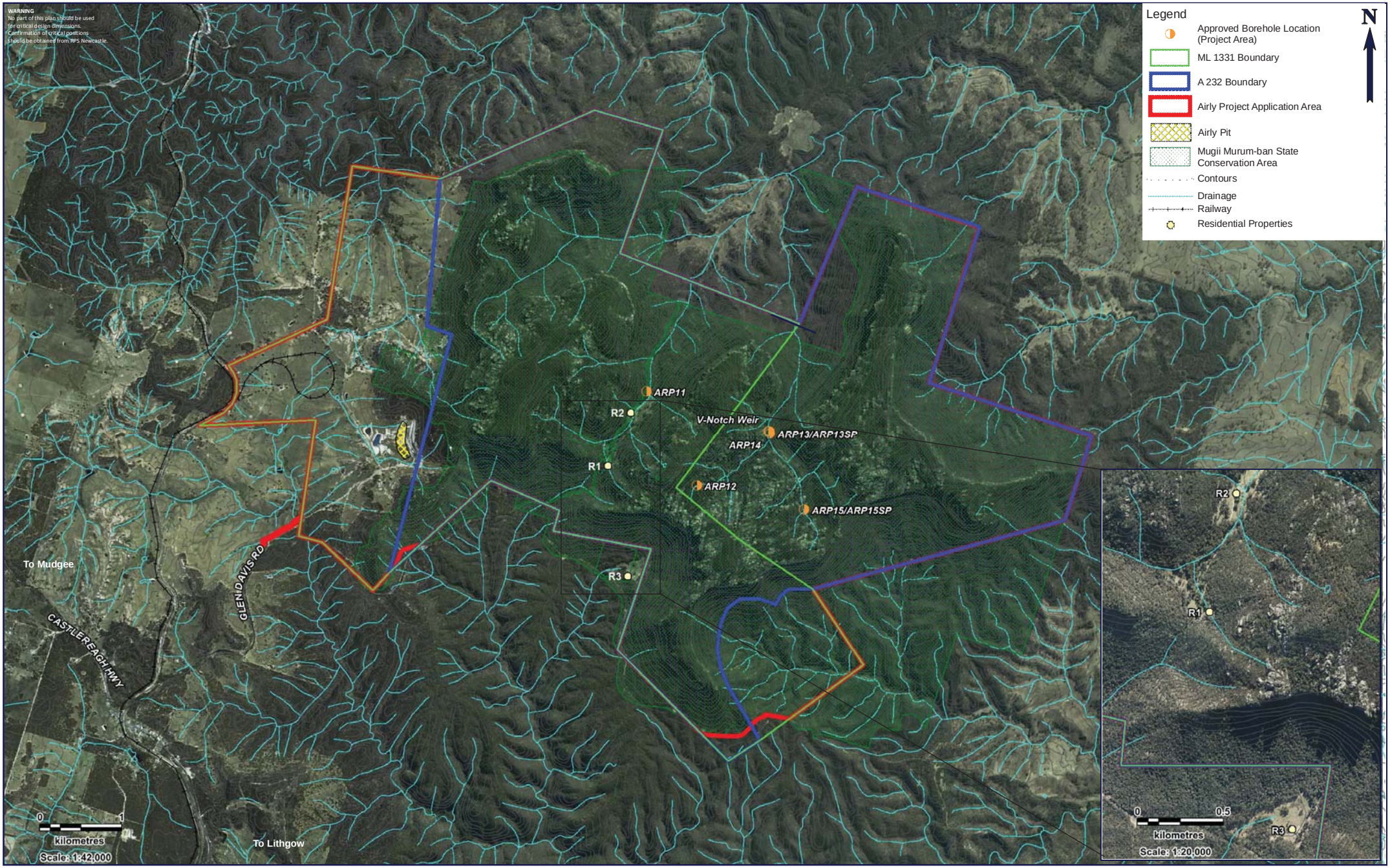
6.2.6.1 Potential air impacts

There are three residential properties within proximity of the proposed activity area as shown on **Figure 5**. The property shown as R1 is privately owned and is approximately 890m away from ARP11, whilst R2 is approximately 450m away from this borehole. Property R3 is approximately 1 km from ARP12.

The proposed activities may generate dust from site preparation activities, drilling and from vehicles driving along the tracks. This has potential to affect residential properties and the values of the SCA. Dust emissions to residential properties are anticipated to be negligible due to the area of ground disturbance, the distance and the intervening vegetation. Dust emissions within the SCA may enter watercourses or affect those using the immediate area for recreation.

Emissions to air from vehicle and equipment exhausts include fine particulates, carbon monoxide, oxides of nitrogen, carbon dioxide and hydrocarbons. Due to the distance to sensitive receptors and the small scale of the works such emissions are likely to be negligible.

Exhausts from plant and machinery comprise potential Scope 1 (direct) greenhouse gas emissions. Given the small scale of the emissions and the temporary timescale impacts on State or National greenhouse gas levels are likely to be negligible.



TITLE: Figure 5: Location of Nearest Residential Properties

LOCATION: Airly

DATUM: (GDA 94)
PROJECTION: MGA Zone 56

DATE: 19/04/2016
PURPOSE: REF

LAYOUT REF: J:\JOBS\Centennial\All Jobs\123266 Airly Boreholes REF\10 - Drafting\MapInfo Workspace\Planning
VERSION (PLAN BY): B A3 (RD-NW)

CLIENT: Centennial Coal
JOB REF: 123266

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au

Gas levels are monitored at Airly Mine and the coal seam in the area is not known to be particularly gassy. In the event that any odour is released during construction of the boreholes, this may be noticeable in the immediate vicinity although vegetation is likely to act as a buffer, reducing win speeds and therefore dispersal. Condition 23, b, ii of A232 required that if any drill hole meets natural or noxious gases it must be plugged or sealed to prevent their escape and this is identified as a mitigation measures in Section 6.2.6.3.

6.2.6.2 Potential noise impacts

The site preparation and drilling activities would generate noise. The noise limit criteria for the type of rig anticipated to be used, a hydraulic drill rig, Hanjin D&B – 35 Multi, is 80dB or less. The noise from drilling would occur for up to four weeks at boreholes ARP13 and ARP15 and for approximately two days at each of the borehole compounds ARP11, ARP12, ARP13SP, ARP14 and ARP15SP plus some noise associated with site preparation and track upgrading within a total duration of approximately three months. Works would be undertaken between the hours of 7.00am to 6.00pm Monday to Friday and Saturday 8.00 am to 1 pm.

As stated above, there are three residential properties, within proximity of the proposed activity area that maybe affected by noise particularly during the two weeks of drilling at each of the borehole compounds nearest those properties (ARP11 and ARP12). There would also be noise from vehicles passing R3. Impacts to the three residential properties, two of which are owned by Centennial, would be transient, as the proposed activities move to the different borehole compounds, short term and managed with the measures identified in section 6.2.6.3. It is also noted that residence R2, which is a holiday residence, is approximately 450 m away from borehole ARP 11.

There may also be recreational uses of the Mugii Murum-ban SCA in the vicinity of the proposed activity. Noise impacts to those using the immediate area for recreation would be transient and short term and managed with the measures identified in section 6.2.6.3.

The proposed activity will be during recommended standard hours, as outlined in the NSW Industrial Noise Policy.

6.2.6.3 Mitigation measures

Mitigation measures for air quality are as follows:

- Dust generated during site preparation, drilling and rehabilitation will be suppressed by spraying water at each borehole compound if required.
- Land disturbance areas will be minimised.
- Vehicles, plant and machinery will be regularly maintained to ensure they are in good working condition and will be turned off when not in use.
- In the event that any drill hole meets natural or noxious gases it will be plugged or sealed to prevent their escape.

Mitigation measures for noise are as follows:

- The three residential properties will be notified of the works at least two weeks prior to the commencement of works. Information such as the type of activities likely to occur and the timing of such activities will be provided to potentially affected residences as well as contact details of a Centennial Airly and/or drilling contractor representative.
- All feasible and reasonable work practices will be applied where practicable to minimise noise levels. These will include construction of temporary noise barrier near ARP11 (if practical), orientation of the drill-rig in such a way that the “high-noise” side is directed away from the noise sensitive receivers and education of operators with regard to potential noise issues and encourage the implementation of quiet work practises.

- In the event of a noise complaint, the effectiveness of noise mitigation measures will be assessed and additional feasible and reasonable measures will be implemented where necessary.
- Signage will be installed at the works areas during the construction of the boreholes including contact details for complaints.

6.2.6.4 Potential impact category

With the implementation of the mitigation measures identified, potential impacts associated with air quality are likely to be negligible to low adverse and those for noise are likely to be low to medium adverse.

6.3 Assessment of biological impacts

6.3.1 Is any vegetation to be cleared or modified (including vegetation of conservation significance)? Is the activity likely to have a significant effect on threatened flora or fauna species, populations, or their habitats, or critical habitat or an endangered ecological community or its habitat?

6.3.1.1 Potential impacts

A Flora and Fauna Assessment has been prepared for the proposed activity and is provided in **Appendix 1**. The Assessment considers the impact of the potential removal of up to 0.54 ha of vegetation based upon a maximum disturbance width of 5m for all tracks. The area calculated includes clearing for each compound (five compounds within an impact area of 450m2 each) upgrading of existing tracks and the reopening of overgrown tracks required for access. The Assessment assumes a maximum width of 5m for all tracks but it is likely that in many instances the disturbance width will be less than 5m. The area of vegetation removal associated with the overgrown access tracks is approximately 0.31 ha. .The Assessment examined the likelihood of impact from the proposed activity on any threatened species, populations or ecological communities listed within the *Threatened Species Conservation Act 1995* (TSC Act 1995). The Assessment identified the relevant requirements of the *Environmental Planning and Assessment Act 1979* (EP&A Act 1979) as amended by the *Environmental Planning and Assessment Amendment Act 1997* (EP&AA Act 1997). The Assessment also considered threatened entities listed federally under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999).

The borehole pad size was determined on the ground at the time of the ecological survey which resulted in a survey area of around 50 metre by 50 metre and an exploration or impact area of 450m^2. As mentioned above the Assessment assumes a maximum width of 5m for the reopening of overgrown tracks and total area to be removed from the overgrown tracks is approximately 0.31 ha.

Two vegetation assemblages associated with the proposed sites and overgrown access tracks were identified as follows:

- MU 3 Hillslope Talus Mountain Gum – Brown Stringybark – Grey gum – Broad-leaved Hickory Moist Forest at sites ARP11, ARP13/ARP13SP, ARP14 and ARP15/ARP15SP; and
- MU 4 Sheltered Gully Brown Barrel Ferny Forest, a community that occurred at site ARP12;

A number of threatened flora species were targeted during flora investigations, due to the presence of existing records from the wider locality. No threatened flora species were detected during targeted surveys within the sites or their associated access tracks.

Habitat within the study area was assessed for its potential to support native flora and fauna species including threatened flora and fauna for which records occur within the wider locality. The dry open forest of MU4 are known to provide habitat for threatened species such as *Derwentia blakelyi*.

No hollows were detected within the sites, however hollows are likely to be prevalent in the immediate surrounding area. Suitable habitat occurs across forested areas for ground-dwelling mammals including the threatened Spotted-tailed Quoll (*Dasyurus maculatus*) as well as threatened woodland bird species including the Scarlet Robin (*Petroica boodang*), Varied Sittella (*Daphoenositta chrysoptera*) and Flame Robin (*Petroica phoenicea*). Common amphibians are likely to utilise the stream and associated habitats adjacent to ARP13 and ARP14, with potential for Red-crowned Toadlets to also occur.

Fauna habitats of the proposed activity area, contained within Mugii Murum-ban State Conservation Area (SCA), are linked to this system by the Gardens of Stone National Park. The Gardens of Stone National Park adjoins the Mugii Murum-ban State Conservation Area to the south and Wollemi National Park in the east. In addition, habitats of the Mugii Murum-ban State Conservation Area maintain connectivity with Capertee National Park to the north.

Fauna observed within the sites were limited to common avian woodland species.

Fourteen threatened fauna species were considered to have potential to be impact upon, namely Red-crowned Toadlet, Rosenberg's Goanna, Spotted-tailed Quoll, Squirrel Glider, Varied Sittella, Flame Robin, Scarlet Robin, Little Bentwing Bat, Large-eared Pied Bat, Eastern False Pipistrelle, Southern Myotis, Eastern Cave Bat, Yellow-bellied Sheathtail Bat and Eastern Bentwing-bat.

These species were afforded further consideration via Section 5A of the EP&A Act 1979 (Seven-Part Test of Significance). The results of the Assessment found that the threatened species considered are unlikely to be significantly impacted upon by the proposed works. Additionally, assessment of Matters of National Environmental Significance (MNES) found that no impacts are expected under the EPBC Act.

Therefore, the proposed activity is unlikely to result in adverse impacts upon locally occurring threatened species or communities provided the mitigation measures in Section 6.3.1.2 are implemented.

6.3.1.2 Mitigation measures

- The drilling and other vehicles are to avoid damaging or removing native vegetation wherever possible by carefully driving around all trees and shrubs to minimise any impacts on native vegetation This will ameliorate the Key Threatening Processes (KTP) '*Removal of Native Vegetation'* and '*Loss of Hollow-bearing Trees'*;
- Where vegetation removal is unavoidable, it shall be kept to a minimum. Particular effort should be made to avoid disturbing mature trees and off site hollow bearing trees;
- All removed vegetation shall remain within close proximity to the site, with mature trees gently placed in surrounding areas to allow for the survival and dispersal of any displaced fauna currently utilising these trees;
- It is recommended that water management strategies be implemented at the proposed sites to prevent the movement of sediments or contaminated waters / liquids into surrounding habitats, including potential down-slope waterways or drainage lines;
- It is recommended that appropriate measures such as vehicle cleaning protocols be employed to ensure that machinery working within the site do not bring materials (soils, weeds or pathogens etc.) onto the sites that may cause the distribution of weed species or introduce pathogens such as *Phytopthera.* This will ameliorate the Key Threatening Processes '*Weed Invasion by Exotic Perennial Grasses'* and '*Infection of Native Plants by Phytopthera cinnamomi'*;
- It is recommended that water extraction for use during construction follow the designated protocols in relation to the accepted levels of extraction to mitigate against the Key Threatening Process '*Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands';* and

- That topsoil management be implemented at each of the sites to ensure that current seed banks in top soil be returned to the site after cessation of geotechnical investigations.

6.3.1.3 Potential impact category

With the implementation of the mitigation measures identified, potential impacts are likely to be low to medium adverse.

6.3.2 Does the activity constitute or is part of a key threatening process?

6.3.2.1 Potential impacts

KTP's are listed in Schedule 3 of the TSC Act 1995. Five KTP's have the potential to affect the sites as a consequence of the proposed sites, being:

- Anthropogenic climate change;
- Clearing of native vegetation;
- Infection of native plants by *Phytophthora cinnamomi*;
- Invasion of native plant communities by exotic perennial grasses; and
- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands.

No other KTP's are believed to be likely as a consequence of the proposed activity.

6.3.2.2 Anthropogenic climate change

The activity is likely to contribute to the Key Threatening Process "Anthropogenic climate change". The proposed works contribute to this KTP as a result of the removal of a small amount (approximately 0.225ha) of vegetation. The extent to which the proposed works contribute to this process is considered very low as the vegetation is likely to regenerate to pre-drilling condition after the completion of the bores.

6.3.2.3 Clearing of native vegetation

This Project will contribute to this KTP through the removal of a very small amount of native vegetation, totalling approximately 0.225 ha. This has the potential to impact upon a range of threatened fauna species (DEC 2001) including the Scarlet Robin, Spotted-tailed Quoll and various microbat species. However, the proposed boreholes will be drilled using a mobile drilling rig which for the most part will be able to navigate through the vegetation without requiring the removal of vegetation. Additionally, the majority of the proposed sites are located within existing clearings or are highly disturbed. The proposed borehole sites will be located in such a manner as to minimise the removal of native vegetation and are therefore unlikely to significantly contribute to this KTP.

6.3.2.4 Infection of native plants by *Phytophthora cinnamomi*

The activity has the potential to result in the importation of this pathogen, which has the potential to impact upon a broad range of threatened plant species (DEC 2002). It is considered that the proposed works will not significantly contribute to this KTP provided that the correct hygiene protocols are established and implemented.

6.3.2.5 Invasion of native plant communities by exotic perennial grasses

Due to the creation of soil disturbance at some sites, there is the potential for these areas to be colonised by exotic perennial grasses at the conclusion of the activities. If introduced, exotic perennial grasses typically

dominate such areas (DEC 2003), incrementally contributing to this KTP. Effective machinery and vehicle cleaning procedures prior to commencing work will reduce the potential for this KTP to occur.

6.3.2.6 Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands

The drilling activity involves the extraction of water from a stream near sites ARP13/ARP13SP and ARP14 to supply the drill rig with water for approximately four weeks during the construction period. Extraction of water which reduces flows, leads to a lower distribution of organic matter on which invertebrates and vertebrates depend (OEH 2014).

The rate of extraction will be timed proportional to the natural flow such that no alteration of flow will occur to significant extents. External water supplies are an alternative option if the stream is unable to provide sufficient levels of water without altering the amount of water and its flow.

The V-notch weir being placed in a stream adjacent to sites ARP13/ARP13SP and ARP14 is a monitoring device that sits in the centre of the stream collecting data on water flow. This device is not expected to alter the flow of water as it is designed with the intention to monitor natural flows, not alter it in the process.

6.3.2.7 Mitigation measures

No further measures to those identified in Section 6.3.1.2.

6.3.2.8 Potential impact category

With the implementation of the mitigation measures identified, potential impacts are likely to be low adverse.

6.3.3 Does the activity have the potential to endanger, displace or disturb fauna (including fauna of conservation significance) or create a barrier to their movement?

6.3.3.1 Potential impacts

A very small amount of foraging habitat (450m^2) will be lost at each site as a result of the proposal, however no mature or hollow bearing trees will be removed and the loss of habitat is temporary given that rehabilitation of the sites is proposed to occur at the completion of the activity. Mitigation measures have been recommended that will reduce, if not prevent, any danger to native fauna.

Assessment via a seven-part test found that the proposed activity was unlikely to significantly impact on any of the identified species listed in the TSC Act. Assessment under the EPBC Act found that the proposal was unlikely to significantly impact on any of the identified species listed on the EPBC Act.

Due to the approach to site selection and the retention of the native vegetation wherever possible within the area there would not be a detrimental effect on the corridors and habitat linkages required for the movements of the local fauna and the proposed activity is highly unlikely to result in fragmentation or isolation of potential habitat for locally occurring threatened species.

6.3.3.2 Mitigation measures

No further measures beyond those identified in Section 6.3.1.2.

6.3.3.3 Potential impact category

With the implementation of the mitigation measures identified, potential impacts are likely to be low adverse.

6.3.4 Is the activity likely to impact on an ecological community of conservation significance? Is the activity likely to cause a threat to the biological diversity or ecological integrity of an ecological community?

6.3.4.1 Potential impacts

As stated above, the proposal is unlikely to significantly impact on any ecological communities listed under the TSC Act or EPBC Act.

6.3.4.2 Mitigation measures

No further measures beyond those identified in Section 6.3.1.2.

6.3.4.3 Potential impact category

With the implementation of the mitigation measures identified, potential impacts are likely to be negligible.

6.4 Assessment of Community Impacts

6.4.1 Is the activity likely to affect existing community services or infrastructure?

6.4.1.1 Potential impacts

Minor increases in traffic may occur along Glen Davis Road and on the tracks from this road to the borehole compounds. However, this is unlikely to result in traffic delays or road safety issues.

The track upgrade and works at the borehole compounds have potential to cause public inconvenience in the event that tracks are blocked with vehicles and equipment. This can be minimised by keeping vehicles and equipment off the tracks where possible and the provision of signage. A232 includes a condition stating that operations must not affect the public's normal use of any road or track without prior permission from the department.

The proposed activity is unlikely to significantly impact on any community services and infrastructure.

6.4.1.2 Mitigation measures

- Public inconvenience will be minimised during the proposed activities, such as by keeping the existing tracks as clear and accessible as possible and the provision of signage.
- In the event of normal public use of any road or track being affected, prior written approval from DTIRIS will be obtained.
- The use of tracks during wet weather will be reduced to prevent damage.
- Activities will not interfere with or impair the stability or efficiency of any transmission line, communication line, pipeline or any other public utility.

6.4.1.3 Potential impact category

Potential impacts would be negligible.

6.4.2 Does the activity affect sites of importance to the local or broader community for their recreational or other values or access to these sites?

6.4.2.1 Potential impacts

The proposed activity is located within the Mugii Murum-ban SCA and therefore has recreational, heritage and conservation value to the community. Impacts on heritage are addressed in Section 6.7 to 6.8 and impacts on flora and fauna are addressed in Section 6.3.

Potential impacts on recreational users within this part of the Mugii Murum-ban SCA would comprise noise, dust, traffic, visual effects and the introduction of a hazard. This would be temporary and it is anticipated that recreational users will go to other parts of the SCA during this short time period.

Potential traffic impacts are addressed in Section 6.4.1.1 and are negligible. Visual impacts are addressed in Section 6.4.5 and are negligible to low adverse.

6.4.2.2 Mitigation measures

Mitigation for dust and noise including notification to residents, site signage and complaints handling is identified in Section 6.2.6.3 and mitigation for the introduction of a hazard in Section 6.4.4.2 of this REF.

6.4.2.3 Potential impact category

With the implementation of the mitigation measures identified, potential impacts are likely to be low adverse.

6.4.3 Is the activity likely to affect economic factors?

6.4.3.1 Potential impacts

The proposed activity is anticipated to provide temporary construction work for around five contractors and comprise the purchasing of material supplies.

6.4.3.2 Mitigation measures

No further measures are proposed for economic factors.

6.4.3.3 Potential impact category

Potential impacts are likely to be negligible to low beneficial.

6.4.4 Is the activity likely to have an impact on the safety of the community? Is the activity likely to cause a bushfire risk?

6.4.4.1 Potential impacts

The proposed activity will introduce a potential hazard comprising:

- Unauthorised access to the boreholes sites and their construction equipment.
- Moving vehicles.
- Fuels and oils.
- Operation of machinery.

These could have safety implications for recreational users of this part of the Mugii Murum-ban SCA. Unauthorised access to the construction sites may occur that could result in injury. Moving vehicles may present a safety risk.

The proposed activity is located within the bushfire zone identified on the Lithgow LEP map. Flammable substances such as fuels and oils will be used in the proposed activity area. Vehicles and machinery will be used and there is potential for ignition. Therefore, there are potential safety implications associated with the risk of bushfire for local residents, users of the Mugii Murum-ban SCA and staff/contractors and management measures are identified in Section 6.4.4.2.

Impacts associated with spills of fuels and oils are addressed in Section 6.2.1.2.

6.4.4.2 Mitigation measures

In addition to measures addressing the storage and use of potentially flammable substances, their removal following drilling and locations for refuelling vehicles and equipment identified in section 6.2.1.2:

- Vehicles will travel at low speeds.
- Site safety protocols, incident management and emergency procedures, including those to manage bushfire risk, will be implemented during site preparation, construction, operation and rehabilitation.
- During site preparation, construction and rehabilitation, a water source will be made available at each works area for fire fighting.
- Availability of existing roads and land for use for fire fighting will not be affected.
- Hazard control measures will be implemented in compliance with the *Mine Health and Safety Act 2004* and *Mine Health and Safety Regulation 2007*.

6.4.4.3 Potential impact category

With the implementation of the mitigation measures identified, potential impacts are likely to be low adverse.

6.4.5 Is the activity likely to cause impacts on the visual or scenic landscape?

6.4.5.1 Potential impacts

The proposed activity area is not highly visible from any residence due to intervening vegetation and the scale of the proposed activity. The proposal may detract from the scenic qualities of the land during temporary construction of the boreholes due to the presence of plant and equipment and to a lesser extent for the duration of the groundwater monitoring during which the compounds will have been mainly rehabilitated. Following decommissioning of the monitoring bores the sites will be completely rehabilitated.

6.4.5.2 Mitigation

- The proposed activity area will be kept in a clean and tidy condition during site preparation, drilling activities and the operation of the monitoring bores.

6.4.5.3 Potential impact category

Due to the small scale and temporary nature of the construction works, a low adverse impact is expected.

6.5 Assessment of natural resource impacts

6.5.1 Is the activity likely to result in the degradation of an area reserved for conservation purposes?

6.5.1.1 Potential impacts

The proposed activity area is within the Mugii Murum-ban SCA,. The locations for the proposed boreholes have been selected to minimise disturbance to land and vegetation. Assessments have been undertaken for flora and fauna and Aboriginal heritage as contained in **Appendix 1** and **Appendix 3**, and significant impacts are not likely as long as the identified mitigation measures are implemented. The proposed activities will be both minor in scale and temporary and the borehole compounds will be fully rehabilitated. Where ever possible clearing will be minimised.

6.5.1.2 Mitigation

Mitigation measures for flora and fauna are provided in Section 6.3.1.2 and for heritage in Sections 6.7.1.2 and 6.8.1.2. No additional specific measures for conservation are identified.

6.5.1.3 Potential impact category

In the context of the total area of Mugii Murum-ban SCA the temporary and minor degradation of this land is considered to be low adverse.

6.5.2 Is the activity likely to affect the use of, or the community's ability to use, natural resources? Is the activity likely to involve the use, wastage, destruction or depletion of natural resources including water, fuels, timber, or extractive materials?

6.5.2.1 Potential impacts

The proposed activity will require the use of fuels to operate vehicles and plant. Quantities of fuel will not be significant.

The proposed activity is not likely to involve the significant use, wastage, destruction or depletion of natural resources.

Agriculture is addressed in Section 6.6.

6.5.2.2 Mitigation measures

Measures for rehabilitation are provided in Section 6.2.1.2, measures for water resources are in Section 6.2.2.2. Additional measures are:

- Fuel will be used as efficiently as possible.

6.5.2.3 Potential impact category

With the implementation of mitigation measures, impacts on natural resources are likely to be negligible.

6.6 Agriculture

6.6.1 Agricultural impact statement

The Strategic Regional Land Use Policy was released in September 2012. It sets out a range of initiatives to balance growth in the mining and coal seam gas industries with a need to protect important agricultural land and water resources. An Agricultural Impact Statement (AIS) is required for mineral exploration activities. DTIRIS issued guidelines for AISs at the exploration stage in November 2012 (the AIS guidelines) and this has been taken into account for this REF. Information specified in Section A of the AIS guidelines is provided below. This is required for all exploration activities to determine the level of risk and whether further assessment is required.

6.6.1.1 Nature, location, intensity and duration of the proposed activity

The proposed activity is described in Section 2 of the REF and the key characteristics are:

- The proposed activity area is located on Genowlan Mountain, approximately three kilometres north east of Capertee, within the Lithgow LGA and within A232.
- The proposed activity area is within the Mugii Murum-ban SCA.
- Seven boreholes will be drilled to obtain geotechnical information about the coal resource and to undertake groundwater monitoring.
- A V-notch weir will be installed into a third order tributary of Genowlan Creek and is anticipated to take approximately one week to construct.
- Trimming of overgrown vegetation may be required for the existing overgrown track to borehole sites ARP13/ARP13SP, ARP14 and ARP15/ARP15SP.
- The boreholes have been located to minimise land disturbance and vegetation clearance.
- Activities are anticipated to commence in quarter 2 of 2016. Following site preparation, drilling of the boreholes will take approximately four weeks each at boreholes ARP13 and ARP15 and approximately 2 days each at boreholes ARP11, ARP12, ARP13SP, APR14 and ARP15SP. All the proposed boreholes will be constructed within three months.
- The quantity of water anticipated to be used for drilling is approximately 80,000 to 120,000 litres per borehole. Water sources are Gap Creek dam located at 'Rock Bottom' or the 35 ML discharge dam at Airly Mine, Genowlan Creek and if insufficient flows, an existing dam at the historic diamond creek mine.
- At the completion of drilling the boreholes will be installed with piezometers for the purpose of monitoring groundwater and the rest of the drill pad will be rehabilitated to their pre-operational state.
- The groundwater monitoring bores are currently anticipated to be operational for approximately 20 years.
- Full rehabilitation will be undertaken following the completion of the useful life of the piezometers.

6.6.1.2 Nature of agricultural resources and industries

Under the Strategic Regional Land Use Policy there are two land use plans at the time of writing. These are for New England and the Upper Hunter. The proposed activity area is not within the areas addressed by either of these plans and is therefore also not within biophysical SAL or a critical industry cluster (CIC) identified within these plans.

The soil assessment shows that the proposed activity area is not considered highly valuable agricultural land.

Agriculture in the Lithgow LGA is a contributor to the local economy although not to the extent of other surrounding regions. Land zoned within the LGA which permits agricultural activities without development consent is mainly fragmented with only just over half of it being capable of productive agriculture (Lithgow City Council, 2007). In 2006-07 the gross regional product for Lithgow LGA was $723.8 million. Of this, the agriculture, forestry and fishing sector contributed 3% (Lithgow City Council, 2010).

Agriculture in the LGA comprises a small number of large hectare pastoral land holdings and many small hectare rural lifestyle blocks. The key primary agricultural products are cattle and sheep production and some poultry. There are also a number of forest plantations. Small primary industry enterprises include goat cheese making, alpaca and lambs wool products, olives, fruit, viticulture, specialist cattle and sheep farms and other home grown products (Lithgow City Council, 2010).

There are no agricultural enterprises within the proposed activity area or the immediate vicinity.

Agricultural support infrastructure includes roads. Vehicles for the proposed activity will access the area via Glen Davis Road. There are no known agricultural activities within the proposed activity area or in the immediate vicinity therefore agricultural activities are not likely to use the tracks that will be either used or upgraded by the proposed activity.

Impacts on water resources are identified in Section 6.2.2. There are no water users that will be impacted by the proposed activities and therefore no resources depended upon by agricultural enterprises. The area is remote and the closest groundwater user is GW035684 stock and domestic approximately five kilometres to the east of the proposed activity area.

Water will be sourced from the range of sources identified at 6.6.1.1.

6.6.1.3 Impacts on agricultural resources and industries

The proposed activity will not impact on any biophysical SAL or CIC defined under a strategic regional land use plan.

The proposed activity area is within the Mugii Murum-ban SCA, is on a mountain and not within land used for agricultural purposes. No land currently used for agricultural purposes will be required. Therefore, there will be no reduction in agricultural land as a result of the proposed activity.

The traffic generation associated with the proposed activity is very low and temporary. Impacts on agricultural businesses from delays associated with this additional traffic will be negligible.

The proposed activity will not impact on any water supply services or processing facilities required for agricultural enterprises. Water impacts are identified in Section 6.2.2. Whilst there is a risk of spills of fuels and oils, that have the potential to impact water resources, mitigation measures are identified. No other impacts to water resources, and therefore agricultural users of water resources, are anticipated.

Neither the dams nor Genowlan Creek identified as the sources of water for drilling are currently used for agricultural purposes. Therefore, there will be no impact on agricultural resources with respect to the use of a water resource.

No existing agricultural jobs will be lost as a direct result of the proposed activity.

Whilst the proposed activity may provide employment for a small number of contractors and there is likely to be some direct and indirect spending, the positive impact on the agricultural economy is likely to be negligible.

6.6.1.4 Mitigation measures

The mitigation measures specified in Sections 6.2.1.2 and 6.2.2.2 will be implemented to minimise impacts on soils, surface water and groundwater respectively.

6.6.1.5 Agricultural impact risk ranking

The AIS guidelines provide guidance on the determination of the level of risk of agricultural impacts.

Table 6 identifies the risks to agriculture taking into account the mitigation measures specified in this REF.

Table 6 Agricultural impact risk ranking

Impact	Probability	Consequence	Risk
Traffic generation on Glen Davis Road may cause delay. Traffic generated will be very minor and will be temporary.	Possible	Negligible	Low
Spills of fuels and oils may pollute water and soil and this risk will be managed through the mitigation measures identified in this REF.	Possible	Minor	Low

The AIS guidelines provide examples of low risk activities. The proposed activity reflects these examples as follows:

- The proposed activity is not located on land used for agriculture and no intensive agricultural activities are being undertaken in the immediate vicinity.
- The duration of the construction activity is short term.
- Whilst the Project is part of Airly Mine's exploration and groundwater monitoring program the proposed activity is not likely to contribute to any cumulative effects on agriculture.
- All surface disturbance will be rehabilitated.
- The proposed activity will not result in permanent impacts on land or water resources.

The proposed activity, with the implementation of the identified mitigation measures, is expected to result in low risk agricultural impacts. Therefore, no further assessment is required.

6.7 Assessment of Aboriginal cultural heritage impacts

6.7.1 Will the activity disturb the ground surface or any culturally modified trees (e.g. a scarred tree)? Does the activity affect known Aboriginal objects or Aboriginal places? Can harm to objects or disturbance of landscape features be avoided?

6.7.1.1 Potential impacts

The activity will disturb the ground surface.

An Aboriginal Archaeological Due Diligence Assessment was undertaken by RPS and is contained in **Appendix 3**. The Assessment included consideration of 5 metre wide potential area of impact along all existing tracks and all disused access tracks proposed for use.

The visual inspection of proposed borehole ARP11, ARP12, ARP13, ARP13SP, ARP14, ARP15 and ARP15SP and the V-notch Weir and access track upgrade identified no Aboriginal cultural heritage objects inside the proposed activity area. The closest recorded Aboriginal site is a stone artefact site; AHIMS#45-1-2765and is situated approximately 20 metres from borehole ARP11.

Visual inspection of the proposed activity area identified no Aboriginal cultural heritage objects and the Aboriginal archaeological due diligence considered that the proposed borehole works and access track upgrade will not harm any Aboriginal objects or places. The Aboriginal archaeological due diligence concluded that an Aboriginal Heritage Impact Permit (AHIP) is not required for the proposed works.

6.7.1.2 Mitigation measures

Mitigation measures are as follows:

- Prior to works commencing at borehole location ARP11, Aboriginal site AHIMS#45-1-2765 will be cordoned off and protected with high visibility sediment fencing as shown in **Figure 2** of **Appendix 3** of this REF.
- Vehicle access is to remain within existing tracks where possible in order to minimise potential impacts on surrounding vegetation and reduce erosion.
- In the event that any vegetation clearing is required to allow large machinery access to a given area, soil disturbance should be kept to a minimum. Subject to ecological constraints it is preferable for vegetation to be cut with a chain saw rather than bulldozed and trees and bushes should be cut at their base just above ground level where possible.
- All relevant Centennial Airly Pty Ltd 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 proposed activity area during works, then all works in the immediate area must cease and the area should be cordoned off. OEH must be notified via Enviroline 131 555 so that the site can be adequately assessed and managed.
- In the unlikely event that skeletal remains are identified, work must cease immediately in the vicinity of the remains and the area must be 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 via Enviroline 131 555. An OEH officer will determine if the remains are Aboriginal or not; and a management plan must be developed in consultation with the relevant Aboriginal stakeholders before works recommence.
- If, during the course of development works, suspected historic cultural 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.

6.7.1.3 Potential impact category

Mitigation measures identified above will be implemented in the event of Aboriginal objects being identified during the proposed activity. Therefore, with the implementation of these measures, impacts to Aboriginal cultural heritage will be negligible.

6.7.2 Does the proposed activity affect areas subject to native title claims, indigenous land use agreements or joint management?

There are no applications or determinations of native title covering the proposed activity area. There are also no registered Indigenous Land Use Agreements or Joint Management arrangements over the proposed activity area. Therefore, there will not be any impacts on such areas from the proposed activity.

6.8 Assessment of historic cultural or natural heritage impacts

6.8.1 What is the impact on places, buildings, landscapes or moveable historic heritage items?

6.8.1.1 Potential impacts

There are no non-Aboriginal heritage items and places recorded within or in close proximity to the proposed activity area.

6.8.1.2 Mitigation measures

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

6.8.1.3 Potential impact category

Impacts to non-Aboriginal heritage are unlikely. In the event of finding materials of non-Aboriginal heritage during the proposed works, the mitigation measures identified above will be implemented.

6.8.2 Is any vegetation of cultural landscape value likely to be affected (e.g. gardens and settings, introduced exotic species, or evidence of broader remnant land uses)?

6.8.2.1 Potential impacts

"The Greater Blue Mountains Area – Additional Values" is identified on the National Heritage List as a place of national natural heritage. It includes the Wollemi, Blue Mountains, Yengo, Nattai, Kanangra-Boyd, Gardens of Stone and Thirlmere Lakes National Parks and the Jenolan Caves Karst Reserve. The closest part of the Greater Blue Mountains Area is the Gardens of Stone National Park at over one kilometre to the south of the proposed activity area. The Greater Blue Mountains Area does not include the proposed activity area and due to the distance from this area and the scale of the proposed activity is unlikely to significantly impact on this place of national natural heritage.

The Mugii Murum-ban SCA within which the proposed activity area is located contains items of heritage value. An Aboriginal due diligence study (including site survey) has been undertaken for the proposed activity and mitigation measures identified as contained in Section 6.7.12 of this REF.

6.8.2.2 Mitigation measures

No further measures in addition to those identified in this REF.

6.8.2.3 Potential impact category

The impact will be negligible.

6.9 Is the proposed activity likely to impact on matters of national environmental significance under the Environmental Protection and Biodiversity Conservation Act 1999?

As discussed in Section 5.5, an EPBC Act protected matters search has been undertaken and the results are reported in Section 5 and 6 of **Appendix 1**.

The proposed activity is not expected to have any significant impact on any MNES provided the mitigation measures set out in Section 6.3.1.2 and the Flora and Fauna assessment in **Appendix 1** are implemented.

6.10 Assessment of cumulative impacts

6.10.1 Potential impacts

There are already existing monitoring bores at Genowlan Mountain. These were the subject of a separate REF and have since been approved and constructed. Both the approved and proposed bores are subject to mitigation measures to minimise environmental impacts. Both projects will contribute to the collection of groundwater data to inform any future mining related development in the area.

There are other mining related projects within the wider region. There may be community concern associated with the general increase in mining related activities in the region. This may be associated with beneficial effects relating to employment and adverse effects associated with environmental impacts. This will be addressed through ongoing community consultation.

Currently there are no plans for further installation of groundwater monitoring boreholes or for further exploration boreholes on Genowlan Mountain beyond those proposed within this REF.

6.10.2 Mitigation measures

- Centennial Airly will implement ongoing community consultation about their activities at Airly Mine and in the region.

6.10.3 Potential impact category

Cumulative impacts associated with community concern about environmental impacts associated with the general increase in mining related activities in the wider area could be low to medium adverse. Cumulative impacts associated with community concern about employment impacts associated with the general increase in mining related activities in the wider area could be negligible to low beneficial.

7.0 Summary of Potential Impacts

7.1 Introduction

The potential impacts associated with the proposed activity are summarised in **Table 7**.

Table 7 Summary of potential impacts

Aspect	Potential impacts	Potential impact category (with mitigation measures)
Soil	There is potential for soil erosion from wind and from run off water. Given the small area of disturbance and the very small gradiant /slope of the terrain the impacts are likely to be negligible.	Negligible
Soil	Fuels and oil will be used during the proposed activity. Any drilling muds used will be biodegradable to avoid the risk of soil (and water) contamination. Mitigation measures to minimise and manage the risk of spills are identified.	Low adverse
Soil	Soil will be removed during excavations and mitigation measures to ensure its re-use for rehabilitation are identified.	Negligible
Soil	Impacts associated with soil profile inversion and soil compaction will be mitigated.	Negligible
Water	Cross contamination of aquifers will be avoided through design and mitigation measures.	Negligible
Water	Changes to groundwater levels are not expected.	Negligible
Water	Risk of seepage of drilling fluids or hydrocarbons will be managed.	Negligible to low adverse
Hazardous substances	Risks associated with transport, use and storage of hazardous substances will be managed.	Negligible to low adverse
Waste	Odours caused by improper storage or treatment of putrescibles waste will be avoided through the mitigation measures.	Negligible
Waste	The risks of leaching of pollutants into groundwater, surface water and soil will be minimised through the mitigation measures.	Negligible to low adverse
Waste	The risks of pollution or contamination of water or land due to illegal dumping of waste and/or a lack of suitable containment of waste will be avoided through the mitigation measures.	Negligible
Waste	Littering of the area due to a lack of suitable containment of waste will be avoided through the mitigation measures.	Negligible
Air quality	Dust impacts to residential properties will be minimised through the mitigation measures.	Negligible
Air quality	Dust impacts affecting the environment and those using the immediate area will be minimised through the mitigation measures.	Negligible to low adverse
Air quality	Emissions from vehicle and plant exhausts will be very low.	Negligible
Air quality	Odour emissions are possible but are likely to be very low	Negligible to low adverse
Noise	Noise impacts will be managed through the mitigation measures.	Low to medium adverse
Noise	Noise impacts to those using the immediate area will be short term and managed through the mitigation measures.	Low to medium adverse
Flora and fauna	The potential loss of approximately 0.225 hectares of native vegetation and additional small areas associated with the track upgrades. Mitigation measures are identified.	Low to medium adverse
Flora and fauna	No significant impact upon any listed threatened ecological communities	Negligible

Aspect	Potential impacts	Potential impact category (with mitigation measures)
	or any listed threatened species.	
Flora and fauna	The risk of vehicles and machinery bringing materials onto the sites that may cause the distribution of weed species or introduce pathogens will be managed through the mitigation measures.	Negligible
Community services, infrastructure and sites of importance	Minor increases in traffic along the Glen Davis Road and on the tracks to the proposed activity area are unlikely to result in traffic delays or road safety issues.	Negligible
Community services, infrastructure and sites of importance	Impacts associated with the recreational, heritage and conservation values of the Mugii Murum-ban SCA to the community will be short term and are addressed in flora and fauna above and heritage below.	Low adverse
Community services, infrastructure and sites of importance	Potential short term impacts on recreational users within the Mugii Murum-ban SCA from noise, dust, traffic, visual effects and the introduction of a hazard.	Low adverse
Economic issues	Provision of temporary construction work for around five contractors and purchasing of material supplies.	Negligible to low beneficial
Public safety	Potential hazards to recreational users of this part of the Mugii Murum-ban SCA will be managed through the mitigation measures.	Low adverse
Public safety	There is a risk of bushfire and mitigation includes site safety protocols, incident management and emergency procedures and the provision of a water source for fire fighting.	Low adverse
Visual or scenic landscape	During construction the works within the Mugii Murum-ban SCA will be visible. This may temporarily detract from the scenic qualities of the land.	Low adverse
Natural resources	The locations for the proposed boreholes have been selected to minimise disturbance to land and vegetation and the areas will be rehabilitated.	Low adverse
Natural resources	Quantities of fuel will not be significant.	Negligible
Natural resources	The proposed activity is not likely to involve the significant use, wastage, destruction or depletion of natural resources.	Negligible
Agriculture	No reduction in agricultural land as a result of the proposed activity.	-
Agriculture	Impacts on agricultural businesses from delays on Glen Davis Road caused by very low traffic generation.	Negligible
Agriculture	No impact on any water supply services or processing facilities required for agricultural enterprises.	-
Agriculture	Risks associated with spills of fuels and oils and potentially contaminating water and soil will be mitigated.	Negligible to low adverse
Aboriginal cultural heritage	No Aboriginal objects, sites or culturally modified trees were identified within the borehole compounds. One Aboriginal site exists 20m from borehole ARP11 and measures for its protection are identified as mitigation.	Negligible
Aboriginal cultural heritage	In the event of Aboriginal objects being identified during the proposed activity, mitigation measures are identified.	Negligible
Historic cultural heritage	No historical cultural heritage items and places recorded within or in close proximity to the borehole areas.	-
Historic cultural heritage	In the event of historic cultural heritage material being identified during the proposed activity, mitigation measures are identified.	Negligible

Aspect	Potential impacts	Potential impact category (with mitigation measures)
Cultural landscape	Impacts to the Greater Blue Mountains Area are not likely due to the distance and scale of the activity.	Negligible
Cumulative	There are existing monitoring bores at Airly Mine and the proposed activity will contribute to the collection of groundwater data to inform any future mining related development in the area.	Negligible
Cumulative	Community concern about environmental impacts associated with the general increase in mining related activities in the wider area. This will be addressed through ongoing community consultation.	Low to medium adverse
Cumulative	Community concern about employment impacts associated with the general increase in mining related activities in the wider area. This will be addressed through ongoing community consultation.	Negligible to low beneficial

On balance, with the implementation of the identified mitigation measures within this REF, the proposed activity will have a low adverse impact on the environment. These impacts will be confined mainly to the construction period and will be temporary (approximately three months) and of a small scale.

7.2 Clause 228 factors

Clause 228 of the Environmental Planning and assessment Regulation 2000 outlines a number of factors that must be taken into account in assessing an activity under Part 5 of the EP&A Act. **Table 8** provides an assessment of the clause 228 factors.

Table 8 Clause 228 Factors

Factor	Impact
Any environmental impact on a community	There are three residential properties within proximity of the proposed activity area. Two are owned by Centennial and one is privately owned. There is potential for noise during a temporary period and mitigation measures are identified in this REF. Traffic generation is likely to be insignificant. There may be combined noise, dust, visual, traffic and hazard impacts to those members of the community using this part of the Mugii Murum-ban SCA for recreational purposes. Recreational users may prefer to use other parts of the Mugii Murum-ban SCA during the temporary construction period. Mitigation measures are identified in this REF. Impacts associated with the proposed activity will be virtually imperceptible to the wider community.
Any transformation of a locality	There will be a localised and temporary visual impact within the Mugii Murum-ban SCA in the immediate vicinity of the boreholes during construction. Following construction and geotechnical logging the compounds will be mainly rehabilitated whilst leaving the piezometers in place during monitoring. The proposed activity area will be completely rehabilitated following decommissioning of the monitoring bores.
Any environmental impact on the ecosystems of the locality	The proposed activity involves the removal of approximately 0.54 hectares of native vegetation (borehole impact area and clearing of overgrown tracks). No hollow bearing trees will be removed. No impacts are expected to occur to any EPBC Act and/or TSC Act listed threatened species.
Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality	The proposed activity will reduce the aesthetic values of the land proposed for the borehole compounds on a temporary basis during the construction period. There will be a temporary impact on those using the Mugii Murum-ban SCA for recreational purposes.
Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical,	There will be a temporary impact on the Mugii Murum-ban SCA although this will be small scale within the context of the Mugii Murum-ban SCA and of a temporary nature.

Factor	Impact
scientific or social significance or other special value for present or future generations	
Any impact on the habitat of protected fauna (within the meaning of the National Parks and Wildlife Act 1974)	The proposed activity area provides potential habitat for a range of protected fauna. A small amount of vegetation will be removed and therefore the impact will be minor as there is alternative habitat within the wider area. The proposed activity area will be rehabilitated.
Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air	The proposed activity will not endanger any species of animal, plant or other form of life, whether living on land, in water or in the air
Any long-term effects on the environment	The proposed activity will have no long term effects on the environment.
Any degradation of the quality of the environment	There is potential for minor short term degradation due to noise emissions and visual impacts or from the accidental release of contaminants during construction.
Any risk to the safety of the environment	There are potential short term risks to the environment associated with incidents and spills. There is also a risk of bushfire. Mitigation measures are identified.
Any reduction in the range of beneficial uses of the environment	There will be potential impacts on the amenity and recreational value of the area in the vicinity of the proposed activity. This will be temporary.
Any pollution of the environment	There is a potential short term risk associated with air emissions, incidents and spills. Mitigation measures are identified.
Any environmental problems associated with the disposal of waste	All wastes will be collected, classified and removed from the proposed activity area in accordance with relevant legislation and guidelines.
Any increase demands on resources (natural or otherwise) that are, or are likely to become, in short supply	The types of resources required for the proposed activity are not in short supply.

8.0 Statement of commitments

Table 9 below sets out the mitigation measures identified in Section 6 together with other commitments made in other parts of the REF including the description of the proposed activity in Section 2, approvals identified in Section 5 and conditions relating to A232 and ML1331.

Table 9 Statement of commitments

Item	Commitment
Activity type and location	▪ The proposed activity will be carried out on Genowlan Mountain and at the locations identified in the REF and will include: » Drilling of seven boreholes (ARP11, ARP12, ARP13, ARP13SP, ARP14, ARP15 and ARP15SP) for the purposes of obtaining geotechnical information about the potential coal resource and groundwater monitoring. » Potential upgrading of parts of the existing track leading to boreholes ARP13/ARP13SP, ARP14 and ARP15/ARP15SP. » Sampling and monitoring. » Partial rehabilitation following geotechnical testing and full rehabilitation following completion of the groundwater monitoring bores useful life (currently anticipated to be approximately 20 years).
Hours of operation	▪ Construction will occur 7.00am to 6.00pm Monday to Friday and Saturday 8.00 am to 1 pm. ▪ During operation of the piezometers, members of staff will travel to the piezometers on a monthly basis to take readings and/or inspect the sites.
Activity duration	▪ Drilling of the boreholes and construction of the V-notch weir will take approximately 3 months. All the proposed boreholes will be constructed and partially rehabilitated within two months (weather permitting). ▪ The boreholes are currently anticipated to be operational for approximately 25 years.
Proposed commencement date	▪ Quarter 2 of 2016
Drilling methodology	▪ As described in Section 2 of the REF and in accordance with Minimum Construction Requirements for Water Bores in Australia (ADAI, 2012).
Maximum area of disturbance	▪ Total of 0.54 ha comprising of 0.225 ha for the borehole compounds, 0.31 ha for vegetation clearance along the existing overgrown track to ARP13/ARP13SP, ARP14 and ARP15/ARP15SP. ▪ Where ever possible clearing will be minimised.
Community consultation	▪ Community consultation will be ongoing.
Access	▪ Under the *Mining Act 1992*, an approval from the NPWS will be obtained by Centennial Airly prior to the commencement of activities.
Other regulatory approvals required	▪ Prior to drilling, a monitoring bore licence application will be lodged with the NSW Office of Water under Part 5 of the *Water Act 1912*. ▪ Approval in the form of a Determination Notice under the NP&W Act.
A232 conditions (in relation to approvals and methodology)	The relevant conditions of A232 will be complied with including: ▪ Surface Disturbance Notice form. To comply with condition 23 and 24 of A232 the following additional measures to those identified elsewhere in this REF are: ▪ All boreholes will be constructed and/or sealed to prevent the collapse of the surrounding surface. ▪ If any borehole meets natural or noxious gases it will be plugged or sealed to prevent their escape. A gas monitor will be used on site whilst drilling.

Item	Commitment
	▪ If any borehole meets an artesian or sub-artesian flow it will be effectively sealed to prevent contamination or cross contamination of aquifers and will be permanently sealed with cement plugs to prevent surface discharge to groundwater. ▪ If any potentially hazardous tools or logging equipment is dropped into the boreholes and is unable to be recovered, this will be reported to the Regional Inspector of Mines in accordance with condition 23 of A232. ▪ Waters flowing from the boreholes will be managed and contained and disposed of in accordance with the ANZECC 2000 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality Guidelines'. ▪ An assessment of the risk of gas blowouts will be undertaken prior to the commencement of drilling in accordance with condition 24, (a) of A232. ▪ All over pressure gas occurrences that occur during drilling will be reported in accordance with condition 24 (b) of A232. ▪ If directed by the Department, analyses and tests on any coal seams intersected by the drill holes that may be economically mineable will be undertaken. ▪ Boreholes will be decommissioned once they cease to be used in accordance with condition 24 (d) of A232. To comply with condition 26 of A232: ▪ All boreholes maintained in an open condition will be cased to prevent collapse and fitted with a removable cap to ensure safety. To comply with condition 38 of A232: ▪ Core samples will be collected in accordance with condition 38 of A232. To comply with condition 23 of A232: ▪ A NOW hydrologist must be notified at least 28 days prior to the commencement of drilling operations.
ML1331 conditions	▪ Relevant conditions under ML1331 will be complied with.
Soils	In addition to measures identified for 'surface and groundwater' below: ▪ Excess soil generated during site preparation activities will be stockpiled at each borehole compound and used as backfill for rehabilitation. ▪ No soil will be removed from the proposed activity area unless it is contaminated in which case it will be taken to a suitably licensed waste facility. ▪ The quantity of chemicals, fuels and oils stored at the proposed activity area will be minimised where practicable. ▪ Maintenance of vehicles, plant and equipment will occur off site at an appropriately licensed facility unless considered appropriate to conduct such maintenance at the proposed activity area. Spill kits will be available and sediment fencing will be in place. ▪ All chemicals, fuels and oils will be removed at the completion of drilling. ▪ Disturbed areas will be rehabilitated in accordance with condition 27 of A232. Partial rehabilitation will be undertaken following drilling and once the geotechnical testing has been undertaken and full rehabilitation once the groundwater monitoring bores have completed their useful life.
Surface water	▪ All required chemicals, fuels and other materials will be stored and managed appropriately in bunded areas; ▪ All refuelling activities will be undertaken off site where possible; ▪ All vehicles and plant will be checked for leaks prior to coming on site; ▪ Appropriate spill kits will be available on site at all times with personnel appropriately trained in the use of spill kits; ▪ All waste and unwanted materials will be removed off site at the completion of works to prevent uncontrolled discharges during rainfall events. Waste will be managed and disposed in accordance with the requirements of state and local authorities. ▪ MSDS and manufacturer's recommendations will be available on the drill site for all drilling fluid products used. These will list instructions for handling, use, potential hazards and any disposal requirements for the product or container. ▪ Erosion and sediment control measures will be installed as necessary prior to the

Item	Commitment
	commencement of any earthworks, including construction of new access tracks and drill sites. Measures will be consistent with the principles set out in Erosion and Sediment Controls - A Field Guide for Erosion and Sediment Control Maintenance Practices on Unsealed Roads (OEH / NSW NPWS April 2010). ▪ Sediment and erosion control measures will be routinely inspected and maintained appropriately; ▪ Steep gradients will be avoided for access tracks and drill sites where possible in the vicinity of surface water sources; ▪ Sediment fences will be installed to prevent soil erosion and sediment laden runoff from areas where earthworks have been undertaken. Sediment fences will be removed by Centennial Airly once disturbed areas are restored as close as practical to pre-drilling conditions; ▪ The areas to be disturbed will be minimised and exposed areas covered to provide a stable surface where possible; ▪ Clean catchment runoff will be diverted around the disturbed areas by the use of diversion drains, sand bags, sediment fences and other control measures to direct water into natural bushland areas; ▪ Drilling and construction operations will be limited to dry weather conditions as far as practical; ▪ Vehicle and machinery movement will be confined to clearly defined access routes, tracks and work areas. ▪ At the completion of construction, all disturbed areas will be restored as close as practical to its pre-drilling conditions, including pre-drilling drainage patterns. ▪ All waste and unwanted materials, including drill cuttings, drilling water and mud, purged groundwater and other materials, will be contained on site in appropriately sized above-ground storage containers. ▪ Storage containers and pipelines will be routinely inspected and maintained appropriately. Storage containers will be covered overnight in case of rainfall. ▪ Drilling and construction operations will be limited to dry weather conditions as far as practical. ▪ All waste and unwanted materials will be removed off site at the completion of works to prevent uncontrolled discharges during rainfall events. Waste will be managed and disposed in accordance with the requirements of state and local authorities. ▪ Steep gradients will be avoided for clean water runoff diversions where possible. ▪ Drilling and construction operations will be limited to dry weather conditions as far as practical. ▪ The areas to be disturbed will be minimised and exposed areas covered to provide a stable surface where possible. ▪ At the completion of construction, all disturbed areas will be restored as close as practical to its pre-drilling conditions, including pre-drilling drainage patterns. ▪ Avoid oversupply of water for drilling activities and maximise the use of recirculated drilling water. ▪ Maintain a maximum extraction rate of 0.05ML/day, which represents half the dry weather flow recorded in November 2014.
Groundwater	▪ Drilling and bore construction will be undertaken in accordance with the Minimum Construction Requirements for Water Bores in Australia (ADIA, 2012). ▪ Only non-toxic, biodegradable drilling mud or fluid additives will be used. ▪ All bores will be positioned so that the headworks can be protected from frequent flooding and surface water drainage. ▪ The bores will be sealed appropriately to ground surface to prevent the ingress of surface water into the bore. ▪ Drilling and bore construction will be undertaken in accordance with the Minimum Construction Requirements for Water Bores in Australia (ADIA, 2012). ▪ Bores will be constructed by a NSW licensed water bore driller. ▪ All bores will be appropriately sealed to protect groundwater sources against contamination. In bores that intercept multiple groundwater sources, there will also be

Item	Commitment
	a seal (bentonite and/or cement) between the aquifers and permeable zones to prevent intermixing, flow and contamination. ▪ The driller will verify that the drilling rods are clean prior to use. ▪ Solid casing will be installed into the borehole, or the hole will be grouted, as soon as possible after drilling to minimise groundwater inflows into the hole.
Hazardous substances	▪ Chemicals and potentially hazardous substances will be used and stored according to regulatory requirements including the *Work Health and Safety Act 2011*. ▪ Any dangerous goods will be transported according to regulatory requirements under the *Dangerous Goods (Road and Rail Transport) Act 2008*.
Waste	▪ Drilling mud will be removed from the borehole compounds, at the completion of drilling. ▪ Drill cuttings will be tested for their suitability for reuse on site for rehabilitation. Testing will be in accordance with Australian Standard 1141 Methods of Sampling and Testing Aggregates. Drill cuttings that qualify as excavated natural material will be reused on site for rehabilitation. Those that exceed the limits set by the excavated material exemption will be transported and disposed of as for the drilling muds specified above. ▪ The management of waste, including its transport will comply with the POEO Act and POEO (Waste) Regulation. ▪ Appropriate waste receptacles will be provided at the borehole compounds and track upgrading areas for the disposal of domestic wastes. ▪ Waste materials will be separated, classified and managed in accordance with the Waste Classification Guidelines Part 1: Classifying Waste (DECCW 2009). ▪ All wastes will be removed from the borehole compounds and the track upgrading areas at the completion of drilling for disposal at an appropriately licensed waste management facility. ▪ All staff and contractors will be made aware of waste management procedures. ▪ Chemical, fuel and oil containers will be managed according to the MSDS or manufacturers' directions to avoid potential impacts to the environment or human health.
Air quality	▪ Dust generated during site preparation, drilling and rehabilitation will be suppressed by spraying water at each borehole compound if required. ▪ Land disturbance areas will be minimised. ▪ Vehicles, plant and machinery will be regularly maintained to ensure they are in good working condition and will be turned off when not in use. ▪ In the event that any drill hole meets natural or noxious gases it will be plugged or sealed to prevent their escape.
Noise	▪ The three residential properties will be notified of the works at least two weeks prior to the commencement of works. Information such as the type of activities likely to occur and the timing of such activities will be provided to potentially affected residences as well as contact details of a Centennial Airly and/or drilling contractor representative. ▪ All feasible and reasonable work practices will be applied where practicable to minimise noise levels. These will include construction of temporary noise barrier near ARP11 (if practical), orientation of the drill-rig in such a way that the "high-noise" side is directed away from the noise sensitive receivers and education of operators with regard to potential noise issues and encourage the implementation of quiet work practises. ▪ In the event of a noise complaint, the effectiveness of noise mitigation measures will be assessed and additional feasible and reasonable measures will be implemented where necessary. ▪ Signage will be installed at the works areas during the construction of the boreholes including contact details for complaints.

Item	Commitment
Flora and fauna	▪ The drilling vehicle and other vehicles will avoid damaging or removing native vegetation wherever possible by carefully driving around all trees and shrubs to minimise any impacts on native vegetation. ▪ Vegetation removal will be avoided where possible. Where vegetation removal is unavoidable, it will be kept to a minimum and the avoidance of the following will be prioritised: » Hollow bearing trees; and » Mature trees. ▪ All removed vegetation will remain within close proximity to the drill sites, with mature trees gently placed in surrounding areas to allow for the survival and dispersal of any displaced fauna currently utilising these trees. ▪ Water management strategies will be implemented to prevent the movement of sediments or contaminated waters / liquids into surrounding habitats, including potential down-slope waterways or drainage lines. ▪ Topsoil management will be implemented at each of the borehole compounds to ensure that current seed banks in top soil be returned to the sites for rehabilitation. ▪ Appropriate measures such as vehicle and machinery cleaning protocols will be employed to ensure that vehicles and machinery working within the proposed activity area do not bring materials (soils, weeds or pathogens etc.) onto the sites that may cause the distribution of weed species or introduce pathogens such as *Phytopthera cinnamomi.*
Community services and infrastructure	▪ Public inconvenience will be minimised during the proposed activities, such as by keeping the existing tracks as clear and accessible as possible and the provision of signage. ▪ In the event of normal public use of any road or track being affected, prior written approval from DTIRIS will be obtained. ▪ The use of tracks during wet weather will be reduced to prevent damage. ▪ Activities will not interfere with or impair the stability or efficiency of any transmission line, communication line, pipeline or any other public utility.
Safety and bushfire risk	In addition to measures addressing the storage and use of potentially flammable substances, their removal following drilling and locations for refuelling vehicles and equipment identified in 'soils' above: ▪ Vehicles will travel at low speeds. ▪ Site safety protocols, incident management and emergency procedures, including those to manage bushfire risk, will be implemented during site preparation, construction, operation and rehabilitation. ▪ During site preparation, construction and rehabilitation, a water source will be made available at each works area for fire fighting. ▪ Availability of existing roads and land for use for fire fighting will not be affected. ▪ Hazard control measures will be implemented in compliance with the *Mine Health and Safety Act 2004* and *Mine Health and Safety Regulation 2007*.
Visual	▪ The proposed activity area will be kept in a clean and tidy condition during site preparation, drilling activities and the operation of the monitoring bores.
Natural resources	In addition to measures identified for 'flora and fauna', 'Aboriginal cultural heritage', `historical cultural heritage', 'soils' and 'surface and groundwater': ▪ Fuel will be used as efficiently as possible.
Aboriginal cultural heritage	▪ Prior to works commencing at borehole location ARP11, Aboriginal site AHIMS#45-1-2765 should be cordoned off and protected with high visibility sediment fencing as shown in Figure 2 of **Appendix 3** of this REF. ▪ All relevant Centennial Airly staff and contractors will be made aware of their statutory obligations for heritage under NSW NP&W Act (1974) and the NSW Heritage Act (1977), which may be implemented as a heritage induction. ▪ The Aboriginal archaeological due diligence report for the proposed activity will be kept by Centennial Airly so that it can be presented, if needed, as a defence from prosecution.

Item	Commitment
	▪ If Aboriginal object/s are identified in the proposed activity area during works, then all works in the immediate area will cease and the area cordoned off. OEH will be notified by ringing the Enviroline 131 555 so that the site can be adequately assessed and managed. ▪ In the event that skeletal remains are uncovered, work will cease immediately in that area and the area cordoned off. Centennial Airly will contact the NSW Police with no further action taken until written advice is provided by the Police. If determined to be Aboriginal, OEH will be notified by ringing the Enviroline 131 555 and a management plan prior to works re-commencing will be developed in consultation with the relevant Aboriginal stakeholders.
Non-Aboriginal cultural heritage	▪ If, during the course of development works, suspected non-Aboriginal cultural heritage material is uncovered, work will cease in that area immediately. The NSW Heritage Branch (Enviroline 131 555) will be notified and works only recommence when an approved management strategy has been developed.
Cumulative	▪ Centennial will implement ongoing community consultation about their activities at Airly Mine and in the region.

9.0 Conclusion

This REF has been prepared to assess the potential impacts of the installation of seven boreholes to identify the potential coal resources and undertake groundwater monitoring within A232. The REF also assesses the potential impact of the installation of a V-notch weir and the upgrading of existing tracks and re-opening of small sections of disused access tracks leading to the proposed boreholes and V-notch weir.

A Flora and Fauna Assessment, Water Impact Assessment and an Aboriginal Due Diligence Assessment have been prepared to inform this REF and included the consideration of 5 metre wide potential area of impact along all existing tracks and all disused access tracks.

The locations for the proposed borehole compounds were selected to minimise vegetation clearance and ground disturbance and are situated beside existing tracks. Clearing along all existing tracks and all disused access tracks that will be utilised by the activity will be kept to a minimum.

The proposed activity area is within the Mugii Murum-ban State Conservation Area. Impacts are mainly associated with the construction period (borehole compound clearing and track upgrading), following which the proposed activity area will be predominately rehabilitated (the heads of the piezometers will remain). Following the useful life of the groundwater monitoring, anticipated to be around 20 years, the boreholes will be decommissioned and completely rehabilitated.

Impacts range from low beneficial to negligible to medium adverse. The assessment concludes that, on balance, the proposed activities impacts categorised in accordance with ESG2 as low adverse provided the mitigation measures identified in this REF are implemented. These potential impacts are predominantly associated with the construction stage that will last for a short duration, approximately three months (weather permitting) and the proposed activity is of a minor scale. The proposed activity is not likely to significantly affect the environment or any threatened species, populations or ecological communities, their habitat or critical habitat. The proposed activity does not require preparation of an EIS or SIS.

This REF has been prepared under Part 5 of the EP&A Act and to assist DTIRIS in their consideration of the conditions of A232, to accompany a surface disturbance notice and as supporting documentation to be granted approval required under the NP&W Act as the proposed sites are within Mugii Murum-ban SCA.

10.0 Abbreviations

Abbreviation	Meaning
A232	Authorisation Area 232
AHIMS	Aboriginal Heritage Information Management Systems
AHIP	Aboriginal Heritage Impact Permit
AIS	Agricultural Impact Statement
BoM	Bureau of Meteorology
CIC	Critical industry cluster
DTIRIS	NSW Department of Trade and Investment, Regional Infrastructure and Services
EEC	Ecologically Endangered Communities
EIS	Environmental Impact Statement
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EMP	Environmental Management Plan
IBC	Intermediate bulk container
ICNG	Interim Construction Noise Guidelines (DECC 2009)
LEP	Local Environmental Plan
LGA	Local government area
KTP	Key threatening processes
ML	Mining lease
OEH	NSW Office of Environment and Heritage
MNES	Matters of National Environmental Significance
MSDS	Materials Safety Data Sheets
NP&W Act	*National Parks & Wildlife Act 1974*
NOW	NSW Office of Water
NPWS	NSW National Parks and Wildlife Services
REF	Review of Environmental Factors
SAL	Strategic agricultural land
SCA	State Conservation Area
SEPP	State Environmental Planning Policy
SEWPAC	Department of Sustainability, Environment, Water, Population and Communities
SHR	State Heritage Register
SIS	Species Impact Statement
SSD	State Significant Development
TSC Act	*Threatened Species Conservation Act 1995*
VWP	Vibrating wire piezometer
WMA	*Water Management Act 2000*

Appendix 1

Flora and Fauna Assessment

Flora and Fauna Assessment

Proposed Boreholes at Airly Mine, Capertee

Prepared by:

RPS AUSTRALIA EAST PTY LTD

241 Denison Street
Broadmeadow NSW 2292

T: +61 2 4940 4200
F: +61 2 4961 6794
E: newcastle@rpsgroup.com.au

Prepared for:

CENTENNIAL AIRLY PTY LIMITED

PO Box 92
Lithgow NSW 2790

T: +61 2 6359 2107
E: gregory.brown@centennialcoal.com.au
W: www.centennialcoal.com.au

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Executive Summary

RPS Australia East Pty Ltd (RPS) was engaged by Centennial Airly Pty Ltd to undertake a Flora and Fauna Assessment for seven proposed geotechnical and water monitoring bore sites, and an additional location for the placement of a V-notch weir. Although only seven boreholes were proposed to be drilled eight possible locations were initially surveyed. This report was undertaken over lands encompassed by the existing Authorisation Area A232. The report relates to a proposed activity to determine the quality of the coal resource, obtain geotechnical data on the strata associated with the coal seam and to monitor groundwater levels. This includes geotechnical investigations regarding coal measures contained within the Airly Mine coal mining exploration area. The construction works will take approximately four months in total. Once the boreholes have been constructed and coal resources tested the bore sites will be mostly rehabilitated but will leave the piezos in place for approximately 20 years. Then the piezos will be decommissioned and the bore sites completely rehabilitated. Eight proposed boreholesites, including the access track were investigated in order to assess their potential for supporting threatened species, populations and ecological communities known to occur within the region.

This assessment aims to examine the likelihood of the proposed exploration program to have a significant effect on any threatened species, populations or ecological communities listed within the NSW *Threatened Species Conservation Act 1995* (TSC Act 1995). The report recognises the relevant requirements of the *Environmental Planning and Assessment Act 1979* (EP&A Act 1979) as amended by the *Environmental Planning and Assessment Amendment Act 1997* (EP&AA Act 1997). Assessment is also made with regard to those threatened entities listed federally under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999).

VEGETATION

Consultation with regional mapping – "Vegetation of the Western Blue Mountains" (VWBM) (DEC 2006) in conjunction with ground-truthing identified two vegetation assemblages associated with the proposed exploration sites as follows:

- MU 3 Hillslope Talus Mountain Gum – Brown Stringybark – Grey gum – Broad-leaved Hickory Moist Forest at exploration sites ARP11, ARP13, ARP13SP, ARP14, ARP15, ARP15SP and ARP15A; and
- MU 4 Sheltered Gully Brown Barrel Ferny Forest, a community that occurred at exploration Site ARP12.

Investigations were also conducted to determine if there was potential for regionally occurring threatened ecological communities (EECs) to occur within the sites. No EECs were found to occur within or in the vicinity of the proposed boreholesites.

Significant Flora

A number of threatened flora species were targeted during flora investigations, due to the presence of existing records from the wider locality, including, *Prostanthera stricta* (Mount Vincent Mintbush), *Pultenaea* sp. Genowlan Point, *Pultenaea* sp. *Olinda, Eucalyptus cannonii* (Capertee Stringybark), *Grevillea evansiana* (Evans Grevillea), *Grevillea obtusiflora, Persoonia marginata* (Clandulla Geebung) and *Euphrasia arguta*. None of the above listed threatened species, or any additional ones, were detected within the exploration sites during surveys.

HABITAT

Habitat within the site was assessed for its potential to support native fauna species including threatened fauna for which records occur within the wider locality. All of the proposed sites are characterised by open forest habitat with a sparse shrub layer and a short mostly grassy groundlayer. Minor differences occur with

respect to the dominant species in the canopy, shrub and ground layers, with site ARP12 having a slightly denser shrub layer in a more moist environment.

Flora Habitat

The vegetation communities throughout the proposed borehole areas are characterised by ridge top sandy soil substrates derived from erosional processes acting upon underlying sandstones offering habitat for a range of common local plant species.

- MU 3 Hillslope Talus Mountain Gum - Brown Stringybark - Grey Gum - Broad-leaved Hickory Moist Forest, a community that occurred at sites ARP11, ARP13, ARP13SP, ARP14, ARP15, ARP15SP and ARP15A. The extent of this vegetation is listed as 2695 ha (DEC 2006). This vegetation type is a tall, moist forest with sandy loams. It is known to provide habitat for threatened species such as *Eucalyptus cannonii* and *Prostanthera stricta*.
- MU 4 Sheltered Gully Brown Barrel Ferny Forest, a community that occurred at exploration site ARP12. The extent of this vegetation is listed as 71ha (DEC 2006). This vegetation type is tall with a high level of soil moisture. It is known to provide habitat for threatened species such as *Derwentia blakelyi*;

Several locally occurring threatened flora species are known to occur within local sclerophyll forests on sandstone substrates.

Fauna Habitat

Open Forest habitat occurred at all of the proposed sites. Associated habitat was found to be a low to moderate density of hollow-bearing trees and occasional rock outcrops with some cracks and crevices and some small perennial watercourses. No hollow bearing trees were identified within the sites, however the presence of mostly small to medium sized hollows in surrounding areas provides suitable habitat in the vicinity of the sites and represents potential breeding habitat for forest owls, treecreepers and cockatoos and also provides a capacity to provide shelter for arboreal mammals and hollow-dwelling microchiropteran bats.

The sites provide nectar producing plant species in low abundance that is highly seasonal in nature and might otherwise be suited to the foraging habits of a variety of migratory or vagrant avifauna. The sites have potential to form a small proportion of home ranges of threatened fauna species and may be occasionally traversed by threatened species such as the Spotted-tailed Quoll and Rosenberg's Goanna that are known from within the area.

CORRIDORS AND HABITAT LINKAGES

The proposed sites occur within contiguous wooded habitats. The proposed activity has been designed to minimise the impact on native vegetation by generally avoiding damage to vegetation by drilling the bores immediately adjacent to the existing track, or where the track does not exist by driving between the trees and drilling in small existing clearings as they provide sufficient room to do so. It is expected that the proposed activitywill have a low impact through the retention of native vegetation in its current state wherever possible. It is considered that this low impact approach and the retention of the native vegetation wherever possible within the area will not have a detrimental effect on the corridors and habitat linkages required for the movements of the local fauna and the proposed works are highly unlikely to result in fragmentation or isolation of potential habitat for locally occurring threatened species.

FAUNA

Fauna observed within the sites were limited to common avian woodland species and numerous traces such as scats and tracks of other mammals such as Wombats and macropods.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

The main ecological impacts associated with the proposedactivity, including the access tracks were investigated in order to assess their potential for supporting threatened species, populations and ecological communities known to occur within the region. The main ecological impact is the removal of foraging habitat for numerous threatened fauna, and potential alteration of flows as a result of water extraction from a stream during construction of the bore holes.

No threatened species or populations were detected on the sites during field surveys. No EECs were recorded within the vicinity of the sites or the access tracks. Assessment via a seven-part test found that the proposal was unlikely to significantly impact on any of the identified species or communities listed in the TSC Act 1995. Assessment under the EPBC Act 1999 found that the proposal was unlikely to significantly impact on any of the identified species or communities listed on the EPBC Act 1999. In conclusion, the proposal is unlikely to significantly impact on any species, populations or ecological communities listed under the TSC Act 1995 or EPBC Act 1999.

Recommendations

The following recommendations have been outlined to provide ecological guidelines and site management strategies that may prevent any ongoing detrimental impacts upon habitat surrounding the proposed exploration sites.

- The drilling and other vehicles are to avoid damaging or removing native vegetation by wherever possible carefully driving around all trees and shrubs to minimise any impacts on native vegetation. This will ameliorate the Key Threatening Processes '*Removal of Native Vegetation'*;
- Where vegetation removal is unavoidable, it shall be kept to a minimum. Particular effort should be made to avoid disturbing mature trees and off site hollow bearing trees;
- All removed vegetation shall remain within close proximity to the site, with mature trees gently placed in surrounding areas to allow for the survival and dispersal of any displaced fauna currently utilising these trees;
- It is recommended that water management strategies be implemented at the proposed sites to prevent the movement of sediments or contaminated waters / liquids into surrounding habitats, including potential down-slope waterways or drainage lines;
- It is recommended that appropriate measures such as vehicle cleaning protocols be employed to ensure that machinery working within the sites do not bring materials (soils, weeds or pathogens etc.) onto the sites that may cause the distribution of weed species or introduce pathogens such as *Phytopthera.* This will ameliorate the Key Threatening Processes '*Weed Invasion by Exotic Perennial Grasses'* and '*Infection of Native Plants by Phytopthera cinnamomi'*;
- It is recommended that water extraction for use during construction follow the designated protocols provided by GHD (2014) in relation to the accepted levels of extraction to mitigate against the Key Threatening Process '*Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands';* and
- That topsoil management be implemented at each of the sites to ensure that current seed banks in top soil be returned to the site after cessation of geotechnical investigations.

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Terms and Abbreviations

Abbreviation	Description
DECCW	NSW Department of Environment, Climate Change and Water (now OEH)
DoE	Department of the Environment
DoP	NSW Department of Planning
EEC	Endangered Ecological Community
EP&AA Act 1997	Environmental Planning and Assessment Amendment Act 1997
EPBC Act 1999	Commonwealth *Environment Protection Biodiversity Conservation Act 1999*
ha	Hectare
OEH	NSW Office of Environment and Heritage
RPS Australia East Pty Ltd	RPS
SEWPaC (now DoE)	Department of Sustainability, Environment, Water, Population and Communities
TSC Act 1995	NSW *Threatened Species Conservation Act 1995*

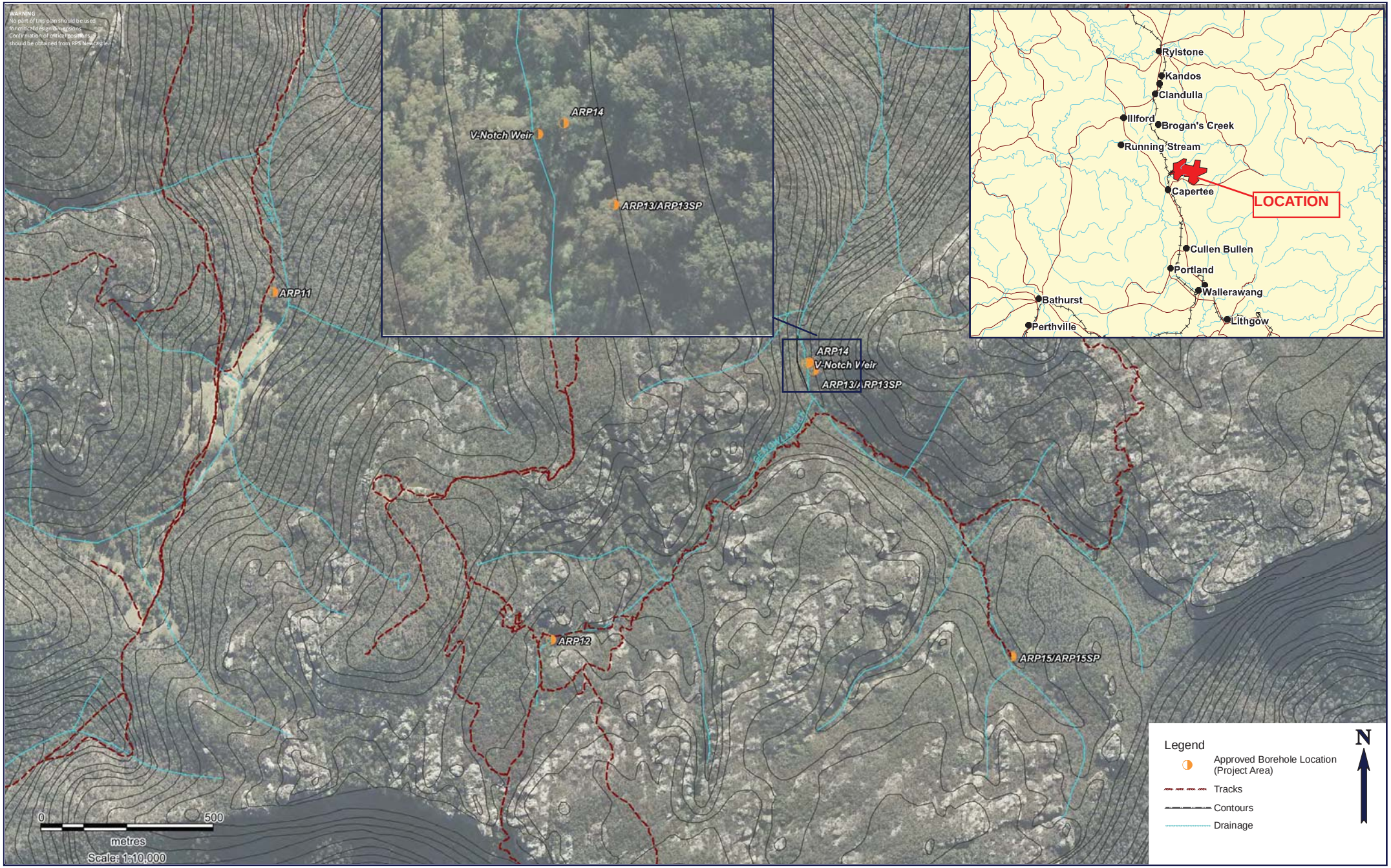
1.0 Introduction

RPS Australia East Pty Ltd (RPS) was engaged by Centennial Airly Pty Ltd to undertake a Flora and Fauna Assessment for seven proposed and one alternative geotechnical and water monitoring bores and a proposed V-notch weir.

This report was undertaken over lands encompassed by the existing Authorisation Area A232. This is important for determination of the quality of the coal resource, to obtain geotechnical data on the strata associated with the coal seam and to monitor groundwater levels. The construction and drilling works will take approx 4 months in total. Once the boreholes have been constructed and coal resources tested the bore sites will be mostly rehabilitated but will leave the piezos in place for approximately 25 years (life of mine). Then the piezos will be decommissioned and the bore sites completely rehabilitated. The seven sites, located adjacent to the existing or the disused access tracks, as well as a location to install a V-notch weir were investigated in order to assess their potential for supporting threatened species, populations and ecological communities known or likely to occur within the region.

This assessment aims to examine the likelihood of the proposed exploration program to have a significant effect on any threatened species, populations or ecological communities listed within the *Threatened Species Conservation Act 1995* (TSC Act 1995). The report recognises the relevant requirements of the *Environmental Planning and Assessment Act 1979* (EP&A Act 1979) as amended by the *Environmental Planning and Assessment Amendment Act 1997* (EP&AA Act 1997). Assessment is also made with regard to those threatened entities listed federally under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999).

Figure 1 shows the locations of the tracks, proposed borehole sites and the weir location.



TITLE: FIGURE 1: SITE LOCATION

LOCATION: AIRLY

DATUM: (GDA 94)
PROJECTION: MGA Zone 56

DATE: 19/04/2016
PURPOSE: FLORA AND FAUNA

LAYOUT REF: J:\JOBS\Centennial\All Jobs\123266 Airly Boreholes REF\10 - Drafting\MapInfo Workspace\Eco
VERSION (PLAN BY): B A3 (PH- NW)

CLIENT: CENTENNIAL COAL
JOB REF: 123266-2

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au

1.2 Site Particulars

Locality – Airly Mine, Capertee, NSW.

LGA – City of Lithgow Council.

Area - The survey areas, incorporating five borehole compounds are each approximately 50m x 50m. The development footprints are 450 m^2 each. The flora and fauna field assessment reviewed six areas of 50m x 50m taking into account surrounding habitats at each exploration site location.

Boundaries - The sites are wholly within the Airly Mine exploration area, which is partly contained within the Mugii Murum-ban State Conservation Area.

Current Land Use – The undeveloped lands contain native vegetation. Some access tracks occur through the Airly Mine exploration area.

Topography - The sites are situated on the upper slopes or ridgeline.

Vegetation - Proposed exploration sites ARP11, ARP13, ARP13SP, ARP14, ARP15, ARP15SP and ARP15A are characterised by MU 3 Hillslope Talus Mountain Gum - Brown Stringybark - Grey Gum - Broad-leaved Hickory Moist Forest and site ARP12 is characterised by MU 4 Sheltered Gully Brown Barrel Ferny Forest.

Exploration Bore Locations – **Table 1** provides MGA-56 coordinates for the six geotechnical exploration and groundwater monitoring sites and one V-notch weir location.

Table 1 MGA-56 Coordinates

Bore No.	Easting	Northing
ARP11	224172	6333539
ARP12	224980	6332531
ARP13 and ARP13SP	225744	6333312
ARP14	225728	6333335
ARP15 and ARP15SP	226319	6332480
ARP15A	226174	6332860
V-notch Weir	225721	6333332

1.3 Description of the Proposal

The proposed exploration program primarily consists of constructing seven bore holes (ARP11, ARP12, ARP13, ARP13SP, ARP14, ARP15 and ARP15SP.). ARP15A is regarded as an alternative site to ARP15 and ARP15SP however the expectation is that ARP15 and ARP15SP will be drilled.

These sites are proposed to be installed to investigate the location, depth, quality and thickness of the coal seam within the Authorisation Area A232. These bore holes will subsequently be equipped with piezos and used to monitor groundwater over the next 25 years (life of mine), after which they will be decommissioned and the bore sites wholly rehabilitated. A V-notch Weir is also proposed to be situated within Genowlan Creek near sites ARP13 and ARP14 to monitor water flow and detect any flow changes as a result of potential subsidence from existing underground mining.

There will be a requirement to reopen the final ~170m of track to access ARP13 / ARP13SP and ARP14 and the V-Notch Weir, and the final ~450m of track to access ARP15 / ARP15SP. An existing overgrown track

leads to these sites. There may also be a requirement to regrade rough sections of track and existing berms along the tracks to allow equipment to travel along the tracks, the berms will be reinstated to the original grades at completion of the works.

A low level of impact is expected due to the methodology used for accessing and drilling the proposed bores. The bore holes will be drilled by a track mounted drill rig. The proposed bores are located within previously cleared areas adjacent to existing or disused tracks to minimise removal of vegetation. In addition, where necessary the drill rig will be guided around any trees or vegetation in order to access the proposed bore sites. This will further minimise the impacts to local vegetation and the habitats within.

Water for drilling will be taken from existing water courses wherever possible. The proposed water extraction sources are:

- ARP11- Gap Creek dam located at 'Rock Bottom' or dam at Airly Mine;
- ARP12 - Genowlan Creek or in the event of insufficient flows the historic diamond creek mine;
- ARP13 - Genowlan Creek or in the event of insufficient flows the historic diamond creek mine;
- ARP13SP - Genowlan Creek or in the event of insufficient flows the historic diamond creek mine;
- ARP14 - Genowlan Creek or in the event of insufficient flows the historic diamond creek mine;
- ARP15 - Genowlan Creek or in the event of insufficient flows the historic diamond creek mine; and
- ARP15SP - Genowlan Creek or in the event of insufficient flows the historic diamond creek mine;

Where water is being sourced from Genowlan Creek, in order to minimise the impacts to natural flows during bore hole construction, water will be gradually pumped into tanks over night. If in the event that Genowlan Creek has insufficient flows water will be sourced from an existing dam at the historic diamond creek mine. The dam is located on an existing access track leading to the northwest from ARP12. Water from the dam will be transported to ARP12 and ARP15 / ARP15SP by helicopter.

1.4 Scope of the Study

The scope of this flora, fauna and ecological constraints assessment report is to:

- Identify vascular plant species found within the six exploration and weir sites;
- Identify existing vegetation communities within each exploration and weir site;
- Assess the status of identified plant species and vegetation communities under relevant legislation;
- Identify existing habitat types within the sites and assess the habitat potential for threatened species, populations, or ecological communities known from the proximate area;
- Through preliminary research, identify threatened fauna potentially using resources within the sites;
- Employ targeted habitat survey techniques to identify fauna, in particular threatened species potentially using the sites; and
- Assess the potential of the proposed exploration sites to have a significant impact on any threatened species, populations or ecological communities identified during field surveys or as having potential habitat on the site.

Whilst survey work has been undertaken wholly within the bounds of the site, consideration has been afforded to areas off the site in order to appreciate the environmental context of the sites. This has included assessment of potential indirect impacts.

The purpose of this report is to:

- Ensure planning, management and development decisions are based on sound scientific information and advice by documenting the presence of any biodiversity components or potential significant impacts that may exist on the site; and
- Provide information to enable compliance with applicable assessment requirements contained within the NSW TSC Act 1995 and EP&A Act 1979, and the Commonwealth EPBC Act 1999, and any other relevant state, regional and local environmental planning instruments.

1.5 Qualifications and Licensing

1.5.1 Qualifications

This report was written by Lauren Vanderwyk BSc and Paul Hillier BEnvSc of RPS.

1.5.2 Licensing

Research was conducted under the following licences:

- NSW National Parks and Wildlife Service Scientific Investigation Licence SL100536 (Valid 31 December 2014).
- Animal Research Authority (Trim File No: 14/195) issued by NSW Agriculture (Valid 12 March 2015).
- Animal Care and Ethics Committee Certificate of Approval (Trim File No: 14/195) issued by NSW Agriculture (Valid 18 March 2016).
- Certificate of Accreditation of a Corporation as an Animal Research Establishment (Trim File No: 14/532 & Ref No: AW2001/014) issued by NSW Agriculture (Valid 22 May 2017).

1.6 Certification

- The results presented in the report are, in the opinion of RPS, a true and accurate account of the species recorded, or considered likely to occur within the site; and
- All research workers have complied with relevant laws and codes relating to the conduct of flora and fauna research, including the *Animal Research Act 1995*, *National Parks and Wildlife Act 1974* and the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes.

2.0 Methodology

Field surveys were undertaken by one ecologist on 28 August 2014. A variety of field survey techniques were employed over the course of fieldwork for this assessment to record the suites of flora species and the fauna guilds likely to occur across the bore sites.

RPS has undertaken numerous assessments of this nature within the region and wider NSW. Considerable local knowledge and experience supports an excellent understanding of the key ecological issues for this locality, and in particular the management strategies required to appropriately address and accommodate these issues in accordance with the requirements of determining authorities. Our extensive portfolio, coupled with Commonwealth, State and Local Government policies and guidelines form the basis for our adopted project methodology.

Trapping and other intensive survey techniques were not conducted due to the relatively small sizes of the sites and limited likely disturbance. Targeted habitat searches and assessment of previous surveys were used to assess the site in place of trapping surveys.

2.1 Flora Survey

2.1.1 Vegetation Mapping

Flora surveys and vegetation mapping carried out on the sites has been undertaken as follows.

Review of previous ecological works in the area:

- DEC (2006) *The Vegetation of the Western Blue Mountains*. Unpublished report funded by the Hawkesbury – Nepean Catchment Management Authority. Department of Environment and Conservation, Hurstville;
- Roger Lembit (1991) *Flora Survey for Proposed Airly Colliery* report prepared for Novacoal Australia Pty Ltd; and
- RPS (2014) *Airly Mine Extension Project - Flora and Fauna Assessment* report prepared for Centennial Airly Pty ltd

Vegetation survey:

- This survey required confirmation of the community type(s) present (based on dominant species) by undertaking flora surveys and community identification at the locations of the proposed borehole sites;
- Consideration was given to the potential for the derived vegetation communities to constitute 'Endangered Ecological Communities' (EECs) as listed within the TSC Act 1995;
- Flora surveys were carried out at each of the proposed borehole site locations, with an emphasis on potentially significant species, as outlined below. The flora survey also included the consideration of the site in line with methodology such as the "Random Meander Technique" described by Cropper (1993); and
- Describe the type and general extent of the vegetation communities present into definable map units where appropriate. Standardised Map Units described in DEC (2006) were used.

2.1.2 Survey Limitations

Timing limitations are often encountered during ecological surveys due to the seasonality of activity and de-tectability for a number of flora and fauna species being studied. There is a range of common albeit cryptic plant species that have a brief flowering period and hence small 'window' of effective detectability. In

addition, the seasonality of surveys also places limits on the number of flora species identified in the site. Therefore, some threatened species not detected cannot be discounted off-hand due to seasonality and other factors, and are therefore addressed in terms of their potential for occurrence within the site based on ecological factors. As such, the precautionary principle is applied and for some species, where appropriate, assumed presence is made for assessment purposes.

2.1.3 Significant Flora Survey

A list of potentially occurring significant flora species from the locality (10km radius) was compiled, which included threatened species, populations and ecological communities listed under the TSC Act 1995 and EPBC Act 1999, as well as any other species deemed to be of local importance. Targeted surveys and habitat assessments were then undertaken over each bore site to determine their presence or likely presence. The positions of any threatened flora encountered were recorded using a Differential GPS system, capable of sub-metre accuracy.

2.2 Habitat Survey

An assessment of the relative value of the habitats present at each site was carried out. This assessment focused primarily on the identification of specific habitat types and resources on each site favoured by known threatened species from the region. The assessment also considered the potential value of each site (and immediate surrounds) for all major guilds of native flora and fauna.

Habitat assessment was based on the specific habitat requirements of each threatened fauna species in regards to home range, feeding, roosting, breeding, movement patterns and corridor requirements. Consideration was given to contributing factors including topography, soil, light and hydrology for threatened flora and assemblages.

2.3 Fauna Survey

The fauna survey methodology initially consisted of the production of an Expected Fauna Species List for the area and an assessment of the potential use of the sites by threatened fauna species (as listed under the TSC Act 1995 and the EPBC Act 1999) identified from the vicinity of the sites. This was achieved by undertaking literature and database reviews followed by confirmation through field surveys and any additional species observed were noted on the list. Opportunistic sightings of scratches, scats, skeletal remains, diggings and tracks as detailed within Triggs (2004) were also recorded to provide secondary indications of fauna habitat utilisation around each site.

3.0 Results

The prevailing weather conditions during the survey period are presented in **Table 2** below.

Table 2 Prevailing Weather Conditions for Thurs 28 Aug 2014

Measurement	Result
Temperature	5.2-11.8°
Wind	Moderate-heavy
Cloud	100%
Rain (24 hrs)	1.8mm
Sun Rise	06:23
Set	17:39

Source: Bureau of Meteorology website: http://www.bom.gov.au/climate/dwo/IDCJDW2075.latest.shtml information for Lithgow, and the Geoscience website:http://www.ga.gov.au/bin/geodesy/run/gazmap_sunrise?placename=lithgow&placetype=0&state=0#loc

3.2 Desktop Assessment

3.2.1 Database Searches

The results of database searches using NSW BioNet, NPWS Atlas of NSW Wildlife (Accessed May 2014) and EPBC Protected Matters Search (Accessed August 2014) indicated that 26 threatened flora species, 59 threatened fauna species and four Endangered Ecological Communities (EECs) have been previously recorded within 10 km of the sites and/or have potential habitat within the sites. These species are listed in **Table 3** below. Additionally, any species known to occur within the area due to previous surveys (RPS 2014) have been considered for further assessment in the threatened species table contained in**Table 5**.

Table 3 Occurring and potentially occurring Threatened Flora, Fauna and Ecological Communities within a 10 km radius of the sites

Scientific name	Common name	TSC Act	EPBC Act	No. of Records in NPWS Atlas
Flora				
Acacia bynoeana	Bynoe's Wattle	E	V	-
Acacia flocktoniae	Flockton Wattle	V	V	-
Asterolasia elegans	-	E	E	-
Astrotricha crassifolia	Thick-leaf Star-hair	V	V	-
Callistemon linearifolius	Netted Bottle Brush	V	-	1
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V	-
Darwinia peduncularis	-	V	-	-
Eucalyptus aggregata	Black Gum	V	-	2
Eucalyptus cannonii	Capertee Stringybark	V	-	114
Euphrasia arguta	-	CE	CE	-
Grevillea evansiana	-	V	V	-
Grevillea obtusiflora subsp. fecunda	Grey Grevillea	E	E	32
Leionema sympetalum	Rylstone Bell	V	V	-
Pelargonium sp. *Striatellum* (G.W.Carr 10345)	Omeo Stork's-bill	E	E	-

Scientific name	Common name	TSC Act	EPBC Act	No. of Records in NPWS Atlas
Persoonia marginata	Clandulla Geebung	V	V	19
Phebalium bifidum	-	E	-	9
Philotheca ericifolia	-	-	V	-
Pomaderris brunnea	Brown Pomaderris	V	V	-
Prasophyllum sp. *Wybong* (C.Phelps ORG 5269)	a Leek Orchid	-	CE	-
Prostanthera cryptandroides subsp. cryptandroides	Wollemi Mint-bush	V	V	2
Prostanthera stricta	Mount Vincent Mint-bush	V	V	118
Pultenaea glabra	Smooth Bush-pea	V	V	-
Pultenaea sp. Genowlan Point	-	E	CE	7
Thesium australe	Austral Toadflax	V	V	-
Triplarina imbricata	Creek Triplarina	E	E	-
Wollemia nobilis	Wollemi Pine	E	E	-
Amphibians				
Heleioporus australiacus	Giant Burrowing Frog	V	V	-
Litoria aurea	Green and Golden Bell Frog	E	-	-
Litoria booroolongensis	Booroolong Frog	E	E	10
Litoria littlejohni	Littlejohn's Tree Frog	V	-	-
Mixophyes balbus	Stuttering Frog	E	-	1
Pseudophryne australis	Red-crowned Toadlet	V	-	-
Reptiles				
Aprasia parapulchella	Pink-tailed Worm-lizard	V	V	-
Hoplocephalus bungaroides	Broad-headed Snake	E	V	-
Suta flagellum	Little Whip Snake	V	-	-
Varanus rosenbergi	Rosenberg's Goanna	V	-	2
Avifauna				
Anthochaera phrygia	Regent Honeyeater	CE	E	243
Botaurus poiciloptilus	Australasian Bittern	E	E	-
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	35
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	21
Chthonicola sagittata	Speckled Warbler	V	-	34
Circus assimilis	Spotted Harrier	V	-	-
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	-	115
Daphoenositta chrysoptera	Varied Sittella	V	-	25
Epthianura albifrons	White-fronted Chat	V	-	1
Falco subniger	Black Falcon	V	-	1
Glossopsitta pusilla	Little Lorikeet	V	-	73
Grantiella picta	Painted Honeyeater	V	-	1
Hieraaetus morphnoides	Little Eagle	V	-	15
Ixobrychus flavicollis	Black Bittern	V	-	1
Lathamus discolor	Swift Parrot	E	E	21

Scientific name	Common name	TSC Act	EPBC Act	No. of Records in NPWS Atlas
Leipoa ocellata	Malleefowl	-	V	-
Lophoictinia isura	Square-tailed Kite	V	-	2
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	39
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	29
Neophema pulchella	Turquoise Parrot	V		31
Ninox connivens	Barking Owl	V		15
Ninox strenua	Powerful Owl	V		9
Pachycephala inornata	Gilbert's Whistler	V	-	-
Petroica boodang	Scarlet Robin	V	-	18
Petroica phoenicea	Flame Robin	V	-	3
Polytelis swainsonii	Superb Parrot	-	V	-
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-	9
Rostratula australis	Australian Painted Snipe	-	V	-
Stagonopleura guttata	Diamond Firetail	V	-	71
Tyto tenebricosa	Sooty Owl	V	-	4
Mammals				
Cercartetus nanus	Eastern Pygmy-Possum	V	-	-
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	16
Dasyurus maculatus maculatus	Spotted-tailed Quoll	V	E	3
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	6
Miniopterus australis	Little Bentwing-bat	V	-	1
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	19
Nyctophilus corbeni	South-eastern Long-eared Bat	-	V	-
Petaurus norfolcensis	Squirrel Glider	V	-	2
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	1
Phascolarctos cinereus	Koala	V	V	1
Potorous tridactylus tridactylus	Long-nosed Potoroo	-	V	-
Pseudomys novaehollandiae	New Holland Mouse	-	V	-
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	1
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	1
Vespadelus troughtoni	Eastern Cave Bat	V	-	-
Insects				
Paralucia spinifera	Bathurst Copper Butterfly	-	V	-
Fish				
Maccullochella peelii	Murray Cod	-	V	-
Macquaria australasica	Macquarie Perch	-	E	-
Prototroctes maraena	Australian Grayling	-	V	-
Ecological Communities				
Genowlan Point *Allocasuarina nana* Heathland		E	-	n/a
Montane Peatlands and Swamps of the New England Tableland, NSW		E	-	n/a

Scientific name	Common name	TSC Act	EPBC Act	No. of Records in NPWS Atlas
North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions				
Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions (Listed as Upper Basalt Eucalypt Forests of the Sydney Basin Bioregion under the EPBC Act)		E	E	n/a
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland		E	CE	n/a

Key:

V Vulnerable

E Endangered

CE Critically Endangered

Migratory species listed under the EPBC Act have also been considered under this assessment. A Protected Matters Search was undertaken (Accessed July 2014) on the DoE website which lists potential migratory species. **Table 4** displays the potentially occurring migratory species within a 10 km radius of the sites.

Table 4 Potentially Occurring Migratory Species within a 10 km radius of the sites

Scientific Name	Common name	EPBC Act Status
Apus pacificus	Fork-tailed Swift	M
Ardea alba	Great Egret	M
Ardea ibis	Cattle Egret	M
Gallinago hardwickii	Latham's Snipe	M
Haliaeetus leucogaster	White-bellied Sea-Eagle	M
Hirundapus caudacutus	White-throated Needletail	M
Leipoa ocellata	Malleefowl	M
Merops ornatus	Rainbow Bee-eater	M
Monarcha melanopsis	Black-faced Monarch	M
Myiagra cyanoleuca	Satin Flycatcher	M
Rhipidura rufifrons	Rufous Fantail	M
Rostratula benghalensis	Painted Snipe	M

Key:

M Migratory
E Endangered

3.2.2 Literature Review

A review of flora and fauna assessment reports conducted within the Airly Project Application Area has been undertaken. This has included RPS (2014) and CMLR (2012). **Table 5** provides a list of any threatened species recorded.

Table 5 Threatened species recorded in the Project Application Area

Scientific name	Common name	Status under TSC Act	Status under EPBC Act
Eucalyptus cannonii	Capertee Stringybark	Vulnerable	
Prostanthera stricta	Mount Vincent Mint Bush	Vulnerable	Vulnerable
Pultenaea sp. Genowlan Point		Critically Endangered	Critically Endangered
*Anthochaera phrygia**	Regent Honeyeater	Critically Endangered	Endangered
Callocephalon fimbriatum	Gang-gang Cockatoo	Vulnerable	-
Calyptorhynchus lathami	Glossy Black-Cockatoo	Vulnerable	-
Chalinolobus dwyeri	Large-eared Pied Bat	Vulnerable	Vulnerable
*Chthonicola sagittatus**	Speckled Warbler	Vulnerable	-
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	Vulnerable	-
Daphoenositta chrysoptera	Varied Sittella	Vulnerable	-
Dasyurus maculatus maculatus	Spotted-tailed Quoll	Vulnerable	Endangered
Glossopsitta pusilla	Little Lorikeet	Vulnerable	-
*Grantiella picta**	Painted Honeyeater	Vulnerable	-
Hirundapus caudacutus	White-throated Needletail	-	Migratory
*Melithreptus gularis gularis**	Black-chinned Honeyeater (eastern subspecies)	Vulnerable	-
Merops ornatus	Rainbow Bee-eater	-	Migratory
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	Vulnerable	-
Myiagra cyanoleuca	Satin Flycatcher	-	Migratory
Myotis macropus	Southern Myotis	Vulnerable	-
Ninox strenua	Powerful Owl	Vulnerable	-
*Pachycephala inornata**	Gilbert's Whistler	Vulnerable	-
Petaurus norfolcensis	Squirrel Glider	Vulnerable	-
Petroica boodang	Scarlet Robin	Vulnerable	-
Petroica phoenicea	Flame Robin	Vulnerable	-
Pomatostomus temporalis temporalis	Grey-crowned Babbler	Vulnerable	-
Stagonopleura guttata	Diamond Firetail	Vulnerable	-
Tyto tenebricosa	Sooty Owl	Vulnerable	-

Scientific name	Common name	Status under TSC Act	Status under EPBC Act
Tyto novaehollandiae	Masked Owl	Vulnerable	-
*Varanus rosenbergi**	Rosenberg's Goanna	Vulnerable	-

*Recorded only by The University of Queensland (*CMLR 2012)*

3.3 Flora Survey

3.3.1 Vegetation Community Mapping

RPS has undertaken extensive surveys across the Airly Mine Project Area as part of the works done by RPS (2014). These surveys have included a review of "*The Vegetation of the Western Blue Mountains including the Capertee, Coxs, Jenolan and Gurnang Areas*" (DEC 2006). RPS undertook extensive vegetation surveys, using a combination of floristic quadrats and rapid data points to describe and map the extents of vegetation across the Airly Project Area. The locations of proposed bore sites occur within the area covered by that work and subsequent 2014 report. The vegetation communities within the sites are as follows:

- MU 3 Hillslope Talus Mountain Gum – Brown Stringybark – Grey gum – Broad-leaved Hickory Moist Forest at exploration sites ARP11, ARP13, ARP13SP, ARP14, ARP15, ARP15SP and ARP15A; and
- MU 4 Sheltered Gully Brown Barrel Ferny Forest, a community that occurred at exploration Site ARP12;

Below is a description of the above-listed vegetation communities. Descriptions of each site are provided in **Section 4**.

1. MU 3 Hillslope Talus Mountain Gum – Brown Stringybark – Grey gum – Broad-leaved Hickory Moist Forest

Plate 1 MU 3 Hillslope Talus Mountain Gum – Brown Stringybark – Grey gum – Broad-leaved Hickory Moist Forest

Description: Structurally this vegetation is a moderately tall forest, usually with an open shrub layer (although *Acacia falciformis* can dominate some sites). Similarly the ground layer can vary from sparse to well covered.

Canopy Layer: 12 to 30 m – 30% PFC. Dominated by *E. cypellocarpa* with *E. punctata* and *E. polyanthemos* also common.

Shrub Layer: 1 to 4 m – 2 to 25% PFC. The shrub layer varies from sparse to well developed (in more protected areas) and can include species characteristic of dry sites (e.g. *Acrotriche rigida*) and also species such as *Indigofera australis* that favour more moist sites

Ground Layer: 0 to 1 m – 30% PFC. A high diversity of herbs and forbs dominated the ground layer, *Pteridium esculentum* was dominant.

Classification: This vegetation community is not commensurate with any Endangered Ecological Community listed under the TSC Act or EPBC Act.

2. MU 4 Sheltered Gully Brown Barrel Ferny Forest

Plate 2 MU 4 Sheltered Gully Brown Barrel Ferny Forest

Description: This vegetation is typically a very tall forest and can include a number of vegetation strata. Occurs in deep protected gullies.

Canopy Layer: 10 to 16 m – 20 to 30% PFC. Dominant species included: *E. fastigata* and/or *E. cypellocarpa.* There is frequently also a lower tree layer of species generally associated with depauperate rainforest or wet gullies (*Myrsine howittana*; *Elaeocarpus reticulatus*).

Shrub Layer: 2 to 4 m – 5 to 25% PFC. Dominant shrub species are ferns including large tree ferns and sometimes *Todea barbara*.

Ground Layer: 0 to 1.5 m – variable 40 to 80% PFC. Ferns and herb species that prefer moist sites dominate the ground layer, but some grass species (*Microlaena stipoides*; *Entolasia marginata*) also occur in the ground layer.

Classification: This vegetation community is not commensurate with any Endangered Ecological Community listed under the TSC Act or EPBC Act.

None of the vegetation communities described above have been listed under the TSC Act 1995 or EPBC Act 1999. Additionally, borehole locations within each vegetation community have been strategically positioned to be within previously cleared or naturally open areas and adjacent to existing or disused tracks to limit vegetation disturbance. Where necessary, the drill rig will be guided around any trees or vegetation in order to access the proposed bore sites. This will further minimise the impacts to vegetation within these communities.

All flora species recorded at the four proposed exploration sites are listed in **Appendix 2**.

3.3.2 Significant Flora

A list of potentially occurring significant flora species from the locality (10km radius) and those that were deemed to have potential to occur within the sites due to habitat attributes, was compiled, which included

threatened species and ecological communities listed under the TSC Act 1995, along with those species listed on the EPBC Act 1999 and any other species deemed to be of local importance. Where suitable habitat for potentially occurring significant flora species was found on some of the sites (these species are included in **Table 2**), targeted surveys were conducted during field surveys.

No threatened flora was detected within any of the sites or associated access tracks.

3.3.3 Habitat Survey

Habitat within the sites was assessed for their potential to support native flora and fauna species including threatened flora and fauna species for which records occur within the wider locality.

3.3.3.1 Flora Habitat

The native vegetation communities throughout the proposed borehole areas are characterised by ridge top sandy soil substrates derived from erosional processes acting upon underlying sandstones, offering habitat for a range of common local plant species.

- MU 3 Hillslope Talus Mountain Gum - Brown Stringybark - Grey Gum - Broad-leaved Hickory Moist Forest, a community that occurred at exploration sites ARP11, ARP13, ARP13SP, ARP14, ARP15, ARP15SP and ARP15A. The extent of this vegetation is listed as 2695 ha (DEC 2006). This vegetation type is a tall, moist forest with sandy loams. It is known to provide habitat for threatened species such as *Eucalyptus cannonii* and *Prostanthera stricta*.
- MU 4 Sheltered Gully Brown Barrel Ferny Forest, a community that occurred at exploration site ARP12. The extent of this vegetation is listed as 71ha (DEC 2006). This vegetation type is tall with a high level of soil moisture. No threatened flora species recorded within the Airly Project Area have been recorded within this vegetation community;

3.3.3.2 Fauna Habitat

Habitat occurring at each of the proposed exploration sites varied from dry sclerophyll, open forest habitat (sites ARP11, ARP13, ARP13SP, ARP14, ARP15, ARP15SP and ARP15A) to a more sheltered, wet sclerophyll forest habitat (site ARP12).

No hollows were detected within the sites however hollows are likely to be prevalent in the immediate surrounding area. Suitable habitat occurs across forested areas for ground-dwelling mammals including the threatened Spotted-tailed Quoll (*Dasyurus maculatus*) as well as threatened woodland bird species including the Scarlet Robin (*Petroica boodang*), Varied Sittella (*Daphoenositta chrysoptera*) and Flame Robin (*Petroica phoenicea*). Common amphibians are likely to utilise the stream and associated habitats adjacent to ARP13 and ARP14.

3.3.3.3 Corridors and Habitat Linkages

The proposed sites occur within areas of contiguous native vegetation and comprise a small part of the larger Mugii Murum-ban State Conservation Area. The proposed activity has been designed to minimise the impact on native vegetation by drilling the bores in areas previously exposed to disturbance, in naturally open areas and within close proximity to existing or disused tracks. It is expected that the proposed activity will retain the native vegetation in its current state by minimising the removal of any vegetation apart from that regenerating on already disturbed areas.

It is considered that this low impact approach and the retention of the native vegetation within the area will not have a detrimental effect on the corridors and habitat linkages required for the movements of the local

fauna. It is considered that the proposed works are unlikely to result in fragmentation or isolation of potential habitat for locally occurring threatened species.

3.4 Fauna Survey

3.4.1 Mammal Species

No mammal species were recorded within the proposed sites, although it is most likely that the proposed sites represent part of the home range of a larger number of common mammal species.

There is potential for threatened mammal species to occur within the dense understory at sites ARP12, ARP15 / ARP15SP and ARP15A, where the accumulation of forest debris and litter presents foraging and shelter opportunities for small mammals and their prey. A mature canopy and shrub layer at these sites also represents good foraging and sheltering habitat for arboreal mammal species and insectivorous bats. However this potential is diminished within the more open forest of sites ARP11, ARP13, ARP13SP and ARP14.

3.4.2 Avifauna Survey

Bird species recorded within the vicinity of the proposed sites were limited to common woodland and forest species.

The wet sclerophyll forest at site 12 provides favoured summer habitat for the threatened Gang-gang Cockatoo (*Callocephalon fimbriatum*), whilst the forested areas at sites the remaining sites provide potential habitat for threatened woodland species including the Scarlet Robin (*Petroica boodang*) and Brown Treecreeper (*Climacteris picumnus victoriae*).

3.4.3 Secondary Indications and Incidental Observations

Opportunistic sightings of secondary indications (scratches, scats, skeletal remains, diggings, tracks etc.) provided evidence for the presence of common mammal species in the vicinity of the proposed borehole locations. Scats and tunnels of the Common Wombat (*Vombatus ursinus*) were identified along with scats of macropod species common to the area, such as the Black Wallaby (*Wallabia bicolor*).

4.0 Potential Impacts

4.1 Construction

This section provides an overview of each site, including the proposed vegetation removal in order to accommodate the installation equipment.

Overall, the footprint for each compound will be 450 m^2, noting that only one compound is required for boreholes ARP13 and ARP13SP and only one compound is required for boreholes ARP15 and ARP15SP.This would result in a temporary footprint of approximately 0.18 ha within MU 3 Hillslope Talus Mountain Gum – Brown Stringybark – Grey gum – Broad-leaved Hickory Moist Forest at exploration sites and approximately 450 m^2within MU 4 Sheltered Gully Brown Barrel Ferny Forest. Assuming a maximum width of 5m (likely to be less), reopening of overgrown tracks required for access, requires the removal of approximately 0.31 ha of regrowth MU 3 Hillslope Talus Mountain Gum – Brown Stringybark – Grey gum – Broad-leaved Hickory Moist Forest.

4.1.1 ARP11

This borehole location is situated on a lower slope with an east to south easterly aspect and is surrounded by steep sandstone escarpments. This site occurs within an area of disturbed MU 3 Hillslope Talus Mountain Gum – Brown Stringybark – Grey gum – Broad-leaved Hickory Moist Forest. This site was dominated by *Eucalyptus cypellocarpa* (Mountain Grey Gum) and *Acacia falciformis* (Broad-leaved hickory). A mid-storey comprised of *Allocasuarina littoralis* (Black She-oak). A sparse shrub layer was dominated by *Acacia obtusifolia*, *Indigofera australis* (Australian indigo) and *Bursaria spinosa* (Blackthorn). The ground layer included *Microlaena stipoides* (Weeping Grass), *Poa sieberiana*, *Lomandra filiformis* (Wattle Mat-rush) and *Lomandra longifolia* (Spiny-headed Mat-rush).

Plate 3 ARP11

An existing track provides access to ARP11. Therefore, no clearing will be required to access this site. This site will require the removal of a small number of small to medium-sized *Eucalyptus cypellocarpa* and *Acacia falciformis*.

Targeted searches were undertaken within the 50m x 50m search area. No threatened flora species were recorded. No fauna habitat features, such as burrows or hollow-bearing trees were recorded within the proposed footprint of this site.

4.1.2 ARP12

This borehole location is situated on a lower slope with a west facing aspect and is surrounded by steep sandstone pagodas. This site occurs within an area of MU 4 Sheltered Gully Brown Barrel Ferny Forest. This site was dominated by *Eucalyptus blaxlandii* (Blaxland's Stringybark) in the canopy. Mid-storey species include *Leptospermum polyanthum*, *Leptospermum polygalifolium* subsp. *polygalifolium* (Tantoon), *Myrsine howittiana* (Brush Muttonwood) and *Cyathea australis* (Rough Tree-fern). A shrub layer was dominated by *Acacia obtusifolia* and *Pomaderris betulina* (Birch Pomaderris). A dense ground layer consisted of *Pteridium esculentum* (Bracken), *Lomandra filiformis* (Wattle Mat-rush) and *Stypandra glauca* (Nodding Blue Lily).

Plate 4 ARP12

An existing track provides access to ARP12. This track is likely to require some regrading to enable vehicle access. Preparation of this site will predominately require the clearing of the mid-storey, shrub and ground cover species noted above.

Targeted searches were undertaken within the 50m x 50m search area. No threatened flora species were recorded. No fauna habitat features, such as burrows or hollow-bearing trees were recorded within the proposed footprint of this site.

4.1.3 ARP13 / ARP13SP

This combined borehole location is situated on a narrow lower slope with a north westerly aspect. APR13 / ARP13SP occurs next to the sites proposed for ARP14 and the proposed V-notch weir. It occurs within an area of MU 3 Hillslope Talus Mountain Gum - Brown Stringybark - Grey Gum - Broad-leaved Hickory Moist Forest. This site was dominated by *Eucalyptus cypellocarpa* (Mountain Grey Gum). A sparse shrub layer was dominated by *Acacia obtusifolia* and *Leptospermum polygalifolium* subsp. *polygalifolium* (Tantoon). The ground layer included *Pteridium esculentum* (Bracken), *Microlaena stipoides* (Weeping Grass), *Poa sieberiana*, *Lomandra filiformis* (Wattle Mat-rush), *Indigofera australis* (Australian indigo) and *Lomandra longifolia* (Spiny-headed Mat-rush).

Plate 5 ARP13 / ARP13SP

A suitably sized clearing exists that is likely to accommodate the construction of ARP13 / ARP13SP. Therefore, clearing is likely to be limited to the shrub and ground layer.

Targeted searches were undertaken within the 50m x 50m search area. No threatened flora species were recorded. No fauna habitat features, such as burrows or hollow-bearing trees were recorded within the proposed footprint of this site.

An existing overgrown track provides access to the site. Reopening of the track, including the removal of regrowth shrubs and small trees will be required. The access track will also provide access to ARP14 and the V-notch weir.

Plate 6 Access to ARP13 / ARP13SP, ARP14 and V-notch Weir.

It is proposed that water for drilling will be taken from the adjacent Genowlan Creek. In order to minimise the impacts to natural flows during bore hole construction, water will be gradually pumped into tanks over night. The operation of a pump may cause short-term noise disturbance to local wildlife, including Spotted-tailed Quoll (*Dasyurus maculatus maculatus*). This species was recorded along Genowlan Creek (RPS 2014).

The location of water extraction is proposed to occur at a creek crossing of Genowlan Creek, which is also used to access ARP14 and the V-notch Weir.

Plate 7 Proposed water extraction site and access to ARP13 / ARP13SP, ARP14 and V-notch Weir.

4.1.4 ARP14

This borehole location is situated on a narrow lower slope with a north westerly aspect. APR14 occurs between the sites proposed for ARP13 / ARP13SP and the proposed V-notch weir. It occurs within an area of MU 3 Hillslope Talus Mountain Gum - Brown Stringybark - Grey Gum - Broad-leaved Hickory Moist Forest. This site was dominated by *Eucalyptus cypellocarpa* (Mountain Grey Gum). A dense shrub layer was dominated by *Acacia obtusifolia*. The ground layer included *Pteridium esculentum* (Bracken), *Microlaena stipoides* (Weeping Grass), *Poa sieberiana* and *Lomandra longifolia* (Spiny-headed Mat-rush).

Plate 8 ARP14

The clearing required for ARP13 / ARP13SP will also accommodate the clearing requirements for ARP14, with some additional clearing required for the bore site.

Targeted searches were undertaken within the 50m x 50m search area. No threatened flora species were recorded. No fauna habitat features, such as burrows or hollow-bearing trees were recorded within the proposed footprint of this site.

Clearing to access this site has been previously discussed in **Section 4.3** above.

It is proposed that water for drilling will be taken from the adjacent Genowlan Creek. In order to minimise the impacts to natural flows during bore hole construction, water will be gradually pumped into tanks over night. The operation of a pump may cause short-term noise disturbance to local wildlife, including Spotted-tailed Quoll (*Dasyurus maculatus maculatus*). This species was recorded along Genowlan Creek (RPS 2014).

The location of water extraction is proposed to occur at a creek crossing of Genowlan Creek, which is also used to access ARP13 / ARP13SP and the V-notch Weir (See **Section 4.3** above).

4.1.5 V-notch Weir

This weir location is proposed to be situated within Genowlan Creek. It occurs within an area of MU 3 Hillslope Talus Mountain Gum - Brown Stringybark - Grey Gum - Broad-leaved Hickory Moist Forest. The proposed location is at a portion of the creek that contains a solid rock base on which to fit the weir. The surrounding vegetation, which may be disturbed during installation, includes *Acacia obtusifolia*, *Leptospermum polygalifolium* subsp. *polygalifolium* (Tantoon), *Pteridium esculentum* (Bracken), *Todea barbara* (King Fern), *Cyathea australis* (Rough Tree-fern), *Blechnum cartilagineum* (Gristle Fern) and *Sticherus flabellatus* (Umbrella Fern).

Targeted searches were undertaken within the proposed site. No threatened flora species were recorded. No fauna habitat features, such as burrows or hollow-bearing trees were recorded.

Plate 9 Proposed V-notch Weir Location

Plate 10 Installation site of proposed V-notch Weir

4.1.6 ARP15 / ARP15SP

This borehole location is situated on a narrow lower slope surrounded by steep sandstone pagodas, with a north facing aspect. It occurs within an area of MU 3 Hillslope Talus Mountain Gum - Brown Stringybark - Grey Gum - Broad-leaved Hickory Moist Forest. This site was dominated by *Eucalyptus cypellocarpa* (Mountain Grey Gum) and *Eucalyptus piperita* (Sydney Peppermint). The mid-storey consisted of *Elaeocarpus reticulatus* (Blueberry Ash) and *Allocasuarina littoralis* (Black She-oak). The shrub layer was dominated by *Acacia obtusifolia*, *Leptospermum polyanthum* and *Banksia spinulosa* var. *spinulosa* (Hairpin Banksia). The ground layer included *Pteridium esculentum* (Bracken), *Dianella caerulea* (Flax Lily) and *Lomandra longifolia* (Spiny-headed Mat-rush).

Plate 11 ARP15 / ARP15SP

A suitably sized clearing exists that is likely to accommodate the construction of ARP15 / ARP15SP. Therefore, clearing is likely to be limited to the shrub and ground layer, with some small to medium sized trees possibly being removed around the edges.

Targeted searches were undertaken within the 50m x 50m search area. No threatened flora species were recorded. No fauna habitat features, such as burrows or hollow-bearing trees were recorded within the proposed footprint of this site.

An existing overgrown track provides access to the site. Reopening of the track, including the removal of regrowth shrubs, small trees and fallen logs will be required.

Plate 12 Proposed access to ARP15 / ARP15SP

Plate 13 Proposed access to ARP15 / ARP15SP

4.1.7 ARP15A

This borehole location is situated on the State Conservation Area track, on a north facing lower slope in a valley surrounded by steep sandstone pagodas. It occurs within an area of MU 3 Hillslope Talus Mountain Gum - Brown Stringybark - Grey Gum - Broad-leaved Hickory Moist Forest. This site was dominated by *Eucalyptus cypellocarpa* (Mountain Grey Gum). The mid-storey consisted of *Allocasuarina littoralis* (Black She-oak). The shrub layer was dominated by *Acacia obtusifolia* and *Leptospermum polygalifolium* subsp. *polygalifolium* (Tantoon). The ground layer included *Pteridium esculentum* (Bracken) and *Lomandra longifolia* (Spiny-headed Mat-rush).

Plate 14 ARP15A

A suitably sized clearing exists that is likely to accommodate the construction of ARP15A. Therefore, clearing would be limited to the shrub and ground layer, with some small to medium sized trees possibly being removed around the edges.

Targeted searches were undertaken within the 50m x 50m search area. No threatened flora species were recorded. No fauna habitat features, such as burrows or hollow-bearing trees were recorded within the proposed footprint of this site.

An existing track provides access to the site. Some track regrading may be required to gain access to this site. This regrading will also assist in gaining access to ARP13 / ARP13SP, ARP14, ARP15 / ARP15SP and the V-notch weir.

Plate 15 Section of access track to ARP13 / ARP13SP, ARP14, ARP15 / ARP 15SP, ARP15A and the V-notch weir requiring regrading

4.2 Key Threatening Processes

A Key Threatening Process (KTP) is defined in the TSC Act 1995 as a process that threatens, or could threaten, the survival or evolutionary development of species, populations or ecological communities. Something can be a threat if it:

- Adversely affects two or more threatened species, populations or ecological communities; or
- Could cause species, populations or ecological communities that are not currently threatened to become threatened.

KTP's are listed in Schedule 3 of the TSC Act 1995. Five KTP's have the potential to occur as a consequence of the proposed exploration sites, being:

- Anthropogenic climate change;
- Clearing of native vegetation;
- Infection of native plants by *Phytophthora cinnamomi*;
- Invasion of native plant communities by exotic perennial grasses; and
- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands.

No other KTP's are believed to be likely as a consequence of the proposed exploration program.

"Anthropogenic climate change"

The activity is likely to contribute to the Key Threatening Process "Anthropogenic climate change". The proposed exploration works contribute to this KTP as a result of the removal of a small amount (approximately 0.54ha) of vegetation. The extent to which the proposed works contribute to this process is considered very low as the vegetation is likely to regenerate to pre-drilling condition after the completion of the bores.

"Clearing of native vegetation"

This project will contribute to this KTP through the removal of a very small amount of native vegetation, totalling approximately 0.54ha. This has the potential to impact upon a range of threatened fauna species (DEC 2001) including the Scarlet Robin, Spotted-tailed Quoll and various microbat species. However, the proposed boreholes will be drilled using a mobile drilling rig which for the most part will be able to navigate through the vegetation without requiring the removal of vegetation. Additionally, the majority of the proposed sites are located within existing, albeit partially regrown, clearings. The proposed borehole sites will be located in such a manner as to minimise the removal of native vegetation and are therefore unlikely to significantly contribute to this KTP.

"Infection of native plants by *Phytophthora cinnamomi*"

The activity has the potential to result in the importation of this pathogen, which has the potential to impact upon a broad range of threatened plant species (DEC 2002). It is considered that the proposed works will not significantly contribute to this KTP provided that the correct hygiene protocols are established and implemented.

"Invasion of native plant communities by exotic perennial grasses"

Due to the creation of soil disturbance at some borehole sites, there is the potential for these areas to be colonised by exotic perennial grasses at the conclusion of exploration activities. If introduced, exotic perennial grasses typically dominate such areas (DEC 2003), incrementally contributing to this KTP. Effective machinery and vehicle cleaning procedures prior to commencing work will reduce the potential for this KTP to occur.

"Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands"

The proposed activity involves the extraction of water from Genowlan Creek to supply the drill rig with water at ARP13 / ARP13SP and ARP14. Extraction of water which reduces flows, leads to a lower distribution of organic matter on which invertebrates and vertebrates depend (OEH 2014).

The rate of extraction will be timed proportional to the natural flow such that no alteration of flow will occur to significant extents. External water supplies are an alternative option if the stream is unable to provide sufficient levels of water without altering the amount of water and its flow.

The V-notch weir being placed in a stream adjacent to sites ARP13 / ARP13SP and ARP14 is a monitoring device that sits in the centre of the stream collecting data on water flow. This device is not expected to alter the flow of water as it is designed with the intention to monitor natural flows, not alter it in the process.

4.3 Considerations Under SEPP 44 – 'Koala Habitat Protection'

All sites are within the Mugii Murum-ban State Conservation Area. SEPP 44 does not apply to lands reserved under the *National Parks and Wildlife Act 1974*. Therefore, SEPP 44 is not applicable. In addition, no Koala feed trees occur within the sites.

5.0 Considerations under the EPBC Act 1999

An EPBC Act Protected Matters Search was undertaken within the SEWPaC (now DoE) online database (accessed July 2014) to generate a list of those Matters of National Environmental Significance (MNES) from within 10 km of the Survey Areas, which may have the potential to occur within the sites.

An assessment of those MNES relevant to biodiversity has been undertaken in accordance within *EPBC Act Policy Statement 1.1 Significant Impact Guidelines Matters of National Environmental Significance* (DoE, 2013). The matters of national environmental significance protected under national environment law include:

- Listed threatened species and communities;
- Listed migratory species;
- Ramsar wetlands of international importance;
- Commonwealth marine environment;
- World heritage properties;
- National heritage places;
- The Great Barrier Reef Marine Park;
- Nuclear actions; and
- A water resource, in relation to coal seam gas development and large coal mining development.

5.1 Nationally Listed Threatened, Migratory Species and Ecological Communities

Consideration of potential impacts to those nationally listed threatened species and ecological communities that have potential to occur has been undertaken and provided in **Table 4**.

No nationally listed species were recorded at any of the proposed sites. Two species, namely the Spotted-tailed Quoll (*Dasyurus maculatus maculatus*) and Large Eared Pied Bat (*Chalinolobus dwyeri*) were considered as having potential to occur within some if not all of the sites.

No nationally listed migratory species were observed throughout the survey period; nevertheless a number of species are likely to fly over the site or through the sites on an intermittent basis, those being the White-throated Needletail (*Hirundapus caudacutus*), Rainbow Bee-eater (*Merops ornatus*) and Rufous Fantail (*Rhipidura rufifrons*).

Ample foraging and roosting habitat for the above listed species is widespread within the immediate surrounding areas. Habitat for these species is unlikely to be impacted upon by the proposed activity due to the small temporary removal of vegetation that is proposed.

5.2 Wetlands of International Importance (the Ramsar convention)

There are no wetlands protected by international treaty (the Ramsar convention) arising from the EPBC Act Protected Matters Report generated for an area within 10km of the sites.

5.3 Commonwealth Marine Area

The proposal will not have a significantly adverse effect on any Commonwealth marine area, as there are no such marine areas within the region. No impacts to Commonwealth marine area will therefore occur.

5.4 World Heritage Properties and National heritage Properties

The western boundary of the NSW Greater Blue Mountains Area (GBMA) is located directly to the south of the sites in the form of the Gardens of Stone National Park. The GBMA is a World Heritage Property and National Heritage Place. Those assessment criteria, which are relevant to biodiversity, are considered below.

As per DoE (2013), an action is likely to have a significant impact on natural heritage values of a World Heritage property if there is a real chance or possibility that the action will:

- Reduce the diversity or modify the composition of plant and animal species in all or part of a World Heritage property;
- Fragment, isolate or substantially damage habitat important for the conservation of biological diversity in a World Heritage property;
- Cause a long-term reduction in rare, endemic or unique plant or animal populations or species in a World Heritage property; and
- Fragment, isolate or substantially damage habitat for rare, endemic or unique animal populations or species in a World Heritage property.

An action is likely to have a significant impact on natural heritage values of a National Heritage place if there is a real chance or possibility that the action will:

- Modify or inhibit ecological processes in a National Heritage place;
- Reduce the diversity or modify the composition of plant and animal species in a National Heritage place;
- Fragment or damage habitat important for the conservation of biological diversity in a National Heritage place;
- Cause a long-term reduction in rare, endemic or unique plant or animal populations or species in a National Heritage place; and
- Fragment, isolate or substantially damage habitat for rare, endemic or unique animal populations or species in a National Heritage place.

Due to the low level of impact and distance from the heritage area, no impact is expected to occur to this area.

5.5 Great Barrier Reef Marine Park

The proposal will not have a significantly adverse effect on Great Barrier Reef Marine Park, as this area is not within the region.

5.6 All Nuclear Actions

No type of nuclear activity is proposed for the area subject of the proposed activity..

5.7 Water resource, in relation to coal seam gas development and large coal mining development.

This MNES has been developed to determine whether a large coal mining development or CSG development is likely to have a significant impact on a water resource.

A large coal mining development relates to impacts on a water resource from activities that form part of the extraction process of coal. The development of associated infrastructure that is not part of the extraction process is not included in the definitions of large coal mining developments. The activities include water

supply for use in the extraction of coal, management of water generated as a result of extraction of coal, such as holding dams or water treatment facilities, and management of waste generated as a result of extraction of coal such as soil heaps.

A significant impact as a result of these activities could significantly alter the hydrological characteristics of a water resource. Changes to hydrology as a result of an action could include changes in water quantity including the timing of variations in water quantity, changes in the integrity of hydrological or hydrogeological connections including substantial structural damage and changes in the area or extent of a water resource.

The bore holes proposed within this proposed activity do not involve the extraction of water from an underground aquifer, rather they provide monitoring data relating to hydrological changes as a result of underground mining. If a bore hole is left open, the risk arises of contamination by run-off water from the surface in saline or industrial areas. This risk is mitigated by the plan to fully enclose each borehole with no potential access from outside water sources, thus contamination is mitigated. Additionally, DoE (2013b) states that exploration, appraisal and pilot activities are less likely to have a significant impact on a water resource, given the usually small scale of that activity. This supports the proposed activity as the impact area of each bore hole is <1m in diameter, a marginal impact in relation to this MNES.

Due to the overall purpose of the bore holes, the mitigation measures involved in eradicating the risk of surface water contamination and the small scale of the impact areas, the proposal is not considered to significantly impact upon a water resource, and thus does not contribute to this MNES.

6.0 Threatened Species and Communities Assessment

6.1 Identification of Subject Species and Communities

Threatened flora and fauna species (listed under the TSC Act 1995 and/or the EPBC Act 1999) that have been gazetted and recorded within a 10 km radius of the sites have been considered within this assessment. Endangered Ecological Communities (EECs) known from the broader area have also been addressed. Each species / community is considered for its potential to occur on the sites and the likely level of impact as a result of the proposal. This assessment deals with each species / community separately and identifies the ecological parameters of significance associated with the proposal.

Those species / communities that have been identified as having a greater than low chance of being impacted upon within the site or that have been recorded on the sites or its near vicinity during field investigations are subject to 7-part tests of significance and are assessed in **Appendix 1**.

This assessment deals with the following heads of consideration in tabulated form (refer to Table 4):

'Species / Community'/ Population – Lists each threatened species / EECs known from the vicinity. The status of each threatened species under the NSW TSC Act 1995 and the Commonwealth EPBC Act 1999 are also provided.

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

'Chance of Occurrence on Site' – Assesses the likelihood of each species / community to occur along or within the immediate vicinity of the sites in terms of the aforementioned habitat description and taking into account local habitat preferences, results of current field investigations, data gained from various sources (such as Atlas of NSW Wildlife etc) and previously gained knowledge via fieldwork undertaken within other ecological assessments in the locality.

'Likely Level of Impacts from Proposal' – Assesses the likely level / significance of impacts to each species / community/ population that would result from the proposed development, taking into account both short and long-term impacts. This assessment is largely based on the chance of occurrence of each species / community on site with due recognition to other parameters such as home range, habitat utilisation, connectivity etc. It also considers the scope of the proposal, including the likely extent of disturbance, duration of construction works etc. The 'subject species / communities' are identified within this part of the assessment process and have been recommended where necessary for the application of the seven-part test of significance in Appendix 1.

Table 6 Threatened Species, Populations or Communities Considered and Assessment of Potential Impacts

Scientific Name	Common Name	Status under TSC Act	Status under EPBC Act	Habitat requirements/ known distribution	Probability of occurrence in the Project Application Area	Potential for Impact
Flora						
Astrotricha crassifolia	Thick-leaf Star-hair	Vulnerable	Vulnerable	A shrub to 2.4 m high, root-suckering. Occurs near Patonga (Gosford LGA), and in Royal NP and on the Woronora Plateau (Sutherland and Campbelltown LGAs). There is also a record from near Glen Davis (Lithgow LGA). Occurs in dry sclerophyll woodland on sandstone. Flowers in spring.	**Unlikely.** Records for this species in the vicinity are incredibly rare and all other records of this species are in coastal environments. Little additional information is available for this species. This species is unlikely to occur.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Pultenaea glabra	Smooth Bush-pea	Vulnerable	Vulnerable	An erect shrub to 1.5 m tall with smooth stems and leaves. Grows in swamp margins, hillslopes, gullies and creek banks and occurs within dry sclerophyll forest and tall damp heath on sandstone. Known distribution restricted to the higher Blue Mountains and Glen Davis area.	**Unlikely.** The sites are outside of the known distribution of this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Pultenaea sp. Genowlan Point	Genowlan Point Pultenaea	Critically Endangered	Critically Endangered	A small shrub to 0.5 m with yellow and red pea flowers. Known from a single population at Genowlan Point in the Capertee Valley where it occurs on well-drained soil near the cliff edge. The population is restricted to a very small area of only 250 square m on Crown Land. The species has not yet been formally described. It is closely related to *Pultenaea glabra*.	**Unlikely.** Surveys did not detect this species. This species is restricted to the most upper limit of Genowlan Point.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Acacia bynoeana	Bynoe's Wattle	Endangered	Vulnerable	A semi-prostrate shrub to 0.8 m tall. Found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. The species is currently known from about 30 locations, where it occurs in small populations (1-5 plants) within heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. This species has been recorded along port Macquarie Road on ridge top habitat, approximately 12 km north of the Project Application Area.	**Unlikely.** The tall moist eucalypt forests that occur within the sites are not suitable habitat for this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Acacia flocktoniae	Flockton Wattle	Vulnerable	Vulnerable	An erect or spreading shrub growing 2-4 m high. Known from isolated occurrences at Mt Wilson and Little Hartley, south to Yerranderie and Picton, in the Central Tablelands of NSW. Grows in dry sclerophyll forest on sandstone; associated species include *Acacia stricta* and *Podolobium ilicifolium*. Usually flowers June-August, pods present in January.	**Unlikely.** Although potential habitat does occur in the sites, the northern limit of its known distribution (Mt Wilson) is over 50 km southeast of Airly.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Prostanthera cryptandroides subsp. cryptandroides	Wollemi Mint-bush	Vulnerable	Vulnerable	A spreading shrub to 2 m tall. Occurs on rocky ridgelines on Narrabeen Group Sandstones, within various vegetation types, particularly open forest dominated by *Eucalyptus fibrosa*. Distributed between Lithgow and Sandy Hollow on the NSW Central Tablelands and in nearby regions.	**Unlikely.** This conspicuous species was not detected within the limited area of the explorations sites.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Prostanthera stricta	Mount Vincent Mint-bush	Vulnerable	Vulnerable	A bushy, aromatic shrub to 2 m tall and 3 m diameter. Often a locally dominant under shrub in heath or scrub communities along cliff edges, or as an understorey species within a range of open forest or tall open forest types, or in adjacent transitional communities. Occurs from Mt Vincent to Genowlan Mountain in the Central Tablelands.	**Unlikely.** Suitable habitat exists within the sites, however targeted surveys of the limited survey area of each site did not detect this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.

Scientific Name	Common Name	Status under TSC Act	Status under EPBC Act	Habitat requirements/ known distribution	Probability of occurrence in the Project Application Area	Potential for Impact
Callistemon linearifolius	Netted Bottle Brush	Vulnerable	-	A shrub reaching 3-4 m tall, growing in dry sclerophyll forest on the coast and nearby ranges. Most records are from the Sydney Region between Georges and Hawkesbury rivers. It has also been recorded in Yengo National Park and parts of northern coastal NSW.	**Unlikely.** The sites are outside of the known distribution of this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Darwinia peduncularis	-	Vulnerable	-	A broadly spreading shrub to 1.5 m high. Occurs as local disjunct populations in coastal NSW with a couple of isolated populations in the Blue Mountains. It has been recorded from Brooklyn, Berowra, Galston Gorge, Hornsby, Bargo River, Glen Davis, Mount Boonbourwa and Kings Tableland. Usually grows on or near rocky outcrops on sandy, well-drained, low nutrient soil over sandstone. Flowers in winter to early spring.	**Unlikely.** Specific habitat types within the sites are not the preferred habitat for this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Eucalyptus aggregata	Black Gum	Vulnerable	-	Tree to 18 m tall with dark, fibrous-flaky bark. Grows in the lowest part of the landscape, within grassy woodland on cold, poorly-drained flats and hollows adjacent to creeks and small rivers. Found in cool, wet parts to the Central and Southern Tablelands, south from Bathurst, although the Wildlife Atlas database contains two records of this species within 10 km of the Project Application Area.	**Unlikely.** The sites are outside of the known distribution of this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Eucalyptus cannonii	Capertee Stringybark	Vulnerable	-	Tree to 15 m high with stringy bark. Distribution is restricted to an area of about 100 by 60 km in the central tablelands of NSW. The western border is approximately marked by a line between Bathurst and Mudgee, while the eastern locations occur approximately on a line between Lithgow and the town of Bylong. The altitude range of *Eucalyptus cannonii* is from about 460 m to 1040 m. Within the range, the species appears to tolerate most situations except valley floors. Tablelands Grassy Woodland Complex communities and Talus Slope Woodland.	**Unlikely.** This conspicuous species was not recorded within any of the sites. The survey area of each site is limited in size, and all canopy trees were readily identifiable, with this species not occurring.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Triplarina imbricata	Creek Triplarina	Endangered	Endangered	A shrub to almost 3 m tall. Often grows in damp places including heath and along watercourses in low open forest with Water Gum (*Tristaniopsis laurina*). Known occurrence is on the ranges of far north eastern NSW and there is a dubious record from Parramatta (before 1810).	**Unlikely.** The sites are outside of the known distribution of this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Cryptostylis hunteriana	Leafless Tongue-orchid	Vulnerable	Vulnerable	A cryptic species, possessing no leaves, thus only visible from November to February when its flowering stem protrudes up to 45 cm from the ground. Occurs in various habitat types ranging from swamp-heath to woodland. Chiefly found in coastal districts between the south and lower north coast of NSW.	**Unlikely.** The sites are outside of the known distribution of this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Prasophyllum sp. Wybong (C.Phelps ORG 5269)	a Leek Orchid	-	Critically Endangered	An orchid that appears as a single leaf over winter and spring. It flowers in spring with a spike to 30 cm tall, and then dies back to a tuber over summer and autumn. Typically found in shrubby and grassy habitats but also occurs in open eucalypt woodland and grassland. The species is known from seven separate populations in NSW spanning from the Northern Tablelands to the Upper Hunter Valley to the Central Tablelands west of Mudgee. The closest known population to the Project Application Area is near Ilford, approximately 20 km northwest of Capertee.	**Unlikely.** The tall moist eucalypt forests that occur within the sites are not suitable habitat for this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.

Scientific Name	Common Name	Status under TSC Act	Status under EPBC Act	Habitat requirements/ known distribution	Probability of occurrence in the Project Application Area	Potential for Impact
Grevillea evansiana	Evans Grevillea	Vulnerable	Vulnerable	A dense spreading shrub, rarely more than 0.5 m high, but can grow to 1.5 m, with white hairy stems. Grows in dry sclerophyll forest or woodland, occasionally in swampy heath, in sandy soils, usually over Hawkesbury sandstone. Restricted to a small area east of Rylstone, on the Central Tablelands, mostly on the western catchment but just getting into the Colo River catchment. Found on the western side of Wollemi National Park and nearby private lands, within the Rylstone LGA.	**Unlikely.** Although potential habitat occurs within some of the sites, flora surveys did not detect this species within the limited survey area.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Grevillea obtusiflora subsp. fecunda	Grey Grevillea	Endangered	Endangered	Spreading shrub, usually 0.2–2 m high, sometimes root-suckering. Consists of two subspecies that both exist within the region. Subspecies obtusiflora occurs as scattered groups in the understorey of low open eucalypt forest at an altitude of 730 m. Subspecies fecunda occurs in clusters within low, open scrub beneath open, dry sclerophyll forest, on orange, sandy loam soils with sandstone boulders, at an altitude of 570 m. Subspecies obtusiflora occurs near Clandulla, while subspecies fecunda occurs in the Capertee Valley, north-west of Lithgow, and in the Gardens of Stone National Park.	**Unlikely.** The tall moist eucalypt forests that occur within the sites are not suitable habitat for this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Persoonia marginata	Clandulla Geebung	Vulnerable	Vulnerable	A spreading shrub that grows to 50 cm high and up to 1 m across. Grows in dry sclerophyll forest and woodland on sandstone in heavier clayey, gravelly loam derived from Permian rocks at c. 700 m altitude on low ridges. Distributed in the Capertee district between Kandos and Portland. Core of the species distribution is within Clandulla State Forest, west of Kandos. Also recorded from Capertee.	**Unlikely.** The tall moist eucalypt forests that occur within the sites are not suitable habitat for this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Pomaderris brunnea	Rufous Pomaderris	Vulnerable	Vulnerable	A shrub to 3 m tall with distinctively hairy stems. Grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines. Has been found in association with *Eucalyptus amplifolia, Angophora floribunda, Acacia parramattensis, Bursaria spinosa* and *Kunzea ambigua*. Occurs at various sites in the Greater Sydney Region, the closest site to the Project Application Area being at Borai Creek, a tributary of the Colo River, located about 60 km ESE of Mount Genowlan.	**Unlikely.** Although potential habitat occurs within some of the sites, flora surveys did not detect this species within the limited survey area.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Asterolasia elegans	-	Endangered	Endangered	A tall, thin shrub to 3 m high. Occurs north of Sydney, within the Hills Shire and Hornsby local government areas. Occurs on Hawkesbury sandstone, in sheltered forests on mid to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest. The canopy at known sites includes *Syncarpia glomulifera* subsp. *glomulifera* (Turpentine), *Angophora costata* (Smooth-barked Apple), *Eucalyptus piperita* (Sydney Peppermint), *Allocasuarina torulosa* (Forest Oak), and *Ceratopetalum gummiferum* (Christmas Bush).	**Unlikely.** The sites are outside of the known distribution of this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Leionema sympetalum	Rylstone Bell	Vulnerable	Vulnerable	A shrub 2 – 3 m high, with angled stems which have star-shaped hairs. Grows on exposed, rocky outcrops/pagodas, chiefly in the ranges east of Rylstone. The species is known from four sites within a small area inside Wollemi National Park. Found in dry sclerophyll forest, but probably also occurs in open or closed heathland communities.	**Unlikely.** The sites are outside of the known distribution of this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.

Scientific Name	Common Name	Status under TSC Act	Status under EPBC Act	Habitat requirements/ known distribution	Probability of occurrence in the Project Application Area	Potential for Impact
Phebalium bifidum	Capertee Phebalium	Endangered	-	A shrub between 0.2 – 1.5 m high. Occurs in dry sclerophyll woodland or heath on structured loam soil; in most instances plants have been found on relatively flat ground on broad ridges and hill crests. Associated tree species include *Eucalyptus fibrosa, E. crebra, E. polyanthemos, E. punctata* and *Callitris endlicheri*. Associated understorey species include *Leptospermum muticus, Calytrix tetragona, Acacia gladiiformis* and *Grevillea obtusiflora* subsp. *fecunda*. Distribution is restricted to the Capertee Valley, south-east of Kandos. The species is extremely rare, in being known from only four disjunct sites from within the Valley. All known sites are outside conservation reserve.	**Unlikely.** Although potential habitat occurs within some of the sites, flora surveys did not detect this species within the limited survey area.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Philotheca ericifolia	-	-	Vulnerable	A spreading shrub to 2 m high. Grows in dry sclerophyll open forest or woodland on sandstone and in heath on damp sandy flats and gullies e.g. alluvial deposits of coarse gravel in dry creek beds. Associated species include *Eucalyptus crebra*, *Beyeria viscosa* and *Philotheca australis*. Inhabits the north-western slopes and central western slopes of NSW, from the upper Hunter Valley, to Pilliga and to the Peak Hill district. Occurrences of this species include within Wollemi National Park.	**Unlikely.** The tall moist eucalypt forests that occur within the sites are not suitable habitat for this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Thesium australe	Austral Toadflax	Vulnerable	Vulnerable	A small herb to 40 cm tall. Occurs in grassland or grassy woodland, often in damp areas. Commonly found in association with Kangaroo Grass (*Themeda australis*). Found in very small populations scattered across eastern NSW. Also found in Tasmania, Queensland and eastern Asia.	**Unlikely.** No suitable habitat containing *Themeda triandra* is found in the sites, in which this species co-habits.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Euphrasia arguta	-	Critically Endangered	Critically Endangered	An erect annual herb 20 – 35 cm high. Actively grows January – April, then dies back over the winter months. Known to occur in grassy habitats, such as open eucalyptus forests, often near rivers. Historically known from a limited number of places from Bathurst north to Walcha and now presumed extinct at many of these localities. Had not been collected for 100 years until its rediscovery in 2008 within the Nundle State forest of the NSW north-western slopes and tablelands. Also recorded from Barrington Tops in 2012.	**Unlikely.** The sites are outside of the known distribution of this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Pelargonium sp. Striatellum (G.W.Carr 10345)	Omeo Stork's-bill	Endangered	Endangered	A tufted perennial herb, usually located just above the high water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities. During dry periods, the species is known to colonise exposed lake beds. Known to occur in Victoria and the NSW Southern Tablelands on lake-beds within basalt plains.	**Unlikely.** The sites are outside of the known distribution of this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Wollemi nobilis	Wollemi Pine	Endangered	Endangered	This species is confined to the remote canyons of the Wollemi National Park west of Sydney NSW. Known habitats include deep gorges on Narrabeen Group Triassic sandstone often within warm temperate rainforest. Exact record locations have been withheld from public knowledge to protect the remaining populations of this species.	**Unlikely.** This species is restricted to gorges of the Wollemi National Park.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.

Scientific Name	Common Name	Status under TSC Act	Status under EPBC Act	Habitat requirements/ known distribution	Probability of occurrence in the Project Application Area	Potential for Impact
Invertebrates						
Paralucia spinifera	Bathurst Copper Butterfly	Endangered	Vulnerable	Found in an area of the Central Tablelands of New South Wales between Oberon, Hartley and Bathurst. All of the known sites occur within the Evans Shire and Lithgow City Local Government areas. Known to occur in areas above 900 m and where native Blackthorn (*Bursaria spinosa* subsp. *lasiophylla*) occurs. Most population sites are also exposed to full sun for a large portion of the day. The butterfly emerges from pupation from early August and is on the wing until at least early November. Although the timing of activity varies across the species range there appears to be a peak of activity for a couple of weeks in September for most sites. Adult butterflies fly between August and November depending on the elevation and aspect of the site.	**Unlikely.** The exploration sites do not support potential habitat with *Bursaria spinosa* subsp. *lasiophylla* for the species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Amphibians						
Heleioporus australiacus	Giant Burrowing Frog	Vulnerable	Vulnerable	Is distributed in south-eastern NSW and Victoria, and appears to exist as two distinct populations: a northern population largely confined to the sandstone geology of the Sydney Basin. Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Breeding habitat of this species is generally soaks or pools within first or second order streams. They are also commonly recorded from 'hanging swamp' seepage lines and where small pools form from the collected water. Spends more than 95% of its time in non-breeding habitat in areas up to 300 m from breeding sites. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter.	**Unlikely.** Although an ephemeral creekline is present near some of the sites, it is not associated with the preferred heath or swamp habitats that this species requires.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Mixophyes balbus	Stuttering Frog	-	Vulnerable	In NSW, known only from three locations south of Sydney. Inhabits rainforest and wet, tall forest in the foothills and escarpment east of the Great Dividing Range. Requires streams with rock shelves or shallow riffles for breeding in summer. Outside of breeding period, species is found under deep leaf little and thick understorey vegetation on forest floor.	**Unlikely.** The sites do not contain permanent streams of rivers. The sites does not support preferred habitat for this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Pseudophryne australis	Red-crowned Toadlet	Vulnerable	-	Distribution restricted to the Sydney Basin, from Pokolbin, south to Nowra, and west to Mt Victoria in the Blue Mountains. Occurs in open forests, where it typically inhabits periodically wet drainage lines below sandstone ridges. Breeds in dense vegetation and debris beside ephemeral creeks and gutters. Outside of breeding season, is found under rocks and logs on sandstone ridges where it forages amongst leaf-litter.	**Unlikely.** The site is outside the known distribution of this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Litoria aurea	Green and Golden Bell Frog	Endangered	Vulnerable	Isolated, scattered populations throughout coastal NSW, several within the Sydney metropolitan area, Shoalhaven and mid-north coast. Breeding habitat comprises natural and constructed water bodies including wetlands, stormwater detention basins, marshes, dams and streams-side, preferably those that are unshaded but with fringing vegetation. Forage for invertebrates within grassy habitats near breeding habitat. May shelter under	**Unlikely.** The sites do not support preferred habitat for this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.

Scientific Name	Common Name	Status under TSC Act	Status under EPBC Act	Habitat requirements/ known distribution	Probability of occurrence in the Project Application Area	Potential for Impact
				vegetation, rocks and building materials.		
Litoria booroolongensis	Booroolong Frog	Endangered	Endangered	Distribution restricted to NSW and north-eastern Victoria, predominantly along the western-flowing streams of the Great Dividing Range. Inhabits permanent streams with fringing vegetation and rocky banks. Lays eggs in submerged rock crevices and tadpoles mature in slow-flowing connected or isolated pools.	**Unlikely.** The sites do not support preferred habitat for this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Litoria littlejohni	Littlejohn's Tree Frog	Vulnerable	Vulnerable	Distributed throughout the plateaus and eastern slopes of the Great Dividing Range south from Watagan State Forest. Breeds in the upper reaches of permanent streams and in perched swamps where it lays eggs on temporary or permanent slow flowing pools. Outside of the breeding season, inhabits forests and woodlands where it shelters under leaf litter and low vegetation and hunts for invertebrates.	**Unlikely.** The sites do not contain permanent streams. The sites do not support preferred habitat for this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Reptiles						
Aprasia parapulchella	Pink-tailed Worm-lizard	Vulnerable	Vulnerable	A legless lizard known from the Central and Southern Tablelands, and the South Western Slopes. There is a concentration of populations in the Canberra/Queanbeyan Region. Other populations have been recorded near Cooma, Yass, Bathurst, Albury and West Wyalong. Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass (*Themeda australis*). Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks and lizards are commonly found beneath small, partially-embedded rocks and appear to spend considerable time in burrows (including ant's nests) below these rocks. The species lays two eggs inside ant nests during summer; the young first appear in March.	**Unlikely.** The sites do not support preferred habitat in the form of grassy open woodlands for this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Varanus rosenbergi	Rosenberg's Goanna	Vulnerable	-	Distributed from Wollemi National Parks south to the ACT region and near Cooma, usually in association with sandstone. Found in heath, open forest and woodland where it forages for carrion, birds, eggs, reptiles and small mammals. Shelters in hollow logs, rock crevices and in burrows. Requires termite mounds for nesting habitat.	**Possible.** The sites support potential foraging and sheltering habitat for the species.	The proposal may impact upon this species. A 7-part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Hoplocephalus bungaroides	Broad-headed Snake	Endangered	Vulnerable	Distribution restricted to sandstone habitats within approximately 250 km of Sydney. Requires rock crevices and flat sandstone rocks on exposed cliff edges for sheltering in cooler months, shelters in tree hollows near sandstone escarpments in summer. Forages for small reptiles, occasionally frogs and small mammals.	**Possible.** The sites support potential foraging and sheltering habitat for this species.	The Project may impact on this potentially occurring species habitat. A 7-part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Suta flagellum	Little Whip Snake	Vulnerable	-	A small, slender snake, reaching 45 cm in length. Found within an area bounded by Crookwell in the north, Bombala in the south, Tumbarumba to the west and Braidwood to the east. Occurs in Natural Temperate Grasslands and grassy woodlands, including those dominated by Snow Gum (*Eucalyptus pauciflora*) or Yellow Box (*E. melliodora*); also occurs in secondary grasslands derived from clearing of woodlands.	**Unlikely.** The sites do not support preferred habitat for this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.

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				Commonly found under rocks or logs lying on, or partially embedded in the soil, on well-drained hillsides, mostly associated with scattered loose rocks. Feeds on lizards and frogs. Up to seven live young are born between September and February.		
Birds						
Leipoa ocellata	Malleefowl	Endangered	Vulnerable	Typically occurs west of the Great Dividing Range, from Pilliga south-west to Griffith. Found in semi-arid to arid shrublands, and low woodlands dominated by mallee and/or acacia where it forages for insects, seeds and berries.	**Unlikely.** The sites do not support preferred habitat for this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Botaurus poiciloptilus	Australasian Bittern	Endangered	Endangered	Widespread distribution but uncommon across south-eastern Australia. Favours permanent freshwater wetlands with tall, dense vegetation, particularly Bulrushes (*Typha* spp.) and spike rushes (*Eleocharis* spp), where it forages at night for amphibians, invertebrates and crustaceans. Nests are built within densely vegetated wetlands on a platform of reeds.	**Unlikely.** The sites do not support preferred habitat for this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Circus assimilis	Spotted Harrier	Vulnerable	-	Occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. Hunts for small terrestrial mammals including bandicoots, bettongs and rabbits. Nest constructed in open or remnant woodland.	**Unlikely.** The habitat within the sites is dense higher altitude vegetation that is unlikely to be utilised by this species.	This species was not detected on the sites and habitat is not optimal for this species. Thus, it is considered unlikely to be impacted upon as a result of the Project. Therefore, an AoS has not been applied to this species.
Hieraaetus morphnoides	Little Eagle	Vulnerable	-	Found throughout the Australian mainland except in the most densely forested parts of the Dividing Range escarpment. Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter. Preys on birds, reptiles and mammals, occasionally adding large insects and carrion.	**Possible.** The sites support potential foraging habitat for this species.	This species was not detected on the sites and is highly mobile. Thus, it is considered unlikely to be impacted upon as a result of the Project. Therefore, an AoS has not been applied to this species.
Lophoictinia isura	Square-tailed Kite	Vulnerable	-	Widespread but sparsely distributed throughout mainland Australia. Is a resident of the north and north-east of NSW and in association with major river systems, where it is often found in association with forest dominated by Wool butts (*Eucalyptus longiflora*), Spotted Gum (*E. maculata*) or Peppermint Gum (*E. elata*). Hunts for smaller birds such as honeyeaters amongst the canopy layer. Nests on a large limb of a eucalypt or angophora along or near a watercourse.	**Possible.** The sites support potential foraging habitat for this species.	This species was not detected on the sites and is highly mobile. Thus, it is considered unlikely to be impacted upon as a result of the Project. Therefore, an AoS has not been applied to this species.
Falco subniger	Black Falcon	Vulnerable	-	The Black Falcon is sparsely distributed across large areas of NSW, mostly occurring in inland regions. Given the high mobility of the species, it is assumed that there is a single NSW population that constitutes part of a larger continental population. The species inhabits woodland, shrubland and grassland in arid and semi-arid zones, nesting in healthy, riparian woodland habitats and mainly feeding on other birds including pigeons and parrots.	**Possible.** The sites support potential foraging habitat for this species.	This species was not detected on the sites and is highly mobile. Thus, it is considered unlikely to be impacted upon as a result of the Project. Therefore, an AoS has not been applied to this species.

Scientific Name	Common Name	Status under TSC Act	Status under EPBC Act	Habitat requirements/ known distribution	Probability of occurrence in the Project Application Area	Potential for Impact
Ixobrychus flavicollis	Black Bittern	Vulnerable	-	The Black Bittern has a wide distribution, from southern NSW north to Cape York and along the north coast to the Kimberley region. The species also occurs in the south-west of Western Australia. In NSW, records of the species are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland. Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves.	**Unlikely.** The sites do not support preferred habitat for the species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Rostratula australis	Australian Painted Snipe	Endangered	Vulnerable	Occurs throughout Australia. Inhabits shallow freshwater wetlands, vegetated ephemeral and permanent lakes and swamps, and inundated grasslands. Roosts during the day in dense vegetation and is active at dusk, throughout the night and dawn. It nests on the ground amongst tall reed-like vegetation near water, and forages near the water's edge and on mudflats for invertebrates and seeds.	**Unlikely.** The sites do not support preferred habitat for the species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Callocephalon fimbriatum	Gang-gang Cockatoo	Vulnerable	-	Found in the central NSW coast and tableland areas, including Canberra and the Hawkesbury/Nepean and Sydney Metro region. Usually frequents forested areas with old growth attributes required for nesting and roosting purposes. Also utilises less heavily timbered woodlands and urban fringe areas to forage, but appears to favour well-timbered country.	**Likely.** The sites support foraging habitat for this species.	Although this species is likely to occur, the habitat to be removed is marginal habitat for this species, and Gang-gang Cockatoos are highly mobile. Therefore, it is unlikely to be impacted upon by the Project.
Calyptorhynchus lathami	Glossy Black-Cockatoo	Vulnerable	-	Occurs from the coast inland to the southern tablelands and central western plains of NSW. Inhabits forests and woodlands supporting Casuarina and Allocasuarina species, the seeds of which Glossy-black Cockatoos feed upon almost exclusively. Requires large hollow-bearing eucalypts for nesting habitat.	**Likely.** The sites support foraging habitat for this species.	Although this species is likely to occur, the habitat to be removed is marginal habitat for this species, and Glossy Black-Cockatoos are highly mobile. Therefore, it is unlikely to be impacted upon by the Project.
Glossopsitta pusilla	Little Lorikeet	Vulnerable	-	In NSW, the species occurs from the coast to the western slopes of the Great Dividing Range. Inhabits forests and woodlands, where it forages for nectar and pollen within the canopy stratum. Requires living, hollow-bearing eucalypts for nesting habitat.	**Likely.** The sites support foraging habitat for this species.	Although this species is likely to occur, the habitat to be removed is marginal habitat for this species, and Little Lorikeets are highly mobile. Therefore, it is unlikely to be impacted upon by the Project.
Lathamus discolor	Swift Parrot	Endangered	Endangered	Migrates from breeding grounds in Tasmania to the south-eastern Australian mainland in winter. Preferred over-winter habitat is woodlands and riparian vegetation where there are winter flowering eucalypts. Forage for pollen, nectar, lerps, insects, seeds and berries.	**Possible.** The sites support foraging habitat for this species.	Although this species has potential to occur, the habitat to be removed is marginal habitat for this species, and Swift Parrots are highly mobile. Therefore, it is unlikely to be impacted upon by the Project.
Neophema pulchella	Turquoise Parrot	Vulnerable	-	In NSW, occurs from the coastal plains to the western slopes of the Great Diving Range. Found along the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Forages on the ground for seeds and grasses. Nests in a tree-hollow, log or post.	**Unlikely.** The sites do not support preferred habitat for the species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Polytelis swainsonii	Superb Parrot	Vulnerable	Vulnerable	Occurs across Riverina area in summer, migrates along Macquarie and Namoi Rivers to northern NSW in winter. Inhabits timbered watercourses and nearby woodlands. Requires deep hollows or hollow limbs for nesting, typically in Red Gums. Forages mainly on the ground for seeds, fruit and insects.	**Unlikely.** The sites do not support preferred habitat for the species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.

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Ninox connivens	Barking Owl	Vulnerable	-	Scattered distribution throughout Australia, excluding central arid areas. In NSW, core populations located on western slopes and plains. Inhabits woodland and open forest, where it hunts for arboreal mammals, occasionally birds, invertebrates and small terrestrial mammals. Roosts in canopy or tall mid-storey trees. Requires large, hollow-bearing eucalypts for nesting habitat.	**Possible.** The sites support potential foraging habitat for the species.	Although this species has potential to occur, the habitat to be removed is marginal habitat for this species, and foraging habitat will remain in the immediate vicinity for this species. Therefore, it is unlikely to be impacted upon by the Project.
Ninox strenua	Powerful Owl	Vulnerable	-	Widely distributed throughout NSW, from the coast inland to the tablelands. Inhabits woodland, open forest, tall wet forest and rainforest, where it hunts for arboreal mammals, occasionally birds. Roosts in dense vegetation, requires old, large hollow-bearing eucalypts for nesting habitat.	**Possible.** The sites support potential foraging habitat for the species.	Although this species has potential to occur, the habitat to be removed is marginal habitat for this species, and foraging habitat will remain in the immediate vicinity for this species. Therefore, it is unlikely to be impacted upon by the Project.
Tyto novaehollandiae	Masked Owl	Vulnerable	-	In NSW, Masked Owls are distributed throughout the length of the Great Dividing Range and extends from the coast to the western slopes. Occupies a range of environments from tall, wet Eucalypt forest to dry woodland, and often, but not always, at the ecotone with cleared land.	**Possible.** The sites support potential foraging habitat for the species.	Although this species has potential to occur, the habitat to be removed is marginal habitat for this species, and foraging habitat will remain in the immediate vicinity for this species. Therefore, it is unlikely to be impacted upon by the Project.
Tyto tenebricosa	Sooty Owl	Vulnerable	-	Occurs on the coast, coastal escarpment and eastern tablelands. Inhabits rainforest and moist eucalypt forests, where it hunts for small for arboreal and terrestrial mammals. Roosts in a large tree hollow or amongst thick vegetation. Nests in a large tree hollow.	**Possible.** The sites support potential foraging habitat for the species.	Although this species has potential to occur, the habitat to be removed is marginal habitat for this species, and foraging habitat will remain in the immediate vicinity for this species. Therefore, it is unlikely to be impacted upon by the Project.
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	Vulnerable	-	Occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. Western boundary of its distribution is through Wagga Wagga, Forbes, Dubbo and Inverell. It is less commonly found on coastal plains and ranges. Forage mainly for invertebrates in fallen timber, trees and shrubs. Requires hollows in standing dead or live trees and tree stumps for nesting.	**Likely.** The sites support foraging habitat for this species.	Although this species is likely to occur in the area, the habitat being removed is marginal foraging habitat. No nesting habitat is being removed, and this mobile species has the ability to utilise the available foraging habitat in the immediate surrounding area. Therefore, it is unlikely to be impacted upon by the Project.
Chthonicola sagittata	Speckled Warbler	Vulnerable	-	In NSW, occurs throughout the hills and tablelands of the Great Dividing Range, rarely from the coast. Inhabits Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies where it forages for insects and seeds. Nests in a depression in the ground or the base of a low dense plant, often among fallen branches and other litter.	**Likely.** The sites support foraging habitat for this species.	Although this species is likely to occur in the area, the habitat being removed is marginal foraging habitat. No nesting habitat is being removed, and this mobile species has the ability to utilise the available foraging habitat in the immediate surrounding area. Therefore, it is unlikely to be impacted upon by the Project.
Anthochaera phrygia	Regent Honeyeater	Critically Endangered	Endangered	Distribution is extremely patchy; in NSW the species has been recorded from coastal areas to Narrabri with most records from the Great Dividing Range. Occurs in temperate eucalypt woodlands, most commonly box-ironbark associations and wet lowland coastal forests. In the Capertee Valley, breeding generally commences with the flowering of Needle-leaf Mistletoe; this is used extensively in the early stages of the breeding season, but birds often switch to Yellow Box when it begins flowering later in the season. Nests usually constructed in eucalypts, casuarinas or mistletoes. Forages for nectar and arthropods.	**Possible.** This species is known from the surrounding area and could potentially forage on site.	The Project may impact on this known species habitat. A 7-part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.

Scientific Name	Common Name	Status under TSC Act	Status under EPBC Act	Habitat requirements/ known distribution	Probability of occurrence in the Project Application Area	Potential for Impact
Epthianura albifrons	White-fronted Chat	Vulnerable	-	In NSW, occurs in association with damp, open habitats below 1000 m elevation along the coast (such as wetlands and saltmarsh), and in association with waterways in the west. Forage for insects on the ground. Nests in low vegetation elevated from the ground.	**Unlikely.** The sites do not support preferred habitat for the species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Grantiella picta	Painted Honeyeater	Vulnerable	-	Is nomadic and occurs at low densities throughout its range. The greatest concentration of the bird, as well as almost all breeding, occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Nest from spring to autumn in a small, delicate nest hanging within the outer canopy of drooping eucalypts, she-oak, paperbark or mistletoe branches.	**Unlikely.** This species is known from the surrounding area; however the habitat on the sites is not representative of preferred habitat for this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	Vulnerable	-	Eastern subspecies occurs from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. It is rarely recorded east of the Great Dividing Range. Inhabits forests or woodlands dominated by box and ironbark eucalypts where it forages for insects and nectar. Nests high in tree crown.	**Unlikely.** This species is known from the surrounding area; however the habitat on the sites is not representative of preferred habitat for this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	Vulnerable	-	Occurs along the east coast of Australia. In NSW, species is known from western slopes of Great Dividing Range, western plains, Hunter Valley and north coast. Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains where it forages for invertebrates. Roosts and nests in shrubs or sapling eucalypts. Generally unable to cross large open areas.	**Unlikely.** This species is known from the surrounding area; however the habitat on the sites is not representative of preferred habitat for this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Daphoenositta chrysoptera	Varied Sittella	Vulnerable	-	Widespread throughout mainland Australia, where it is found in eucalypt woodlands and forests, most commonly in areas of rough-barked eucalypts. Forages for insects in rough-bark eucalypts such as ironbark and stringybarks. Nests in a tree branch or fork.	**Possible.** The sites support potential foraging habitat for this species.	The Project may impact on this known species habitat. A 7-part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Pachycephala inornata	Gilbert's Whistler	Vulnerable	-	Sparsely distributed over much of the arid and semi-arid zone of inland southern Australia, from the western slopes of NSW to the Western Australian wheat belt. Widely recorded in mallee shrublands, but also occurs in box-ironbark woodlands, Cypress Pine and Belah woodlands and River Red Gum forests along the Murray, Edwards and Wakool Rivers. Forages for insects on or near the ground in shrub thickets and in tops of small trees. Nests are usually built below about two and a half m (but up to six mm) above the ground in the fork of dense foliage of plants such as wattles or cypress pines.	**Unlikely.** This species is known from the surrounding area; however the habitat on the sites is not representative of preferred habitat for this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	Vulnerable	-	Widespread throughout much of inland NSW, with the exception of the extreme north-west of the state. Typically inhabits structurally diverse open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas where it hunts for insects. Nests in tree fork or crevice, 1- 5 m above the ground.	**Unlikely.** This species is known from the surrounding area; however the habitat on the sites is not representative of preferred habitat for this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Petroica boodang	Scarlet Robin	Vulnerable	-	Distributed from the coast, inland to the western slopes of the Great Dividing Range. Inhabits open forests and woodlands, also found in grasslands in winter. Constructs a cup-shaped nest in a tree fork. Forages for insects on	**Likely.** The sites contain suitable foraging and nesting habitat for this species.	The Project may impact on this known species habitat. A 7-part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.

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				the ground. In NSW, the species breeds in tall moist eucalypt forests and woodlands in upland areas. In winter, moves to dry forests, open woodlands and grasslands of the inland slopes and plains. Forages amongst low branches for invertebrates. Nests near the ground in sheltered areas such as tree cavities or stumps.		
Petroica phoenicea	Flame Robin	Vulnerable	-	In NSW, the species breeds in tall moist eucalypt forests and woodlands in upland areas. In winter, moves to dry forests, open woodlands and grasslands of the inland slopes and plains. Forages amongst low branches for invertebrates. Nests near the ground in sheltered areas such as tree cavities or stumps.	**Likely.** The sites contain suitable foraging and nesting habitat for this species.	The Project may impact on this known species habitat. A 7-part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Stagonopleura guttata	Diamond Firetail	Vulnerable	-	Widely distributed in NSW, known from the Northern, Central and Southern Tablelands, the Northern, Central and South Western Slopes and the North West Plains and Riverina. Not common in coastal districts. Found mainly in grassy eucalypt woodlands, occasionally open forest and riparian areas. Forages on the ground for seeds and insects. Roost and nest amongst shrubby understorey.	**Unlikely.** The sites do not support preferred habitat for the species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Mammals						
Dasyurus maculatus maculatus	Spotted-tailed Quoll	Vulnerable	Endangered	Found along the escarpments, tablelands and coast of the eastern seaboard from the Bundaberg area in south-east Qld south through NSW to Victoria and Tasmania. Known from dry and moist eucalypt forests and rainforest. Species tends to move along drainage lines and make dens in fallen hollow logs or among large rocky outcrops. Usually nocturnal but are known to hunt and bask during the day. Hunts terrestrially and arboreally.	**Likely.** The sites contain suitable foraging habitat for this species, which has been recorded in close proximity to site ARP13, ARP13SP, ARP14 and the V-notch weir.	The Project may impact on this known species habitat. A 7-part Test of significance (TSC Act) has been applied to this species in Appendix 1, as well as an AoS (EPBC Act) in **Appendix 2**.
Phascolarctos cinereus	Koala	Vulnerable	Vulnerable	Distribution of the species throughout Australia is highly fragmented. In NSW it mainly occurs on the central and north coasts with some populations in the western region inhabiting eucalypt woodlands and forests. The species feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred species.	**Unlikely.** Although no feed trees listed under Schedule 2 of SEPP 44 are present within the sites, sites ARP11, ARP13, ARP13SP and ARP14 contain *E. cypellocarpa* which is a secondary feed tree for Koalas. Koalas have not been recorded within the Airly mining lease in previous surveys, and records are infrequent in the surrounding areas. The lack of records suggests that the local population is significantly small in size, and the likelihood of a koala occurring within the limited area of the borehole locations is incredibly low.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Cercartetus nanus	Eastern Pygmy Possum	Vulnerable	-	Occurs from the coast inland to the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes. Inhabits woodlands and heath, occasionally rainforest where it forages for nectar and pollen of banksias, eucalypts and bottlebrushes. Shelters in tree hollows, rotten stumps, holes in the ground or abandoned bird-nests.	**Unlikely.** The sites do not support suitable foraging or nesting habitat for this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project

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Petaurus norfolcensis	Squirrel Glider	Vulnerable	-	Sparsely distributed throughout eastern Australia. Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Require abundant tree hollows for refuge and nest sites. Forages for nectar, sap, invertebrates and pollen.	**Possible.** The sites support foraging habitat for this species.	The Project may impact on this known species habitat. A 7-part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Potorous tridactylus tridactylus	Long-nosed Potoroo	Vulnerable	Vulnerable	Distribution in NSW restricted to coastal heaths and forests east of the Great Dividing Range. Also known from dry and wet sclerophyll forest. Requires dense understory and ground layer vegetation for sheltering. Forages from fungi, roots tubers and insects in the soil.	**Unlikely.** The sites are outside the general distribution of the species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Petrogale penicillata	Brush-tailed Rock-wallaby	Endangered	Vulnerable	Occurs along NSW coast, inland to the Warrumbungle Ranges. Occupies rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Shelter in rock crevices and overhangs. Forages in and adjacent to rocky areas for grasses, foliage and fruits of shrubs and trees.	**Unlikely.** The sites do not support preferred habitat for the species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Pteropus poliocephalus	Grey-headed Flying-fox	Vulnerable	Vulnerable	Found within 200 km of the east coast of Australia. Roosting camps commonly found in gullies, close to water, in vegetation with a dense canopy. Camps typically located within 20 km of a regular food source – nectar and pollen of native trees and fruits of rainforest trees and vines. Also forage in cultivated gardens and fruit crops.	**Unlikely.** Species is rarely observed west of the Great Dividing Range.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Chalinolobus dwyeri	Large-eared Pied Bat	Vulnerable	Vulnerable	Found mainly in areas with extensive cliffs and caves. It is generally rare with a very patchy distribution in NSW, with scattered records from the New England Tablelands and North-west Slopes. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (Hirundo ariel). Forage in low to mid-elevation dry open forest and woodland and well-timbered areas containing gullies close to roosting habitat, for small, flying insects. Most likely hibernates through coolest months.	**Likely.** This species is known from the Airly mining lease site and foraging habitat occurs within the sites.	The Project may impact on this known species habitat. A 7-part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Falsistrellus tasmaniensis	Eastern False Pipistrelle	Vulnerable	-	Occurs along the east coast of NSW, where it inhabits tall moist forests. Roosts in hollows of eucalypts, occasionally under loose bark on trees or in buildings. Hunts for flying insects above or below the tree canopy.	**Possible.** The Project Application Area supports potential foraging habitat for the species.	The Project may impact on this known species habitat. A 7-part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Miniopterus australis	Little Bentwing-bat	Vulnerable	-	Distributed across the east coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. Occurs in moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and Banksia scrub. Generally found in well-timbered areas. Roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day. Often share roosting sites with the Common Bentwing-bat and, in winter, the two species may form mixed clusters. Only five nursery sites / maternity colonies are known in Australia. Forage for small insects beneath the canopy of densely vegetated habitats	**Possible.** The sites support foraging habitat for this species. Additionally this species has returned 'possible' calls via the use of anabats over the Airly site.	The Project may impact on this known species habitat. A 7-part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	Vulnerable	-	This species utilises a range of habitats for foraging, including rainforest, wet and dry sclerophyll forests, woodlands and open grasslands. Requires caves or	**Likely.** This species is known from the Airly mining lease site and foraging habitat occurs within the sites.	The Project may impact on this known species habitat. A 7-part Test of significance (TSC Act) has been applied

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				similar structures for roosting habitat.		to this species in **Appendix 1**.
Myotis macropus	Southern Myotis	Vulnerable	-	A coastal species occurring from the coast of north western Australia, eastwards to southern Victoria. Primarily cave dwellers but have been known to roost in tree hollows and manmade structures. Commonly occur in groups of 10-15 individuals. They occur in most habitat types associated with water including mangroves, paperbarks, swamps, rainforest, open woodland and wet and dry sclerophyll forests. Requires streams and small bodies of water for hunting where they forage for insects and small fish.	**Likely.** This species is known from the Airly mining lease site and foraging habitat occurs within the sites.	The Project may impact on this known species habitat. A 7-part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Nyctophilus corbeni	South-eastern Long-eared Bat	Vulnerable	Vulnerable	Distribution of the south-eastern form coincides approximately with the Murray Darling Basin with the Pilliga Scrub region being the distinct stronghold for this species. Occurs in a variety of vegetation types, including mallee, bulloak *Allocasuarina luehmannii* and box eucalypt dominated communities, but it is distinctly more common in box / ironbark / cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. Roosts in tree hollows, crevices, and under loose bark. Slow flying agile bat, utilising the understorey to hunt non-flying prey, especially caterpillars and beetles, and will hunt on the ground.	**Unlikely.** The sites support marginal foraging and roosting habitat for the species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	Vulnerable	-	Wide-ranging across Australia, covering the whole state of NSW (Churchill 2009). Occurs in almost all habitat types from wet and dry sclerophyll forest, open woodland, acacia shrubland, mallee, grasslands and desert (Churchill 2009). In NSW requires small hollows in trees to roost.	**Possible.** The sites support foraging habitat for this species.	The Project may impact on this known species habitat. A 7-part Test of significance (TSC Act) has been applied to this species in **Appendix 1.**
Vespadelus troughtoni	Eastern Cave Bat	Vulnerable	-	Distributed along eastern of Australia, from Cape York south to mid-New South Wales. Inhabits tropical woodlands and wet sclerophyll forest on the coast, occur in drier forest of the western slopes and inland areas. Roosts in colonies of 6 - 50 individuals, in sandstone overhang caves, boulder piles, mine tunnels and occasionally buildings. Foraging habits of the species are unknown.	**Possible.** The sites support foraging habitat for this species.	The Project may impact on this known species habitat. A 7-part Test of significance (TSC Act) has been applied to this species in **Appendix 1**.
Pseudomys novaehollandiae	New Holland Mouse	-	Vulnerable	Fragmented distribution across Tasmania, Victoria, NSW and Queensland where it inhabits open heathlands, open woodlands with a heathland understorey and vegetated sand dunes. Forages for seeds, insects, leaves, flowers and fungi. Shelters and nests communally in burrows.	**Unlikely.** The sites do not support habitat consistent with preferred habitat by this species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Fish						
Maccullochella peelii	Murray Cod	-	Vulnerable	The largest freshwater fish found in Australia. Found extensively throughout the Murray Darling Basin in the south-eastern region of Australia in a diverse range of habitats, including clear rocky streams (such as those found in the upper western slopes of NSW), to slow flowing, turbid rivers and billabongs. Typical diet consists of spiny crayfish, yabbies and shrimps. The species migrates upstream prior to spawning in late spring and	**Unlikely.** The sites do not support preferred habitat for the species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.

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				early summer when the water reaches a temperature of between 16-21°C. Spawns on a sunken red gum log in lowland rivers or a submerged rock in upland streams.		
Macquaria australasica	Macquarie Perch	-	Vulnerable	Found within the southern tributaries of the Murray Darling Basin (particularly the upstream reaches), Hawkesbury-Nepean and Shoalhaven river systems of NSW. Inhabits rivers and lakes, utilising the upper reaches of rivers and their tributaries. Feeds on aquatic insects, crustaceans and molluscs. Breeds in spring and summer in shallow upland streams or flowing rivers; requires riffle over cobble and gravel substrates in which to spawn deposit eggs. Deep rock pools, overhanging vegetation and snags provide refuge habitat for this species.	**Unlikely.** The sites do not support preferred habitat for the species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Prototroctes maraena	Australian Grayling	-	Vulnerable	Found in freshwater streams and rivers to the east of the Great Dividing Range, extending from Sydney southwards. Prefers habitats with a moderate flow over clear gravelly substrates in coastal streams, and estuarine areas. Feeds on aquatic algae and invertebrates. Eggs are deposited during late summer to autumn, in rivers with gravelly substrates. Larvae migrate to marine waters and return as juveniles and remain in freshwater for their adult life.	**Unlikely.** The sites do not support preferred habitat for the species.	This species is unlikely to occur, hence is considered unlikely to be impacted upon as a result of the Project.
Threatened Ecological Communities						
Genowlan Point Allocasuarina nana Heathland		Endangered	-	This community is a low closed heath community dominated by Allocasuarina nana. Its floristic composition is unique with the following species co-occurring; *Xanthorrhoea johnsonii*, *Micromyrtus sessilis*, *Pseudanthus divaricatissimus, Callitris muelleri* and *Isopogon prostratus*. Occurs at a single location at Genowlan Point in the Capertee Valley within the Lithgow LGA in the Central West of NSW. Its area of occupancy is about 10 ha.	The vegetation composition used to determine the presence of this ecological community was not found to occur within the Project sites. This community therefore does not occur.	Due to the lack of occurrence, it is considered that this vegetation community is unlikely to be impacted on by the proposal. No further assessment is required.
Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions		Endangered	-	This community is associated with accumulated peaty or organic-mineral sediments on poorly drained flats in the headwaters of streams. It occurs on undulating tablelands and plateaus above 400 - 500 m ASL generally in catchment with basic volcanic or fine-grained sedimentary substrates. Comprises a dense, open or sparse layer of shrubs with soft-leaved sedges, grasses and forbs. Is habitat for a number of endangered plant species. Is known from many LGAs including the Lithgow LGA and the Blue Mountains.	The vegetation composition used to determine the presence of this ecological community was not found to occur within the Project sites. This community therefore does not occur.	Due to the lack of occurrence, it is considered that this vegetation community is unlikely to be impacted on by the proposal. No further assessment is required.
Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions (Listed as Upper Basalt Eucalypt Forests of the Sydney Basin Bioregion under the EPBC Act)		Endangered	Endangered	This community is associated with clay or loam soils derived from basalt or, less commonly, alluvium, fine-grained sedimentary rocks. Floristic composition is variable, comprising such eucalypt species as *Eucalyptus viminalis, Eucalyptus radiata, E. dalrympleana subsp. dalrympleana* and/or *E. pauciflora*. The community is found in the Eastern Highlands and Southern and Central Tablelands within the LGAs of Bathurst, Goulburn, Oberon and the Upper Lachlan among others.	The vegetation composition used to determine the presence of this ecological community was not found to occur within the Project sites. This community therefore does not occur.	Due to the lack of occurrence, it is considered that this vegetation community is unlikely to be impacted on by the proposal. No further assessment is required.

Scientific Name	Common Name	Status under TSC Act	Status under EPBC Act	Habitat requirements/ known distribution	Probability of occurrence in the Project Application Area	Potential for Impact
White Box-Yellow Box-Blakely's Red Gum Woodland (Listed as White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland under the EPBC Act)		Endangered	Critically Endangered	White Box – Yellow Box – Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands (Box-Gum Woodland) is found on relatively fertile soils on the tablelands and western slopes of NSW and generally occurs between the 400 and 800 m isohyets extending from the western slopes, at an altitude of c. 170m to c. 1200 m, on the northern tablelands. The community occurs within the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands and NSW South Western Slopes Bioregions. Less than 5% of this community remains in good condition, and much of this occurs in small, isolated patches. Box-Gum Woodland is an open woodland community (sometimes occurring as a forest formation), in which the most obvious species are one or more of the following: *Eucalyptus albens* (White Box), *E. melliodora* (Yellow Box) and *E. blakelyi* (Blakely's Red Gum). This community can also occur as a cleared modified state, where no canopy is present, but where a native derived grassy understorey persists.	The vegetation composition used to determine the presence of this ecological community was not found to occur within the Project sites. This community therefore does not occur.	Due to the lack of occurrence, it is considered that this vegetation community is unlikely to be impacted on by the proposal. No further assessment is required.

Key: **(V)** = Vulnerable Species listed under Threatened Species Conservation Act 1995 (TSC Act 1995).
(E) = Endangered Species listed under TSC Act 1995.
(V*) = Vulnerable Species listed under Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999).
(E*) = Endangered Species listed under EPBC Act 1999.
(CE*) = Critically Endangered Species listed under EPBC Act 1999
(M*) = Listed as a Migratory species under the EPBC Act 1999
(EP) = Listed as an Endangered Population under the TSC Act 1995

7.0 Conclusion and Recommendations

Conclusion

RPS was engaged to undertake a Flora and Fauna Assessment over proposed borehole sites and the location of a V-notch weir to the north of the existing Airly Mine. Two locally common vegetation communities were identified as occurring within the sites. Proposed borehole sites ARP11, ARP13, ARP13SP ARP14, ARP15, ARP15SP and ARP15A were characterised by MU 3 Hillslope Talus Mountain Gum – Brown Stringybark – Grey gum – Broad-leaved Hickory Moist Forest and site ARP12 was characterised by MU 4 Sheltered Gully Brown Barrel Ferny Forest DEC (2006).

No threatened flora or ecological communities were detected within the sites or on existing tracks into the sites.

Fauna recorded within the sites were limited to common bird species; however other guilds of fauna including mammals, reptiles, amphibians and microchiropteran bats are likely to occur within the sites and wider locality. Some potential exists for a number of locally occurring threatened species to occur within the sites on at least an intermittent basis. However, the removal of vegetation associated with the proposed works is minimal as a result of the small area required for the borehole sites and track work (approximately 0.54ha), the selection of previously disturbed or naturally open areas for the bores and the minimal vegetation removal for the existing access tracks. This suggests that these works are unlikely to result in adverse impacts upon locally occurring threatened species or communities provided the recommendations contained below are implemented.

Recommendations

The following recommendations have been outlined to provide ecological guidelines and site management strategies that may prevent any ongoing detrimental impacts upon habitat surrounding the proposed exploration sites.

- The drilling and other vehicles are to avoid damaging or removing native vegetation by wherever possible carefully driving around all trees and shrubs to minimise any impacts on native vegetation. This will ameliorate the Key Threatening Processes '*Removal of Native Vegetation'*;
- Where vegetation removal is unavoidable, it shall be kept to a minimum. Particular effort should be made to avoid disturbing mature trees and off site hollow bearing trees;
- All removed vegetation shall remain within close proximity to the site, with mature trees gently placed in surrounding areas to allow for the survival and dispersal of any displaced fauna currently utilising these trees;
- It is recommended that water management strategies be implemented at the proposed exploration sites to prevent the movement of sediments or contaminated waters / liquids into surrounding habitats, including potential down-slope waterways or drainage lines;
- It is recommended that appropriate measures such as vehicle cleaning protocols be employed to ensure that machinery working within the site do not bring materials (soils, weeds or pathogens etc.) onto the sites that may cause the distribution of weed species or introduce pathogens such as *Phytopthera.* This will ameliorate the Key Threatening Processes '*Weed Invasion by Exotic Perennial Grasses'* and '*Infection of Native Plants by Phytopthera cinnamomi'*;
- It is recommended that water extraction for use during construction follow the designated protocols provided by GHD (2016) in relation to the accepted levels of extraction to mitigate against the Key Threatening Process '*Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands';* and

- That topsoil management be implemented at each of the sites to ensure that current seed banks in top soil be returned to the site after cessation of geotechnical investigations.

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Appendix 1

TSC Act 7-Part Test

Consideration under Section 5A of the Environmental Planning and Assessment Act 1979

Considerations of the effects of the proposed geotechnical sites under the guidelines of Section 5A of the *Environmental Planning and Assessment Act 1979* (EP&A Act 1979) for the concerned threatened species / populations / ecological communities are given below.

The majority of information used for the assessment has been sourced from OEH Threatened Species Information and Environmental Impact Assessment Guidelines, OEH Atlas of NSW Wildlife and other published or widely available literature sources such as scientific journals and reports. For the purposes of the Seven-Part Test, threatened species have been grouped into 'guilds', that is, species sharing similar habitat or ecological requirements have been grouped and assessed together.

No species is likely to be significantly impacted upon due to the very low level of impact expected from the proposed action. These low levels of impact are achievable due to the following factors:

- The proposed bores ARP11-ARP15A are to be located in close proximity to the existing vehicular track;
- Manoeuvring the drill rig to each site is to be carried out by avoiding trees and shrubs and minimising the impacts on the environment and soil surface;
- Where vegetation removal is unavoidable, it is to be undertaken in such a manner as to remove as little vegetation as possible; and
- All mitigating strategies regarding topsoil/seedbank replacement and sediment controls are to be implemented.

Seven Part Tests

(a) *in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,*

Threatened species that are potentially impacted upon by the proposed works based on available habitat and previous records include:

Fauna

- Rosenberg's Goanna
- Broad-headed Snake
- Varied Sittella
- Regent Honeyeater
- Flame Robin
- Scarlet Robin
- Spotted-tailed Quoll
- Squirrel Glider
- Large-eared Pied-bat
- Eastern False Pipistrelle
- Little Bentwing-bat
- Eastern Bentwing-bat
- Southern Myotis
- Yellow-bellied Sheath tail Bat
- Eastern Cave Bat

Rosenberg's Goana (*Varanus rosenbergi*)

Rosenberg's Goanna is distributed from Wollemi National Parks south to the ACT region and near Cooma, usually in association with sandstone. It is found in heath, open forest and woodland where it forages for

carrion, birds, eggs, reptiles and small mammals. Shelters in hollow logs, rock crevices and in burrows. This species requires termite mounds for nesting habitat.

This species is known to occur in the immediate vicinity however, it was not detected on any of the exploration sites. Potential foraging habitat only occurs within the sites. This habitat is a small proportion of substantially larger protected surrounding habitats. The level, to which an impact could potentially occur from the proposed removal of vegetation, is not considered substantial enough to render the habitat uninhabitable for this species or its prey items. Additionally, noise disturbance from the pumping of water during night hours is not expected to impact upon this species. Therefore, it is unlikely that the Project will significantly affect the life cycle of the Rosenberg's Goanna such that a viable local population of the species is likely to be placed at risk of extinction.

Broad-headed Snake (*Hoplocephalus bungaroides*)

The Broad-headed Snake is largely confined to Triassic sandstones, including the Hawkesbury, Narellan and Shoalhaven formations, within the coast and ranges. Its distribution extends from Wollemi National Park in the north; the edge of the Clyde River catchment in the ranges southwest of Nowra in the south; and west to the upper Blue Mountains at Blackheath and Newnes. There are also historic records from outlying sandstone extensions at the north-west edge of the Sydney Basin between Bathurst and Mudgee.

This species shelters by day in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. In summer it is known to become semi-arboreal in its search for prey including geckos and skinks, and will shelter in hollows in large trees within 200 m of rocky escarpments.

This species was not detected within the sites during surveys, however potential habitat exists. This habitat is a small proportion of substantially larger protected surrounding habitats. The level, to which an impact could potentially occur from the proposed removal of vegetation, is not considered substantial enough to render the habitat uninhabitable for this species or its prey items. Additionally, noise disturbance from pumping water during night hours is not expected to impact upon this species. Therefore, it is unlikely that the Project will significantly affect the life cycle of the Broad-headed Snake such that a viable local population of the species is likely to be placed at risk of extinction.

Woodland Birds

Varied Sittella (Daphoenositta chrysoptera)

Regent Honeyeater (Anthochaera phrygia)

Scarlet Robin (Petroica boodang)

Flame Robin (Petroica phoenicea)

These woodland bird species forage and nest in open eucalypt woodland environments and have been detected around the sites in previous surveys, but were not observed during current surveys. The above species are likely to continue using the surrounding environments despite the temporary disturbance at the exploration sites. Given the level of disturbance that currently exists at the sites, comparative to the larger areas of surrounding habitats, it is unlikely that the understorey vegetation to be removed is critical to these species.

Noise disturbance may temporarily relocate these species to nearby locations, however as the activity is only temporary, it is not considered extensive enough to entirely redistribute these species from within the area.

Therefore, it is considered that the proposal will not have an adverse effect on these species such that a viable population of these species is likely to be placed at risk of extinction.

Spotted-tailed Quoll (*Dasyurus maculatus maculatus*)

The Spotted-tail Quoll occurs in a range of habitat types including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Nests are made in rock caves and hollow logs or trees, and basking sites are usually found nearby. Potential habitat for this species exists within the larger surrounding areas at Airly and Genowlan Mountain. Similarly, extensive tracts of suitable habitat would occur throughout the adjacent Gardens of Stone National Park.

Sites ARP13 / ARP13SP, ARP14 and the V-notch weir are close to a known location of Spotted-tailed Quoll (RPS 2014). These sites lie within a connecting corridor to large areas of habitat to the east and the Airly State Forest to the north-west, both of which contain records of Spotted-tail Quolls.

Suitable habitat for this species occurs within the sites. This habitat is a small proportion of substantially larger protected surrounding habitats. The level, to which an impact could potentially occur from the proposed removal of vegetation, is not considered substantial enough to render the habitat uninhabitable for this species or its prey items. Additionally, noise disturbance from pumping water during night hours is not expected to impact upon this species. Therefore, it is unlikely that the Project will significantly affect the life cycle of the Spotted-tail Quoll such that a viable local population of the species is likely to be placed at risk of extinction.

Squirrel Glider (*Petaurus norfolcensis*)

Squirrel Gliders occur throughout eastern Australia, from northern QLD to western Victoria. Habitat includes mature or old growth Box, Box-Ironbark Woodlands, and River Red Gum forest west of the Great Divide and Blackbutt-Bloodwood dominated forest with heath understorey in coastal areas. They prefer vegetation communities with a variety of species with a shrub or Acacia mid-storey. They live in family groups of a single adult male with one or more females. An abundance of tree hollows is required for refuge and nest sites. They feed on resources such as Acacia gum, eucalypt sap, nectar and honeydew with insects and pollen providing protein.

The strategies of siting the bores within clearings or already disturbed areas, avoiding the felling of trees wherever possible and reducing the removal or lopping of vegetation to an absolute minimum required to allow the drill rig to traverse the access tracks helps to produce a very low impact for Squirrel Gliders. Canopy vegetation immediately surrounding the sites may be used by this species for foraging. No breeding habitat (tree hollows) will be removed by the project.

Noise disturbance is not expected to impact upon this nocturnal species. Regular movement patterns may be altered to avoid the location of water pumping during the drilling period, however it is unlikely that the activity will disturb this species such that it vacates the area permanently or prevents it from undertaking its normal behaviours.

Therefore, it is unlikely that the Project will affect the life cycle of the Squirrel Glider such that a viable local population of the species is likely to be placed at risk of extinction.

Microchiropteran Bats

Little Bentwing Bat (*Miniopterus australis*)
Eastern Bentwing-bat (*Miniopterus oceanensis schreibersii*)
Large-eared Pied Bat (*Chalinolobus dwyeri*)

Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
Southern Myotis (*Myotis macropus*)
Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)

These threatened Microchiropteran bat species are highly mobile species with a range of habitat preferences that overlap and utilise a range of different habitat niches. They encompass two main sheltering habits; those that dwell in caves, and, due to similar characteristics, sometimes manmade structures, and those that dwell in tree hollows. These species have the potential to occur within the exploration sites, however the proposal will have a low impact through the strategies of siting the bores within natural clearings or already disturbed areas, avoiding the felling of trees wherever possible and reducing the removal or lopping of vegetation to an absolute minimum required to allow the drill rig to traverse the access tracks. No hollow bearing trees were detected within the sites and additionally more suitable roosting trees for these species are likely to exist in the locality. Therefore, it is considered that the proposal will not result in an adverse effect on these species such that a viable population of these species is likely to be placed at risk of extinction.

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

No endangered populations were identified within the subject site or surrounding area.

(b) *in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

No endangered ecological communities are present or will be affected by the proposed exploration works.

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

No endangered ecological communities are present or will be affected by the proposed exploration works.

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

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The total area to be used for this project, including areas containing habitat for the species included in this assessment totals approximately 0.54ha. This habitat will be rehabilitated with pre-existing surface soil after the works have been completed.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

Operations at the proposed exploration sites will not substantially or significantly fragment or isolate the locally occurring habitat from the extensive areas of similar adjoining habitat.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

A very small area of habitat may be subject to removal at some of the proposed exploration sites, totalling approximately 0.54ha for the entire proposal. This may include the removal of a low number of small ground cover species or saplings to establish a work pad or trimming of tree branches to facilitate the passage of the drill rig along the access track, however removal of vegetation will be kept to an absolute minimum. It is considered that the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of any species, population or ecological community in the locality is low.

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

Operations at the proposed exploration sites will not affect critical habitat either directly or indirectly.

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

Recovery Plans exist for a number of species. However none have the potential to be impacted upon by the proposed exploration works:

The impact of the proposed works is minimal as a result of the small area required for the borehole sites (approximately 0.54ha), the selection of previously disturbed or naturally open areas for the borehole sites and the strategy of avoiding the removal of trees and other vegetation. Furthermore, any required habitat removal or modification will not impact upon the habitat required for the above species due to the large areas of similar habitat in the locality that is to be retained. The proposed actions are therefore consistent with the objectives or actions stated within the Recovery Plans.

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

A total of five different KTPs have been identified as having potential to occur as a consequence of the proposed exploration sites, being:

- Anthropogenic climate change;
- Clearing of native vegetation;
- Infection of native plants by *Phytophthora cinnamomi;*
- Invasion of native plant communities by exotic perennial grasses; and
- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands.

Due to the small size of each exploration borehole site and the selection of previously disturbed areas adjacent to existing or disused tracks, along with the use of adequate hygiene protocols for machinery and vehicles, the potential contribution of each KTP has been minimised.

Appendix 2

Flora Species List

Flora Species List

The following list includes all species of vascular plants observed within the proposed six exploration sites during fieldwork. It should be noted that such a list should not be considered comprehensive, but rather indicative of the flora present on the site during threatened species searches. It can take many years of flora surveys to record all of the plant species occurring within any area, especially plant species that are only apparent in some seasons such as Orchids.

A number of species cannot always be accurately identified during a brief survey, generally due to a lack of suitable flowering and/or fruiting material. Any such species are identified as accurately as possible, and are indicated in the list:

- specimens that could only be identified to genus level are indicated by the generic name followed by the abbreviation “sp.”, indicating an unidentified species of that genus;
- specimens for which identification of the genus was uncertain are indicated by a question mark (“?”) placed in front of the generic, which is followed by the abbreviation “sp.” and;
- specimens that could be accurately identified to genus level, but could be identified to species level with only a degree of certainty are indicated by a (“?”) placed in front of the epithet.

Authorities for the scientific names are not provided in the list. These follow the references outlined below.

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Names of families and higher taxa follow a modified Cronquist System (1981).

Introduced species are indicated by an asterisk “*”.

Threatened species listed under the *Threatened Species Conservation Act 1995* (TSC Act 1995) or *the Environmental Protection of Biodiversity and Conservation* (EPBC Act 1999) and / or Rare or Threatened Australian Plant (ROTAP) listed species are indicated in **bold font** and marked as:

(V) = Vulnerable Species listed under the TSC Act
(E) = Endangered Species listed under the TSC Act
(EE) = Species listed under the Commonwealth EPBC Act 1999 as Endangered
(EV) = Species listed under the Commonwealth EPBC Act 1999 as Vulnerable
(R) = ROTAP as per Briggs and Leigh (1996)

The following standard abbreviations are used to indicate subspecific taxa:

ssp. - subspecies
var.- variety
agg. Aggregate

Class/ Subclass	Family	*Scientific Name*	Common Name
Magnoliidae	Fabaceae	*Acacia falciformis*	Broad-leaved Hickory
Magnoliidae	Fabaceae	*Acacia obtusifolia*	Blunt-leaf Wattle
Magnoliidae	Ericaceae	*Acrotriche rigida*	-
Magnoliidae	Casuarinaceae	*Allocasuarina littoralis*	Black She-oak
Magnoliidae	Loranthaceae	*Amyema pendulum* subsp. *pendulum*	Mistletoe
Magnoliidae	Proteaceae	*Banksia penicillata*	-
Filicopsida	Blechnaceae	*Blechnum cartilagineum*	Gristle Fern
Magnoliidae	Pittosporaceae	*Bursaria spinosa var. spinosa*	Blackthorn
Filicopsioda	Sinopteridaceae	*Cheilanthes sieberi subsp. sieberi*	Poison Rock Fern
Magnoliidae	Santalaceae	*Choretrum pauciflorum*	Dwarf Sour Bush
Magnoliidae	Ranunculaceae	*Clematis glycinoides var. glycinoides*	Headache Vine
Filicopsida	Cyatheaceae	*Cyathea australis*	Rough Tree-fern
Magnoliidae	Fabaceae/	*Desmodium varians*	Slender Tick-trefoil
Liliidae	Phormiaceae	*Dianella caerulea var. caerulea*	Flax Lily
Magnoliidae	Convolvulaceae	*Dichondra repens*	Kidney Weed
Filicopsida	Blechnaceae	*Doodia aspera*	Prickly Rasp Fern
Magnoliidae	Eleocarpaceae	*Elaeocarpus reticulatus*	Blueberry Ash
Magnoliidae	Myrtaceae	*Eucalyptus blaxlandii*	Blaxland's Stringybark
Magnoliidae	Myrtaceae	*Eucalyptus cypellocarpa*	Mountain Grey Gum
Magnoliidae	Myrtaceae	*Eucalyptus fastigata*	Brown Barrel
Magnoliidae	Myrtaceae	*Eucalyptus piperita*	Sydney Peppermint
Magnoliidae	Geraniaceae	*Geranium solanderi*	Cutleaf Cranesbill
Magnoliidae	Apiaceae	*Hydrocotyle laxiflora*	Stinking Pennywort
Magnoliidae	Fabaceae	*Indigofera australis*	Native Indigo
Magnoliidae	Myrtaceae	*Leptospermum polyanthum*	-
Magnoliidae	Myrtaceae	*Leptospermum polygalifolium subsp. polygalifolium*	Tantoon
Liliidae	Lomandraceae	*Lomandra filiformis subsp. filiformis*	Wattle Mat-rush
Liliidae	Lomandraceae	*Lomandra longifolia*	Spiky-headed Mat-rush
Liliidae	Poaceae	*Microlaena stipoides var. stipoides*	Weeping Rice Grass
Magnoliidae	Myrsinaceae	*Myrsine howittiana*	Brush Muttonwood
Liliidae	Poaceae	*Poa sieberiana var. sieberiana*	Snowgrass
Magnoliidae	Rhamnaceae	*Pomaderris betulina*	Birch Pomaderris
Filicopsida	Dennstaedtiaceae	*Pteridium esculentum*	Bracken
Filicopsida	Gleicheniaceae	*Sticherus flabellatus*	Umbrella Fern
Magnoliidae	Ericaceae	*Stypandra glauca*	Nodding Blue Lily
Filicopsida	Osmundaceae	*Todea barbara*	King Fern

Appendix 2

Water Impact Assessment

Centennial Airly Pty Ltd

Exploration Drilling Program Review of Environmental Factors
Water Impact Assessment

April 2016

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Glossary

Aquifer	A groundwater bearing formation sufficiently permeable to transmit and yield groundwater.
Australian height datum	A common national surface level datum approximately corresponding to mean sea level.
Bord and pillar	Method of underground coal mining where the coal seam is divided into a regular block array (pillars) by driving roadways. In some cases, the pillars are partly or completely removed in a concurrent or later operation.
Bore	Constructed connection between the surface and a groundwater source that enables groundwater to be transferred to the surface either naturally or through artificial means.
Catchment	The land area draining through the main stream, as well as tributary streams, to a particular site.
Cumulative rainfall departure	Monthly accumulation of the difference between the observed monthly rainfall and long-term average monthly rainfall.
Drawdown	A reduction in piezometric or hydraulic head within an aquifer.
Fracture	Cracks within the strata that develop naturally or as a result of underground works.
Groundwater	Subsurface water that occurs in soils and geological formations.
Hydrogeology	The area of geology that deals with the distribution and movement of groundwater in soils and rocks.
Hydrograph	A graph which shows how a water level (either surface or underground) at any particular location changes with time.
Infiltration	The downward movement of water into soil and rock. It is largely governed by the structural condition of the soil, the nature of the soil surface (including presence of vegetation) and the antecedent moisture content of the soil.
Interburden	The strata between coal seams.
Outcrop	Where the bedrock is exposed at the ground surface.
Overburden	The strata between the coal seam being extracted and the surface.
Permian Age	The youngest geological period of the Palaeozoic era, covering a span between approximately 290 and 250 million years ago.
Quaternary	The most recent geological period spanning from approximately 2.5 million years ago to present.
Roadway	Underground tunnel constructed to enable access to working face.

Run of mine	Raw coal production (unprocessed).
Runoff	The amount of rainfall which actually ends up as streamflow, also known as rainfall excess.
Strata	Layers of rock above, below and including the coal seam.
Structure	The combination or spatial arrangement of primary soil particles (clay, silt, sand, gravel) into aggregates such as peds or clods, and their stability to deformation.
Subsidence	The vertical difference between the pre-mining surface level and the post-mining surface level at a point.
Surface water	Water that is derived from precipitation or pumped from underground and may be stored in dams, rivers, creeks and drainage lines.
Triassic	The geological period that spans between approximately 250 and 200 million years ago.
Water hardness	A measure of the concentration of multivalent metallic cations in water, primarily calcium and magnesium, and derived largely from contact with the soil and rock formations. ANZECC/ARMCANZ (2000) defines soft water as hardness concentration 0–59 mg/L as CaCO3, moderate hardness as 60–119 mg/L as CaCO3, hard water as 120–179 mg/L as CaCO3, and very hard water as 180–240 mg/L as CaCO3.

Abbreviations

bgl	Below ground level
BOM	Bureau of Meteorology
Centennial Airly	Centennial Airly Pty Limited
Centennial	Centennial Coal Company Limited
CRD	Cumulative rainfall departure
EP&A Act	*Environmental Planning and Assessment Act 1979*
GDE	Groundwater dependent ecosystem
GHD	GHD Pty Ltd
km	Kilometre
L	Litre
L/s	Litre per second
m	Metre
mg/L	Milligram per litre
ML	Megalitre
ML/year	Megalitre per year
mm	Millimetre
MSDS	Material safety data sheet
NOW	NSW Office of Water
REF	Review of Environmental Factors
VWP	Vibrating wire piezometer
WIA	Water impact assessment
WM Act	*Water Management Act 2000*
WSP	Water Sharing Plan

1. Introduction

1.1 Background

GHD Pty Ltd (GHD) was commissioned by Centennial Airly Pty Limited (Centennial Airly), a wholly owned subsidiary of Centennial Coal Company Limited (Centennial), to prepare a water impact assessment (WIA) for the proposed 2016 exploration drilling program. This assessment forms part of a Review of Environmental Factors (REF) to be assessed under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Airly Mine is an underground coal mine located near the village of Capertee, approximately 40 km north-west of Lithgow in the Western Coalfield, as shown in Figure 1-1. Centennial acquired Airly Mine in 1997 and coal production commenced in 2009. The mine is located on Mining Lease ML1331 and Authorisation Area A232. Currently Airly Mine operates under Development Consent DA162/91, which allows for the extraction of coal and transportation of product by rail to Port Kembla for the export market.

Centennial Airly proposes to drill seven boreholes and construct a V-notch weir within Authorisation Area A232, as shown in Figure 1-2. Groundwater monitoring is the primary purpose of the drilling program, with geological information obtained as a secondary dataset for input into the geological model of the mine. The V-notch weir will be installed to provide for continuous surface water flow monitoring.

1.2 Study area

The Study Area for the water impact assessment encompasses Authorisation Area A232, which includes the locations of the seven proposed boreholes, as shown in Figure 1-2.

1.3 Report objectives

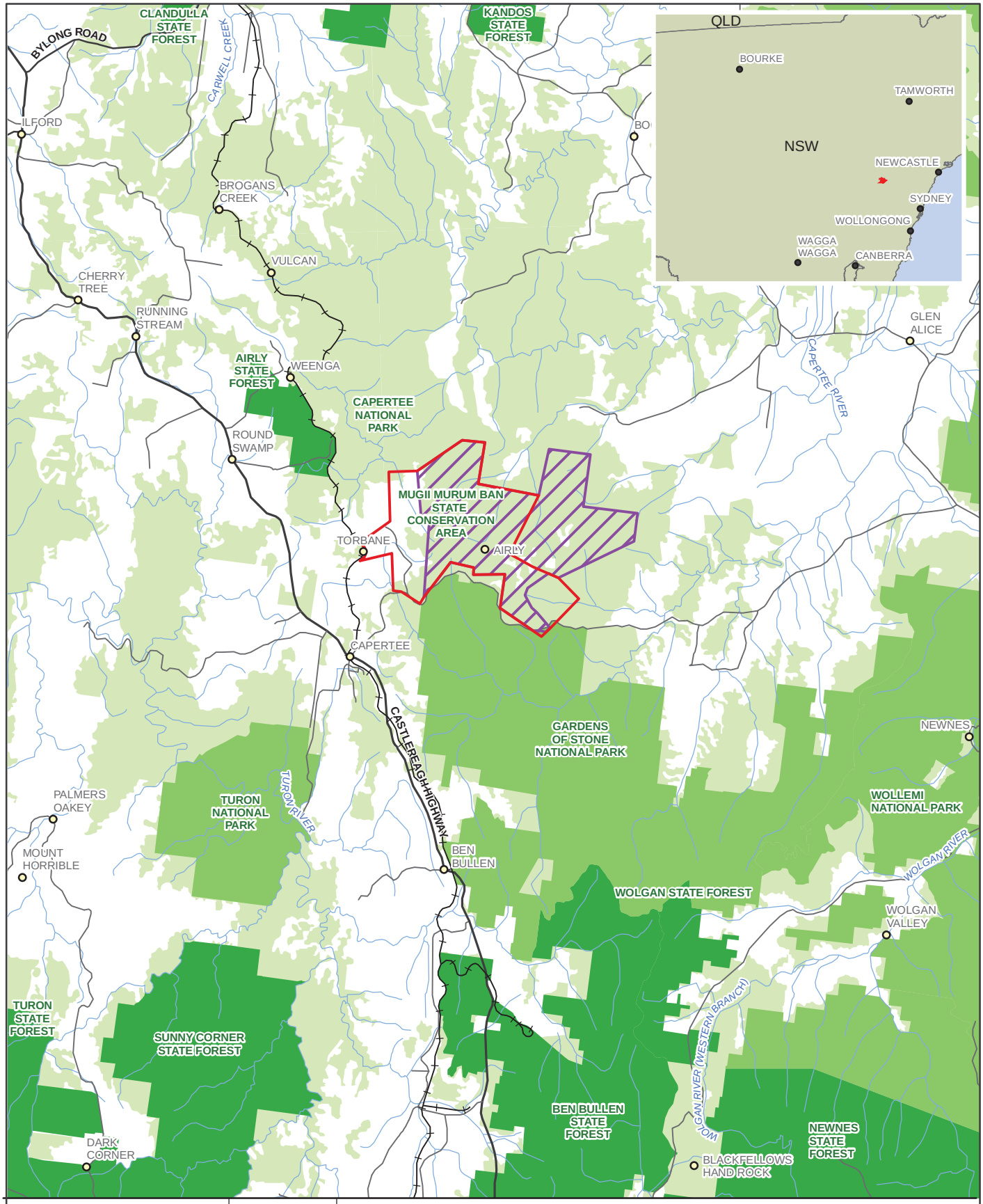
The WIA has been prepared to:

- Describe the existing surface water and groundwater environment of the Study Area, including the identification of sensitive receptors.
- Describe the proposed drilling works, including site preparation, water supply, borehole construction details and waste disposal.
- Describe the proposed construction of the V-notch weir.
- Identify any licensing requirements for the proposed drilling program.
- Assess the potential impacts of the proposed drilling program on surface water and groundwater sources.
- Develop mitigation measures to avoid any potentially adverse impacts identified.

1.4 Regulatory context

1.4.1 Water Act 1912

The *Water Act 1912* is administered by the NSW Office of Water (NOW) and regulates access, trading and allocation of licences associated with both surface and groundwater sources where Water Sharing Plans (WSPs) under the more recent *Water Management Act 2000* (WM Act) have not been put in place. The elements to which the *Water Act 1912* applies include extraction of water from a river, extraction of water from groundwater sources, aquifer interference (less than 3 ML/year) and diversion works of surface water runoff for capture (of a



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0 0.5 1 2 3 4

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N

ML 1331 Boundary
A232 Boundary
Waterway
Existing Rail
Principal Road
Secondary Road
Minor Road
Nature Conservation
State Forest
Forest Or Shrub

LOCATION	Airly
SEAM	Lithgow Seam
DRAWN	S.M.
CHECKED	F.M.
APPROVED	S.G.
SCALE	Refer to scalebar

2016 Exploration Drilling Program REF Water Impact Assessment

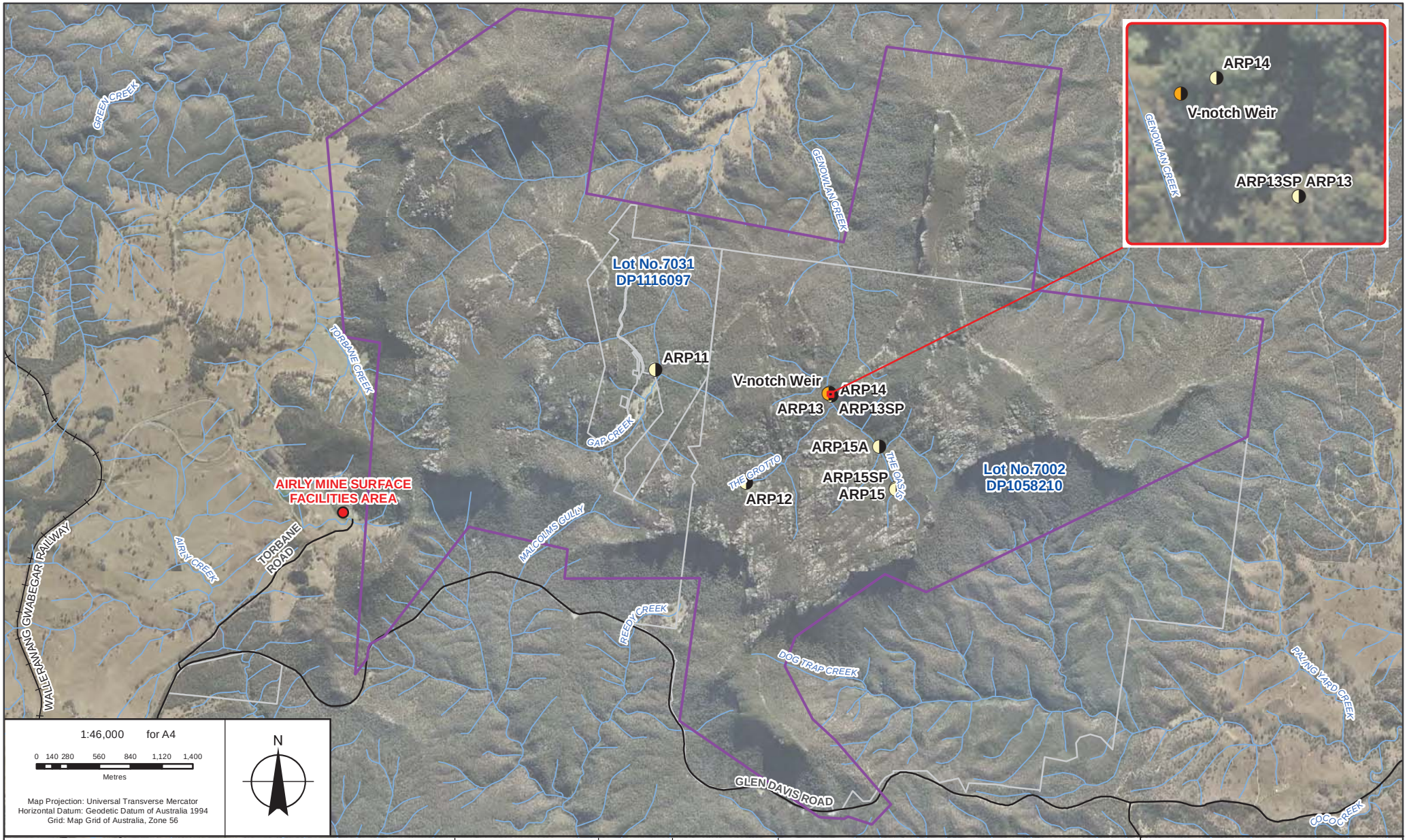
Locality Plan

Centennial Airly

DATE 11/03/2016

Figure 1-1

GIS Filename: G:\22\0105001\GIS\Maps\Deliverables\Western\Airly\2217479\2217479_WIA_001_Locality_A.mxd



LOCATION	Airly
SEAM	Lithgow
DRAWN	S.M.
CHECKED	F.M.
APPROVED	S.G.
SCALE	refer to scalebar

2016 Exploration Drilling Program REF Water Impact Assessment

Proposed Borehole Locations

Centennial Airly

DATE 11/03/2016

Figure 1-2

GIS Filename: G:\22\0105001\GIS\Maps\Deliverables\Western\Airly\2217479\2217479_WIA_002_ProposedBoreholeLocations_A.mxd

capacity less than basic landholder rights). The installation of groundwater monitoring bores at Airly Mine will be licensed under Part 5 of the *Water Act 1912*.

1.4.2 Water Management Act 2000

The WM Act, administered by NOW, is progressively being implemented throughout NSW to manage water resources in the state, superseding the *Water Act 1912*. The aim of the WM Act is to ensure that water resources are conserved and properly managed for sustainable use benefiting both present and future generations. It is also intended to provide a formal means for the protection and enhancement of the environmental qualities of waterways and their in-stream uses as well as to provide for protection of catchment conditions. Fresh water sources throughout NSW are managed via WSPs under the WM Act. Key rules within WSPs specify when licence holders can access water and how water can be traded.

Water sharing plans

The Greater Metropolitan Region Unregulated River Water Sources Water Sharing Plan, which became operational in July 2011, regulates the interception and extraction of surface water within the Study Area. The Study Area is located within the Capertee River Management Zone of the Hawkesbury and Lower Nepean Rivers Water Source of this WSP.

The Greater Metropolitan Region Groundwater Sources Water Sharing Plan, which commenced in July 2011, regulates the interception and extraction of groundwater within the Study Area. The Study Area is located within the Sydney Basin North Groundwater Source of this WSP.

Controlled activity approvals

Section 91 of the WM Act details the requirements for controlled activity approval to carry out work on waterfront land, which includes the bed of any river, lake or estuary and any land within 40 m of its high water mark. Clause 39 of the *Water Management (General) Regulation 2011* exempt activities carried out in accordance with any lease or licence under the *Mining Act 1992*. Thus, controlled activity approvals will not be required for the drilling and construction of the proposed boreholes. However, it remains an offence to harm waterfront land when carrying out an exempt controlled activity.

1.4.3 Aquifer Interference Policy

The NSW Aquifer Interference Policy (NOW, 2012) was finalised in September 2012 and clarifies the water licencing and approval requirements for aquifer interference activities in NSW. Many aspects of this Policy will be given legal effect through an Aquifer Interference Regulation.

Stage 1 of the Aquifer Interference Regulation commenced on 30 June 2011 and specifies the requirement to hold a WAL if more than 3 ML per year of water is taken during coal exploration. Clause 18 of the *Water Management (General) Regulation 2011* exempt certain activities from the requirement of a WAL, including the taking of water for prospecting or fossicking activities approved under the *Mining Act 1992* up to a maximum of 3 ML per water year.

2. Existing environment

2.1 Topography

The Study Area is characterised by steep and rugged topography, with areas of cliffs and rock outcrops, as well as lower lying, undulating areas. The topography is dominated by Mount Airly to the west and Genowlan Mountain to the east. The two mountains form a mesa complex, separated by a low saddle known as Airly Gap. Site elevation varies from over 1,000 m on Mount Airly to less than 400 m in the south-eastern section of the Study Area.

2.2 Land use

Land use surrounding the Study Area includes rural residential, grazing land, coal mining, recreation activities, commercial forestry and nature conservation. The majority of the Study Area consists of rugged unpopulated bushland including the Mugii Murum-ban State Conservation Area. An operational limestone mine, Excelsior Limestone Mine, is located 5 km north-west of the surface facilities area at Airly Mine. Historically, oil shale mining was an important land use in the region, with mining for diamonds and gold also occurring in the past.

The western regions of the Study Area consist of cleared agricultural land used primarily for grazing of stock as well as the Airly Mine surface facilities area. Those portions of the Study Area not within the Mugii-Murum-ban State Conservation Area is land owned by Centennial Airly. Glen Davis Road, the Airly Mine Access Road and Torbane Road pass through the south-western corner of the Study Area.

The Gardens of Stone National Park and Wollemi National Park are both within the vicinity of Airly Mine, as shown in Figure 1-1. Both these protected areas, along with the Blue Mountains, Yengo, Nattai, Kanangra-Boyd and Thirlmere Lakes National Parks and the Jenolan Karst Conservation Reserve, make up the Greater Blue Mountains World Heritage Area.

2.3 Climate

2.3.1 Rainfall

Daily rainfall data was obtained as SILO patched point data from the Queensland Climate Change Centre of Excellence. SILO patched point data is based on historical data from a particular Bureau of Meteorology (BOM) station with missing data ‘patched in’ by interpolating with data from nearby stations. For this assessment, SILO data was obtained for the BOM Ilford (Warrangunyah) Station (station number 62031), which is located approximately 29 km north-west of Airly Mine. This station was chosen based on the length and quality of the data record and proximity to the site.

The period of rainfall data used for this assessment extended from January 1901 to December 2013 and is summarised as annual totals in Figure 2-1. The statistics for the rainfall data set are:

- Minimum annual rainfall – 277 mm in 1982
- Average annual rainfall – 673 mm
- Median annual rainfall – 659 mm
- Maximum annual rainfall – 1,513 mm in 1950

The average monthly rainfall was observed to vary from a low of approximately 44 mm in May to a high of approximately 67 mm in January.

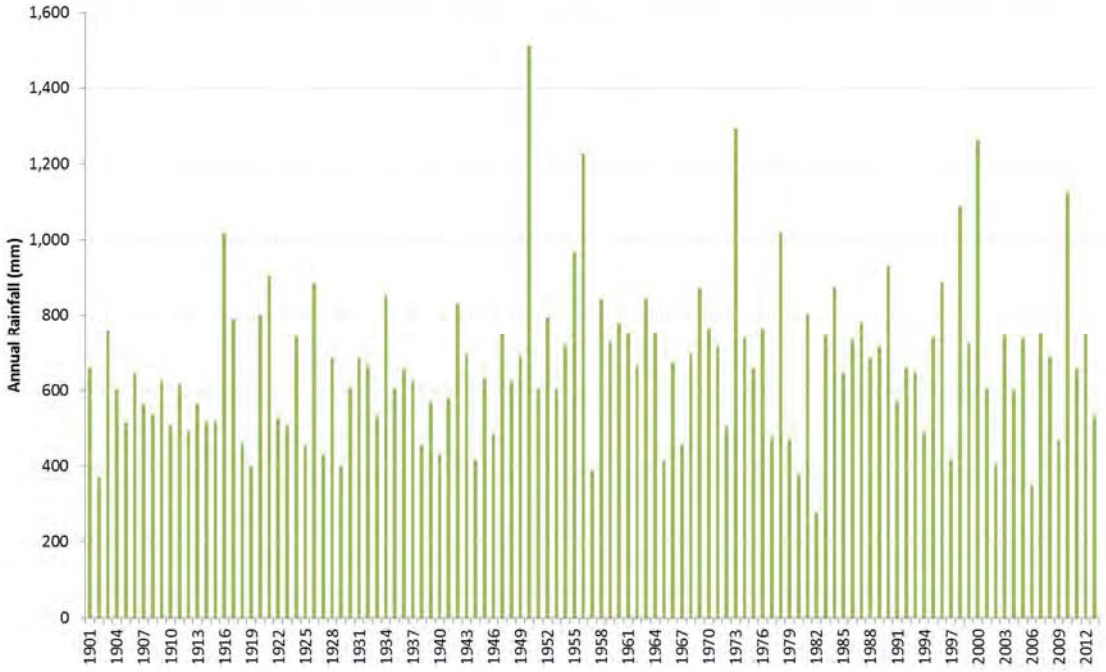


Figure 2-1 Annual rainfall for Ilford (Warrangunyah) Station

The SILO patched point data for the Ilford (Warrangunyah) Station was also used to generate a cumulative rainfall departure (CRD) curve over the period from 1901 to 2013, presented in Figure 2-2. CRD is the monthly accumulation of the difference between the observed monthly rainfall and long-term average monthly rainfall. Any increase in the CRD reflects above average rainfall while a decrease in the CRD reflects below average rainfall. The CRD curve only deviates from zero due to atypical (above and below average) rainfall.

Figure 2-2 Cumulative rainfall departure curve for Ilford (Warrangunyah) Station

Figure 2-2 indicates that the region generally experienced below average rainfall during the period extending from 1901 to 1946. Since this time, the CRD curve generally shows an increasing trend, indicating above average rainfall.

2.3.2 Evaporation

Information provided at the closest BOM station which records evaporation, Bathurst Agricultural Station (station number 63005), was reviewed and average monthly evaporation rates were determined, as presented in Figure 2-3.

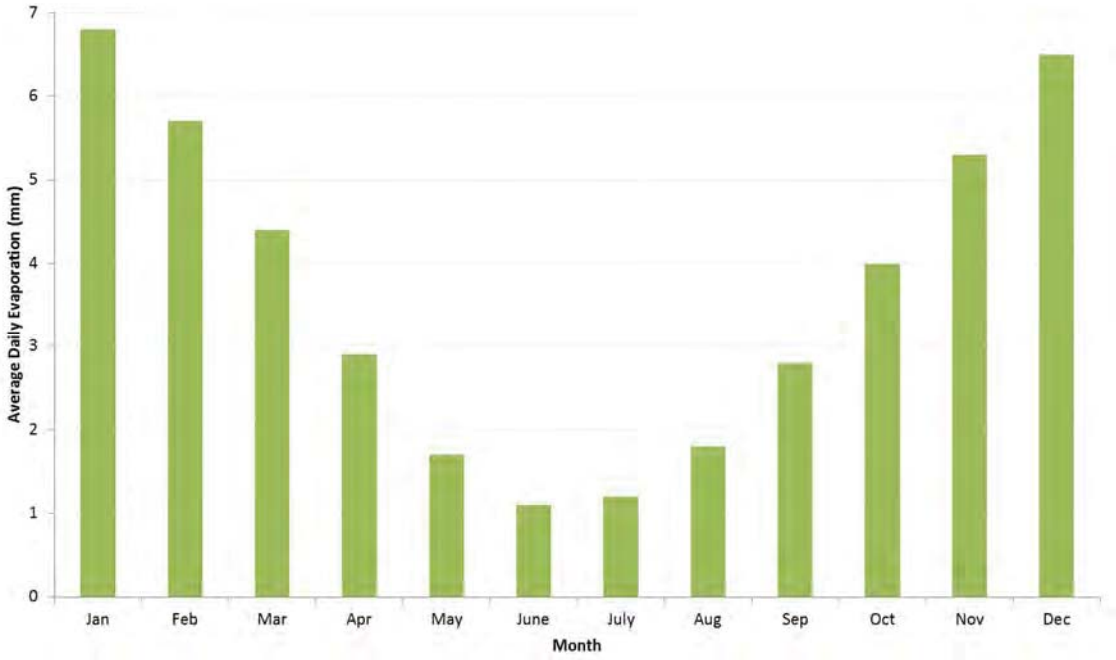


Figure 2-3 Average daily evaporation from Bathurst Agricultural Station

The average annual evaporation total was approximately 1,341 mm, compared to the annual average rainfall of 673 mm. This gives an annual deficit (difference between annual rainfall and annual evaporation) of approximately 668 mm on average.

2.4 Surface water sources

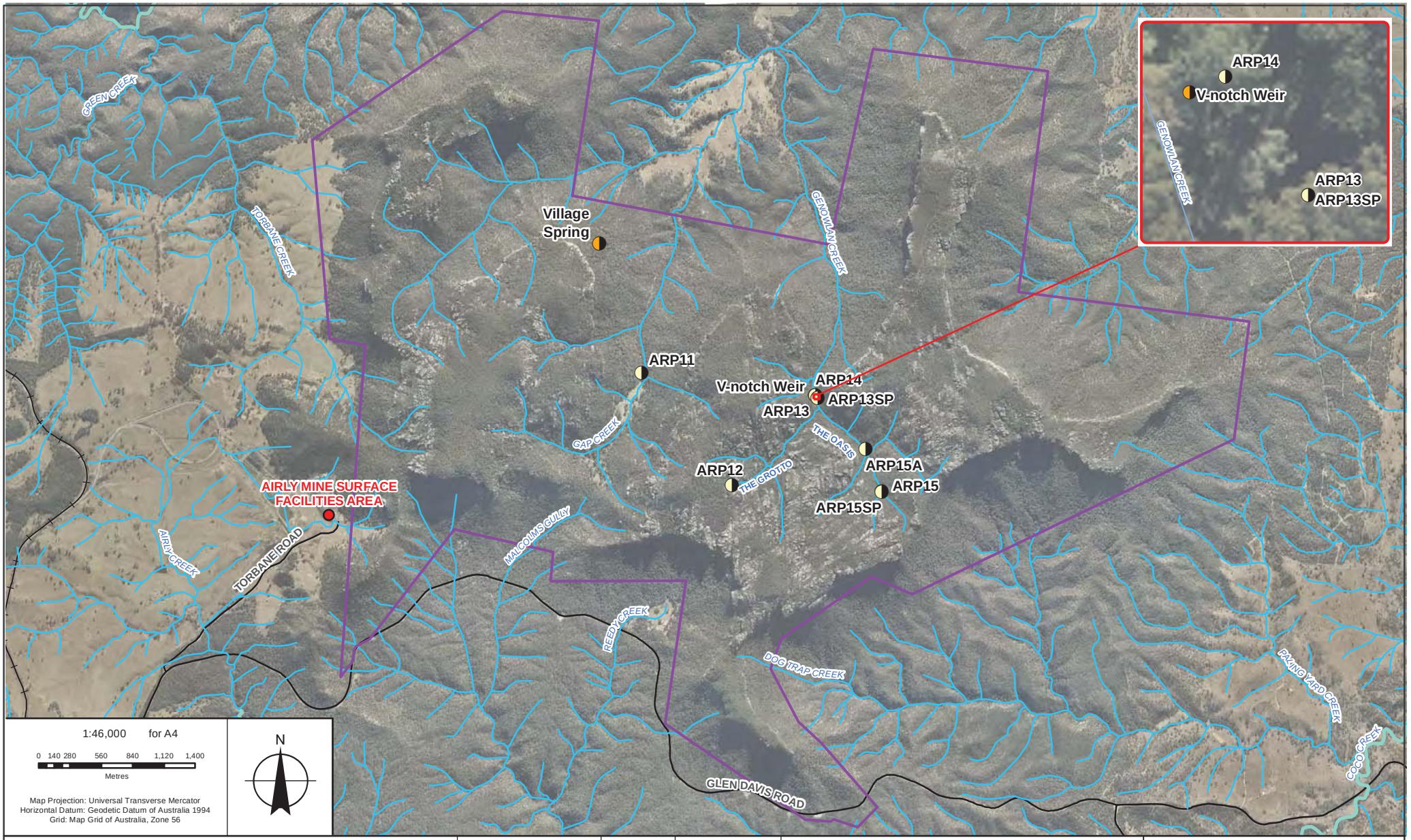
The Study Area lies within the Capertee River catchment, which is part of the Greater Hawkesbury/Nepean catchment. The Capertee River flows in a south-east direction to its confluence with the Wolgan River to form the Colo River, which ultimately contributes to the Hawkesbury River and Broken Bay.

The Study Area includes the following four major creek systems, as shown in Figure 2-4:

- Airly Creek system
- Emu Swamp Creek system
- Gap Creek and Genowlan Creek system
- Torbane Creek and Oaky Creek system

As shown in Figure 2-4, the Airly Creek system drains the southern part of the Study Area and joins the Capertee River approximately 17 km north-east of the surface facilities area at Airly Mine.

Surface runoff from a small area in the north-east of the Study Area drains to Emu Swamp Creek, which flows in a north-east direction and joins the Capertee River approximately 10 km downstream.



LOCATION	Airly
SEAM	Lithgow
DRAWN	S.M.
CHECKED	F.M.
APPROVED	S.G.
SCALE	refer to scalebar

2016 Exploration Drilling Program REF Water Impact Assessment

Catchment Areas and Watercourses

Centennial Airly

DATE 11/03/2016

Figure 2-4

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Surface runoff from the northern section of the Study Area drains into Gap Creek and Genowlan Creek. The two creeks, which are groundwater fed in parts, drain northward for approximately 2 km before converging into the greater Genowlan Creek. The surface water features locally referred to as 'The Grotto' and the 'Oasis' are located on the upper reaches of Genowlan Creek as shown in Figure 2-4. Genowlan Creek continues to drain in a north easterly direction until its confluence with the Capertee River approximately 8 km downstream. All proposed drilling activities will occur within the Genowlan Creek catchment.

The Torbane-Oaky Creek sub-catchment drains the north-west region of the Study Area. Torbane Creek rises in the north-west of the Study Area and flows in a north-west direction and joins Oaky Creek approximately 2 km downstream of the Study Area boundary. A small north-west portion of the Study Area drains directly to an unnamed tributary of the Capertee River.

Airly Creek enters the Gardens of Stone National Park immediately south of the Study Area before joining the Capertee River. All other watercourses within the Study Area also drain into the Capertee River, which enters the Wollemi National Park downstream of Airly Mine approximately 35 km east of the Study Area.

All of the creeks within the Study Area are ephemeral as shown in Figure 2-4. Generally, these watercourses flow for relatively brief periods following significant rainfall events. Flows within Airly Creek, Oaky Creek, Coco Creek and Genowlan Creek become perennial outside the Study Area as shown in Figure 2-4.

2.5 Geology

The Study Area is located within the southern part of the Western Coalfield of NSW, on the western edge of the Sydney Basin. The area is underlain by Triassic sandstone of the Narrabeen Group, which is underlain by the Illawarra Coal Measures. The outcrop geology in the vicinity of the Study Area is shown in Figure 2-5.

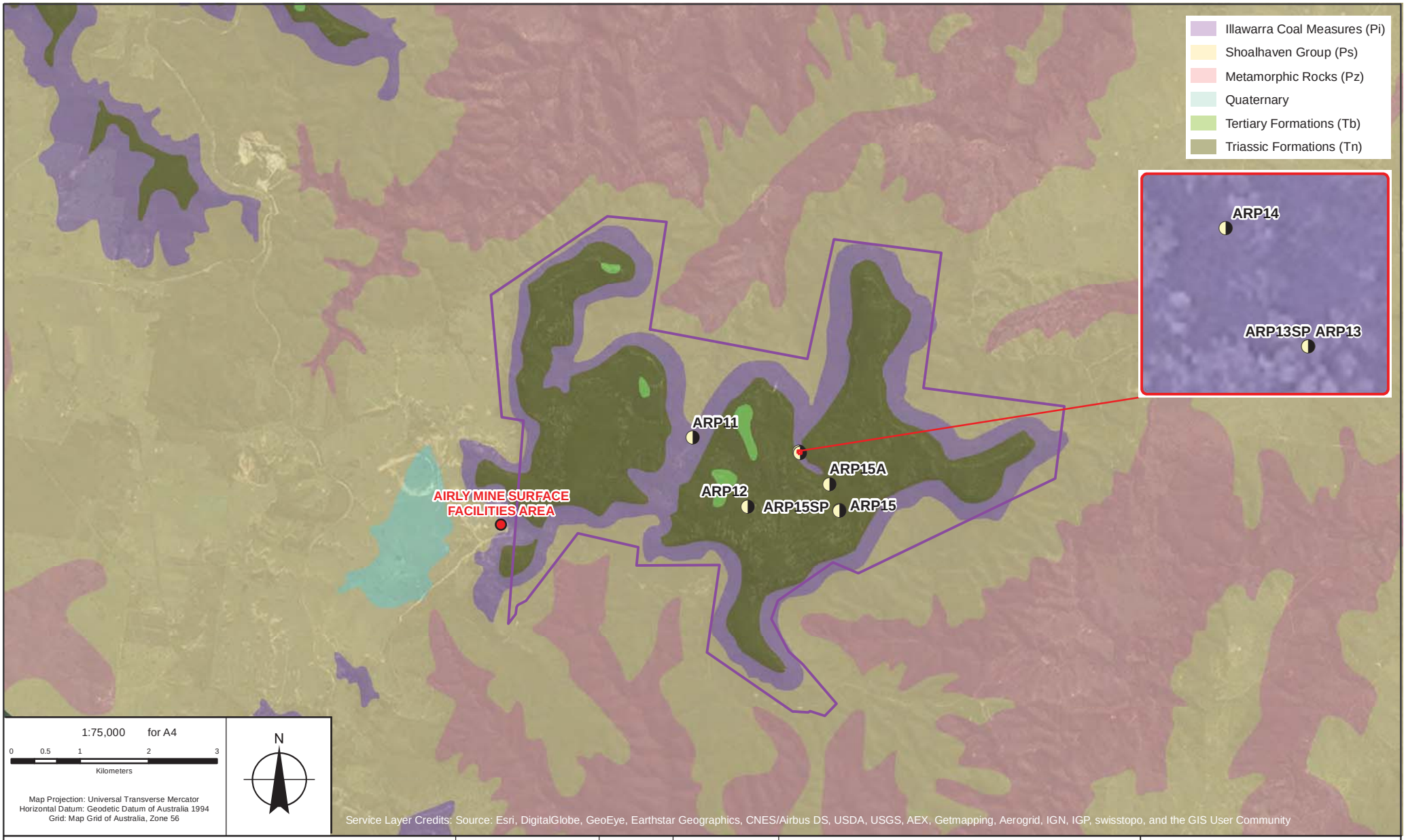
Sandstone of the Triassic Narrabeen Group outcrops throughout the plateau and cliffs of Mount Airly and Genowlan Mountain, with small areas of Tertiary basalt outcrop at the higher elevations as shown in Figure 2-5. The Triassic strata are up to 200 m thick.

The Permian Illawarra Coal Measures outcrop around the Triassic formations at lower elevations, including the zone between Mount Airly and Genowlan Mountain. The Lithgow Seam, within the lower Illawarra Coal Measures, is the target coal seam at Airly Mine. The seam outcrops completely within the vicinity of Study Area and is therefore disconnected to the areas of occurrence of this seam located several kilometres to the south and north-west.

The depth of cover above the Lithgow Seam ranges from less than 20 m in areas of outcrop and in the Gap Creek area, up to approximately 310 m. The seam dips gradually to the east at about 1 degree. The average thickness of the Permian overburden is 105 m (Golder Associates, 2013).

Interbedded siltstone and sandstone of the older Shoalhaven Group outcrop across the Airly Mine surface facilities area and beyond the Study Area. Older Devonian rocks also outcrop beyond the Study Area in areas of lower elevation.

Based on high resolution aeromagnetic and radiometric data (SKR, 2012), the basement (or pre-Permian) and shallow geology is characterised by a number of north-west, north-east and north-south trending fault and joint features. SKR (2012) also reports that igneous intrusions are not pervasive in the area.



GHD

- Airly Surface Facilities Area
- Proposed Borehole
- A232 Boundary

LOCATION	Airly
SEAM	Lithgow
DRAWN	S.M.
CHECKED	
APPROVED	S.G.
SCALE	refer to scalebar

2016 Exploration Drilling Program REF Water Impact Assessment

Geological Map

Centennial Airly

DATE 11/03/2016

Figure 2-5

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2.6 Groundwater sources

The local groundwater sources within the Study Area are generally low yielding and predominantly within the Quaternary alluvium, weathered and/or fractured sandstone and coal seams that occur within Mount Airly and Genowlan Mountain. They are classified as 'less productive' in accordance with the criteria specified in the NSW Aquifer Interference Policy (i.e. the yield is typically less than 5 L/s and/or the total dissolved solids concentration is typically greater than 1,500 mg/L).

The regional groundwater sources occur within the Shoalhaven Group below the target coal seam, as well as within the underlying Devonian rocks.

A schematic representation of local and regional groundwater flow is shown in Figure 2-6.

2.6.1 Local groundwater sources

Alluvium

The alluvium throughout the Study Area forms an unconfined shallow aquifer with groundwater ranging in depth from less than 1 m to over 5 m below ground level (bgl) and aquifer thickness generally less than 12 m.

The alluvium associated with Gap Creek and Genowlan Creek is generally a silty sand material and recharged from rainfall as well as inter-aquifer flow from adjacent (primarily Permian) strata in some areas. Alluvial groundwater discharges to the connected streams.

Some areas of Gap Creek and Genowlan Creek are fed relatively consistently by rainfall-based flows only, which emerge from the Quaternary colluvium and alluvium. Although the source for this recharge is rainfall-based, anecdotal evidence infers that these rainfall-based flows are held in the Quaternary strata and released slowly into the reaches of Genowlan Creek above the 'Grotto' and the 'Oasis' areas, as well as in certain reaches of Gap Creek. The water within the Quaternary strata in these areas is disconnected from other local and regional groundwater sources. Flows in the Grotto and Gap Creek vary with rainfall seasonality, whereas anecdotally the flows through the Oasis are persistent and vary from approximately 2.2 L/s in average conditions to 1 L/s during drought.

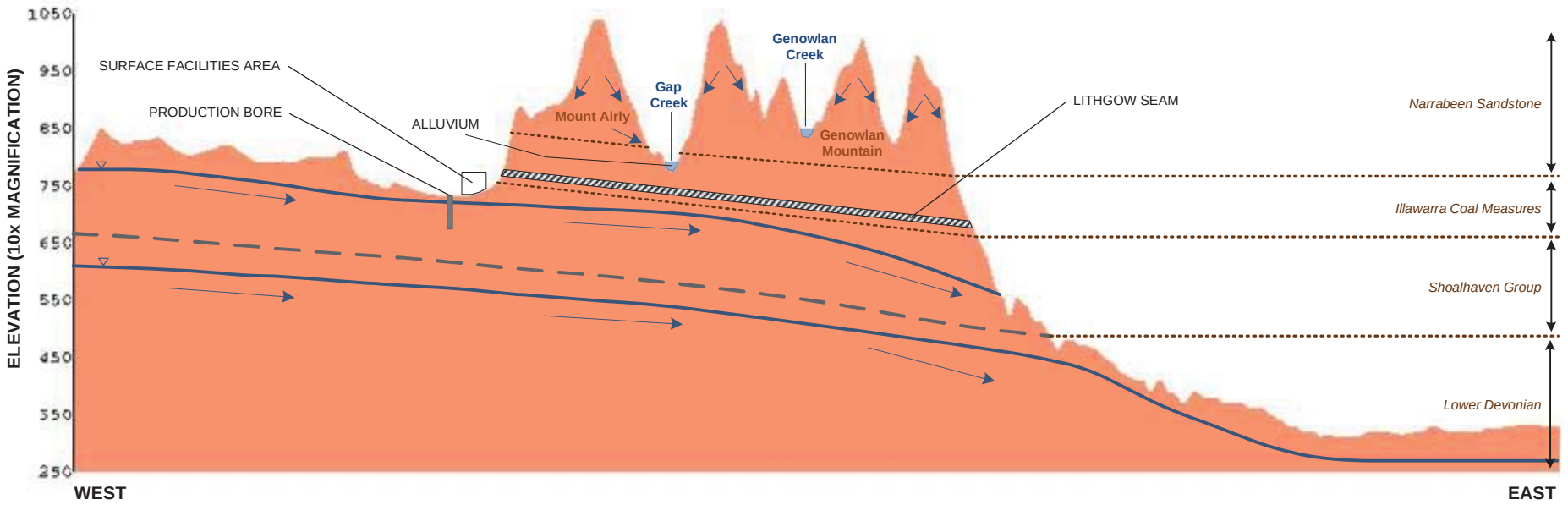
Groundwater Dependent Ecosystems (GDEs) are likely to occur within the shallow alluvial aquifer zones where groundwater levels are shallow and exist as moist sheltered gully forests. They are unlikely to be entirely groundwater dependent and are termed 'facultative' ecosystems. The GDEs that may exist within the Study Area are not listed as high priority GDEs in the WSP.

Porous and fractured rock

The local porous and fractured rock groundwater sources include the Narrabeen Sandstone and coal seams of the Illawarra Coal Measures. These sources are recharged by rainfall via fractures within overlaying strata and seep out of the side of the mountains or directly into watercourses. With the majority of discharge from these sources being to seepage areas, there is minimal inter-aquifer flow to underlying regional groundwater sources.

Piezometric pressure within the local porous and fractured rock groundwater sources is generally low, reflecting the extensive groundwater seepage/drainage area across the slopes of Mount Airly and Genowlan Mountain. Piezometric contours generally follow the dip of the strata to the east – northeast.

There is a downward vertical hydraulic gradient across the strata from the Narrabeen Sandstone to the Illawarra Coal Measures.



GROUNDWATER FLOW

LOCATION	Airly
SEAM	NA
DRAWN	SM
CHECKED	SG
APPROVED	SG
SCALE	NTS

2016 Exploration Drilling Program REF
Water Impact Assessment

Local and Regional Groundwater Flow

Centennial Airly

DATE Dec 2014

Figure 2-6

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2.6.2 Regional groundwater sources

The upper regional groundwater source occurs within siltstone and sandstone of the Shoalhaven Group. According to the *Western Coalfield (Southern Part) Regional Geology 1:100,000 map* (NSW Department of Mineral Resources, Edition 1 1992), this rock formation was deposited in a marine environment and therefore the groundwater is highly brackish to saline. The recharge area is predominantly to the west of the Study Area where the Shoalhaven Group outcrops as shown in Figure 2-5. Groundwater flow is generally to the east.

The lower regional groundwater source occurs within Devonian metamorphic strata containing shale, sandstone and limestone. The groundwater is slightly brackish and therefore has a lower salt content than the Shoalhaven Group and it is less sulfate dominant. Recharge areas occur to the north, south and east of the Study Area and groundwater flow is generally to the east.

Registered bores

There are no registered bores recorded in the NSW Groundwater Bore Database that are located within the Study Area. The majority of registered domestic and stock bores in the vicinity of the Study Area are located to the east of the Study Area and extract groundwater from the lower regional groundwater source (sandstone and conglomerate formations). Bore yields are generally less than 2.5 L/s and the majority of these bores are utilised under basic landholder rights.

2.7 Sensitive receptors

2.7.1 Surface water

The water impact assessment focuses on potential impacts of the proposed exploration drilling program on the following sensitive surface water sources:

- Airly Creek
- Emu Swamp Creek
- Gap Creek and Genowlan Creek, including ‘The Grotto’ and the ‘Oasis’
- Torbane Creek and Oaky Creek

These surface water sources may be impacted by changes in water quantity and/or quality

2.7.2 Groundwater

The water impact assessment focuses on potential impacts of the proposed exploration drilling program on the following sensitive groundwater sources:

- Alluvium and Quaternary strata – provides baseflow to Gap Creek and Genowlan Creek (including the Grotto and Oasis areas), supports potential GDEs, and is a groundwater source to a small number of users along Genowlan Creek downstream of the Study Area.
- Narrabeen Sandstone – local groundwater source within the Study Area that provides a potential habitat to GDEs and feeds seepage areas/springs.
- Illawarra Coal Measures – local groundwater sources within the Study Area that provide baseflow to Gap Creek and Genowlan Creek and feed seepage areas/springs such as the Village Spring.
- Shoalhaven Group – a highly brackish to saline regional groundwater source supplying a small number of registered users, including Airly Mine.

- Devonian metamorphic strata – a slightly brackish regional groundwater source that provides the majority of registered groundwater users to the east of the Study Area.

These groundwater sources may be impacted by water loss, depressurisation and/or change in groundwater quality.

3. Project description

Centennial Airly proposes to undertake an exploration and groundwater monitoring drilling program in 2016. Seven boreholes and a V-notch weir within Authorisation Area A232 have been proposed, as shown in Figure 1-2.

3.1 Proposed boreholes

The location, installation details and purpose of the seven proposed boreholes are presented in Table 3-1. Borehole depths range from 6 m to approximately 365 m below ground level (bgl).

ARP11, ARP12, ARP13SP, ARP14 and ARP15SP, are proposed to be monitored with standpipes and water level loggers. ARP13 and ARP15 are proposed to be monitored using grouted vibrating wire piezometers (VWPs). In addition, a V-notch weir will be installed in Genowlan Creek near ARP13 and ARP14 to monitor daily stream flows.

Table 3-1 Proposed monitoring location and installation details

Borehole	Easting	Northing	Monitored strata	Approximate depth (m)	Monitoring method
ARP11	224172	6333539	Alluvium/Permian	12	Standpipe
ARP12	224980	6332531	Alluvium	6	Standpipe
ARP13SP	225744	6333312	Lithgow Seam	77	Standpipe
ARP13	225744	6333312	Shoalhaven Group	120	VWP
			Devonian strata	300	VWP
ARP14	225728	6333335	Alluvium	6	Standpipe
ARP15SP	226319*	6332480*	Narrabeen Sandstone	30	Standpipe
ARP15	226319*	6332480*	Lithgow Seam	140	VWP
			Shoalhaven Group	200	VWP
			Devonian strata	365	VWP
V-notch weir	225721	6333332	-	-	-

* Current preferred location. The site ARP15A (E 226172; N 6332854) has been identified as an alternative location for this borehole

3.1.1 ARP11

ARP11 is proposed to be located close to Gap Creek within Lot 7031 DP1116097 to monitor potential drawdown in the alluvium and Permian strata as a result of future mining. The hole will be drilled within the alluvium and will extend down to the Lithgow Seam to a depth of approximately 12 m bgl. A standpipe monitoring bore will be installed in the hole and screened across the alluvium and Permian strata.

A photo of the site location (facing northeast) is shown in Plate 1. The site is located off an existing access track from Glen Davis Road as shown in Figure 3-1.

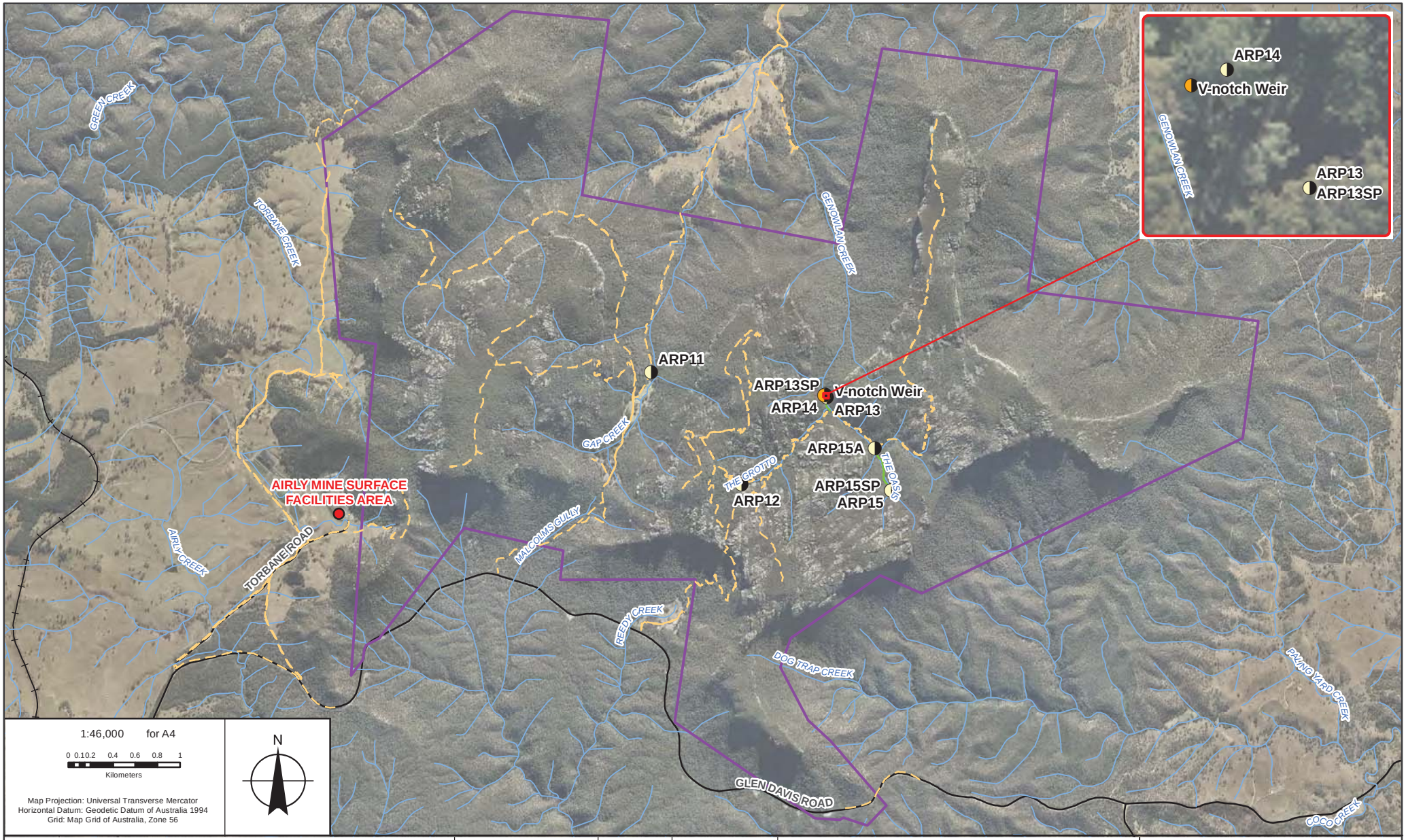
Plate 1 Borehole location ARP11 – view to the northeast

3.1.2 ARP12

The proposed borehole location ARP12 is immediately upstream of the entrance to the Grotto canyon on Genowlan Mountain within Lot 7002 DP1058210. The hole will be drilled within alluvium to a depth of approximately 6 m bgl. A standpipe monitoring bore will be installed to monitor surface water flows through the alluvium and monitor for potential impacts as a result of future mining.

A photo of the site location (facing west) is shown in Plate 2. The site is located off an existing access track from Glen Davis Road as shown in Figure 3-1.

Plate 2 Borehole location ARP12 – view to the west



LOCATION	Airly
SEAM	Lithgow
DRAWN	S.M.
CHECKED	F.M.
APPROVED	S.G.
SCALE	refer to scalebar

2016 Exploration Drilling Program REF Water Impact Assessment

Existing and Proposed Access Tracks

Centennial Airly

DATE 11/03/2016

Figure 3-1

GIS Filename: G:\22\0105001\GIS\Maps\Deliverables\Western\Airly\2217479\2217479_WIA_005_ExistingandProposedAccessTracks_A.mxd

3.1.3 ARP13

Boreholes ARP13 and ARP13SP are proposed to be drilled at a site located on Genowlan Creek downstream of the confluence with the tributary from the Oasis within Lot 7002 DP1058210. ARP13 will be drilled to the Devonian strata to a depth of approximately 300 m bgl. Within this borehole, VWPs will be installed to monitor piezometric height in the Shoalhaven Group and the Devonian strata located beneath the Lithgow Seam. ARP13SP will be drilled separately to the Lithgow Seam to a depth of approximately 77 m bgl. Within this borehole a standpipe will be installed to monitor potential future drawdown in the Permian strata as a result of proposed mining.

A photo of the site location (facing southeast) is shown in Plate 3. An existing access track from Glen Davis Road does not extend to this location and therefore a former overgrown track (shown in Figure 3-1) will be cleared to access ARP13 and ARP13SP. It is considered necessary to drill at this location (rather than further upstream adjacent to the existing access track), since it is closer to an area of predicted groundwater drawdown within the shallow strata and Permian formations, as reported in GHD (2014).

Plate 3 Borehole location ARP13 and ARP13SP – view to the southeast

3.1.4 ARP14

Proposed site ARP14 is located approximately 30 m from ARP13 within Lot 7002 DP1058210. A shallow borehole will be drilled within alluvium to a depth of approximately 6 m bgl and a standpipe monitoring bore will be installed to monitor alluvial groundwater.

A photo of the site location (facing southeast) is shown in Plate 3 4. As for ARP13, an existing access track from Glen Davis Road does not extend to this location and therefore a former overgrown track (shown in Figure 3-1) will be cleared to access ARP14. Again, it is considered necessary to drill at this location (rather than further upstream adjacent to the existing access track), since it is closer to an area of predicted groundwater drawdown within the shallow strata and Permian formations, as reported in GHD (2014).

Plate 4 Borehole location ARP14 – view to the southeast

3.1.5 V-notch weir

A V-notch weir is proposed to be constructed on Genowlan Creek within Lot 7002 DP1058210. The proposed construction will involve the installation of a 2 cm thick timber and metal plate (with V-notch) across the width of the creek. The plate will be fixed to the creek bed and banks using cement and openings sealed off with cement. A device will be attached to the V-notch which will measure the water level in the V-notch. A data logger, sensor, wiring, solar panel and reference gauge will be installed at the monitoring location. The data logger will be installed within an instrument cabinet that will be fitted to a pole with a solar panel attached. A modem and aerial is also proposed to be installed if an adequate signal can be achieved.

As for ARP13 and ARP14, an existing access track from Glen Davis Road does not extend to this location and therefore a former overgrown track (shown in Figure 3-1) will be cleared to access the V-notch weir location. A photo of the proposed location for the V-notch weir to be installed within Genowlan Creek is shown in Plate 5.

3.1.6 ARP15

The proposed location for boreholes ARP15SP and ARP15 is on Genowlan Mountain upstream of the Oasis within Lot 7002 DP1058210. ARP15 will be drilled to the Devonian strata to a depth of approximately 365 m bgl. VWPs will be installed in this borehole to monitor potential change in piezometric height in the Permian strata as a result of proposed mining and piezometric height in the Shoalhaven Group and the Devonian strata located beneath the Lithgow Seam. ARP15SP will be drilled separately to the Triassic Narrabeen Sandstone to a depth of 30 m bgl. A standpipe will be installed in this borehole to monitor potential future drawdown in the Triassic Narrabeen Sandstone.

A photo of the site location (facing south) is shown in Plate 6. An existing access track from Glen Davis Road does not extend to this location and therefore a former overgrown track (shown in Figure 3-1) will be cleared to access ARP15SP and ARP15. This site has been chosen to provide additional baseline groundwater data within the south-eastern portion of A232 and to expand the spatial coverage of the groundwater monitoring network.

Although ARP15 is the preferred site for a shallow and a deep borehole on Genowlan Mountain, an alternative site (ARP15A) has been identified should it not be possible to access ARP15. Should it not be possible to access site ARP15, both the shallow and deep borehole would be drilled at site ARP15A. Site ARP15A is located upstream of the Oasis within Lot 7002 DP1058210 and is on the existing access track from Glen Davis Road. A photo of location ARP15A (facing west) is shown in Plate 7.

Plate 5 Proposed location of V-notch weir

Plate 6 Borehole location ARP15 and ARP15SP – view to the south

Plate 7 Location ARP15A – view to the west

3.2 Site preparation

3.2.1 Access tracks

The borehole locations have been selected to utilise existing tracks leading from Glen Davis Road and to minimise land disturbance and vegetation clearing requirements. Existing tracks are shown in Figure 3-1. As outlined in Section 3.1, drill sites ARP11 and ARP12 will be accessed completely via existing tracks. These tracks have been used previously at Airly Mine to provide access to drill rigs.

Minor clearing of overgrown tracks will be required to access drill sites ARP13, ARP14 and ARP15. The locations of these proposed access tracks are shown in Figure 3-1.

3.2.2 Drill sites

As specified in the REF document, each drill site will be levelled and approximately 450 m^2 in size. Drill sites will contain above ground water supply tanks, above ground tanks for recirculation of drilling water and bunded areas for the storage of chemicals, fuels and drill cuttings. Clean water diversions will be constructed around the upslope side of each drill site so that the work area remains free of excess water and a sediment fence will be installed along the downslope side.

3.3 Borehole construction

Monitoring bores will be constructed in accordance with the *Minimum Construction Requirements for Water Bores in Australia* (ADIA, 2012).

The seven boreholes will be installed using a track mounted drilling rig using rotary mud and air hammer drilling methods. Drilling will involve the use of clean water pumped down through the drill pipe and out through nozzles in the drill bit. Potential clean water sources are identified in Section 3.4.

The water circulates continuously to remove drill cuttings and also serves to cool and lubricate the drill bit. Water and drill cuttings brought to the surface will be collected in above-ground tanks to allow sediments to settle out of the solution. Recovered water will be recirculated down the drilling rods.

A biodegradable bentonite clay-based mud will be used for rotary mud drilling. Material safety data sheets (MSDS) will be available on site for all drilling fluids and products used, to provide information about the material composition, associated risk and manufacturer's recommendations.

At the completion of drilling, each borehole will be flushed to remove any remaining drilling mud from the walls of the borehole and the location of the borehole will be recorded using GPS. Following geophysical logging, standpipes and VWPs will be installed. All aquifers and permeable zones, other than the targeted zone, shall be adequately sealed to prevent aquifer interconnection between zones of different pressure and water quality. All waste, including drill cuttings, will be removed from the site for disposal at the completion of drilling.

Boreholes ARP11, ARP12, ARP13SP, ARP14 and ARP15SP will be constructed as standpipes using a 50 mm class 18 threaded PVC with factory slotted PVC screen. Bore screens of length 3 – 6 metres will be placed at the bottom of boreholes, with the bores extended to the surface using PVC casing. A gravel pack will be placed in the annulus adjacent to the screen and above the screen with a bentonite seal placed above the gravel pack. The remaining bore annulus will be backfilled to near surface with bentonite and/or cement and a concrete collar will be placed at the surface. The standpipes will be completed with a lockable steel monument cover.

Boreholes ARP13 and ARP15 will be constructed as VWPs with probes installed at various depths to measure the pore pressure in the target strata (specified in Table 3-1). These boreholes will be fully grouted with a cement/bentonite mixture to ensure a complete seal. The VWPs will be completed with a lockable steel monument cover.

Vented water pressure transducers will be installed in each standpipe to continuously measure groundwater levels. A data logger will be secured within the monument cover of each standpipe to record these groundwater levels. Data loggers will also be installed at the groundwater surface at ARP13 and ARP15 to continuously record piezometric head measurements from the VWPs.

3.4 Water supply

Based on previous bore construction at Airly Mine, it is expected that approximately 400,000 – 600,000 L (0.4 – 0.6 ML) of water will be required to drill the seven proposed boreholes. Water sources for each location are shown in Table 3-2. At each borehole location, water will be stored in above-ground tanks for drilling-related activities.

The preferred water supply for ARP11 is the existing dam on Gap Creek located in the cleared area to the south of ARP11 locally known as 'Rock Bottom'. The dam is located on the existing access track from Glen Davis Road. A photo of this dam (facing south) is shown in Plate 8. Water from the dam will be transported by vehicle to drill site ARP11 or will be pumped from the dam to the drill site via a polyethylene pipe laid along the edge of the existing track. Should the dam contain an insufficient volume of water at the time of drilling, water will be sourced from the Airly Mine surface facilities area and transported to drill site ARP11 by helicopter or vehicle.

The preferred supply of water to ARP12, ARP15 and ARP15SP (or ARP15A) is to pump at a slow sustainable rate from Genowlan Creek and transfer to storage tanks located at the drill sites using a polyethylene pipe. Flow gauging of Genowlan Creek was undertaken on 19 November 2014 by ALS using surface velocity and volumetric methods (ALS, 2014). Measured flows ranged from 0.1 ML/day (volumetric method) to 0.12 ML/day (surface velocity method). These flow rates are considered to represent drier conditions, since only 10 mm of rain was recorded over the month prior. In the event that Genowlan Creek has insufficient flows, water will be sourced from an existing dam at the historic diamond creek mine. The dam is located on an existing access track leading to the northwest from ARP12. A photo of this dam (facing

north) is shown in Plate 9. Water from the dam will be transported to ARP12, ARP15SP and ARP15 by helicopter.

Similarly, Airly Mine proposes to source water for ARP13, ARP13SP and ARP14 from Genowlan Creek by pumping at a slow sustainable rate from the creek and transferring to each drill site by polyethylene pipe. It is estimated that less than 200,000 L will be required for drilling at ARP13, ARP13SP and ARP14. Based on an extraction rate of 0.05 ML/day (half the available dry weather flow), the required volume would be supplied in less than four days. It is therefore considered that there will be a sufficient volume of water available to supply the drilling operations at ARP13, ARP13SP and ARP14. In the event that Genowlan Creek has insufficient flows, water will be sourced from an existing dam at the historic diamond creek mine. Water from the dam will be transported to ARP13, ARP13SP and ARP14 by helicopter.

Table 3-2 Water sources for drilling at Airly Mine

Borehole	Water sources	Approximate volume required (ML)
ARP11	Gap Creek dam located at 'Rock Bottom' or dam at Airly Mine.	< 0.002
ARP12	Genowlan Creek or, in the event of insufficient flows, the historic diamond creek mine.	< 0.002
ARP13 and ARP13SP	Genowlan Creek or, in the event of insufficient flows, the historic diamond creek mine.	< 0.23
APR14	Genowlan Creek or, in the event of insufficient flows, the historic diamond creek mine.	< 0.002
ARP15 and ARP15SP (or ARP15A)	Genowlan Creek or, in the event of insufficient flows, the historic diamond creek mine.	< 0.31

Plate 8 Gap Creek dam at 'Rock Bottom' – view to the south

Plate 9 Dam at the old diamond mine – view to the north

As specified by Clause 18 of the *Water Management (General) Regulation 2011*, up to 3 ML/year of water taken for use in mining or petroleum exploration activities is exempt from the requirement for a WAL. Since the total water requirement for the proposed drilling and bore construction works is approximately 0.4 – 0.6 ML, a WAL will not be required.

3.5 Rehabilitation

Following the construction of each borehole, the work area will be rehabilitated as far as is practicable following best practice management principles. Rehabilitation may include grading of the site, landscaping, replacing topsoil and reseeding disturbed areas.

3.6 Licensing requirements

Monitoring bore licences will be obtained from the NOW under Part 5 of the *Water Act 1912* prior to drilling and installation.

4. Potential impacts and mitigation measures

The objective of the WIA is to determine the potential impact of the construction and operation of the boreholes on the surface water and groundwater environment. The identification of potential impacts enables the development of measures to avoid or mitigate impacts. Due to the localised nature and duration of the drilling and borehole construction works, it is expected that mitigation measures to be implemented will prevent any significant impacts on surface water and groundwater sources.

4.1 Potential impacts

4.1.1 Surface water sources

All proposed drilling sites are in close proximity to watercourses associated with Gap Creek or Genowlan Creek. Potential impacts of the construction and operation of the boreholes on these surface water sources are as follows:

- Contamination of surface water sources due to fuel, oil or chemical spills.
- Soil erosion from disturbed areas (i.e. drill sites and new tracks) and sedimentation of surface water sources.
- Contamination of surface water sources due to the discharge of recirculating drilling water.
- Temporary changes to catchment flows due to the placement of the work pad.
- Temporary reduction in flows in Genowlan Creek due to extraction to supply water for drilling.

4.1.2 Groundwater sources

Potential impacts of the construction and operation of the boreholes on groundwater sources are as follows:

- Contamination of aquifers from the introduced water supply, drilling chemicals or surface water runoff directly entering the borehole.
- Cross-contamination of aquifers through vertical connection between aquifers of different head or groundwater quality.
- Contamination of aquifers from contaminated drilling rods.
- Localised depressurisation of alluvial aquifers and/or porous and fractured rock groundwater sources.

4.2 Mitigation measures

Specific mitigation measures to address the potential impacts identified in Section 4.1 are outlined in Table 4-1 and Table 4-2. In addition, a risk assessment will be undertaken prior to all site preparation and drilling works to identify and assess site specific environmental risks, review mitigation measures and ensure all persons on site are aware of these measures.

Table 4-1 Proposed mitigation measures – surface water sources

Potential impact	Proposed mitigation measures
Contamination of surface water sources due to fuel, oil or chemical spills.	• All required chemicals, fuels and other materials will be stored and managed appropriately in bunded areas. • All refuelling activities will be undertaken off site where possible or within bunded areas. • All vehicles and plant will be checked for leaks prior to coming on site. • Appropriate spill kits will be available on site at all times with personnel appropriately trained in the use of spill kits. • All waste and unwanted materials will be removed off site at the completion of works to prevent uncontrolled discharges during rainfall events. Waste will be managed and disposed in accordance with the requirements of state and local authorities. • MSDS and manufacturer's recommendations will be available on the drill site for all drilling fluid products used. These will list instructions for handling, use, potential hazards and any disposal requirements for the product or container.
Soil erosion from disturbed areas (i.e. drill sites and new tracks) and sedimentation of surface water sources.	• Erosion and sediment control measures will be installed as necessary prior to the commencement of any earthworks, including construction of new access tracks and drill sites. Measures will be consistent with the principles set out in *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004). • Sediment and erosion control measures will be routinely inspected and maintained appropriately. • Steep gradients will be avoided for access tracks and drill sites where possible in the vicinity of surface water sources. • Sediment fences will be installed to prevent soil erosion and sediment laden runoff from areas where earthworks have been undertaken. • The areas to be disturbed will be minimised and exposed areas covered to provide a stable surface where possible. • Clean catchment runoff will be diverted around the disturbed areas by the use of diversion drains, sand bags, sediment fences and other control measures to direct water into natural bushland areas. • Drilling and construction operations will be limited to dry weather conditions as far as practical.

Potential impact	Proposed mitigation measures
	• Vehicle and machinery movement will be confined to clearly defined access routes, tracks and work areas. • At the completion of construction, all disturbed areas will be restored as close as practical to its pre-drilling conditions, including pre-drilling drainage patterns.
Contamination of surface water sources due to the discharge of recirculating drilling water.	• All waste and unwanted materials, including drill cuttings, drilling water and mud, purged groundwater and other materials, will be contained on site in appropriately sized above-ground storage containers. • Storage containers and pipelines will be routinely inspected and maintained appropriately. Storage containers will be covered overnight in case of rainfall. • Steep gradients will be avoided for drill sites where possible in the vicinity of surface water sources. • Drilling and construction operations will be limited to dry weather conditions as far as practical. • All waste and unwanted materials will be removed off site at the completion of works to prevent uncontrolled discharges during rainfall events. Waste will be managed and disposed in accordance with the requirements of state and local authorities.
Temporary changes to catchment flows due to the placement of the work pad.	• Steep gradients will be avoided for clean water runoff diversions where possible. • Drilling and construction operations will be limited to dry weather conditions as far as practical. • The areas to be disturbed will be minimised and exposed areas covered to provide a stable surface where possible. • At the completion of construction, all disturbed areas will be restored as close as practical to its pre-drilling conditions, including pre-drilling drainage patterns.
Temporary reduction in flows in Genowlan Creek due to extraction to supply water for drilling.	• Avoid oversupply of water for drilling activities and maximise the use of recirculated drilling water. • Maintain a maximum extraction rate of 0.05 ML/day, which represents half the dry weather flow recorded in November 2014.

Table 4-2 Proposed mitigation measures – groundwater sources

Potential impact	Proposed mitigation measures
Contamination of aquifers from the introduced water supply, drilling chemicals or surface water runoff directly entering the borehole.	• Drilling and bore construction will be undertaken in accordance with the *Minimum Construction Requirements for Water Bores in Australia* (ADIA, 2012). • Only non-toxic, biodegradable drilling mud or fluid additives will be used. • All bores will be positioned so that the headworks can be protected from frequent flooding and surface water drainage. • The bores will be sealed appropriately to ground surface to prevent the ingress of surface water into the bore.
Cross-contamination of aquifers through vertical connection between aquifers of different head or groundwater quality.	• Drilling and bore construction will be undertaken in accordance with the *Minimum Construction Requirements for Water Bores in Australia* (ADIA, 2012). • Bores will be constructed by a NSW licensed water bore driller. • All bores will be appropriately sealed to protect groundwater sources against contamination. In bores that intercept multiple groundwater sources, there will also be a seal (bentonite and/or cement) between the aquifers and permeable zones to prevent intermixing, flow and contamination.
Contamination of aquifers from contaminated drilling rods.	• Drilling and bore construction will be undertaken in accordance with the *Minimum Construction Requirements for Water Bores in Australia* (ADIA, 2012). • Bores will be constructed by a NSW licensed water bore driller. • The driller will verify that the drilling rods are clean prior to use.
Localised depressurisation of alluvial aquifers and/or porous and fractured rock groundwater sources.	• Solid casing will be installed into the borehole, or the hole will be grouted, as soon as possible after drilling to minimise groundwater inflows into the hole.

5. References

ALS (2014). *Airly Mine Genowlan Creek Flow Report*.

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NSW Department of Primary Industries, Office of Water (2012). *NSW Aquifer Interference Policy: NSW Government policy for the licencing and assessment of aquifer interference activities.*

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The services undertaken by GHD in connection with preparing this Report were specifically limited to those specifically detailed throughout this Report.

The opinions, conclusions and any recommendations in this report are based on assumptions and information obtained from, and testing undertaken at or in connection with, specific sample location, and on conditions encountered and information reviewed at the date of preparation of the report. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared. GHD disclaims liability arising from any of the assumptions being incorrect.

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GHD

Level 3 GHD Tower 24 Honeysuckle Drive Newcastle NSW 2300
PO Box 5403 Hunter Region Mail Centre NSW 2310
T: (02) 4979 9999 F: (02) 4979 9988 E: ntlmail@ghd.com

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	T Davies	S Gray		S Gray		16/12/2014
1	T Davies	S Gray		S Gray		28/08/2015
2	T Davies	S Gray		S Gray		11/01/2016
3	I Gilmore	S Gray		S Gray		05/04/2016

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Appendix 3

Aboriginal Due Diligence Assessment

Newcastle Office
Ground Floor, 241 Denison Street, Broadmeadow, NSW Australia 2292
PO Box 428, Hamilton, NSW Australia 2303

Our Ref: PR123266: PS
Date: April 2016 (28/8/2014 visual inspection date)

Attn: Sam Price
Environment and Community Coordinator
Centennial Airly Pty Ltd
319 Glen Davis Road
Capertee NSW 2846

Via: sam.price@centennialcoal.com.au

Dear Sam,

RE: ABORIGINAL DUE DILIGENCE ASSESSMENT FOR A REVIEW OF ENVIRONMENTAL FACTORS FOR PROPOSED BOREHOLE LOCATIONS, AIRLY MINE, CAPERTEE NSW

RPS was engaged by Centennial Airly (the proponent) to provide an Aboriginal Due Diligence Assessment for inclusion in a Review of Environmental Factors (REF) for seven proposed boresholes and one V-notch Weir at Centennial Airly Pty Ltd (the Project Area). This project is located within the Airly Mine exploration area, partly contained within the Mugii Murum-ban State Conservation Area and in the Lithgow Local Government Area (LGA).

This report has been prepared in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (2010) ("Due Diligence Code") and the *NSW Minerals Industry Due Diligence Code of Practice for the Protection of Aboriginal Objects* (Minerals Council 2010) ("Minerals Due Diligence Code").

Proposed Activity

The proposed exploration programme will involve the drilling of seven boreholes: ARP11, ARP12, ARP13, ARP13SP, ARP14, ARP15 and ARP15SP to investigate the location, depth, quality and thickness of the coal seam within the Airly Mine exploration area. These boreholes will subsequently be fitted with piezometers and used to monitor groundwater over the next 20 years, after which they will be decommissioned and the boreholes wholly rehabilitated. A V-notch Weir is proposed to be installed within the stream adjacent to borehole ARP13 / ARP13SP and ARP14 to monitor water flow and detect any flow changes as a result of potential subsidence from underground mining.

The boreholes will be drilled by a track mounted rig. Surface disturbance footprints associated with the drilling works will be approximately 450m^2 in extent. Boreholes have been placed within previously cleared areas adjacent to existing or disused tracks to minimise ground disturbance and removal of vegetation.

Environmental Background

Geology and Soils

Aboriginal people often made stone tools using siliceous, metamorphic or igneous rocks and therefore understanding the local geology can provide important information regarding resources in a Project Area. The nature of stone exploitation by Aboriginal people depends on the characteristics of the resource material (Doelman et al. 2008).

The Project Area is situated on the geological landscapes of the Narrabeen group and Illawarra Coal Measures. The Narrabeen group is characterised by sandstone, claystone, siltstone and Widden Brook Conglomerate and is part of the Clifton Subgroup. The Illawarra Coal Measures are characterised by shale, sandstone, conglomerate and chert with coal and torbanite seams.

The borehole locations and weir are situated across two soil landscapes. Borehole locations ARP11, ARP13, ARP13SP, ARP14, ARP15 and ARP15SP and the V-notch Weir are located on the Hassans Walls soil landscape and borehole location ARP12 is located on the Warragamba soil landscape.

The Hassans Walls soil landscape is typically shallow (0cm to 20cm in depth) and may occur over two horizons (A^1 and A^2). A^1 horizon consists of brownish black loamy sand (hw1). A^2 horizon comprises of greyish yellow brown sand (hw2). The underlying subsoils (B^1 and B^2 horizon) may occur at 20cm to 100cm in depth. The subsoils consist of bright yellowish brown pedal clay (hw3) and light grey medium clay (hw4) (King 1993:52-55).

The Warragamba comprises shallow topsoil which occurs over two horizons (A^1 and A^2). A^1 horizon consists of brownish black loamy sand topsoil (wb1) and A^2 horizon comprises of very dark reddish brown clayey sand (wb2). The underlying subsoil consists of pedal clay which varies from dull brown, yellowish brown and reddish brown in colour (wb3) (King 1993:63-65).

Topography and Hydrology

The Project Area is approximately 650 metres to 1000 metres Australian Height Datum (AHD). The surrounding area forms part of the Mugii Murum-ban State Conservation Area and is dominated by narrow valleys, narrow and deep incised drainage lines, narrow spurs and crests, steep sandstone escarpments and pagoda formations.

Gap Creek and Genowlan Creek traverse the Project Area and drain to the north. Gap Creek is approximately 50 metres east of borehole location ARP11. Genowlan creek and associated first order tributaries are situated approximately 20 metres from Borehole locations ARP12, ARP13 / ARP13SP, ARP14, ARP15 and ARP15SP and the V-notch Weir; which is proposed to be installed within the creek line.

Flora and Fauna

An overview of these resources is to provide an indication of the types and variety of flora and fauna that were likely to have been available to Aboriginal people in the past. This information is based on broad scale vegetation mapping for NSW (Keith 2006) and does not replace more detailed studies undertaken for the Project Area and locality.

Past Aboriginal inhabitants are likely to have encountered Western Slopes Dry Sclerophyll Forest which is characterised by ironbark eucalypts and cypress pines at heights of approximately 10 to 25 metres tall. Sclerophyll shrubs are prominent, while grasses are relatively scarce, placing this class in the shrubby subformation of the dry sclerophyll forests. Indicative species of trees include Tumbledown Red Gum, Mugga, Black Cypress Pine, White Cypress Pine, Dirty Gum, Narrow-leaved Ironbark and Blue-leaved Ironbark. Shrub species commonly present include several varieties of Wattle, Heath and Myrtle in addition to Hakea, Grevillea and Grass Trees (Keith 2006:166-167).

This vegetation community provides habitat for a variety of animals and would have also provided potential food and raw material sources for Aboriginal people. Typical animals which may have been hunted by Aboriginal people include kangaroos, wallabies, sugar gliders, possums, echidnas, a variety of lizards and snakes, birds, as well as rats and mice. The bones of such animals have been recovered from excavations of Aboriginal sites suggesting that they were sources of food (Attenbrow 2003:70-76).

Heritage Background

A search of the Aboriginal Heritage Management Information System (AHIMS) was conducted on 25 August 2014 for the Project Area. The following coordinates were searched Eastings 221882 to 227160 and Northings 6331465 to 6334697 (GDA 94, Zone 56). This search revealed that Aboriginal site AHIMS#45-1-2765 (an artefact scatter) is approximately 20 metres to the north-west of proposed borehole location ARP11. This site was groundtruthed during the visual inspection of the borehole location.

Table 2 Results of AHIMS Search

Site Type	Frequency	Percentage
Artefact Site (Number Unspecified)	3	33.33%
Isolated Find	3	33.33%
Art (pigment or engraved); Habitation Structure	1	11.11%
Isolated Find; Habitation Structure	1	11.11%
Shelter with Deposit	1	11.11%
Grand Total	**9**	**100.00%**

Source: AHIMS Search ID 25/08/2014

Visual Inspection Results

A visual inspection of the Project Area for borehole locations: ARP11, ARP12, ARP13 / ARP13SP, ARP14 and ARP15 / ARP15SP and a V-notch Weir, was undertaken on Thursday 28 August 2014 by RPS Cultural Heritage Consultant Philippa Sokol. It is expected that the proposed activity and access to the borehole locations and the weir will not deviate from, or impact outside of the inspected footprints. In some instances existing tracks may require a surface upgrade for access by machinery. These tracks were inspected and no Aboriginal cultural heritage objects were identified.

Table 2 Proposed Borehole Locations

Borehole Location	GDA Easting	GDA Northing
ARP11	224172	6333539
ARP12	224980	6332531
ARP13 and ARP13SP	225744	6333312
ARP14	225728	6333335
ARP15 and ARP15SP	226319	6332480
ARP15A	226174	6332860
V-notch Weir	225721	6333332

Borehole Location ARP11

This borehole location is situated on a lower slope with an east to south easterly aspect and is surrounded by steep sandstone escarpments (Plate 1). The closest water source is Gap Creek approximately 50 metres to the east. The ground surface exposure (GSE) was observed to be approximately 5% with a ground surface visibility (GSV) of approximately 80%. Soils in the area were an organic sandy loam with inclusions of quartz and sandstone fragments. No raw materials suitable for stone tool manufacture were identified in the proposed borehole impact area. Vegetation is characterised as open forest with scattered shrubs and grasses, although bushes were also noted. Previous disturbance to the area includes tailing drains associated with the adjacent access track, previous land clearance and associated erosion, dumped debris including vehicle tyres and metal, as well as stockpiled soils (Plate 2). Access to the borehole location will be via Glen Davis Road and a formed, but unsealed road.

Aboriginal stone artefact site; AHIMS#45-1-2765, is situated approximately 20 metres to the west of the proposed borehole ARP11 location and was groundtruthed during the visual inspection for the borehole (Plate 3 & 4). This site is situated outside of the borehole location and ground disturbance footprint.

Borehole Location ARP12

This borehole location is situated on a lower slope with a west facing aspect and is surrounded by steep sandstone pagodas (Plate 5). The closest water source is a first order tributary of Genowlan Creek approximately 20 metres to the east. GSE was approximately 10% with a GSV of 70%. Soils in the area comprise dark organic loam and deposited alluvial sands. Small quartz and conglomerate fragments are present; however, no raw materials suitable for stone tool manufacture were identified (Plate 6). Vegetation comprised open forest with a shrubby understorey and dense ferns and grasses. Disturbance in this area was minimal and mainly due to burrowing animals and periodical inundation events. Access to the borehole location will be via the Glen Davis Road and a formed State Conservation Area track.

Borehole Location ARP13 and ARP13SP

This combined borehole location is situated on a narrow lower slope with a north westerly aspect (Plate 7). The closest water source is Genowlan Creek approximately 20 metres to the west. GSE was observed to be approximately 5% with a GSV of 75%. Soils in the area were a dark, sandy loam with small quartz inclusions. No raw materials suitable for stone tool manufacture were identified. Vegetation comprised open forest, scattered shrubs and dense ferns and grasses. The main previous disturbance to the area was the vegetation clearance for the access track and associated erosion. Access to the combined borehole location will be via the Glen Davis Road, a formed State Conservation Area track and following a previously used track to the area (Plate 8).

Borehole Location ARP14

This borehole location is situated on a narrow lower slope with a north westerly aspect (Plate 9). The closest water source is Genowlan Creek within 10 metres to the west. GSE during the visual inspection was approximately 5% with a GSV of 75%. Soils in the area were a dark organic loam covered by a thick layer of dried leaves, grass and bark fragments. No raw materials suitable for stone tool manufacture were identified. Vegetation comprised open forest, scattered shrubs, dense ferns and grasses (Plate 10). Disturbances included clearing for the previously formed track, burrowing animals and erosion. Access to the borehole location will be via the Glen Davis Road, a formed State Conservation Area track and following a previously used track to the area.

V-Notch Weir

This weir location is proposed to be situated within Genowlan Creek (Plates 11 & 12). A number of large sandstone rocks and boulders were identified lining the creek bank; however were not considered to be cultural features. Vegetation surrounding the proposed weir comprised mature eucalypt trees, dense ferns and grasses. Access to the weir location will be via the Glen Davis Road, a formed State Conservation Area track and following a previously used track to the area.

Borehole Location ARP15 and ARP15SP

This combined borehole location is situated on a narrow lower slope surrounded by steep sandstone pagodas, with a north facing aspect (Plate 13). The closest water source is a second order tributary of Genowlan Creek approximately 50 metres to the north. GSE was observed to be low at 5% with a GSV of 10%. Soils in the area are characterised by a sandy, dark organic loams with small quartz fragments. No raw materials suitable for stone tool manufacture were identified. Vegetation is characterised by open forest, scattered shrubs with a dense cover of leaf and bark litter and clusters of ferns and grasses. Disturbances included vegetation clearance for the previously formed track. Access to the combined borehole location will be via the Glen Davis Road, a formed State Conservation Area track and following a previously used track to the area (Plate 14).

Summary of Results

The visual inspection of the proposed borehole locations: ARP11, ARP12, ARP13, ARP13SP, ARP14, ARP15, ARP15SP and the V-notch Weir identified no Aboriginal cultural heritage objects inside the area proposed to be disturbed. The closest recorded Aboriginal site is a stone artefact site; AHIMS#45-1-2765 and is situated approximately 20 metres outside of proposed borehole location ARP11. This site is outside of the impact footprint of the proposed activity.

Impact Assessment

The visual inspection of the Project Area identified no Aboriginal cultural heritage objects within the proposed borehole impact footprints. Thus it is considered that the proposed activity associated with the borehole locations and weir installation will not harm any Aboriginal objects or places. An Aboriginal Heritage Impact Permit (AHIP) is not required for the proposed works. However, in order to protect AHIMS#45-1-2765 from inadvertent impact, this area should be cordoned off during works at proposed borehole location ARP11 as per Figure 2.

Conclusions and Recommendations

This report has considered the available archaeological information for the Project Area, the land condition and the nature of the proposed activity. The purpose of this investigation was to identify if there is risk of impact to Aboriginal objects for the works associated with the proposed borehole locations: ARP11, ARP12, ARP13, ARP14, ARP15, ARP15SP and the V-notch Weir. The following recommendations are made in relation to the proposed activity:

Recommendation 1

Prior to works commencing at borehole location ARP11, Aboriginal site AHIMS#45-1-2765 should be cordoned off and protected with high visibility sediment fencing as shown on Figure 2.

Recommendation 2

Vehicle access is to remain within existing tracks where possible in order to minimise potential impacts on surrounding vegetation and reduce erosion.

Recommendation 3

In the event that any vegetation clearing is required to allow large machinery access to a given area, soil disturbance should be kept to a minimum. Subject to ecological constraints it is preferable for vegetation to be cut with a chain saw rather than bulldozed and trees and bushes should be cut at their base just above ground level where possible.

Recommendation 4

All relevant Centennial Airly Pty Ltd 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.

Recommendation 5

This due diligence assessment must be kept by Centennial Airly Pty Ltd so that it can be presented, if needed, as a defence from prosecution under Section 86(2) of the *National Parks and Wildlife Act* 1974.

Recommendation 6

If unrecorded Aboriginal object/s are identified in the Project Area during works, then all works in the immediate area must cease and the area should be cordoned off. OEH must be notified via Enviroline 131 555 so that the site can be adequately assessed and managed.

Recommendation 7

In the unlikely event that skeletal remains are identified, work must cease immediately in the vicinity of the remains and the area must be 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 via Enviroline 131 555. An OEH officer will determine if the remains are Aboriginal or not; and a management plan must be developed in consultation with the relevant Aboriginal stakeholders before works recommence.

Recommendation 8

If, during the course of development works, suspected historic cultural 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.

This report has been prepared by RPS Cultural Heritage Consultant Philippa Sokol and reviewed by Tessa Boer-Mah, Newcastle Cultural Heritage Manager.

Yours sincerely
RPS

Philippa Sokol
Cultural Heritage Consultant

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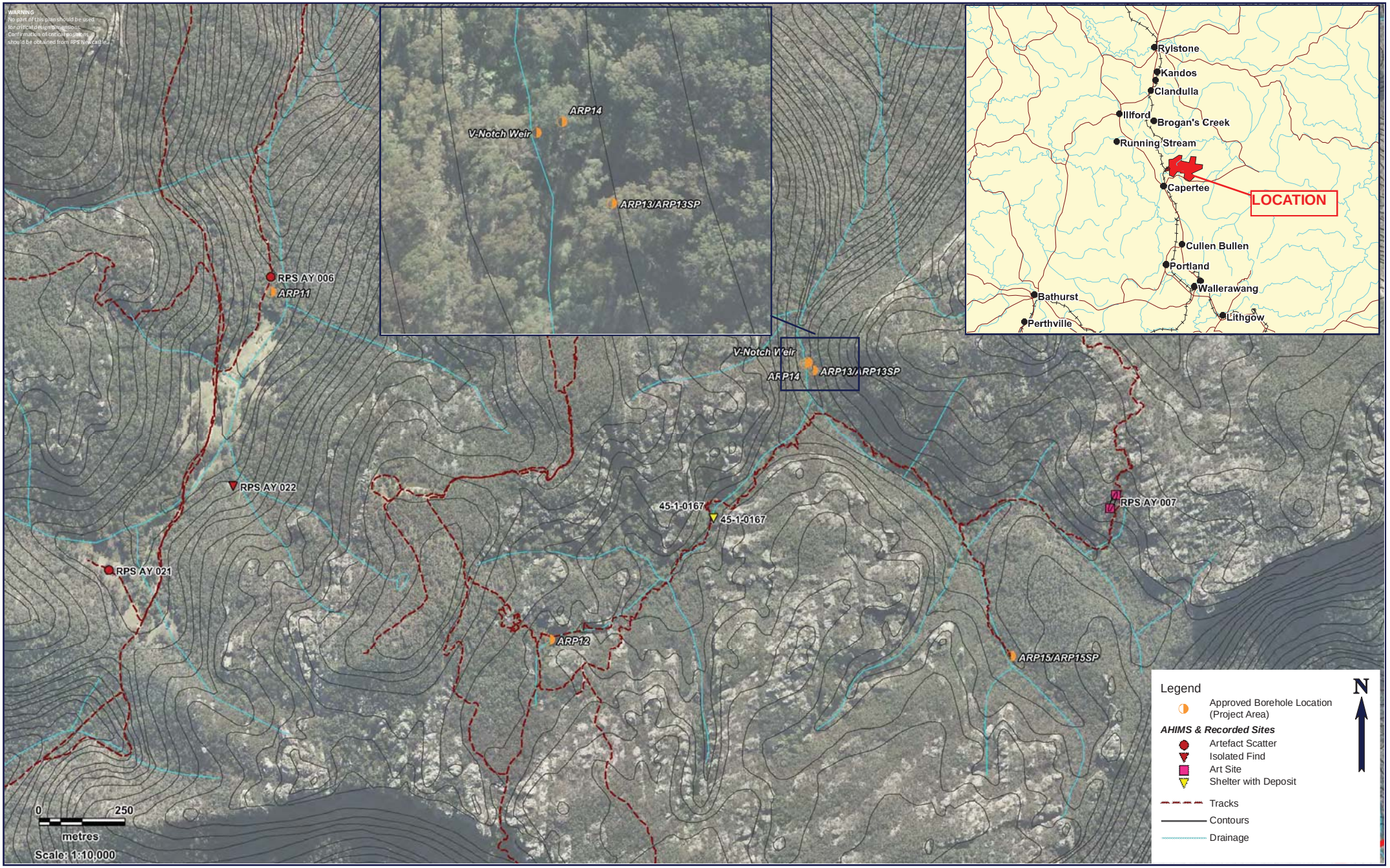
Attachment 1

Figures



TITLE: FIGURE 1: PROJECT AREA WITH AHIMS SEARCH RESULTS

LOCATION: AIRLY

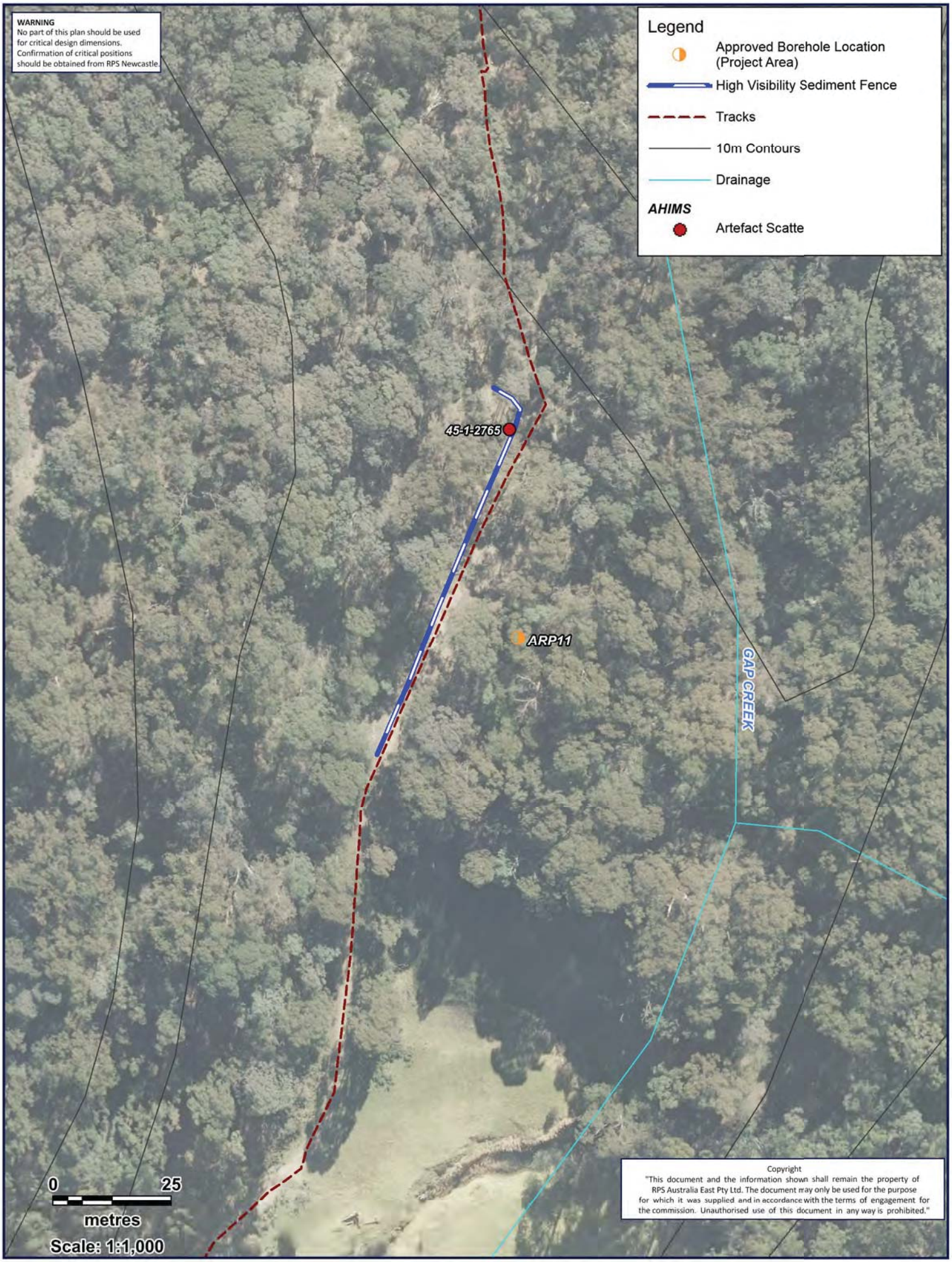
DATUM: (GDA 94)
PROJECTION: MGA Zone 56

DATE: 19/04/2016
PURPOSE: HERITAGE

LAYOUT REF: J:\JOBS\Centennial\All Jobs\123266 Airly Boreholes REF\10 - Drafting\MapInfo Workspace\Arch
VERSION (PLAN BY): C A3 (PS-NW)

CLIENT: CENTENNIAL COAL
JOB REF: 123266-1

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au



TITLE: FIGURE 2: AHIMS #45-1-2765 WITH HIGH VISIBILITY SEDIMENT FENCE

LOCATION: AIRLY

DATUM: (GDA 94)
PROJECTION: MGA ZONE 56

DATE: 5/09/2014
PURPOSE: HERITAGE

LAYOUT REF: I:\JOBS\Centennial\All Jobs\123266 Airly Boreholes REF\10 - Drafting\MapInfo Workspaces\Arch
VERSION (PLAN BY): A A4 (PS - NW)

CLIENT: CENTENNIAL COAL
JOB REF: 123266-1

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au

RPS

Attachment 2

Plates

Plate 1: Borehole location ARP11 view to the north east showing open forest vegetation and accumulated debris

Plate 2: Borehole location ARP11 view of disturbed and exposed stockpiled soils

Plate 3: View to the north identifying a portion of AHIMS#45-1-2765

Plate 4: Stone artefacts identified at AHIMS#45-1-2765

Plate 5: Borehole location ARP12 view to the west showing open forest vegetation and dense ferns

Plate 6: Borehole location ARP12 view of exposed alluvial sands and conglomerate fragments

Plate 7: Borehole location ARP13/ARP13SP view to the south east showing vegetation cover of dense ferns and grass

Plate 8: View to the north showing disused track that will be used to access borehole location ARP13/ARP13SP

Plate 9: Borehole location ARP14 view to the south east showing dense leaf and bark litter with ferns

Plate 10: Borehole location ARP14 view of densely compacted organic loam and leaf litter

Plate 11: V-notch Weir location view inside creek line

Plate 12: V-notch Weir location view to the west and showing creek line

Plate 13: Borehole location ARP15/ARP15SPview south showing a narrow landscape, open forest and dense ground cover

Plate 14: View to the south showing disused track that will be used to access borehole location ARP15/ARP15SP

Attachment 3

AHIMS Search

AHIMS Web Services (AWS)
Search Result

Your Ref Number : PR123266

Client Service ID : 145690

RPS Australia East Pty Ltd -Hamilton

Date: 25 August 2014

Accounts Payable Fortitude Valley PO Box 237
Brisbane Queensland 4006

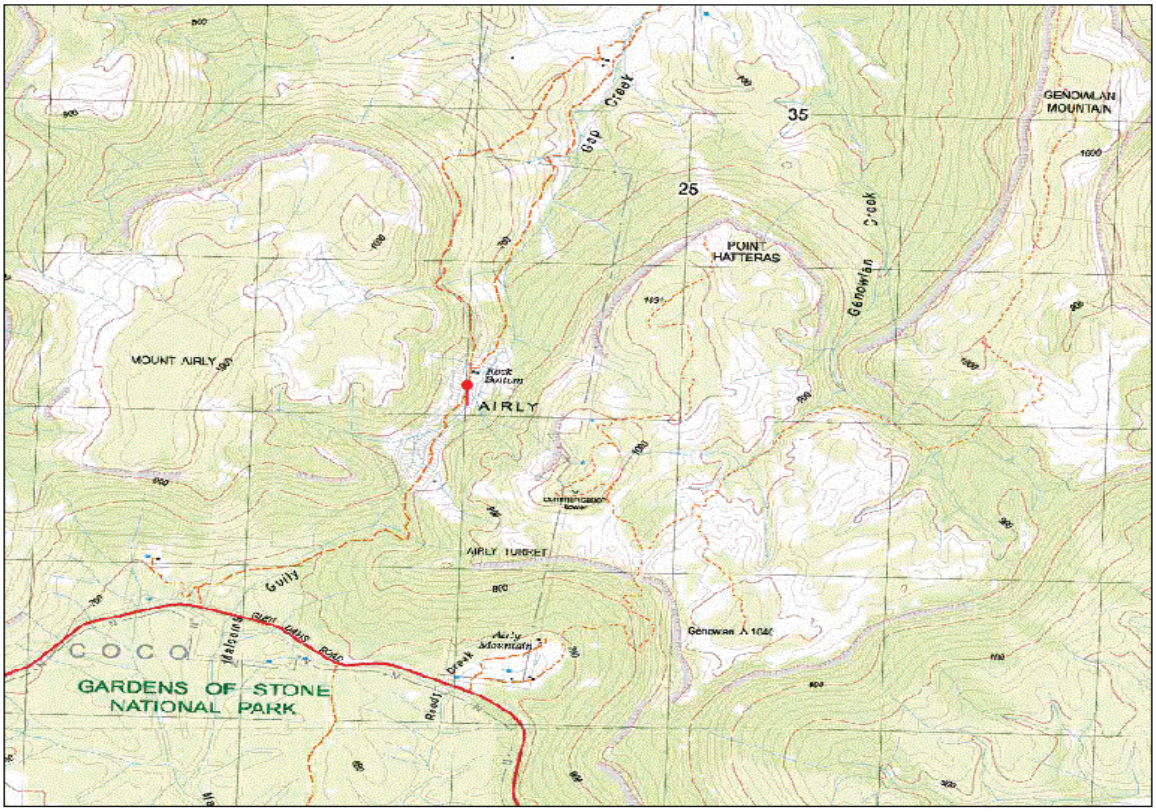
Attention: Cultural Heritage Team Administrator

Email: clh@rpsgroup.com.au

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 56, Eastings : 221882 - 227160, Northings : 6331465 - 6334697 with a Buffer of 0 meters, conducted by Cultural Heritage Team Administrator on 25 August 2014.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.



A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

9	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

PO BOX 1967 Hurstville NSW 2220
43 Bridge Street HURSTVILLE NSW 2220
Tel: (02)9585 6345 (02)9585 6471 Fax: (02)9585 6094

ABN 30 841 387 271
Email: ahims@environment.nsw.gov.au
Web: www.environment.nsw.gov.au

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref Number : PR123266

Client Service ID : 145690

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-1-2742	RPS AY 023	GDA	56	223226	6332207	Open site	Valid	Artefact : 1, Habitation Structure : 1		
	Contact	**Recorders**	RPS - Echuca					**Permits**		
45-1-2746	RPS AY 020	GDA	56	221936	6332676	Open site	Valid	Artefact : 1		
	Contact	**Recorders**	RPS - Echuca					**Permits**		
45-1-2747	RPS AY 021	GDA	56	224223	6332733	Open site	Valid	Artefact : 1		
	Contact	**Recorders**	RPS - Echuca					**Permits**		
45-1-2748	RPS AY 022	GDA	56	224061	6332976	Open site	Valid	Artefact : 1		
	Contact	**Recorders**	RPS - Echuca					**Permits**		
45-1-2762	RPS-AY-003	GDA	56	221930	6332867	Open site	Valid	Artefact : -		
	Contact	**Recorders**	RPS Australia East Pty Ltd -Hamilton,Mr.David White					**Permits**		
45-1-2763	RPS-AY-004	GDA	56	222036	6332723	Open site	Valid	Artefact : -		
	Contact	**Recorders**	RPS Australia East Pty Ltd -Hamilton,Mr.David White					**Permits**		
45-1-2765	RPS-AY-006	GDA	56	224170	6333583	Open site	Valid	Artefact : -		
	Contact	**Recorders**	RPS Australia East Pty Ltd -Hamilton,Mr.David White					**Permits**		
45-1-2766	RPS-AY-007	GDA	56	226583	6332980	Open site	Valid	Art (Pigment or Engraved) : -, Habitation Structure : -		
	Contact	**Recorders**	Ms.Tessa Boer-Mah					**Permits**		
45-1-0167	Genowlan Creek 1	AGD	56	225360	6332640	Closed site	Valid	Artefact : -	Shelter with Deposit	2193
	Contact	**Recorders**	Helen Brayshaw,Mary Dallas Consulting Archaeologists,John Bugg					**Permits**		

Report generated by AHIMS Web Service on 25/08/2014 for Cultural Heritage Team Administrator for the following area at Datum :GDA, Zone : 56, Eastings : 221882 - 227160, Northings : 6331465 - 6334697 with a Buffer of 0 meters. Additional Info : Background information. Number of Aboriginal sites and Aboriginal objects found is 9