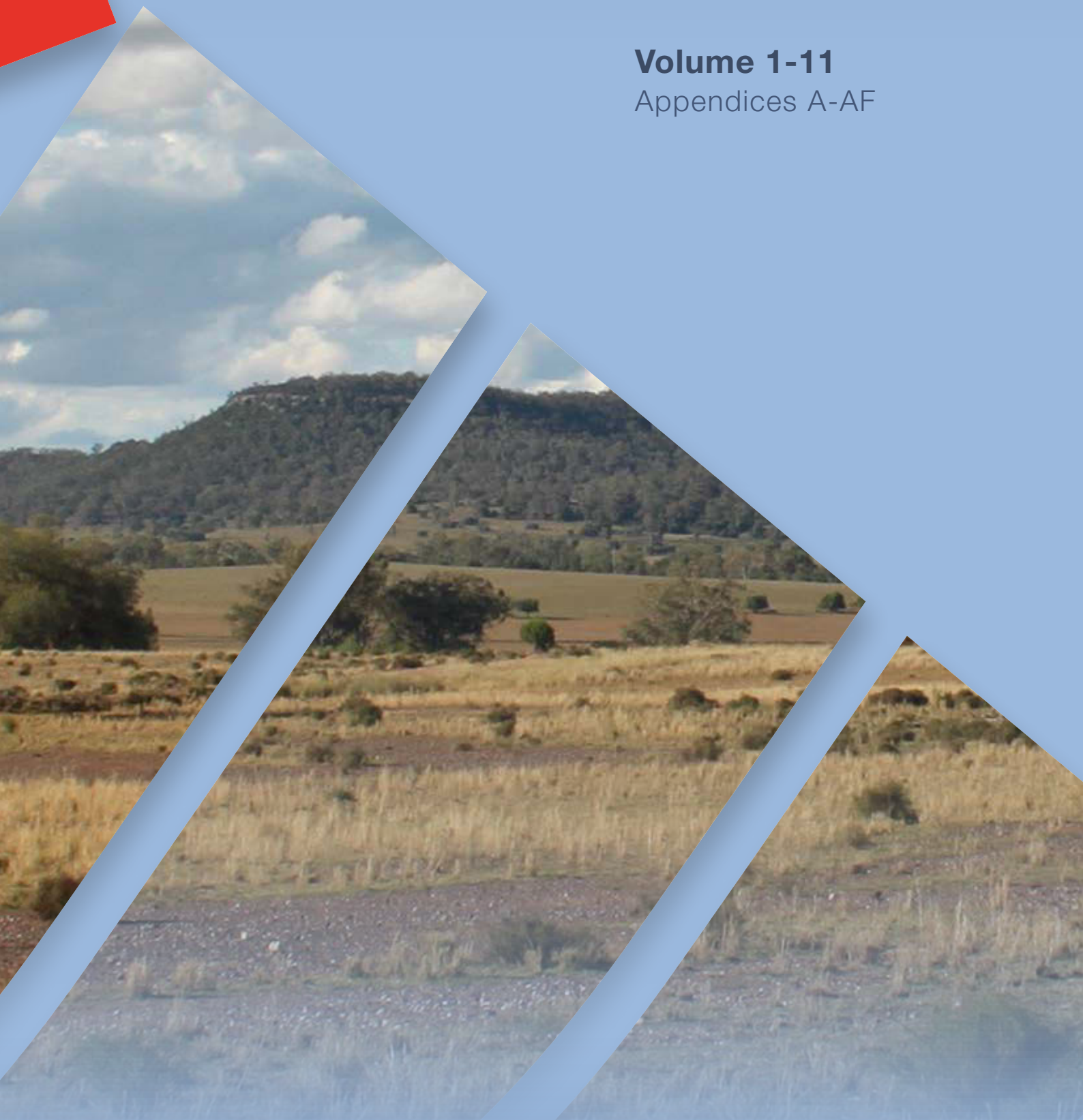
WATERMARK
COAL PROJECT
ENVIRONMENTAL IMPACT STATEMENT

February 2013

Volume 1-11
Appendices A-AF



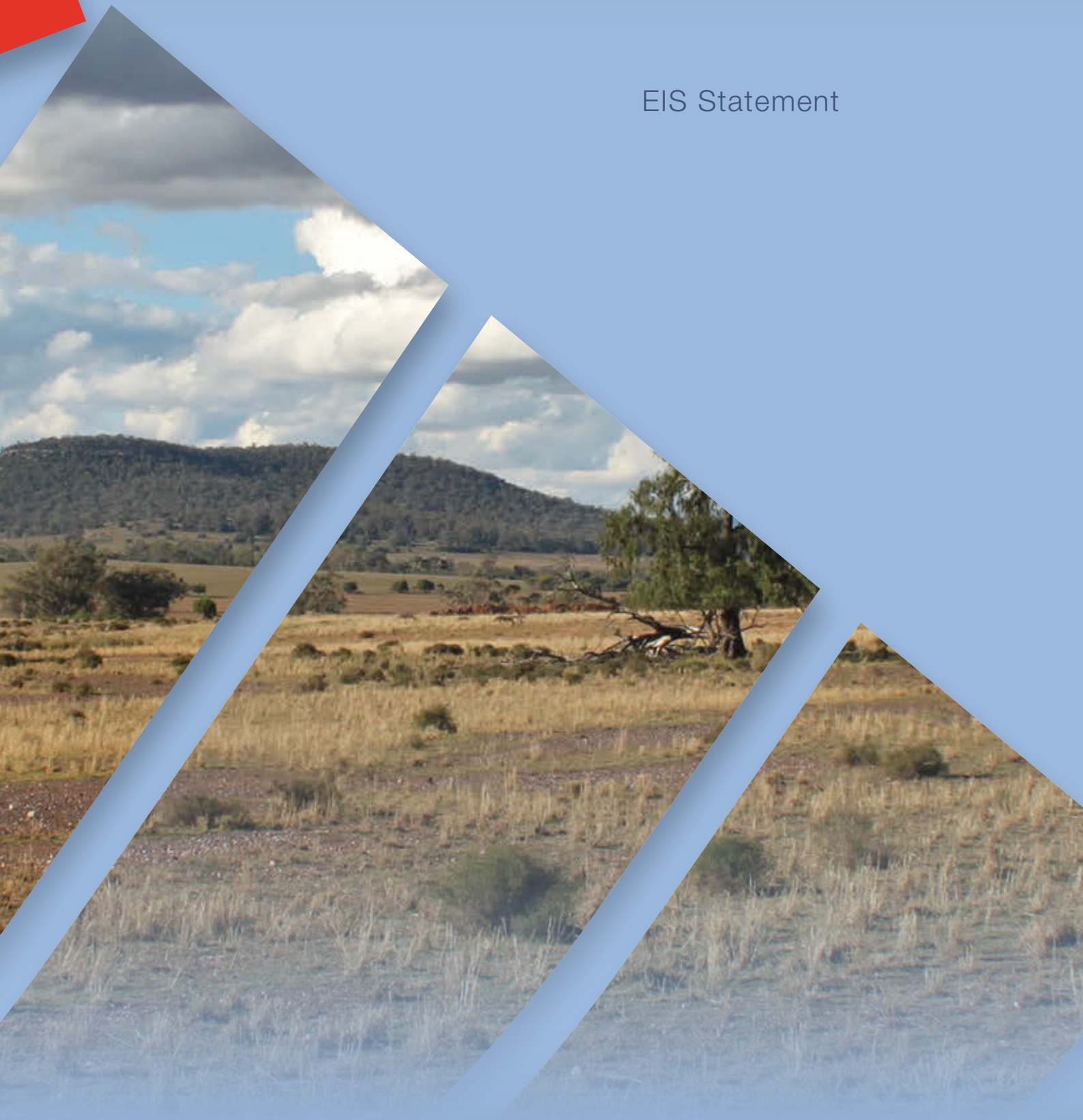
Hansen Bailey
ENVIRONMENTAL CONSULTANTS

SHENHUA WATERMARK COAL PTY LIMITED
神华沃特马克煤矿有限公司

WATERMARK
COAL PROJECT
ENVIRONMENTAL IMPACT STATEMENT

February 2013

EIS Statement





EIS Statement

Submission of Environmental Impact Statement (EIS)
Under Section 78A(8A) of the *Environmental Planning and Assessment Act 1979*

EIS Prepared by	
Name	James Bailey
Qualifications	B. Natural Resources, MBA
Address	Hansen Bailey PO Box 473 SINGLETON NSW 2330
In Respect of	Watermark Coal Project
Proponent Name	Shenhua Watermark Coal Pty Limited
Proponent Address	368 Conadilly Street, Gunnedah NSW 2380
Land to be Developed	See Appendix A of this EIS.
Proposed Development	Development and operation of the Watermark Coal Project and associated activities as outlined in Section 3 of this EIS.
Environmental Impact Statement	An EIS for the Project is attached.
Certification	I certify that I have read and am aware of the terms of the Expert Witness Code of the Land & Environment Court of NSW. I further certify that I have prepared the contents of this EIS, and to the best of my knowledge: • It is in accordance with Section 78A(8A) of the *Environmental Planning & Assessment Act 1979*; • Meets the form and content requirements under Clauses 6 and 7 of Schedule 2 of the *Environmental Planning & Assessment Regulation 2000*; • It contains all available information that is relevant to this EIS for the activity to which it relates; and • The information contained in this EIS is neither false nor misleading.
Signature	
Name	James Bailey Director
Date	February 2013

WATERMARK
COAL PROJECT
ENVIRONMENTAL IMPACT STATEMENT

February 2013



Executive Summary

Executive Summary

Introduction

The Shenhua Group Corporation Limited (Shenhua Group) is one of the world's leading integrated coal based energy companies and the largest coal supplier in the world. The business has a key focus on the production and marketing of coal, power generation, railway transportation, port operations, shipping, coal-to-liquids and coal-to-chemicals.

The Shenhua Group undertakes its many coal operations within some of the largest reserves in China. In 2011, the raw coal output for the business reached 407 Million tonnes from 62 operating mines. Complementing this core business component is Shenhua Group's large scale power generation operations, which have a combined capacity to supply 42,830 Megawatts of electricity to market. The demand for clean energy is increasing and the Shenhua Group's operations are fast growing to meet these needs. The Shenhua Group also has interest in a large scale rail and port network across China, and includes the self-owned railway of 1,467 kilometres in length, the Huanghua Port and Tianjin Coal Terminal with a throughput capacity of 100 Million tonnes and 45 Million tonnes respectively, and a shipping company with 12 vessels.

Given its extensive operations, the Shenhua Group places great emphasis on its environmental responsibilities. This has been demonstrated through the implementation of an environmental management system and leading practice energy and emission reduction strategies across a range of its operations. The company also regularly audits the environmental management and performance of its operations to proactively prevent and minimise harm to the environment. It also actively promotes environmental protection education and training throughout its strong workforce of over 176,000 employees.

The Shenhua Group is committed to fulfilling its social responsibilities and actively seeks avenues to benefit people within the local communities in which it operates. The company demonstrates this through local employment and contributions to the local economy, including funding for education, health services, job training and infrastructure development.

International growth is a significant factor in expanding the Shenhua Group business. As such, the company has investigated extending its operations to Australia.

In October 2008, Shenhua Watermark Coal Pty Ltd (Shenhua Watermark), a subsidiary of the Shenhua Group, was granted Exploration Licence 7223 by the New South Wales Minister for Mineral Resources. Since this time, Shenhua Watermark has operated in accordance with the terms of Exploration Licence 7223, including the payment of $300 Million to the New South Wales Department of Primary Industries (now Department of Trade and Investment, Regional Infrastructure and Services).

Shenhua Watermark has since completed a comprehensive exploration program focused on defining the potential open cut coal resource within Exploration Licence 7223. This has consequently led to the development of a detailed mine plan for the Project, which will facilitate the extraction of up to 10 Million tonnes per annum Run of Mine coal via open cut mining methods over a 30 year period. This will result in the production of a primary Pulverised Coal Injection or semi-soft coking coal product with low ash content (10 %) and a secondary thermal coal product with high ash content (18 %).

The Project is located approximately 25 kilometres south south-east of the township of Gunnedah and to the immediate west of the village of Breeza within the Gunnedah Local Government Area. The Project is approximately 282 kilometres by rail from the export Port of Newcastle.



Existing Environment

Topography and Catchments

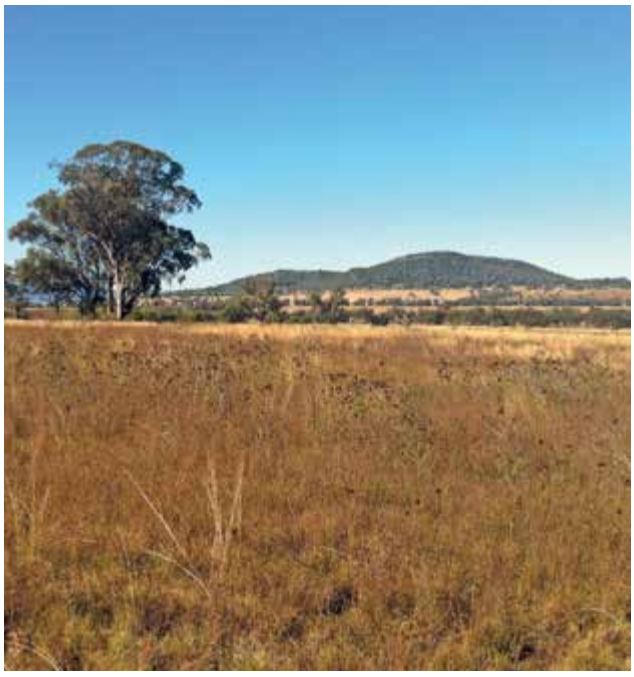
The Project is situated in a relatively flat region with only 1% of the landscape recording slopes greater than 15 degrees. The land within the Project Boundary primarily comprises of gently undulating cleared grasslands with small steep sections of rock outcrops intersecting the landscape. The land generally varies between Reduced Level 280 metres and 340 metres with the exception of topographic highs, including Mt Watermark, Smokey Point, Black Mountain and an unnamed topographic high referred to as 'Springhurst Hill' by local residents.

The Project Boundary is located within the catchment of the Mooki River, a tributary of the Namoi River. The headwaters of the Mooki River originate on the northern slopes of the Liverpool Ranges and Coolah Tops, flowing in a northerly direction to the Namoi River north-east of Gunnedah. Several ephemeral first and second order streams traverse and drain the land within the Project Boundary, including Watermark Gully, Native Dog Gully and a series of smaller unnamed watercourses.

Flooding within the Project Boundary largely occurs during high rainfall events along Watermark Gully. This regime is typically influenced by surface water runoff from Mt Watermark and the western ridges. Under similar conditions, Native Dog Gully is affected by backwater from the Mooki River.

Land Use

The land within the Project Boundary and its immediate vicinity have historically been utilised for a variety of agricultural enterprises, including cattle grazing and cropping. Current land use practices in the region continue to be dominated by agricultural production, however, other land uses such as mining and gas exploration, rural and residential developments and recreational and conservation areas have become more prominent in recent years.



Land Ownership

Shenhua Watermark owns all of the land for the proposed mining development and infrastructure associated with the Project. A small parcel of Crown land is located on Mt Watermark and will be excluded from the Project. Private freehold land primarily surrounds the Project Boundary with the exception of the Breeza State Forest to the south-west, which is owned by the State and managed by Forests New South Wales.

Climate

Regional climatic conditions of the Gunnedah Basin consist primarily of seasonal variations of hot, wet summer months giving way to mild, dry winters. The warm, dry summer conditions are caused by high pressure systems over the northern parts of Australia. Temperatures in the region range from a mean maximum of 38.9 degrees Celsius in summer down to a minimum of -4.8 degrees Celsius in the winter months.

While there are intermittent periods of rainfall, the Gunnedah Basin is characterised by extensive periods of low precipitation causing an increase in severity and intensity of droughts. The maximum rainfall across the region occurs during January with mean monthly values varying between 74.0 and 84.4 millimetres. Low rainfall typically occurs between the months of April to September with mean minimum values varying between 35.7 and 39.5 millimetres.

In spring, summer, and autumn months, south-easterly and southerly winds prevail across the region with minor variations occurring as a result of local topographic influences. In the winter months, the region experiences dominant west south-westerly, south-easterly and southerly winds.

Geology

Authorisation 216 was originally held by the Director-General of the New South Wales Department of Primary Industry on behalf of the Crown for the purposes of prospecting for coal within the Gunnedah Basin. Preliminary exploration by the Department identified major resources of more than 1 billion tonnes of in situ coal within the Watermark deposit. This subsequently resulted in the department inviting competitive tenders for part of Authorisation 216. Following this process, Shenhua Watermark was successfully granted Exploration Licence 7223 in October 2008 by the New South Wales Minister for Mineral Resources. Since then, Shenhua Watermark has complied with the terms of Exploration Licence 7223 and completed a comprehensive exploration program focused on defining the potential open cut coal resource within the Project Boundary. These investigations established a robust understanding of the geology of the site, coal location and coal quality and also assisted in characterising the groundwater regime within and adjacent to the Project Boundary.

The target coal seams for the Project are contained within the Black Jack Group of the Late Permian strata and include the Hoskissons and Melvilles seams.

Exploration drilling, feasibility studies and geological modelling from the Stage 3A exploration program within Exploration Licence 7223 indicate that there is an estimated in situ coal tonnage of approximately 1.8 billion tonnes within the late Permian Black Jack Group. From this in situ coal tonnage, a Run of Mine coal reserve of approximately 268 Million tonnes is proposed for extraction using open cut mining methods.

Environmental Monitoring

Shenhua Watermark has established an Environmental Monitoring Program for the purposes of obtaining relevant background monitoring data. The network includes a suite of meteorological, air quality, noise, surface water and groundwater monitoring stations.

The Project

Shenhua Watermark is seeking State Significant Development Consent under Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979* for the development and operation of an open cut coal mine for a period of 30 years.

The Project involves:

- The development of an open cut mining operation extracting up to 10 Million tonnes per annum of Run of Mine coal from the Hoskissons and Melvilles seams over a period of 30 years;
- Utilising a standard mining equipment fleet of excavators and shovels, supported by haul trucks, dozers, graders, drill rigs and water carts;
- Progressive rehabilitation of all disturbed areas;
- The co-disposal of tailings and coarse reject within the Overburden Emplacement Areas;
- The construction and operation of a Mine Access Road;
- The construction and operation of administration, workshop and related facilities;
- The construction and operation of a Coal Handling and Preparation Plant with a throughput of 10 Million tonnes per annum of Run of Mine coal;
- The construction and operation of a rail spur, rail loop, Kamilaroi Highway rail overpass, associated train load out facility and connection to the Werris Creek to Moree Railway Line;
- Transportation of product coal by rail via the Werris Creek to Moree Railway Line and the Main Northern Railway Line to the Port of Newcastle for export;
- The construction and operation of surface and groundwater management and reticulation infrastructure including pipelines, pumping stations/bore field and associated infrastructure for access to water from the groundwater aquifers in the vicinity of the Project, the Mooki River and private dams to the north-east of the Project Boundary;
- The closure of Court Lane, Rowarth Road, Whitby Road, part of The Dip Road (from the intersection of Clift Road to Nea Siding Road) and other unnamed paper roads within the Project Boundary;
- The installation of communications and electricity infrastructure; and
- A workforce of approximately 600 full-time equivalent employees during construction and up to approximately 600 full-time equivalent employees and associated contractors during operation of the Project at full production.

The Project will generally be undertaken within the Disturbance Boundary. Some of the infrastructure such as water, power and communications infrastructure will be located outside the Disturbance Boundary (and quite possibly the Project Boundary). Minor additional disturbance associated with ancillary works including fencing, firebreaks, water diversion structures, pipelines, a bore field, minor contour banks, access tracks, explosives storage facilities, power lines, sediment and erosion control structures will also be required and are part of the Project for which consent is sought.



Regulatory Framework

The Project is development "for the purpose of mining that is 'coal mining'", as listed under Clause 5 of Schedule 1 of the *State Environmental Planning Policy (State and Regional Development) 2011*. Development for the purposes of mining is not permissible without Development Consent on the land within the Project Boundary. As such, the Project is declared a State Significant Development and will be subject to the provisions of Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979*.

The Project is located entirely within the Gunnedah Local Government Area. The majority of the land within the Project Boundary is zoned as RU1 (Primary Production) with two small areas of land zoned as E3 (Environmental Management) under the *Gunnedah Local Environmental Plan 2012*. Clause 5 of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* states that where there is an inconsistency with another environmental planning instrument, the provisions of the State Environmental Planning Policy will prevail. As such, the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* overrides the *Gunnedah Local Environmental Plan 2012*, which results in mining being permissible in Zone E3 (Environmental Management) and therefore on all land within the Project Boundary.

In accordance with Clause 3 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*, Shenhua Watermark made a request for Director-General's Requirements on 14 October 2011. This request was supported by the *Watermark Coal Project Background Document, October 2011* (Hansen Bailey, 2011).



Following consultation with the relevant New South Wales government agencies and the Commonwealth Department of Sustainability, Environment, Water, Population and Communities, the Director-General of the Department of Planning and Infrastructure issued Director-General's Requirements for the Project on 19 April 2012.

The Project will seek as required, relevant approvals under New South Wales legislation not exempt by Section 89J under Division 4.1 of Part 4 of the *Environmental Planning & Assessment Act 1979*.

The Project was referred to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities on 14 November 2011. The Minister for Sustainability, Environment, Water, Population and Communities declared the development to be a 'controlled action' on 22 December 2011 due to its potential impact on threatened species and communities and migratory species listed under the *Environment Protection and Biodiversity Conservation Act 1999*. As such, the Project will subsequently require assessment under the *Environment Protection and Biodiversity Conservation Act 1999*.

The Department of Sustainability, Environment, Water, Population and Communities accredited the assessment process under the *Environmental Planning and Assessment Act 1979*. The department's assessment requirements were provided to the Director-General of the Department of Planning and Infrastructure who included them in the Director-General's Requirements for the Project.

Stakeholder Engagement

Since the granting of Exploration Licence 7223 in October 2008, Shenhua Watermark has been actively undertaking stakeholder engagement over the Project. The stakeholder engagement activities undertaken for the Project prior to commencement of the Environmental Impact Statement process included:

- Establishment of a local office in Gunnedah with a designated community contact person available at all times and a free call 1800 community input telephone number, dedicated community email and reply-paid postal address;
- Dedicated community website;
- More than 300 separate meetings with stakeholders, including government agencies, the New South Wales Farmers Federation, Aboriginal groups and catchment management groups;
- Presentations to community groups / representatives and Non-Government Organisations;
- Active engagement with the local community on the Project through local media;
- Establishment of a Community Fund and Community Fund Advisory Committee;
- Establishment of a number of Community Reference Groups; and the
- Establishment of a Community Consultative Committee.

The stakeholder engagement program during the preparation of the Environmental Impact Statement included consultation with Local, State and Commonwealth government agencies, infrastructure owners, service providers, near neighbours and the Aboriginal and wider local community.

A number of briefings and presentations were provided to Local, State and Commonwealth government agencies, including a Planning Focus Meeting, which was held on 4 November 2011. Such consultation efforts provided regulators with an understanding of the Project, some of the key findings from the technical studies and an overview of community stakeholder issues recorded. It also provided further opportunity for regulators to raise any outstanding issues for consideration in the Environmental Impact Statement.

Shenhua Watermark actively engaged with near neighbours and the local community through the distribution of Community Information Sheets, hosting of community information sessions and the establishment of Community Reference Groups.

Community Information Sheets were developed to familiarise the local community with the Project, while providing information regarding specific timelines, the consultation process and the various technical studies associated with the Environmental Impact Statement. These were distributed to more than 6,800 community stakeholders in the Gunnedah, Liverpool Plains and Tamworth Local Government Areas and regulatory stakeholders.

Community information sessions were held to provide information on the Project and to gain feedback from the local community in relation to the Project. Details of the community information sessions were included in Community Information Sheet 2 and were also advertised in the Namoi Valley Independent newspaper, the Northern Daily Leader and Quirindi Advocate from 19 November to 16 December 2011.

Community Reference Groups focussing on the assessment and management of Koalas, water and the environment for the Project were established by Shenhua Watermark in March 2011. The primary purpose of the groups was to allow Shenhua Watermark to work directly with the community to ensure all issues and concerns were identified and addressed in the Environmental Impact Statement.

The Aboriginal consultation for the Project was conducted by a team from Shenhua Watermark, Hansen Bailey Environmental Consultants, AECOM Australia and Connect for Effect in accordance with the relevant guidelines. The consultation process was undertaken in four stages:

- Stage 1 - Notification and registration. Relevant government agencies, Aboriginal organisations and Aboriginal stakeholders were notified of the Project. Aboriginal stakeholders who possess cultural knowledge required to determine the cultural significance of Aboriginal objects or places in the area and/or desired to be consulted regarding the Project were invited to register in the consultation program;



- Stage 2 - Project information. Registered Aboriginal Parties were provided with information regarding the Project and the archaeology and cultural heritage assessment process at meetings and through written correspondence;
- Stage 3 - Survey strategy and conservation values. Registered Aboriginal Parties were encouraged to participate in the preparation of the field survey methodology, the archaeological field assessment survey and the exchange of cultural heritage information. The activities undertaken during Stage 3 provided input into the development of the draft Aboriginal Archaeological Impact Assessment and Aboriginal Cultural Heritage Values Assessment; and
- Stage 4 - Draft assessment review. The draft Aboriginal Archaeological Impact Assessment, draft Aboriginal Cultural Heritage Values Assessment and draft Geotechnical of Geomorphology Investigation of WM-GG1-11 and WM-GG3-12 Grinding Groove sites was provided to all Registered Aboriginal Parties for review. All comments received in response to the draft assessments were acknowledged and where practicable incorporated into the revised and final assessments.

Following completion of the issue scoping phase, suggested management recommendations were developed. These are all detailed in this Environmental Impact Statement.

Impacts, Management and Mitigation

A risk assessment was undertaken to identify potential environmental and socio-economic issues associated with the Project. The purpose of the risk assessment process was to prioritise and focus the required assessments for the Project in consideration of the Director-General's Requirements and the findings from the stakeholder engagement program.

Key findings from the environmental and socio-economic impact assessments are discussed below.

Groundwater

A Groundwater Impact Assessment was undertaken by Australasian Groundwater and Environmental Consultants. The purpose of the assessment was to characterise the existing groundwater system, predict inflows into the mining areas throughout the life of the Project and assess the impacts of the Project on groundwater sources.

Within Exploration Licence 7223, groundwater occurs in the following two main systems:

- The Quaternary / Tertiary alluvial systems of the Upper Namoi alluvium; and
- The older, deeper and poorer quality bedrock that contains localised aquifers within weathered rock, porous sandstones, fractured zones, volcanics and the coal seams of the Gunnedah Basin (Permian Formations).

The Upper Namoi alluvium comprises two major formations, the Narrabri Formation and the Gunnedah Formation. The Narrabri Formation is a typical brown clay dominated aquitard overlying the Gunnedah Formation, which is comprised of porous sand and gravel layers separated by clays. The Gunnedah Formation has high permeability and yield and is commonly referred to as the primary aquifer system in the region.

The Gunnedah Formation does not exist within the Project Boundary. The closest occurrence of this aquifer is 900 metres from the north-eastern corner of the Eastern Mining Area and more than 1.3 kilometres to the south of the Project Boundary.

A three-dimensional groundwater flow model was used to simulate the Project's impacts on the groundwater regime over time. The model was developed using hydrology, hydrogeology and geological structure data and previous groundwater assessments undertaken within the region. It includes the current understanding of the interactions between the aquifers within the Project Boundary and the regional groundwater system. The model was constructed in accordance with the approach recommended in the *Australian Groundwater Modelling Guidelines 2012*, as required by the *Aquifer Interference Policy*.

Two separate models were constructed for the Project, a calibration model and a predictive model. The groundwater model was calibrated via two processes; a steady state calibration and a transient calibration. The aim of the calibration process was to adjust aquifer parameters and stresses to produce the best match between the observed and simulated water levels and fluxes.

The modelling effort indicates that the groundwater seepage into the mining areas will average 0.5 Mega litres per day (180 Mega litres per year) over the life of the Project. The peak annual average seepage into the mining areas is estimated at 2.1 Mega litres per day (756 Mega litres per year) in Year 23 as mining advances through higher permeability material. The predicted cumulative inflow of groundwater over the life of Project is approximately 5,500 Mega litres, which represents less than 0.1% of the extraction limits set for the Gunnedah–Oxley Basin Murray Darling Basin Zone (Other) as prescribed under the *Water Sharing Plan for the Murray-Darling Basin Porous Rock Groundwater Sources*.



The depressurisation induced by operations in the Eastern Mining Area extends to a maximum of 1.8 kilometres. This occurs in Year 21 of the mine plan. Groundwater levels are predicted to reduce by 3 metres or less in the Permian underlying the Narrabri Formation, laterally extending up to 0.7 kilometres. The model does not predict drawdown of greater than 1 metre in the Permian underlying the Gunnedah Formation due to the Eastern Mining Area.

The depressurisation induced by operations in the Southern Mining Area is predicted to be more extensive and extends to a maximum of 3.2 kilometres in Year 25. The model predicts a drawdown of 25 metres or less in the Permian underlying the Narrabri Formation. The depressurisation in the Permian extends to the south where the overlying Gunnedah Formation is present. At this distance, drawdown in the Gunnedah Formation is predicted to be less than 2 metres.

The depressurisation induced by operations in the Western Mining Area is predicted to be less significant than the Eastern and Southern Mining Areas as it is located in an elevated area where groundwater levels are deeper and the operating life is short. The zone of depressurisation is predicted to extend to a maximum of 1 kilometre in Year 30, however, it does not extend in the Permian under the alluvial aquifers.

The depressurisation and associated take of water from the alluvial aquifer is considered to be small and represents a negligible change in groundwater availability to adjacent groundwater users.

The mining areas do not directly intersect the Narrabri and Gunnedah Formations. In a zone immediately around the mining areas, depressurisation in the underlying Permian strata may induce downward vertical flow from the overlying alluvial aquifers. At a greater distance from the mining areas, a reduced rate of upward flow from the Permian to the alluvium is predicted. The change in upward flow from the Permian to the alluvium due to mining is negligible beyond the immediately adjacent Zone 7 of the *Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003*. Zones 3 and Zone 8 of the *Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003* report only a very small change. No change in flow rates is predicted for Zones 1, 6 and 10 of the *Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003*, which are relatively distant from the Project.

The groundwater model found a small increase in the net flow from the Mooki River to the underlying aquifer. The increase in seepage from the Mooki River to the underlying alluvium of 0.13 Mega litres per day represents an undetectable proportion of the total river leakage along the Mooki River of 0.4 %.

There is no significant impact on Lake Goran as the groundwater level drawdown is not predicted to exceed 0.01 metres. Lake Goran is an ephemeral lake and does not receive a significant contribution from groundwater and therefore will not be impacted by the Project.

Modelling indicates that the groundwater levels begin to recover after the Eastern Mining Area and Southern Mining Area are backfilled and eventually exceed pre-mining levels. This is due to a higher recharge rate on the overburden material than the pre-mining condition. The higher recharge rate and rehabilitated landform mean that there will not be an ongoing water deficit post mining, and a zone of seepage occurs at spill points, which are topographic low points at the base of Overburden Emplacement Areas.

The predicted groundwater levels within the Western Mining Area final void will slowly recover and reach equilibrium at approximately 303 metres Australian Height Datum after approximately 2,000 years post-mining. Groundwater levels remain below the regional water table by approximately 1-2 metres, indicating the pit lake void will act as a groundwater sink, not a source. The water level in the final void will therefore stabilise well below the crest of the open cut mining area, and spillage of water into the environment will not occur.

WRM (2013) also assessed the recovery of water levels in the final void and the final void water quality using the OPSIM software. WRM predicted the water level in the final void would stabilise at between 280 metres AHD and 290 metres Australia Height Datum. The OPSIM model recovered much more quickly than the groundwater model. The more rapid recovery is because the OPSIM model simulates daily rainfall which includes storm events. During these events, the pit lake recovers faster than the groundwater model which uses annual average rainfall rates. Another factor contributing to the more rapid recovery time in the OPSIM model is the representation of the open void. Despite the difference in the predicted recovery rate, both the groundwater model and the OPSIM model indicate that the water level in the final void will stabilise well below the crest of the open cut mining area, and therefore spillage of water into the environment will not occur.

The Gunnedah Formation is considered to satisfy the '*highly productive groundwater*' criteria of the *Strategic Regional Land Use Plan – New England North West* (DP&I, 2012) and the *Aquifer Interference Policy* (NOW, 2012) for yield and salinity; however, it does not occur beneath Biophysical Strategic Agricultural Land impacted by the Project nor elsewhere within the Project Boundary. The Project will create a zone of depressurisation induced by mining in the Permian formations underlying the Gunnedah Formation. The average pumping rate from a single licensed agricultural bore in the Upper Namoi alluvium (within 10 km of the Project Boundary) is 142 Mega litres per year.

The groundwater model predicts that the volume of water removed from the Zones 3, 7 and 8 of the *Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003* combined is a very small quantity of water being equivalent to no more than the usage from a single licensed agricultural bore in the peak years of mining. The volume pumped from licensed bores from these three zones has averaged 27,898 Mega litres per year between 2006 and 2011.

There are a number of land users that utilise the groundwater systems within and adjacent to the Project Boundary, in particular the Gunnedah Formation, for irrigation, stock, domestic and industrial purposes. Within 10 kilometres of the Project Boundary, 35 bores are predicted to experience maximum groundwater level reductions of greater than or equal to 0.1 metres. Of these, four bores adjacent to the Southern Mining Area have a maximum predicted drawdown between 1 metre and 2 metres.

At completion of the Southern Mining Area and Eastern Mining Area, groundwater levels are predicted to largely recover rapidly within approximately five years as the pits are fully backfilled.

An independent Peer Review of the Groundwater Impact Assessment was undertaken by Heritage Computing in accordance with the Murray-Darling Basin Commission's (MDBC's) *Australian Flow Modelling Guideline* (MDBC 2001) and the *Australian Groundwater Modelling Guidelines* (Barnett et al 2012). The Peer Review concluded that the "*groundwater model has been developed competently and is regarded as "fit for purpose" for addressing the potential environmental impacts from the three open cut mining areas and for estimating indicative dewatering rates. The stated objectives of the modelling study have been addressed satisfactorily.*"

The relevant water licences will be required to account for water taken as a result of the Project. Shenhua Watermark has secured part of these required licences and will purchase the remaining licences within the operating water market. Each of the water sources of which licences are required for the Project have a readily available market of share component which is available to be transferred / purchased by Shenhua Watermark.

The current groundwater monitoring network will continue to be implemented through the life of the Project along with the development of a Water Management Plan. Additional monitoring bores will also be installed within the predicted zone of depressurisation to assess the extent and rate of depressurisation against model predictions. Trigger levels for water quality parameters will be developed as part of the Water Management Plan to provide mine management with an early warning mechanism that identifies water quality trends departing from historical values. The monitoring program will also measure parameters for groundwater quality and seepage.



Geophysics

A Transient Electromagnetic Geophysical Survey was undertaken by Groundwater Imaging in collaboration with Australasian Groundwater and Environmental Consultants. The purpose of the survey was to define the extent of alluvial material within and adjacent to the Project Boundary and identify any other potential conduits or barriers for groundwater flow from the mining areas.



The geophysics survey successfully identified the Upper Namoi alluvium boundary (Narrabri and Gunnedah Formations) as represented by a low resistivity layer on the floodplain. The Narrabri Formation conforms to heavy clay, saline, unconsolidated material identified within the alluvium. Underlying these materials is a resistive layer consisting of coarse sediment, palaeochannels and fresh water, which is representative of the Gunnedah Formation.

Based on the imagery and geophysical characteristics identified during the survey, the Upper Namoi alluvial boundary is inferred as being restricted to the south of the Project Boundary and in the north-eastern corner of Exploration Licence 7223.

The Eastern and Southern Mining Areas are set back from the Upper Namoi alluvium by a minimum distance of 150 metres and approximately 900 metres from the Gunnedah Formation. This buffer prevents the direct connection of water between the Gunnedah Formation aquifer and the mining areas.

Surface Water

A Surface Water Impact Assessment was undertaken by WRM Water and Environment. The purpose of the assessment was to characterise existing catchments, develop a water balance with consideration of the proposed water management system and assess the impacts to surface water sources as a result of the Project.

A computer-based simulation model was used to assess the dynamics of the water balance (both volume and salt loads) under varying rainfall and catchment conditions. The model was then configured to dynamically simulate the operation of the water management system proposed for the Project.

During the life of the Project, there is a potential for the reduction of catchment flows to surrounding waterways, including the Mooki River, Watermark Gully, Native Dog Gully and Lake Goran.

At the completion of mining, the conceptual final landform will influence the local catchment area and drainage regimes. An area of approximately 108 hectares, which originally drained to Lake Goran, will continue to drain to the final void of the Western Mining Area. The final landform will also result in an increase in catchment area draining north via Watermark Gully and to the Mooki River floodplain and a loss in catchment area draining south to Native Dog Gully and the Mooki River floodplain.

Under the proposed water management system, annual volumes of water required for the Project vary depending on the effects of fluctuating climatic conditions. During wet years, it may be possible to obtain all water requirements for mining operations from local runoff and groundwater inflows. However, during average and dry years it is predicted that annual volumes up to 600 Mega litres will be required to supplement the mine water supplies to ensure a reliable source of water for operational demands. Where water additional to captured dirty surface water and water intercepted by mining is required in the mine water management system, the Project proposes to draw water from adjoining water sources pursuant to water access licences already held or to be purchased from within the operating water market.

In order to minimise the volume of water collected in onsite storages and the need for discharge from the water management system, runoff from undisturbed areas will be redirected around the Project using diversion drains. Sediment-laden runoff from areas disturbed for mining purposes (as opposed to mine water) will be collected and treated in sediment dams. The maximum total average salt load associated with this runoff is predicted to reach 65.7 tonnes per day at Year 30, which represents an increase in the pre-mine salt load of approximately 0.8 %. Runoff water will only be released from site if the quality is acceptable and during a rainfall event that exceeds the design capacity of the sediment dam. This configuration ensures that the Project does not significantly impact on downstream catchments and water quality.

Modelling suggests that the final void in the Western Mining Area will reach an equilibrium water level of approximately 280 to 290 metres Australian Height Datum, which is approximately 20 metres to 30 metres below the overflow level of 310 metres Australian Height Datum.

The current surface water monitoring network will continue to be implemented through the life of the Project along with the development of a Water Management Plan. At commencement of operations, the surface water monitoring program will be expanded to include samples from key storages within the water management system. The parameter suite and sampling frequency for surface water monitoring will be initially undertaken in accordance with the current monitoring program and then refined over time in accordance with the mine site's regulatory approved Water Management Plan.

A Sediment and Erosion Control Management Plan will also be prepared in accordance with *Managing Urban Stormwater, Soils and Construction* (Landcom, 2004) and *Managing Urban Stormwater, Soils and Construction, Volume 2E Mine and Quarries* (DECC, 2008). The design of sediment control measures will be based on the principle of ensuring that runoff from disturbed areas is separated from clean area runoff and collected in sediment dams for treatment.

Flood

A Flood Study was undertaken by WRM Water and Environment as part of the Surface Water Impact Assessment. The purpose of the assessment was to assess the potential of the Project to interact with flood flows along Watermark Gully and the Mooki River, thereby affecting local and regional flood regimes.

Under a 100 year Average Recurrence Interval design flood event along the Mooki River, a small area at the south-east corner of the Disturbance Boundary will be inundated to a depth of up to 1.7 metres with flow velocities of less than 0.1 metres per second. Placement of overburden on this small area will not affect flood behaviour on the floodplain; however, it will reduce the flood storage of the larger Mooki River floodplain by approximately 235 Mega litres.

This represents 2 % of the flood storage volume in the northern Native Dog Gully floodplain, part of the larger Mooki River floodplain, during a 100 Year Average Recurrence Interval event. The remaining area along the Mooki River will be flood free and will not be impacted by the Project.



The Project will impact Watermark Gully through a reduction in the contributing catchment area by approximately 25 %. This consequently affects the magnitude and frequency of flows along the watercourse. At Year 30, the maximum reduction in the associated catchment area will be reached resulting in low flows of 15.1 Mega litres per day at the downstream boundary. This is a decline of 7.8 Mega litres per day from the pre-mining flow conditions. Following cessation of mining, the catchment area draining to Watermark Gully will exceed pre-mining conditions increasing flows to 26.5 Mega litres per day.

There is a measurable change in the flow-duration relationship for Watermark Gully given the high variability of runoff in natural watercourses in the area. However, it is considered unlikely that these flow frequency changes will significantly alter the hydraulic characteristics of Watermark Gully, which will readjust to the altered flow regime.

In addition, the Project will partially fill the main channel in the upper reaches of Watermark Gully for the development of the Overburden Emplacement Area associated with the Western Mining Area. This will result in a relocation of the main channel further to the east. A Channel Diversion Plan will be developed for the portion of Watermark Gully directly affected. Detailed design of the channel cross section in the modified reach will be undertaken as part of the detailed design phase to provide a stable channel configuration. The general principles of the design will be to mimic the natural channel features, as far as practical. Changes in flow velocity and flood levels will be accommodated in the detailed design of the site drainage system. Limited and minor flood levees will be constructed as required in potential inundation areas.

Geomorphology

A Geomorphology Impact Assessment was undertaken by GHD. The purpose of the assessment was to characterise the type, geomorphic condition and stream order of watercourses within Exploration Licence 7223 and determine the potential impacts of the Project on the geomorphology of these watercourses.

As each mining area advances over the life of the Project, there will be minor losses to the catchments draining Watermark Gully, Native Dog Gully and the Mooki River. This will result in minor changes to the flow regime and the capacity for sediment transportation. As the predicted reduction is minimal when compared to the overall catchment area of each watercourse, the impact on associated geomorphic processes will generally be negligible with the exception of a section of Watermark Gully.

The eastern extent of the Western Mining Area will encroach on a section of Watermark Gully. This is predicted to alter or impede the existing flow regime of Watermark Gully potentially causing erosion along the channel and increased sediment deposition upstream. Following the cessation of mining, catchment areas and geomorphic processes will largely be restored.

Infrastructure required to support the Project, including a pump station(s) and vehicle crossings, will be constructed along watercourses within Exploration Licence 7223. Given the high propensity for bank erosion along these watercourses, a range of sediment and erosion control measures will be implemented and outlined in an associated management plan.

Air Quality

An Air Quality and Greenhouse Gas Impact Assessment was undertaken by PAEHolmes. The purpose of the assessment, in part, was to predict the Project's air quality impacts on receivers in the vicinity of the Project.

Dispersion modelling was undertaken for Years 1, 2, 5, 10, 15, 21, 25 and 30 of the Project. These representative years were identified as the periods most likely to contain the worst case dust levels from a range of mining activities in various locations within the Project Boundary. The results from the modelling indicate that the Project considered alone and cumulatively with other sources is not predicted to contribute to exceedances of the annual average assessment criteria for Total Suspended Particulates, dust deposition, Particulate Matter less than 10 microns and Particulate Matter less than 2.5 microns at privately owned or Shenhua Watermark owned receivers over the life of the Project.

There are six private receivers (on five properties) that are predicted to experience exceedances of the 24-hour average Particulate Matter less than 10 microns assessment criterion for between one and 36 days per year. These maximum impacts represent the worst case operation of the Project under adverse prevailing weather conditions in the event that no proactive management measures to modify or curtail offending activities are taken. It is expected that the proactive management of operations will result in modifications to operations so that these impacts will not be experienced at the suggested receivers.



Shenhua Watermark has adopted numerous leading practice air quality controls for the Project based on recommendations of the *NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining* (Donnelly et al., 2011). These controls will be incorporated into the operations of the Project and outlined in an Air Quality Management Plan.

Shenhua Watermark will also install a comprehensive air quality monitoring network proximal to private sensitive receivers surrounding the Project. This will include a real-time dust monitoring and management system with predictive capabilities to forecast meteorological conditions to understand in advance where the risk of dust emissions may occur.

Greenhouse Gas

An Air Quality and Greenhouse Gas Impact Assessment was undertaken by PAEHolmes. The purpose of the assessment, in part, was to estimate the greenhouse gas emissions generated by the Project.

The main sources of greenhouse gas emissions from the Project will primarily be associated with electricity consumption, fugitive emissions of carbon dioxide and methane, diesel usage and the transport and end use of the product coal.

The direct greenhouse gas emissions generated by the Project have been estimated to be on average 0.25 Million tonnes of Carbon Dioxide equivalent per annum. This represents a small portion of global anthropological greenhouse gas emissions. These emissions in themselves will not have any significant impact on global warming. Applying the principles of Ecologically Sustainable Development, it is considered that there will be no increase or measurable impact on climate change as a result of the Project.

An Energy Savings Action Plan will be developed in accordance with the relevant legislation and guidelines. The action plan will describe the measures that will be implemented to minimise greenhouse gas emissions and ensure energy efficiency.

Noise

An Acoustics Impact Assessment was undertaken by Bridges Acoustics. The purpose of the assessment was to predict the Project's construction, operation and transport noise impacts on receivers in the vicinity of the Project Boundary.

Predictive noise modelling was undertaken for Year 1, 2, 5, 10, 15, 21, 25 and 30 of the Project. These representative years were identified as the periods most likely to contain the worst case noise levels. While this situation may occur occasionally, noise levels will generally be lower than the predicted levels. Additional model scenarios were used to determine construction and sleep disturbance noise levels to ensure these issues were comprehensively assessed.

Numerous noise modelling investigations have been undertaken during the initial planning and mine plan development stages of the Project in order to minimise adverse noise impacts on neighbouring receivers. As such, predicted noise levels for construction and operation activities include all feasible and reasonable noise management and mitigation measures.

During the construction phase, predicted noise levels generated by the Project are acceptable under the relevant assessment criteria with the exception of receiver 125 under day neutral, day prevailing and night prevailing conditions. Exceedances of the assessment criteria are primarily associated with construction of the Mine Access Road, Kamilaroi Highway realignment and the rail spur. As such, a Construction Noise Management Plan will be developed by Shenhua Watermark, which will include a range of mitigation and management measures to control noise and avoid adverse impacts on sensitive receivers during this time.

Throughout the operations phase, a receiver is deemed to be significantly impacted if the predicted operational noise level exceeds the intrusive criteria by greater than 5 dBA. There are six receivers that will experience significant noise impact at residences (14, 32, 60, 62, 103 and 125). There are a further seven vacant properties that will be subject to significant noise impacts over an area greater than 25 % of the property (20, 26, 27, 28, 61, 65 and 116).



If the predicted operational noise level exceeds the intrusive criteria by 2 to 5 dBA, the receiver is deemed to experience moderate noise impacts. There are four receivers (13, 25, 39 and 41) that will experience moderate noise impacts at residences. There are a further three vacant properties that will be subject to moderate noise impacts over an area greater than 25 % of the property (7, 114 and 119).

A receiver is deemed to experience a mild noise impact if the intrusive criteria are exceeded by less than 2 dBA. There are 13 receivers (10, 12, 16, 22, 35, 40, 43, 44, 99, 104, 105, 106, and 115) that will experience a mild noise impact at residences. There are a further six vacant properties that will be subject to mild noise impacts over an area greater than 25 % of the property (21, 31, 42, 108, 112 and 118).

A Noise Management Plan will be prepared for the Project and will include all feasible and reasonable noise controls described in the Acoustics Impact Assessment. Shenhua Watermark will also establish a noise monitoring network at representative locations surrounding the Project Boundary. This will allow for ongoing monitoring to confirm and manage predicted noise levels at receivers.

Blasting

An Acoustics Impact Assessment was undertaken by Bridges Acoustics. The purpose of the assessment, in part, was to predict the Project's blasting impacts on receivers in the vicinity of the Project Boundary. The blasting associated with the Project is predicted to produce ground vibration and overpressure levels well below the relevant amenity criteria at all privately owned residences and structures.

In conjunction with the Acoustics Impact Assessment, a Blasting Impacts on Landforms and Slopes assessment was undertaken by SCT Operations. The purpose of the assessment was to identify the risks associated with mining activities, including blasting, on sensitive sites, landforms and slopes in each mining area.

Slopes, landforms and sensitive sites, such as the Aboriginal grinding grooves, associated with underlying bedrock have a low sensitivity to vibration as these features are able to naturally fluctuate with ground movements. In this regard, the impacts generated from blasting on these features is limited to overbreak, which is a breakage beyond the excavation limits in the immediate area surrounding blast holes. As such the enforcement of a 100 metre buffer from these features is deemed effective in reducing the potential for overbreak until other effective risk management measures are established.

A Blast Management Plan will be prepared to ensure that landform stability is maintained and the relevant criteria are met for all privately owned residences and Aboriginal and historic heritage items during blast events associated with the Project.

Ecology

An Ecological Impact Assessment was undertaken by Cumberland Ecology. The purpose of the assessment was to characterise the terrestrial and aquatic flora and fauna within the Project Boundary, including threatened species, populations and ecological communities and assess the impacts of the Project on biodiversity.

Land within the Project Boundary is dominated by low diversity grassland derived from previous clearing of woodland to accommodate agricultural pursuits. Remnant and regrowth open forest and woodland occur as fragmented, narrow tracts along boundary fences and road verges and in isolated patches on hills, steep slopes and in paddocks within the Project Boundary. A substantial area of this vegetation conforms to Box Gum Woodland, a Critically Endangered Ecological Community listed under the *Environment Protection and Biodiversity Conservation Act 1999*. These vegetation communities contain threatened flora species, including the Lobed Blue Grass (*Bothriochloa biloba*), and provide suitable habitat for threatened fauna species.

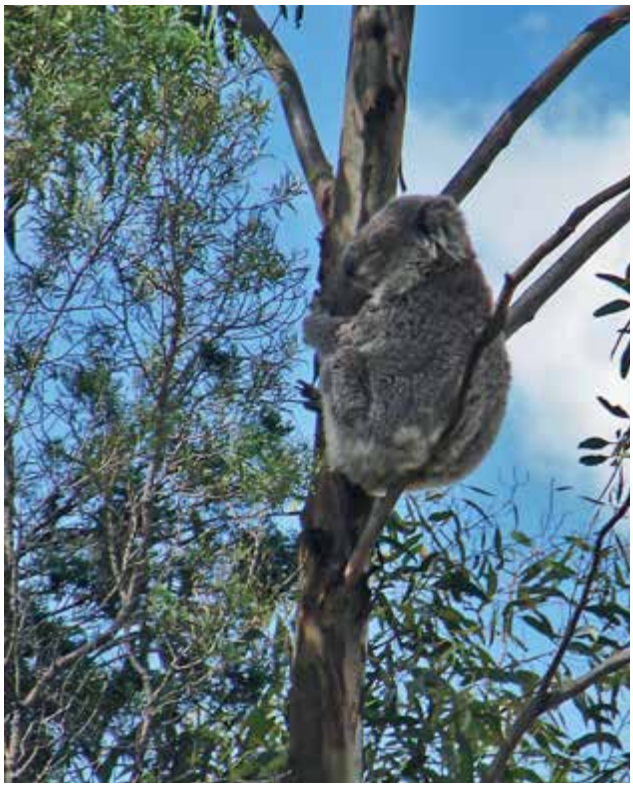
Historical clearing from agricultural production and relative isolation from more extensive forest and woodland areas has influenced the fauna assemblage within the Project Boundary and its surrounds. As a result, the Project Boundary now supports mostly highly mobile species resilient to disturbance and isolation, including nine bird species and one bat species. Koalas have also been consistently detected across the Project Boundary and Breeza State Forest in all eucalypt dominated woodland.

Aquatic habitat along the Mooki River and Native Dog Gully is highly degraded. Native riparian and floodplain vegetation has been historically cleared for agriculture and is now practically non-existent with the exception of a few scattered paddock trees. These watercourses provide only highly simplified aquatic habitat with little or no in-stream vegetation or rocks and snags required for aquatic fauna habitation, including macro-invertebrates and fish.



A total of 4,084 hectares of vegetation will be removed progressively over the life of the Project, including 738 hectares of Box Gum Woodland and Derived Native Grassland and 51 hectares of other listed vegetation communities and flora species. The clearance of a large proportion of woodland within the Disturbance Area is likely to represent a loss of locally important habitat for various fauna species.

Extensive vegetation clearing has already and continues to occur in the sub bioregion as a result of agriculture, forestry and other mining projects. The scale of vegetation clearance that will occur as a result of the Project will exacerbate these existing ecological impacts. However, the Project is unlikely to threaten the overall occurrence of the vegetation communities and threatened flora recorded from within the Project Boundary.



Avoiding environmental impacts has been incorporated, where possible, throughout the Project planning and design phases to improve biodiversity outcomes. This has included restricting mining operations from the Breeza State Forest, Critically Endangered Ecological Communities within the Project Boundary, Watermark Gully, Mt Watermark and the Alluvial black soil plains. The mine plan and Mine Infrastructure Area adopted for the Project achieves the minimum practical Disturbance Boundary whilst still allowing access to an economically viable portion of the minable coal resource.

A range of management plans will be prepared to guide all facets of biodiversity management and mitigation for the Project. These will each include key performance indicators and measures to prevent adverse impacts to flora and fauna.

Biodiversity Offset Strategy

A Biodiversity Offset Strategy for the Project has been developed to mitigate the residual impacts on biodiversity and to address the ecological impacts of the Project in a strategic and meaningful way that will deliver a real biodiversity outcome. The strategy consists of three main components which work together to ensure that the best compensatory outcomes are achieved with the most efficient utilisation of resources and to meet State and Commonwealth offsetting requirements. The components of the Biodiversity Offset Strategy include:

- Onsite Biodiversity Offsets, comprising:
  - Conservation and ongoing management of existing vegetated land within the Mt Watermark Offset Area and Offset Area 6;
  - Restoration of vegetation communities and associated habitat within the aforementioned offset areas and the Mooki River Offset Area; and
  - Rehabilitation of mined areas.
- Offsite Biodiversity Offsets, comprising:
  - Conservation of existing vegetated areas on land near Barraba, NSW; and
  - Restoration of vegetation communities and associated habitat on land near Barraba, NSW.
- Indirect offsets, such as funding for Landcare, targeted research or recovery planning.

The Onsite Biodiversity Offset Areas have been developed to maximise the opportunity to conserve large areas of comparable or "like for like" vegetation communities within close proximity to the Disturbance Boundary. These vegetation communities are known habitat for a number of threatened fauna species, including the Koala. The Onsite Biodiversity Offset Areas are in good condition but are currently not managed for conservation. The ecological values associated with these areas could be substantially improved by means of revegetation to provide additional areas of Critically Endangered Ecological Communities and habitat for threatened fauna species.

Shenhua Watermark has identified and secured Offsite Biodiversity Offset Areas to complement the Onsite Biodiversity Offset Areas and to ensure the Project will not result in a net loss of biodiversity. These areas provide similar woodland and forest, including Box Gum Woodland that will be impacted by the Project and offer valuable habitat for native flora and fauna. The Offsite Biodiversity Offset Areas also indirectly connect to nearby national parks and build onto existing proposed offset areas of other mining projects.

A total of 4,084 hectares of vegetation will be removed progressively over the life of the Project, including 738 hectares of Box Gum Woodland and Derived Native Grassland and 51 hectares of other listed vegetation communities.

The Biodiversity Offset Strategy as a whole will address the predicted loss of vegetation by ultimately providing, following revegetation and rehabilitation initiatives, 6,366 hectares of Box Gum Woodland and Derived Native Grassland, 1,759 hectares of other listed Endangered Ecological Communities and 4,890 hectares of other woodland vegetation. The Biodiversity Offset Strategy will provide large areas of habitat for threatened species that will be impacted by the Project.

The active management of both Onsite and Offsite Biodiversity Offset Areas will substantially increase the biodiversity values of the land for fauna and flora in the medium to long term.

Stygofauna

A Stygofauna Impact Assessment was undertaken by Eco Logical. The purpose of the assessment was to determine the occurrence and potential impacts on stygofauna.

There was no occurrence of stygofauna recorded within the Project Boundary and its surrounds during the sampling program. Further assessment of the existing groundwater regime and potential impacts that may occur to the system as a result of the Project, confirmed it is unlikely stygofauna communities will be affected should they occur within the Project Boundary or immediate surrounds.

Aboriginal Archaeology

An Aboriginal Archaeological Impact Assessment was undertaken by AECOM Australia. The purpose of the assessment was to identify Aboriginal archaeological resources within the Project Boundary and assess the potential impacts of the Project on these resources.

The assessment included a detailed desktop review of previous studies, search of the Office of Environment and Heritage's Aboriginal Heritage Information Management System and a comprehensive field survey of the Project Boundary undertaken over a total of 25 days with members of the Aboriginal community.

A total of 55 Aboriginal archaeological sites were identified in the Project Boundary, consisting of the 51 new sites and four Aboriginal Heritage Information Management System registered sites. The newly recorded sites were represented by 17 artefact scatters, 23 isolated finds, eight potential Aboriginal scarred trees and three grinding groove sites. The Aboriginal Heritage Information Management System registered sites were entirely represented by artefact scatters.

As a result of the Project, a total of 29 Aboriginal archaeological sites within the Project Boundary will be directly impacted. To manage these impacts, an Aboriginal Archaeology and Cultural Heritage Management Plan will be developed in consultation with Registered Aboriginal Parties and relevant government agencies. The plan will provide detailed salvage methodologies, including surface collection of 25 artefact scatters, combined surface collection and excavation of two significant artefact scatters and relocation of two significant grinding groove sites.

The plan will also provide provisions for the in-situ conservation of an additional 26 Aboriginal archaeological sites and the establishment of the Watermark Gully Aboriginal Cultural Heritage Conservation Area and the Mooki River Aboriginal Cultural Heritage Conservation Area. These offset areas offer both known and potential Aboriginal archaeological resources and cultural values on land owned by Shenhua Watermark within and adjacent to the Project Boundary.

Aboriginal Cultural Heritage

An Aboriginal Cultural Heritage Values Assessment was undertaken by Connect for Effect. The purpose of the assessment was to assess the Aboriginal cultural values and significance of the land within the Project Boundary. The assessment of cultural significance was undertaken in accordance with the relevant guidelines and in collaboration with the Aboriginal community. The cultural significance of the land within the Project Boundary was drawn from an analysis of values identified by Registered Aboriginal Parties.

Concerns raised during the consultation with Registered Aboriginal Parties regarding the perceived impact of the Project include:

- The impact on recorded cultural sites or landscape features of significant cultural value;
- The direct impact on two sets of grinding grooves identified as having high cultural value;
- The possible impact on unrecorded subsurface cultural sites or items;
- The potential for increased threat to cultural values, including the loss of animal habitats and the drawdown of watercourses;
- The loss of bush foods, medicinal plants, cultural resources (for art and ceremony), animals and plants;
- Regional inability to access land on which to hunt or gather bush foods and medicinal plants due to changed land tenure. This reflects a core concern regarding the loss of opportunities for knowledge to be passed down from older to younger generations and the inability to retain fundamentally important cultural practices on Country; and
- The landscape as a whole becoming unrecognisable as a result of the Project and cumulative development in the region. Such loss of known landscapes is perceived to be a serious threat to Aboriginal cultural heritage, both traditionally and contemporarily, as stories and knowledge are linked to Country.

To manage the impacts of the Project on cultural heritage, an Aboriginal Archaeology and Cultural Heritage Management Plan will be developed with consideration of the suggested management recommendations raised by Registered Aboriginal Parties throughout the consultation period. These recommendations reflect the importance of Aboriginal communities having a greater involvement in managing cultural heritage.

Historic Heritage

A Historic Heritage Impact Assessment was undertaken by AECOM Australia. The purpose of the assessment was to identify and determine the impacts on historic heritage items within the Project Boundary.

A total of 14 historic heritage sites were identified within the Project Boundary. The Project will result in direct impacts (i.e. removal) to 10 historic heritage sites identified within the Disturbance Boundary. These sites will be removed prior to disturbance subject to archival recordings, archaeological test excavation and archaeological salvage, if warranted by testing.

A further four historic heritage sites will be indirectly impacted by the Project through changes to the existing visual environment. Once successfully rehabilitated, the elements of the Project will be substantially integrated into the existing landscape and the overall visual impact will be negligible. If required, offsite mitigation measures, such as tree screening or plantings, will be implemented at the site to reduce the visual impact further.

The management of historic heritage sites within the Project Boundary during the life of the Project will be undertaken through a Historic Heritage Management Plan and Historic Heritage Conservation Management Plan.

Traffic and Transportation

A Traffic and Transport Impact Assessment was undertaken by DC Traffic Engineering. The purpose of the assessment was to quantify traffic generated during the construction and operation phases of the Project and assess potential impacts on the capacity, efficiency and safety of the existing road and rail network.

Early in the construction phase, the Kamilaroi Highway/ Mine Access Road intersection will be built and opened for improved access to the Project. Under the new configuration, the intersection is predicted to maintain a good to adequate Level of Service.

In the event that the construction of the Mine Access Road and associated intersection at the Kamilaroi Highway is delayed, all access to the Project will be via the existing Court Lane. Under these conditions, the Kamilaroi Highway/ Court Lane intersection will perform at a satisfactory Level of Service. However, this intersection configuration offers no physical protection for queued or decelerating right-hand turning traffic from the Kamilaroi Highway onto Court Lane thereby presenting a potential crash risk. As such, mitigation measures for the Court Lane intersection will be implemented whilst construction of the Kamilaroi Highway / Mine Access Road intersection is underway.

During the peak operations phase, the Kamilaroi Highway / Mine Access Road intersection is predicted to maintain a good to adequate Level of Service with much of the traffic efficiently absorbed into the existing traffic stream. This is largely due to the substantial spare capacity available in the network.

The Project will result in the permanent and temporary closure of local roads within the Project Boundary and its immediate surrounds. The entire length of Court Lane, a section of The Dip Road between Cull and Clift Roads and some minor local roads will be permanently closed to accommodate mining operations. Furthermore, any public roads that are within 500 metres of blasting activities undertaken for the Project will be required to be temporarily closed for approximately 15 to 20 minutes, including The Dip Road, Clift Road and Werner Road. A range of measures will be implemented to manage traffic safely during these periods.

The Kamilaroi Highway will be realigned in the vicinity of the current intersection with Court Lane. This will involve a minor deviation of the highway to the south of the existing alignment. To minimise road closures along the Kamilaroi Highway, the realigned section of the highway and Mine Access Road will be constructed offline. Minor disruptions are only anticipated during the construction of the new alignment connections to the existing highway. A Construction Traffic Management Plan will be implemented to manage traffic safely during these periods.

The existing rail network currently caters for grain exports and a number of existing mining operations. The rail requirements of these operations with consideration of the Project and other mining proposals will have a cumulative impact on the rail network. Together, these existing and proposed operations will generate a total of 47 train movements per haul day on the Werris Creek-Moree Railway Line between Narrabri and Muswellbrook. In response, the Australian Rail and Track Corporation has proposed a number of network upgrades to increase the capacity and operational flexibility for existing rail users. These initiatives will assist in relieving the impact of the Project on other and future proposed rail users.



Visual and Lighting

A Visual Impact Assessment was undertaken by JVP Visual Planning and Design. The purpose of the assessment was to define the character of the surrounding landscape and assess the visual and lighting impacts of the Project.

A conceptual view of the Project (photomontage) was generated for Years 1, 2, 5, 10, 15, 21, 25 and 30. The photomontages were used to accurately illustrate the level of visual contrast between the existing environment and the visible aspects of the Project.

The visual impacts associated with the Project will affect viewing locations to the north, south, east and west of the Project Boundary; however, such impacts vary in significance and in time during the life of the Project.

Visual effects to the north of the Project Boundary will be created primarily by views to the Eastern Mining Area. During the initial years of operation, views to the Project will be shielded by existing topography. Between Year 3 and 5 the northern-most portion of the Overburden Emplacement Areas will be constructed creating a high visual effect.

Visual effects to the east of the Project Boundary will be created primarily by views to the Eastern Mining Area and to a lesser extent the Southern Mining Area. During the initial years of operations, the Eastern Mining Area will create high visual effects until shaping is complete along the northern and eastern faces of the Overburden Emplacement Areas by Year 5 and 15, respectively. High visual effects will also be experienced from the Southern Mining Area, when some views of raw overburden are available over the adjoining tree canopies.

Visual effects to the south of the Project Boundary will be created primarily by views to the Eastern and Southern Mining Areas. Operations will create moderate to high visual effects when views of Overburden Emplacement Areas are available over the adjoining tree canopies.

Visual effects to the west of the Project Boundary will be created primarily by views to the Western Mining Area. This mining area is developed from east to west and therefore the active face of the Overburden Emplacement Area will be orientated to the west, which will create high visual effects during the operational period from approximately Year 24 to Year 30.

Due to the high to moderate sensitivity of nearby receivers, the visual effect of each mining area typically creates high and moderate visual impacts. This will be reduced to moderate and low following completion and rehabilitation of Overburden Emplacement Areas and backfilling of the Eastern and Southern Mining Areas. These impacts will further be reduced to very low as rehabilitation matures. By Year 30, the final landform will be integrated with the existing landscape.

Lighting generated by the Project will predominantly be caused by vehicles and equipment outside the open cut mining areas and by collective operations, including the light generated by the Mine Infrastructure Area.

In most cases, spillage of light to the surrounding environment will be limited as a result of existing topography, Overburden Emplacement Areas and vegetation. Generally, lighting associated with the Project will not create a significant visual effect; however, it may be apparent from time to time.

Numerous mitigation measures have been incorporated into the design and operating plans for the Project that will reduce the visual effect and mitigate the visual impact of the Project on viewing locations. A Visual and Lighting Management Plan will also be developed for the Project and will include onsite mitigation and management measures to reduce visual impacts further. Where deemed necessary through consultation within relevant stakeholders, offsite mitigation and management measures will be implemented.

Geochemical

A Geochemical Assessment of Overburden/Interburden and Coal Reject Materials was undertaken by RGS Environmental. The purpose of the assessment was to characterise the overburden, interburden and coal rejects (including coarse rejects and tailings) associated with open cut mining of the target coal seams for the Project.

The majority of overburden, interburden and coal rejects are expected to have low sulphur content, significant excess acid buffering capacity and are classified as non-acid forming. These characteristics indicate that the materials are likely to have a high factor of safety with respect to potential acid generation and a low propensity for spontaneous combustion.

A small proportion of the interburden and coal rejects derived from the Lower Hoskissons seam has potential acid forming capacity and a high sulphur content, which could represent a risk for spontaneous combustion. As most overburden / interburden has significant excess buffering capacity, the use of this material as capping will more than adequately buffer the negligible amount of acid that could theoretically be produced and reduce the likelihood of spontaneous combustion. In addition, the small amount of coal rejects with high sulphur content will be well mixed across the operation and diluted to produce an inert composite material further reducing the potential for spontaneous combustion.

The concentration of total metals detected in most overburden, interburden and coal rejects is below the applied guideline criteria for soils and is unlikely to present any environmental issues associated with revegetation and rehabilitation. Some overburden, interburden and coal rejects are sodic and prone to dispersion and erosion. These materials are generally unsuitable for reuse in revegetation and rehabilitation activities. They will be selectively handled and buried in inert overburden.

Soils and Land Capability

A Soil Survey and Land Capability Impact Assessment was undertaken by GSS Environmental. The purpose of the assessment was to define the soil types present within the Project Boundary, provide a description of the pre and post-mining land capability and determine the available topsoil resource for post-mining rehabilitation.

The soil field survey was undertaken at a medium to high intensity scale of between 1:50,000 and 1:25,000. A total of 131 reference soil profile sites were assessed. In total, 103 samples were tested from 36 separate test pits within the Project Boundary. The samples were sent for laboratory analysis to determine physical, chemical and fertility characteristics of the soil types in the Project Boundary.

Transect surveys were undertaken in January and August 2011 to confirm the distribution of alluvial black soils in the Project Boundary and immediate surrounds. A total of nine transects were established in areas where mining activities could potentially encroach on alluvial black soils. A series of survey points were established along each transect, with 20 soil profiles later selected for chemical analysis.

A targeted field visit of the Project Boundary, Onsite Biodiversity Offset Areas and Offsite Biodiversity Offset Areas was also completed to verify the extent of Biophysical Strategic Agricultural Land in consideration of the *Strategic Regional Land Use Plan - New England North West* (DP&I, 2012).

Eighteen soil types were identified within the Project Boundary. Impacts to the land as a result of the Project will remain within the Disturbance Boundary and the confinements of the Eastern, Southern and Western Mining Areas. The remaining areas outside this are expected to maintain their existing pre-mining class, including the alluvial black soils.

The current land capability classification within the Disturbance Boundary ranges from Class II to Class VII, with Class VII dominating the existing landscape. No Class II land will be disturbed as a result of the Project.

As part of the Project, Shenhua Watermark has maintained a 150 metre buffer from the open cut mining areas to the Alluvial Black Soils and thus, no disturbance of this soil type is anticipated.

Approximately 9,130,500 cubic metres of suitable topsoil and 19,149,300 cubic metres of suitable intermediate soil are considered to be available for stripping prior to the commencement of mining and reuse in future rehabilitation. To achieve the desired post-mining land capability, the total volume of material required for rehabilitation (topsoil and subsoil) is 24,578,000 cubic metres. The total volume of suitable material available for reuse in rehabilitation is 28,279,800 cubic metres, which results in a surplus of 3,701,800 cubic metres.

Following the completion of mining, land capability classes within the Disturbance Boundary are predicted to range from Class II to Class VIII. It is proposed that 1,000 hectares of rehabilitated land with Class III characteristics within the Disturbance Boundary will be reinstated for agricultural purposes. The remaining rehabilitated land will be used for ecological conservation through the restoration of native woodland and grassland.

In order to reduce the potential for soil degradation within the Project Boundary during the life of the Project, a range of strategies will be implemented during operations and rehabilitation to achieve the desired post-mining land capability.



Agriculture

An Agricultural Impact Statement was undertaken by Scott Barnett & Associates. The purpose of the assessment was to identify and determine the agricultural productivity of resources and enterprises within the Project Boundary, Onsite and Offsite Biodiversity Offset Areas and surrounding locality and assess the loss of agricultural production from these areas as a result of the Project.

There are several existing agricultural enterprises within Shenhua Watermark owned land, which includes the Project Boundary, Mt Watermark Offset Area and a portion of Offset Area 6 (Onsite Biodiversity Offset Areas). Shenhua Watermark owned land is currently managed as agricultural land for extensive grazing and cropping operations. Based on current land use, the gross value and net value of production from Shenhua Watermark owned land is $5.5 Million per annum and $2.8 Million per annum, respectively.

The portion of Offset Area 6 (residual Onsite Biodiversity Offset Area), which is not owned by Shenhua Watermark, is primarily used for extensive beef cattle and sheep grazing and dryland winter cropping. The gross value and net value of production from lands within the residual Onsite Biodiversity Offset Areas, based on current land use, is $1.6 Million per annum and $0.7 Million per annum, respectively.

The Offsite Biodiversity Offset Areas are densely timbered and primarily used for extensive grazing for breeding cattle and sheep. The gross value and net value of production from lands within the Offsite Biodiversity Offset Areas, based on current land use, is $0.4 Million per annum and $0.2 Million per annum, respectively.

Any agricultural land that is situated within the Disturbance Boundary and the Onsite and Offsite Biodiversity Offset Areas will be removed from production as a result of the Project. Much of this land will no longer be available for agricultural purposes as it will also be reserved in perpetuity for the conservation of its ecological values. Sustainable farming practices will, however, continue in available areas owned by Shenhua Watermark not required as biodiversity offsets outside of the Disturbance Boundary throughout the life of the Project.

Post-mining, 1,000 hectares land of Class III land will be reinstated within the Disturbance Boundary. Assuming this area will be returned to wheat, canola and beef cattle production at the end of the Project it will result in a gross value and net value of production of $0.7 Million per annum and $0.3 Million per annum, respectively.

In total, foregone gross value and net value of agricultural production from land resources required for the Project is estimated at a present value of $73.4 Million and $39.3 Million, respectively.

The Project is also predicted to result in the annual average relocation of approximately 194 Mega litres per year of water from agricultural purposes to coal mining consisting of:

- Average reduction in the rate of groundwater flow from the Permian into the overlying Gunnedah Formation of 33.3 Mega litres per year;
- Annual average transfer of water from the Mooki River to the underlying alluvium of 10.7 Mega litres per year; and
- Average of approximately 150 Mega litres per year of external water supply.



The impact of removing 194 Mega litres from agricultural use within the Project area results in a gross value loss of $0.1 Million per annum. The net value lost is $0.06 Million per annum.

Over the life of the Project, the present value of the gross value and net value of production foregone is $1.4 Million and $0.9 Million, respectively.

Gillespie Economics undertook a Benefit Cost Analysis, which included an estimation of the present value of production costs and benefits of the Project over a 30 year period. The present value of net production benefits of the Project to Australia are estimated at $1,310 Million. In contrast, the present value of future use of agricultural lands and water that will be utilised by the Project is estimated at $40 Million. Based on these comparative values, the Project is considered to be a significantly more efficient land use than continued agricultural production.

As defined by the *Strategic Regional Land Use Plan – New England North West* (DP&I, 2012), a small area encompassing 96.1 hectares of Biophysical Strategic Agricultural Land has been identified and verified within the Disturbance Boundary and will be impacted through surface disturbance associated with open cut mining.

A further 696 hectares of Biophysical Strategic Agricultural Land has been identified and verified within the Onsite Biodiversity Offset Areas and will be conserved for ecological purposes by excluding agricultural activities and actively regenerating the land for the purposes of recreating Koala habitat. As such, the Onsite Biodiversity Offset Areas will experience a change in land use as a result of the Project; however, the inherent agricultural productivity of the land will not be affected. There is no significant Biophysical Strategic Agricultural Land within the Offsite Biodiversity Offset Areas.

The Upper Namoi alluvium is a primary source of agricultural water in the region. The Gunnedah Formation is considered to satisfy the highly productive groundwater criteria of the *Strategic Regional Land Use Plan – New England North West* (DP&I, 2012) and the *Aquifer Interference Policy* (NOW, 2012). Given that the Project will not directly intercept or significantly reduce groundwater flow from the underlying Permian to the Gunnedah Formation, the Project is not considered to reduce the agricultural productivity of Biophysical Strategic Agricultural Land within the Project Boundary and surrounds due to impacts to highly productive groundwater.

The Project will not have any impact on the alluvial soils or agricultural productivity of land outside the Project Area and the Biodiversity Offset Areas.

The Project will require up to 600 Mega litres of water from external sources to supply operational demands (average of 150 Mega litres per annum). Where water additional to captured dirty surface water and water intercepted by mining is required in the mine water management system, the Project proposes to draw water from adjoining water sources pursuant to water access licences already held or to be purchased from within the operating water market.

The water management system will be operated to fully contain mine water and to preferentially reuse this water to meet site demands. The results of the water balance modelling show that under the full range of historical rainfall conditions, the proposed water management system will have sufficient capacity to contain all mine water on the site without the need for offsite releases. Overall the Project will not impact on receiving waters in the locality and as such will not impact on agricultural resources in the region.

The Project is not anticipated to have significant impacts on:

- Surrounding enterprises as a result of excessive dust or noise;
- Traffic regimes along support infrastructure routes associated with neighbouring agricultural enterprises;
- Long term visual amenity of surrounding enterprises;
- Labour supply to agricultural enterprises; and
- Support services directly employed by agricultural enterprises.

To maintain and where possible enhance, the agricultural productivity of Shenhua Watermark owned land, the following mitigation measures will be applied:

- Minimise the area of disturbance of agricultural land at any one time;
- Continue to work with land managers to ensure the continued productivity of Shenhua Watermark owned agricultural land not directly impacted by the Project;
- Develop and implement a weed and pest management plan to control the distribution of invasive plant species and feral animals at the Project and Biodiversity Offset Areas;
- Implement sustainable farming practices, including reduced till farming and rotational grazing techniques in available areas;
- Rehabilitate the mining areas to the best possible rural land capability (including not less than 3,230 hectares of Class III rehabilitated land) with slopes generally less than 10 degrees; and
- Reinstate at least 1,000 hectares of the rehabilitated Class III land to primary production.

Rehabilitation, Conceptual Final Landform and Mine Closure

A Rehabilitation and Mine Closure Strategy was prepared by GSS Environmental. The purpose of the strategy was to develop objectives for the rehabilitation of land that will be disturbed as a result of the Project, provide a strategy for mine closure and describe management measures to address the final void.

The final land use of for the Project Boundary will comprise a mixture of the native vegetation communities (including grassy woodland (70%), shrubby woodland / open forest (25%) and riparian forest (5%) for conservation purposes) and a mixture of pasture species for agricultural purposes. Revegetation of native communities within the Project Boundary will focus on reinstating White Box Grassy Woodland with small areas of other species to enhance diversity

across the final landform.

To compensate for the loss in available agricultural land as a result of the Project, not less than 1,000 hectares of the post-mining landform will be dedicated to primary production. This area will be reserved for agricultural purposes following the cessation of mining.

The targeted post mining land capability Class III is achievable due to the creation of relatively gentle topography, excess topsoil and subsoil resources available.

The post mining landform contains relatively gentle slopes compared to the majority of mines within NSW and QLD, which allows for the potential establishment of land capability Class III on the rehabilitated landform. Furthermore, these relatively gentle slopes will contain slope lengths and suitable soil depth designed to minimise erosion risk and ensure the land meets criteria for land capability Class III.

The mining areas, excluding the final void in the Western Mining Area, will be progressively rehabilitated as mining advances or concludes. A suite of measures will be applied during the rehabilitation program, including soil management and translocation, implementation of erosion and sediment controls, revegetation and relevant maintenance and monitoring to achieve a successful and self-sustaining landscape. The rehabilitation efforts will be measured against the performance objectives or standards outlined in the rehabilitation success criteria developed for the Project.

The criteria comprise indicators that reflect the nominated post-mining land uses of native woodland and land capability Class III agricultural land. Ongoing achievement of the success criteria (as indicated by monitoring results) will demonstrate that the rehabilitated landscape is in a productive and sustainable condition.

A conceptual final landform has been designed for the Project assuming mining will not continue beyond 30 years. The final landform has been developed to promote visual characteristics that generally conform to the existing landscape. This involves completely backfilling the final voids of the Eastern and Southern Mining Areas and developing gentle slopes at a maximum of approximately 10 degrees, which also ensures long term stability and sustainability of the landform. The conceptual final landform will also be free draining and integrated with the surrounding catchments.

A final void will remain in the Western Mining Area and will cover an area of approximately 100 hectares. It will have a maximum depth of 80 metres below the natural ground surface. As part of the conceptual final landform, it is planned that the void will have the majority of the highwall blasted back and low wall graded to improve long term safety and stability. A cost benefit analysis was undertaken to consider the financial and environmental costs of backfilling or partially backfilling the final void. The analysis found that partial backfilling of the void would incur a total additional cost of $42 Million, whilst complete backfilling would incur an additional cost of $438 Million. The process of backfilling the void would also extend the duration of noise and air quality impacts.

Therefore, in recognition of the further potential coal resources and the ability of the Western Mining Area void highwall to provide access to these resources, the cost / benefit analysis found that the retention of a safe and stable final void in the Western Mining Area was the most appropriate outcome.

A Mine Closure Plan will be developed for the Project within five years of closure, which will reflect contemporary expectations including any new regulatory requirements, the adoption of any new technologies and stakeholder expectations. This will allow the later years of the mine plan to be adjusted to facilitate any required changes to the final void configuration.

Bushfire

The land within the Project Boundary poses a moderate to low bushfire risk to the Project due to the limited fuel source, the existing vegetation composition and current agricultural land use practices. However, the adjoining Breeza State Forest experiences build-up of high fuel loads over time from dense vegetation, leaf drop and tinder. A combination of relatively low rainfall, the dry nature of the landscape and high fuel loads suggests Breeza State Forest could pose a significant bushfire risk to the Project. Consultation will continue with Forests NSW over the ongoing management of this risk.

A Bushfire Management Plan will be prepared for the Project in accordance with the *Rural Fires Act 1997* and *Coal Mine Health and Safety Act 2002* and regulated by the New South Wales Rural Fire Service. Forests NSW will also be consulted over the preparation of this plan.

Hazard Analysis

A Preliminary Hazard Analysis was undertaken by Hansen Bailey Environmental Consultants. The purpose of the analysis was to identify potential hazards associated with the Project and identify potential risk levels. The main potentially hazardous materials identified will be stored within the fuel delivery, storage and refill area, the explosives storage area and the Dangerous Goods Store. These materials will include diesel, explosives products, oils, coolant and other minor hazardous materials.

Contamination

A Preliminary Contamination Assessment was undertaken by Hansen Bailey Environmental Consultants. The purpose of the assessment was to identify any past and present potential contamination sources within the Project Boundary. Based on the desktop assessment, a range of potential contaminants were identified including, deregistered and concentrated chemical use, imported filling and waste materials, sewage / sewage treatment and disposal, livestock slaughter operations, building materials and potential chemical leaks and spills.

The Preliminary Contamination Assessment identified the need for further investigation by a licensed contractor. A detailed field investigation will be undertaken to validate the type, extent and levels of contamination at each site identified and assess the impacts on public health, the surrounding environment, including air, water, soil and biota. If required, following the detailed site assessment, a Remedial Action Plan will be developed.

Waste

Waste streams that are likely to be generated for the Project will include general waste, hazardous waste, sewage and coarse rejects and tailings. Gunnedah Shire Council has confirmed it will accept general waste from the Project. Waste will be managed in accordance with the objectives of the *Waste Avoidance and Resource Recovery Act 2001* and the *Protection of the Environment Operations Act 1997* along with other relevant legislative requirements and outlined in a Waste Management Plan.

Social

A Social Impact Assessment was undertaken by Hansen Bailey Environmental Consultants. The purpose of the assessment was to develop a socio-economic profile of the local and regional area with a focus on the Gunnedah, Liverpool Plains and Tamworth Local Government Areas in order to identify any future social impacts which may result from the Project and to propose a range of mitigations to address any identified impacts.

The Project will require approximately 600 full-time equivalent employees during the 18 month construction phase, with an operational peak of 600 employees expected at approximately Year 21. The operations workforce will be a combination of local hires already residing within the Gunnedah, Liverpool Plains and Tamworth Regional Local Government Areas and non-local hires who will migrate to the region. Assessments of future population and housing impacts were modelled on three 'scenarios' – each modelling scenario varying the proportions of local and non-local hires.

The Gunnedah, Liverpool Plains and Tamworth Regional Local Government Areas support relatively high unemployment and low employment participation rates compared to the NSW average and as such will be able to absorb a substantial proportion of the jobs created by the Project. Due to the scale of the Project it has the potential to assist in improving the current high rates of youth and Indigenous unemployment in the local and regional area and to assist in improving women's labour force participation rates in the mining industry.

The operations phase of the Project will result in an increase in population across the Gunnedah, Liverpool Plains, Tamworth, Narrabri and Upper Hunter Local Government Areas. The additional population expected at Year 1 in these combined areas is likely to be between 100 and 400 people, depending on the workforce hiring scenario used. At Year 21 of the Project, the additional population is likely to be between 300 and 1,200 people. Between Year 1 and Year 21, an additional 10 to 40 people per year are anticipated in the combined area of these Local Government Areas. The majority of the population increase will be in the Gunnedah urban area, although this is expected to be only between four and 14 additional people annually.

The expected population growth will result in an incremental increase on housing demand within the local and regional areas as the incoming operational workforce and their families are likely to settle in a variety of locations.



At Year 1, between 40 and 160 additional dwellings will be required in the combined Local Government Areas, increasing to between 120 and 480 dwellings by Year 21, depending on the workforce hiring scenario used. The growth will be incremental between Year 1 and Year 21, with approximately four to 16 additional dwellings being required annually.

The construction workforce of the Project will be encouraged to make use of the proposed Workforce Accommodation Facility (MAC Werris Creek), thereby alleviating pressure on the local and regional housing market.

The combined Local Government Areas can also expect a population of 1,463 that is attributed to the flow-on employment effects of the operational phase of the Project, which equates to an average of 50 people per year over the life of the Project. However, the proportion of these people that are already living in the combined Local Government Areas is not known, therefore an estimate of the additional population expected as a result of flow on employment cannot be made.

The cumulative impact of current and future mining and resource projects in the region will have a far greater impact on population growth, housing demand and service delivery in the region than the Project alone. In 2022, the Project operational workforce (approximately 383) will represent only 11% of the total personnel expected to be employed in mining and resource industry projects in the Gunnedah Basin at that time.

The expected impacts of the Project on existing community facilities and services in the Gunnedah, Liverpool Plains and Tamworth Regional Local Government Areas will generally be incremental. Much of the population growth generated particularly by the operations phase will be absorbed by the natural growth of facilities and services. However, there may be a need to adjust the content of some services to account for the expected change in demographics, for example a focus on integrated health care. The most pronounced impacts on existing community facilities will be the impact of the construction workforce on health facilities, especially facilities nearest to the proposed Workforce Accommodation Facility (MAC Werris Creek) and the impact of the construction and operational workforces on the requirement for appropriate skills training.

To assist in mitigating the potential social impacts of the Project on the local and regional area, Shenhua Watermark has made an offer to enter into separate Voluntary Planning Agreements with Gunnedah Shire Council, Liverpool Plains Shire Council and Tamworth Regional Council to provide in kind and monetary contributions to support the community. The Voluntary Planning Agreements are proportionate to the identified social and community impacts of the Project on each area.

A broad range of other initiatives to mitigate and manage the social impacts of the Project on the local and regional area have also been proposed.

Economics

An Economic Impact Assessment was undertaken by Gillespie Economics, which aimed to determine both the economic efficiency and economic impacts of the Project.

A Benefit Cost Analysis confirms that when production costs (acquisition costs for affected land, opportunity cost of land, operating costs, decommissioning costs, etc.) and production benefits (revenues from production, residual values of land, etc.) are considered, the Project will have net production benefits of $3,047 Million with a minimum of $1,310 Million of these net production benefits accruing to Australia. This net production benefit is distributed amongst a range of stakeholders including the local community, Shenhua Watermark, its shareholders and government.

In summary, the Project will result in the following economic benefits to the New South Wales economy:

- $1,554 Million in annual direct and indirect regional output or business turnover;
- $802 Million in annual direct and indirect regional value added;
- $276 Million in annual direct and indirect household income; and
- 3,260 direct and indirect jobs.

The Project will result in the following economic benefits to the regional economy (Gunnedah, Tamworth, Liverpool Plains, Narrabri and Upper Hunter LGAs):

- $913 Million in annual direct and indirect regional output or business turnover;
- $507 Million in annual direct and indirect regional value added;
- $91 Million in annual direct and indirect household income; and
- 1,015 direct and indirect jobs.

The Project will result in the following economic benefits to the local economy (Gunnedah, Tamworth and Liverpool Plains LGAs):

- $902 Million in annual direct and indirect regional output or business turnover;
- $493 Million in annual direct and indirect regional value added;
- $80 Million in annual direct and indirect household income; and
- 908 direct and indirect jobs.

Based on the above, the Project is considered desirable and justified from an economic efficiency perspective.

Cessation of the Project operation may lead to a reduction in economic activity. Given the uncertain circumstances at the time of Project cessation, it is important for government to effectively utilise the economic benefits, skills and expertise generated by the Project to further strengthen and broaden the region's economic base.

Management and Monitoring

Shenhua Watermark has identified and commits to the operational controls outlined in the Management and Monitoring Summary (see **Section 8**) of this Environmental Impact Statement for all activities associated with the Project.

The aim of the Management and Monitoring Summary is to ensure that any potential environmental and socio-economic impacts resulting from the Project as identified in this Environmental Impact Statement are managed and monitored appropriately.



Project Justification

The Australian and New South Wales economies are increasingly reliant on mining in a world that is experiencing, and will continue to experience fiscal and economic challenges. In response, the Project will facilitate the recovery of a valuable, export quality metallurgical and thermal coal, which remains a highly sought after commodity in Asian countries, including Japan, China and India. These countries continue to be the world's largest coal importers, and will largely account for *approximately 70% growth in total coal imports from 2009 to 2035 (U.S. EIA, 2011).

The Project will assist Australia in continuing to meet the international and local demand for metallurgical and thermal coal, for at least the next 30 years, during which time it is expected that there will continue to be a strong world demand for coal. It will also support Australia in maintaining its reputation as a consistent and reliable supplier of metallurgical and thermal coal to its existing and expanding markets.

The Project will maximise the economic value of a significant coal resource by a mine plan that addresses the environmental and socio-economic constraints and the objects of the *Environmental Planning and Assessment Act 1979*, including the principles of Ecologically Sustainable Development. It will contribute materially to sustaining the economic stability of Australia, New South Wales and the Gunnedah region. Net production benefits of $3,047 Million are expected to be generated globally with a minimum of $1,310 Million accruing to Australia.

There are substantive social benefits that are expected to enhance the Gunnedah, Liverpool Plains and Tamworth Local Government Areas as a result of the Project. During the operations phase, a total of approximately 908 jobs will be generated in the local Gunnedah, Liverpool Plains and Tamworth Local Government Areas.

On a regional basis (Gunnedah, Liverpool Plains, Tamworth, Narrabri and Upper Hunter Local Government Areas) the Project is expected to generate a total of approximately 1,015 jobs. These employment opportunities will provide significant benefits to the local region, which is characterised by a high rate of unemployment within the Gunnedah (6.7%), Liverpool Plains (6.6%) and Tamworth Regional (6.3%) Local Government Areas when compared to other local regions, including the Upper Hunter Local Government Area (1.7%), Narrabri Local Government Area (5.2%) and New South Wales more generally (5.2%) (DEEWR, 2012b).

In creating significant employment opportunities and attracting people to the region, there will be a need for supporting infrastructure and services. As such, Shenhua Watermark is in the advanced stages of discussions with Gunnedah Shire Council, Liverpool Plains Shire Council and Tamworth Regional Council with the view of entering into separate Voluntary Planning Agreements pursuant to Section 93F of the *Environmental Planning and Assessment Act 1979* to provide in kind and monetary contributions to support the community.

It has been demonstrated that the Project will serve the essential purpose of providing metallurgical and thermal coal for current and future generations and will generate significant economic and social benefits in the process. Unacceptable and uncertain environmental effects have been avoided. The Project's social and environmental costs have been avoided or minimised as far as practicable by implementing all reasonable and feasible management and mitigation measures. As a consequence, the socio-economic benefits of the Project will far outweigh its social and environmental costs. Therefore, it is considered the Project is in the public interest.



WATERMARK
COAL PROJECT
ENVIRONMENTAL IMPACT STATEMENT

February 2013



1
Introduction



Introduction 1

This section provides an introduction to the Environmental Impact Statement (EIS) for the Watermark Coal Project (the Project). It describes the background and context of the Project, introduces the proponent and outlines the purpose and structure of the EIS.

1.1 Background

The Shenhua Group Corporation Limited (Shenhua Group) is one of the world's leading integrated coal based energy companies and the largest coal supplier in the world. The business has a key focus on the production and marketing of coal, power generation, railway transportation, port operations, shipping, coal-to-liquids and coal-to-chemicals.

The Shenhua Group undertakes its many coal operations within some of the largest reserves in China. In 2011, the raw coal output for the business reached 407 Million tonnes (Mt) from 62 operating mines. Complementing this core business component is Shenhua Group's large scale power generation operations, which have a combined capacity to supply 42,830 Megawatts (MW) of electricity to market. The demand for clean energy is increasing and the Shenhua Group's operations are fast growing to meet these needs. The Shenhua Group also has interest in a large scale rail and port network across China that includes self owned railway of 1,467 kilometres (km) in length, the Huanghua Port and Tianjin Coal Terminal with a throughput capacity of 100 Mt and 45 Mt respectively, and a shipping company with 12 vessels.

Given its extensive operations, the Shenhua Group places great emphasis on its environmental responsibilities. This has been demonstrated through the implementation of environmental management systems and leading practice energy and emission reduction strategies across a range of its operations. The company also regularly audits the environmental management and performance of its operations to proactively prevent and minimise harm to the environment. It also actively promotes environmental protection education and training throughout its dedicated workforce of over 176,000 employees.

The Shenhua Group is committed to fulfilling its social responsibilities and actively seeks avenues to benefit people within the local communities in which it operates. The company demonstrates this through local employment and contributions to the local economy, including funding for education, health services, job training and infrastructure development.

International growth is a significant factor in expanding the Shenhua Group business. As such, the company has investigated extending its operations to Australia.

In October 2008, Shenhua Watermark Coal Pty Ltd (Shenhua Watermark), a subsidiary of the Shenhua Group, was granted Exploration Licence (EL) 7223 by the New South Wales (NSW) Minister for Mineral Resources. Since this time, Shenhua Watermark has operated in accordance with the terms of EL 7223, including the payment of $300 Million (M) to the NSW Department of Primary Industries (now Department of Trade and Investment, Regional Infrastructure and Services).

Shenhua Watermark has since completed a comprehensive exploration program focused on defining the potential open cut coal resource within the EL. This has consequently led to the development of a detailed mine plan for the Project, which will facilitate the extraction of up to 10 Million tonnes per annum (Mtpa) Run of Mine (ROM) coal via open cut mining methods over a 30 year period. This will result in the production of a primary Pulverised Coal Injection (PCI) or semi-soft coking coal product with low ash content (10%) and a secondary thermal coal product with high ash content (18%).

The Project is located approximately 25 km south south-east of the township of Gunnedah and to the immediate west of the village of Breeza within the Gunnedah Local Government Area (LGA). The Project is approximately 282 km by rail from the export Port of Newcastle. Figure 1 illustrates the location of the Project at a regional scale.

1.2 Proponent

The proponent for the Project is Shenhua Watermark for which the contact details are:

Shenhua Watermark Coal Pty Limited

368-370 Conadilly Street

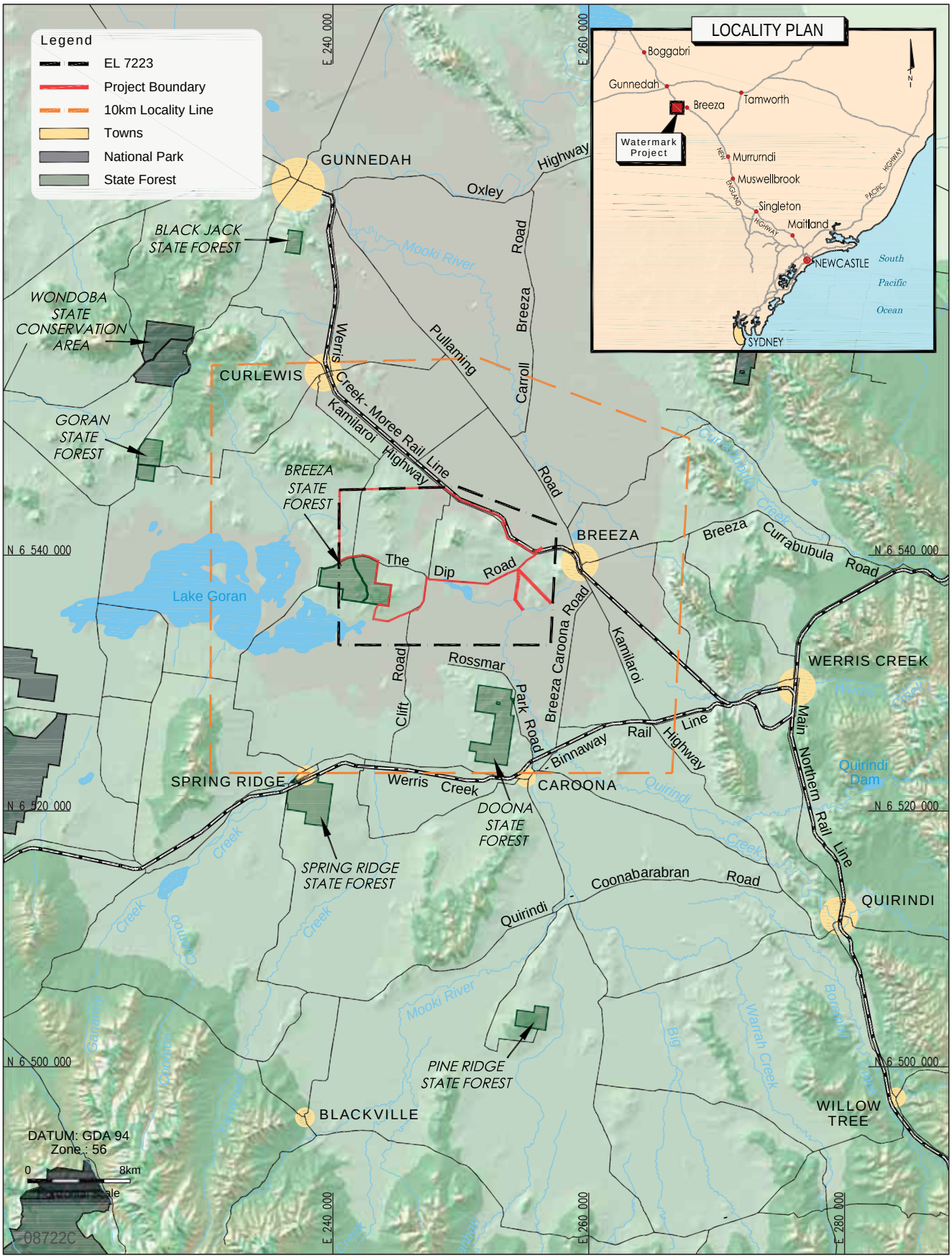
GUNNEDAH NSW 2380

Phone: (02) 6741 8800

Fax: (02) 6741 8817

Website: http://www.shenhuawatermark.com

Shenhua Watermark has not been the subject of any proceedings under Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources.



WATERMARK COAL PROJECT

Regional Locality

FIGURE 1

1.3 Document Purpose

Shenhua Watermark is seeking State Significant Development (SSD) Consent under Division 4.1 of Part 4 of the *Environmental Planning & Assessment Act 1979* (EP&A Act) for the Project. A request for Director-General's Requirements (DGRs) was made to the Department of Planning and Infrastructure (DP&I) under Part 2 of Schedule 2 of the *Environmental Planning & Assessment Regulation 2000* (EP&A Regulation) in October 2011. This was supported by a relevant Background Document. Subsequently, the DGRs were issued by DP&I on 19 April 2012.

This EIS has been prepared by Hansen Bailey Environmental Consultants (Hansen Bailey) on behalf of Shenhua Watermark to support an application for Development Consent under Section 78A (8A) of the EP&A Act. It has been prepared to the form and content requirements in Clauses 6 and 7 of Schedule 2 of the EP&A Regulation.

This EIS also supports an application to the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) as the Project has been determined to have a significant impact on Matters of National Environmental Significance (MNES), which are set out in Part 3 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The Project Application Boundary (Project Boundary) is illustrated on Figure 1. The Project Boundary represents what will be the Mining Lease Application Area for the Project under the *Mining Act 1992* (Mining Act). The schedule of lands to which this EIS applies is provided in Appendix A.

This EIS includes consideration of all issues raised during the extensive stakeholder consultation program and fulfils the requirements of the DGRs by adequately assessing the environmental, social and economic impacts of the Project to enable the Planning Assessment Commission (PAC) to determine the Development Consent as sought. A summary of stakeholder issues raised in relation to the Project and a checklist of each DGR and where these have been addressed in this EIS is presented in Section 5.

1.4 Document Structure

The EIS consists of 11 volumes. This volume (Volume 1) encompasses the main report prepared by Hansen Bailey, which presents a description of the Project, a summary of associated environmental, social and economic impacts and proposed mitigation and management measures. This volume is structured as follows:

- Section 2 provides relevant information on the existing environmental setting;
- Section 3 provides a detailed description of the Project;
- Section 4 outlines the regulatory framework applicable to the Project;
- Section 5 details the extensive stakeholder engagement undertaken for the Project and discusses issues raised. Specifically, this section lists the DGRs and identifies where each matter is addressed in this EIS;
- Section 6 outlines the environmental risk assessment process adopted to rank all identified environmental and social issues to assist in directing the focus of this EIS;
- Section 7 presents the predicted environmental and social impacts and outlines the management and mitigation measures proposed for the Project;
- Section 8 presents a summary of the management and monitoring commitments;
- Section 9 provides a detailed Project justification and conclusion;
- Section 10 presents the study team involved in the compilation of this EIS;
- Section 11 lists abbreviations used throughout this EIS; and
- Section 12 provides a list of all materials referenced in this EIS.

Volume 1 also contains the schedule of land to which this EIS applies and detailed design drawings as required by Schedule 1 of the EP&A Regulation. Volumes 2 to 11 provide complete copies of all technical impact assessments that form appendices to the main volume and support this EIS.



WATERMARK
COAL PROJECT
ENVIRONMENTAL IMPACT STATEMENT
February 2013



2
Existing Environment



Existing Environment 2

This section provides an overview of the existing topography and catchments, land use, climate and geology of the region within and surrounding the Project Boundary. It also provides a description of the land ownership status within and surrounding the Project Boundary and outlines the existing environmental monitoring program implemented by Shenhua Watermark.

2.1 Topography and Catchments

The Project is situated within the Gunnedah Basin which covers more than 15,000 square kilometres (km^2) in the north-western region of NSW. The Gunnedah Basin extends from the southern boundary of the Liverpool Ranges, where it meets the Hunter Coalfields, to the township of Moree at its northern boundary.

Figure 2 illustrates the local topography within the Project Boundary. The Project is situated in a relatively flat region with only 1 % of the landscape recording slopes greater than 15 degrees. Gently undulating cleared grasslands dominate the landscape with small steep sections of rock outcrops in the central, western and south-western portions within the Project Boundary. The land within the Project Boundary generally varies between Reduced Level (RL) 280 m and RL 340 m with the exception of topographic highs, including Mt Watermark (512 m Australian Height Datum (AHD)), Smokey Point (445 m AHD), Black Mountain (393 m AHD) and an unnamed topographic high referred to as 'Springhurst Hill' by local residents.

The Project is located within the catchment of the Mooki River, a tributary of the Namoi River (see **Figure 2**). The headwaters of the Mooki River originate on the northern slopes of the Liverpool Ranges and Coolah Tops, flowing in a northerly direction to the Namoi River north-east of Gunnedah. Several ephemeral first and second order streams traverse and drain the land within the Project Boundary, including Watermark Gully, Native Dog Gully and a series of smaller unnamed watercourses.

Water bodies within the Project Boundary are primarily represented by farm dams. Further to the west of the Project Boundary is Lake Goran, which is a naturally occurring ephemeral lake. During periods of intense rainfall, the lake overflows to the east via Native Dog Gully. The catchment of Lake Goran is drained by Coomoo Coomoo Creek, Moreduval Hut Gully and Lever Gully from the south and some unnamed watercourses from the north and west.

Flooding within the Project Boundary largely occurs during high rainfall events along Watermark Gully. This regime is typically influenced by surface water runoff from Mt Watermark and the western ridges. Under similar conditions, Native Dog Gully is affected by backwater from the Mooki River.

The floodplain area outside the Project Boundary between Native Dog Gully and Lake Goran is very flat with the flow direction during flood events affected by the relative levels and flows of these watercourses / bodies.

2.2 Land Use

The land within the Project Boundary and its immediate vicinity have historically been utilised for a variety of agricultural enterprises, including cattle grazing and cropping. Current land use practices in the region continue to be dominated by agricultural production, however, other land uses such as mining and gas exploration, rural and residential developments and recreational and conservation areas have become more prominent in recent years. Shenhua Watermark has purchased all of the land required for the mining activities associated with the Project and since this time, has maintained agricultural activities on this land. Each of the key land uses is discussed further below and shown on **Figure 3**.

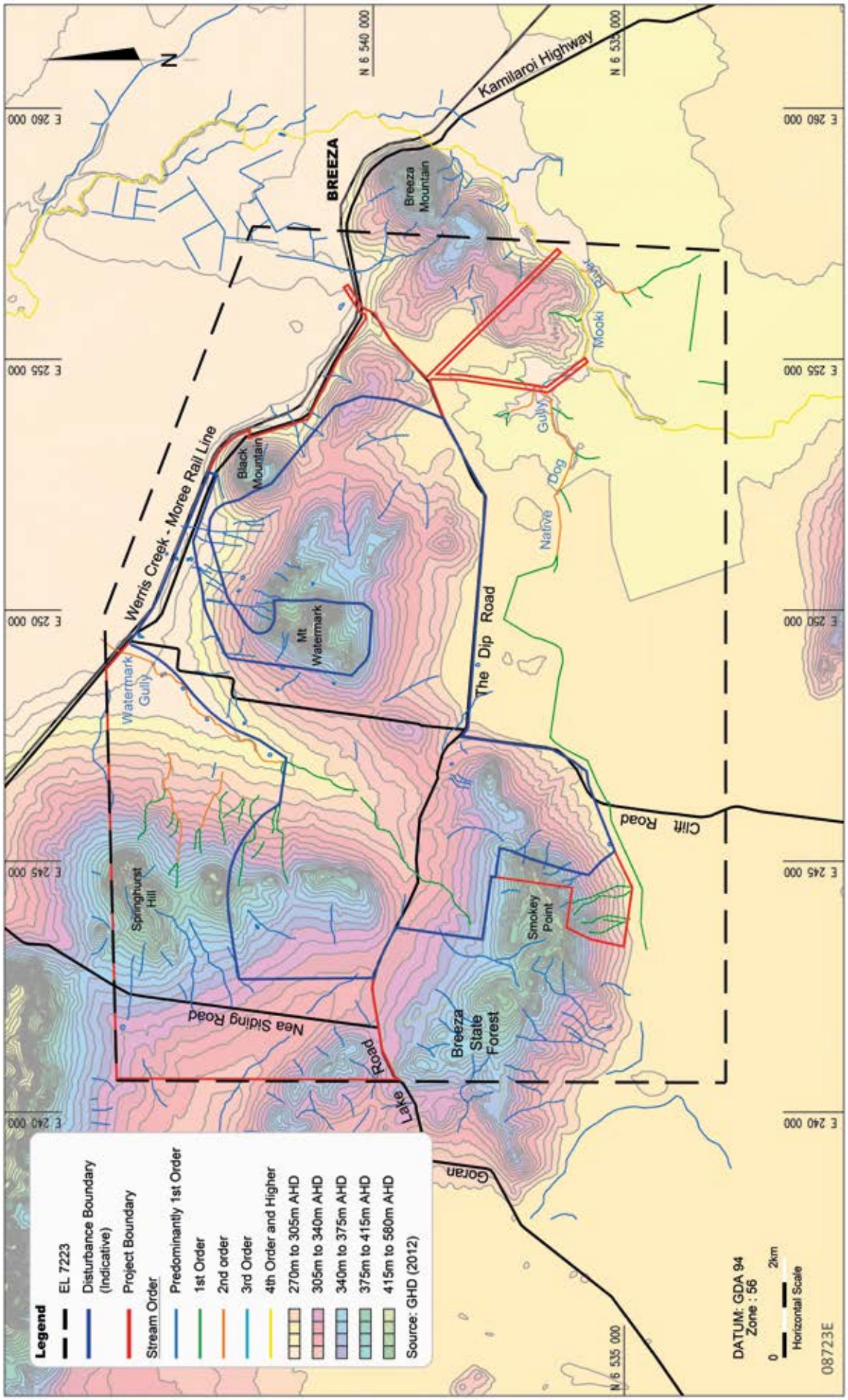
2.2.1 Agriculture

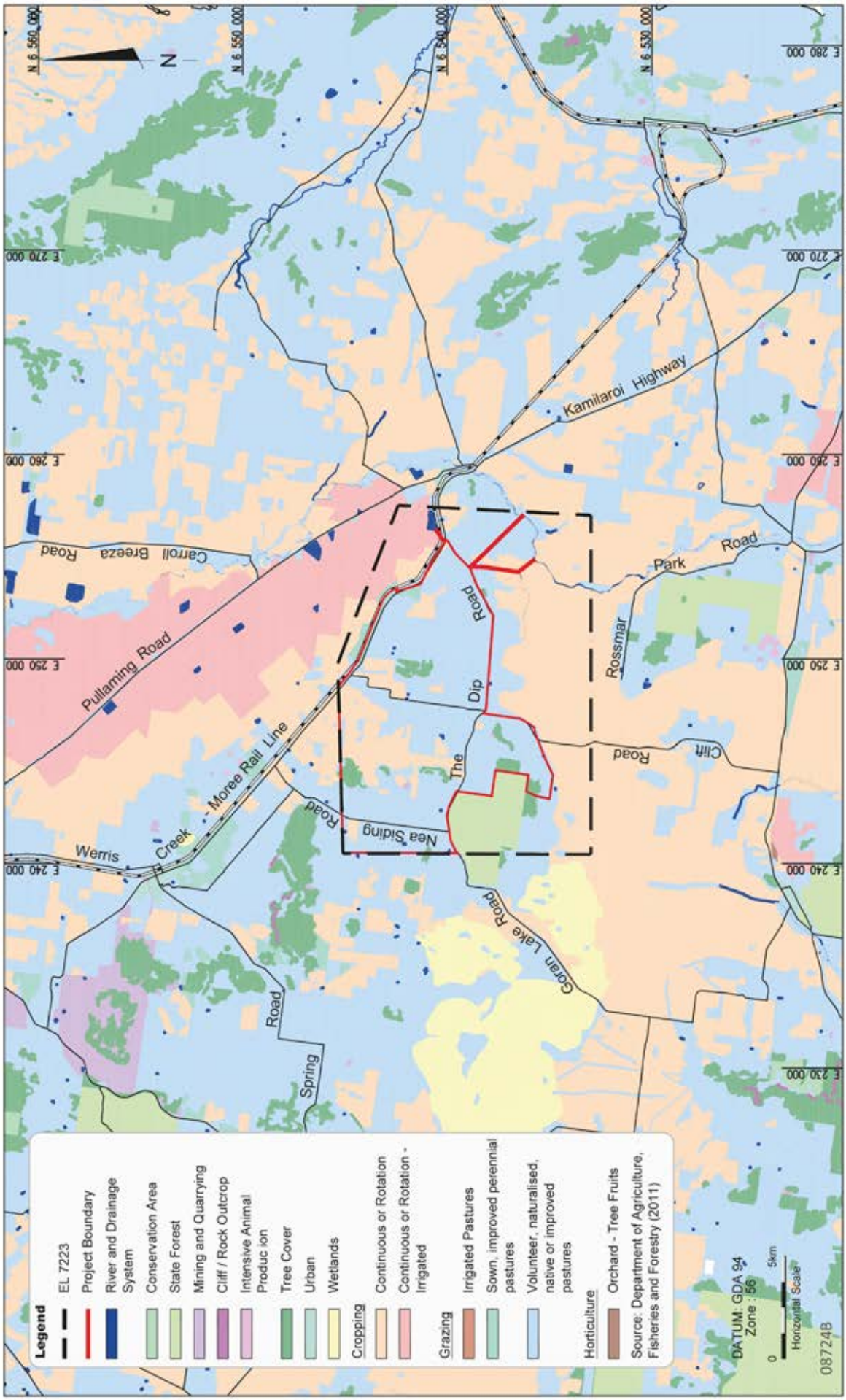
The local area within the vicinity of the Project Boundary has a long history of agricultural production. The current state of the land within the Project Boundary is a reflection of past agricultural practices. The majority of the land is comprised of large expanses of grassland interspersed with isolated remnant woodland patches along boundary fences, road verges, on hills and steep slopes.

The lightly textured red soils were extensively cleared from the 1890s primarily for cereal crops and grazing. Over time, the soil structure of the land deteriorated with constant cultivation causing the landscape to be subject to erosion, especially during high intensity summer storms.

The heavily textured, self-mulching black soil plains were primarily used for sheep and cattle grazing. With the arrival of innovative equipment in the 1950s, more intensive cultivation and cropping of the black soil plains was made possible. This was closely followed by the development of new irrigation techniques, which allowed for an expansion of the cotton industry.




WATERMARK COAL PROJECT
Topography and Drainage
FIGURE 2
N
BREEZA
Kamilaroi Highway
Wernis Creek - Moree Rail Line
The Dip Road
Cliff Road
New Siding Road
Lake Road
Gorari
Breeza State Forest
Breeza Mountain
Black Mountain
Mt Watermark
Springhurst Hill
Smokey Point
Watermark Gully
Native Dog Gully
Mooki River
N 6 540 000
N 6 535 000
E 260 000
E 255 000
E 250 000
E 245 000
E 240 000
Legend
EL 7223
Disturbance Boundary (Indicative)
Project Boundary
Stream Order
Predominantly 1st Order
1st Order
2nd order
3rd Order
4th Order and Higher
270m to 305m AHD
305m to 340m AHD
340m to 375m AHD
375m to 415m AHD
415m to 580m AHD
Source: GHD (2012)
DATUM: GDA 94
Zone : 56
0
2km
Horizontal Scale
08723E
Hansen Bailey
ENVIRONMENTAL CONSULTANTS



WATERMARK COAL PROJECT

Existing Land Use

FIGURE 3

Hansen Bailey | ENVIRONMENTAL CONSULTANTS

In more recent years, major cropping areas have shifted towards establishment on the black soil plains while grazing has been transferred to land situated on the lighter red soils and ridge country, as seen within the Project Boundary. Today the key enterprises within the Project Boundary encompass a range of sheep and cattle grazing and cropping, including wheat, sorghum and barley.

Much of the operations on the black soil plains continue to be sustained by groundwater from the Upper Namoi alluvium and farm dams. In addition, water from the Mooki River provides supplementary irrigation supply for intensive agriculture in the region.

2.2.2 Coal and Gas

The Gunnedah Basin has long been known for its extensive in situ coal resources and has previously been thought to have the potential to become one of the largest coal mining regions in NSW. In recent years, this has resulted in a minor increase in the number of exploration programs and developments in the Gunnedah Basin.

Existing, approved and proposed coal mining and gas extraction operations in the Gunnedah Basin are shown in **Table 1**. The majority of these operations or projects are located over 20 km from the Project Boundary. The cumulative impacts of these operations have been considered throughout the preparation of this EIS as relevant.

Coal

Coal mining has occurred within the Gunnedah Basin for the past 130 years. Some of the early operations included the Gunnedah Colliery, Vickery Mine and an underground mine at Red Hill. Coal mining has also previously occurred inside the eastern portion of the Project Boundary. The Wilga Coal and Coke Company established an operation in 1914, however, was forced to close in 1916 (see **Appendix R**). In the 1990s, many of the other coal mining operations in the region closed due to poor market conditions.

Table 1 Mining and Gas Operations and Projects within the Region

Project Type	Project Title	Development Type	Proponent	EP&A Act Status[1]	Approval Expiration/ Proposed Mine Life	Production	Distance to Project
Coal Mining	Caroona Coal Project	Underground	BHP Billiton	EL Only	N/A	N/A	3 km south
	Werris Creek Mine	Open Cut	Whitehaven Coal Mining Ltd	Approved	2032	2.5 Mtpa (ROM)	20 km south-east
	Canyon Mine	Open Cut (production ceased)	Whitehaven Coal Mining Ltd	Approved	2012	1.25 Mtpa (ROM)	25 km north
	Sunnyside Mine	Open Cut (Care & Maintenance Mode)	Namoi Mining Pty Ltd (Whitehaven Coal Mining Ltd)	Approved	2015	1 Mtpa (ROM)	28 km north-west
	Vickery South Project	Open Cut	Whitehaven Coal Mining Ltd	EL Only	N/A	3 Mtpa (ROM) (estimation)	44 km north
	Vickery Mine	Open Cut (production ceased)	Whitehaven Coal Mining Ltd	Approved	2012	N/A	45 km north
	Vickery Coal Project	Open Cut	Whitehaven Coal Mining Ltd	DGRs Issued	2043 (estimation)	4.5 Mtpa (ROM)	45 km north
	Rocglen Coal Mine	Open Cut	Whitehaven Coal Mining Ltd	Approved	2022	1.5 Mtpa (ROM)	47 km north
	Tarrawonga Coal Mine	Open Cut	Whitehaven Coal Mining Ltd – 70%, Idemitsu Australia Resources Pty Ltd – 30%	Approved	2030	3 Mtpa (Product)	62 km north north-west
	Goonbri Project	N/A	Goonbri Coal Company Pty Limited	EL Only	N/A	N/A	62 km north
	Boggabri Coal Mine	Open Cut	Idemitsu Australia Resources Ltd	Approved	2033	7 Mtpa (Product)	64 km north
	Maules Creek Coal Project	Open Cut	Whitehaven Coal Mining Ltd	Approved	2033	13 Mtpa (ROM)	67 km north
	Narrabri Coal Mine	Underground	Narrabri Coal Pty Ltd (70% Whitehaven Coal Mining Ltd)	Approved	2031	8 Mtpa (Product)	76 km north north-west
Coal Seam Gas	Coonarah Gas Field	N/A	Santos and Eastern Star Gas Limited	Approved	N/A	5.8 Petajoules (proven and probable)	115 km north north-west
	Santos Gunnedah CSG Project	N/A	Santos	Exploration Phase	2016	210 Petajoules	North West NSW Region, comprising 4 subregions.

1 – EP&A Act status and development phase as of January 2013

Recently, the coal mining industry within the Gunnedah Basin has resumed with several new mining development projects commencing operations or undertaking exploration activities.

EL 6505 is held by BHP Billiton and located immediately to the south of EL 7223. BHP Billiton is currently undertaking an exploration program to determine whether viable underground reserves exist for its proposed Caroona Coal Project. A hypothetical sensitivity analysis for cumulative air quality and noise impacts with a conceptual Caroona Coal Project infrastructure layout has been completed and is discussed further in **Section 7**. Further, the Namoi Water Study assessed potential cumulative impacts including the Project and a conceptual Caroona Coal Project. This is considered further in **Section 7**.

Gas

The gas industry within the Gunnedah Basin and the broader region is slowly developing. The Central Ranges Pipeline, which is owned by the APA Group, is one of the only existing gas developments in the region. The pipeline provides natural gas from Dubbo to 10 towns in the Central Ranges region, including Tamworth, Gunnedah, Mudgee, Dunnedoo, Coolah, Gulgong, Quirindi, Werris Creek, Coonabarabran and Gilgandra. The pipeline runs in a northerly direction along the eastern portion of the Project Boundary (see **Figure 9**).

Santos QNT Pty Ltd (Santos) holds Petroleum Exploration Licence (PEL) No 1 over the Project Boundary and its surrounds. Santos has commenced the Gunnedah Basin Gas Exploration Project at Caroona, adjacent to the Project Boundary. There is one existing coal seam gas development in the Gunnedah Basin; the Coonarah Gas Fields Project. The project is situated 25 km west of Narrabri and 115 km north north-west of the Project Boundary. The gas extracted from the project is supplied domestically to a nearby gas fired power station and via a pipeline to Narrabri.

The proposed Narrabri Coal Seam Gas Project intends to incorporate the existing Coonarah Gas Fields Project into a significantly larger area, which is anticipated to facilitate coal seam gas extraction for a further 20 years.

Several other PELs are registered across the Gunnedah Basin, indicating the potential for multiple coal seam gas developments in the near future. The existing coal seam gas PELs in the Gunnedah Basin are generally held or under access agreement by Santos, including PEL 1, PEL 12, PEL 238, PEL 433, PEL 434, PEL 450, PEL 452, PEL 456, and PEL 462. As shown in **Table 1**, the distance between existing and proposed developments and the Project limits the occurrence of cumulative environmental impacts.

2.2.3 Rural and Residential Developments

The Project exists wholly within a rural landscape. The village of Breeza is the closest urban settlement to the Project Boundary. It is located on the Kamilaroi Highway approximately 3 km to the immediate east of the Project Boundary. Based on 2011 census data, the village of Breeza contains a small population of 63 individuals (see **Appendix AE**) and is serviced by limited facilities, including a community hall, fire station, silos and a playground.

The Project is also situated in the vicinity of a number of other small urban settlements, including Caroona, the Walhallow Aboriginal community, Spring Ridge and Curlewis, which are approximately 15 km to the south and north-west of the Project Boundary, respectively.

2.2.4 Conservation Areas and Reserves

Breeza State Forest is located immediately adjacent to the Project Boundary in the south-west portion of EL 7223 and encompasses an area of approximately 1,364 hectares (ha) (see **Figure 3**). The forest is classed Zone 4 – Forestry under the *Community Conservation Area* of the *Brigalow and Nandewar Community Conservation Area Act, 2005*. Zone 4 allows for forestry, recreation and mineral extraction. The forest is currently used for the production of white cypress pine (*Callitris glaucophylla*), white box (*Eucalyptus albens*) and iron bark logs (various *Eucalyptus spp*.).

The Breeza State Forest was set aside as a timber reserve on 15 November 1880 and was converted to a State Forest in 1914. The earliest reports relating to the forests in the Gunnedah area date back to 1910 and indicate that the vegetation was typically characterised by native hardwood and pine. The pines were young, being regeneration after the previous stands fell in the 1880s to 1890s. The regenerated pines were logged in the 1980s, making the current growth third generation (see **Appendix R**). Breeza State Forest has been excluded from the Project Boundary application area.



The Doona State Forest and the Spring Ridge State Forest are situated approximately 8 km and 14 km to the south of the Project Boundary, respectively. To the north-west lies the Goran State Forest and Wandoba State Conservation Area, approximately 15 km and 16 km, respectively from the Project Boundary. Further abroad is the Trinkey State Forest and Black Jack State Forest situated approximately 26 km to the south-west and 20 km north, respectively, from the Project Boundary.

2.2.5 Recreation

Amongst the large areas of agricultural land associated with the region, there are several conservation areas and reserves (see **Section 2.2.4**) that provide areas of public use and recreation.

Breeza State Forest is listed as a conservation hunting area by the Game Council of NSW, allowing licensed recreational hunters to assist with the control of introduced feral animal species (Game Council of NSW, 2012).

Lake Keepit is located approximately 38 km north north-east of the Project Boundary and is utilised for fishing and various water sporting activities.

Bindea Walking Track and Waterways Wildlife Park are located in the Gunnedah LGA. Nearby recreation areas with lookouts include the Wandobah Reserve incorporating Porcupine Lookout and the *"Who'd a Thought it"* Lookout located in Quirindi.

2.3 Land Ownership

Shenhua Watermark owns all of the land for the proposed mining development associated with the Project. A small parcel of Crown land is located on Mt Watermark and is excluded from the Project. Private freehold land primarily surrounds the Project Boundary with the exception of the fore mentioned and Breeza State Forest to the south-west, which is owned by the State and managed by Forests NSW.

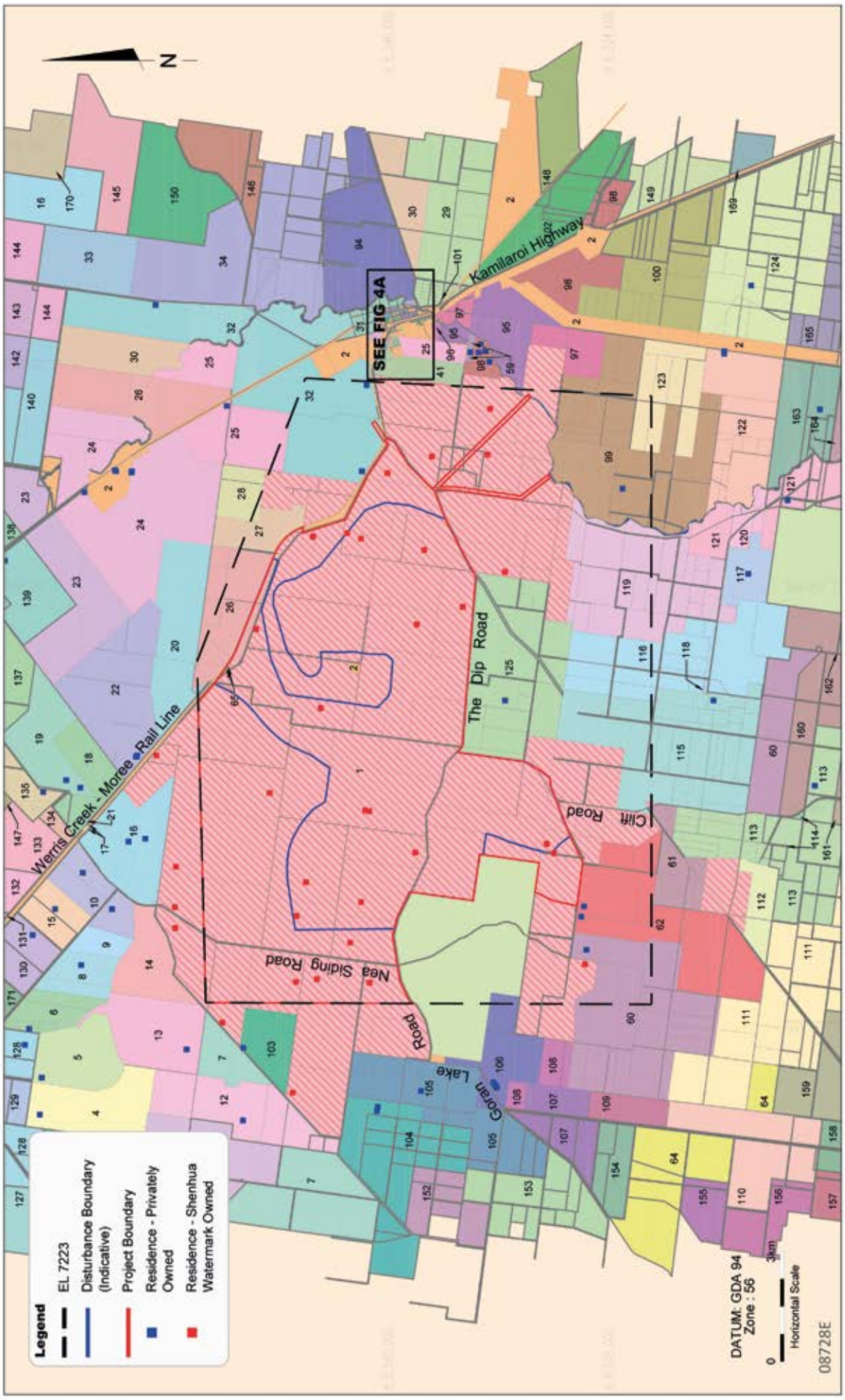
The land ownership within and surrounding the Project Boundary for a 5 km radius is listed in **Table 2** and shown on **Figure 4**. **Figure 4A** provides an inset of the landownership within the village of Breeza. **Figure 4B** provides the legend to **Figure 4** and **Figure 4A**. Landholders that own several contiguous parcels of land are illustrated with a single colour on **Figure 4** and **Figure 4A**.

Table 2 Land Ownership

ID	Name	Residence	ID	Name	Residence	ID	Name	Residence
1	Shenhua Watermark	x 33	58	W Clift		115	Birrawa Pastoral Co Pty Ltd	■
2	Crown		59	DT Clift	■	116	CJ & PA Duddy Pty Ltd	
3	Telstra Corporation Ltd	■	60	RS & A Clift	■	117	CJ Duddy	■
4	BM, MA & CB O'Meley ^		61	RS Clift		118	V R Vescio	
5	LJ Sedran		62	M Clift	■ ■	119	Rossmar Park Pastoral Co Pty Ltd	
6	KK & MR Picton	■	63	W & S Clift & J Cock	■	120	BA & NJ Evans	
7	WJ & JA Picton		64	PK Clift & MH Lane		121	BA , NJ & GC Evans	■
8	WH & PG Schubert	■	65	LH Tregenza		122	MC , WP & WA Burt	■ ■
9	DE & EC Mirow		66	KM Donnelly	■	123	WA & MC Burt	
10	RA & AE Fullwood Pty Ltd	■ ■	67	SJ Smith		124	SL & MJ Piper	■
11	The Cedars Pty Ltd		68	T Smith		125	G Clift	■
12	Kalimna Holdings Pty Ltd	■	69	NE Hutton		127	BA & KS Pryor	
13	PR & DM Gibbons ^	■	70	G Cohen		128	KK & MR Picton	■
14	JR & ND McNamara ^	■*	71	NB King		129	WJ & EL Le Cornu	
15	NR Squires	■	72	NB & ME King	■	130	PY & DM Hubbard	■
16	MA & LL Latham	■ ■	73	ARH O'Rourke		131	JA BP JM & HA Middlebrook	
17	NSW Grain Corporation Ltd		74	LL Cameron		132	OL & WK Manning	
18	TJR Lyle		75	W Johnson		133	Sandhurst Trustees Ltd	
19	JR Lyle	■ ■	76	MA Brown		134	HY & GG Hubbard	
20	SB Lyle		77	HG Brown		135	PK Baker	■
21	Clearpine Pty Ltd		78	PH Hicks	■	136	Hamblin Pastoral Co Pty Ltd	N
22	Nullabean Pastoral Co Pty Ltd	■	79	NI Wright		137	Kaythree Pty Ltd	

ID	Name	Residence	ID	Name	Residence	ID	Name	Residence
23	AR Riordan		80	AA Mendoza		138	Woneena Pty Ltd	
24	Kalori Pty Ltd	■ ■ ■	81	SJ & SC Ryan		139	Camilleri Farms Pty Ltd	■
25	RE & BM Baker	■ ■	82	ITT & VL Rowney	■	140	EC Riordan	
26	GJ Baker		83	KD & RM Sampson	■	141	JJ Warner & JM Mackay	N
27	JD , NM & DJ Tudgey		84	GL Matthews		142	C Bellenger	
28	DJ Tudgey		85	WR Matthews	■	143	Lyne Pastoral Co Pty Ltd	
29	DJ & JM Tudgey		86	S Griffin	■	144	HR Hicks	
30	PJ , DJ & LM Warmoll		87	SG Carr		145	BJ & JJ McNamara	
31	DJ & PJ Warmoll		88	BF Manning	■	146	CC Alston	
32	PJ, DJ, LME, LF Warmoll & AM Waugh	■ ■ ■	89	RC & LA Wiles		147	Paul Ramsey Agribusiness Pty Ltd	
33	ME , J & I Fairhall		90	BJ & GD Taber	■	148	MLD Bonner	
34	TN Bailey		91	BT O'Keefe	■	149	WTA & P Craig	
35	M Salvador	■	92	RJ Nutbeam		150	LM Sulman	
36	LW Sullivan	■ ■	93	WR & SG Steedman	■	151	SJ & MA Kelly	
37	LM Newell	■	94	WTA Craig		152	Singlestone Pty Ltd	
38	NG Peterson & MJ Wilson	■	95	ST , JW & NL Craig		153	Rarene Pty Ltd	
39	LJ & S Collins	■	96	MJ Parry		154	KJ & CM Kelly	
40	LAC Ridgeway	■	97	AL Pursehouse		155	BS Kelly	
41	PB & RL Baldo	■	98	AL & CI Pursehouse		156	KJ Kelly	
42	Walhallow Local Aboriginal Land Council		99	Pursehouse Properties Pty Ltd	■	157	Grein Pty Ltd	
43	RE & JF O'Farrell		100	Pursehouse Investments Pty Ltd		158	J & NP Malden	
44	PJ & CG Van De Moosdijk	■	101	Boala Ltd		159	Nilwon Pastoral Co Pty Ltd	
45	HG & EM Mills	■	102	Holifall Pty Ltd		160	M & KA Clift	
46	ED Mills		103	K & J Fordham	■	161	Carbon Minerals NL	
47	CA Griffiths	■	104	Piyawoola Pty Ltd	■ ■	162	JBS Australia Pty Ltd	
48	MD Neave	■	105	Lochiel Park Pty Ltd	■	163	WH & EC Ryan	■
49	GR Neave		106	AR Delve	■ ■ ■	164	RJF Cohen	
50	DR McVeigh &WA Lewis		107	Byrwyn Pty Ltd		165	MJ & NG Bradfield	
51	B W Dunstan	■	108	BJ Kelly & PG Calbert		166	RC WP Barnett & IW JK Merrick	
52	BM Pepper	■	109	Rejilo Pty Ltd		167	KM & HJ Fulwood	
53	R Mercieca & B Cockerill		110	Quimili Pty Ltd		168	AH Craig	N
54	HJ Lickorish	■	111	Single Tree Pty Ltd		169	DR & DW Frankham	
55	AGA Auctions Pty Ltd		112	Frofour Pty Ltd		170	PG & C Mahoney	
56	Acrobatic Pty Ltd		113	GS Norman	■	171	SA Shannon	
57	JB , SB & WW Clift		114	CF Norman				

Note: A coloured square denotes a residence on the property.
** A temporary residence is present*
^ Contract exchange for purchase by Shenhua Watermark pending as at January 2013.
Searches undertaken in February 2011
ID numbers not represented in the above table or labelled 'N' is outside the frame of **Figure 4**.


WATERMARK COAL PROJECT
Land Ownership (Overall)
FIGURE 4
N
SEE FIG 4A
Kamilaroi Highway
Werris Creek - Moree Rail Line
The Dip Road
Cliff Road
Nea Siding Road
Goran Lake Road
Legend
EL 7223
Disturbance Boundary (Indicative)
Project Boundary
Residence - Privately Owned
Residence - Shenhua Watermark Owned
DATUM: GDA 94
Zone : 56
Horizontal Scale
0
3km
087281E
Hansen Bailey
ENVIRONMENTAL CONSULTANTS

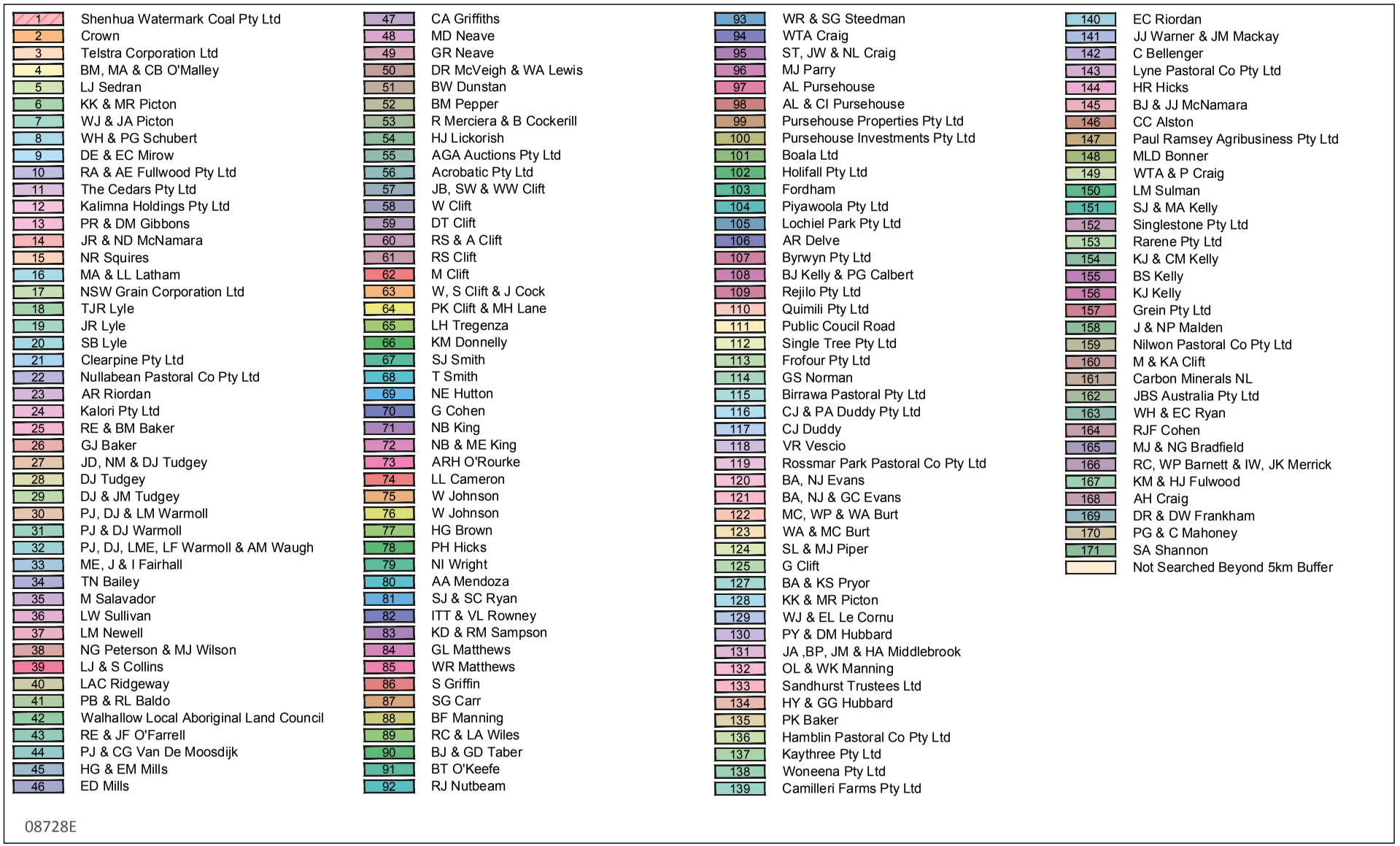


WATERMARK COAL PROJECT

Land Ownership (Breeza)

FIGURE 4A

Hansen Bailey | ENVIRONMENTAL CONSULTANTS



WATERMARK COAL PROJECT

SHENHUA WATERMARK COAL PTY LIMITED | Hansen Bailey ENVIRONMENTAL CONSULTANTS

Land Ownership

FIGURE 4B

2.4 Climate

Regional climatic conditions of the Gunnedah Basin consist primarily of seasonal variations of hot, wet summer months giving way to mild, dry winters. This results in an overall warm temperate climate. While there are intermittent periods of rainfall, the Gunnedah Basin is characterised by extensive periods of low precipitation causing an increase in severity and intensity of droughts.

The warm, dry summer conditions are caused by high pressure systems over the northern parts of Australia. Sporadic periods of high intensity rainfall and thunderstorms in summer are influenced by a number of phenomena including:

- Passage of moist upper atmospheric low pressure cells from the north;
- Passage of inland tropical cyclones and low pressure systems; and
- Localised convection storms.

The cool dry conditions experienced from mid-autumn to late spring are associated with the high pressure systems that alternate with cold fronts.

Shenhua Watermark has two functioning meteorological monitoring stations, which have been strategically located with consideration of the surface terrain. This ensures the meteorological conditions within the entire Project Boundary and beyond can be well represented and understood. Weather Station 1 (WS1) was installed in January 2010 and Weather Station 2 (WS2) was installed in July 2010. Where possible, the data from WS1 and WS2 was utilised during the preparation of this EIS. The locations of WS1 and WS2 are shown on **Figure 8**.

It should be noted that complete datasets from WS1 and WS2 are unavailable in some cases, as shown in **Table 4**. Such issues are generally experienced as a new monitoring system is established and calibrated over the first two years.

As more data is collected, verified and calibrated, a more accurate monitoring and baseline record can then be achieved. As such, additional data sources from government agencies have been utilised where possible in this EIS to ensure robust and conservative impact assessment.

Data sets from the Bureau of Meteorology (BoM) monitoring stations at Breeza (Main Street) and Gunnedah Resource Centre were also considered. The locations of these stations relative to the Project Boundary, the parameters recorded and the associated recording period are outlined in **Table 3**. A summary of meteorological data sourced from the Shenhua Watermark and BoM meteorological monitoring stations in the vicinity of the Project Boundary are provided in **Table 4**, with key parameters discussed further below.

2.4.1 Temperature and Humidity

Temperatures in the region range from a mean maximum of 38.9 degrees Celsius (°C) in summer down to a minimum of -4.8°C in the winter months.

Humidity levels exhibit seasonal variability throughout the year. Mean morning (9:00 am) humidity levels range from 58% to 79% and mean afternoon (3:00 pm) while humidity levels range from 40% to 55% at the BoM Gunnedah Resource Centre station. The humidity levels recorded at WS1 and WS2 range from 10.1% to 98.4%.



Table 3 Regional Meteorological Stations

Name	Location	Operator	Station Number	Parameters Recorded	Data Availability
WS1	Western portion of the Project Boundary	Shenhua Watermark	N/A	• Air temperature at 2 m and 10 m; • Rainfall; • Average and maximum wind speed, direction and peak wind gusts; • Relative humidity; and • Solar radiation	January 2010 to present
WS2	Eastern portion of the Project Boundary	Shenhua Watermark	N/A	• Air temperature at 2 m and 10 m; • Rainfall; • Average and maximum wind speed, direction and peak wind gusts; • Relative humidity; and • Solar radiation	July 2010 to present
Breeza (Main Road)	3 km east of the Project Boundary	BoM	055008	• Rainfall	1883 to present
Gunnedah Resource Centre	20 km north of the Project Boundary	BoM	055024	• Temperature; • Rainfall; • Mean rain days; • Evaporation; and • Wind speed	1948 to present (wind speed and humidity measurements available until 2010 only)

Table 4 Meteorological Data Summary

Month	Daily Temperature (°C)						Mean Rainfall (mm)				Mean Rain Days			Mean Humidity (%)						Mean Daily Evaporation (mm)
	Gunnedah RC		WS1		WS2		Breeza	Gunnedah RC	WS1	WS2	Gunnedah RC	WS1	WS2	Gunnedah Pool		WS1		WS2		Gunnedah RC
	Min	Max	Min	Max	Min	Max								9:00 AM	3:00 PM	Min	Max	Min	Max	
January	13.6	38.9	9.2	38.5	10.0	38.8	74.0	84.4	57.4	88.4	7.2	7.5	10.0	61	43	17.4	94.5	16.9	95.5	239
February	15.0	36.3	9.9	39.0	12.1	36.2	64.0	73.8	142.1	92.8	6.5	10.0	8.0	65	45	24.8	95.6	25.5	96.1	189
March	12.3	35.6	8.0	35.5	7.7	37.7	48.5	41.0	32.5	26.6	4.8	8.0	9.0	65	44	22.4	97.4	25.2	96.6	186
April	6.8	29.0	3.1	32.0	3.6	30.3	39.5	39.1	32.5	38.6	4.5	7.0	5.0	67	46	22.4	98.3	23.8	95.2	129
May	1.2	25.7	-3.3	27.1	-4.1	25.3	40.5	44.8	35.8	58.4	5.4	7.0	6.0	73	51	15.7	97.9	12.7	96.1	84
June	-0.1	20.7	-2.8	21.8	-5.0	21.1	42.9	39.0	14.1	6.2	6.4	11.5	4.0	79	55	34.8	98.0	38.2	95.4	57
July	-0.1	20.3	-4.8	20.2	-3.9	20.7	40.8	43.3	36.3	4.6	6.2	10.5	1.0	77	53	29.1	98.4	29.9	96.8	59
August	1.3	23.7	-1.7	23.6	-1.4	23.4	39.4	35.3	45.2	18.7	6.3	11.5	9.0	71	48	23.8	97.9	25.8	96.6	84
September	3.7	28.1	-0.8	28.3	-0.4	27.9	39.9	40.3	34.1	15.2	6.0	6.5	3.0	65	44	10.1	96.9	21.3	96.6	120
October	5.2	29.6	1.2	29.2	3.6	31.2	54.2	59.4	67.1	53.0	7.6	8.5	7.0	61	43	24.3	97.9	24.9	96.7	164
November	9.9	33.7	6.4	34.1	6.9	34.5	63.6	70.9	180.3	111.4	7.4	12.5	12.0	59	40	22.6	97.7	22.0	96.5	198
December	10.0	32.3	10.4	31.5	9.9	31.6	66.9	71.5	154.5	134.4	7.7	10.5	14.0	58	40	33.9	97.2	26.3	96.6	239
Annual	6.6	29.5	2.9	30.0	3.2	29.9	608.1	641.9	831.9	648.3	76	111.0	88.0	67	46	23.4	97.3	24.4	96.2	1748

WS1 installed January 2010
WS2 installed July 2010
Source: BoM, 2012
= Incomplete Rainfall Data

2.4.2 Rainfall

The maximum rainfall within the Project Boundary occurs during November and December with maximum mean monthly values of 180.3 millimetres (mm) at WS1 and 134.4 mm at WS2. Low rainfall is generally experienced at both monitoring stations during June and July with minimum mean monthly values of 14.1 mm at WS1 and 4.6 mm at WS2.

The maximum rainfall across the region occurs during January with mean monthly values of 74.0 mm to 84.4 mm, respectively. These maximum rainfall events are typically experienced marginally later in the broader region than that within the Project Boundary. Low rainfall typically occurs between the months of April to September in the region with mean minimum values of 39.5 mm at Breeza and 35.7 mm at the Gunnedah Resource Centre. These values are substantially higher than that recorded within the Project Boundary.

2.4.3 Evaporation

Data from the BoM Gunnedah Resource Centre station was used to assess representative evaporative trends typical of the region. Summer months experienced higher daily evaporation in direct correlation with increased temperature and presence of afternoon winds.

Mean monthly pan evaporation rates varying seasonally from 239 mm during January and December to 57 mm during June, with an annual mean evaporation of 146 mm.

2.4.4 Wind Speed and Direction

Seasonal windroses for WS1 and WS2 are presented in **Figure 5**. The figure indicates the following:

- The prevailing wind direction at WS1 is east south-easterly and south-easterly in the spring, summer, and autumn months, and west south-westerly and south-easterly in the winter months;
- The prevailing wind direction at WS2 is southerly throughout all seasons;
- At WS2 there are almost no northerly winds, with the exception of slight north north-westerly to north north-easterly winds during the winter months;
- Recorded wind speeds were generally between 1.5 metres per second (m/s) and 6 m/s throughout all seasons; and
- Summer months appear to experience the lowest calms (i.e. wind speeds less than 0.5 m/s).

The variations observed between WS1 and WS2 are a result of local topographic influences.

2.5 Geology

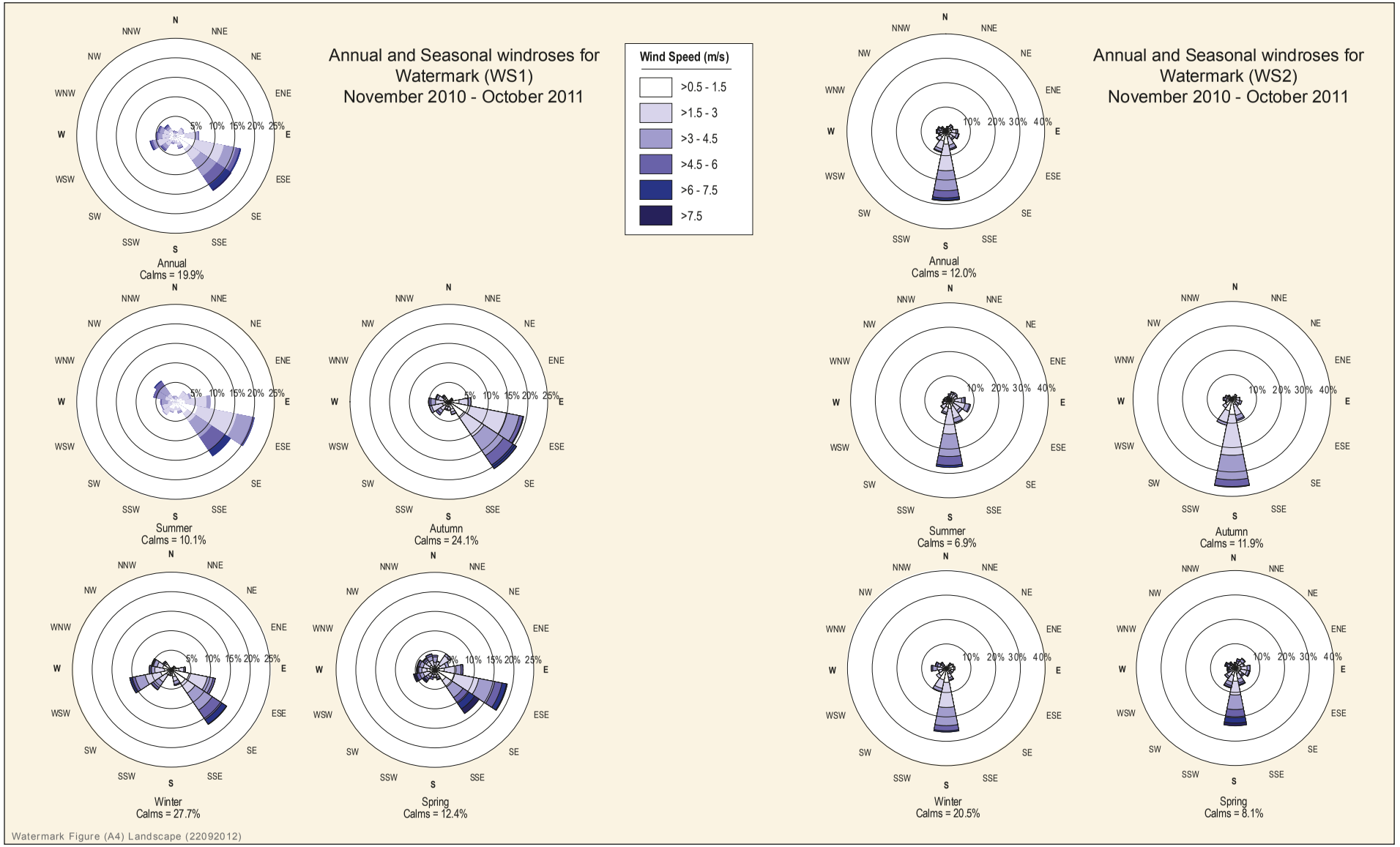
2.5.1 Exploration

Authorisation 216 was originally held by the Director-General of the NSW Department of Primary Industries on behalf of the Crown for the purposes of prospecting for coal within the Gunnedah Basin. Preliminary exploration by the Department identified major resources of more than 1 billion tonnes (bt) of in situ coal within the Watermark deposit. This subsequently resulted in the Department inviting competitive tenders for part of Authorisation 216. As a result, Shenhua Group submitted an expression of interest for a five year EL. Following the competitive tender process, Shenhua Watermark was granted EL 7223 in October 2008 by the NSW Minister for Mineral Resources, which included the following special conditions (amongst others):

- *"54 - …the licence holder shall provide $A1 million per annum during its exploration and feasibility program, up to a maximum of five years, to a new Regional Community Trust to be established with the regional communities…;*
- *55 – The licence holder shall, within a reasonable period of time, establish a "Watermark Coal Exploration Project – Community Consultative Committee"…;*
- *59 – The licence holder…shall, within the timeframe specified in the EOI Information document, pay the Department of Primary Industries an amount of A$23.6 million;*
- *60 – The licence holder shall, within the timeframe specified in its successful EOI, pay the Department of Primary Industries the nominated additional amount of A$276.3 million;*
- *61 – Subject to ongoing title tenure and the future grant of a mining lease, the licence holder shall pay the Department of Primary Industries the nominated additional amount of A$200 million…;"*

Shenhua Watermark has complied with the terms of EL 7223. Subsequently, EL 7223 was renewed in January 2012 until February 2016, inclusive of the following additional special conditions:

- *"47 – If the licence holder purchases or has purchased any land within the area of the licence that was used for prime agricultural purposes immediately prior to the purchases', the licence holder is to ensure that the land continues to be used for prime agricultural purposes during the life of the exploration licence;*
- *48 – Any development approval sought by the licence holder within the initial term of the licence or during any extensions or renewals of the licence shall not include any of the following activities in the area covered by the licence:*
  - *Long wall mining underneath the "deep alluvial irrigation aquifers";*
  - *Long wall mining underneath the "floodplain";*
  - *Open cut mining anywhere on the "floodplain".*



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Watermark Windroses

FIGURE 5

- *49 – All 3D groundwater modelling carried out by the licence holder within the licence area is to be subjected to a peer review by an appropriately qualified independent groundwater expert;*
- *50 – All plans for mining within the licence area must include a horizontal barrier of natural material with a minimum width of 150 metres, between proposed mining excavations and the Gunnedah Formation."*

In the time since EL 7223 was granted, Shenhua Watermark has completed four stages of a comprehensive exploration program focused on defining the potential open cut coal resource within the Project Boundary (see **Figure 6**). These investigations established a robust understanding of the geology of the site, coal location and coal quality. Exploration activities undertaken to date within EL 7223 has consisted of:

- Desktop studies;
- Airphoto and regional airborne geophysical survey analysis;
- A Light Detection and Ranging survey;
- Geophysical surveys, including ground magnetic surveys, 2D seismic cross sections and resistivity traverses;
- Hydrogeological studies;
- Drilling (Core and Limit of Oxidisation (LOX) drill holes); and
- Geological reconnaissance.

As at the completion of the Stage 3A exploration program in May 2011, Shenhua Watermark had completed a total of 625 bores, including 318 HQ bores, 250 LOX bores and 33 large diameter bores, and 24 Sonic and Alluvial bores within EL 7223. The results from the Stage 3A exploration programme have been used to estimate the Project resource, which has been defined and reported in accordance with Australasian Joint Ore Reserves Committee (JORC) requirements (see **Appendix C**).

The drilling program has identified with a high level of certainty the groundwater regime within the Project Boundary and assisted with the collection of the relevant samples for this EIS and the installation of numerous groundwater monitoring bores within the Project Boundary for ongoing monitoring.

2.5.2 Stratigraphy

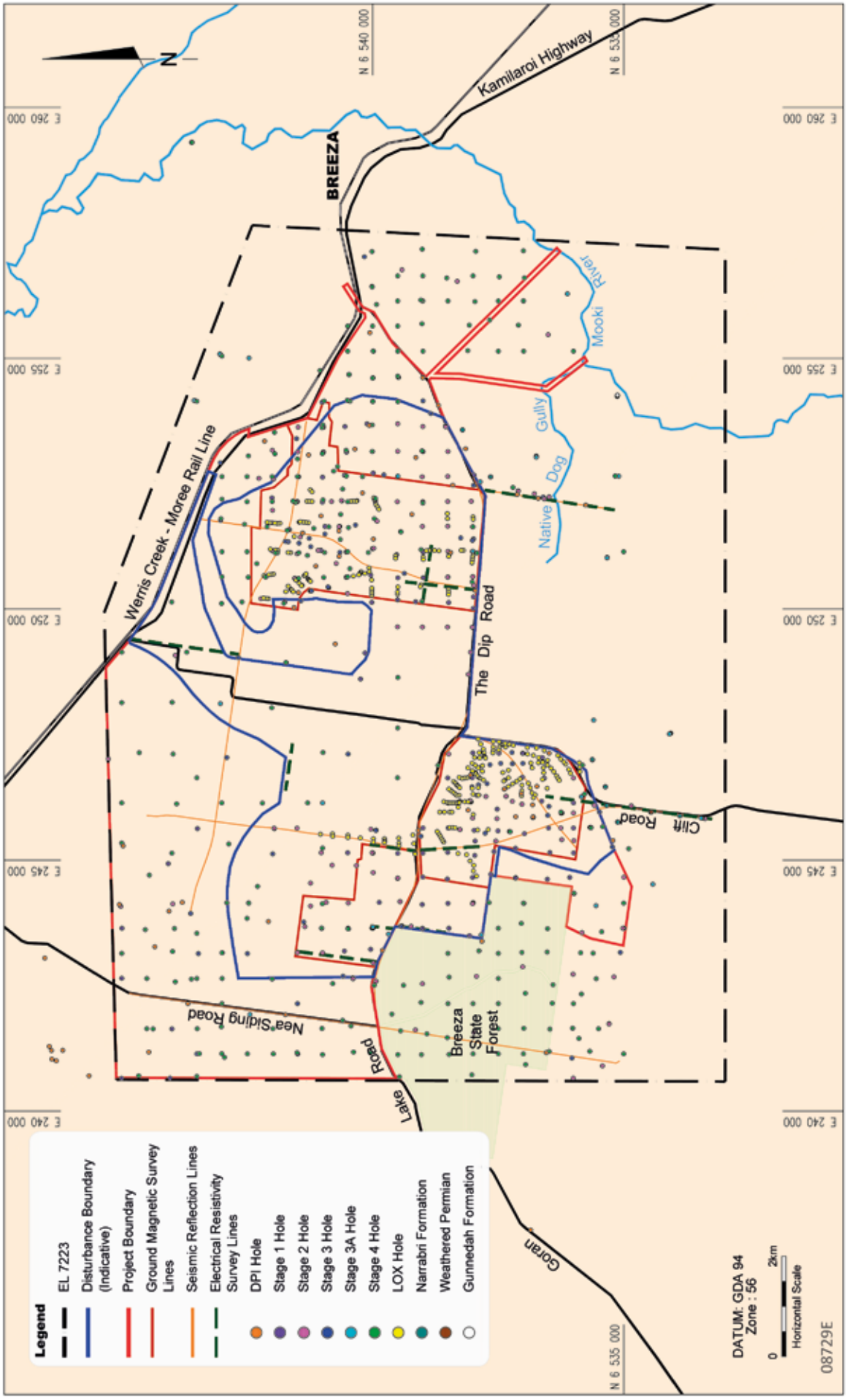
The Project is located within the Gunnedah Basin, which is one of the largest coal resources within NSW. An indicative stratigraphic column within the Project Boundary is presented in **Figure 7**. The stratigraphy of the area generally includes:

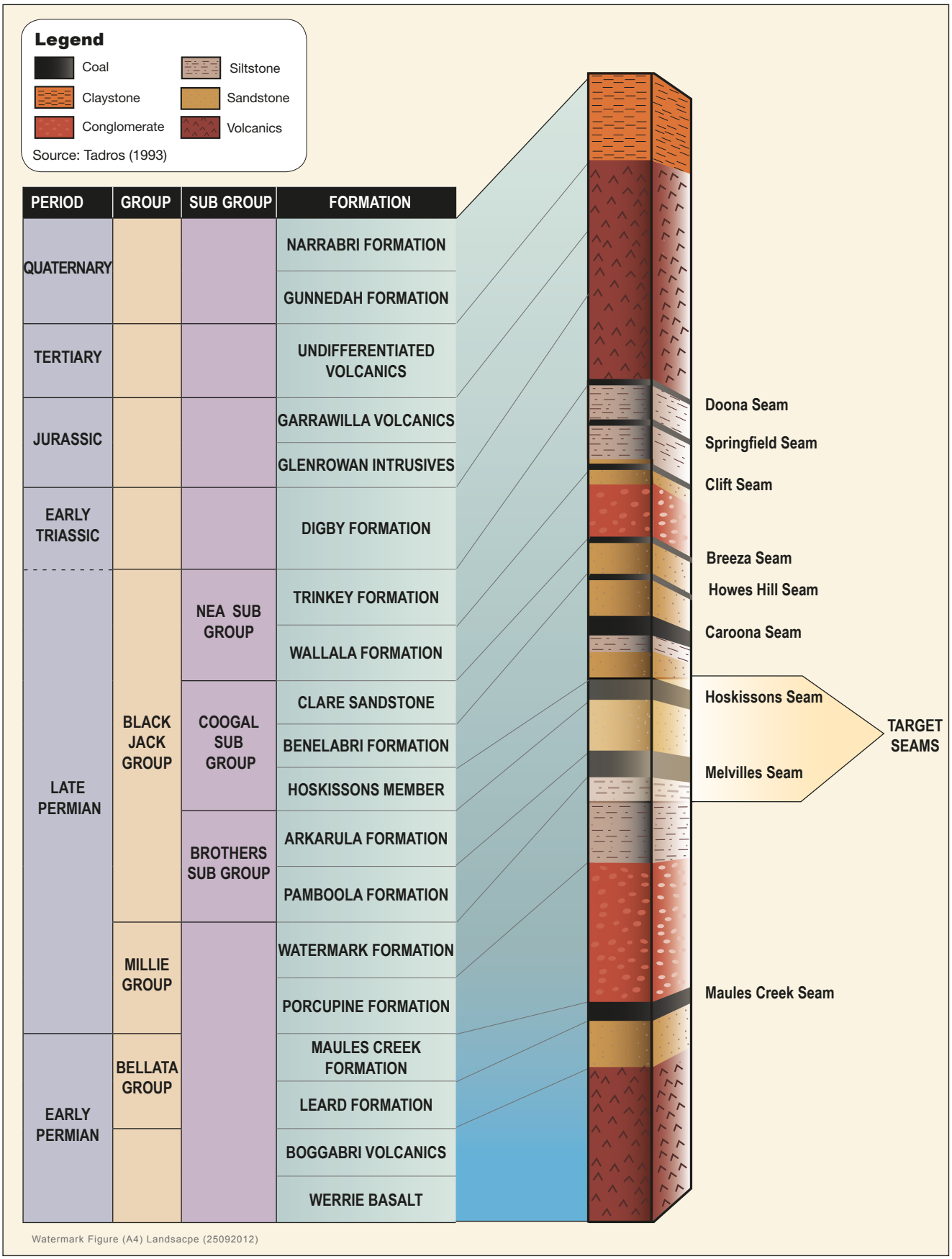
- Quaternary Alluvium;
- Tertiary Basalt and Dolerite of the Liverpool Range Beds;
- Jurassic Garrawilla Volcanics of the Surat Basin deposit;
- Gunnedah Basin Sequence, including:
- Early Triassic Digby Formation Lithic and Quartz conglomerates alluvial fan deposits found to the west of the Project Boundary;
- Late Permian Black Jack Group sediments containing the Breeza Coal Member, Hoskissons seam and the Melvilles seam;
- Late Permian Millie Group Watermark and Porcupine Formation of marine and deltaic sedimentary rocks;
- Early Permian Bellata Group sediments containing Maules Creek seams; and
- Early Permian Werrie Basalt the basement of the Gunnedah Basin.

The early Permian to Triassic strata in the Project Boundary has a thickness of approximately 600 m and comprises predominately alluvial, deltaic and marine shelf sediments. These strata are, in places, overlain by Jurassic volcanic and sedimentary sequences of the Surat Basin.

The target coal seams sought after by the Project are contained within the Black Jack Group of the Late Permian strata and include the Hoskissons and Melvilles seams. Above the Hoskissons seam are several smaller seams, which in ascending order are defined as the Caroona, Clift, Springfield and Doona seams. These seams commonly have high ash concentrations and are not economically viable for extraction.




WATERMARK COAL PROJECT
Exploration Activities
FIGURE 6
N
BREEZA
Kamilaroi Highway
Wernis Creek - Moree Rail Line
The Dip Road
Native Dog Gully
Mooki River
Cliff Road
Lake Road
Breeza State Forest
Goran
Legend
EL 7223
Disturbance Boundary (Indicative)
Project Boundary
Ground Magnetic Survey Lines
Seismic Reflection Lines
Electrical Resistivity Survey Lines
DPI Hole
Stage 1 Hole
Stage 2 Hole
Stage 3 Hole
Stage 3A Hole
Stage 4 Hole
LOX Hole
Narrabri Formation
Weathered Permian
Gunnedah Formation
DATUM: GDA 94
Zone : 56
0
2km
Horizontal Scale
087291E
N 6 540 000
N 6 535 000
E 260 000
E 255 000
E 250 000
E 245 000
E 240 000
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Watermark Figure (A4) Landsacpe (25092012)

WATERMARK COAL PROJECT

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Indicative Stratigraphic Column

FIGURE 7

The Hoskissons seam is approximately 4 m to 5 m thick and splits into an upper and lower seam as it traverses the Project Boundary. Within the central portion of the Project Boundary, the Watermark Anticline has resulted in erosion and removal of both the Hoskissons and Melvilles seams. Accordingly, this has been selected as the proposed location for the Mine Infrastructure Area (MIA). Throughout the remainder of the Project Boundary, the Melvilles seam is relatively uniform in thickness (approximately 3 m) and composition.

Drilling has revealed evidence of faulting across the Project Boundary, such as truncation of seams, fault gouge structures, slickensides, polished surfaces and other abundant defects. The Permian rocks found in the northern and eastern corners of the Project Boundary have dips between 1 degree and 2 degrees. Between Mt Watermark and west of the Breeza State Forest, local folding has increased the dip of the strata to 10 degrees.

2.5.3 Resource and Reserve Utilisation

Exploration drilling, feasibility studies and geological modelling from the Stage 3A exploration program within EL 7223 indicate that there is an estimated in situ coal tonnage of approximately 1.8 bt within the late Permian Black Jack Group (including estimated insitu coal under the black soil plains). From this in situ coal tonnage, a Measured and Indicated JORC resource of approximately 283 Mt is viable for extraction using open cut mining methods.

A total of approximately 268 Mt of ROM reserves were identified across the three proposed open cut mining areas. The total is made of:

- 154.7 Mt from the Eastern Mining Area;
- 48.9 Mt from the Southern Mining Area; and.
- 64.8 Mt from the Western Mining Area.

This will result in the production of a primary PCI or semi-soft coking coal product with low ash content (10%) and a secondary thermal coal product with high ash content (18%).

2.6 Environmental Management

2.6.1 Environmental Monitoring Program

Since 2009, Shenhua Watermark has operated an Environmental Monitoring Program (EMP) for the purposes of obtaining relevant background monitoring data. The environmental monitoring network comprises of:

- Two meteorological monitoring stations;
- 17 air quality monitoring stations;
  - 13 dust deposition gauges;
  - Four High Volume Air Samplers (HVAS) (including provisions for Particulate matter less than 10 μm (PM_{10}), Particulate matter less than 2.5 μm ($PM_{2.5}$) and Total Suspended Particulate (TSP) measurements);
- Five noise monitoring stations;
- 13 surface water monitoring stations; and
- 103 groundwater monitoring stations.

The EMP is described further in **Table 5**, and illustrated in **Figure 8**.

Collection of baseline data as part of the EMP has informed the impact assessments and predictive models completed as part of this EIS. The summary results of the EMP are discussed further in **Section 7** under the background chapter for each relevant discipline (i.e. Groundwater – **Section 7.1.1**, Air Quality – **Section 7.6.1** etc).



Table 5 Environmental Monitoring Program

Aspect	Mechanism	Monitoring Location	Data Availability	Parameters Monitored
Meteorology	Meteorological stations	WS1, EL 7223	January 2010 - ongoing	Rainfall, temperature, relative humidity, solar radiation, wind speed and wind direction
		WS2, EL 7223	July 2010 - ongoing	
Air Quality	Depositional dust gauges	DM1, EL 7223	November 2010 - ongoing	Depositional dust (g/m^2/month)
		DM2, EL 7223	November 2010 - ongoing	
		DM3, EL 7223	November 2010 - ongoing	
		DM4, EL 7223	November 2010 - ongoing	
		DM5, EL 7223	November 2010 - ongoing	
		DM6, EL 7223	November 2010 - ongoing	
		DM7, EL 7223	November 2010 - ongoing	
		DM8, EL 7223	November 2010 - ongoing	
		DM9, EL 7223	November 2010 - ongoing	
		DM10, EL 7223	November 2010 - ongoing	
		DM11, EL 7223	October 2010 - ongoing	
		DM12, Breeza	October 2010 - ongoing	
		DM13, Gunnedah Pool	November 2010 - ongoing	
	HVAS	HV1, EL 7223	March 2010 - ongoing	TSP
		HV2, EL 7223	July 2010 - ongoing	PM_{10} ($\mu g/m^3$)
		HV3, Breeza	July 2010 - ongoing	PM_{10} and $PM_{2.5}$ ($\mu g/m^3$)
		HV4, Gunnedah Service Club	July 2010 - ongoing	PM_{10} ($\mu g/m^3$)
Noise	Unattended noise loggers and attended noise monitoring surveys	NM1, EL 7223	July - December 2010	$LA_{eq(period)}$, LA_{min}, LA_{max}, $LA_{10(period)}$, $LA_{90(period)}$
		NM2, Boori Road	July - December 2010	
		NM3, EL7223	July - December 2010	
		NM4, Breeza	July - December 2010	
		NM5, EL 7223	July - December 2010	
Surface Water	Sample collection	SWM1, Mooki River	October 2009 - ongoing	Range of water quality parameters including Electrical Conductivity, pH, Total Dissolved Solids and Total Suspended Solids
		SWM2, Mooki River	October 2009 - ongoing	
		SWM3, Currabubula Creek	October 2009 - ongoing	
		SWM4, Mooki River	October 2009 - ongoing	
		SWM5, Native Dog Gully	October 2009 – October 2010	
		SWM6, Native Dog Gully	October 2009 - ongoing	
		SWM11, Mooki River	February 2010 - ongoing	
		SWM12, Mooki River	February 2010 - ongoing	
		SWM13, Quirindi Creek	February 2010 - ongoing	
		SWM14, Intersection of the Mooki River and Carroll-Breeza Road	March 2010 - ongoing	
		SWM15, Native Dog Gully	March 2010 - ongoing	
		SWM16, The Dip Road	July 2010 - ongoing	
		SWM17, Watermark Gully	July 2010 - ongoing	
Groundwater	Sample collection and vibrating wire piezometers	103 groundwater bores	August 2009 – ongoing (progressively installed)	Water quality (including Electrical Conductivity, pH, Total Dissolved Solids and Total Suspended Solids), depth and level

$LA_{eq(period)}$ – Equivalent sound pressure level: the steady sound level that, over a specified period of time, will produce the same energy equivalence as the fluctuating sound level actually occurring
LA_{min} – The minimum sound level recorded during the measurement period
LA_{max} – The maximum sound level recorded during the measurement period
$LA_{10(period)}$ – The sound pressure level exceeded for 10% of the measurement period
$LA_{90(period)}$ – The sound pressure level exceeded for 90% of the measurement period


WATERMARK COAL PROJECT
Environmental Monitoring Program
FIGURE 8
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Legend
EL 7223
Disturbance Boundary (Indicative)
Project Boundary
Depositional Dust Monitoring Location
Farm Dam Monitoring Location
High Volume Air Sampler Monitoring Location
Noise Monitoring Location
Surface Water Monitoring Location
Weather Station Monitoring Location
Groundwater Monitoring Location
Wemis Creek - Moree Rail Line
Kamilaroi Highway
The Dip Road
Cliff Road
Nea Siding Road
Lake Goran
Breeza State Forest
BREEZA
DATUM: GDA 94
Zone : 56
Horizontal Scale
0
2km
08730D

WATERMARK
COAL PROJECT
ENVIRONMENTAL IMPACT STATEMENT

February 2013



3
The Project



The Project 3

This section provides a detailed description of the Project including the conceptual mine plan, infrastructure, equipment, personnel requirements, waste and water management and the proposed construction program. It also includes a detailed account of alternatives considered during the development of the Project.

3.1 Introduction

Shenhua Watermark is seeking State Significant Development Consent under Division 4.1 of Part 4 of the EP&A Act for the development and operation of an open cut coal mine for a period of 30 years within the Project Boundary as shown on Figure 9 on the land listed in Appendix A.

The Project involves:

- The development of an open cut mining operation extracting up to 10 Mtpa of ROM coal from the Hoskissons and Melvilles seams over a period of 30 years;
- Utilising a standard mining equipment fleet of excavators and shovels, supported by haul trucks, dozers, graders, drill rigs and water carts;
- Progressive rehabilitation of all disturbed areas;
- The co-disposal of tailings and coarse reject within the Overburden Emplacement Areas (OEA);
- The construction and operation of a Mine Access Road;
- The construction and operation of administration, workshop and related facilities;
- The construction and operation of a Coal Handling and Preparation Plant (CHPP) with a throughput of 10 Mtpa of ROM coal;
- The construction and operation of a rail spur, rail loop, Kamilaroi Highway rail overpass, associated train load out facility and connection to the Werris Creek to Moree Railway Line;
- Transportation of product coal by rail via the Werris Creek to Moree Railway Line and the Main Northern Railway Line to the Port of Newcastle for export;
- The construction and operation of surface and groundwater management and reticulation infrastructure including pipelines, pumping stations/bore field and associated infrastructure for access to water from the groundwater aquifers in the vicinity of the Project, the Mooki River and private dams to the north-east of the Project Boundary;
- The closure of Court Lane, Rowarth Road, Whitby Road, part of The Dip Road (from the intersection of Clift Road to Nea Siding Road) and other unnamed paper roads within the Project Boundary;
- The installation of communications and electricity infrastructure; and
- A workforce of approximately 600 full-time equivalent employees during construction and up to approximately 600 full-time equivalent employees and associated contractors during operation of the Project at full production.

The Project will require 4,084 ha of land disturbance (Disturbance Area) which will generally be undertaken within the Disturbance Boundary as illustrated in Figure 9. Some of the infrastructure such as water, power and communications infrastructure will be located outside the Disturbance Boundary (and quite possibly the Project Boundary). Minor additional disturbance associated with ancillary works including fencing, firebreaks, water diversion structures, pipelines, a bore field, minor contour banks, access tracks, explosives storage facilities, power lines, sediment and erosion control structures will also be required and are part of the Project for which consent is sought.





WATERMARK COAL PROJECT

Project Layout

FIGURE 9

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3.2 Conceptual Mine Plan

3.2.1 Mine Layout

The Project seeks to recover approximately 268 Mt of ROM coal within the 30 year mining limit to produce approximately 159 Mt of product coal (see Figure 9). The Project will extract the open cut coal reserve from the Hoskissons and Melvilles seams. Up to 1,629 Million bank cubic metres (Mbcm) of overburden material will be moved and approximately 108 Mt of coal reject and tailings will be produced during processing of ROM coal during the life of the Project.

Figure 10 to Figure 17 illustrate the conceptual mine plan layouts for phases occurring indicatively in Years 1, 2, 5, 10, 15, 21, 25 and 30 respectively. The staged mine plans provided are indicative only and have been included for modelling purposes and may vary due to the ultimate production levels achieved in the period in question. These stages of the mine plan have been selected for modelling as they represent a combination of mining at the extremities of the Project mine life and the greatest intensities of mining.

Mining operations will commence with an initial box cut in the north-west of the Eastern Mining Area. Overburden will be removed by excavators / shovels and haul trucks. Coal seams will be uncovered and are planned to be selectively mined using excavators and front end loaders and haul trucks.

Overburden from the Eastern Mining Area will be initially placed to the south-west and immediate north and east and rehabilitated so as to visually shield the mining operation from the Kamilaroi Highway. Mining will continue down-dip of the coal seams towards the eastern extent of the Project Boundary until Year 12. The active mining area will then shift to the southern side of the Eastern Mining Area and commence in a reverse direction, up-dip back towards the initial box cut. Overburden will then be progressively placed and rehabilitated behind the active mining area, up to RL 380 m. By Year 17, active mining will be completed in the Eastern Mining Area.

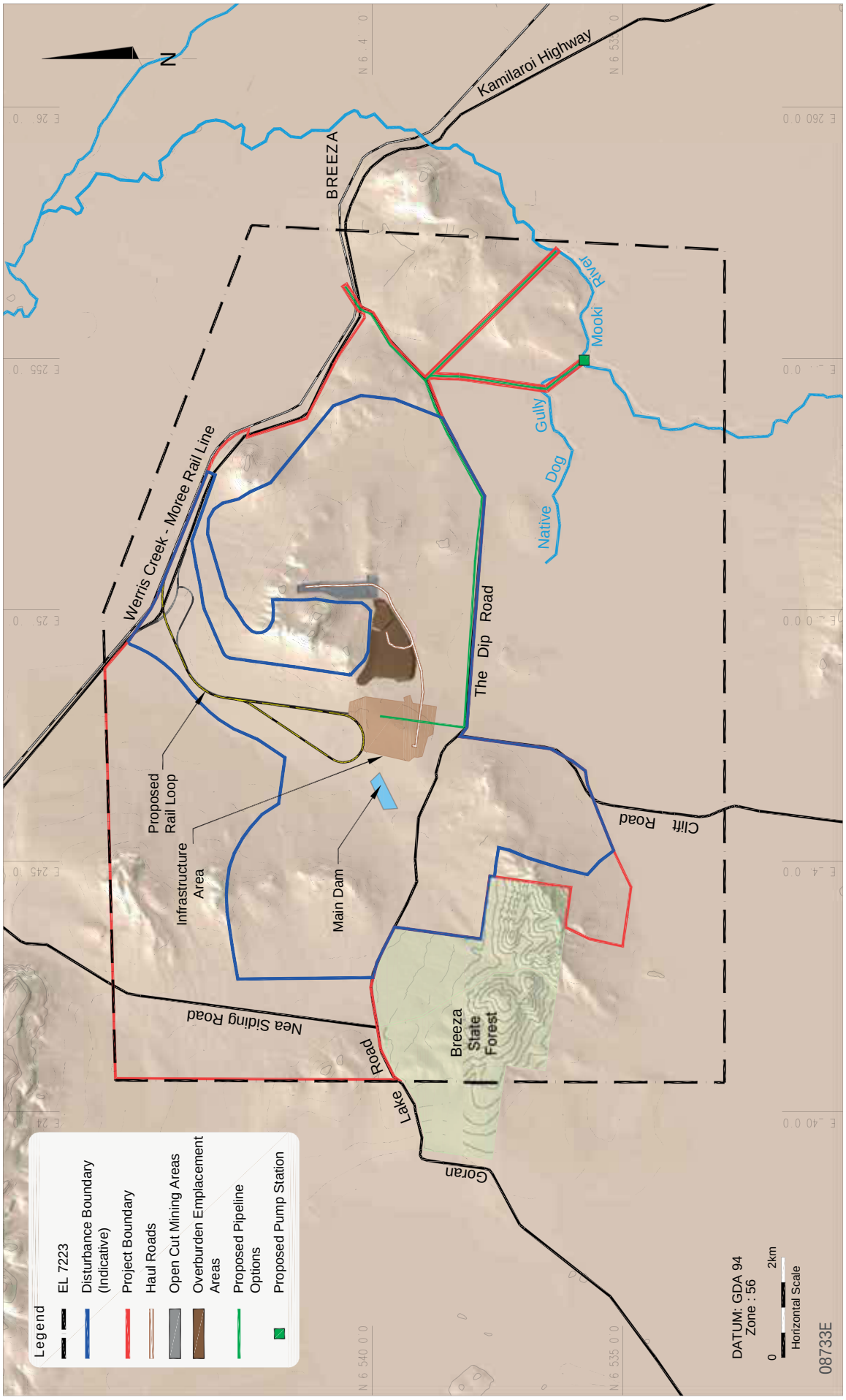
In Year 17, mining operations will commence in the northern end of the Southern Mining Area, progressing to the south-west. Overburden from the Southern Mining Area will initially be utilised to backfill the Eastern Mining Area void. By approximately Year 21, the Eastern Mining Area will be completely backfilled and rehabilitated up to RL 380 m. Overburden from the Southern Mining Area will then be placed behind active mining so as to develop a second OEA. By Year 24, active mining will be completed in the Southern Mining Area.

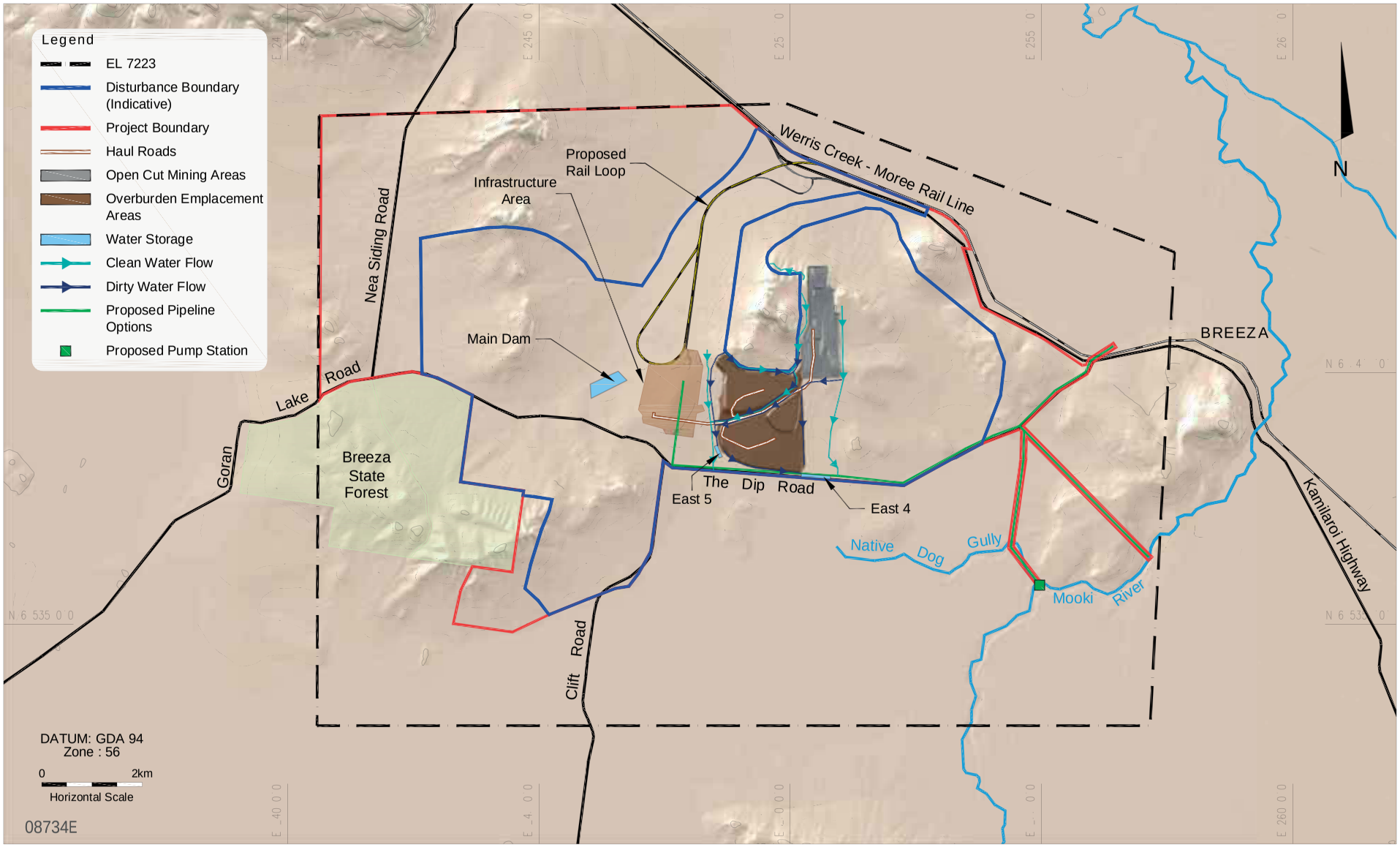
By approximately Year 24, mining operations will commence in the eastern edge of the Western Mining Area. All overburden from this area will initially be utilised to backfill the Southern Mining Area void. By Year 26, the Southern Mining Area is expected to be completely backfilled and rehabilitated up to RL 330 m. Overburden from the Western Mining Area will then be placed behind active mining so as to develop a third OEA. By Year 30, active mining in this area is completed leaving a final void in the Western Mining Area. The mine plan was specifically redesigned so that the final void will be located in the north-west of the Project Boundary remote from the blacksoil plains.

There are deeper coal resources present beyond the 30 year mining limit. Shenhua Watermark may, depending upon market factors and resource confirmation, seek further relevant approvals for the extraction of these. In this instance the Western Mining Area final void will be ideally placed for underground access to this coal resource.

A conceptual final landform design has been developed in the event that an approval for the continuation of mining beyond the 30 year mine plan is not sought or granted. This has been prepared to confirm that should mining operations not continue beyond the 30 year mine plan, that the orderly closure of the mine at that time could be achieved.



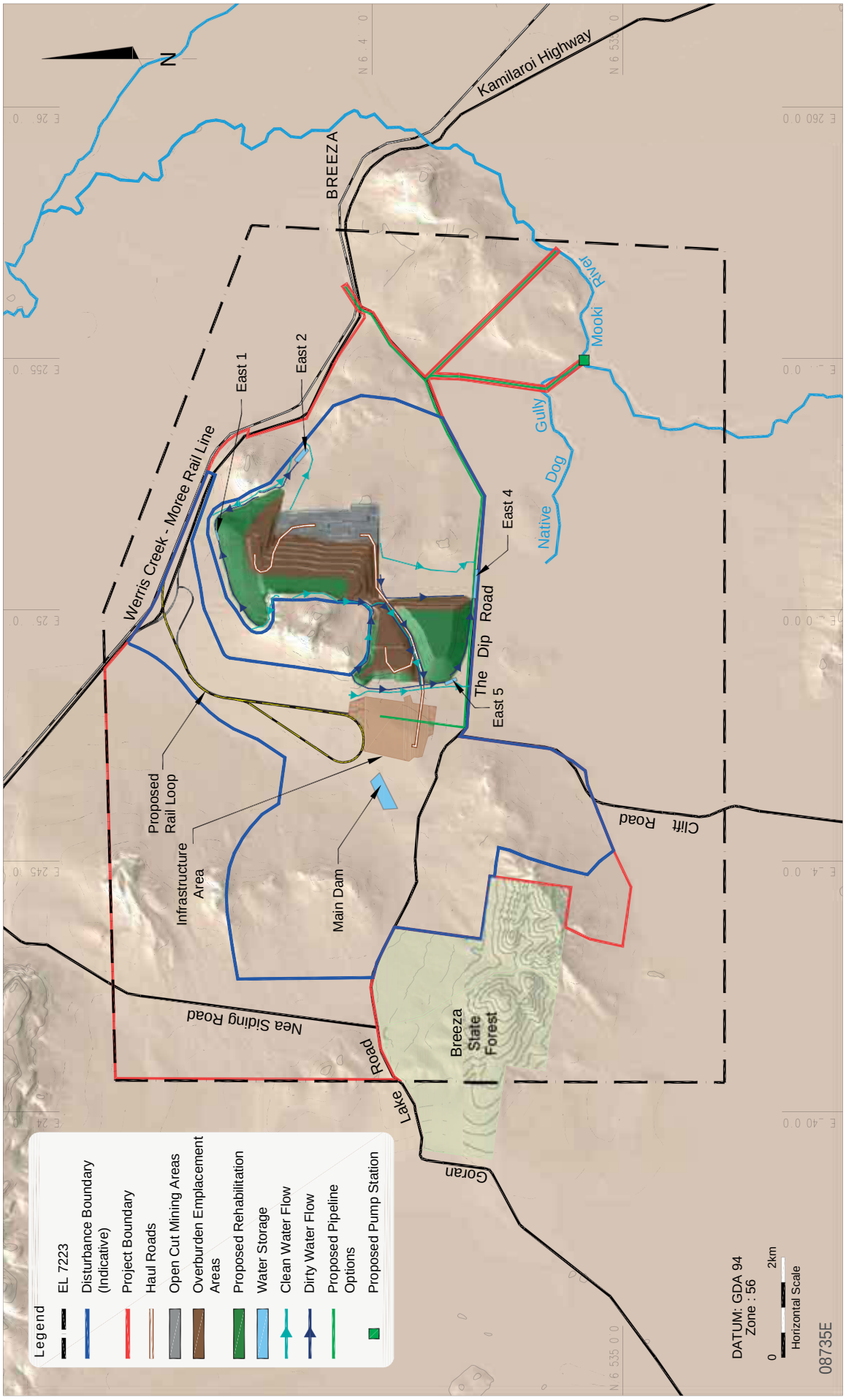

WATERMARK COAL PROJECT
Conceptual Mine Plan Year 1
FIGURE 10
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N
Kamilaroi Highway
BREEZA
Werris Creek - Moree Rail Line
Mooki River
Gully
Native Dog
The Dip Road
Proposed Rail Loop
Infrastructure Area
Main Dam
Cliff Road
Nea Siding Road
Breeza State Forest
Lake Road
Goran
Legend
EL 7223
Disturbance Boundary (Indicative)
Project Boundary
Haul Roads
Open Cut Mining Areas
Overburden Emplacement Areas
Proposed Pipeline Options
Proposed Pump Station
DATUM: GDA 94
Zone : 56
0
2km
Horizontal Scale
08733E



WATERMARK COAL PROJECT

Conceptual Mine Plan Year 2

FIGURE 11

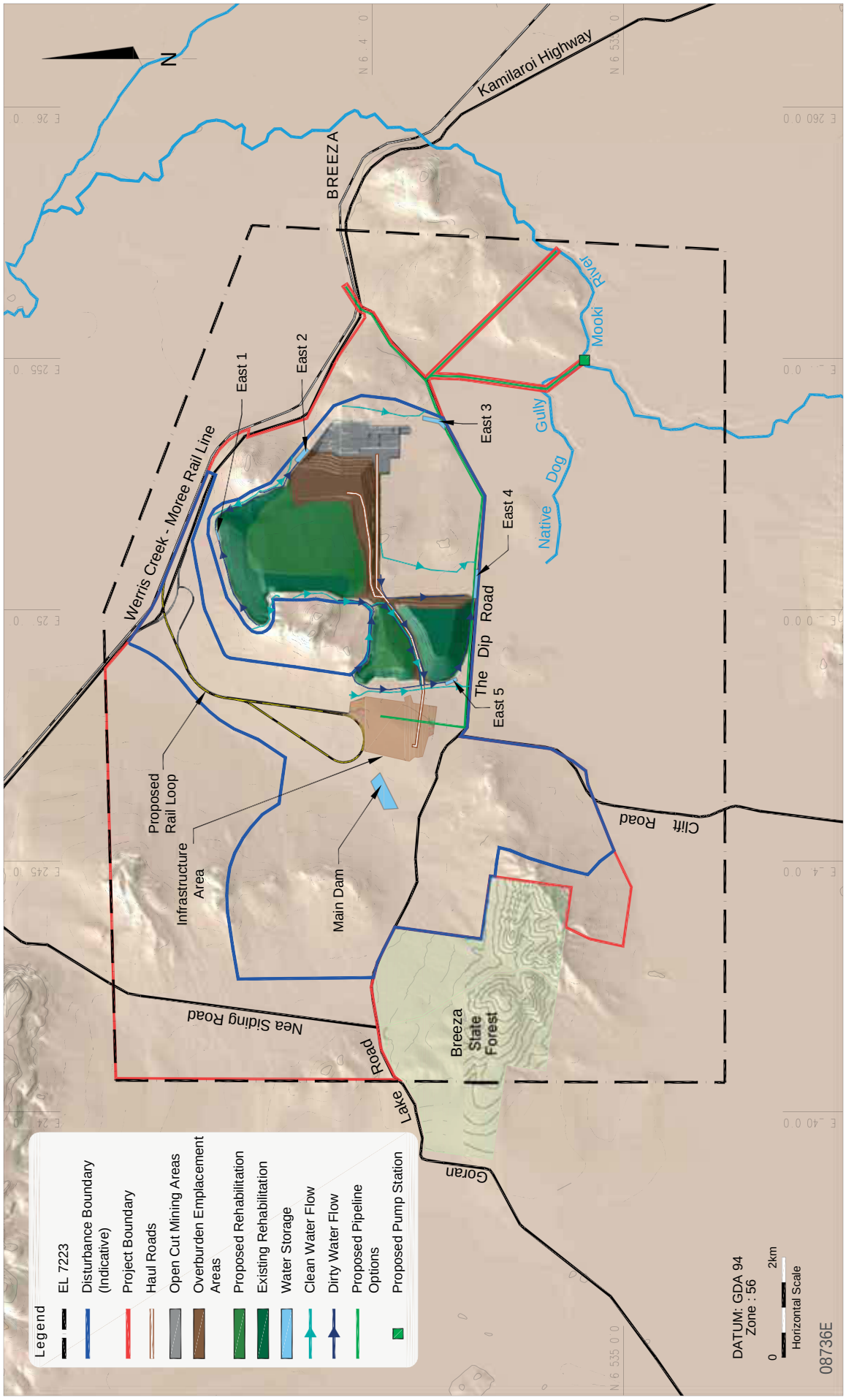


WATERMARK COAL PROJECT

Conceptual Mine Plan Year 5

FIGURE 12

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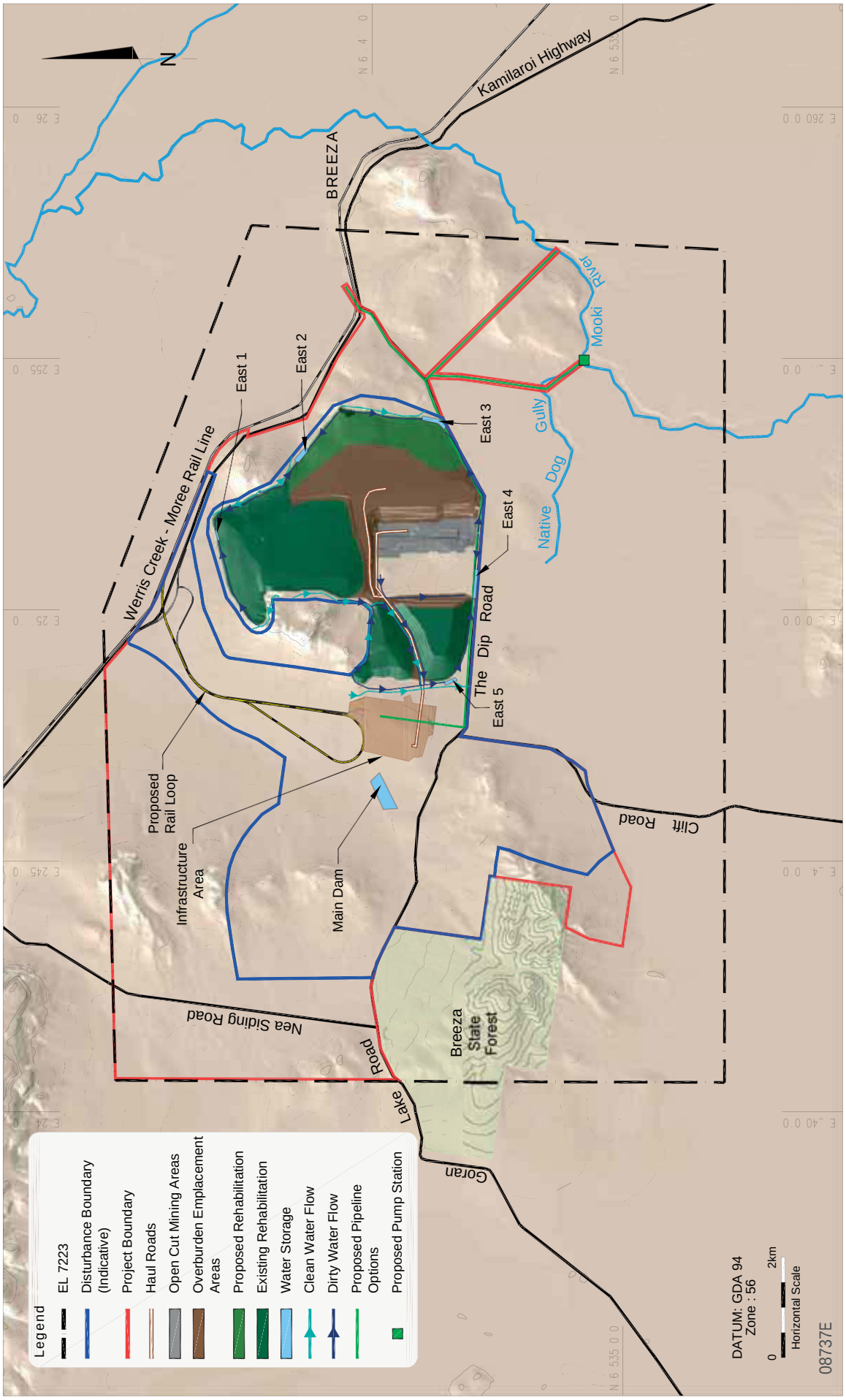


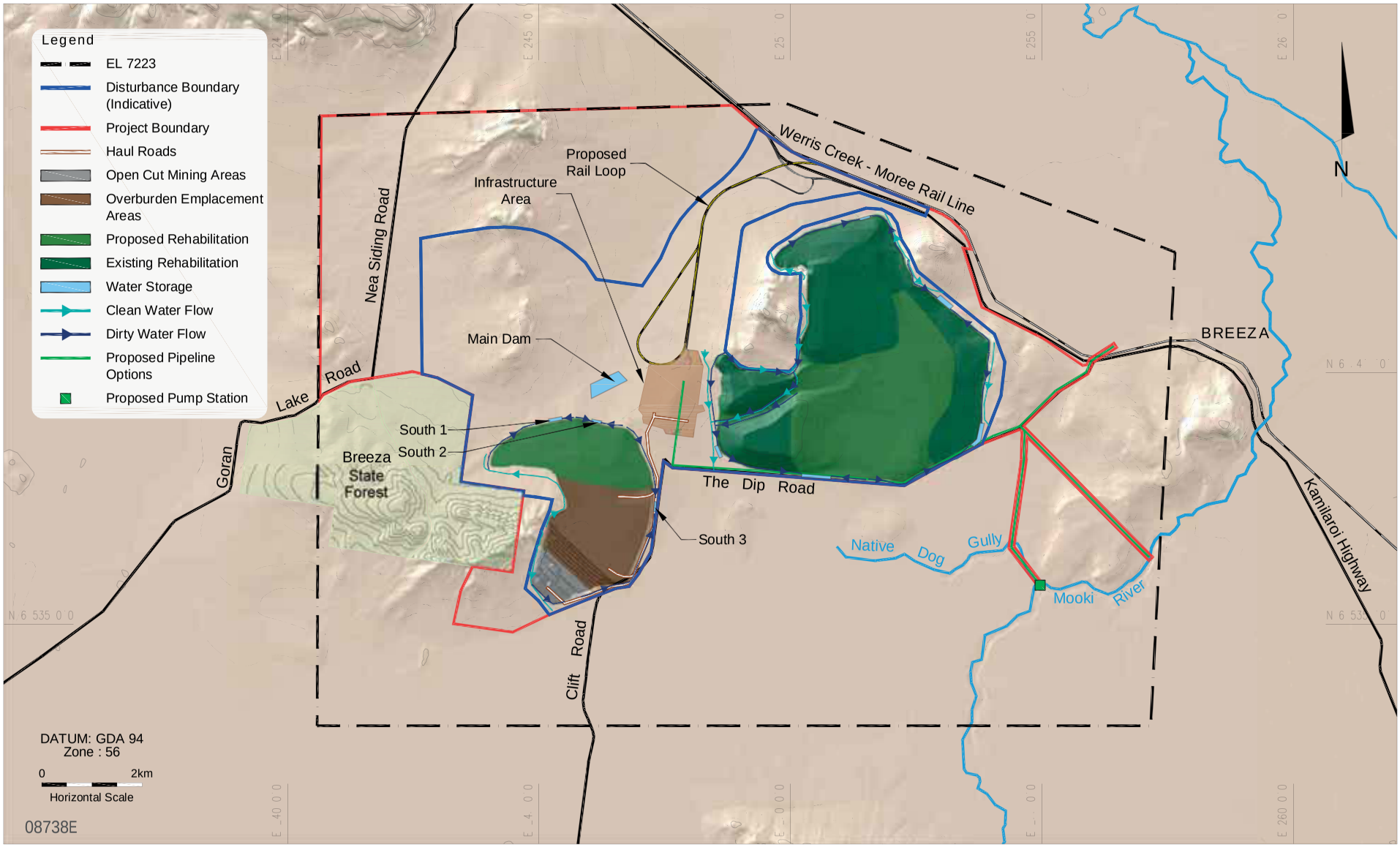
WATERMARK COAL PROJECT

Conceptual Mine Plan Year 10

FIGURE 13

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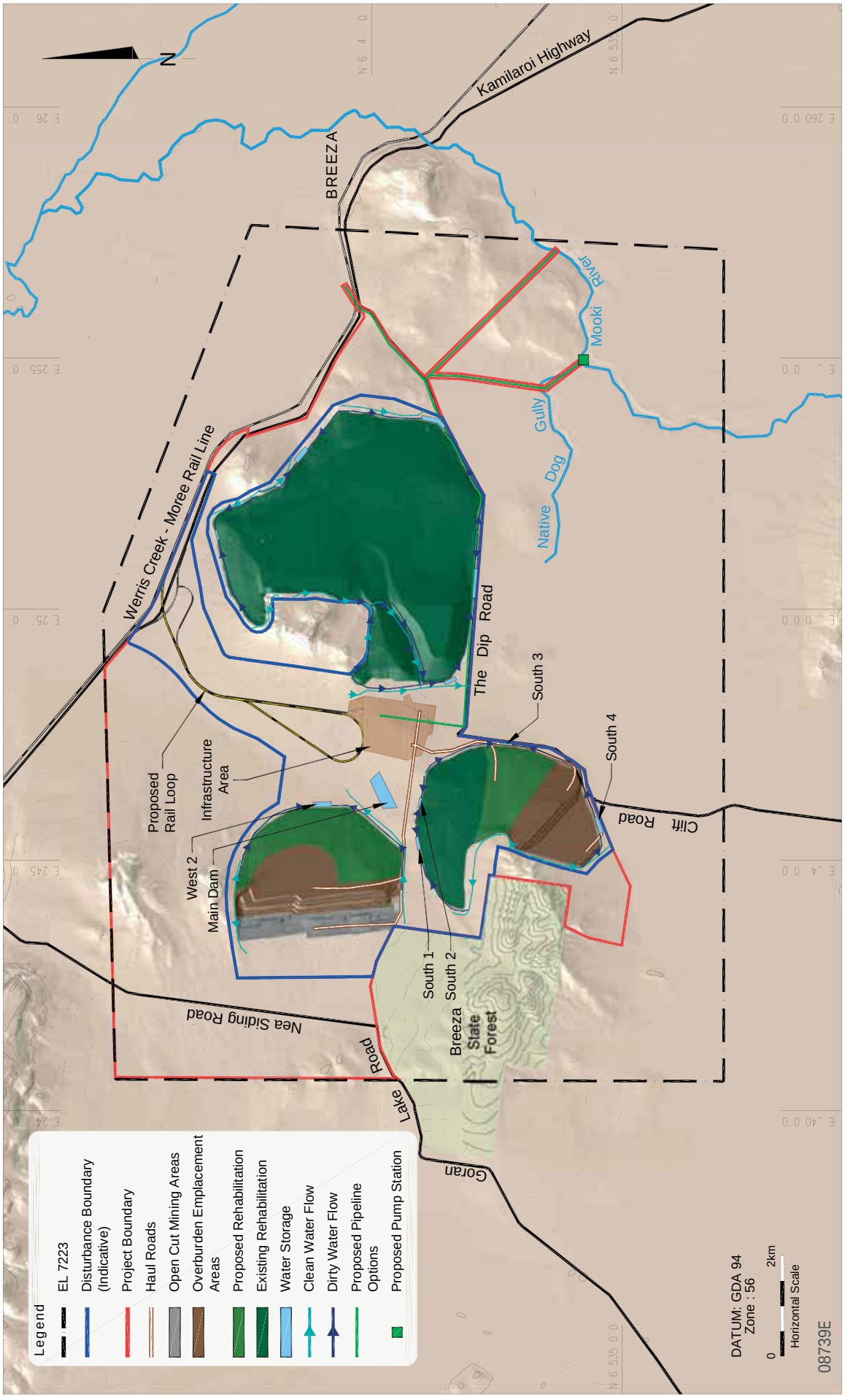

WATERMARK COAL PROJECT
Conceptual Mine Plan Year 15
FIGURE 14
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N
Kamilaroi Highway
BREEZA
Werris Creek - Moree Rail Line
East 1
East 2
East 3
East 4
East 5
The Dip Road
Gully
Native Dog
Mooki River
Proposed Rail Loop
Infrastructure Area
Main Dam
Clift Road
Nea Siding Road
Lake Road
Breeza State Forest
Goran
Legend
EL 7223
Disturbance Boundary (Indicative)
Project Boundary
Haul Roads
Open Cut Mining Areas
Overburden Emplacement Areas
Proposed Rehabilitation
Existing Rehabilitation
Water Storage
Clean Water Flow
Dirty Water Flow
Proposed Pipeline Options
Proposed Pump Station
DATUM: GDA 94
Zone : 56
0
2km
Horizontal Scale
08737E



WATERMARK COAL PROJECT

Conceptual Mine Plan Year 21

FIGURE 15

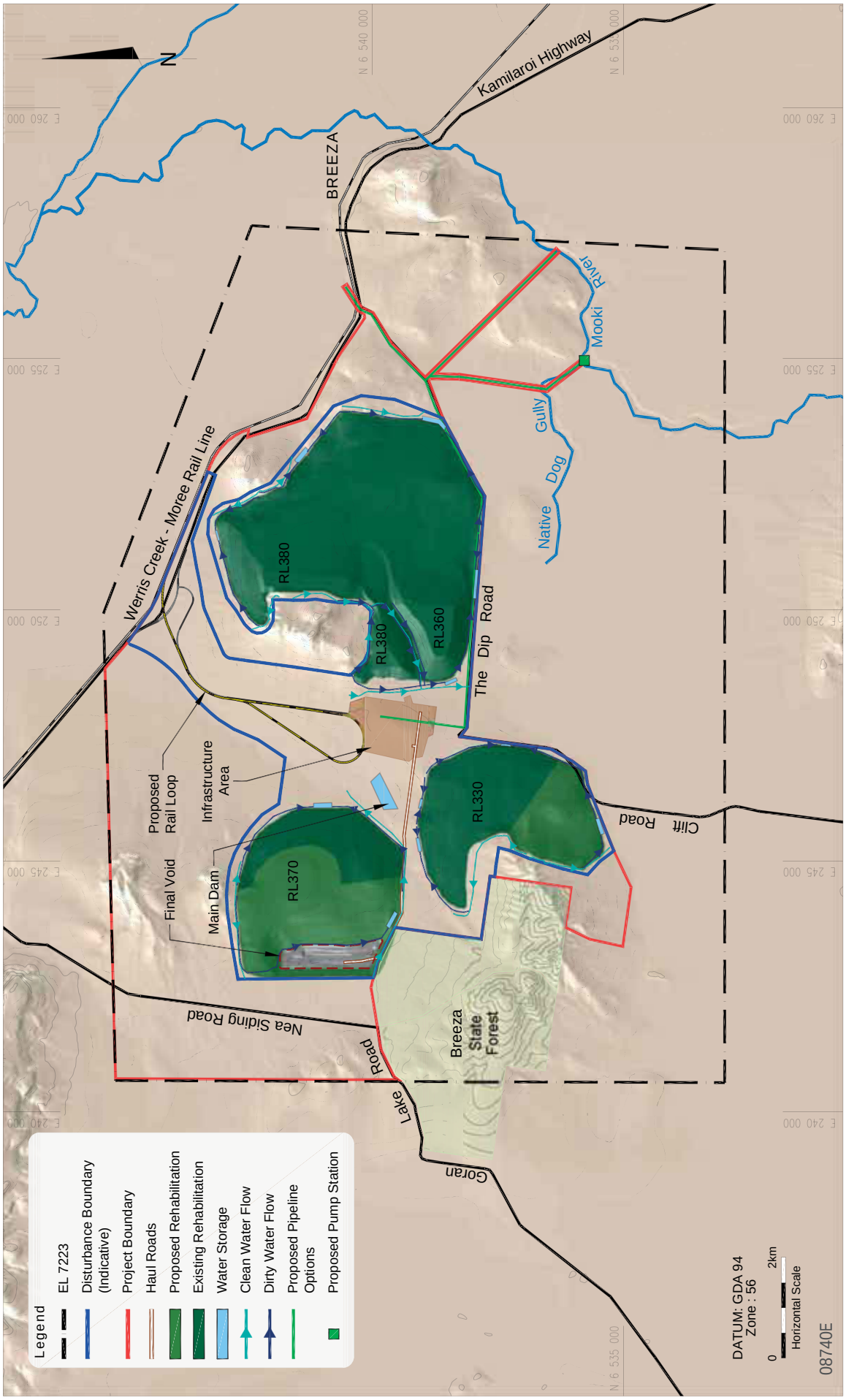


WATERMARK COAL PROJECT

Conceptual Mine Plan Year 25

FIGURE 16

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WATERMARK COAL PROJECT

Conceptual Mine Plan Year 30

FIGURE 17

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The conceptual final landform for the Project has been developed in consideration of neighbouring land uses. A discussion on the conceptual post-mining land use and management of the final landform is provided in Section 7.21. The conceptual final landform design indicates the presence of a final void in the Western Mining Area. The OEA has been shaped down towards the base of this void area to an acceptable slope as practical for drainage purposes and will ultimately exhibit a lake surface.

The final landform will minimise the surface catchment of the final void as far as practical, utilising diversion drains and contour banks to divert surface water runoff away from the lower lying void area. Further refinement to the conceptual final landform may occur during the preparation of the Mining Operations Plan (MOP) for the Project. Should further approvals for the continuation of mining be granted, the landform conceptually illustrated within this EIS will not be required.

3.2.2 Mining and Rehabilitation Method

An indicative ROM coal production schedule for the conceptual staged years of the Project is provided in Table 6. However, this application seeks consent for extraction of up to 10 Mtpa ROM coal in any year of the Project.

The Project will utilise a contemporary shovel and excavator operation supported by a fleet of trucks. Typical of standard shovel and excavator mining methods, topsoil will be initially stripped from the mining area by scrapers and either utilised on available rehabilitation areas and/or stockpiled for later use.

Overburden will then be blasted prior to being removed by shovel and/or excavator and trucks before proceeding with coal extraction. The fleet will then progress through the sequence to uncover each coal seam to be extracted. Various minor infrastructure supporting day to day activities will be constructed within the Disturbance Boundary as required. This is likely to include: topsoil stockpiles, erosion and sediment control structures, power supply sub-lines and substations, water reticulation systems, in-pit fuelling areas, truck parking areas, crib facilities, access tracks and storage areas.

Placement and shaping of overburden to create slopes with gradients up to approximately 10 degrees will be undertaken in a manner which, wherever practicable, will allow competent material to be placed below the subsoil and topsoil layers ensuring that the exposure of large rocks on the final surface will be avoided. Any coarse rejects or tailings placed as backfill in the mining areas will be covered with at least 3 m of overburden material.

Rehabilitation activities for the Project will be undertaken progressively and as early as practicable to ensure that the total area of disturbance at any one time is minimised. This will be conducted in conjunction with the open cut mining process. The general progression of rehabilitation over the life of the Project is shown in the conceptual mine plans in Figure 10 to Figure 17.

Prior to the re-establishment of vegetation cover, temporary control measures will be utilised for erosion and sediment control. These measures may include sediment fences, sand bag sediment traps and rip rap scour protection (see Section 7.21.3). Consideration will be given to erosion and sedimentation control measures during the construction and operational phases such as restricting access or modifying activities during wet weather, establishing exclusion zones around areas undergoing rehabilitation, reporting erosion and sediment hazards and regular inspections and maintenance of structures.

3.2.3 Blasting

The hard rock overburden materials in the mining sequence typically require some blasting to achieve suitable fracturing and fragmentation to enable efficient and safe removal of these materials. Exploration drilling has confirmed that the burden materials generally consist of conglomerate, sandstone, claystone and siltstone.

Mine planning has predicted approximately 240 blast events per year, or up to an average of five blast events per week, will be required once mining rates reach steady state. Blasting will only be undertaken during the hours 9:00 am to 5:00 pm Monday to Saturday, excluding Sundays and public holidays unless prior approval from the Office of Environment and Heritage (OEH) is given.

Table 6 Indicative Production Schedule

Year	Overburden (Mbcm)	ROM Coal (Mt)*	Product Coal (Mt)	Coarse Reject (Mt)	Tailings (Mt)	Rehabilitation (ha)
1	9.70	0.1	0.05	0.04	0.01	0
2	27.34	2.7	1.6	0.94	0.39	10
5	43.36	10.0	6.3	3.06	1.44	159
10	68.24	10.0	6.0	3.23	1.44	167
15	67.98	9.8	5.3	2.97	1.44	202
21	68.21	9.9	5.6	3.60	1.44	670
25	63.52	10.0	5.6	3.25	1.44	1,136
30	6.90	1.9	1.1	0.65	0.27	815
Total	1,629	268.3	159.4	70.12	38.67	3,348

** Minor discrepancies due to rounding*

The Project will require the storage of explosives and other related materials. These storage facilities will be designed and sited within the Disturbance Boundary in accordance with the relevant standards and guidelines (AS2187.2-2006 – Explosives – Storage, Transport and Use. Part 2: Use of Explosives).

Any public roads that are within 500 m of blasting activities carried out as part of the Project will be temporarily closed. Blasting activities will generally occur over an approximate 15 to 20 minute period.

3.3 Indicative Mobile Equipment Fleet

Table 7 lists the indicative mobile equipment fleet utilised for modelling purposes for the conceptual staged years of the Project. Actual equipment utilised for the Project may vary from those stipulated in Table 7, however operations will be undertaken to ensure that air quality and noise levels meet the predictions within this EIS irrespective of the equipment fleet used. Water carts will be preferentially serviced during wet weather to ensure their full availability when needed. Further to these items of plant, there will be other ancillary equipment required for the Project including (but not limited to) lighting plants, generators, water pumps, light vehicles, self bunded fuel tanks / facilities, service trucks, mobile cranes, elevated platforms and fuel and oil trucks.

3.4 Coal Handling and Preparation Facilities

The Project involves the construction and operation of a CHPP and associated facilities to enable the handling and processing of up to 10 Mtpa ROM coal during the 30 year mine life.

Figure 18 provides a schematic illustrating the coal handling and preparation process for the Project. The indicative layout of the CHPP and other associated facilities is illustrated on Figure 19. The orientation of the CHPP and other associated facilities within the Disturbance Boundary may vary depending on detailed engineering design.

An indicative detailed design as required under Schedule 1 of the EP&A Regulation is provided in Appendix B which will be revised and finalised upon seeking relevant additional approvals.

Relevant components of the CHPP are described further below.

3.4.1 ROM Coal Handling

ROM coal will be unloaded from rear dump trucks (either directly from the mining area or from temporary ROM coal stockpiles) into the ROM coal hopper, where it will be fed at a controlled rate into a preliminary crushing station that will reduce the size of the ROM coal to 300 mm.

The coal will then be conveyed either directly to the ROM coal surge bin or alternatively to the ROM coal stockpile (100,000 tonnes (t)) for later reclaim and processing. A stacker reclaimer or single tunnel reclaim conveyor and associated vibrating feeders will transport coal from the ROM stockpile to enable blending.

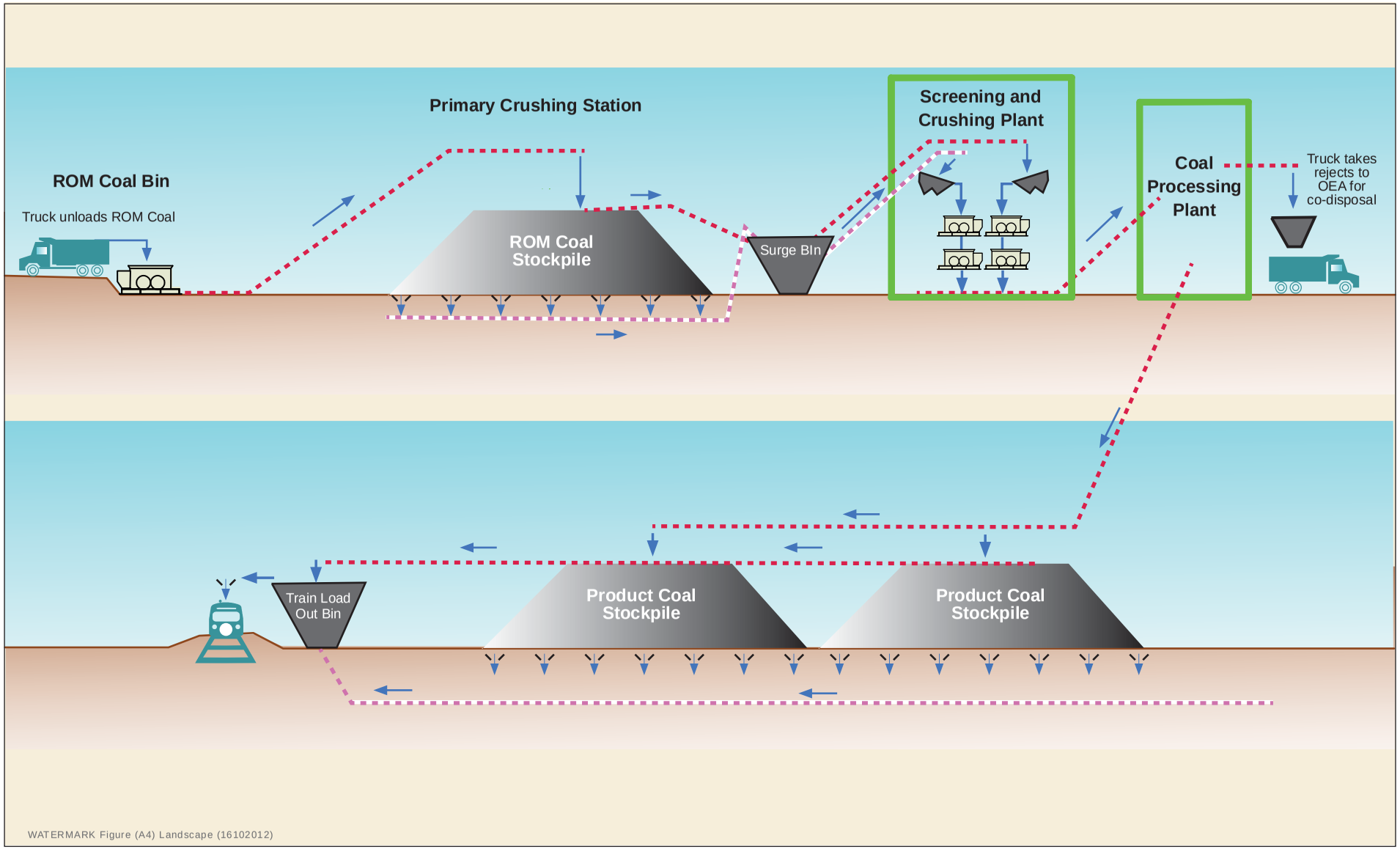
The conveyors from the ROM coal surge bin and ROM coal stockpile both then feed the screening and crushing plant at a controlled rate of up to 1,450 tonnes per hour (tph).

The screening and crushing plant consists of two stages; the secondary sizing station and tertiary sizing station. The ROM coal will be fed through to the secondary sizing station where it will be reduced from 300 mm to 150 mm in size. The ROM coal will then be conveyed to the tertiary sizing station where it will be further reduced to 50 mm in size. The 50 mm ROM coal is then conveyed to the CHPP at a controlled rate of 1,450 tph.

Table 7 Indicative Mobile Equipment List

Equipment Type	Year 1	Year 2	Year 5	Year 10	Year 15	Year 21	Year 25	Year 30
Rope Shovel (P&H 4100 or equivalent)	0	0	1	1	2	2	2	0
Rope Shovel (P&H 2800 or equivalent)	1	1	1	2	2	2	2	1
Hydraulic Excavator (Terex RH 340 or equivalent)	0	2	2	2	2	2	2	0
Hydraulic Excavator (Terex RH 200 or equivalent)	1	1	1	1	1	1	1	0
Front End Loaders	1	2	3	3	4	4	4	2
226 t Haul Trucks	10	16	20	23	34	52	50	6
136 t Haul Trucks	3	5	16	15	16	17	17	5
Dozers	5	5	7	6	8	8	6	6
Graders	3	3	3	3	3	3	3	3
Scrapers	2	2	2	2	2	2	2	2
Water Carts	3	3	3	3	3	3	3	3
Drills	2	2	5	5	6	6	5	5

Note: This table represents the maximum equipment proposed for the Project. The air quality and noise modelling has included utilisation rates to account for periods when the equipment will not be operating (such as servicing etc.).



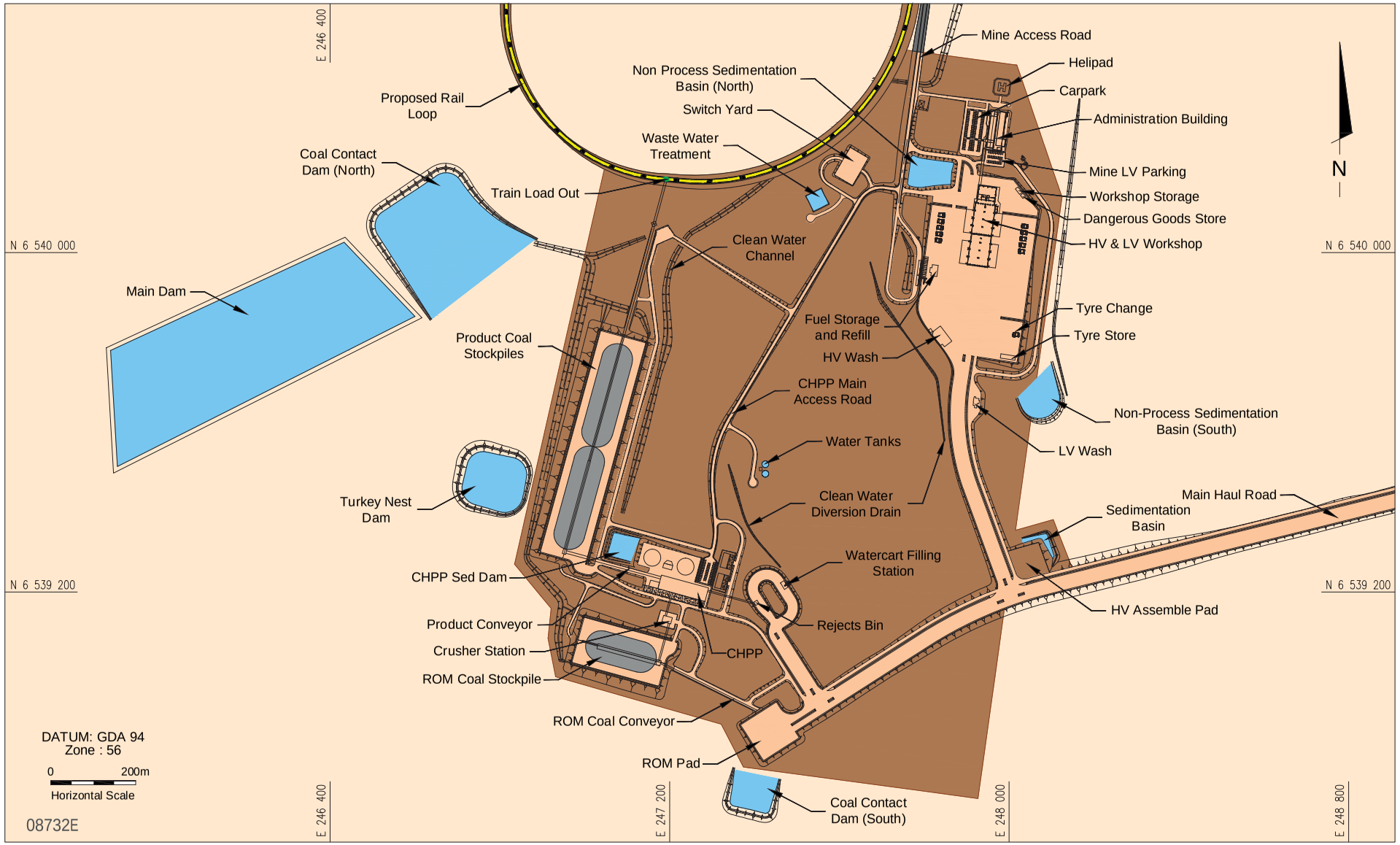
SHENHUA WATERMARK COAL PTY LIMITED
神华沃特马克煤矿有限公司

Hansen Bailey
ENVIRONMENTAL CONSULTANTS

WATERMARK COAL PROJECT

Conceptual Coal Handling Flowchart

FIGURE 18



WATERMARK COAL PROJECT

Conceptual Project Infrastructure

FIGURE 19

3.4.2 Coal Handling and Preparation Plant

The CHPP will utilise a typical Dense Medium Cyclone (DMC) / Reflux Classifier process to remove a proportion of the rock impurities from the coal to ensure that product specifications are maintained.

ROM coal will then be treated in the CHPP via a washing and sizing process, whereby coarse reject and fine tailings will be generated. A conveyor system will be constructed to direct coarse rejects and fine tailings (after dewatering through band press filters) to a rejects bin, where it will be loaded onto haul trucks for co-disposal within the OEAs.

ROM coal will be fed into the desliming screen feed box where it will be mixed with water and discharged onto a desliming screen which will contain 1.4 mm screen decks. Coal between 2 mm and 50 mm will be directed into the coarse coal cleaning circuit, whilst coal smaller than 2 mm particles will continue to the fines coal circuit.

Coarse coal will be mixed with magnetite slurry and pumped into a DMC circuit. Cleaned coal will discharge from the cyclone onto a vibrating drain and rinse screen where the adhering magnetite medium will be rinsed from the coal and returned to the DMC circuit. Rinsed clean coal will then be diverted into a centrifuge to remove the majority of the surface moisture prior to being conveyed to the product coal stockpiles. Coarse reject is then conveyed to the rejects bin, where this material will be loaded onto haul trucks for co-disposal with overburden.

Finer coal will be pumped into the bank of desliming cyclones. High ash discharges from the vortex finders of the desliming cyclones will be directed into a thickener and further mechanically dewatered to an extent that it can be conveyed into the rejects bin. This material will be loaded onto haul trucks with the coarse reject material for co-disposal within the OEAs.

Deslimed fine coal will be diverted from the desliming cyclone spigots onto a sieve bend that removes any remaining slimes prior to this fine coal discharging into a sump where it will be mixed with water and pumped to a bank of reflux classifiers. Clean coal will then discharge to a fine coal centrifuge to remove surface moisture before being combined with the coarser coal component and conveyed to the product coal stockpiles.

3.4.3 Product Coal Handling

Product coal will be conveyed to two product coal stockpiles which will both be designed to receive up to approximately 300,000 t of product coal. A stacker reclaimer or single tunnel reclaim conveyor and associated vibrating feeders will transport product coal to the train load out facility. This facility will be designed to hold up to 1,500 t of product coal and facilitate the loading of trains at a rate of up to 6,000 tph.

3.4.4 Tailings and Reject Management

The CHPP will generate coarse rock and fine tailings rejects representing the waste products of the coal preparation process. The indicative volume of coarse rejects and fine tailings to be produced by the Project is shown in Table 6.

Coarse rejects and fine tailings will be dewatered as part of the CHPP process and directed to a rejects bin via a conveyor system from the CHPP. This material will then be loaded onto haul trucks for co-disposal within the OEAs.

3.5 Rail Spur and Loop

The transport of all product coal will be by rail to the Port of Newcastle for sale to the export market. The construction of a rail loop and spur will be required to provide access to the Werris Creek to Moree Railway Line. A train load out facility will be constructed on the rail spur to facilitate the loading of product coal onto the trains.



A refuelling facility may also be placed on land within the Project Boundary adjacent to the rail loop and spur.

To ensure fugitive dust emissions are kept to a minimum during the journey to port, Shenhua Watermark will construct a water spray system that will have the ability to apply a dust suppressant to the loaded coal wagons if deemed necessary.

Figure 20 illustrates the rail loop and spur alignment for the Project. This alignment entails the construction of the rail spur travelling towards the north and meeting with the Werris Creek to Moree Railway Line, with a rail junction located to the east of the Kamilaroi Highway / Court Lane intersection. From this junction, the rail spur will pass under the Kamilaroi Highway, then turn to the south and run parallel with the contours of Mt Watermark.

The rail spur will be designed and constructed in order to meet Australian Rail Track Corporation (ARTC) track design standards. The rail spur design will enable a turnout to exit and enter the Werris Creek to Moree Railway Line at speeds of up to 80 kilometres per hour (km/hr).

Whilst train movements will vary depending on factors such as production, sales and availability in the transport chain, the Project is expected to require up to an average of eight return train movements per day, with a peak of 12 return train movements per day to transport the product coal from the site at any one time.

3.6 Site Access

The land within the Project Boundary is currently accessed predominately via The Dip Road, Court Lane and Nea-Siding Road.

Court Lane will be required for access during the initial phase of construction activities to enable equipment and materials to be delivered to the site whilst the Mine Access Road is under construction.

The Mine Access Road will be constructed to access the site from the Kamilaroi Highway (see Figure 20). The Mine Access Road has been designed to generally follow the alignment of Court Lane and to avoid the threatened flora and fauna identified within the existing road reserve of Court Lane. The Mine Access Road will be designed with a bitumen seal capable of withstanding heavy vehicles required during the construction and operation of the Project.

A rail overpass will also be constructed to allow the Kamilaroi Highway to safely cross the rail spur.

The construction of a new T intersection will be required at the intersection of the Mine Access Road and the Kamilaroi Highway. The final design of the intersection will be developed in consultation with Gunnedah Shire Council (GSC) and the NSW Transport, Roads and Maritime Services (RMS). Preliminary assessments indicate that a channelised T intersection with an indented right-turn lane for southbound traffic will be required. The right-turn lane will provide sufficient length for deceleration and queue storage. The modelling indicated that the right-turn lane will be 140 m long.

The Kamilaroi Highway is to be realigned in the vicinity of the current intersection with Court Lane. This will involve a minor (170 m) deviation of the highway to the south of the existing alignment.

Figure 20 illustrates the conceptual realignment of the Kamilaroi Highway, the alignment of the Mine Access Road, the rail spur and the location of the road-over-rail bridge.

3.6.1 Road Closures

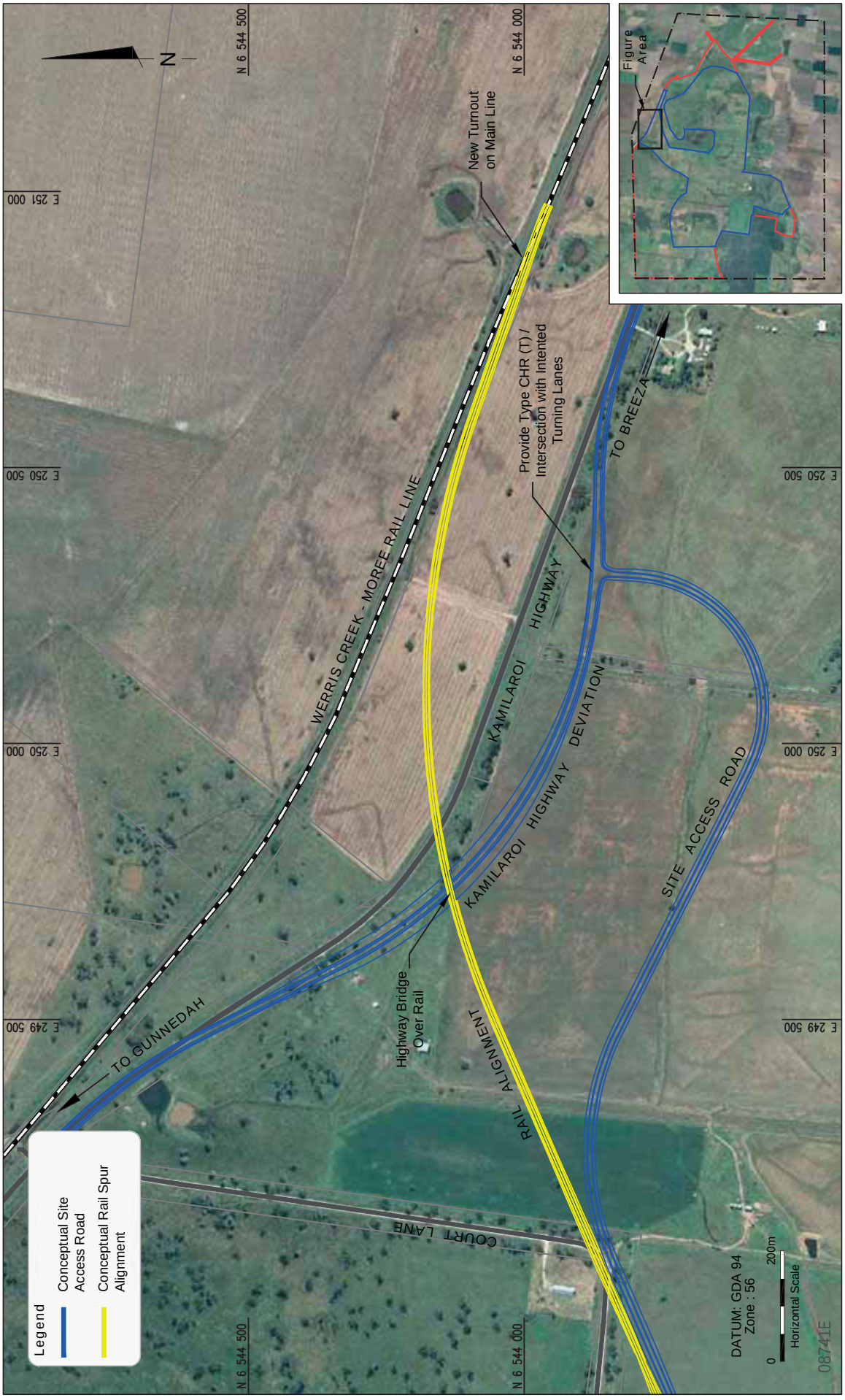
The following roads within the Project Boundary will require permanent closure:

- Court Lane (entire length);
- Rowarth Road (entire length);
- Whitby Road (entire length);
- The Dip Road (from the intersection of Clift Road to Nea Siding Road); and
- Other unnamed paper roads within the Project Boundary.

The closure of The Dip Road as described above will be required in Year 15 of the Project. This will require an alternative route via Cull Road, Werner Road and Clift Road. The alternative route via Cull, Werner and Clift roads will be developed in consultation with GSC. The required approvals for the alternative route will be sought separately to this application, as required.

These road closures and upgrades are discussed further in Section 7.16 and Appendix AB. The permanent road closures are shown on Figure 48.





WATERMARK COAL PROJECT

Conceptual Road and Rail Alignments

FIGURE 20

3.7 Power and Communications

The maximum power requirement for the Project is estimated to be approximately 40 MW. In order to supply this power requirement, a 132 kilovolt (kV) or 66 kV electricity transmission line will be constructed from the existing Breeza substation to the substation within the Project Boundary. A switch yard will also be constructed. Conceptual locations of the substation and switchyard within the Project Boundary are shown on Figure 19. This Application is seeking planning approval for the substation and switchyard within the Project Boundary only.

Preliminary design discussions with Essential Energy indicate that the preferred power supply option is to upgrade an existing 22 kV power line from the Carroll substation to the Breeza substation. This will provide the necessary power requirements for the Project. The ultimate power supply route will be determined and assessed separately to this Project Application. A separate Review of Environmental Factors document and planning approval application will be prepared in this regard.

Existing 11 kV power lines from the Breeza substation to the Project Boundary will be upgraded as part of this Application. Shenhua Watermark is in discussions with Essential Energy in this regard.

Whilst the electricity transmission line is being constructed, Shenhua Watermark proposes to install and operate a temporary system comprising of five 1,250 kilovolt amperes (kVA) diesel generators for an installed capacity of 5 MW if required. One of these generators will be the stand-by generator whilst up to four will operate in combination at any one time to supply the construction site's power needs.

A number of existing rural 11 kV transmission lines occur throughout the Project Boundary which will need to be removed. Shenhua Watermark is in discussions with Essential Energy in this regard.

Communications lines required for the Project will be fed from the existing infrastructure located along the Kamilaroi Highway (such as the Telstra Optic Fibre Network). Communications lines will generally be located within the corridor required for the Mine Access Road and rail spur.

Onsite communications towers and an optical fibre network connection to enable communications throughout the 30 years of mining operations will also be required and will be located largely within the Project Boundary.

3.8 Mine Infrastructure Area

The Project will require the construction of various items of surface infrastructure to assist the mining operations. These items will generally be contained within the MIA which is to be located centrally within the Disturbance Boundary. The indicative layout of the MIA, conceptual water management structures and other associated facilities is illustrated on Figure 19.

A conceptual detailed design (as required under Schedule 1 of the EP&A Regulation) is provided in Appendix B which will be revised and finalised upon seeking relevant additional building and construction approvals from GSC.

The orientation of individual components of the MIA, location and sizing of water management structures and the location of other associated facilities within the Disturbance Boundary will be confirmed during detailed engineering design.

The MIA is anticipated to contain (at least) the necessary infrastructure for the operation of the Project as proposed and which will include the following items:

- Administration building;
- Parking facilities;
- Helicopter pad;
- Heavy and light vehicle workshop, including hot work and hardstand areas;
- Stores building and hardstand area;
- Dangerous goods store (including explosives storage area);
- Fuel delivery, storage and refill area;
- Vehicle wash down facilities;
- Water cart filling station;
- Tyre change bay and storage area;
- Waste water treatment facility; and
- Water management infrastructure.

3.8.1 Administration Building

The administration building has been designed as a single storey structure. It will comprise an administration and technical services office, supervisor's office, training rooms, separate male and female bathhouses with individual lockers, plant rooms, kitchen / meal room, first aid centre, and a breezeway linking these areas and providing the building entry points.

Landscaping will be undertaken surrounding the administration building, incorporating rainwater tanks and a barbeque area.

The structure of the administration building (subject to gaining appropriate Building Certificates) will be steel framed with Colorbond cladding (or equivalent), founded on a reinforced concrete ground slab. Internal walls will be plasterboard with suspended tile ceilings. External walls and ceiling space will have thermal and acoustic insulation.

3.8.2 Parking Facilities

The following car parking facilities will be constructed for the Project:

- A visitors and administration car park (main car park) comprising at least 132 covered car spaces, including two disabled parking spaces;
- A secondary and light mine vehicle car park comprising 30 car spaces and 12 light mine vehicle car spaces at the rear (north) of the administration building;
- A bus drop off and parking zone; and
- A covered ambulance bay.

3.8.3 Waste Water Treatment Facility

Waste water produced in the MIA will be collected, treated and irrigated via an appropriately licensed waste water treatment facility. The treated effluent will be utilised on rehabilitation / garden areas or removed from the site for appropriate disposal by a licensed waste contractor.

3.8.4 Electrical Distribution Yard

An electrical distribution switch yard will be located in the MIA and will be fed by the high voltage power lines to be constructed for the Project. The yard will be fenced for safety and security purposes.

3.8.5 Helicopter Pad

A bitumen sealed helipad will be constructed to allow for both emergency and transport purposes. The helipad will be located in the MIA.

3.8.6 Vehicle Workshop

A heavy vehicle workshop will be constructed to accommodate maintenance activities required on mobile equipment throughout the life of the Project.

The heavy vehicle workshop will be steel framed with Colorbond cladding (or equivalent), containing up to six concrete floor double bays. The workshop will feature electronic vertical lift doors. The workshop floor area will be bunded and drained to a dirty water sump and oily water separator system.

An enclosed store building will adjoin the heavy vehicle workshop. This area will contain separate male and female toilets, arching area and office space for maintenance and store personnel. The office area will provide a space for 20 standard workstations and four larger desks in the muster area.

The light vehicle workshop will be steel framed with Colorbond cladding (or equivalent) and constructed adjacent to the light vehicle visitors parking area. The workshops will have sufficient lighting for 24 hour operation.

3.8.7 Hardstand Area

A large level hardstand area will be constructed to the south of the MIA to facilitate the construction and maintenance of heavy vehicles.

Level hardstand areas will also be constructed in the vicinity of the workshops to provide heavy vehicles with sufficient turning room to manoeuvre into and around the workshop and for laydown and storage areas.

3.8.8 Tyre Change Bay and Storage Area

The tyre change bay will be located separately from the workshops and associated stores area for safety reasons. The tyre change bay will be designated for heavy and medium vehicles tyre change only (not light vehicles) and will be provided with reticulated air, water and power.

Used tyres will be stored horizontally in piles at the edge of the tyre change area to be collected for recycling. This area will be surrounded by a berm for protection of those outside of it against tyre explosion.

3.8.9 Dangerous Goods Stores

Two separate dangerous goods stores, comprising a flammable gas store and a chemical store will be constructed for the Project. The buildings will be steel framed with Colorbond cladding (or equivalent), founded on a reinforced concrete ground slab with 4-hour fire rated partition walls. Each dangerous goods store will be bunded and any contaminated stormwater from the facility will be collected at a common collection point for removal from the site by a licensed contractor for recycling or disposal at a licensed facility. Any spills that occur within collection areas will be actively recovered, remediated and contained within bunds (see Section 7.25.3 for further details). The stores will be contained by wire mesh fencing.

Shenhua Watermark will utilise initiating products, detonators, primers, and emulsion explosives for blasting activities to facilitate open cut coal mining. The Project may require the storage on site of ammonium nitrate and fuel oil (ANFO) explosives, which will be housed in a storage magazine within sufficient distance from the Project Boundary to ensure no offsite impacts. This will be constructed in accordance with the relevant Australian Standards (AS) including *AS 2187:1998 Explosives - Storage, Transport and Use – Storage* (AS 2187:1988) and relevant NSW occupational health and safety regulations.

3.8.10 Bulk Oil and Fuel Storage Facilities

The fuel storage facility will be constructed to house and dispense diesel, oils and lubricants that are required for day to day operations. The fuel storage facility will be constructed with bunding in accordance with the relevant Australian Standards, including but not limited to *AS 1940 – The Storage and Handling of Flammable and Combustible Liquids*. The tanks and the facility will be designed and constructed to the required standards.

The storage tanks will contain at least five different oil products, concentrated engine coolant and diesel. The facility will also provide for the reclaiming and storage of waste oil and waste coolant resulting from vehicle servicing and repair. Indicatively the oil, coolant and fuel facility will contain the following above ground storage tanks:

- Eleven 97,000 litres (L) tanks for diesel storage;
- One 15,000 L tank for engine oil storage (SAE 15W-40);
- One 10,000 L tank for gear oil storage (SAE 85W-140);
- One 10,000 L tank for transmission oil storage (SAE 30);
- One 10,000 L tank for hydraulic oil storage (ISO 46);
- One 10,000 L tank for final drive oil storage (SAE 50);
- One 17,000 L tank for waste oil storage;
- One 10,800 L tank for concentrated engine coolant storage; and
- One 10,800 L tank for waste coolant storage.

Fuel and bulk lubricant will be delivered by trucks to the unloading area, which will be designed for the containment of spillage. Diesel will be delivered on a daily basis with up to three B-Double (50,000 L) tankers per day. Access for the delivery of fuels, oils and lubricants will be provided via the Mine Access Road.

Any contaminated stormwater from the facility will be collected at a common collection point and pumped into a designated contained storage area for oil separation and treatment, located at the heavy vehicle wash. An automated electronic tank gauging system will be installed to monitor the level of diesel, oil and coolant in the storage tanks remotely from the site office.

3.8.11 Vehicle Wash Facilities

The vehicle wash facilities will be located within the MIA. These facilities will be designed and constructed to have separate heavy and light vehicle wash areas. Runoff water from the vehicle wash facilities will be diverted through a sediment trap to capture sediment prior to being fed into an oil / water separation unit for treatment before release for reuse within the mine water management system.

3.8.12 Water Cart Filling Station

The water cart filling station will be located in the southern portion of the MIA and will provide a refilling station for water carts used to service the haul roads, mine area, and the edges of stockpiles.

The water cart filling station will consist of an elevated tank located on a concrete pad for trucks to stand on while filling. The station will facilitate a water gravity filling rate of approximately 35,000 L per minute. Water will generally be sourced from the Main Dam. Other water cart filling stations will be installed adjacent to or in the mining areas.

3.9 Water Management System

3.9.1 Mine Water

The Project will require an ongoing and reliable water source to enable the processing of ROM coal and also for dust suppression. Figure 10 to Figure 17 illustrates the indicative water management system for the Project as mining activities progress, opening and creating new catchments.

The main components of water-related infrastructure for the Project include:

- Sediment dams to collect and treat runoff from the OEAs;
- Dirty water drains to divert sediment-laden runoff from the OEAs to sediment dams;
- Clean water drains to divert runoff from undisturbed catchments around areas disturbed by mining;
- A dirty water storage system to store water pumped out of the mining areas and to collect runoff from the CHPP and coal stockpile area. The mine water dams will be the first priority water source for road watering and CHPP water demands; and
- Raw water storage (the Main Dam) from the water supply pipeline.

Further details of the water management system are presented in Section 7.3.

The water management system will be designed and operated to minimise the impacts of the Project on downstream water quality. Wherever possible, runoff from undisturbed areas will be diverted around disturbed areas using diversion drains. The objective is to minimise the volume of water collected in onsite storages and also minimise the impacts on downstream catchments.



Sediment-laden runoff from the natural environment and areas disturbed for mining purposes (as opposed to mine water) will be collected and treated in sediment dams. If the quality of this water is not suitable for release to receiving waters, it will be pumped back into the water management system. Runoff water will only be released from site if the quality is acceptable and during a rainfall event that exceeds the design capacity of the sediment control dam system. Appropriate licences for the release of this water will be obtained.

The water management system will be operated to fully contain mine water on the mine site and to preferentially reuse this water. The results of the water balance modelling show that under the full range of historical rainfall conditions, the water management system will have sufficient capacity to contain all mine water on the site without the need for offsite releases.

Water intercepted by from mining operations (quantities and origins set out in Section 7.1 & 7.3) will be pumped to mine water storages and used within the water management system. During abnormally wet periods where excess mine water exists onsite, part of the open cut mining area will be used to store this water which will be later reused in the mine water management system.

Where water additional to captured dirty surface water and water intercepted by mining is required in the mine water management system, the Project proposes to draw water from adjoining water sources pursuant to water access licences already held or to be purchased from within the operating water market. This water allocation will be utilised during both the construction and operation of the Project. One or more electric pump stations (or possibly a licensed bore field) and an associated water pipeline will be constructed on Shenhua Watermark owned land to transfer water from Groundwater Management Zones or unregulated surface water sources to the Main Dam. The pipelines and pump station(s) to the Mooki River are shown on Figure 9.

This would supplement water supplies required for the CHPP. Gravel access tracks and power lines will also be constructed to enable the ongoing operation and maintenance of the pump stations and/or bore field.



3.9.2 Mine Infrastructure Area

The MIA will be designed to ensure that all surface water runoff is diverted to water management infrastructure for treatment and ultimate reuse within the site water management system. Water runoff from the hardstand areas will be diverted to sediment dams within the MIA.

Water from the workshop areas will be diverted to the oil / water separation unit to be treated prior to being reused within the site water management system.

3.9.3 Potable Water

Potable water will be delivered to site as required for use in administration and bathhouse facilities for:

- Drinking and showering;
- Emergency shower and eye wash stations;
- Kitchen sinks; and
- Workshop potable water supply.

3.10 Hours of Operation and Employment

The Project will require a workforce of approximately 600 full-time equivalent employees during construction and up to 600 full-time equivalent employees during operation at full production. Maintenance activities, deliveries, coal processing, coal transport and mining operations will occur 24 hours a day, seven days a week.

All coal mining operations and associated activities relating to the Project will be undertaken up to 24 hours per day, seven days a week.

Construction activities as described in Section 3.11 will be undertaken up to 24 hours per day, seven days a week. Construction activities will be designed to minimise impacts on the Kamilaroi Highway during the construction of the rail overpass and the Kamilaroi Highway / Mine Access Road intersection upgrade, as far as practicable.

3.11 Construction Schedule

The construction of the Project is proposed to be undertaken as expeditiously as possible. The indicative construction schedule for the Project is shown in Table 8. Temporary construction site facilities will be established at the MIA, while temporary satellite facilities will be positioned adjacent to the work fronts at the Kamilaroi Highway rail overpass and intersection upgrade. Temporary construction access will be required along Court Lane, in consultation and approval with GSC and RMS.

Table 8 Indicative Construction Schedule

Action	Project Month																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Mine Access Road																					
Bulk earthworks																					
Civil works																					
- Drains																					
- Structures																					
- Pavement and seal																					
Site establishment (Temporary Construction Complex)																					
- Earthworks																					
- Construction																					
Kamilaroi Highway Road Overpass																					
Bulk earthworks																					
Civil works																					
- Drains																					
- Structures																					
- Pavement and seal																					
Rail Loop and Spur																					
Bulk earthworks																					
Civil works																					
- Drains																					
- Structures																					
- Track and signalling																					
CHPP																					
Bulk earthworks																					
Civil works																					
- Construction																					
- Construct process water infrastructure																					
ROM and Product Coal Stockpiles																					
Bulk earthworks																					
Civil works																					
- Drains																					
- Structures																					
- Construction stockyard machines																					
MIA																					
Bulk earthworks																					
Civil works																					
- Drainage																					
- Building construction																					
- Access and parking																					
HV/LV power supply																					
Water Management System																					
- Water pump station and pipeline																					
- Dams																					
- Drains																					
Commence Box Cut Construction																					

3.12 Project Alternatives

Since the granting of EL 7223, extensive exploration programs and detailed feasibility studies have been carried out in order to identify the extent and quality of the coal resource and to determine the most appropriate mine plan and mining method. This process has included the consideration and refinement of numerous mine plans and operational alternatives with the principal focus on seven alternate combinations of mine plan and mining methods.

The objective of these studies was to develop a financially and operationally feasible mine plan and mining method that optimises the recovery of the coal and therefore the social and economic benefits for the local and regional communities, as well as the State of NSW and Australia. This has been achieved by developing a mining plan and method that avoids uncertain and unacceptable social and environmental costs and one where the environmental effects could be determined with certainty and shown to be manageable.

Certain environmental impacts were considered unacceptable or unmanageable or unable to be predicted with certainty. These aspects were excluded from the Project presented in this EIS.

Seven alternate mine plans (including the Project as proposed) were considered in this context and against the 'objects' of the EP&A Act, community expectations and requirements for the grant of a 'licence to mine'. In addition the 'Do Nothing' approach was considered and ultimately rejected as an acceptable mine plan was identified in the form of the Project as proposed. Not proceeding with the Project would sacrifice the demonstrable social and economic benefits that will flow from the conduct of the Project.

The seven alternate mine plans considered for the Project are described below along with the reasons for the selection of the Project as the appropriate development.

Appendix C provides a summary of the work that was undertaken in order to arrive at this conclusion.

3.12.1 Alternative 1 – Maximum Resource Recovery

This alterative involved the development of a large-scale open cut mining operation, utilising all areas of EL 7223 to maximise resource extraction. This would require disturbance of the Upper Namoi alluvium, black soil plains, Breeza State Forest, Critically Endangered Ecological Communities, Aboriginal archaeological sites and Class II rural land capability.

This alternative was considered unsuitable because it would result in unacceptable environmental and social impacts and in particular could pose a threat to the water regime of the black soil plains. Further, it is noted that this alternative would be inconsistent with the revised conditions of EL 7223.

3.12.2 Alternative 2 – Three Final Voids

Open cut mining conventionally extracts coal following the dip of the coal resource, thereby leaving a final void at the deepest part of the mining area. This alternative involved the development of an open cut mining operation within three distinct mining areas (i.e. Eastern, Southern and Western Mining Area), each with a final void at the end of mining. This alternative was considered operationally feasible.

However final voids are not acceptable where they can be avoided and, in any event must be minimised with the preferred approach of no final void.

This alternative was rejected as it did not meet contemporary regulatory and community expectations.

3.12.3 Alternative 3 – Twenty-One Year Mine Plan

This alternative involved the development of an open cut mining operation for a period of 21 years with a maximum ROM coal production rate of 10 Mtpa. This alternative was considered financially and operationally feasible. However, the mine plan schedule for this alternative would result in a final void located adjacent to the black soil plains and would limit the amount of coal extracted by open cut methods, potentially resulting in the sterilisation of viable open cut coal reserves.

This alternative was rejected as it may result in increased social and environmental impacts with a final void located adjacent to the black soil plains and did not achieve the optimal social, environmental and economic benefits from the coal resource.

3.12.4 Alternative 4 – Night Time Operations

This alternative involved restricting mining activity to the day or day and evening times only, primarily to reduce noise emissions in the quietest background periods. Not mining during the evening and/or night period would require an increase in the equipment fleet in addition to mining multiple pits simultaneously and at a higher intensity (increased disturbance areas at any one time to that proposed in this EIS). A restriction on Project mining activities to the day; or day and evening periods only would also reduce the time available for rehabilitation works and maintenance of the Project mining fleet. Furthermore, the Acoustics Impact Assessment found that the increase in the number of machines working during the day and evening would result in the same, or in some cases increased, number of affected properties and residences. These results clearly indicate restricted working hours would not provide an acoustic benefit to receivers (see Section 7.8.4 for further details).

A reduction in the intensity of mining during the night was also considered, with a corresponding reduction in annual production to avoid an increase in day and evening noise levels. The economic effects of restricted night operations based on three levels of night mining intensity are shown in Table 9.

A moderate 3 dBA reduction in night noise levels would result from two out of four mining fleets remaining idle during the night, with a resulting reduction of approximately 50 full time equivalent staff, a loss of revenue of $144 – $184 Million per annum and loss of government royalties from an estimated reduction of 1.47 Mtpa of product coal per annum.

A significant noise reduction of 6 dBA in night noise levels would result from three out of four mining fleets remaining idle during the night, with a resulting reduction of approximately 75 full time equivalent staff, a loss of revenue of $233 - $297 Million per annum and loss of government royalties from an estimated reduction of 2.38 Mtpa of product coal per annum.

This alternative was rejected as it did not meet the required environmental or social outcomes and would also result in a large portion of the resource being sterilised due to mining inefficiencies.

3.12.5 Alternative 5 – Dragline or In-pit Crushing Mining System

This alternative involved the use of a dragline or in-pit crushing mining system as opposed to truck/shovel mining operations.

The dragline option was excluded after a study of seam geometry and production requirements which demonstrated that it was not a suitable method for the geological configuration of the coal deposit in the Project Boundary. The dragline method could not be utilised to its full capacity in the mining of the coal reserves for the Project and was therefore discounted.

The in-pit crushing and conveying method was considered for its high overburden removal productivities and reduced truck (hence manning) requirements. However the flexibility of its operation is limited by the small footprint area of the mining area and, therefore, this method was excluded.

3.12.6 Alternative 6 – Underground Mining

Underground mining was considered as a potential mining method for the Project's targeted coal seams. It was determined not to be operationally or economically feasible to mine the Hoskissons and Melville seams by this method.

This is due to the following factors:

- The open cut target Hoskissons and Melville seams are close to the surface (as demonstrated in the open cut strip ratio of 6:1) and as such are more suitable to open cut mining methods. Mining of these seams via underground methods would not fully recover the resource and would potentially induce significant subsidence impacts;
- The Hoskissons and Melville seams are characterised by rolling floor levels and associated seam splitting, both of which are unfavarouble to underground mining;
- Irregular interburden thickness between the Hoskissons and Melville seams would lead to a large number of seams being sterilised if subject to underground mining;
- The variable seam thickness of the Hoskissons and Melville seams would led to high level of rock dilution if subject to underground mining;
- The Hoskissons and Melville seams sub-crop close to the surface, which is unfavourable to underground mining methods;
- The deeper Maules Creek seam (occurring at a depth of 250 m and greater within the Project Boundary) is the most appropriate seam for underground mining. However, to facilitate maximum resource extraction whilst minimising social and environmental impacts, this coal resource would more be suitable for underground mining once open cut mining associated with the Project is completed;
- The geology of the Maules Creek seam is not completely understood within the Project Boundary. Further work is required to identify deeper intrusions, faulting and geotechnical issues, all of which are required to be completely understood to ensure underground mine safety and efficiency;
- The development work (roads and gateways) required for underground mining and the underground mining methods available result in a materially reduced percentage of resource recovery and can reduce mining efficiency and productivity; and
- In terms of operating costs, the underground coal mining operating costs are significantly greater than open cut operating costs.

Table 9 Economic Effect of Restricted Night Time Operations

Operational Intensity	Active Mining Fleets	Noise Impact Reduction	Economic Impact	Employment Impact	Product Coal Reduction
Proposed 100%	4	Base Case as Proposed			
25% Reduction	3	1 dBA	$62-79 M	20 FTE	0.63
50% Reduction	2	3 dBA	$144-184 M	50 FTE	1.47
75% Reduction	1	6 dBA	$233-297 M	75 FTE	2.38
100% Reduction	0	N/A - No night time operation	$316-403 M	120 FTE	3.22*

** The approximate acoustic benefit, compared to the proposed night operation using all mining equipment, assumes similar equipment operating locations and exposure to or shielding from receivers.*

It is concluded that the underground mining of the Project target coal seams would result in a large portion of the resource being sterilised and the remainder more than likely not being economically viable for extraction.

3.12.7 Alternative 7 – 'Do Nothing'

The 'Do Nothing' approach would result in the relinquishment of EL 7223 to the NSW government. This would result locally in a loss of employment opportunities, socio-economic benefits and royalties and other payments to the locality, the region, NSW and the Commonwealth.

This alternative would fail to realise the value and economic benefits that flow from the recovery of a coal resource which is shown to be capable of being environmentally and socially acceptably mined and as such it would conflict with the Objects of the EP&A Act. In particular the objective of encouraging the proper development of natural resources for the purpose of promoting the social and economic welfare of the community would not be achieved.

In addition, the 'Do Nothing' approach would result in significant financial inefficiency due to the loss of the substantial investment already made in land purchases, exploration, mine planning and environmental studies, EL payments to the NSW government and further contributions made to the local community.

3.12.8 Alternative 8 – The Project

The Project as it is proposed and assessed in this EIS is a 30 year open cut coal mining operation within the Disturbance Boundary. This option will maximise the social and economic benefits of the Project while avoiding unacceptable impacts and minimising impacts on environmental aspects such as groundwater and surface water regimes, soils, ecology and Aboriginal archaeology.

The mine plan incorporates the following benefits to the environment and society:

- The protection of the groundwater regime of the black soil plains with a minimum 900 m horizontal barrier of natural material between active mining areas and the highly productive Gunnedah Formation aquifer;
- A minimum 150 m buffer to alluvial black soils and black soil plains;
- Disturbance of only land owned by Shenhua Watermark;
- No disturbance of Mt Watermark;
- No disturbance of Breeza State Forest;
- There is only one final void which is distant from the black soil plains and Gunnedah Formation;
- The OEA merges into the natural topography (such as Mt Watermark and Black Mountain);
- Reduced slopes of the OEA to facilitate the re-establishment of Box Gum Woodland on the mine rehabilitation and to achieve the maximum post-mining land capability classification practicable;
- Reconfiguration of the Eastern Mining Area OEA to avoid 143 ha of Critically Endangered Ecological Communities (CEEC) Box Gum Woodland;
- Avoidance of four Aboriginal archaeological sites of high, moderate and low significance within the Eastern Mining Area;
- Early and progressive rehabilitation of the OEA;
- Early development and rehabilitation of the northern OEA in the Eastern Mining Area to assist as a visual screen;
- Allocating night mining activities to locations deeper in the open cut mining area to enhance shielding effects;
- Haul routes designed to reduce exposure in elevated areas and to reduce the overall haul distance;
- Utilising large equipment to reduce the number of mobile equipment operating at any one time;
- Implementation of best-practice sound power levels on all of the equipment fleet to reduce noise impacts;
- The CHPP ROM bins and conveyors include shielding to reduce air and noise impacts;
- Rail loop with minimum grade to reduce the grade and thus locomotive power and noise while loading;
- Minimal drop height to/from equipment during loading/unloading activities;
- Haul routes and active exposed mining areas are to be suppressed with chemical agents and surface crusting agents;
- The train load out water spray system will have the ability to apply a dust suppressant to the loaded coal wagons if deemed necessary;
- Avoidance of 351 ha of Class II land capability;
- A rehabilitation strategy to reinstate approximately 3,233 ha of Class III rural land capability, of which approximately 1,000 ha is to be dedicated for agricultural purposes; and
- Situating the MIA to avoid CEEC where possible and to obtain maximum natural shielding from private receivers.

These constraints and the necessary changes made are described in greater detail below.

Buffer to Gunnedah Formation

The Upper Namoi alluvium comprises of two major formations, the Narrabri Formation and the Gunnedah Formation. The Narrabri Formation is the uppermost aquifer and is a typical brown clay dominated aquitard. The underlying Gunnedah Formation is composed of porous sand and gravel.

The Gunnedah Formation typically has high permeability and yield and is commonly referred to as the primary aquifer system in the region (GHD, 2009). Groundwater from the Gunnedah Formation is used extensively for irrigation, stock and domestic use and for the town water supply at Gunnedah, Breeza, Curlewis and Quirindi.

Regulatory and community stakeholders expressed the importance of ensuring the Gunnedah Formation would not be impacted, either directly or indirectly by the Project.

Thus, the mine plan for the Project was designed to ensure a minimum 150 m horizontal barrier of natural material between active mining areas and the highly productive Gunnedah Formation aquifer. This minimum buffer was guided by the DIPNR (2005) policy "*Management of stream/aquifer systems in coal mining developments – Hunter Region*". Although the policy is for the Hunter Region, it is relevant in providing guidance for buffer requirements to alluvium in NSW. A condition in EL 7223 also specifies a minimum width of 150 m of natural material must be maintained between proposed mining operations and the Gunnedah Formation.

However, field investigations have shown that the Gunnedah Formation does not exist within the Project Boundary, as shown on Figure 21. The closest occurrence of this aquifer is 900 m from the north-eastern corner of the Eastern Mining Area. To the south, the aquifer exists more than 1.3 km away from the Project Boundary.

Buffer to Alluvial Soils

Regulatory and community stakeholders expressed the importance of protecting the fertile soils of the black soil plains and the agricultural productivity associated with it.

Thus, the mine plan for the Project was designed to ensure a minimum 150 m buffer to alluvial black soils. In particular, the mine plan for the Project was constrained to the 'ridge country' of EL 7223, off the black soil plains.

Detailed field surveys were conducted to map the alluvial black soils. The Soils Survey and Land Capability Assessment describe in detail the work undertaken to map the alluvial black soils. Figure 21 presents the extent of the alluvial black soils as defined from the detailed field survey.

Land Ownership

The mine plan for the Project was designed to occur only on land owned by Shenhua Watermark. This was undertaken so as to provide certainty for landholders. Figure 4A presents the land ownership within EL 7223.

Avoidance of Mt Watermark

The mine plan for the Project was designed to avoid any disturbance of Mt Watermark, in recognition of the importance the site provides to the local vista and the dense presence of CEEC.

Avoidance of Breeza State Forest

The mine plan for the Project was designed to avoid any disturbance of the Breeza State Forest.

Ecological surveys of Breeza State Forest indicate that the forest contains a more complex CEEC community with a lesser degrading edge effect than the vast majority of the Project Boundary. Database analysis and field surveys have also shown that a wide variety of native flora and fauna occur within and around Breeza State Forest.

The forest and surrounding lands are known to support a population of the Koala. There is also considerable potential for other threatened flora and fauna, including threatened ecological communities, populations, and species to occur.

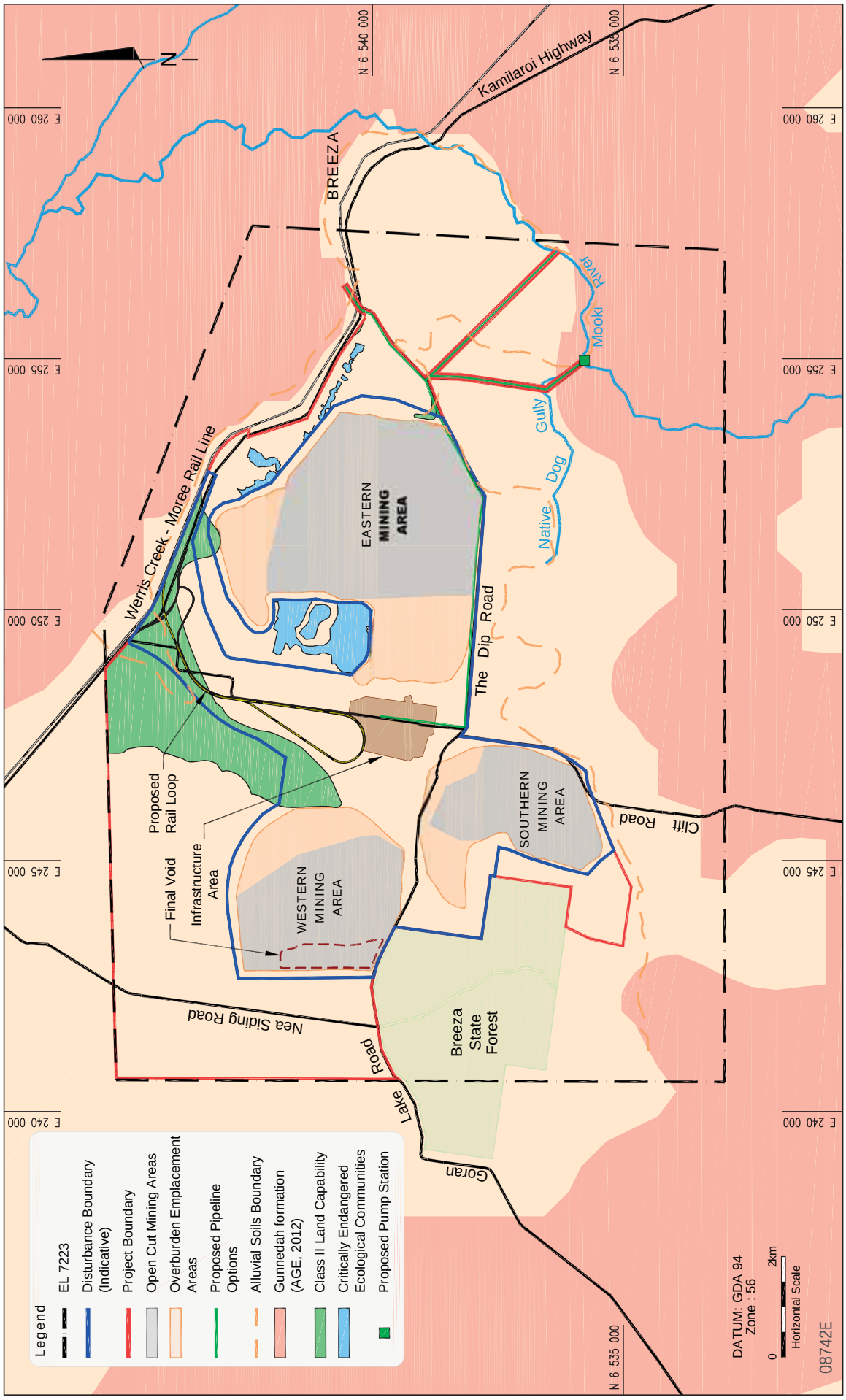
Final Voids

As described above, the mine plan for the Project has been specifically designed to ensure the final void is distant from the black soil plains. This has required a reconfiguration of the mine plan sequencing to facilitate backfilling of the Eastern and Southern Mining Area voids, leaving a final void in the Western Mining Area remote from the black soil plains. To achieve this sequencing, the mine plan commences in the higher strip ratio mining area and requires a double pass in the Eastern Mining Area which is uncommon in conventional truck/shovel mining operations.

The mine plan reconfiguration for the Project has resulted in significant costs of over $340 Million being incurred by Shenhua Watermark to ensure only one final void remains at the end of mining. This includes:

- Estimation for the cost to completely backfill the Eastern Mining Area void (using material from the Southern Mining Area) is approximately $130 Million, in conjunction with the use of 50% of the Project's annual mining capacity for over six months. In addition to this cost, an allowance of $5 million has also been provided for final rehabilitation (topsoil spreading, water management and revegetation); and
- Estimation for the cost to completely backfill the Southern Mining Area void (using material from the Western Mining Area) is approximately $210 Million, in conjunction with the use of 50% of the Project's annual mining capacity for a year. In addition to this cost, an allowance of $5 million has also been provided for final rehabilitation (topsoil spreading, water management and revegetation).

As discussed, it is proposed that a final void will remain in the Western Mining Area at the end of mining due to the Project. There are deeper coal resources present beyond the 30 year mining limit of the Project. Shenhua Watermark may, seek further relevant approvals for the extraction of these, depending upon market factors and resource confirmation.



WATERMARK COAL PROJECT

Project Design Constraints

FIGURE 21

Hansen Bailey
ENVIRONMENTAL CONSULTANTS

In this instance the Western Mining Area final void will be ideally placed for underground access to this coal resource.

Nonetheless, two approaches for the treatment of the Western Mining Area void were considered and the costs and benefits associated with each assessed:

- Option 1 – The Western Mining Area final void is left partly backfilled. Partial backfilling and rehabilitation represents a total cost of $42 Million, in conjunction with the use of 50% of the Project's annual mining capacity of the Project for an additional extra year of dozing and ancillary works; or
- Option 2 – The Western Mining Area final void is completely backfilled. Estimated costs to completely backfill and rehabilitate a total 76 Mbcm final void represents a total cost of approximately $461 Million. This total includes provision for $438 Million operating cost and $23 Million in capital cost. This option assumes the removal of overburden material from existing rehabilitated OEAs. One hundred percent of the Project's annual mining capacity and dozing and ancillary works will be utilised for more than one year to complete the activities required under Option 2.

In recognition of the further potential coal resources and the ability of the Western Mining Area void highwall to provide access to these resources, the cost / benefit analysis found that the retention of a safe and stable final void in the Western Mining Area was the most appropriate outcome.

Rehabilitation and Final Landform

The mine plan for the Project has been specifically designed to minimise the area of out-of-pit OEA and to allow the OEA to merge into the natural topography of the area (such as Mt Watermark and Black Mountain).

The mine plan sequencing and OEA design also avoided large flat top areas on the OEA and incorporates undulation where possible to recreate a natural looking landform. The outer slopes of the OEA were designed to slopes of ten degrees or less and include water and erosion management structures.

The mine plan sequencing was also specifically designed to allow for the early and progressive rehabilitation of the OEA.

Further, the mine plan has been designed to ensure reduced slopes on the OEA to facilitate the re-establishment of Box Gum Woodland on the mine rehabilitation and to achieve the maximum post-mining land capability classification practicable.

Critically Endangered Ecological Communities

The mine plan for the Project was specifically redesigned so that the Eastern Mining Area OEA avoids the disturbance of 143 ha of Box Gum Woodland CEEC, located adjacent to Mt Watermark (see Figure 21). This involved a redesign of the mine plan and overburden emplacement strategies to ensure overburden mass balance.

Aboriginal Archaeological Sites

The mine plan for the Project was specifically redesigned to avoid the disturbance of four Aboriginal archaeological sites of high, moderate and low significance within the Eastern Mining Area (see Figure 46).

Conserving these Aboriginal archaeological sites within the Eastern Mining Area involved committing to a minimum 20 m buffer to the sites. This subsequently required a redesign of the mining area wall.

Visual Considerations

The mine plan for the Project was designed to reduce visual impacts by minimising the area of out-of-pit OEA and to allow the OEA to merge into the natural topography of the area (such as Mt Watermark and Black Mountain).

The mine plan sequencing was also designed to allow for the early and progressive rehabilitation of the OEA. Mine plan sequencing was modified to allow the quick development and rehabilitation of the northern OEA in the Eastern Mining Area to assist as a visual screen.

Acoustic Considerations

The mine plan for the Project was designed to reduce noise and blasting impacts by allocating night mining activities to locations deeper in the mining area to enhance shielding effects and thereby reduce noise impacts.

The mine plan sequencing has been planned to allow for the early and progressive rehabilitation of the OEA. This reduces noise impacts by reducing the time equipment operates in exposed areas.

The haul routes were also designed to reduce exposure in elevated areas and to reduce the overall haul distance.

Large equipment was selected to reduce the number of operating machines at any one time. Best-practice sound power levels were imposed on all of the equipment fleet to reduce noise impacts. This extended to imposing white noise reversing alarms on equipment and minimising dozer track noise at night by controlling reversing speed.

The CHPP have been designed to reduce potential noise impacts, by including cladding/sheeting of the CHPP, ROM bins and conveyors in the design. The rail loop has also been graded to reduce locomotive power while loading.



Air Quality Considerations

The mine plan for the Project was designed to reduce air quality impacts by applying mining operations involving minimised drop height to/from equipment during loading/unloading activities.

The haul routes were designed to reduce exposure in elevated areas and to reduce the overall haul distance. The haul routes and active exposed mining areas have been designed to be suppressed with chemical agents and surface crusting agents.

The mine plan sequencing was designed to allow for the early and progressive rehabilitation of the OEA which reduces air quality impacts by reducing the portion of time disturbed areas are exposed.

The CHPP have been designed to reduce potential air quality impacts, by including cladding/sheeting of the CHPP, ROM bins and conveyors in the design. The train load out water spray system will have the ability to apply a dust suppressant to the loaded coal wagons if deemed necessary.

Land Capability

The mine plan for the Project was redesigned to avoid Class II land, as defined in the *Systems Used to Classify Rural Lands in New South Wales* (Cunningham et al., 1988). This required a reconfiguration of the mine plan and OEA to avoid 351 ha of Class II identified for open cut mining (see Figure 21).

The Rehabilitation and Mine Closure Strategy for the Project has been designed so as to reinstate approximately 3,233 ha of Class III rural land capability, of which approximately 1,000 ha will be dedicated for agricultural purposes in order to maintain the high value production of the area.

The maintenance of all land capability Class II land and the increase in Class III land by 284.6 ha are consistent with the intent of the *Namoi Catchment Action Plan* (Namoi CAP) (Namoi CMA, 2011a). The Namoi CAP has been developed using "resilience thinking", where resilience is defined as the capacity of a system to absorb disturbance and still retain its basic function and structure. Whilst there is no CAP target associated with maintaining or improving land capability, the existing area value of Class III land will be reinstated post-mining to ensure the Project is consistent with the resilience commitment in the Namoi CAP.

Conclusion

Of the eight alternatives considered, the Project is the most environmentally sensitive and economically efficient alternative for all stakeholders. It will maximise the social and economic benefits associated with the Project and ensure that a significant coal resource is utilised.

The implementation of the Project design changes as outlined above to reduce its environmental and social impacts has resulted in a number of associated socio-economic costs.

In total, approximately 1,490 Mt of insitu coal potential within the Black Jack Group in EL 7223 have been excluded from the preferred mine plan so as to minimise social and environmental impacts and to comply with the principles of ESD.

Shenhua Watermark has developed a preferred mine plan for the Project which balances economics costs and environmental and social benefits for both the proponent and community.

The costs and benefits associated with adopting Alternative 8 – the Project is outlined in Table 10.

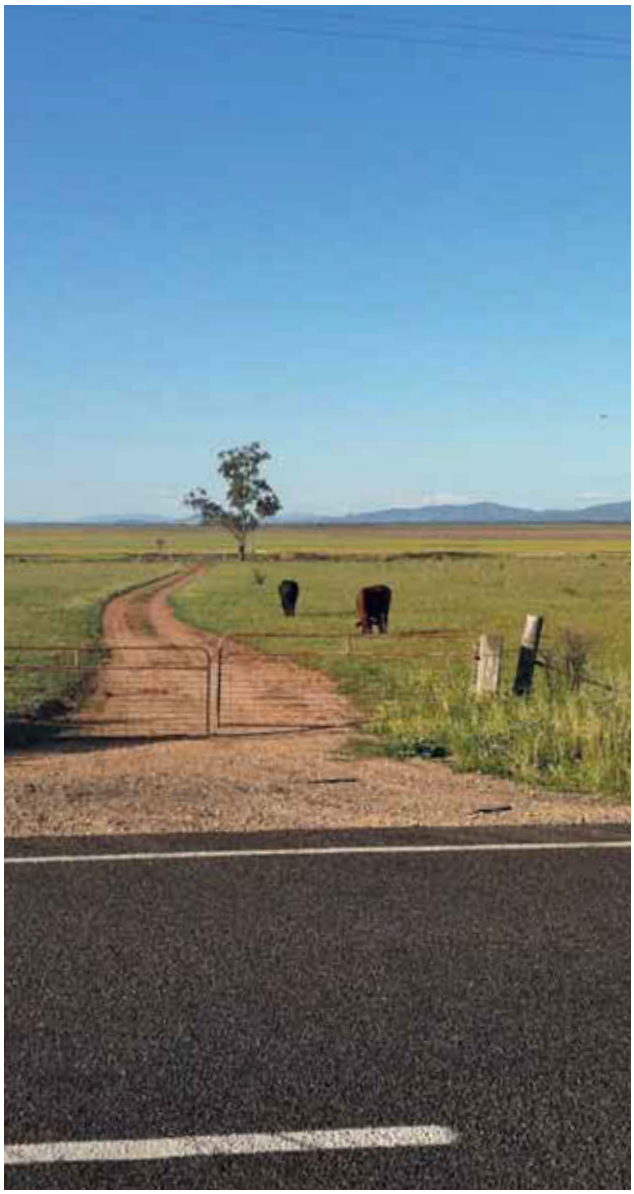


Table 10 Costs and Benefits of Alternative 8 – The Project

Description	Environmental Benefits	Socio-economic Costs
150 m buffer to alluvial black soils & Gunnedah Formation	• Protection of highly fertile black soils (Class I and II land capability) • Protection of highly production Gunnedah Formation	• Total coal sterilised: Approx 900 Mt of potential insitu coal in the Black Jack formation
No disturbance of Mt Watermark	• Protection of 143 ha of Box Gum Woodland CEEC	• Total cost: Minimal
No disturbance of Breeza State Forest	• Avoidance of CEEC, other threatened species and habitat (including the Koala)	• Total coal sterilised: Approx 590 Mt of potential insitu coal in the Black Jack formation
Reduction in amount of final voids	• Reduction of three finals to one, which is located distant from the black soil plains and Gunnedah Formation	• Mine plan redesign costs: Minimal
Early and progressive rehabilitation	• Reduced dust levels generated by the Project (consistent with Katestone report)	• Total cost: Minimal
Integration of rehabilitation with surrounding landforms	• Reduced visual impacts • Increase in Box Gum Woodland CEEC throughout rehabilitation process	• Total cost: Minimal
Avoidance of Class II land capability	• Protection of 351 ha of Class II land capability	• Mine plan redesign costs: Minimal
Reinstatement of Class III land	• Increase in Class III rural land capability as part of rehabilitation process • Dedication of at least 1,000 ha of Class III land for agriculture post-mining	• Total cost: Minimal
Relocation of mining activities at night	• Reduced noise levels generated by the Project	• Total cost: Minimal
Redesigning haul roads	• Reduced noise and dust levels generated by the Project	• Total cost: Minimal
Utilising large equipment	• Reduced dust levels generated by the Project (consistent with Katestone report)	• Total cost: Minimal
Best practice noise Sound Power Levels	• Reduced noise levels generated by the Project	• Total cost: $30 M
Infrastructure modifications	• Reduced noise and dust levels generated by the Project	• Total cost: $5 M
Rail loop modifications	• Reduced noise levels generated by the Project	• Total cost: Minimal
Minimising drop height	• Reduced dust levels generated by the Project (consistent with Katestone report)	• Total cost: Minimal
Treating haul roads and infrastructure areas with a dust suppressant agent	• Reduced dust levels generated by the Project (consistent with Katestone report)	• Total cost: $150 M
Treating coal train wagons with water and/or a dust suppressant agent	• Reduced dust levels generated by the Project (consistent with Katestone report)	• Total cost: Minimal

WATERMARK
COAL PROJECT
ENVIRONMENTAL IMPACT STATEMENT
February 2013



4
Regulatory Framework



Regulatory Framework 4

This section describes the environmental and planning legislative framework applicable to the Project and considers both NSW and Commonwealth legislation. In particular, this section describes the:

- *Environmental assessment regime under the EP&A Act;*
- *Environmental Planning Instruments (EPIs) that are relevant to the Project;*
- *Approvals required for the operation of the Project;*
- *Approvals rendered unnecessary by the granting of Development Consent;*
- *Approvals which must be granted following the granting of Development Consent;*
- *Environmental assessment regime under the EPBC Act; and*
- *Plans and policies relevant to the Project.*

A flowchart illustrating the planning assessment and consultation process relevant to the Project is presented in Figure 22.

4.1 Background

The principal approval required for the Project is State Significant Development Consent under Division 4.1 of Part 4 of the EP&A Act. The approvals regime under Division 4.1 of Part 4 of the EP&A Act is described in Section 4.2.

Section 89J of the EP&A Act lists the approvals that are not required for approved developments under Division 4.1 of Part 4 (see Section 4.5). In addition, section 89K of the EP&A Act lists a number of approvals that must be granted for an approved development under Division 4.1 of Part 4 on terms consistent with consent (see Section 4.4). Other approvals required under other NSW legislation will be required for the Project, as described in Section 4.4.

The Project will also require approval under the Commonwealth EPBC Act (see Section 4.7).

4.2 Environmental Planning & Assessment Act 1979

4.2.1 Objects of the Environmental Planning & Assessment Act 1979

Section 5 of the Act states the objects of the EP&A Act:

(a) to encourage:

(i) the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment,

(ii) the promotion and co-ordination of the orderly and economic use and development of land,

(iii) the protection, provision and co-ordination of communication and utility services,

(iv) the provision of land for public purposes,

(v) the provision and co-ordination of community services and facilities,

(vi) the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats,

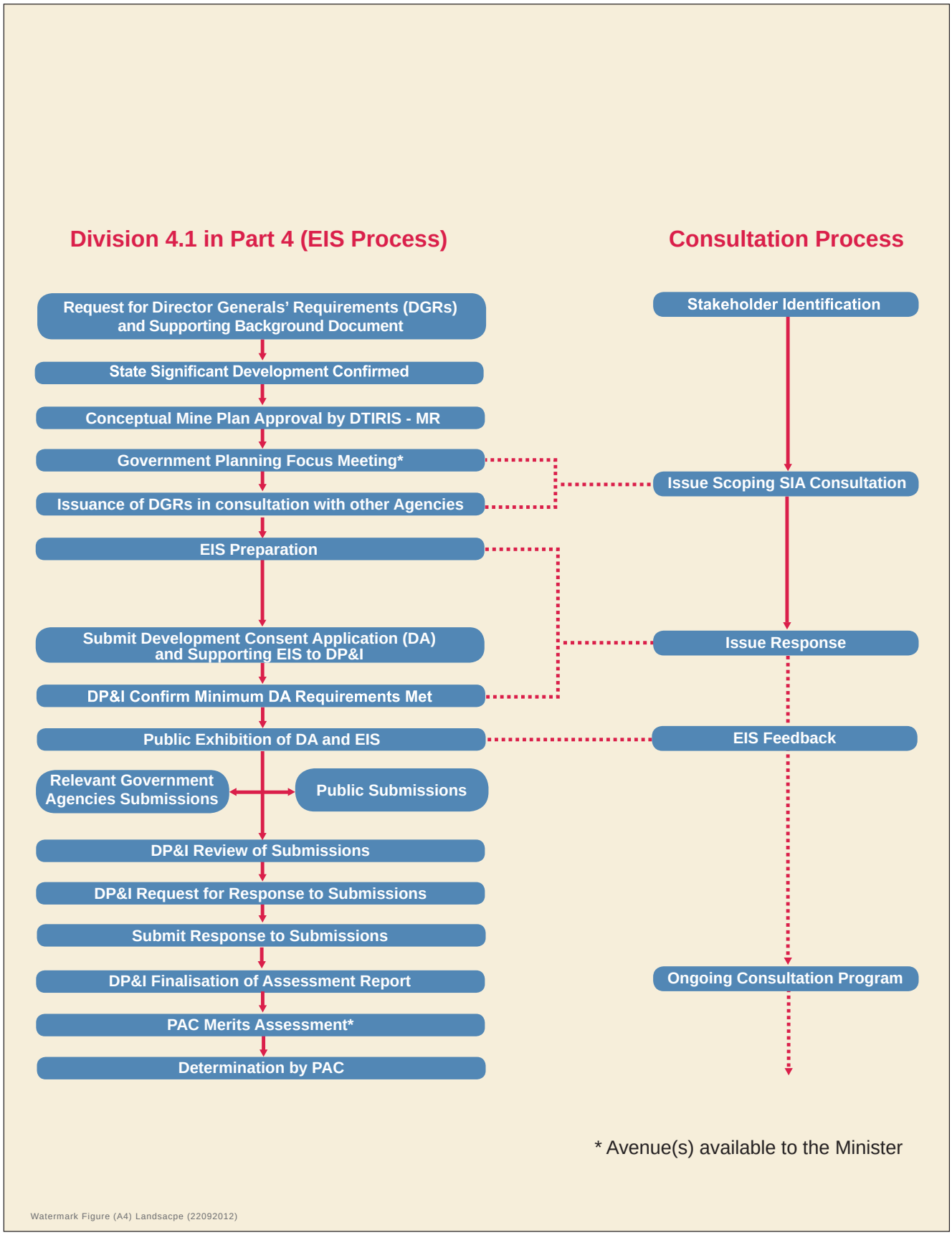
(vii) ecologically sustainable development,

(viii) the provision and maintenance of affordable housing,

(b) to promote the sharing of the responsibility for environmental planning between the different levels of government in the State, and

(c) to provide increased opportunity for public involvement and participation in environmental planning and assessment.

Section 9 explains how the Project is consistent with the objects of the EP&A Act.



WATERMARK COAL PROJECT

SHENHUA WATERMARK COAL PTY LIMITED
神华沃特马克煤矿有限公司

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Planning Approvals & Consultation

FIGURE 22

4.2.2 Applicability of Division 4.1 of Part 4

On 1 October 2011, Division 4.1 of Part 4 replaced Part 3A as the planning and determination regime for State Significant Development (SSD) in NSW.

Under section 89C of the EP&A Act, a development is SSD if it is so declared by any State Environmental Planning Policy (SEPP) to be SSD. The relevant SEPP is *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP). Clause 8(1) of SRD SEPP provides:

> *8 Declaration of State significant development: section 89C*
>
> *(1) Development is declared to be State significant development for the purposes of the 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.*

In order for the Project to constitute SSD, both limbs of Clause 8(1) must to be satisfied.

Development for the purposes of mining is not permissible without Development Consent on the land within the Project Boundary (see Section 4.2.3). In addition, coal mining is listed under Clause 5 of Schedule 1 of the SRD SEPP. Since both limbs of Clause 8(1) are satisfied the Project is SSD. As a result, the Project will be subject to the provisions of Division 4.1 of Part 4 of the EP&A Act.

4.2.3 Permissibility

Section 89E(2) of the EP&A Act provides that *"Development consent may not be granted if the development is wholly prohibited by an environmental planning instrument"*.

The Project is located entirely within the Gunnedah LGA. The majority of the land within the Project Boundary is zoned as RU1 (Primary Production) with two small areas of land zoned as E3 (Environmental Management) under the *Gunnedah Local Environmental Plan 2012* (Gunnedah LEP). The zonings for the land within and surrounding the Project Boundary are shown in Figure 23.

All land within the Disturbance Boundary is zoned as RU1 (Primary Production). The land use table in the Gunnedah LEP states that open cut mining is permissible with Development Consent on land within Zone RU1.

The two areas of land within Zone E3 (Environmental Management) are within the Project Boundary but outside of the Disturbance Boundary. These areas are located immediately west of the Eastern Mining Area (Mt Watermark) and to the north of the Western Mining Area (Springhurst Hill). The land use table in the Gunnedah LEP states that mining is prohibited in Zone E3.

However, the permissibility of mining developments is also governed by *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2011* (Mining SEPP). Clause 7(1) of the Mining SEPP states that mining is permissible with consent on any land where agriculture and industry can be carried out (with or without development consent). Under the Gunnedah LEP, *"extensive agriculture"* can be carried out without Development Consent on land within Zone E3. Therefore, Clause 7(1) of the Mining SEPP provides that mining is permissible in Zone E3.

Clause 5 of the Mining SEPP states that where there is an inconsistency between the SEPP and another EPI, the SEPP will prevail to the extent of the inconsistency. The Mining SEPP will therefore override the Gunnedah LEP, which results in mining being permissible in Zone E3 (Environmental Management). As a result, mining is permissible on all land within the Project Boundary.

4.2.4 Consent Authority

Pursuant to section 89D of the EP&A Act, the Minister for Planning and Infrastructure (the Minister) is the consent authority for SSD. Section 23 of the EP&A Act enables the Minister to delegate his or her functions to a number of other persons or authorities. The Minister has delegated his functions as the consent authority for SSD in the following circumstances:

- To the PAC for development applications made by private proponents; and
- To the DP&I for development applications where there are less than 25 public submissions objecting to the development and where the local council has not objected.

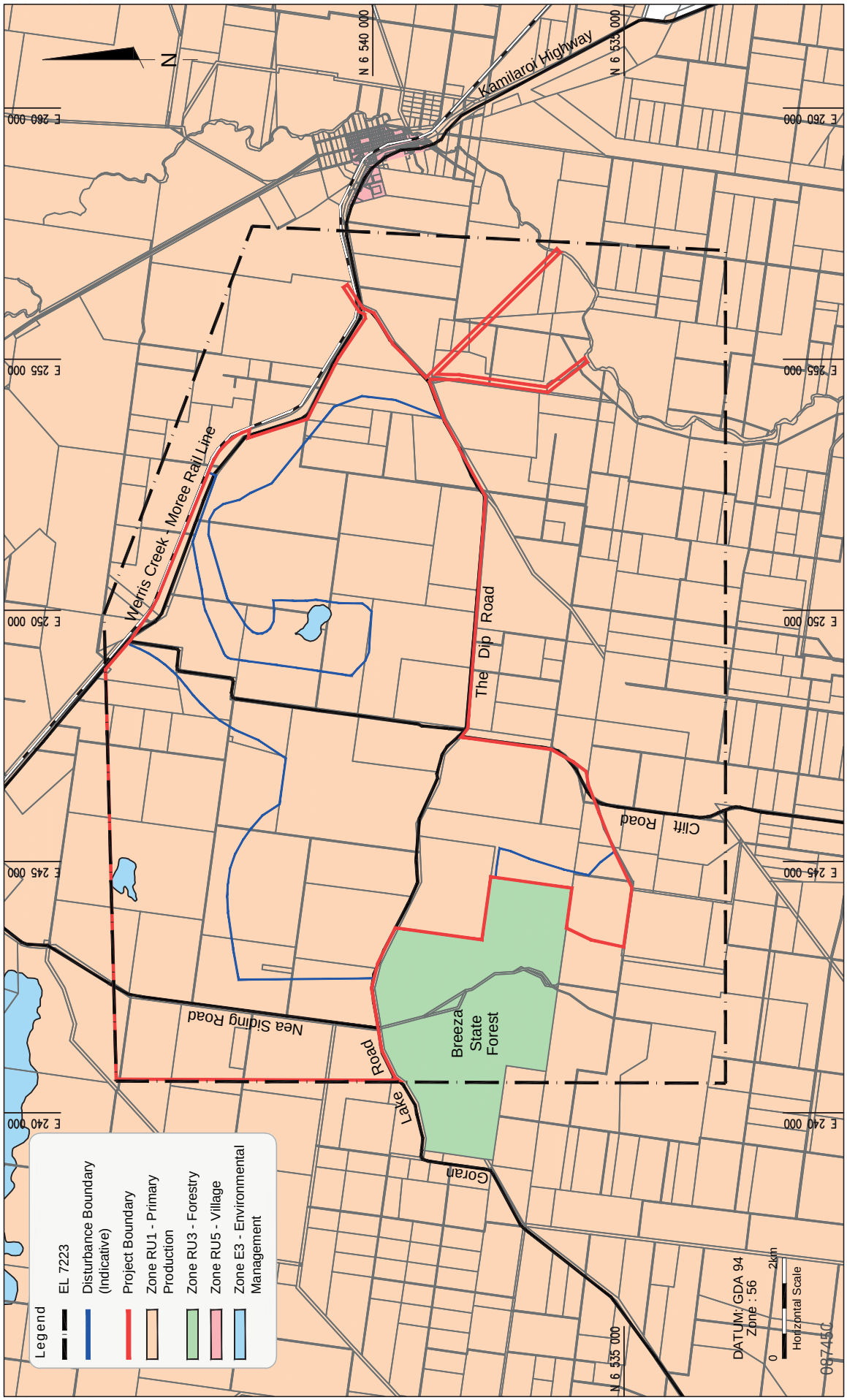
4.2.5 Need for an Environmental Impact Statement

Section 78(8A) states that a development application for SSD must be accompanied by an EIS prepared in accordance with the EP&A Regulation. The form and content requirements for an EIS are provided in Clauses 6 and 7 of Schedule 2 of the EP&A Regulation.

4.2.6 Director-General's Requirements

Clause 3 of Schedule 2 of the EP&A Regulation states that prior to the preparation of an EIS, the applicant must make a written application to the Director-General for DGRs. The DGRs list matters that must be addressed in the EIS. Shenhua Watermark made a request for DGRs on 14 October 2011. This request was supported by the *Watermark Coal Project Background Document, October 2011* (Hansen Bailey, 2011).

Following consultation with the relevant NSW government agencies and SEWPaC, the Director-General issued DGRs for the Project on 19 April 2012. Section 5 lists the DGRs and specifies where each has been addressed in this EIS.



WATERMARK COAL PROJECT

Land Zoning

FIGURE 23

Hansen Bailey
ENVIRONMENTAL CONSULTANTS

4.2.7 Public Participation

Under section 89F of the EP&A Act, the development application and supporting EIS must be placed on public exhibition for a period of at least 30 days. During this exhibition period, any person may make written submissions to the Minister regarding the proposed development.

4.2.8 Evaluation

Section 79C of the EP&A Act specifies the matters that the consent authority is to consider when determining a development application. The consent authority is to consider the following matters that are of relevance to the development application:

(1) Matters for consideration — general In determining a development application, a consent authority is to take into consideration such of the following matters as are of relevance to the development the subject of the development application:

(a) the provisions of:

(i) any environmental planning instrument, and

(ii) any proposed instrument that is or has been the subject of public consultation under this Act and that has been notified to the consent authority (unless the Director-General has notified the consent authority that the making of the proposed instrument has been deferred indefinitely or has not been approved), and

(iii) any development control plan, and

(iv) any planning agreement that has been entered into under section 93F, or any draft planning agreement that a developer has offered to enter into under section 93F, and

(v) the regulations (to the extent that they prescribe matters for the purposes of this paragraph), and

(vi) any coastal zone management plan (within the meaning of the Coastal Protection Act 1979),

(vii) that apply to the land to which the development application relates,

(b) the likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality,

(c) the suitability of the site for the development,

(d) any submissions made in accordance with this Act or the regulations,

(e) the public interest.

Section 9 describes how each of these matters has been addressed in this EIS.

4.2.9 Planning Assessment Commission

The Minister can refer a development application to the PAC for its review and report to the Minister. The functions of the PAC are prescribed by section 23D of the EP&A Act:

(1) The Commission has the following functions:

(a) any function delegated to the Commission under this Act,

(b) if requested to do so by the Minister or the Director-General:

(i) to advise the Minister or the Director-General as to planning or development matters, environmental planning instruments or the administration or implementation of the provisions of this Act, or any related matter, and

(ii) to review any (or any aspect or part of any) development, activity, infrastructure or project to which this Act applies, and

(iii) to hold a public hearing into any matter the subject of any such advice or review, and

(iv) (Repealed)

(v) to review a proposal to constitute, alter or abolish a development area under section 132 or 133,

(c) any function of a regional panel, an independent hearing and assessment panel or a planning assessment panel conferred on it by order in writing by the Minister,

(d) if a regional panel has not been appointed for any part of the State, any function that is conferred on a regional panel under an environmental planning instrument applicable to that part or that is otherwise conferred on a regional panel under this Act.

4.2.10 Determination and Appeals

Pursuant to section 80 of the EP&A Act, the consent authority can determine a development application by either granting consent or refusing consent. If the consent authority decides to grant consent, the consent can be either unconditional or subject to conditions.

Under section 82(1) of the EP&A Act, a development application is deemed to have been refused consent if a determination has not been made within the relevant period. The relevant period for SSD applications is 90 days, as provided by Clause 113 of the EP&A Regulation. Under section 82(2) of the EP&A Act, the expiration of the relevant period does not preclude the consent authority from making a determination. However, the deemed refusal of the development application does provide the applicant with a right of appeal.

Section 97 of the EP&A Act states that an applicant who is dissatisfied with the consent authority's determination can lodge an appeal in the Land and Environment Court within six months after the determination. If the appeal is against a deemed refusal under section 82(1) of the EP&A Act, the appeal must be commenced within six months after the expiration of the relevant period.

Section 98 of the EP&A Act allows an objector to appeal against a consent authority's decision to grant consent. The objector must commence appeal proceedings within 28 days after the date on which notice of the determination was given. Under section 23D(1)(b) of the EP&A Act, the Minister or Director-General can direct the PAC to hold a public hearing. Section 23F of the EP&A Act states that a determination made by the PAC cannot be challenged if it was made following a public hearing.

4.2.11 Development Contributions

Section 94 of the EP&A Act enables the consent authority to impose a condition requiring the applicant to provide a development contribution. The purpose of the contribution is to compensate public authorities for the costs of providing public amenities and services to satisfy the additional demand generated by the development. The contribution can be a dedication of land (free of charge or at reduced cost), a monetary contribution, or both.

Section 94A(1) of the EP&A Act allows the consent authority to impose a condition requiring the applicant to pay a levy proportional to the cost of the development. Pursuant to section 94A(2), a levy cannot be imposed if the applicant has been required to make a development contribution. That is, the consent authority cannot impose conditions under both section 94 and section 94A.

Section 93F of the EP&A Act enables the applicant to enter into a planning agreement with planning authorities. A planning agreement, often referred to as a Voluntary Planning Agreement (VPA), facilitates the provision of benefits by the applicant to compensate for the increased demand on infrastructure and services generated by the development as well as community enhancement. Section 93F(3A) states that if the consent authority is a party to the VPA, the agreement can preclude the consent authority from imposing a condition under section 94 or 94A.

Shenhua Watermark is currently negotiating separate VPAs with GSC, Tamworth Regional Council (TRC) and Liverpool Plains Shire Council (LPSC). Letters of offer have been provided to each council in this regard. If an agreement can be reached, Shenhua Watermark will offer to enter into the VPAs on the agreed terms. If such an agreement cannot be negotiated, the consent authority may impose a condition under section 94 of the EP&A Act in any consent requiring Shenhua Watermark to provide the necessary development contributions to address the increased demand for public amenities and services resulting from the Project.

4.2.12 Disclosure of Reportable Political Donations and Gifts

Pursuant to section 147 of the EP&A Act, an applicant is required to provide full disclosure of any political donations and gifts at the time of making a development application. A person making a submission regarding a development application is also required to provide full disclosure of any political donations and gifts. The existence of political donations and gifts are not grounds for challenging the validity of the consent authority's determination.

No relevant political donations or gifts have been made that would be reportable by Shenhua Watermark.

4.3 NSW Environmental Planning Instruments

The following sections provide a review of the EPIs that are applicable to the Project. EPIs include local environmental plans (LEPs) and SEPPs. Pursuant to section 79C(1)(a) of the EP&A Act, the consent authority is required to consider the relevant EPIs.

4.3.1 SEPP (Mining, Petroleum Production and Extractive Industries) 2007

The Mining SEPP provides as to the permissibility of mining related developments, and the additional matters that must be considered by consent authorities when evaluating development applications for mining developments. The provisions of the Mining SEPP concerning permissibility of mining have been discussed in Section 4.2.3.

The consent authority is required to consider the compatibility of the proposed development with surrounding land uses. Clause 12 of the Mining SEPP states that:

> *Before determining an application for consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must:*
>
> *(a) consider:*
>
> *(i) the existing uses and approved uses of land in the vicinity of the development, and*
>
> *(ii) whether or not the development is likely to have a significant impact on the uses that, in the opinion of the consent authority having regard to land use trends, are likely to be the preferred uses of land in the vicinity of the development, and*
>
> *(iii) any ways in which the development may be incompatible with any of those existing, approved or likely preferred uses, and*
>
> *(b) evaluate and compare the respective public benefits of the development and the land uses referred to in paragraph (a) (i) and (ii), and*

(c) evaluate any measures proposed by the applicant to avoid or minimise any incompatibility, as referred to in paragraph (a) (iii).

The land uses in the vicinity of the Project are described in Section 2. The land uses in the vicinity of the Project are agriculture, conservation areas / state forests and rural residential developments. The impacts of the Project on these land uses have been assessed in this EIS, and mitigation and management measures have been proposed to avoid or alleviate potential land use incompatibilities.

Clause 13 requires the consent authority to consider the compatibility of a proposed development with existing mines, petroleum production facilities and extractive industries. Clause 13 states that:

(1) Before determining an application to which this clause applies, the consent authority must:

(a) consider:

(i) the existing uses and approved uses of land in the vicinity of the development, and

(ii) whether or not the development is likely to have a significant impact on current or future extraction or recovery of minerals, petroleum or extractive materials (including by limiting access to, or impeding assessment of, those resources), and

(iii) any ways in which the development may be incompatible with any of those existing or approved uses or that current or future extraction or recovery, and

(b) evaluate and compare the respective public benefits of the development and the uses, extraction and recovery referred to in paragraph (a) (i) and (ii), and

(c) evaluate any measures proposed by the applicant to avoid or minimise any incompatibility, as referred to in paragraph (a) (iii).

There are no existing mines or petroleum production facilities within 20 km of the Project. As a result, the Project is not expected to have any impact on resource recovery at other existing operations.

Australian Coalbed Methane Pty Ltd is the holder of PEL 1, which encompasses all of the land within the Project Boundary. Santos has entered into a farm-in agreement with Australian Coalbed Methane on 15 June 2007. This agreement allows Santos to explore for petroleum within PEL 1. Petroleum production has not commenced within the boundaries of PEL 1 and cannot commence until a Petroleum Production Lease has been issued.

The extent of EL 7223 is limited to a depth of 1,100 m. EL 7223 is underlain by Authorisation 216, which is held by the Department of Trade and Investment, Regional Infrastructure and Services (DTIRIS) (on behalf of the Crown). Mining operations associated with the Project will be undertaken within the boundaries of EL 7223 and above a depth of 1,100 m. Therefore, the Project will not prejudice the recovery of the resources contained within Authorisation 216.

Pursuant to Clause 14, the consent authority is required to consider whether or not to impose conditions to ensure that the development is carried out in an environmentally responsible manner.

Clause 15 requires the consent authority to consider the development's efficiency of resource recovery. The consent authority must also consider whether or not to impose conditions to optimise the resource recovery. The Project has adopted a mine plan that seeks to optimise resource recovery without causing unacceptable environmental impacts. Shenhua Watermark has considered a number of alternatives for the recovery of the resource, as discussed in Section 3.12 and Appendix C. The Project was determined to be the most appropriate alternative for recovering the resource.

Pursuant to Clause 16, the consent authority must consider whether or not to impose conditions concerning the transportation of coal by public roads. The Project will not involve the transportation of coal by public road.

Under Clause 17, the consent authority must consider whether or not to impose conditions to facilitate the rehabilitation of the land. The Project will involve the rehabilitation of all land that is disturbed in the course of mining operations, as described in Section 7.21.

4.3.2 SEPP (State and Regional Development) 2011

SEPP (State and Regional Development) 2011 (SRD SEPP) governs whether or not a development constitutes SSD. The applicability of the SRD SEPP is discussed in Section 4.2.2.

4.3.3 SEPP 33 – Hazardous and Offensive Development

SEPP 33 – Hazardous & Offensive Development (SEPP 33) governs the assessment of developments for the purposes of a *"potentially hazardous industry"* or *"potentially offensive industry"*. These terms are defined in Clause 3 of SEPP 33.

The Project is a potentially hazardous industry since it could pose a significant risk to human health and the biophysical environment if mitigation measures were not implemented. Clause 12 of SEPP 33 provides that a preliminary hazard analysis must be prepared for any development application for a potentially hazardous industry. In accordance with this clause, a preliminary hazard analysis has been included in this EIS (see Section 7.23 and Appendix AC).

The Project has also been considered a potentially offensive industry as there is the potential to emit polluting discharges (e.g. dust, noise, saline water) if mitigation and management measures were not implemented.

Since the Project is a potentially hazardous industry and a potentially offensive industry, Clause 13 of SEPP 33 applies. This clause requires the consent authority to consider the following:

(a) *current circulars or guidelines published by the Department of Planning relating to hazardous or offensive development, and*

(b) *whether any public authority should be consulted concerning any environmental and land use safety requirements with which the development should comply, and*

(c) *in the case of development for the purpose of a potentially hazardous industry – a preliminary hazard analysis prepared by or on behalf of the applicant, and*

(d) *any feasible alternatives to the carrying out of the development and the reasons for choosing the development the subject of the application (including any feasible alternatives for the location of the development and the reasons for choosing the location the subject of the application), and*

(e) *any likely future use of the land surrounding the development.*

For the purposes of Clause 13(d), the alternatives to the Project are described in Section 3. The Project was deemed to be the only feasible alternative for the recovery of the coal resource.

4.3.4 SEPP 44 – Koala Habitat Protection

State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP 44) encourages the conservation and management of natural vegetation areas to ensure that there is ongoing protection of Koalas and their habitat.

Clause 5 of SEPP 44 provides that the SEPP only applies to lands within the LGAs listed in Schedule 1. The Gunnedah LGA is listed under Schedule 1 of the SEPP.

Clause 9 of SEPP 44 requires the preparation of a Koala Plan of Management where a development is proposed to be carried out on lands that constitute *"core Koala habitat"*. A Koala Plan of Management is required where important Koala populations and/or Koala habitat are under threat and where a council Koala Plan of Management has not been prepared. Koala habitat is identified by community and field-based surveys and ranked in terms of its quality (primary, secondary and tertiary habitat).

To determine whether the land constitutes *"core Koala habitat"*, the first step is to determine whether the land is *"potential Koala habitat"*.

"Potential Koala habitat" is defined under Clause 4 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"*. The Ecological Impact Assessment (see Section 7.10) undertaken for the Project has determined that the land is *"potential Koala habitat"*.

If the land is determined to be *"potential Koala habitat"*, the next step is to determine whether the land is *"core Koala habitat"*. Clause 4 of SEPP 44 defines *"core Koala habitat"* 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."*

The ecological surveys for this EIS have identified populations of Koalas within the Project Boundary. Therefore, the land within the Project Boundary constitutes *"core Koala habitat"*. A Koala Plan of Management has been prepared for the Project (see Appendix L), as required by Clause 9 of SEPP 44.



4.3.5 SEPP 55 – Remediation of Land

State Environmental Planning Policy 55 – Remediation of Land (SEPP 55) aims to promote the remediation of contaminated land. Clause 7 imposes the following obligations on a consent authority:

(1) *A consent authority must not consent to the carrying out of any development on land unless:*

(a) *it has considered whether the land is contaminated, and*

(b) *if the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out, and*

(c) *if the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land will be remediated before the land is used for that purpose.*

Pursuant to Clauses 7(2) and 7(4), a preliminary investigation must be undertaken for land that has previously been used for agriculture and mining. If the proposed development represents a change in use of this land, the consent authority cannot grant consent to the development application unless it has considered the preliminary investigation of the land. The Project will involve a change in the use of the land from agriculture to mining. Accordingly, the applicant has undertaken the required preliminary investigation, which is provided in Section 7.24 and Appendix AD.

4.3.6 REP 1 – Orana Regional Environmental Plan

REP 1 - Orana Regional Environmental Plan (OREP) is relevant to land within the Coonabarabran, Coonamble, Gilgandra Shires and the City of Dubbo. The purpose of the OREP is to protect the Anglo - Australian Telescope at the Siding Springs Observatory in the Warrumbungle Mountains from deleterious light spill from anthropogenic sources. Section 8 of the OREP provides that it may be necessary for Council to consult with the Observatory Director and obtain the concurrence of the Director of Planning prior to consenting to any application regarding land within 100 km of the observatory. At approximately 122 km from Siding Springs, the Project falls outside of the land potentially requiring concurrence or consultation.

However, in determining any development application, the Minister for Planning & Infrastructure (or delegate) will take into consideration the amount and type of light likely to be emitted by and from the Project and the probable effect of that emission on the level of artificial sky glow at the Siding Springs Observatory.

4.3.7 Gunnedah Local Environmental Plan 2012

The Gunnedah LEP prescribes as to the permissibility of development types and implements development controls for proposed developments in the Gunnedah LGA. The Project is situated entirely within the Gunnedah LGA.

Zone RU1 (Primary Production)

As shown in Figure 23, the Project is predominantly located on land zoned as RU1 (Primary Production). All disturbance works associated with the Project will occur on land within Zone RU1. The objectives of the zone are stated in the land use table in the Gunnedah LEP:

- *To encourage sustainable primary industry production by maintaining and enhancing the natural resource base;*
- *To encourage diversity in primary industry enterprises and systems appropriate for the area;*
- *To minimise the fragmentation and alienation of resource lands;*
- *To minimise conflict between land uses within this zone and land uses within adjoining zones;*
- *To provide for a range of ecologically sustainable agricultural and rural land uses and development on broad acre rural lands;*
- *To protect significant agricultural resources (soil, water and vegetation) in recognition of their value to Gunnedah's longer term economic sustainability; and*
- *To conserve and enhance the quality of valuable environmental assets, including waterways, riparian land, wetlands and other surface and groundwater resources, remnant native vegetation and fauna movement corridors as part of all new development and land use.*

The land use table provides that open cut mining is permissible with consent in zone RU1.

Zone E3 (Environmental Management)

Two small areas of land within the Project Boundary are zoned as E3 (Environmental Management). These areas are located immediately west of the Eastern Mining Area (Mt Watermark) and to the north of the Western Mining Area (see Figure 23). The objectives of the zone are listed in the land use table:

- *To protect, manage and restore areas with special ecological, scientific, cultural or aesthetic values; and*
- *To provide for a limited range of development that does not have an adverse effect on those values*.

Under the Gunnedah LEP, mining is prohibited in Zone E3. However, Clause 7(1) of the Mining SEPP provides that mining is permissible on any land where agriculture is permissible. Since agriculture is permissible in Zone E3, the Mining SEPP provides that mining is also permissible within Zone E3 (see Section 4.2.3). Pursuant to Clause 5(3) of the Mining SEPP, the SEPP prevails over the Gunnedah LEP to the extent of any inconsistency. Therefore, mining is permissible on areas of land zoned as E3 (Environmental Management).

4.4 Requirements Under Other NSW Legislation

In order to carry out the Project, Shenhua Watermark will require a number of approvals in addition to Development Consent. Since the Project constitutes SSD, section 89K of the EP&A Act applies. Section 89K states that the following authorisations must be granted in terms that are substantially consistent with the consent for the Project being SSD:

(a) *an aquaculture permit under section 144 of the Fisheries Management Act 1994,*

(b) *an approval under section 15 of the Mine Subsidence Compensation Act 1961,*

(c) *a mining lease under the Mining Act 1992,*

(d) *a production lease under the Petroleum (Onshore) Act 1991,*

(e) *an environment protection licence under Chapter 3 of the Protection of the Environment Operations Act 1997 (for any of the purposes referred to in section 43 of that Act),*

(f) a consent under section 138 of the Roads Act 1993,

(g) a licence under the Pipelines Act 1967.

Each of the above that is relevant to the Project is described further below.

4.4.1 Mining Act 1992

The mining of coal in NSW is regulated by the Mining Act, which is administered by the Minister for Resources and Energy. Under section 5 of the Mining Act, it is an offence to mine for minerals except in accordance with a valid authorisation. Section 6 of the Mining Act provides that a valid authorisation is also required for certain developments that are incidental to mining, including water storages, tailings dams and stockpiles.

Shenhua Watermark will obtain the necessary Mining Lease (ML) prior to commencing the Project. The ML application area will be consistent with the Project Boundary for the Project. Under section 51(3) of the Mining Act, an application for a ML can only be made by the holder of an EL or assessment lease over that land. Shenhua Watermark currently holds EL 7223, which includes the entire Project Boundary. Therefore, Shenhua Watermark is eligible to apply for a ML for the Project. Pursuant to section 89K(1)(c) of the EP&A Act, a ML must be issued for any development that has been granted Development Consent under Division 4.1 of Part 4.

4.4.2 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) establishes a licensing system to control and manage pollution. Section 48 of the POEO Act provides that an environment protection licence (EPL) is needed for the carrying out of scheduled activities under the Act. Under Clause 28 of Schedule 1 of the POEO Act, *"mining for coal"* is declared to be a scheduled activity if the daily production exceeds 500 t, or if the disturbance area exceeds 4 ha. Therefore, the Project is a scheduled activity and will require an EPL.

Shenhua Watermark will apply for the necessary EPL prior to commencing the Project. Pursuant to section 89K(1)(e) of the EP&A Act, an EPL must be granted if it is necessary for the carrying out of a development that has been granted development consent. Pursuant to section 89K(1)(e) of the EP&A Act, the EPL must be issued in terms that are substantially consistent with the development consent.



4.4.3 Roads Act 1993

The *Roads Act 1993* (Roads Act) provides for the dedication of classified and unclassified roads and confers functions on public authorities in relation to the management of roads. Under section 138(1) of the Roads Act, a structure cannot be erected in, on or over a public road unless the appropriate roads authority has given consent. The Project will involve the construction of a road over rail pass for the Kamilaroi Highway. Accordingly, consent under section 138 of the Roads Act will be required for this work. Under section 7(4) of the Roads Act, the local council is the roads authority for the section of a highway within that LGA.

Under section 138(2) of the Roads Act, consent from the appropriate roads authority is required for any works that will disturb the surface of the road. The Project will involve mining through Court Lane, part of The Dip Road, Rowarth Road, Whitby Road and some unnamed minor roads (see Section 7.16). As such, approvals under section 138 will be required prior to mining. Since these roads are neither freeways nor Crown roads, GSC is the roads authority for these roads.

Pursuant to section 89K(1)(f) of the EP&A Act, consent under section 138 of the Roads Act cannot be refused if it is necessary for the carrying out of a project that has been granted Development Consent.

The roads that will be mined through will need to be permanently closed. An application for closure of public roads will need to be made under section 34 of the Roads Act. Section 34 states that:

(1) An application for the closing of a public road (other than a freeway) may be made:

(a) in the case of a Crown road, by any person, and

(b) in the case of any other public road, by the roads authority for the road or by any other public authority.

Since the relevant roads are not Crown roads, the application can only be made by the relevant roads authority. Pursuant to section 7(4) of the Roads Act, the roads authority for these roads is GSC. Following the grant of Development Consent, Shenhua Watermark will request that GSC apply to the Minister for Roads and Ports for closure of these roads.

4.4.4 Pipelines Act 1967

The *Pipelines Act 1967* (Pipelines Act) imposes licensing requirements for the construction and operation of pipelines. The Project will require the construction of pipelines for the transfer of clean water, mine water and wastewater across the site. Section 11 of the Pipelines Act provides that a pipeline shall not be constructed except where authorised by a licence issued under the Act.

However, section 5(1)(d) of the Pipelines Act states that a licence is not required for pipelines that are used for the supply of water or the conveyance of wastewater, mine water or mineral tailings. Therefore, the Project will not require a licence under the Pipelines Act.

4.4.5 Water Management Act 2000 and Water Act 1912

The *Water Act 1912* (Water Act) regulated activities which relate to or impact upon water sources in NSW including provisions for the licensing of taking of water from water sources. The *Water Management Act 2000* (WM Act) has been progressively replacing the Water Act as relevant Water Sharing Plans (WSPs) are introduced for each water source and proclamations are made by the Minister for Water which commences the majority of the licensing and approval provisions of the WM Act in respect of water sources subject to a WSP.

The licensing and approvals provisions of the Water Act continue to apply to the extent that they have not been replaced by the WM Act through the introduction of WSPs and commencement of licensing and approvals provisions by proclamation.

All water sources affected by the Project are now subject to a WSP.

Water Act

Section 180 of the Water Act provides that it is an offence to construct a *"controlled work"* without an approval. The "*controlled work"* provisions of the Water Act apply until such time as the *"flood work"* provisions under Part 3 of Chapter 3 of the WM Act are commenced.

Section 165A relevantly defines a "*controlled work"* as:

> *"(1)(a) an earthwork, embankment or levee that is situated, or proposed to be constructed on land that:*
>
> *(i) is, or forms part of, the bank of a river or lake; or*
>
> *(ii) is within a floodplain; or…*
>
> *(c) an earthwork embankment or levee, wherever situated or proposed to be constructed, that:*
>
> *(i) affects or is reasonably likely to affect the flow of water to or from a river or lake; and*
>
> *(ii) is used or is to be used for, or has the likely effect of, preventing land from being flooded by water..."*

A *"floodplain"* means any land which is so designated by order published in the Gazette under Section 166(1) of the Water Act. Any land within the Liverpool Plains that has a slope of less than 2% slope is a designated floodplain.

Limited and minor flood levees will be constructed as required in potential inundation areas as part of the Project. If the levees are within a "floodplain", or will affect the flow of water to or from a river or lake and will prevent land from being flooded by water, a "controlled work" approval will be sought under Part 8 of the Water Act.

Water Sharing Plans

The Project Boundary lies within the Namoi River Catchment and the Murray-Darling Basin. The following water sources and WSPs are relevant to the Project (Figure 24):

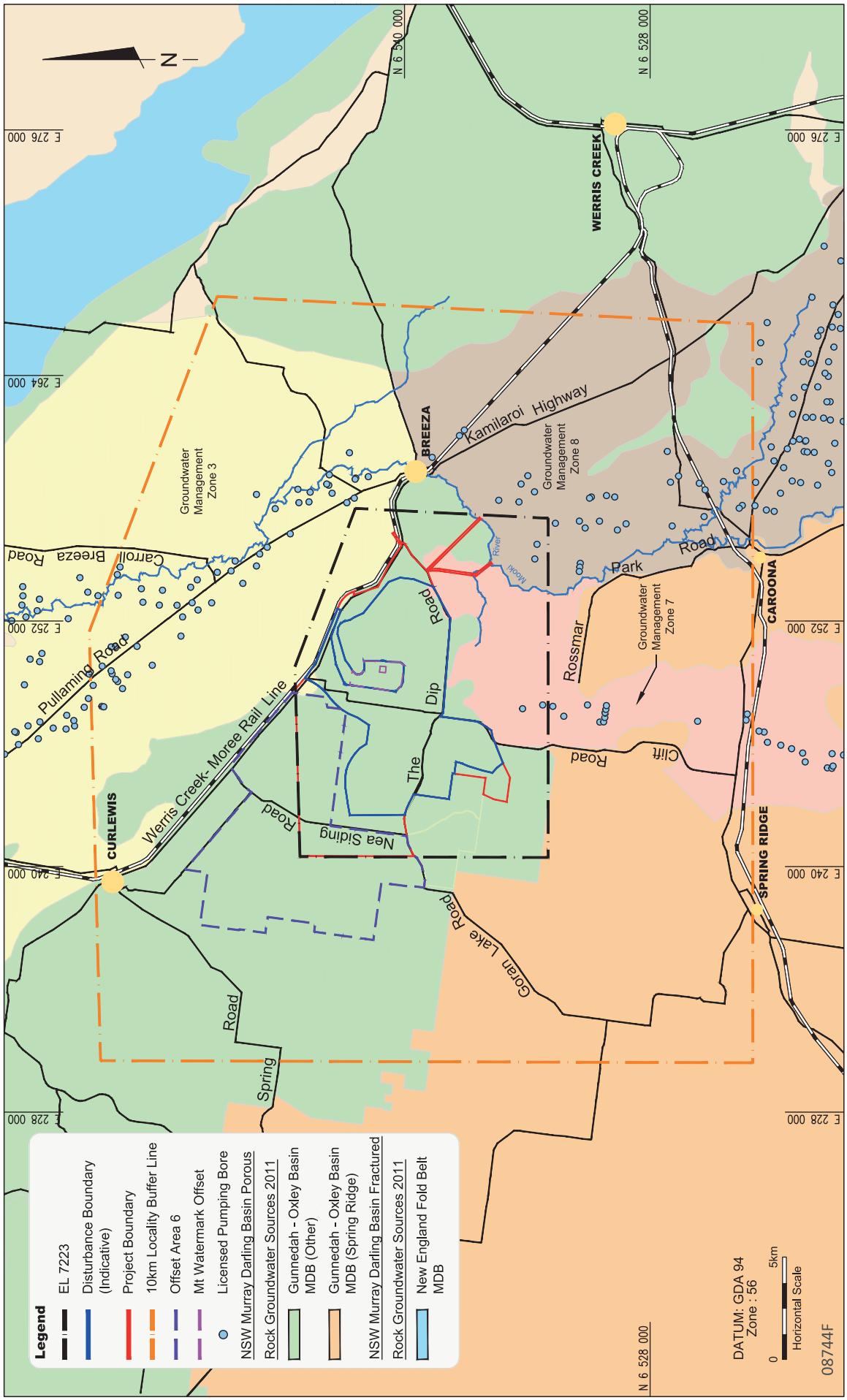
- *Water Sharing Plan for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2011* (Porous Rock WSP), as developed under the WM Act, particularly with regard to the following groundwater sources:
  - Gunnedah – Oxley Basin (Other) Porous Rock Groundwater Source; and
  - Gunnedah – Oxley Basin (Spring Ridge) Porous Rock Groundwater Source.
- *Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003*, as developed under the WM Act, particularly with regard to the following groundwater sources:
  - Upper Namoi Zone 3, Mooki Valley (Breeza to Gunnedah) Groundwater Source;
  - Upper Namoi Zone 7, Yarraman Creek (East of Lake Goran to Mooki River) Groundwater Source;
  - Upper Namoi Zone 8, Mooki Valley (Quirindi – Pine Ridge Road to Breeza) Groundwater Source; and
  - All water contained in the "unconsolidated alluvial sediment aquifers associated with the Namoi River and its tributaries" (but excludes the underlying Great Artesian Basin).
- *Water Sharing Plan for the Phillips Creek, Mooki River, Quirindi Creek and Warrah Creek Water Sources 2003* – Mooki River water source.
- The *Water Sharing Plan for the Namoi Unregulated and Alluvial Water Sources 2012* – Lake Goran water source.

Water Access Licences

Section 60A of the WM Act provides that it is an offence to take water from a water source without a Water Access Licence (WAL). Similarly, it is an offence to take water in contravention of a WAL, as provided by section 60B of the WM Act. It is also an offence to take a quantity of water exceeding the water allocation under a WAL, as provided by section 60C of the WM Act.

For the purposes of the licensing provisions of the WM Act, the proponent will "take" water if, as a result of or in connection with, the mining activity carried out by the proponent, water is removed or diverted from a water source (whether or not water is returned to that water source) or water is relocated from one part of an aquifer to another part of an aquifer.

The Groundwater and Surface Water Impact Assessments undertaken for the Project have modelled and calculated the amounts of water which will be taken from each relevant water source by or as a result of the Project in each year of the Project and after.



WATERMARK COAL PROJECT

Water Users and Management Zones

FIGURE 24

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Those amounts are set out in the reports and summarised in Section 7.1 & 7.3. The amounts estimated as required for the Project are based upon the maximum amount of annual take from each relevant water source in the year of the Project in which the most water is taken from that water source. Shenhua Watermark has undertaken a comprehensive study of the water licences available or issued for each of the water sources from which water will be taken as a result of the Project. This is discussed in Section 7.1.4.

The DGRs for the Project require an assessment of the Aquifer Interference Policy (which was released in its final form in September 2012) (AIP). Page 11 of the AIP requires a proponent of a mining project to have "*… ability to demonstrate that they have the ability to obtain the necessary licences in order to account for the take of water from any relevant water source*."

Water Management System

Clause 18(1) of the *Water Management (General) Regulation 2011* (WM Regulation) states that a WAL is not required for any of the purposes listed under Part 1 of Schedule 5 of the WM Regulation. 'Excluded works' are listed under Part 1 of Schedule 5 as a purpose that does not require a WAL. 'Excluded works' are defined in Schedule 1 of the WM Regulation and include:

> *Dams solely for the capture, containment and recirculation of drainage and / or effluent, consistent with best management practice or required by a public authority (…) to prevent the contamination of a water source, provided such dams are located on a minor stream.*

Therefore, a WAL does not need to be obtained for water captured in sediment dams.

Approvals Under the Water Management Act

Section 91A of the WM Act provides that "*A person who uses water from a water source to which this Part applies, and who does not hold a water use approval for that use, is guilty of an offence*".

Section 89 of the WM Act specifies that a water use approval may authorise use of water.

Section 91B of the WM Act provides that "*A person who constructs or uses a water supply work, and who does not hold a water supply work approval for that work, is guilty of an offence*".

Section 90 of the WM Act specifies that a water supply work approval may authorise the construction or use of a water supply work.

Section 91E of the WM Act provides that "*A person who carries out a controlled activity in, on or under waterfront land, and who does not hold a controlled activity approval for that activity, is guilty of an offence*".

Section 91F of the WM Act which prohibits the carrying out of an aquifer interference activity without approval has not yet commenced in the area of or in respect of any water sources relevant to the Project. However, the AIP published in September 2012 is relevant due to the DGRs and is referred to elsewhere in this section.

Section 91 of the WM Act specifies that a controlled activity approval and aquifer interference activity approval may authorise controlled activities or aquifer interference activities as the case may be.

Pursuant to section 89J(1)(g) of the EP&A Act, the Project will not require approval under sections 89, 90 and 91 of the WM Act (except aquifer interference approvals which provisions have not yet commenced).

Aquifer Interference Policy

The DGRs for the Project require an assessment of the *Aquifer Interference Policy*.

The AIP requires proponents to hold water licences to account for all water taken from groundwater and surface water sources as a result of the Project. Section 7.1.4 summarises the predicted water take due to the Project and water licences required for the Project.

The AIP sets out "minimal impact considerations" and indicates that "*if the predicted impacts are less than the Level 1 minimal impact considerations, then these impacts will be considered as acceptable*". The Project complies with the AIP as the predicted impacts of the Project are all less than the Level 1 requirements outlined below:

(a) *For both highly and less productive groundwater sources, changes in pressures and water tables due to the Project should not induce a decline of more than 2m at any water supply work (i.e. a bore or a well);*

(b) *The AIP minimal impact considerations protect water quality by requiring "any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40m from the activity";*

(c) *To protect surface water, the AIP requires "no increase of more than 1% per activity in the long term average salinity in a highly connected surface water source at the nearest point to the activity";*

(d) *The AIP also sets out set back distances for mining activities from a highly connected water source that is defined as a reliable water supply. The AIP states "no mining activity to be below the ground surface within 200m laterally from the top of high bank or 100m vertically beneath (or the three dimensional extent of the alluvial water source – whichever is the lesser distance) of a highly connected surface water source that is defined as a reliable water supply."; and*

(e) *The AIP also limits the amount of alluvial material that can be excavated by an activity by requiring "not more than 10% cumulatively of the three dimensional extent of the alluvial material in this water source to be excavated by mining activities…" .*

These matters are further considered in Section 7.1 and 7.3.

Other Water Resource Policies

The requirements of the water resources policies stipulated in Attachment 2 to the DGRs have been addressed in the Groundwater and the Surface Water Impact Assessments.

4.4.6 Dams Safety Act 1978

The *Dams Safety Act 1978* (Dams Safety Act) requires the NSW Dams Safety Committee (DSC) to "*formulate measures to ensure the safety of dams*" and to "*maintain a surveillance of prescribed dams*". A *"prescribed dam"* is any dam listed under Schedule 1 of the Dams Safety Act.

The Project will involve the construction of the Main Dam, which is a potential prescribed dam. The dam will be referred to the DSC in the course of the stakeholder consultation undertaken for this EIS. If one or more of the dams are deemed to be prescribed dams, these dams will be regulated by the Dams Safety Act and the DSC.

4.4.7 Coal Mine Health and Safety Act 2002

The primary objective of the *Coal Mine Health and Safety Act 2002* (CMHS Act) is to assist in achieving the objectives of the *Work Health and Safety Act 2011* that relate to coal mines. The CMHS Act imposes requirements necessary for the management of particular risks arising from the mining of coal.

Of particular relevance are the provisions pertaining to tailings emplacement areas. Under section 100 of the CMHS Act, emplacement areas can only be established with the approval of the Minister.

The Project will operate without any dedicated tailings emplacement areas. Instead, fine tailings will be dewatered and co-disposed with overburden. However, *"emplacement area"* is defined broadly under section 98 of the CMHS Act, and includes *"any pile, heap, hole, excavation or place in which or on which reject (whether in a solid state or in a solution or suspension) is piled, heaped, dumped, accumulated, deposited or placed*". The OEAs, in which tailings will be co-disposed, fall within this definition of *"emplacement areas"*. Therefore, Shenhua Watermark will need to obtain the approval of the Minister under section 100 of the CMHS Act.

4.4.8 Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) lists and defines threatened species, populations and ecological communities, and critical habitat within NSW. The TSC Act also provides a framework for the assessment of a development's impacts on threatened species. A detailed assessment of the Project's impacts on threatened species and ecological communities is provided at Section 7.10. Under section 114 of the TSC Act, the Director-General can make a *"stop work order"* to restrain an action that is likely to harm threatened species, populations, ecological communities and critical habitat. However, section 114(4)(a) provides that a *"stop work order"* cannot be made where the action is authorised by a Development Consent under the EP&A Act.

4.5 Exemptions from other approval requirements

Since the Project constitutes SSD, the applicant receives the benefit of section 89J of the EP&A Act. Under section 89J, the following authorisations are not required for any SSD that has been granted development consent:

- *A permit under section 201, 205 or 219 of the Fisheries Management Act 1994,*
- *An approval under Part 4, or an excavation permit under section 139 of the Heritage Act 1977,*
- *An Aboriginal heritage impact permit under section 90 of the National Parks and Wildlife Act 1974,*
- *An authorisation referred to in section 12 of the Native Vegetation Act 2003 (or under any Act repealed by that Act) to clear native vegetation or State protected land,*
- *A bushfire safety authority under section 100B of the Rural Fires Act 1997,*
- *A water use approval under section 89, a water management work approval under section 90 or an activity approval (other than an aquifer interference approval) under section 91 of the WM Act.*

The approvals which are potentially relevant to the Project are discussed in the following sections.

4.5.1 Heritage Act 1977

The *Heritage Act 1977* (Heritage Act) governs the management of items of European heritage significance (referred to as *"relics"*). Section 139(1) of the Heritage Act states that *"A person must not disturb or excavate any land knowing or having reasonable cause to suspect that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed unless the disturbance or excavation is carried out in accordance with an excavation permit"*.

By virtue of section 89J(1)(c) of the EP&A Act, an excavation permit is not required for a development that has been granted Development Consent.

A detailed assessment of the Project's impacts on historic heritage items is provided at Section 7.15.

4.5.2 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) aims to facilitate the conservation of the natural environment and the protection of Aboriginal objects and places. Under section 86 of the NPW Act, it is an offence to harm or desecrate an Aboriginal place or object except in accordance with an Aboriginal Heritage Impact Permit (AHIP) issued under section 90 of the NPW Act.

Pursuant to section 89J(1)(d) of the EP&A Act, the granting of Development Consent will remove the requirement to obtain an AHIP prior to the salvage or destruction of Aboriginal objects. However, Aboriginal cultural heritage impacts assessments and management plans are required and must be consistent with OEH guidelines. A detailed assessment of the Project's impacts on Aboriginal archaeology and cultural heritage is provided at Section 7.13 and 7.14.

Part 8A of the NPW Act establishes offences pertaining to the harming of threatened species, populations, ecological communities, and critical habitats. However, sections 118A(3)(b)(i), 118C(5)(b)(i) and 118D(2)(b)(i) state that a valid defence exists where the act causing the harm is essential to the carrying out of a development for which development consent has been granted.

Nonetheless, a Section 120 and Section 127 licence under the NPW Act may be required for the Project to facilitate any Koala relocations, as agreed with OEH.

4.5.3 Native Vegetation Act 2003

The *Native Vegetation Act 2003* (NV Act) aims to promote the management of native vegetation on a regional scale and to protect native vegetation of high conservation value. Section 12 of the NV Act states that native vegetation cannot be cleared except in accordance with a development consent granted under the EP&A Act or a Property Vegetation Plan. The Project will only involve the clearing of native vegetation where such clearing is authorised by a Development Consent.

4.6 Plans and Policies

4.6.1 Strategic Regional Land Use Plan – New England North West

The NSW government released the draft *Strategic Regional Land Use Plan – New England North West* which was placed on public exhibition from 8 March to 14 May 2012. During the exhibition period, over 2,000 submissions were received, representing the views of farmers, mining stakeholders, and the wider community. On 11 September 2012 the government released the Strategic Regional Land Use Policy and the finalised *Strategic Regional Land Use Plan – New England North West* (SRLUP) as part of a package which sets out a range of initiatives to better balance growth in the mining and coal seam gas industries with the need to protect important agricultural land and water resources.

The SRLUP establishes the *"Gateway"* process. The Gateway process is an independent and scientific assessment of the impacts of a state significant mining development on the agricultural value of the land. The Gateway process occurs prior to the planning assessment process under the EP&A Act. A mining proposal to which the Gateway process applies will be assessed by an independent panel of experts known as the *"Gateway Panel"*. A development application can only be lodged after the panel has issued a *"Gateway certificate"* for the proposed development which must be issued and may be unconditional or conditional.

The Gateway process will be implemented through an amendment to the Mining SEPP. This amendment has not yet been made, and as such, current mining proposals are not subject to the Gateway process.

Projects that have received DGRs and are located on *"Strategic Agricultural Land"* (SAL) will not be required to go through the Gateway process; however, will be subject to a range of transitional measures, including:

- Referral to the Gateway Panel for advice;
- Requirement to prepare an Agricultural Impact Statement (AIS);
- Assessment against the *Aquifer Interference Policy* (AIP) (NOW, September 2012); and
- Referral to the Independent Expert Scientific Committee for advice.

Applicability of the Gateway Process

The Gateway process will apply to all proposals for new mines, as well as expansions of existing mines beyond the boundaries of existing MLs. The Gateway process will not apply to proposed expansions of existing mines that will occur entirely within existing MLs.

The applicability of the Gateway process is only dependent on the nature of the proposal. It is not dependent on the nature of the land on which the proposal is located.

Strategic Agricultural Land

The SRLUP introduces the concept of SAL, which is defined as highly productive land that has both unique natural resource characteristics (such as soil and water resources) as well as a socio-economic value (such as high productivity, infrastructure availability and access to markets). There are two categories of SAL: *"Biophysical Strategic Agricultural Land"* (BSAL) and "*Critical Industry Cluster*" land (CIC).

The criteria used to identify areas of BSAL and CIC are listed in Table 1 of the SRLUP. Land only constitutes SAL if the criteria for either BSAL or CIC are satisfied. These criteria are reproduced in Table 11.

The areas identified as being BSAL are illustrated on Map 6 of the SRLUP. There is no land mapped as CIC within the New England North West region. There is a significant amount of BSAL in the region, including in the locality of the Project. Figure 25 illustrates the location of the Project Boundary and Disturbance Boundary relative to areas mapped as BSAL. There are 96 ha of land mapped as BSAL within the Disturbance Boundary.

Verification Process

The mapping of BSAL (Map 6 of the SRLUP) is merely indicative of areas that constitute SAL. The first phase of the Gateway process is site verification to determine whether or not the land actually constitutes BSAL. Site verification involves assessing the land against the criteria listed in Table 11. The land is only verified as being BSAL if the criteria are satisfied.

Table 11 Verification Criteria for Biophysical Strategic Agricultural Land

Value	Criteria	Project	EIS Section
Biophysical Strategic Agricultural Land	Land that falls under soil fertility classes 'high' or 'moderately high' under the Draft Inherent General Fertility of NSW (OEH), and	✓	7.19
	Land capability classes I, II or III under the Land and Soil Capability Mapping of NSW (OEH), and	✓	7.19
	Reliable water of suitable quality, characterised by land having rainfall of 350 mm or more per annum (9 out of 10 years); or properties within 150 m of a regulated river, or unregulated rivers where there are flows for at least 95% of the time (i.e. the 95th percentile flow of each month of the year is greater than zero) or 5th order and higher rivers; or groundwater aquifers (excluding miscellaneous alluvial aquifers, also known as small storage aquifers) which have a yield rate greater than 5L/s and total dissolved solids or less than 1,500 mg/L	✓	7.1 and 7.3
	OR		
	Land that falls under soil fertility classes 'moderate' under the Draft Inherent General Fertility of NSW (OEH), and	✓	7.19
	Land Capability classes I or II under the Land and Soil Capability Mapping of NSW (OEH), and	×	7.19
	Reliable water of suitable quality, characterised by land having rainfall of 350 mm or more per annum (9 out of 10 years); or properties within 150 m of a regulated river, or unregulated rivers where there are flows for at least 95% of the time (i.e. the 95th percentile flow of each month of the year is greater than zero) or 5th order and higher rivers; or groundwater aquifers (excluding miscellaneous alluvial aquifers, also known as small storage aquifers) which have a yield rate greater than 5L/s and total dissolved solids or less than 1,500 mg/L	✓	7.1 and 7.3
Critical Industry Cluster	Industry clusters that meet the following criteria: • There is a concentration of enterprises that provides clear development and marketing advantages and is based on an agricultural product; • The productive industries are interrelated; • It consists of a unique combination of factors such as location, infrastructure, heritage and natural resources; • It is of national and/or international importance; • It is an iconic industry that contributes to the region's identity; and • It is potentially substantially impacted by coal seam gas or mining proposals	N/A	N/A

N/A Not Applicable

If a proposed mining development is located on land that is mapped as BSAL, the proponent can undertake verification to determine whether the land is actually BSAL. If the verification determines that the land does not constitute BSAL, the proposal will not require an assessment under the Gateway process, and can proceed directly to the assessment process under the EP&A Act. If the land is confirmed as being BSAL, the proposal will require an assessment under the Gateway process. Alternatively, the proponent can waive the right to undertake site verification. That is, the proponent can accept that the land is BSAL and proceed directly to the assessment phase of the Gateway process.

If a proposed mining development is located on land that is not mapped as BSAL, the proponent must undertake site verification. If the verification process determines that the land is in fact BSAL, contrary to the mapping, the proposal will require an assessment under the Gateway process. Table 11 indicates whether the land within the Project Boundary satisfies the verification criteria.

Assessment

If a mining proposal is located on land that has been confirmed as BSAL, the proposal will be assessed by the Gateway Panel against the criteria listed in Table 2 of the SRLUP. The assessment criteria are reproduced in Table 12. The Gateway Panel will also consider the advice of the Commonwealth Independent Expert Scientific Committee.

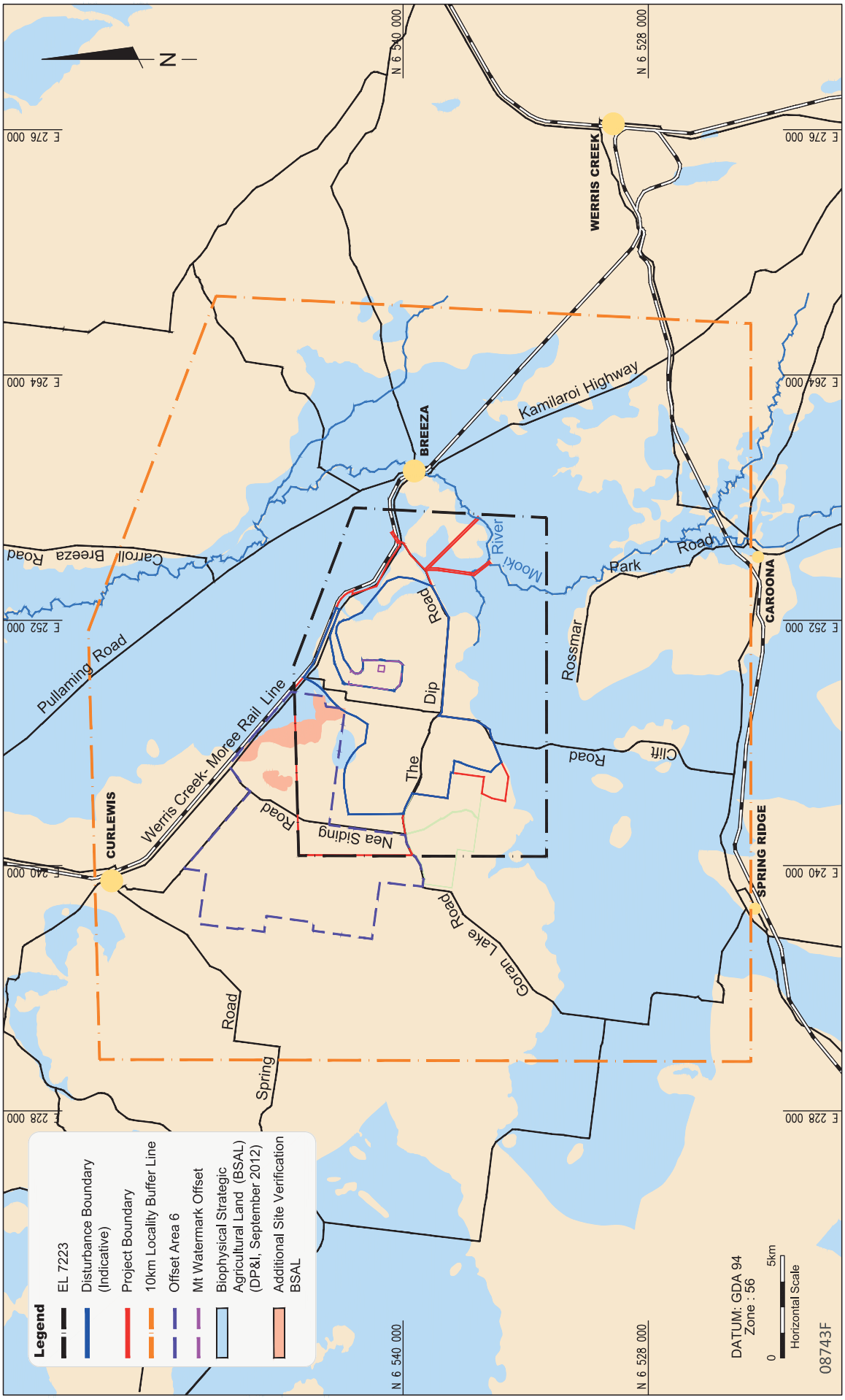
If a proposal can demonstrate that it meets the assessment criteria, a Gateway certificate will be issued unconditionally. The proposal then can proceed to a full merits assessment under Part 4 of the EP&A Act. If a proposal cannot demonstrate compliance with all the assessment criteria, the proposal will be issued a Gateway certificate subject to conditions. These conditions must be addressed in the assessment under the EP&A Act.

4.6.2 Strategic Agricultural Land Assessment Policy

Whilst the government considers the implementation of the SRLUP, it has adopted the *Interim Strategic Agricultural Land Policy for State Significant and Transitional Part 3A Mining and Coal Seam Gas Proposals in the Upper Hunter and New England North West Regions* (Strategic Agricultural Land Assessment Policy). This policy is legally enforceable as it was attached to the DGRs for the Project issued on 19 April 2012.

The SAL Assessment Policy states that:

> *Projects which have not commenced public exhibition or that have not been deemed adequate for public exhibition as at 6 March 2012 (date of commencement of the draft SRLUPs) will be required to submit an AIS that includes a specific focused assessment of the impacts of the proposal on strategic agricultural land, having regard to the draft gateway criteria in the draft SRLUPs.*



WATERMARK COAL PROJECT

Biophysical Strategic Agricultural Land

FIGURE 25

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Table 12 Assessment Criteria for Biophysical Strategic Agricultural Land

Value	Criteria	EIS Section
Biophysical Strategic Agricultural Land	Whether the proposal would significantly reduce the agricultural productivity of the land based on a consideration of: (a) Impacts on the land through surface area disturbance and subsidence;	7.19 and 7.20
	(b) Impacts on: (i) Soil fertility (ii) Rooting depth, or (iii) Soil profile materials and thickness	7.19 and 7.20
	(c) Increases in land surface microrelief or soil salinity, or significant changes to soil pH, and	7.19 and 7.20
	(d) Impacts on highly productive groundwater, including the provisions of the Aquifer Interference Policy and the advice of the Minister for Primary Industries (note that the Minister for Primary Industries must take into account the advice of the Commonwealth Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development in providing advice in this stage)	7.1 and 7.20
Critical Industry Cluster	Whether the proposal would lead to significant impacts on the CIC through:	N/A
	(a) Surface area disturbance	N/A
	(b) Subsidence	N/A
	(c) Cost Benefit Reduced access to agricultural resources	N/A
	(d) Reduced access to support services and infrastructure	N/A
	(e) Reduced access to transport routes	N/A
	(f) Loss of scenic and landscape values	N/A
Consultation	Any advice on water impacts received from the Commonwealth Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development	No advice received

N/A Not Applicable

In accordance with this requirement, this EIS includes an AIS, which addresses the Gateway criteria outlined in the SRLUP (see Table 12). The AIS is discussed further in Section 7.20 and is provided in Appendix Z.

4.6.3 Consistency with the Namoi Catchment Authority Plans & Policies

Namoi Catchment Action Plan 2010 - 2020

The *Namoi Catchment Action Plan 2010 – 2020* (Namoi CMA, 2011a) (Namoi CAP) provides a number of strategic biodiversity and land use objectives for the period to 2020, including that:

- Woody vegetation cover at 30% in cleared sub-catchments;
- Woody vegetation cover at 70% in intact sub-catchments; and
- 61% of Regional Vegetation Communities maintain 30% extent.

The Namoi CAP also aims to ensure that by 2020:

- There is an increase in native vegetation extent and vegetation does not decrease to less than 70% in less cleared sub-catchments and 30% in over cleared sub-catchments and no further Regional Vegetation Community decreases to less than 30% extent as identified by 2010 baseline;
- Sustainable populations of a range of native fauna species are maintained by ensuring that no further Regional Vegetation Community decreases to less than 30% extent as identified by 2010 baseline;
- Contribution is made to the recovery of priority viable threatened species, populations and communities;
- No new invasive species are established in the Catchment and the spread of key emerging invasive plants and animals is limited;
- There is an improvement in soil health as measured by an increase in groundcover at the paddock, sub-catchment and catchment scales;
- There is an improvement in the condition of those riverine ecosystems that have not crossed defined geomorphic thresholds as at the 2010 baseline;
- There is an improvement in the ability of groundwater systems to support groundwater dependent ecosystems and designated beneficial uses;
- There is an improvement in the condition of regionally important wetlands and the extent of those wetlands is maintained;
- Natural resource management decisions contribute to social wellbeing; and
- There is an increase in the adaptive capacity of the catchment community.

Through the detailed assessment of ecological, soils, Aboriginal heritage, non-Aboriginal surface water and groundwater impact mitigation measures for the Project, including the Biodiversity Offsets Strategy as described in Section 7.11, it is considered that the Project is consistent with and will assist in meeting the long-term objectives and aims of the Namoi CAP.

Namoi CMA Extractive Industries Policy

The key objective of the Namoi CMA Extraction Industries Policy (EIP) (Namoi CMA, 2012) is:

> *"To ensure that extractive industries in the Namoi Valley are developed in a way which is consistent with Namoi Catchment Management Authority's vision "Vibrant Communities and Landscapes for the Future" and in line with the Namoi Catchment Action Plan (2010-2020)."*

The Namoi EIP recognises the need for the Namoi CMA to deliver environmental and social outcomes identified in the CAP and the potential competition of extractive industries in the region to compete for a number of natural resources and result in a range of environmental impacts.

As noted above, the objectives of the CAP were considered in the detailed assessment of environmental impacts and management measures for the Project to ensure consistency with the long-term objectives of the Namoi CMA. This included the assessment of the assessment and management recommendations as detailed in the Namoi EIP.

Namoi CMA Biodiversity Offsets Policy

Under the *Namoi CMA Biodiversity Offsets Policy* (Namoi CMA, 2011b), it is noted that the agency is required to advise and make recommendations to the governments of the Commonwealth and NSW and the community to ensure that catchment assets are sustained and maintained. This policy notes that any offsets proposed for the Namoi Catchment would need to:

1. *"Compensate for predicted impacts of a development proposal on biodiversity values;*
2. *Ensure that development results in no net loss of native vegetation in the catchment;*
3. *Ensure that development avoids the Namoi catchment or sub-catchments crossing critical thresholds identified in the Namoi CAP;*
   - *(a) 30% (in cleared sub-catchments) woody native vegetation extent threshold;*
   - *(b) 70% (in intact sub-catchments) woody native vegetation extent threshold;*
   - *(c) 30% of Regional Vegetation Communities threshold within the Catchment; and*
4. *Be consistent with the existing NSW Government and Commonwealth legislative requirements, as a minimum standard."*

It is also noted that the following principles must be applied when considering using biodiversity offsets in the Namoi Catchment for any development:

- *"Offsets will be used as a last resort, after consideration of alternatives to avoid and/or mitigate impacts;*
- *Offset areas be kept within the Namoi Catchment boundaries (either wholly or in part – as a contiguous area of native vegetation);*
- *Offsets must be of the same vegetation type and be at least the size, equivalent biodiversity value & configuration of the vegetation lost through development and additional to existing native vegetation areas;*
- *Offsetting must achieve biodiversity benefits in perpetuity and be registered on title;*
- *Offset conditions must be monitored, enforceable, clearly mapped, recorded and publicly available; and*
- *An offset area, once designated, cannot be used for further offsetting of subsequent developments in future."*

The objectives of the Namoi CMA policy outlined above were considered during the development of the Biodiversity Offset Strategy proposed for the Project to ensure consistency with CMA policy. The proposed Biodiversity Offset Strategy for the Project is discussed further in Section 7.11.



4.7 Commonwealth Legislation

4.7.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act prescribes the Commonwealth's role in environmental assessment, biodiversity conservation and the management of protected areas of national significance. The EPBC Act is administered by SEWPaC and provides protection for listed MNES. There are eight MNES in total:

- Listed threatened species and ecological communities;
- World heritage properties;
- National heritage places;
- Wetlands of international importance;
- Migratory species;
- Commonwealth marine areas;
- The Great Barrier Reef Marine Park; and
- Nuclear actions.

If a proposed action is likely to have a significant effect on one or more MNES, an approval from the Minister for Sustainability, Environment, Water, Population and Communities must be obtained before the action can be carried out.

Under section 68 of the EPBC Act, a proposed action must be referred to the Minister if the proponent considers that the action is or may be a *"controlled action"*. If the Minister declares that the proposed action is a controlled action, the action must be the subject of an impact assessment under Part 8 of the EPBC Act. A controlled action cannot be carried out unless the Minister has granted approval under section 133 of the EPBC Act.

The Project was referred to SEWPaC on 14 November 2011. On 22 December 2011, SEWPaC declared that the Project is a controlled action and will subsequently require assessment under the EPBC Act. The Project was considered a controlled action due to its potential impacts on threatened species and communities, which is a protected matter under sections 18 and 18A, and listed migratory species, which is a protected matter under sections 20 and 20A.

The assessment approach prescribed by SEWPaC was accreditation of the assessment process under the EP&A Act. Therefore, this EIS will be considered by the Commonwealth Minister when deciding whether or not to approve the Project under Section 133 of the EPBC Act.

Shenhua Watermark is the company proposing to take the action. No proceedings have been bought under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against the proponent or (for an action for which a person has applied for a permit), the person making the application.

4.7.2 Native Title Act 1993

The *Native Title Act 1993* (NT Act) facilitates the recognition and protection of native title. Under section 13 of the NT Act, a person can apply to the Federal Court for a determination of native title. There is currently a native title determination application over a large area of land in north-western NSW, including the land within the Project Boundary. This application, known as 'Gomeroi People' (NSD2308/11) has not yet been determined by the Federal Court.

Section 23A of the NT Act states that native title is extinguished by *"previous exclusive possession acts"* attributable to the Commonwealth. Under section 23B of the Act, native title over land is extinguished by the grant of a freehold estate over that land, provided that the grant occurred on or before 23 December 1996. Freehold estates were granted for all of the land within the Project Boundary prior to 23 December 1996. Therefore, native title has been extinguished for all land on which mining operations will occur.

There is a small area of land near Mt Watermark that is still under Crown ownership. This land is outside the Disturbance Boundary and will not be affected by mining. This land will be excised from the proposed Mining Lease application.



4.8 Summary of Required Licences and Approvals

Table 13 provides a summary of the licences, leases and approvals needed to enable the construction and operation of the Project.

Table 13 Licences and Approvals Required for the Project

Approval	Legislation	Authority	Comments
Development Consent for the construction and operation of the Project	Section 89E of Division 4.1 of Part 4 of the EP&A Act empowers the Minister for Planning & Infrastructure to grant a Development Consent	Minister for Planning and Infrastructure	Under section 23 of the EP&A Act, the Minister may delegate his / her consent authority to the PAC
ML	Section 63 of the Mining Act authorises the Minister for Resources and Energy to grant a ML	Minister for Resources and Energy	Under section 89K of the EP&A Act, a ML must be granted following the granting of development consent. The ML must be substantially consistent with the Development Consent
Preparation of a MOP (or equivalent) to the satisfaction of DRE	Required by a ML issued under the Mining Act	Division of Resources and Energy	Will be prepared following the issuing of a ML
Approval for the carrying out of a *"Controlled Action"*	Section 133 of the EPBC Act enables the Minister for SEWPaC to approve the taking of a controlled action	SEWPaC	SEWPaC has accredited the assessment process under Division 4.1 of Part 4 of the EP&A Act
EPL	Chapter 3 of the POEO Act	OEH	Section 89K of the EP&A Act provides that an EPL must be granted following the granting of development consent
AHIP	Section 90 of the NPW Act	National Parks and Wildlife Services	Section 89J of the EP&A Act provides that a permit is not required for the Project following the granting of development consent
Authorisation to clear Native Vegetation	Section 12 of the NV Act	OEH	Section 89J of the EP&A Act provides that an authorisation is not required for the Project following the grant of development consent
Water Use Approval	Section 89 of the WM Act	NSW Office of Water	Section 89J of the EP&A Act provides that a water use approval is not required for the Project following the granting of development consent
Water Management Work Approval	Section 90 of the WM Act	NSW Office of Water	Section 89J of the EP&A Act provides that a water management work approval is not required for the Project following the granting of development consent
Controlled Activity Approval	Section 91 of the WM Act	NSW Office of Water	Section 89J of the EP&A Act provides that a controlled activity approval is not required for the Project following the granting of development consent
WAL(s)	Parts 2 of Chapter 3 of the WM Act	NSW Office of Water	Will be obtained as required
Bore Licence	Part 5 of the Water Act	NSW Office of Water	Will be obtained as required
Controlled Work Approval	Part 8 of the Water Act	NSW Office of Water	Will be obtained as required
Licence Under Threatened Species Conservation Act	TSC Act & NPW Act	OEH	A Section 120 and Section 127 licence under the NPW Act may be required for the Project to facilitate any Koala relocations, as agreed with OEH
Consent to carry out a work in on or over a public road	Section 138 of the Roads Act	GSC and Minister for Road and Ports	Section 89K of the EP&A Act provides the granting of this approval must be approved substantially consistent with the Development Consent
Closure of a public road	Section 33 of the Roads Act	Minister for Roads and Ports	An application for closure of a public road can only be made by the roads authority for that road. Shenhua Watermark will ask GSC to make an application for closure of the roads that will be intercepted by mining
Construction and Occupation Certificate	Division 1 of Part 4A of the EP&A Act	GSC or Certified Accreditor	Will be obtained as required
Approval for works over Crown land	Crown Lands Act	Department of Lands	Separate Approval
Notification of Dangerous Goods	Work Health and Safety Regulation 2011	WorkCover	Will be provided when required
Environment Management Plans	Conditions of Development Consent	DP&I	Will be prepared following the granting of Development Consent

WATERMARK
COAL PROJECT
ENVIRONMENTAL IMPACT STATEMENT
February 2013



5
Stakeholder Engagement

Stakeholder Engagement 5

This section provides a summary of the stakeholder engagement undertaken for the Project by Shenhua Watermark and Hansen Bailey. The stakeholder engagement program has included consultation with Local, State and Commonwealth government agencies, infrastructure and service providers, neighbouring land owners and industries, and the Aboriginal and wider local community. This section describes the objectives and phases of the stakeholder engagement program, the consultation activities undertaken, and the outcomes of the engagement.

5.1 Existing Stakeholder Engagement

Since the granting of EL 7223 in October 2008, Shenhua Watermark has been actively undertaking stakeholder engagement over the Project. The stakeholder engagement activities undertaken for the Project prior to the commencement of the EIS process included:

- Establishment of a local office in Gunnedah with a designated community contact person available at all times and a free call 1800 community input telephone number, dedicated community email and reply-paid postal address;
- Dedicated community website;
- More than 300 separate meetings with stakeholders including government agencies, the NSW Farmers Federation, Aboriginal groups and catchment management groups;
- Presentations to community groups / representatives and Non-Government Organisations (NGOs);
- Active engagement with the local community on the Project through local media;
- Establishment of a Community Fund and Community Fund Advisory Committee (comprised of ten community members and a Shenhua Watermark representative), who determine where the funds ($1 Million per annum up to five years) will be allocated in the community. The Fund aims to support the development of the region's economy, enhance and maintain the environment, improve important local facilities and develop and promote training and employment opportunities; and
- Establishment of a Community Consultative Committee (CCC) for the Project in March 2009, which is chaired by the Hon. Ian Armstrong (as appointed by the Minister of DTIRIS – Division of Resources and Energy (DTIRIS – DRE)) and is made up of 18 members representing the local community, GSC, LPSC, other government agencies and Shenhua Watermark representatives. Prior to the EIS process, 16 monthly CCC meetings were held, with each meeting providing a forum for education on the Project, exchange of information and the identification and discussion of concerns. Minutes of each meeting are available on the Shenhua Watermark website.

5.2 Purpose and Objectives

The primary purpose of the stakeholder engagement program for the EIS was to conduct effective consultation with all stakeholders to identify issues, amend the Project design where necessary and ensure all issues are addressed in the EIS. The objectives of the stakeholder engagement program were to:

- Proactively engage with key stakeholders to identify potential issues and concerns in relation to the Project;
- Identify the primary and higher order social impacts (direct and indirect) associated with the Project;
- Promote community awareness and manage expectations over the Project;
- Facilitate the development and implementation of response and feedback strategies to address identified stakeholder issues;
- Enable stakeholders to have input into the direction of the EIS and Project design; and
- Establishment of effective and ongoing two way consultation with key stakeholders and the community on all aspects of the Project.



5.3 Issue Scoping

The key stakeholders identified for the Project and consultation activities undertaken for each as part of the EIS are summarised in Table 14.

Table 14 Stakeholder Consultation Methods

Stakeholders	Consultation
Federal Government Agencies	
SEWPaC	• Provision of Background Document (October 2011)
	• Initial Project briefing on 4 March 2011
	• Project update meeting on 28 October 2011, 2 April 2012, 21 June 2012 and 11 October 2012
	• Planning Focus Meeting on 4 November 2011
	• Project update meeting with Minister for Environment on 16 April 2012
	• Presentation of proposed offset strategy on 21 June 2012
	• Community Information Sheets No. 1, 2 and 3
State Government Agencies	
DP&I	• Initial Project briefing on 19 October 2010
	• Project update meeting on 28 January 2011, 12 October 2011, 4 November 2011, 5 April 2012, 12 May 2012 and 28 August 2012
	• Project update meeting with Director-General on 11 March 2011, 11 April 2011, 14 June 2011 and 20 June 2012
	• Project update meeting with the Minister of Planning and Infrastructure on 30 June 2011
	• Project briefing with Dr Richard Sheldrake and Director-General on 15 September 2011
	• Provision of Background Document (October 2011)
	• Planning Focus Meeting on 4 November 2011
	• Presentation of proposed offset strategy on 21 June 2012
	• Regular correspondence and updates on the Aboriginal Archaeology Impact Assessment, Aboriginal Cultural Heritage Values Assessment and consultation
	• Community Information Sheets No. 1, 2 and 3
OEH and EPA	• Provision of Background Document (October 2011)
	• Planning Focus Meeting on 4 November 2011
	• Project update meeting on 21 June 2012, 25 September 2012 and 27 September 2012
	• Presentation of proposed offset strategy on 21 June 2012
	• Letter outlining grinding groove geotechnical investigations dated 4 July 2012
	• Regular correspondence and updates on the Aboriginal Archaeology Impact Assessment, Aboriginal Cultural Heritage Values Assessment and consultation
	• Community Information Sheets No. 1, 2 and 3
Heritage Branch	• Provision of Background Document (October 2011)
	• Planning Focus Meeting on 4 November 2011
	• Project briefing offered on 22 August 2012
	• Community Information Sheets No. 1, 2 and 3
DTIRIS – DRE	• Initial Project briefing note issued on 3 February 2011
	• Conceptual Project Development Plan presentation on 14 February 2011
	• Letter regarding additional resource information issued on 25 February 2011
	• Initial Project briefing with the Minister for Resources and Energy on 17 May 2011
	• Site visit with the Minister for Resources and Energy on 28 June 2011
	• Provision of Background Document (October 2011)
	• Planning Focus Meeting on 4 November 2011
	• Project update meeting on 12 October 2012
	• Community Information Sheets No. 1, 2 and 3

Stakeholders	Consultation
DTIRIS – Primary Industry (Agriculture)	• Provision of Background Document (October 2011)
	• Planning Focus Meeting on 4 November 2011
	• Project meeting 15 March 2012
	• Project briefing offered on 15 October 2012
	• Community Information Sheets No. 1, 2 and 3
DTIRIS – Primary Industries (Fisheries)	• Provision of Background Document (October 2011)
	• Planning Focus Meeting on 4 November 2011
	• Project briefing offered on 27 September 2012
	• Community Information Sheets No. 1, 2 and 3
DTIRIS – Primary Industries (Forestry)	• Project briefing on 7 February 2012
NSW Office of Water	• Initial Project briefing on 9 March 2011
	• Project update and conceptual groundwater model discussion on 10 June 2011
	• Site visit and Project update meeting on 26 July 2011
	• Provision of Background Document (October 2011)
	• Planning Focus Meeting on 4 November 2011
	• Groundwater model presentation on 10 November 2011, 17 November 2011, 14 March 2012, 3 April 2012, 2 May 2012 and 7 August 2012
	• Community Information Sheets No. 1, 2 and 3
Catchments and Lands	• Provision of Background Document (October 2011)
	• Planning Focus Meeting on 4 November 2011
	• Community Information Sheets No. 1, 2 and 3
RMS	• Provision of Background Document (October 2011)
	• Planning Focus Meeting on 4 November 2011
	• Project briefing offered on 15 October 2012
	• Community Information Sheets No. 1, 2 and 3
Centre for Transport Planning	• Provision of Background Document (October 2011)
	• Planning Focus Meeting on 4 November 2011
	• Community Information Sheets No. 1, 2 and 3
NSW Health	• Provision of Background Document (October 2011)
	• Planning Focus Meeting on 4 November 2011
	• Social Impact Assessment telephone interview with Peel Cluster (including Project Briefing) on 9 February 2012
	• Social Impact Assessment telephone interview with Quirindi Health Service (including Project Briefing) on 15 February 2012
	• Social Impact Assessment telephone interview with Werris Creek Health Service (including Project Briefing) on 8 March 2012
	• Project briefing in Tamworth on 16 October 2012
	• Community Information Sheets No. 1, 2 and 3
Namoi Catchment Management Authority	• Provision of Background Document (October 2011)
	• Planning Focus Meeting on 4 November 2011
	• Project update meeting on 25 September 2012
	• Community Information Sheets No. 1, 2 and 3
NSW Family and Community Services	• Social Impact Assessment meeting (including Project briefing) on 20 December 2011
	• Social Impact Assessment meeting (including Project Briefing) with Gunnedah Aboriginal Child and Family Health Centre on 20 December 2011
	• Community Information Sheets No. 1, 2 and 3
Department of Education and Training	• Provision of Background Document (October 2011)
	• Social Impact Assessment meeting (including Project Briefing) on 21 December 2011
	• Community Information Sheets No. 1, 2 and 3
TAFE New England Institute	• Social Impact Assessment telephone interview (including Project Briefing) on 25 January 2012
	• Community Information Sheets No. 1, 2 and 3

Stakeholders	Consultation
District Emergency Management Office	• Social Impact Assessment telephone interview (including Project Briefing) on 16 January 2012
	• Community Information Sheets No. 1, 2 and 3
Ambulance Service of NSW	• Social Impact Assessment telephone interview (including Project Briefing) on 14 February 2012
	• Community Information Sheets No. 1, 2 and 3
Fire and Rescue NSW	• Social Impact Assessment telephone interview (including Project Briefing) on 14 February 2012
	• Community Information Sheets No. 1, 2 and 3
NSW Rural Fire Service	• Social Impact Assessment telephone interview (including Project Briefing) on 14 February 2012
	• Community Information Sheets No. 1, 2 and 3
NSW Police - Oxley Local Area Command	• Social Impact Assessment telephone interview (including Project Briefing) on 23 February 2012
	• Community Information Sheets No. 1, 2 and 3
NSW Housing	• Social Impact Assessment telephone interview (including Project Briefing) on 6 March 2012
Local Government Agencies	
GSC	• Initial Project briefing with Mayor and General Manager on 7 March 2011
	• Initial Project briefing with Councillors on 16 March 2011, 17 November 2011 and 15 February 2012
	• Koala Plan of Management presentation on 26 July 2011
	• Project briefing on 26 August 2011
	• Provision of Background Document (October 2011)
	• Planning Focus Meeting on 4 November 2011
	• Social Impact Assessment meeting on 17 November 2011
	• EIS briefing 9 May 2012
	• Various briefings and discussions on the VPA (Meetings held on 3 July 2012, 10 July 2012, 12 July 2012, 16 July 2012 and 14 September 2012)
	• Community Information Sheets No. 1, 2 and 3
LPSC	• Provision of Background Document (October 2011)
	• Planning Focus Meeting on 4 November 2011
	• Initial Project briefing with Councillors on 17 November 2011
	• Social Impact Assessment meeting on 18 November 2011
	• Project update meeting with Councillors on 18 April 2012
	• Various briefings and discussions on the VPA on 26 September 2012
	• Community Information Sheets No. 1, 2 and 3
TRC	• Provision of Background Document (October 2011)
	• Planning Focus Meeting on 4 November 2011
	• Social Impact Assessment meetings on 20, 21 and 22 December 2011
	• Various briefings and discussions on the VPA (Meeting held on 10 July 2012)
	• Project update meeting with Councillors on 26 September 2012
	• Community Information Sheets No. 1, 2 and 3
Relevant State and Commonwealth Members of Parliament	• Initial Project briefing with Tony Windsor, Independent Federal Member for New England on 7 March 2011
	• Initial Project briefing with Peter Draper, Independent State Member for Tamworth on 7 March 2011
	• Project briefing meeting with The Hon. Sarah Mitchell on 5 July 2011
	• Project briefing meeting with The Hon. Trevor Khan on 17 August 2011
	• Project briefing with The Hon. Andrew Stoner on 15 September 2011
	• Project briefing and site visit with Kevin Anderson, Member for Tamworth on 26 October 2011
	• Project briefing with Steve Whan, Shadow Minister for Resources and Primary Industries on 8 November 2011
	• Project briefing with Kevin Anderson, Member for Tamworth on 11 April 2012
	• Project briefing with Steve Whan, Shadow Minister for Resources and Primary Industries on 17 May 2012
	• Meeting with Kevin Anderson, Member for Tamworth, to discuss the VPA and provide an update on the EIS on 5 July 2012
	• Community Information Sheets No. 1, 2 and 3

Stakeholders	Consultation
Infrastructure Owners and Service Providers	
ARTC	• More than 53 meetings and correspondence from July 2010 to April 2012
	• Provision of Background Document (October 2011)
	• Planning Focus Meeting on 4 November 2011
	• Email correspondence in regard to the ARTC Pollution Reduction Program on 16 July 2012
Rail Corp	• No direct consultation as the railway line is leased to ARTC
Newcastle Ports Corporation	• Meeting to discuss nominations on 13 August 2010, 18 August 2010, 23 August 2011 and 29 August 2011
	• Initial Project briefing on 25 January 2011
	• Presentation of Project shipping requirements on 9 August 2011
	• Coal chain review presentation on 18 August 2011
	• Site visit on 25 June 2012
Hunter Valley Coal Chain Coordinator	• Initial Project briefing on 5 May 2010
	• Discussion regarding capacity framework arrangements on 28 May 2010
	• Discussion regarding Project load out on 8 July 2010
	• Discussion regarding rail capacity on 31 August 2010
	• Discussion regarding coal chain logistics on 13 January 2011
	• Project update / membership discussions on 7 July 2012
APA Group	• Provision of Background Document (October 2011)
	• Email correspondence in regard to the Project and proposed blasting criteria of the Central Ranges Gas Pipeline on 1 August 2012
	• Neighbouring Enterprises
Gunnedah Basin Coal Producers Group	• Project meetings on 13 September 2011, 11 October 2011, 9 November 2011, 13 December 2011, 7 February 2012, 6 March 2012, 3 April 2012, 5 June 2012 and 7 August 2012
Namoi Catchment Regional Organisation of Councils – Mining Working Group	• Project meetings held on 10 August 2011, 12 October 2011, 19 April 2012 and 14 June 2012
Community Stakeholders	
Watermark CCC	• Meetings held on 8 March 2011, 6 April 2011, 18 May 2011, 13 July 2011, 25 August 2011, 5 October 2011, 16 November 2011, 15 February 2012, 18 April 2012, 13 June 2012, 18 July 2012 and 15 August 2012
	• Muswellbrook Coal Company rehabilitation site visit on 29 November 2011
	• Community Information Sheets No. 1, 2 and 3
Individual Near Neighbours	• Local media coverage
	• Community Information Sheets No. 1, 2 and 3
	• 1800 community input free call phone number
	• Community input email address
	• Reply paid feedback forms
Gunnedah, Breeza, Curlewis, Carroll, Quirindi, Caroona, Spring Ridge and Tamworth Local Communities	• Community Information Sheets No. 1, 2 and 3
	• Reply paid feedback forms
	• 1800 community input free call phone number
	• Community input email address
	• Local media coverage
	• Community information session at Tamworth Community Centre on 13 December 2011
	• Community information session at Breeza Community Hall on 14 December 2011
	• Two community information sessions at Gunnedah Civic Centre on 15 December 2011
	• Community information session at Quirindi Royal Theatre on 16 December 2011
	• Presentation to the Carroll Progress Association on the Project and progress of the EIS on 15 May 2012

Stakeholders	Consultation
Community Reference Group – Environment	• Community Information Sheets No. 1, 2 and 3
	• Reply paid feedback forms
	• 1800 community input free call phone number
	• Community input email address
	• Local media coverage
	• Introductory meeting on 22 June 2011
	• Meeting No. 2 and Site visit on 28 July 2011
	• Meeting No. 3 on 15 September 2011
	• Meeting No. 4 on 13 October 2011
	• Muswellbrook Coal Company rehabilitation site visit on 29 November 2011
	• Meeting No. 5 on 28 February 2012
	• Meeting No. 6 on 27 March 2012
	• Meeting No. 7 on 7 June 2012
Community Reference Group – Koala	• Community Information Sheets No. 1, 2 and 3
	• Reply paid feedback forms
	• 1800 community input free call phone number
	• Community input email address
	• Local media coverage
	• Introductory meeting on 22 June 2011
	• Meeting No. 2 and site visit on 3 August 2011
	• Meeting No. 3 on 15 September 2011
	• Muswellbrook Coal Company rehabilitation site visit on 29 November 2011
	• Meeting No. 4 on 1 March 2012
	• Meeting No. 5 on 7 June 2012
Community Reference Group – Water	• Community Information Sheets No. 1, 2 and 3
	• Reply paid feedback forms
	• 1800 community input free call phone number
	• Community input email address
	• Local media coverage
	• Introductory meeting on 22 June 2011
	• Meeting No. 2 on 11 August 2011
	• Meeting No. 3 and site visit on 14 September 2011
	• Meeting No. 4 on 13 October 2011
	• Muswellbrook Coal Company site visit on 29 November 2011
	• Meeting No. 5 on 1 March 2012
	• Meeting No. 6 on 6 June 2012
Aboriginal Community	• Expression of interest notice advertised in Namoi Valley Independent on 1 and 3 February 2011
	• Aboriginal heritage planning meeting and initial Project briefing on 10 March 2011
	• Revised survey methodology meeting on 24 March 2011
	• Field work on 28 March 2011 to 20 April 2011 and 2 May 2011 to 6 May 2011
	• Post field work meeting on 8 April 2011 and 21 April 2011
	• Project update meeting on 21 November 2011
	• Aboriginal cultural heritage workshop on 19 and 21 December 2011
	• Aboriginal social wellbeing workshop on 20 December 2011
	• Senior Elders and Elders group meeting on 25 January 2012
	• Senior Elders and Elders 'Walk on Country' and scarred tree assessment on 21 February 2012
	• Senior Elders and Elders site visit on 27 February 2012 to 2 March 2012
	• Senior Elders and Elders site visit of WM-GG3-12 on 23 April 2012
	• Senior Elders and Elders observation of geotechnical investigation works at WM-GG1-11 and WM-GG3-12 on 18 June 2012 to 20 June 2012

Stakeholders	Consultation
Aboriginal Community cont.	• Review of draft Aboriginal Archaeology Impact Assessment and Aboriginal Cultural Heritage Values Assessment (16 August 2012 to 28 September 2012)
	• Draft Aboriginal Archaeology Impact Assessment and mitigation strategies workshops on 29 to 31 August 2012
	• Group meeting on draft Aboriginal Archaeology Impact Assessment and mitigation strategies on 31 August 2012
	• Site visit for all Registered Aboriginal Parties on 10 September 2012 and 11 September 2012
	• Group meeting to discuss Aboriginal Cultural Heritage Values Assessment and mitigation strategies on 12 September 2012
	• Group meeting to discuss changes to Aboriginal Cultural Heritage Values Assessment and mitigation strategies on 26 September 2012 and 27 September 2012
	• Group meeting on 3 October 2012 to present final Aboriginal Archaeology Impact Assessment and Aboriginal Cultural Heritage Values Assessment

5.3.1 Local Community Engagement

Community Information Sheets

Engagement with Shenhua Watermark's near neighbours and local community over the preparation of this EIS involved the distribution of three Community Information Sheets (as provided in Appendix E). These Community Information Sheets were developed to familiarise the local community with the Project, while providing information regarding specific timelines, the consultation process and the various technical studies associated with the EIS process.

Community Information Sheet 1 was distributed in March 2011 to stakeholders and the key regulatory agencies. This Community Information Sheet introduced the Project and provided an outline of the process and activities to be undertaken for the EIS.

Community Information Sheet 2 was distributed to more than 6,800 community stakeholders in the Gunnedah LGA, Liverpool Plains LGA, Tamworth LGA and regulatory stakeholders in November 2011. This Community Information Sheet provided more detail on the Project description and the approvals process to be followed, including the preparation of certain studies to be included in this EIS. A notification of the dates and times for the Community information sessions held from 13 December 2011 to 16 December 2011 was provided in Community Information Sheet 2. A reply paid feedback form was also attached for any feedback.

Community Information Sheet 3 was also distributed to more than 6,800 community stakeholders in the Gunnedah LGA, Liverpool Plains LGA, Tamworth LGA and regulatory stakeholders in August 2012. This Community Information Sheet provided an update on the Project, along with a summary of the findings from the stakeholder consultation process to date and Shenhua Watermark's response to these issues and questions.

A fourth Community Information Sheet is proposed to be distributed prior to this EIS being placed on public exhibition, notifying stakeholders of the key findings from the assessment and where they will be able to view a copy of this EIS.

Community Information Sessions

Community information sessions were held to provide information on the Project and to gain feedback from the local community in relation to the Project. Details of the community information sessions were included in Community Information Sheet 2 and were also advertised in the Namoi Valley Independent newspaper, the Northern Daily Leader and Quirindi Advocate from 19 November to 16 December 2011.

Approximately 39 community members attended the following Community Information Sessions:

- Tamworth Community Centre - Tuesday, 13 December 2011, 11:00 am – 2:00 pm;
- Breeza Community Hall – Wednesday, 14 December 2011, 11:00 am – 2:00 pm and 4:00 pm – 7:00 pm;
- Gunnedah Civic Centre – Thursday, 15 December 2011, 11:00 am – 2:00 pm and 4:00 pm – 7:00 pm; and
- Quirindi Royal Theatre – Friday, 16 December 2011, 11:00 am – 2:00 pm.

The sessions included a one hour presentation from Shenhua Watermark on the Project and EIS, followed by the formation of smaller groups. Each group was then asked to brainstorm responses to the following questions on butcher's paper:

- *I would like to see the Watermark EIS include…*
- *I am concerned about…*

A spokesperson for each group then presented their responses back to the group, including Shenhua Watermark and Hansen Bailey representatives. Open discussion and questions were also encouraged during this time.

A report on the Community Information Sessions and the issues raised was prepared and provided to all attendees. The report was also made available for the wider community on the Shenhua Watermark website. The issues raised in these community information sessions are outlined in Section 5.4.5.

Community Reference Groups

Community Reference Groups (CRGs) focussing on the assessment and management of Koalas, water and the environment for the Project were established by Shenhua Watermark in March 2011. The primary purpose of the CRGs was to allow the EIS Project team to work directly with the community to ensure all issues and concerns were identified and addressed in the EIS.

Nominations to participate in the CRG were sought from the community during March 2011 via advertisements in local newspapers, media releases and website updates. As a result, the following members were inducted to the CRG as shown in Table 15. The meetings and site visits conducted with the CRGs is summarised in Table 14.

5.3.2 Regulatory Engagement

Briefings and Presentations

As indicated in Table 14, a number of briefings, interviews and presentations were provided to regulators throughout the preparation of this EIS. These included providing details on the Project description, updates of the findings of the environmental studies, interviews regarding social impact and information on the planning approvals process. This level of engagement assisted with the identification of any stakeholder issues in relation to the Project that needed to be addressed within this EIS. Issues raised during these Project briefings and presentations to regulators are discussed further in Section 5.4.3.

Planning Focus Meeting

A Planning Focus Meeting (PFM) was held in Gunnedah on 4 November 2011. The PFM included a presentation and discussion on the Project, identified potential environmental impacts, proposed assessment methodology and preliminary management and mitigation measures. The Project presentation was followed by a site tour for the Project.

The PFM was attended by Hansen Bailey and Shenhua Watermark representatives and 23 government regulators representing agencies, including SEWPaC, DP&I, OEH, Environment Protection Agency (EPA), Heritage Branch, DTIRIS – DRE, DTIRIS – Primary Industry (PI) (Agriculture and Fisheries), NSW Office of Water (NOW), Catchment and Lands, RMS, NSW Health, Namoi Catchment Management Authority (CMA), GSC, LPSC, TRC and ARTC.



Table 15 Community Reference Group Members

Ref.	Member	CRG
1	Ronald Fuller	Environment
2	Mark Kesby	Environment
3	Cr Hans Allgayer (representative of GSC)	Environment
4	Cr Gary Dunkley (representative of Curlewis Progress Association)	Environment
5	Cr Colleen Fuller (no longer member as of 26/09/12)	Environment
6	Robert Campbell (representative of GSC)	Environment
7	Owen Hasler (representative of Gunnedah Urban Landcare Group)	Koala
8	David Walker (representative of Liverpool Plains Land Management Inc.)	Koala
9	Jackie Stewart-Hilton (representative of NSW Wildlife Information Rescue and Education Services Inc.)	Koala
10	Lachlan Johnson (representative of GSC)	Koala
11	Stephen Warden	Water
12	Juanita Hampersum	Water
13	Robyn King	Water
14	Tony Clift	Water
15	Kevin Martin	Water
16	Dr Wendy Timms	Water

5.4 Issue Response

The objective of this stage of stakeholder engagement was to ensure that appropriate responses were provided for all stakeholder issues raised in relation to the Project and that relevant strategies for their management and mitigation were considered in this EIS and the Project design. Where possible, specific issues raised in relation to the Project were addressed with the relevant stakeholders.

5.4.1 Director-General Requirements

In response to the stakeholder engagement undertaken for the Project and the Project Application, DP&I issued DGRs for the Project on 19 April 2012, which consolidated responses from other State and Federal regulators. These responses are presented in full in **Appendix D**. **Table 16** lists each requirement of the DGRs and where it is addressed in this EIS.

Table 16 Director-General's Requirements

Issue	Description	EIS Section
General Requirements	The Environmental Impact Statement (EIS) for the development must meet the form and content requirements in Clauses 6 and 7 of Schedule 2 of the *Environmental Planning & Assessment Regulation 2000*	EIS Statement
	In addition, the EIS must include a: • detailed description of the development, including: – need for the proposed development;	3 and 9.2
	– justification for the proposed mine plan, including efficiency of coal resource recovery, mine safety, and environmental protection;	9
	– likely staging of the development - including construction, operational stage/s and rehabilitation;	3 and 7.21
	– likely interactions between the development and existing, approved and proposed mining operations in the vicinity of the site;	2.2 and 7
	– plans of any proposed building works;	3 and Appendix B
	• consideration of all relevant environmental planning instruments, including identification and justification of any inconsistencies with these instruments;	4
	• risk assessment of the potential environmental impacts of the development, identifying the key issues for further assessment;	6
	• detailed assessment of the key issues specified below, and any other significant issues identified in this risk assessment, which includes: – a description of the existing environment, using sufficient baseline data;	2 and 7
	– an assessment of the potential impacts of all stages of the development, including any cumulative impacts, taking into consideration relevant guidelines, policies, plans and statutes; and	7
	– a description of the measures that would be implemented to avoid, minimise and if necessary, offset the potential impacts of the development, including proposals for adaptive management and/or contingency plans to manage any significant risks to the environment; and	7
	– consolidated summary of all the proposed environmental management and monitoring measures, highlighting commitments included in the EIS.	8
	The EIS must address the requirements of the Commonwealth Department of Sustainability, Environment, Water, Populations, and Communities (SEWPaC) set out in Attachment 4.	Table 17, 7.10 and 7.11
Key Issues	The EIS must address the following specific issues: – **Agricultural and Other Land Resources** – including an Agricultural Impact Statement that includes a specific focused assessment of the impacts of the proposal on strategic agricultural land, having regard to the gateway criteria in the draft New England North West Strategic Regional Land Use Plan. The EIS must also include a detailed description and assessment of the potential impacts on: – soils and land capability (including salinisation and contamination); – landforms and topography, including cliffs, rock formations, steep slopes, etc; – land use, including agricultural, forestry, conservation and recreational use, with particular reference to agricultural land use and Breeza State Forest; – agricultural resources and/or enterprises in the local area, with particular reference to highly productive alluvial soils that may be impacted directly or indirectly by the project, and including: • pre-mining and post-mining agricultural assessment and mapping (including Land Capability and Agricultural Suitability mapping) of soil characteristics across all proposed disturbance areas, and an assessment of their value and rehabilitation limitations; • definition of the limit of the Upper Namoi Alluvium, and justification for the nominated limit; • any change in land-use arising from requirements for biodiversity offsets; • a detailed description of the measures that would be implemented to avoid, reduce or mitigate impacts of the development on local agricultural resources and/or enterprises; and • justification for any significant long term changes to agricultural resources, particularly highly productive soils potentially affected by the development.	2, 7.2, 7.11, 7.19 and 7.20

Issue	Description	EIS Section
Key Issues cont.	• Water Resources – including: – detailed assessment of potential impacts on the quality and quantity of existing surface and ground water resources, including: • detailed modelling of potential groundwater impacts; • impacts on affected licensed water users and basic landholder rights; • impacts on riparian, ecological, geo-morphological and hydrological values of watercourses, including environmental flows; and • a consideration of the proposal against the draft Aquifer Interference Policy; – a detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures; – an assessment of proposed water discharge quantities and quality/ies against receiving water quality and flow objectives; – assessment of impacts of salinity from mining operations on groundwater and surface water resources, including disposal and management of coal rejects and modified hydrogeology, a salinity budget and the evaluation of salt migration to surface, near surface and groundwater sources; – identification of any licensing requirements or other approvals under the *Water Act 1912* and/or *Water Management Act 2000*; – demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant WSP or water source embargo; – a detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts; and – a detailed flood impact assessment, which identifies impacts on local and regional flood regimes, including: • an assessment of the potential for flooding to occur in the open cut pits; and • any measures proposed to mitigate potential flood impacts.	3.9, 7.1, 7.2, 7.3, 7.4, 7.5, and 7.10
	• Biodiversity – including: – measures taken to avoid, reduce or mitigate impacts on biodiversity; – accurate estimates of proposed vegetation clearing; – a detailed assessment of potential impacts of the development on any: • terrestrial or aquatic threatened species or populations and their habitats, endangered ecological communities and groundwater dependent ecosystems; and • regionally significant remnant vegetation, or vegetation corridors; – a comprehensive offset strategy to ensure the development maintains or improves the terrestrial and aquatic biodiversity values of the region in the medium to long term.	7.10 and 7.11
	• Heritage – including an assessment of impacts on Aboriginal cultural heritage and Historic heritage, including: – an Aboriginal cultural heritage assessment (including cultural and archaeological significance) which must: • demonstrate effective consultation with Aboriginal communities in determining and assessing impacts, and developing and selecting options and mitigation measures; • outline any proposed impact mitigation and management measures (including an evaluation of the effectiveness and reliability of the measures); and – a Historic heritage assessment (including archaeology) which must: • contain a detailed history and land-use summary of the site; • include a statement of heritage impact (including significance assessment) for any State significant or locally significant historic heritage items; and • outline any proposed mitigation and management measures (including an evaluation of the effectiveness and reliability of the measures);	7.13, 7.14 and 7.15
	• Air Quality – including a quantitative assessment of potential: – construction and operational impacts, with a particular focus on dust emissions (including $PM_{2.5}$ and PM_{10} emissions, and dust generation from coal transport), as well as diesel and blast fume emissions; – spontaneous combustion properties of overburden or reject material; – reasonable and feasible mitigation measures to minimise dust, diesel and blast fume emissions, including evidence that there are no such measures available other than those proposed; and – monitoring and management measures, in particular real-time air quality monitoring and predictive meteorological forecasting.	7.6
	• Greenhouse Gases – including: – a quantitative assessment of potential Scope 1, 2 and 3 greenhouse gas emissions; – a qualitative assessment of the potential impacts of these emissions on the environment; and – an assessment of reasonable and feasible measures to minimise greenhouse gas emissions and ensure energy efficiency;	7.7
	• Noise, Vibration & Blasting – including a quantitative assessment of potential: – construction, operational and offsite transport noise impacts; – blasting impacts on people, livestock and property; – reasonable and feasible mitigation measures (including assessment of restricted night time operations), including evidence that there are no such measures available other than those proposed; and – monitoring and management measures, in particular real-time, attended noise monitoring and predictive meteorological forecasting;	7.8 and 7.9

Issue	Description	EIS Section
Key Issues cont.	• **Traffic & Transport** – including: – a detailed assessment of the potential impacts of the development on the capacity, safety and efficiency of the: • local and regional rail network, having regard to the strategic objectives and cumulative impacts for the passenger and freight rail network; and • local and regional road network, with particular regard to a cumulative traffic impact assessment; condition assessment of the existing network; proposed new road infrastructure; and impacts of coal trains on level crossing operations; – details of mine to port or other domestic customer transport movements, train path availability and any required rail infrastructure works; and – a detailed description of the measures that would be implemented to maintain and/or improve the capacity, efficiency and safety of the road and rail networks in the surrounding area over the life of the project;	7.16
	• **Visual** – including: – a detailed assessment of the: • changing landforms on the site during the various stages of the project; and • potential visual impacts of the project on private landowners in the surrounding area as well as key vantage points in the public domain, including lighting impacts; and – a detailed description of the measures that would be implemented to minimise the visual impacts of the project;	7.17
	• **Waste** – including: – accurate estimates of the quantity and nature of the potential waste streams of the development, including tailings and coarse reject; and – a detailed description of the measures that would be implemented to minimise the production of waste on site, and ensure that any waste produced is appropriately managed;	7.25
	• **Hazards** – including bushfires;	7.22 and 7.23
	• **Social & Economic** – including an assessment of the: – potential direct and indirect economic benefits of the project for local and regional communities and the State; – potential impacts on local and regional communities, including: • increased demand for local and regional infrastructure and services (such as housing, childcare, health, education and emergency services); and • impacts on social amenity; – a detailed description of the measures that would be implemented to minimise the adverse social and economic impacts of the project, including any infrastructure improvements or contributions and/or voluntary planning agreement or similar mechanism; and – a detailed assessment of the costs and benefits of the development as a whole, and whether it would result in a net benefit for the NSW community; and	7.26 and 7.27
	• **Rehabilitation** – including the proposed rehabilitation strategy for the site, having regard to the key principles in the Strategic Framework for Mine Closure, including: – rehabilitation objectives, methodology, monitoring programs, performance standards and proposed completion criteria; – nominated final land use, having regard to any relevant strategic land use planning or resource management plans or policies; and – the potential for integrating this strategy with any other rehabilitation and/or offset strategies in the region	7.21
Plans and Documents	The EIS must include all relevant plans, architectural drawings, diagrams and relevant documentation required under Schedule 1 of the *Environmental Planning & Assessment Regulation 2000*. These documents should be included as part of the EIS rather than as separate documents	Appendix B
Consultation	During the preparation of the EIS, you must consult with relevant local, State or Commonwealth Government authorities, service providers, community groups and affected landowners. In particular you must consult with the: • Commonwealth Department of Sustainability, Environment, Water, Population and Communities; • Office of Environment and Heritage (including the Heritage Branch and the Environmental Protection Authority); • Division of Resources and Energy within the Department of Trade and Investment, Regional Infrastructure and Services; • Department of Primary Industries (including the NSW Office of Water; NSW Forestry, Agriculture and Fisheries sections; Catchments and Lands (Crown Lands Division)); • Transport for NSW (including the Centre for Transport Planning, Roads and Maritime Services); • NSW Health; • Australian Rail Track Corporation, and downstream coal chain operators including Railcorp, Newcastle Ports Corporation and the Hunter Valley Coal Chain Co-ordinator; • Namoi Catchment Management Authority; • Gunnedah Shire Council; • Liverpool Plains Shire Council; and • Tamworth Regional Council. The EIS must: • describe the consultation process used and demonstrate that effective consultation has occurred; • describe the issues raised by public authorities, service providers, community groups, and land owners; • identify where the design of the development has been amended in response to issues raised; and • otherwise demonstrate that issues have been appropriately addressed in the assessment.	5

Issue	Description	EIS Section
Further consultation after 2 years	If you do not lodge a DA and an EIS for the development within 2 years of the issue date of these DGRs, you must consult further with the Director-General in relation to the requirements for lodgement	N/A
References	The assessment of the key issues listed above must take into account relevant guidelines, policies, and plans as identified. While not exhaustive, Attachment 2 contains a list of some of the guidelines, policies, and plans that may be relevant to the environmental assessment of this development	12

5.4.2 Regulatory Stakeholder Director-General's Requirements

Table 17 lists the requirements raised by regulatory stakeholders to be addressed in the EIS as part of their input to the DGRs. The table also indicates where each issue is addressed in this EIS.

Table 17 Regulatory Stakeholder Director-General's Requirements

Ref	Issue	EIS Section
DTIRIS – PI (Agriculture)		
1	Apply the guidelines for the completion of AIS	7.20
2	Identify the following: • The impact on surrounding agriculture from the disturbance to surface and ground water flow, pressure, recharge and quality • The importance of groundwater for livestock • The loss of water from the irrigation sector • The accumulated impact of water moving from the irrigation sector to the mining sector over the long term	7.20
3	Assess the impact on rural labour and rural communities	7.20, 7.26 and 7.27
4	Assess how the development will increase competition for the rural sector to attract labour, particularly the irrigation industry which requires higher labour inputs	7.20 and 7.26
5	Assess how much competition and capacity there is for access to rail for the transport of grain out of Gunnedah, Narrabri, Moree and Weemelah	7.16
6	Assess the cumulative impacts of mining including visual impacts, rail transport and air quality impacts	7
7	Assess the current and future agricultural production of biodiversity offset	7.20
8	Identify appropriate weed suppression, management and containment	7.10, 7.11, 7.20 and 7.21
9	Identify post-mining land use and land capability and agricultural land capability	7.19
10	The staging of the development should be described along with any other initiatives to minimise the impact of final voids	3.2 and 7.21
11	Outline the proposed standard of mine rehabilitation and its productive potential component, including but not limited to subsoil constraints and soil fertility	7.21
DTIRIS – PI (Fisheries)		
12	An aquatic ecological assessment should be made of the impacts of the pipeline on the Mooki River and Native Dog Gully	7.10 and 7.12
13	Identify the area which may be affected either directly or indirectly including the proposed location of all pipelines to waterways within the project area	3
14	Provide a description and quantification of aquatic and riparian vegetation. This should include an assessment of the extent and condition of riparian vegetation and the extent and condition of freshwater aquatic vegetation including the presence of significant habitat features (e.g. gravel beds, snags, reed beds, etc.)	7.10
15	Quantify the extent of aquatic and riparian habitat removal or modification which will result from the proposed development	7.10
16	Identify the impacts of altered hydrology on associated aquatic and riparian ecosystems such as floodplain wetlands and riparian vegetation. Changes in flow patterns may result in the death of aquatic and riparian vegetation that relies on surface water/shallow ground water flows	7.3, 7.4, 7.5 and 7.10
17	Provide monitoring recommendations of groundwater and surface water interactions to ensure that no negative impacts on surface water quantity or quality	7.1.4 and 7.3.4
18	Address the use of pump extraction screen technology for water extraction from the Mooki River to minimise the impacts of fish mortality	7.1, 7.3 and 7.10
19	Include a threatened aquatic species assessment (as per part 7A *Fisheries Management Act 1994*) to address whether there are likely to be any significant impacts on listed threatened species, populations or ecological communities listed under the *Fisheries Management Act 1994*	7.10

Ref	Issue	EIS Section
Heritage Council of NSW		
20	The Historic Heritage Assessment should contain a detailed history and a land use summary of the site	7.15
21	If excavation works for non–Indigenous archaeology are recommended, the Historic Heritage Assessment must contain an appropriate research design and excavation methodology for its management / mitigation	7.15
LPSC		
22	It is expected that a high level of communication would be conducted with community stakeholders and consultation processes and should also sufficiently underpin the required economic and social impact analysis required as part of the assessment process	5, 7.26 and 7.27
23	It is expected that a robust and high level assessment of potential impacts on surrounding rural and regional communities will be undertaken for this project. The assessment should extend beyond that of a desk-top review, shall use appropriate and accepted methodologies, be conducted by suitably experienced and qualified consultants and be prepared in accordance with recognised best practice guidelines using locally available data collated from both primary and secondary research (wherever practicable)	7
24	It is anticipated that this project will create significant additional demands on community infrastructure (including local halls, libraries and health facilities) within a number of LPSC communities including Quirindi, Werris Creek and Currabubula. Due regard should be given to these additional demands and their corresponding impacts in the EIS preparation process. It would be also useful if any proposed community enhancement funding (CEF) process could be clearly articulated as part of the EIS	7.26
25	The proposal is likely to have significant impacts on the surrounding road networks, particularly given workforce commuting requirements. Following a preliminary review, Council's Works Department has identified key areas for consideration, including (but not limited to): (i) Werris Creek Gap Road upgrade (including the Kamilaroi Highway intersection and associated rail interface); (ii) Breeza – Currabubula Road; (iii) Werris Creek – Tamworth Road; and (iv) Impacts on existing rail level crossings given increased rail movements, particularly on the Werris Creek Quirindi communities.	7.16
26	Potential impacts on community water supplies and sewer infrastructure arising from the operation of the development and additional demand created as a result of workforce housing requirements should be duly considered	7.26
27	Voluntary Planning Agreement for regional infrastructure should be considered in detail and appropriate liaison with Council should be undertaken	7.26
28	A scientifically robust assessment of the range of cumulative impacts should be undertaken	7
29	Ongoing consultation with Council	5
Namoi CMA		
30	The offsets proposed by the proponent need to compensate for the predicted impacts, ensure that there is no net loss of native vegetation, ensure that the development does not cross any critical ecological thresholds, and be consistent with the existing NSW government and Commonwealth legislative biodiversity offset requirements, as a minimum standard	7.11
31	The Watermark Biodiversity Offset Strategy should meet the following principles: • Offsets should be considered as a last resort, after consideration of alternatives to avoid and/or mitigate impacts. • Offsets must be based on sound ecological principles and deliver on priorities identified in the draft Namoi Biodiversity Conservation Plan. • Offset areas must be within the Namoi Catchment boundaries (either wholly or in part – as a contiguous area of native vegetation). • Offsets must be beneficial and of the same vegetation type and be at least the size, equivalent biodiversity value and configuration of the vegetation lost and additional to existing native vegetation areas. • Offsets must be in perpetuity and be registered on title. • Offset conditions must be monitored, enforceable, clearly mapped, recorded and publicly available. • An offset area, once designated, cannot be used for further offsetting of subsequent developments in future.	7.11
32	Consider and address the *Namoi Catchment Action Plan 2010-2020*, the NCMA EIP 2009 and the BOP 2011	4.6.3 and 7.10
33	The EIS should identify all vegetation communities along with condition assessments of communities in accordance with a recognised methodology	7.10
34	Maps should be included in the EIS depicting vegetation communities with various condition ratings and non vegetated areas	7.10
35	Potential impacts on both fauna and flora from clearing, specifically impacts resulting from fragmentation of vegetation, destruction of habitat, corridor loss, edge effects, increased predation and weed introduction should be documented	7.10
36	Mapped vegetation communities should be aligned with the Regional Vegetation Communities (RVC) (NCMA 2009) with assessment against RVC ecological condition benchmarks and CAP 2010-2020 critical thresholds	7.10 and 7.11
37	All riparian areas need to be identified, terrestrial and aquatic impacts assessed and mitigation measures and safeguards addressed	7.10
38	Biodiversity offset areas need to comply with requirements contained within the NSW and Commonwealth governments' approaches to biodiversity offsets along with the Namoi CMA Biodiversity Offset Policy	7.10 and 7.11
39	Vegetation communities within offset areas need to be identified, mapped and assessed for condition, ranked against ecological benchmarks and assessed against critical thresholds	7.11

Ref	Issue	EIS Section
40	Agricultural suitability needs to be undertaken for offset areas to identify any prime agricultural land and any other areas not suitable or not to be used for replanting	7.11 and 7.20
41	Details need to be provided for revegetation measures, management actions and security arrangements for offset areas	7.11
42	The EIS needs to consider the impacts, safeguards and contributions especially in consideration of the *Catchment Targets within the Namoi CAP* (2010- 2020)	4.6.3, 7.10 and 7.11
43	The EIS needs to undertake a thorough and rigorous pre and post-mining risk assessment with respect to long term site specific and cumulative impacts on the ecology both within the project area, the Breeza to Curlewis area and within the Catchment. The EIS also needs to provide details on clearing and offset ratios and balances based on both extent and condition	7.10 and 7.11
44	The EIS should consider and address the potential impacts of the development on both the deep groundwater systems as well as the very shallow groundwater systems. Soil salinity is known to occur in the southern parts of the project area adjacent to the floodplain. The soil salinity issue is driven by shallow groundwater systems recharging from the Watermark Hills and from the floodplains east of Lake Goran. The EIS should consider mitigation measures and safeguards to ensure this issue is not exacerbated during and post-mining operations	7.1, 7.3 and 7.19
45	The EIS needs to consider and address the potential impacts on groundwater, especially with regard to likely quantities and qualities of groundwater intercepted, treatment and disposal methods, likely impacts on the availability of groundwater to other uses including river systems and GDE's	7.1, 7.10 and 7.12
46	The EIS needs to provide details on changes to catchments, long term yield losses, changes to runoff volumes, velocities and discharges	7.3, 7.4 and 7.5
47	The EIS needs to identify any potential impacts on creeks and watercourses that may result in changes to hydrology, water quality and vegetation communities	7.3, 7.4, 7.5 and 7.10
48	The EIS needs to identify proposed water sources and management of water from within the project disturbance area. Water treatment proposals, uses and disposal methods need to be completely and thoroughly addressed	3.10, 7.10 and 7.3
49	The EIS needs to identify operational characteristics of the final void and its impact on surface water flows	7.1, 7.3 and 7.21
50	The EIS needs to include an assessment of local, regional and cumulative impacts of catchment changes and surface water balance	7.3
51	The EIS should address and consider the potential impacts on Aboriginal archaeology and cultural heritage especially with regard to clearing and potential loss of significant Aboriginal cultural sites. Mitigation measures and safeguards need to be addressed and assessed	7.13 and 7.14
52	The EIS should address and consider the potential impacts, mitigation measures and safeguards on Noise and Blasting, Air Quality and Greenhouse Gas, Traffic and Transport, Visual Amenity, Social Impact Assessment and Economics especially with regard to impacts on both the local and broader catchment community	7.8, 7.9, 7.6, 7.7, 7.16, 7.17, 7.26 and 7.27
53	The EIS needs to undertake a thorough and rigorous pre and post-mining risk assessment with respect to long term site specific and cumulative impacts of Noise and Blasting, Air Quality and Greenhouse Gas, Traffic and Transport, Visual Amenity, Social Impact Assessment and Economics on local and catchment communities	6 and 7
54	If the proponent covers all the prescribed scope of assessment as detailed in the background document then it is expected that the impact of the project on agricultural resources and industries will be thoroughly assessed	7.20
55	The EIS should address and consider the potential impacts on the soils within the development area. Issues that need to be addressed are the potential for soil degradation, soil salinity, soil characteristics and quality, and potential erosion, soil biology and chemistry impacts	7.19
56	Soils (topsoils and subsoils) need to be characterised, mapped and assessed for topdressing suitability using Australian standards and the most recent assessment methodologies	7.19
57	Measures to manage soils to prevent degradation and methods to monitor and evaluate soils need to be thoroughly addressed in the EIS	7.19
58	The EIS should address the pre and post-mining and long term land use, land capability and agricultural suitability	7.19
59	The EIS should include a complete and thorough soil balance detailing depths and extents of subsoil and topsoil	7.19
60	Soil and land capability assessments need to be integrated with rehabilitation and final landforms, agricultural impact and ecological impacts	7.10, 7.20 and 7.21
61	The EIS needs to consider and address the proposed methods of rehabilitation, land uses and final landforms which should be similar to current land uses and landforms. Detailed plans of proposed landforms including the location and specifications of emplacements and voids should be included in the EIS	7.21
62	The EIS needs to consider and address the impacts of clearing, access and rehabilitation on the current and proposed long term land uses. These activities have the potential to result in soil degradation and erosion and off site sedimentation, reduced water quality, weed invasion and changes to vegetation communities and therefore altered land use and management	7.19 and 7.21
63	The EIS needs to consider and address reject disposal and the methods for rehabilitation and long term land uses, especially with regards to the potential for salinity and pH impacts on soils, surface and groundwater	7.18, 7.19, 7.21 and 7.25

Ref	Issue	EIS Section
NOW		
64	Demonstrate adequate and secure water supply is available for the life of the project. This includes confirmation that water supplies for construction and operation of the mine and associated activities are sourced from an appropriately authorised and reliable supply in accordance with the operating rules of relevant water sharing plans, including the: • *Water Sharing Plan for the Upper Namoi and Lower Namoi Regulated River Water Sources 2003;* • *Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003;* • *Water Sharing Plan for the Phillips Creek, Mooki River, Quirindi Creek and Warrah Creek Water Sources;* • *Draft Water Sharing Plan for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2011* (to commence early 2012); and • Draft Water Sharing Plan for the Namoi Unregulated and Alluvial Water Sources (to commence in 2012).	3.9, 7.1 and 7.3
65	Demonstrate compliance with the rules in relevant water sharing plans, in particular the distance restrictions for water supply works and the process of assessment with respect to water source protection criteria	4, 7.1 and 7.3
66	Baseline monitoring/data over a minimum two year period of all surface and groundwater sources and dependent ecosystems within and adjacent to the mining operation area for calibration of models	7.1, 7.3, 7.10 and 7.12
67	Predictive assessments of the impact of the project on surface and groundwater sources, basic landholder rights to water, adjacent licensed water users and groundwater dependent ecosystems	7.1, 7.3, 7.10 and 7.12
68	Definition of the boundary limit to the Upper Namoi alluvium, and assessment and justification for the nominated boundary limit. Full geomorphic, hydrologic and salinity assessment of the surface and alluvial groundwater systems associated with the Upper Namoi alluvium	7.1 and 7.2
69	Development of a salinity budget, evaluation of salt migration to any surface water sources and justification for any salt migration changes pre to post-mining	7.3
70	Identification of and design and implementation of a monitoring program for all surface and groundwater sources and dependent ecosystems, within and adjacent to the mining operation area to provide confidence in predictions made on surface and ground water impacts by the proposal. This generally requires a baseline of at least two years surface and ground water data to form an adequate baseline	7.1, 7.3, 7.5, 7.10 and 7.12
71	Mitigation strategies to address unavoidable impacts on surface and groundwater sources and dependent ecosystems, for the operational and post-mining phases of the project, and final landform hydrogeological regime	7.1, 7.3, 7.10, 7.12 and 7.21
72	Measures to maintain any identified groundwater-dependent ecosystems, including stygofauna assemblages within the groundwater drawdown area of the Namoi alluvium	7.1, 7.10 and 7.12
73	Detailed examination of options to remediate and rehabilitate any excavated and/or disturbed areas of watercourses draining to Native Dog and/or Watermark Gully and any connected alluvium, and justification for criteria to completion of the project rehabilitation program	7.5, 7.12 and 7.21
74	Identify site water demands in terms of both volume and timing for the life of the project. This is to include details of any water reticulation infrastructure and alternate mechanisms (e.g. vehicles) that supply water to the site	3.9, 7.1 and 7.3
75	Provide a description and assessment of any requirements (including potential requirements) to intercept groundwater, including predicted dewatering volumes, zone of drawdown and associated impact, and water quality and disposal methods	7.1
76	Provide a justification to nominated setback distance from the Upper Namoi alluvium in terms of existing and predicted changes in contribution, flux and migration of groundwater, and maintenance of existing groundwater quality ranges and zonations	7.1 and 7.2
77	Salinity budgets for pre and post-mining scenarios should be assessed in the EIS, including an evaluation of salt migration to any surface water sources and justification for any salinity discharge changes (i.e. pre to post-mining)	7.3
78	Provide an analysis of the water sources affected by the project and identification of which water sources are the subject of a water sharing plan	4.4.5, 7.1 and 7.3
79	Detailed assessment of the impact of the project on surface and groundwater sources, basic landholder rights to water, adjacent licensed water users and groundwater dependent ecosystems; and analysis of the effect of any predicted impacts on water sharing arrangements prescribed in any relevant water sharing plan which is in force. This must address the hierarchy of water source value and dependence, including but not limited to impacts on the following: yield or flow classes; quality; connectivity between porous/fractured rock, alluvial and surface water sources; environmental dependence and dependence for basic landholder rights; and environmental water established and maintained by the plan rules	7.1 and 7.3
80	Analysis of options for the project in terms of achieving avoidance of impacts to surface and groundwater sources, basic landholder rights to water, adjacent licensed water users and groundwater dependent ecosystems. If the options analysis cannot demonstrate avoidance, then sufficient mitigation, remediation and rehabilitation options must be examined	7.1, 7.3, 7.10 and 7.12
81	Detailed examination of options to remediate and rehabilitate any excavated and/or disturbed watercourses including Watermark Creek and any connected alluvium, and justification for criteria regarding completion of the project rehabilitation program	7.1, 7.2, 7.3, 7.5 and 7.21
82	The EIS is required to take into account the objects and regulatory requirements of the ***Water Act 1912*** and ***Water Management Act 2000*** (WMA 2000), as applicable	4.4.5, 7.1 and 7.5

Ref	Issue	EIS Section
83	The EIS is required to demonstrate how the project is consistent with the relevant rules in these WSPs, including rules for access licences and rules for the management of local impacts. In particular, the EIS must demonstrate that rules governing access to water within the surface and groundwater sources affected by the project are appropriately incorporated into planning for the proposal, and that rules governing ecosystem protection, water quality and surface-groundwater connectivity are fully considered. NOW requires this to be addressed in a separate section of the EIS, with a checklist of rules under these WSPs governing: • Planned and adaptive environmental water provisions • Water supply work approvals (considering the mining excavation as forming a work that has, or could have, the effect of diverting water flowing to or from a water source, as defined in the WMA) • Long term average extraction limits and available water determinations for the life of the project, and final landform and post-mining hydrologic configuration • Water allocation account management rules • Total daily extraction limits and rules governing environmental protection • Rules governing surface and groundwater connectivity, constraints within the water source and local impacts • Access licence dealings	4.4.5, 7.1 and 7.3
84	The EIS must address the NSW State government natural resource management policies, as applicable. These policies include but are not limited to: • *NSW Inland Groundwater Shortage Zones Order No.2 (2008);* • *NSW State Groundwater Policy Framework Document (1997);* • *NSW State Groundwater Quality Protection Policy (1998);* • *NSW State Groundwater Dependent Ecosystems Policy (2002);* • *Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000);* • *Australian and New Zealand Guidelines for Water Quality Monitoring and Reporting (2000);* • *Guidelines for the Assessment and Management of Groundwater Contamination (2007);* • *Guidelines for Groundwater Protection in Australia (1995); and* • *NSW Office of Water Guidelines for Controlled Activities (2008).*	4, 7.1, 7.3, 7.10 and 7.12
85	The EIS must identify all proposed groundwater extraction and all proposed water supply works which take groundwater, including bores and excavations for the purpose of investigation, extraction, dewatering, testing or monitoring. The EIS must provide analysis of the proposed water supply arrangements against the operating rules and other requirements of any relevant water sharing plan in force	7.1
86	The EIS must provide details of the purpose, location and expected annual extraction volumes of all proposed groundwater extraction. The EIS must also provide details of the purpose, location, construction details and expected annual extraction volumes for all proposed water supply works which take groundwater. Although approved State Significant Developments are exempt from requiring a water supply work approval (s 89J of the *Environmental Planning and Assessment Act 1979*), the EIS must take into account the approval requirements of relevant water related legislation	7.1
87	Provide details on the groundwater sources which will be subjected to any of the following: a) the penetration of an aquifer b) the interference with water in an aquifer c) the obstruction of the flow of water in an aquifer d) the taking of water from an aquifer in the course of carrying out mining, or any other activity prescribed by the regulations e) the disposal of water taken from an aquifer as referred to in paragraph (d)	7.1
88	Baseline monitoring or data for a minimum of 2 years fortnightly sampling for groundwater quantity and quality for all aquifers within and adjacent to the mining operation area	7.1
89	Description of flow directions and rates, and the physical and chemical characteristics of the aquifers within the mine area and adjacent catchments	7.1
90	Details of the predicted highest groundwater table within the aquifers within the mine area and adjacent catchments	7.1
91	Extent of alluvium within the mine area and adjacent catchments, and details on connectivity of aquifers to these watercourses within the mine area and adjacent catchments	7.1 and 7.2
92	Details of any works likely to result in pollutants infiltrating into the groundwater sources	7.1 and 7.18
93	Details of proposed methods of the disposal of waste water and approval from the relevant authority	3.9 and 7.3
94	Assessment of salinity downstream of the site within the Mooki catchment within Zones 7, 8 and 3 of the Namoi alluvium	7.3
95	Assessment of the potential effects of mining operations on the quality of groundwater both in the short and long (post-mining) term	7.1
96	Details of the existing groundwater users within the area (including the environment) and details of any potential impacts on these users	7.1
97	Details on preventing groundwater pollution so that remediation is not required	7.1
98	Details of the predicted impacts of any final landform on the groundwater regime	7.1, 7.3 and 7.21
99	Details of critical thresholds for negligible impacts to groundwater sources	7.1
100	Details of the results of any models or predictive tools used to predict groundwater drawdown, inflows into the site and impacts on affected water sources within the mine area and adjacent catchments	7.1

Ref	Issue	EIS Section
101	The NSW *Groundwater Dependent Ecosystem Policy* provides principles for the management of groundwater dependent ecosystems (GDEs). The EIS is required to demonstrate how the project is consistent with these principles, especially Principle 5, relate to protection of species and ecosystems which are dependent on maintenance and quality within adjacent groundwaters to the mining proposal	7.1, 7.10 and 7.12
102	The EIS must provide the following information: • Identification of potential GDEs within the Project Boundary • Details of current GDE condition, and water quantity and quality required by the GDEs (based on minimum 2 year fortnightly baseline data) • Details of a flora and fauna assessment for all GDEs, which includes, macroinvertebrate and macrophyte diversity and abundance assessments within all watercourses within and adjacent to the mining area • Stygofauna within any aquifer which will be potentially impacted during mining • Details of critical thresholds for negligible impacts	7.1, 7.10 and 7.12
103	The EIS must also demonstrate the following: • That, where possible, natural patterns of groundwater flow will be maintained • That groundwater extraction will be managed within defined limits, so that groundwater levels which are critical for GDEs will not be disrupted and that there is sufficient flow to sustain ecological processes and maintain biodiversity • That the project will not cause adverse changes in groundwater quality, leading to degradation of existing beneficial use class(es) of groundwater and that sufficient groundwater of suitable quality is available to GDEs when needed • That the precautionary principle is applied in the protection of GDEs, particularly with regard to the dynamics of flow and availability, and the species reliant on these attributes • Protective measures will minimise any impacts on GDEs and potential offset areas will be monitored and protected	7.1, 7.10 and 7.12
104	Where potential impacts on a groundwater source, GDE or water users are identified, the EIS will need to identify threshold limits to the level of impact and contingency measures that would remediate, reduce or manage potential impacts. In particular, the EIS must provide the following: • Details of any proposed monitoring programs, including water level and quality data • Reporting procedures for any monitoring program including mechanism for transfer of information to the Office of Water • Identification of any nominal thresholds as to the level of impact beyond which remedial measures or contingency plans would be initiated (this may entail water level triggers or a beneficial use category) • Description of the remedial measures or contingency plans proposed • An assessment of any groundwater source/aquifer that may be sterilised as a consequence of the project • Any funding assurances covering the anticipated post development maintenance cost, for example, on-going groundwater monitoring for the nominated period	7.1, 7.10 and 7.12
105	To ensure the sustainable and integrated management of surface water sources which may be affected by this project, and to protect waterfront land from impacts arising from controlled activities which form part of this project, the Office of Water requires the following: • Identification of watercourses which will be governed under the WM Act • Remediation and rehabilitation requirements for the long term integrity of watercourses which are disturbed	7.3 and 7.21
106	The EIS must identify all proposed surface water extraction and all proposed water supply works to take surface water. The EIS must provide details of the purpose, location and expected annual extraction volumes of all proposed surface water extraction. The EIS must also provide details of the purpose, location, construction details and expected annual extraction volumes for all existing and proposed water supply works which take surface water, including pumps, dams, diversions, cuttings and levees. Although consented State Significant Developments are exempt from requiring a water supply work approval (s 89J of the *Environmental Planning and Assessment Act 1979*) the EIS must take into account the requirements of relevant water related legislation	3.9 and 7.3
107	The EIS must include an assessment of the impact of the project on watercourses and associated riparian vegetation and provide the following: • Identification of sources of surface water within and adjacent to the mining area • Baseline monitoring or data for a minimum of 2 years fortnightly sampling for surface water quantity and quality for all watercourses within and adjacent to the mining operation area • Geomorphic assessment of Dog Trap and Watermark Creeks and associated tributaries within the mining area, including details of stream order (using the Strahler System), river style and energy regimes both in channel and on any adjacent floodplains • Detailed description of any proposed development or diversion works including all construction, clearing, draining, excavation and filling • Detailed description of all potential environmental impacts of any proposed development in terms of vegetation, sediment movement, channel stability, water quality and hydraulic regime • For the proposed construction of any watercourse diversions, detailed design description and associated hydrologic and hydraulic modelling, impact assessment, and supporting stabilisation and rehabilitation measures. The impact assessment should also include consideration of the existing riparian and aquatic environments, associated impacts and rehabilitation requirements • Details of the existing surface water users within the area (including the environment) and details of any potential impacts on these users • Description of the design features and measures to be incorporated into the project to guard against long term actual and potential environmental disturbances, particularly in respect of maintaining the natural hydrological regime and sediment movement patterns and the identification of riparian buffers • Details of the impact on water quality and remedial measures proposed to address any possible adverse effects • Details of critical thresholds for negligible impacts to water sources	3.9, 7.3, 7.5 and 7.10

Ref	Issue	EIS Section
108	Riparian corridors form a transition zone between terrestrial and aquatic environments and perform a range of important environmental functions. The protection or restoration of vegetated riparian areas is important to maintain or improve the geomorphic form and ecological functions of watercourses through a range of hydrologic conditions	7.5 and 7.10
109	The EIS must provide the following: • Details of any proposed monitoring programs, including flow rates and quality data • Reporting procedures for any monitoring program including mechanism for transfer of information to the Office of Water • Identification of any nominal thresholds as to the level of impact beyond which remedial measures or contingency plans would be initiated (surface water energy and water quality limits and thresholds, and any ground water level triggers or a beneficial use category) • Description of the remedial measures or contingency plans proposed • Assessment of both operational and long term (post project period) impacts to any surface and/or ground water source which may be detrimentally affected • Any funding assurances covering the anticipated post development maintenance cost, for example, stream rehabilitation maintenance and performance monitoring and/or on-going groundwater monitoring for the nominated period	7.1, 7.3 and 7.21
110	The EIS should provide information on the following: • Clarification if the structures are on a watercourse • Details of the purpose, location and design specifications for the structures • Size and storage capacity of the structures • Calculation of the maximum harvestable right dam capacity for the site • Details if the structures are affected by flood flows and changes in hydrologic and/or energy regime occurring as a consequence of the proposed project • Details of any proposal for shared use, rights and entitlement of the structures	3, 7.3, 7.4 and 7.5
111	The EIS must include: • Justification of the proposed final landform with regard to minimising the impact on local and regional groundwater and surface water systems • The measures that would be established for the minimisation of impacts on local and regional groundwater and surface water systems, and for the ongoing management of the site following the cessation of the project • Detailed modelling of potential groundwater volume, flow and quality impacts associated with the presence of an inundated final void on identified receptors, specifically considering those environmental systems that are likely to be groundwater dependent • A detailed description of the measures to be put in place to ensure that sufficient resources are available to implement the proposed rehabilitation of water related impacts	7.1, 7.3 and 7.21
OEH		
112	Describe mitigation and management options that will be used to prevent, control, abate or mitigate identified environmental impacts associated with the project and to reduce risks to human health and prevent the degradation of the environment. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented	7
113	The proponent will also need to clearly identify and fully evaluate options to avoid/ minimise impacts. A key issue will be minimising surface disturbance through open cut mining vs. underground mining. The full costs (including environmental) and benefits of open cut vs. underground mining need to be identified	3.2.1, 7 and 9
114	The air quality impacts from the proposed development will need to be assessed using the methodology detailed in the EPA document *"Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales"*	7.6
115	All assumptions used in modelling air quality impacts will need to be clearly identified and justified. In particular, if the modelling and proposed management incorporates dust suppression using water then the volume requirements and source of the water must be identified, particularly for drier periods where water availability for dust suppression may be problematic. Contingencies to modify operations during high wind periods and as a result of water availability may need to be considered to minimise dust impacts. Best practice dust management will need to be incorporated into the design including, consideration of real time dust monitoring and weather forecasting to feed into mine operations	7.6
116	Any assumptions made in relation to wind borne dust sources from disturbed / undisturbed land, particularly the progressive / maximum area of disturbance against realistic rehabilitation objectives must be clearly established. It is expected that any assumptions in the air quality modelling made in relation to rate of progressive rehabilitation to minimise dust sources from wind borne erosion be a clear commitment by the proponent	7.6
117	Air quality impacts from movement of coal in uncovered wagons by rail should also be assessed. The proponent should liaise with ARTC regarding any outcomes from Pollution Reduction Program on the ARTC rail network licence (EPL 3142) to evaluate coal dust issues from rail transport and implement a work program to reduce dust emissions. The cumulative impacts incorporating adjoining mining operations and general ambient rural dust levels needs to be assessed - this includes PM_{10} 24 hr dust impacts	7.6
118	The EIS should include a comprehensive assessment of, and report on, the project's predicted greenhouse gas emissions (tCO_2-e). Emissions should be reported broken down by: a) direct emissions (scope 1 as defined by the Greenhouse Gas Protocol- see reference below) b) indirect emissions from electricity (scope 2), and c) upstream and downstream emissions (scope 3) before and after implementation of the project, including annual emissions for each year of the project (construction, operation and decommissioning)	7.7
119	If relevant, greenhouse emissions intensity (per unit of production) should be compared before and after the project. Emissions intensity should be compared with best practice if possible	7.7

Ref	Issue	EIS Section
120	The proponent should also evaluate and report on the feasibility of measures to reduce greenhouse gas emissions associated with the project. This could include a consideration of energy efficiency opportunities or undertaking an energy use audit for the site	7.7
121	The proponent should also identify if there are any cost-effective opportunities to reduce scope 3 emissions (e.g. by using different methods of supply or distribution)	7.7
122	The development should be designed so that the mine premises and associated activities comply with the NSW government's *Industrial Noise Policy* (INP) and the Australia and New Zealand Environmental Council's *Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration*. Please note that the recently released publication *Interim Construction Noise Guideline, DECC 2009* has advised that construction noise from mining and quarrying needs to be assessed and considered as operational noise under the INP	7.8
123	Noise impacts associated with road haulage off the defined premises will need to be assessed against the DEC's guidance document *NSW Environmental Criteria for Road Traffic Noise* (EPA, 1999)	7.8
124	Sleep disturbance as a result of mine activities, including road / rail movements on the private premises needs to be fully assessed	7.8
125	Modifying factor adjustments as outlined in section 4 of the INP need to be fully considered, particularly low frequency noise from locomotive operation and coal handling and preparation plant, impulsive and tonal noise sources	7.8
126	Impacts of increased rail movements along the rail network to Newcastle needs to be evaluated against the noise objectives set in the ARTC rail network licence (EPL 3142) and the guideline *"Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects, 2007"*	7.8
127	A key issue in the Gunnedah Basin area is that an adequate assessment of impact of inversions be undertaken, using if available, real temperature lapse rate data as outlined in section E of the INP. Anecdotal evidence from existing mining operations near Boggabri suggests that inversions greater than the default of 3°C/100 m are a feature of the area exacerbating noise impacts. This issue needs to be fully evaluated in the EIS	7.8
128	The cumulative effects of operational noise and blasting (including increase in blast frequency) from adjoining mining operations needs to be fully evaluated	7.8 and 7.9
129	The EPA recommends that a water balance be prepared to model water management through the life cycle of the mine. A detailed water management plan will be required for control of clean water, sediment laden water from disturbed areas and potentially saline/ contaminated water from mining operations and groundwater seepage into the mining void. The proposed mine is adjacent to the Liverpool Plains and the design incorporates a pit of varying depth to over 200 m deep. This is a key concern due to likely water management of excess water and potential impacts on beneficial use of aquifers and groundwater dependent ecosystems	3.9 and 7.3
130	Any discharge points will need to be identified with estimates of the frequency and volume of discharges and likely water quality discharges for key pollutants (but not limited to): • Total dissolved and suspended solids; • Heavy metals • Grease and oil • Nutrients • pH • Total organic carbon • Conductivity (salts)	7.3
131	The EIS should consider any proposed discharge in terms of NSW *Water Quality and River Flow Objectives* and utilising the Australian and New Zealand *Guidelines for Fresh and Marine Water Quality* (2000). In addition, the Namoi Catchment Action Plan (CAP) objectives should be used to guide discharges including reference to the NSW Salinity Strategy end of catchment salt concentration and load targets. Discharges of salt to the Namoi River, including potential lateral seepage and inputs to deep drainage, from land application, need to consider green offsets with an objective of no net impact from the development	7.3
132	An assessment of potential water quality impacts on groundwater resources must also be undertaken. An assessment of likely water quality and frequency of discharges from the final mining void following rehabilitation must also be undertaken. The proponent must demonstrate that options for minimising the final mine void have been identified and that discharges from the mining void will meet ambient water quality targets and stored mine void water quality will meet requirements for proposed future land-use on the premises. An objective of no final mine void should also be fully evaluated with a minimum objective of final void depth being above predicted groundwater recovery levels to avoid long term impacts as a groundwater sink and land use sterilisation	7.1, 7.3 and 7.21
133	A field survey of the site should be conducted and documented in accordance with the gazetted draft *Guideline for Threatened Species Assessment* and the document *"Threatened Biodiversity Assessment - Guidelines for Developments and Activities"* (Working Draft) (DEC 2004)	7.10
134	Likely impacts on threatened species and their habitat need to be assessed, evaluated and reported on. The assessment should specifically report on the considerations listed in Step 3 of the draft guideline	7.10
135	Describe the actions that will be taken to avoid or mitigate impacts or compensate for unavoidable impacts of the project on threatened species and their habitat. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented	7.10 and 7.11
136	Describe the extent of loss of any native vegetation and a strategy to offset any losses to ensure maintenance of, or improved outcome for biodiversity	7.10
137	The EIS needs to clearly state whether it meets each of the key thresholds set out in Step 5 of the guideline	7.10

Ref	Issue	EIS Section
138	The EIS must consider the corridor values or connective importance of any vegetation on the subject land. The EPA prefers that vegetation on adjoining land that exhibits these corridor values should be retained and, where necessary, rehabilitated. The final rehabilitation objectives, with appropriate performance monitoring against rehabilitation objectives, should be clearly defined in the EIS	7.10, 7.11 and 7.21
139	The impact on Koala habitat is obviously a key concern. It noted that work has been commenced on identifying and protecting Koalas and their habitat in the proposed mine area. Management of Koalas and their habitat will need to be fully assessed and impacts avoided / mitigated in accord with Best Practice	7.10 and 7.11
140	The EIS should address and document the information requirements set out in the draft ***Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation*** involving surveys and consultation with the Aboriginal community. Please note that the EPA has recently released a new guideline ***"Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010."***	7.13 and 7.14
141	Identify the nature and extent of impacts on Aboriginal cultural heritage values across the project area	7.13 and 7.14
142	Describe the actions that will be taken to avoid or mitigate impacts or compensate to prevent unavoidable impacts of the project on Aboriginal cultural heritage values. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented	7.13 and 7.14
143	The EIS needs to clearly demonstrate that effective community consultation with Aboriginal communities has been undertaken in determining and assessing impacts, developing options and making final recommendations	5.5, 7.13 and 7.14
144	The EIS needs to address the potential impact on native vegetation, specifically: • The hectares of native vegetation that will have to be cleared to accommodate mining for the extension project; • The floristics of the botanical communities of native vegetation that will need to be cleared • The extent of native vegetation on the site which may be remnant vegetation, protection regrowth or non-protected regrowth as defined by the ***Native Vegetation Act 2003*** • The requirement to develop suitable offset(s) to improve or maintain environmental outcomes for the lawful clearing of native vegetation, in relation to four environmental values: water quality, soils, salinity and biodiversity (including threatened species)	7.10 and 7.11
TRC		
145	Request that the VPA not only apply wholly to the Gunnedah Local Government Area, but also include the neighbouring areas, such as Tamworth, which significantly contribute to, and support the mining industry	7.26 and 7.27
146	The VPA should also be prepared and exhibited before, or concurrently with, the Development Application for the Watermark Coal Project	7.26 and 7.27
147	With regard to the Director-General's Requirements, Council requests that given the potential social and economic impacts, not only on the Gunnedah LGA, but also on the adjoining LGA's, such as Tamworth, particular emphasis be placed upon providing very robust and realistic Economic and Social Impact Assessments, which respect to the Gunnedah LGA and surrounding LGAs	7.26 and 7.27
148	In addition, as infrastructure demand impacts are not limited to the Gunnedah LGA, any Community Enhancement Funds should also allocate funding to adjoining LGA's for the provision of soft infrastructure, as well as regional infrastructure	7.26 and 7.27
DTIRIS – DRE		
149	As coal is a prescribed mineral under the ***Mining Act 1992***, the proponent is required to hold appropriate mining titles from DRE in order to mine this mineral. The proponent should liaise with DRE regarding any proposed mining lease application	4.4
150	Any EIS for this project should clearly identify existing coal titles, coal title applications and the final proposed mining lease area	3
151	The EIS must outline the interaction between the proposed mining activities and the existing environment and include a comprehensive description of the following activities and their impacts: • Mine layout and scheduling • Mine Infrastructure • Coal preparation and coal handling activities • Surface facilities and storage requirements • Water management	2 and 3
152	Post-mining land use - for the project area directly impacted (by mining facilities and infrastructure) the proponent must identify and assess post-mining land use options and provide a statement of the preferred post-mining land use outcome in the EIS. This should include a discussion of the benefits of the post-mining land use to a subsequent landowner, the local community and the state of NSW	7.21
153	Rehabilitation objectives and domains - a set of project rehabilitation objectives must be included that clearly define the environmental outcomes required to achieve the post-mining land use. This should include identification of each rehabilitation domain and a description of rehabilitation objectives for each domain	7.21
154	Rehabilitation methodology - outline general rehabilitation methods and procedures that will be employed by the project to ensure the rehabilitation objectives for each domain are met	7.21
155	Strategic rehabilitation completion criteria - nominate strategic completion criteria for the five phases of the rehabilitation process, namely 1. Decommissioning 2. Landform Establishment 3. Growth Media Development 4. Ecosystem Establishment 5. Ecosystem Development	7.21

Ref	Issue	EIS Section
156	If necessary, objective criteria may be presented as ranges rather than finite indicator levels. Subjective criteria may also apply where a gap in technical knowledge is experienced. It is expected that further refinement of these criteria will be undertaken and included in the MOP or Rehabilitation and Environmental Management Plan	7.21
157	Conceptual Final landform Design - a drawing at an appropriate scale with final landform contours should be provided. This drawing should identify, but not be limited to, the following attributes of the final landform; vegetation types, habitat features, contaminated areas, final voids, access and internal roads, fencing design and other remaining infrastructure	7.21
RMS		
158	The location of the proposed new road access and intended rail loop overpass is of concern to the RMS as it has the potential to impact upon a classified state road, the Kamilaroi Highway (HW29)	3.6 and 7.16
159	A detailed traffic study should be undertaken that takes into account the key issues relevant to the scale of this proposal as set out in Table 2.1 of the Roads and Traffic Authority's current *'Guide to Traffic Generating Developments'*. This should include information relating to: • Total impact of existing and proposed development on the state road network; • Intersection sight distances; • Existing and proposed access conditions; • Improvements for road junctions / intersections; • Detail of servicing and parking arrangements; • Connectivity to existing developments; • Impact on Transport (Public and School Bus Routes); • Provisions for pedestrians, alternative transport modes such as bicycles; and • Road Traffic Noise.	7.16
160	In particular, the traffic study should identify the design options for grade separation of the proposed rail loop to the Kamilaroi Highway. This should justify options for road-over-rail or rail-over-road including a cost-benefit analysis of potential impacts upon the state road network to ensure minimal impact upon the traffic flows, including construction delays to the state road, options for removal or retention of infrastructure on project closure, and whole-of-life maintenance planning for any bridge/s and/or road/s to be constructed	7.16
161	To ensure that the proposed access and rail overpass meet the necessary requirements the RMS will assist the consultants during the preliminary design stages if required	7.16
162	Current AUSTROADS standards should be adopted for any necessary upgrading of the surrounding road infrastructure	7.16
163	As road works are required on a State road, the Kamilaroi Highway, the developer will be required to enter into a Works Authorisation Deed (WAD) with RMS, who will exercise its powers under Section 87 of the *Roads Act 1993* (the Act) and/or the functions of the roads authority, to undertake road works in accordance with Sections 64 and 71 of the Act, as applicable, for all works under the WAD. The developer shall enter into the WAD with RMS for all road works on the Kamilaroi Highway prior to the construction of any access for the proposed development. The developer shall complete all road works required under the WAD to practical completion, as determined by RMS prior to commencement of the proposed development. All works shall be undertaken at full cost to the developer to the satisfaction of the RTA	7.16
SEWPaC		
164	General information 1. The background of the action, including: a) the title of the action b) the full name and postal address of the designated proponent c) A clear outline of the objective of the action d) The location of the action e) The background to the development of the action f) How the action relates to any other actions (of which the proponent should reasonably be aware) that have been, or are being, taken or that have been approved in the region affected by the action g) The current status of the action h) The consequences of not proceeding with the action	1
165	Description of the controlled action 2. A description of the action, including: a) all the components of the action	3
166	b) the precise location of any works to be undertaken, structures to be built or elements of the action that may have relevant impacts	3
167	c) how the works are to be undertaken and design parameters for those aspects of the structures or elements of the action that may have relevant impacts	3
168	d) the timing and duration of the works to be undertaken	3
169	e) to the extent reasonably practicable, a description of any feasible alternatives to the controlled action that have been identified through the assessment, and their likely impact, including:	9.3
170	i) if relevant, the alternative of taking no action	9.3
171	ii) a comparative description of the impacts of each alternative on the matters protected by the controlling provisions for the action	9.3
172	iii) sufficient detail to clarify why any alternative is preferred to another	9.3

Ref	Issue	EIS Section
173	Description of the existing environment 3. A description of the existing environment of the proposal location and the surrounding areas that may be affected by the action, including: a) surveys using accepted methodology for targeting listed threatened species, ecological communities and their respective habitat, including but not limited to OEH's Survey and assessment guidelines (2009) and the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) species-specific survey guidelines for nationally threatened species	7.10
174	In addition to the requirements outlined in OEH's *Survey and Assessment Guidelines* (2009) and SEWPaC survey guidelines for relevant species, the following must also be included: b) a description of the distribution and abundance of threatened species and ecological communities, as well as suitable habitat (including breeding, foraging, roosting habitat, habitat critical to the survival of threatened species) within the site and in surrounding areas that may be impacted by the proposal	7.10
175	c) the regional distribution and abundance of suitable and potential habitat surrounding the site	7.10 and 7.11
176	Description of the Relevant Impacts of the Controlled Action 4. An assessment of all relevant impacts with reference to the EPBC Act *Policy Statement 1.1 Significant Impact Guidelines Matters of National Environmental Significance* (2009) that the controlled action has, will have or is likely to have on relevant threatened species and/or threatened ecological communities (s18 and s18A),and migratory species (s20 and s20A). Information must include: a) a description of the relevant impacts of the action on matters of national environmental significance	7.10
177	b) a detailed assessment of the nature and extent of the likely short term and long term relevant impacts	7.10
178	c) a statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible	7.10
179	d) analysis of the significance of the relevant impacts	7.10
180	e) notwithstanding mitigation and offset, details on the cumulative impacts on matters of National Environmental Significance at a regional scale	7.10
181	f) any technical data and other information used or needed to make a detailed assessment of the relevant impacts	7.10
182	5. A description of the relevant impacts on the ecological communities should include an analysis of the vegetation condition on the site, as well as the methods by which this was determined. It should also include direct, indirect, cumulative and facilitative impacts on the: a) extent of the ecological community, including connectivity with other areas of the ecological communities	7.10
183	b) quality or integrity of the ecological community including, but not limited to, assisting invasive species, that are harmful to the ecological communities to become established; or causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the communities which kill or inhibit the growth of species in the ecological community	7.10
184	c) EPBC Act listed species in, or in any way dependent upon, the ecological community	7.10
185	d) composition of the ecological community	7.10
186	e) habitat present on site critical to the survival of the ecological community	7.10
187	f) abiotic (non-living) factors (such as water, nutrients or soil) necessary for the ecological community survival, for example increasing groundwater levels or making the site wetter, soil disturbance or substantial alteration of surface water drainage patterns	7.10
188	These impacts should be described for the construction and operation phases of the controlled action	7.10
189	This information should be provided with reference to the ecological community as it is defined and listed under the EPBC Act	7.10
190	6. Where there is a potential habitat for EPBC Act listed species (Appendix A), surveys must be undertaken. These surveys must be timed appropriately and undertaken for a suitable period of time by a qualified person. A subsequent description of the relevant impacts on such EPBC Act listed species should include, inter alia, direct, indirect, cumulative and facilitative impacts on the: a) population of the species at the site b) area of occupancy of the species c) habitat critical to the survival of the species d) breeding cycle of the population e) availability or quality of habitat for the species	7.10
191	If an endangered ecological community, threatened or migratory species listed at Appendix A is not believed to be present on the proposed site, detailed information must be included in the EIS to provide certainty that this community will not be impacted	7.10
192	Information relating to water. The EIS must consider any water related impacts associated with the proposed project on MNES	7.1, 7.2, 7.3, 7.4 and 7.5
193	7. How the proponent will comply with all relevant Commonwealth, state and local government environment laws and policies pertaining (either directly or indirectly) to water quality management;.	4
194	8. A description and maps of all surface water and groundwater sources relevant to the Project, and a delineation of their associated National Water Quality Management Strategy (NWQMS) environmental values	7.1 and 7.3
195	9. The results of surface water and groundwater hydrological assessments, including an assessment of hydrological interactions where water sources are connected	7.1, 7.2, 7.3, 7.4 and 7.5
196	10. Hydro-geological reports	7.1 and 7.3

Ref	Issue	EIS Section
197	11. A geological map showing fault lines	2.5, 7.1 and 7.2
198	12. A topographical map	2.1
199	13. Hydrological modelling information	7.1, 7.2, 7.3, 7.4 and 7.5
200	14. Baseline data and information on current water quality, including reference and test site data. Where this information does not exist, there should be an undertaking to carry out the necessary investigations in order to provide the required baseline data, including a description of how these investigations will be carried out (methodology and timeframe)	7.1, 7.2, 7.3, 7.4 and 7.5
201	15. Data and information on proposed discharge water quality, including timing of discharges, concentrations, and loads of toxicants and stressors	7.3
202	16. Water quality issues, including planning, monitoring and management informed by the National Water Quality Management Strategy: a) Sewage treatment b) Waterway crossings	3.9, 7.3, 7.5 and 7.25
203	17. Modelling showing the cumulative environmental impacts of the action	7
204	18. A comprehensive water quality risk management and monitoring plan for the project, including management triggers to detect potential issues in a timely manner and to avoid, minimise or ameliorate adverse impacts. This should include: a) Identification and description of all potential water quality hazards	7.1 and 7.3
205	b) Water quality risks should be considered and, where possible, quantified	7.1 and 7.3
206	c) Cumulative effects, including environmental impacts, should be considered	7.1 and 7.3
207	d) Threshold trigger and/or guideline values that protect MNES should be considered	7.1 and 7.3
208	e) Biological as well as chemical monitoring and assessment	7.1 and 7.3
209	f) Statistical analysis such as data averages, standard deviation and number of samples	7.1 and 7.3
210	g) Test and reference site locations	2.6, 7.1 and 7.3
211	h) Sampling and analytical methods	7.1 and 7.3
212	i) Quality control and quality assurance data	7.1 and 7.3
213	19. Some of the main water quality issues the proponent should consider include: a) Salinity	7.1 and 7.3
214	b) Sedimentation	7.3
215	c) Nutrients	7.1 and 7.3
216	d) Stressors such as pH, EC, turbidity	7.1 and 7.3
217	e) Heavy metals and metalloids	7.1, 7.3 and 7.10
218	f) Macroinvertebrate species assemblages, compositions and assessment results	7.10
219	g) Disturbed/exposed acid sulfate soils	7.19
220	h) Hydrocarbons, hydrocarbon derivatives and PAHs	7.1 and 7.3
221	Proposed Safety Guards and Mitigation Measures 20. A description of feasible mitigation measures, changes to the controlled action or procedures, which have been proposed by the proponent or suggested in public submissions, and which are intended to prevent or minimise relevant impacts. Information must include: a) a description of the mitigation measures that will be undertaken to prevent or minimise the relevant impacts of the action. These mitigation measures should be substantiated and based on best available practices	7.1, 7.3, 7.10 and 8
222	b) an assessment of the expected or predicted effectiveness of the mitigation measures including the effect on abundance and condition of species, suitable habitat and ecological communities	7.10 and 7.11
223	c) any statutory or policy basis for the mitigation measures	4
224	d) the cost of the mitigation measures	7.27
225	e) an environmental management plan that sets out the framework for continuing management, mitigation and monitoring programs (including any relevant thresholds for corrective actions) for the relevant impacts of the action. Include the person or agency responsible for implementing these programs and the effectiveness of all mitigation measures, including any provisions for independent environmental auditing	2.6 and 8
226	f) the name of the agency responsible for endorsing or approving each mitigation measure or monitoring program	5.3
227	g) identification of mitigation measures proposed to be undertaken by State governments, local governments or the proponent	8
228	h) any changes to the controlled action which prevent or minimise relevant impacts on listed threatened species and communities	3.12, 7.10 and 7.11

Ref	Issue	EIS Section
229	Offsets 21. Should any residual impact exist that cannot be mitigated it may be necessary for offset measures to be considered in order to ensure the protection of matters of national environmental significance in perpetuity. If required, the department may negotiate offsets with you during the assessment phase. Reference should be made to the Department's draft policy statement, including any revisions to this statement a) the description of any offset package should include how the offset compensates for the residual impacts, when the offset will be delivered and how the offset will be managed	7.11
230	b) an assessment of the impact of the offsets on other matters of environmental, economic, or social significance	7.11
231	c) analysis of cost, both financial and other, related to offsets	7.27
232	Other approvals and conditions 22. Any other requirements for approval or conditions that apply, or that the proponent reasonably believes are likely to apply, to the proposed action. Information must include: a) details of any local or State government planning scheme, or plan or policy under any local or State government planning system that deals with the proposed action, including:	4.8
233	i) what environmental assessment of the proposed action has been, or is being, carried out under the scheme, plan or policy	4.8
234	ii) how the scheme provides for the prevention, minimisation and management of any relevant impacts	8
235	b) a description of any approval that has been obtained from a State, Territory or Commonwealth agency or authority (other than an approval under the Act), including any conditions that apply to the action	4
236	c) a statement identifying any additional approval that is required	4.8
237	d) a description of the monitoring, enforcement and review procedures that apply, or are proposed to apply, to the action	8
238	Economics and Social Matters 23. A description of the short-term and long-term social and economic implications and/or impacts of the project	7.26 and 7.27
239	Environmental record of person proposing to take the action 24. Details of any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against: a) the proponent b) for an action for which a person has applied for a permit, the person making the application	1.2, 4 and 7.1
240	25. Details of the proponent's environmental policy and planning framework	2.6 and 8
241	Information sources 26. For information given in an environment assessment, the draft must state: a) the source of the information b) how recent the information is c) how the reliability of the information was tested d) what uncertainties (if any) are in the information	7.10 and 12
242	Consultation 27. Any consultation about the action, including: a) any consultation that has already taken place b) proposed consultation about relevant impacts of the action c) if there has been consultation about the proposed action — any documented response to, or result of, the consultation	5
243	28. Identification of affected parties, including a statement mentioning any communities that may be affected and describing their views	5.4



5.4.3 Regulatory Responses

Following the completion of the initial community and regulatory stakeholder engagement processes and issuance of the DGRS for the Project, all issues raised were addressed by Shenhua Watermark or the relevant specialists for inclusion in the impact studies undertaken as part of this EIS. Table 18 outlines the regulatory stakeholder issues raised and the section of the EIS where each is addressed.

Table 18 Regulatory Stakeholder Issues Raised

Ref.	Issue Raised	Regulator	EIS Section
1	Project Justification		
a	Different mine plan options need to be strongly justified	DP&I	3.12
2	Rehabilitation and Final Landform		
a	Relief in the final landform is preferable over a blocky structure	DTIRIS	7.21
b	Direct replacement of derived native grasslands would be a potential rehabilitation method	DTIRIS	7.21
c	Rehabilitation work will need to consider wildlife corridors from an ecological perspective	DTIRIS	7.11 and 7.21
d	It is important to get the final land use mix of woodland versus pasture correct	DTIRIS	7.21
e	Propose a blend of agriculture and ecology in the rehabilitation plan	DP&I	7.1, 7.2 and 7.19
f	Specify the proportion of agricultural land to rehabilitated land in the Project Boundary	DTIRIS	7.21
3	Soils and Land Capability		
a	Management of soil and where it is positioned onsite requires careful consideration	DP&I	7.19
b	Salinity will demote parcels of land to a lower land capability class, however that does not mean it is poor quality land if appropriately managed thus it is important to understand the underlying factors which inform the dataset	DTIRIS – PI	7.19
c	Determine soil fertility using the physical structure, slope, erodibility and properties such as self-mulching	DTIRIS – PI	7.19
d	Definition of the alluvial boundary, including a detailed methodology. Assess the adequacy of the buffer distance between the Eastern Mining Area and the alluvial boundary	DTIRIS – PI, GSC, DP&I and NOW	7.1, 7.2 and 7.19
e	Assess the adequacy of the buffer distance between the Southern Mining Area and the black soil plains	GSC, DP&I and NOW	7.1, 7.2 and 7.19
4	Groundwater and Surface Water		
a	Provide empirical groundwater connectivity data	DP&I	7.1
b	The groundwater study needs to be comprehensive	DP&I	7.1
c	Provide an understanding of potential flow on effects of mining to the floodplain, especially in the southern cropping areas	Namoi CMA	7.1, 7.3 and 7.4
d	Changes in flow and water quality are imperative inclusions to the EIS	DP&I	7.1, 7.3 and 7.18
e	Include surface water assumptions regarding harvest water, discharge quality, sediment dams and environmental flows	DP&I	7.3
f	Management of stormwater and erosion control for adjoining landholders should be considered	DTIRIS – PI	7.3 and 7.5
g	Groundwater quality within the open cut mining areas	DTIRIS	7.1
h	Include water balance and water storage details	GSC	7.3
i	Minimise disturbance to local creeks, riparian vegetation, and catchment loss	Namoi CMA	7.3 and 7.10
j	Indicate where water is proposed to be sourced in the EIS and assess the impacts of the final void interaction with surface and groundwater	DP&I and NOW	7.1 and 7.3
k	Consider the results of the Namoi Water Study	DP&I	7.1 and 7.3
l	Assess the impact of the Project potable water as nearby residents likely utilise the local surface and groundwater for consumption and household uses	NSW Health	7.1 and 7.3
m	Differentiate local and regional recharge	NOW	7.1
n	Consider any impacts on Lake Goran associated saline flow	NOW	7.1 and 7.3
o	Consider Department of Agriculture soil water characteristics for black soils in the groundwater model	NOW	7.1
p	Consider the groundwater levels of the sandstone at Spring Ridge in the groundwater model	NOW	7.1
q	Include CSIRO climate tiles (wet / dry / middle scenarios) in the groundwater models	NOW	7.1
r	Consider CSIRO runoff and surface water characteristics	NOW	7.3

Ref.	Issue Raised	Regulator	EIS Section
s	Assess the porous rock water sharing plan into the EIS	NOW	4.3 and 7.1
t	Assess the impacts of dewatering on the Permian aquifer	NOW	7.1
u	Identify and assess impacts on existing groundwater users	NOW	7.1
v	Include stormwater runoff in the surface water study	DP&I	7.3
w	The surface water and ground water studies should be integrated	DP&I	7.1 and 7.3
x	The aquifer recharge policy should be incorporated into the EIS	NOW	4.3 and 7.1
y	Water use for dust suppression will need to be included as part of the water balance	DP&I	7.3
z	Provide groundwater inflow rates	DP&I and NOW	7.1 and 7.3
aa	Need to model water storage within the final void and prevent the formation of a fluctuating mud pit	DTIRIS	7.3
ab	Investigate the water balance and salt water demand range	NOW	7.3
ac	Cumulative water impacts should be investigated	NOW	7.1 and 7.3
ad	Develop one groundwater model suitable for both BHP and Shenhua Watermark to provide common output	NOW	7.1
5	Ecology		
a	Cropped areas continuously fallowed should be delineated on the vegetation communities figure	Namoi CMA	7.10
b	Consider the Namoi CMA action plans and preferably address the Namoi CMA's management targets	Namoi CMA	4.6 and 7.10
c	Consider biobanking options	DP&I	7.10
d	Consider indirect offsetting options	SEWPaC and OEH	7.11
e	Encourage rehabilitation of Box Gum Woodland	SEWPaC and OEH	7.11 and 7.21
f	Encourage protection of vegetation corridors	SEWPaC and OEH	7.11 and 7.21
g	Encourage direct offsetting of properties situated close to the Project. Offset properties located at a significant distance from the Project Boundary will need to be strongly justified	SEWPaC and OEH	7.11
h	Impacts to Box Gum Woodland and offset ratio requirements	SEWPaC and OEH	7.10 and 7.11
i	If there are no MNES which are water dependent, a justification of this would be sufficient	SEWPaC	7.10
j	Consider the Namoi CMA biodiversity offset policy in the EIS and condition assessments	Namoi CMA	4.6 and 7.10
k	Assess impacts to floristics and Koala populations	GSC	7.10
6	Agriculture		
a	The AIS should include the economic impact of extraction of groundwater from agricultural use	DP&I	7.20
b	All land mined or disturbed should be capable of being returned to a similar land capability after mining	DP&I	7.19
c	Ensure that land is returned to its pre-mining productive potential	DTIRIS – PI	7.19, 7.20 and 7.21
d	Include sections providing the results of the surface water and groundwater assessments in the Watermark AIS for simplicity of review	DTIRIS – PI	7.20
e	The AIS needs to be repeatable and verifiable when presented to the community	DTIRIS – PI	7.20
f	The AIS should consider impacts in perpetuity	DTIRIS – PI	7.20
g	The AIS should include a comparison of the dry sheep equivalent (DSE) of the land	DTIRIS – PI	7.20
h	Analyse the displacement of agricultural communities within the AIS	DTIRIS – PI	7.20
i	Demonstrate a high level of detail in the methodology section and also determine the long term goals of the landholders as these may have changed with the purchase of their land by a mining company	Office of Agriculture	7.20
j	The AIS must quantify the net loss of agriculture	DTIRIS – PI	7.20
k	If a new, well documented and repeatable "multiplier effect" is found it may be used for the AIS (the most up to date example was present within WA)	DTIRIS – PI	7.20
l	Genuine consultation with surrounding landholders needs to be documented, which could be tabulated in the AIS report	DTIRIS – PI	5.4
m	Identify the impact of mining on the surrounding land, the decline in production and displacement of the farming community in the AIS	DTIRIS – PI	7.20
n	Identify any fragmentation of agriculture and access to infrastructure due to the Project	Office of Agriculture	7.20
o	Consult with local or producer group agronomists and livestock consultants	DTIRIS – PI	7.20
p	Assess impacts within a 10 km radius	DTIRIS – PI	7.20

Ref.	Issue Raised	Regulator	EIS Section
q	Make observations on surrounding agricultural land use to inform the AIS	DTIRIS – PI	7.20
r	Capture the agricultural history in the AIS for example the growing of sorghum increased as a result of the close proximity to Caroona feedlot	DTIRIS – PI	7.20
s	Rehabilitation is of great interest to the Department and the methodology of rehabilitating the land needs to be repeatable	Office of Agriculture	7.21
t	Rooting depth is an important component of productive capacity which should be included in the post-mining land characteristics section of the rehabilitation chapter	DTIRIS – PI	7.21
u	Recognise the importance of grain in the region for agricultural production	DTIRIS – PI	7.20
v	Consider the potential loss of employees from the rural sector and a demographic shift of the workforce in the AIS	DP&I and DTIRIS – PI	7.20 and 7.26
w	Key components of the AIS should include: • Measured Baseline data • Understanding and assessment of the disturbance and processes involved with an agricultural focus • Ability to protect and rehabilitate the land with a focus on a measured level of production	DTIRIS – PI	7.20
x	Identification of BSAL within the Project Boundary	DP&I	7.20
7	Aboriginal Archaeology and Cultural Heritage		
a	An analysis of potential avoidance of impact on significant sites should be undertaken	DP&I	3.12, 7.13 and 7.14
b	Appropriate assessment of scarred trees	DP&I	7.13
c	A geotechnical investigation of the grinding groove sites to test rock strength would allow for assessing multiple best cultural heritage outcomes	DP&I	7.13 and 7.14
d	Involvement of local Aboriginal land councils	DP&I	7.13 and 7.14
e	It is imperative to establish why registered Aboriginal parties want to be part of the EIS process	DP&I	7.13 and 7.14
f	Consider commissioning a keeping place for Aboriginal artefacts	DP&I	7.13 and 7.14
g	Ensure that intellectual property is appropriately handled	DP&I	7.13 and 7.14
h	Encourage provision of Aboriginal employment and housing	DP&I	7.13 and 7.14
i	Permanent protection of Aboriginal artefacts	DP&I	7.13 and 7.14
j	Provide the Aboriginal community with the results of the biodiversity survey and inform them of any biodiversity impacts	DP&I	7.13 and 7.14
8	Noise		
a	Consider the no night time noise option, to assess what is reasonable and feasible. Include this in the EIS	DP&I	3.12 and 7.8
b	Noise complaints are more frequent under inversion conditions. Consider noise reduction options during inversion conditions	DP&I and OEH	7.8
c	Assess construction noise	DP&I	7.8
9	Visual and Lighting		
a	Visual and lighting impacts for sensitive receptors will need to be taken into consideration, with consideration of lighting across the floodplain at night time.	DP&I	7.17
b	Visual impact of the Project on nearby roads	GSC	7.17
10	Air Quality		
a	Cumulative impacts and background data need be assessed	DP&I	7.6
b	Consider the Katestone air quality publication	DP&I and DTIRIS	7.6
c	Peak operating times where haulage is frequent should be modelled to assess the worst case scenario	DP&I	7.6
d	A $PM_{2.5}$ assessment will require completion, due to the proximity to Breeza	DP&I	7.6
e	There is a definite push toward a regional air monitoring network, especially for $PM_{2.5}$. Shenhua could make a contribution to establishing a monitoring network	OEH	7.6
f	Transparency in regional air quality data and data availability for the community is recommended so that the community can make informed decisions regarding health management	NSW Health	7.6
g	Consider the impact of blast fumes	DP&I	7.6
h	Incorporation of best practice air quality management	DTIRIS	7.6
11	Social		
a	Investigate Aboriginal employment and housing opportunities	DP&I	7.14 and 7.26
b	Royalties need to come back to the regions where they are being taken from	GSC	7.26 and 7.27

Ref.	Issue Raised	Regulator	EIS Section
12	Traffic and Transport		
a	Investigate alternative arrangements for Court Lane and indicate whether the closure will be temporary during the life of mine and reinstated post-mining or if it is to be a permanent road closure	GSC	3.6 and 7.16
b	Provide permanent road closure requirements	DTIRIS	7.16
c	Noise and air quality impacts from additional trains will need to be mitigated	ARTC	7.6 and 7.8
d	Consider ARTC noise objectives and pollution reduction programs and proposed potential solutions	ARTC	7.6 and 7.8
13	Mine Plan		
a	Ensure that the final void is distant from the Mooki River and alluvials	DP&I	3.2
b	Add a rail servicing facility (fuel station) to the Project	ARTC	3.5
c	Ensure maximisation of recovery	DTIRIS	3.2 and 9.3
d	Clearly identify the mining lease application area	DTIRIS	3.2
14	General		
a	Consider power line construction and power supply capabilities	DP&I	3.6
b	Consider the capacity and availability of Newcastle port services	DP&I	7.16 and 7.20
c	Provide public access to monitoring data	NSW Health	2.6 and 8
d	Require adequate assessment of any impacts to the black soil plains	GSC	7.19
e	Consider cumulative impacts due to the conceptual Caroona project	DP&I	7.1, 7.6, 7.8 and 7.16
f	Assess spontaneous combustion potential of course reject stockpiles	DTIRIS	7.6 and 7.18

5.4.4 Community Reference Group Responses

A range of environmental and social issues of concern were raised by the CRGs throughout the meetings and site visits. Table 19 provides a summary of the issues raised by the Community Reference Groups and where each has been addressed in this EIS.

Table 19 Issues Raised by the Community Reference Groups

	Ref.	Issue / Question Raised	EIS Section
Environment CRG	1	Employment and Community	
	a	Assess cumulative impacts to services and infrastructure	7.16 and 7.26
	b	Consider fatigue management and social implications of drive-in-drive-out employees	7.26
	c	Avoid community segregation of mining and non-mining families by effective community integration programs	7.26
	d	Consider the potential to work with local mining companies on training incentives	7.26
	e	Consider the impact of demand for local labour on other industries	7.26
	f	Consider social impacts associated with accommodation villages	7.26
	g	Respond to community concerns and individual submissions made on the EIS	5
	h	Provide specific working hours within the EIS	3.10
	2	Surface Water and Groundwater	
	a	Provide water demand and pumping requirement figures	7.3
	b	Determine whether extraction of water from the Mooki River and / or Native Dog Gully will be required	7.3
	c	Consider the impacts on regional water availability	7.1 and 7.3
	d	Consider various water treatment options	7.3
	e	Assess the impacts on surface water and groundwater quality	7.1, 7.3 and 7.18
	f	Background surface water and groundwater quality levels should be assessed	7.1 and 7.3
	g	Determine whether water will need to be discharged into the Mooki River	7.3
	h	Contribute collected surface water and groundwater data to regional data sources such as Namoi CMA	7.1 and 7.3
	i	Determine the water quality within the final void	7.1 and 7.3

	Ref.	Issue / Question Raised	EIS Section
Environment CRG cont.	2	Surface Water and Groundwater cont.	
	j	Provide water storage volume requirements	7.3
	k	Provide figures on drawdown of groundwater aquifers	7.1
	3	Ecology	
	a	Assess the impacts of the Project on CEEC and EEC	7.10
	b	Provide details on whether offset properties can be revegetated and whether pre-established offset habitats can be purchased as part of the offsetting package	7.11
	c	Collaborate with GSC to develop a regional Koala Plan of Management	7.10
	d	Establish wildlife corridors as part of the offset strategy	7.11
	e	Provide details on pest and weed management strategies for the offset properties	7.11
	f	Provide offset ratio requirements	7.11
	g	Assess the impacts of the Project on Koala habitat	7.10
	4	Air Quality and Greenhouse Gas	
	a	Explain dust suppression methods	7.6
	b	Provide the air quality monitoring methodology	7.6
	c	Assess cumulative air quality impacts	7.6
	d	Consider the development of the EPA's regional air quality monitoring program	7.6
	e	Justify the reliability of background air quality monitoring data	7.6
	f	Assess dust impacts at the Siding Spring Observatory, Coonabarabran	7.6
	g	Assess the air quality impacts on neighbouring residences	7.6
	5	Rehabilitation and Final Landform	
	a	Determine the likelihood of re-establishing CEEC and EEC	7.11 and 7.21
	b	Determine the land capability classification of the final landform	7.19
	c	Provide the revegetation plan of the Project Boundary	7.11 and 7.21
	d	Determine the suitability of the land for agriculture post-mining	7.19 and 7.21
	6	Noise	
	a	Assess noise generation from increased train movements	7.8
	b	Identify background noise levels	7.8
	c	Assess the noise impacts at neighbouring residences	7.8
	d	Assess the noise impacts at Breeza	7.8
	7	Visual and Lighting	
	a	Asses the visual and lighting impacts at the Siding Spring Observatory, Coonabarabran	7.17
	8	Soil and Land Capability	
	a	Identify the impacts of the Project on soil salinity	7.19
	b	Provide details on the delineation of the alluvial soils boundary	7.2 and 7.19
	c	Provide the soil survey methodology including soil fertility methodology	7.19
	d	Assess the impacts on soil fertility, land capability and the impact of the Project on BSAL	7.19
	e	Explain how soil layers will be identified and distinguished during stripping	7.19
	f	Consider the potential erosion of topsoils following placement	7.19
	9	Agriculture	
	a	Consider the loss of agricultural productivity and associated benefits to the region	7.20
	b	Consider the potential to continue agricultural practices in offset lands	7.20
	c	Consider the impact of water usage on regional agriculture	7.20
	10	Aboriginal Archaeology and Cultural Heritage	
	a	Mitigate and manage impacts to Aboriginal archaeology	7.13 and 7.14
	11	Traffic and Transport	
	a	Assess cumulative road and rail impacts	7.16
	12	Mine Plan	
	a	Feasibility of altering the mine plan to avoid areas of CEEC	3.12
	b	Encourage a minimal final void size	3.2 and 3.12
	c	Justify why open cut mining has been chosen over underground mining	3.12

	Ref.	Issue / Question Raised	EIS Section
Water CRG	13	Surface Water and Groundwater	
	a	Consider the Namoi Water Study in the EIS	7.1 and 7.3
	b	Define the groundwater aquifers	7.1 and 7.2
	c	Determine groundwater aquifer connectivity	7.1 and 7.2
	d	Assess the impacts on alluvial groundwater quality	7.1
	e	Assess the impacts of the Project on groundwater quality	7.1
	f	Complete carbon dating of groundwater	7.1
	g	Assess the impacts of agriculture on groundwater quality and hydrology	7.1 and 7.3
	h	Assess drawdown / depressurisation of groundwater aquifers	7.1
	i	Determine the water quality within the final void	7.1 and 7.3
	j	Explain how water salinity will be managed	7.1, 7.3 and 7.18
	k	Explain the groundwater modelling methodology and model extent	7.1
	l	Explain the interaction of the Project with regional coal seam gas exploration Projects	7.1
	m	Consider the cumulative impacts on groundwater from regional mining and coal seam gas projects	7.1
	n	Provide detail on the impacts on surface water quality	7.3
	o	Assess the impacts to the water quality and flow of the Mooki River	7.3
	p	Consider impacts from flood events	7.4
	q	Assess the impacts on stygofauna	7.12
	r	Indicate water demands and pumping requirements	7.3
	s	Indicate water storage volume requirements	7.3
	t	Justify how the sustainable yield has been determined	7.3
	u	Consider seasonal groundwater fluctuations	7.1
	v	Identify whether discharges into the Mooki River will be required and / or permitted	7.3
	w	Provide the flood modelling methodology	7.4
	x	Justify the reliability of the Project's groundwater model	7.1
	y	Determine whether there is a response of groundwater to atmospheric pressure	7.1
	z	Assess the quality of surface water runoff	7.3
	aa	Explain how speed and volume of horizontal groundwater flow will be impacted by the Project and how flow will be managed	7.3 and 7.4
	ab	Consider implications of a lack of reliable historical rainfall and evapotranspiration data availability and reliability	7.1 and 7.3
	14	Rehabilitation and Final Landform	
	a	Explain the open cut mining area backfill and management procedures	3.2 and 7.21
	15	Soil and Land Capability	
	a	Assess the interaction of surface infiltration and saturation points with soils	7.1 and 7.19
Koala CRG	16	Ecology	
	a	Provide details on collation of survey and assessment data	7.10
	b	Consider distances travelled by Koalas per day in the management strategy	7.10
	c	Consider in the Koala Plan of Management the potential that habitats within the Project Boundary not being utilised because Koalas are unable to reach them via corridors	7.10
	d	Consider changing fertility of habitats prior to agriculture and how this has implications for Koala behaviour and survival in the Koala Plan of Management	7.10
	e	Consider the ability of the Project landscape to support quality Koala feed trees post-mining	7.10, 7.11 and 7.21
	f	Provide offset location details	7.11
	g	Provide vegetation mapping details to the GSC for their Koala Plan of Management	7.10
	h	Avoid revegetation in areas of remnant Plains Grass	7.10 and 7.11
	i	Consider the utilisation of non-eucalypt trees, such as the White Cyprus Pine in times of drought	7.10 and 7.21
	j	Identify preferred Koala feed and habitat tree species	7.10
	k	Consider the quality of feed trees, both in terms of tree species and soil type	7.10

	Ref.	Issue / Question Raised	EIS Section
Koala CRG cont.	l	Provide offsetting requirements for the Project, where offset properties are located, whether areas can be improved to gain more offsets and whether condition assessments are completed on offset properties	7.11
	m	Consider research from other sources in addition to information obtained by the survey completed for the Project	7.10
	n	Explain the feasibility of relocating Koalas to rehabilitated areas	7.10 and 7.11
	o	Provide details on who will be responsible for managing and monitoring of the compensatory habitats	7.11
	p	Consider the potential for community involvement in managing the compensatory habitats	7.11
	q	Consider overbrowsing potential in 'fragmented landscapes'	7.10 and 7.11
	r	Consider the distance of creek lines from the proposed mining operations in the Koala Plan of Management	7.10
	s	Consider replanting riparian vegetation prior to commencement of the Project	7.11
	t	If wild dogs were observed during the survey, consider their presence as part of the Koala Plan of Management as a threat to Koalas	7.10 and 7.11
	u	Consider the success of Koala relocations in the past	7.10
	v	Integrate Project Koala Plan of Management with the GSC Koala Plan of Management	7.10
	w	Consider recent listing of Koalas as a Threatened species under the EPBC Act	7.10
	x	Provide the number of hectares considered for offsetting around Mt. Kaputar	7.11
	y	Explain if there is potential to mine offset areas in the future	7.11
	z	Consider the feasibility of tracking Koalas and consider the findings of tracking work completed by Dan Lunney	7.10
	17	Soils and Land Capability	
	a	Provide details on the ability of rehabilitation to replace the biophysical and soil ecology properties of the soil and ability of soil to support the same quality trees	7.19 and 7.21
	18	Other	
	a	Provide mine scheduling and impact time frames	3.2
	b	Justify how a few kilometres is a substantial enough distance to avoid impact from dust, vibration, and noise generated by the Project	7.6, 7.8 and 7.9



5.4.5 Community Responses

A range of issues were raised by near neighbours and local communities during the stakeholder engagement program. The potential for air quality impacts, noise and blasting impacts, visual amenity issues and cumulative impacts were commonly raised. Other issues raised included employment and economic impacts, water management, rail and road traffic and community contributions.

Table 20 provides a summary of the issues raised by community stakeholders and where each has been addressed in this EIS.

Table 20 Community Stakeholder Issues Raised

Ref	Issue Raised	EIS Section
1	Employment and Community	
a	Consider employment and training opportunities for local residents as a priority	7.26
b	Detail whether accommodation villages and fly in / fly out employees will be utilised	7.26
c	Consider the separation of Project personnel from community activities and facilities (in relation to accommodation villages) and provide options to mitigate against this separation	7.26
d	Assess the impact of the Project on non-mining industries in the local area	7.26
e	Assess the changes to current living conditions and increased cost of living	7.26
f	Assess the impact of a reduction in housing availability	7.26
g	Impact on community services and facilities	7.26
h	Consider the post-mining social and economic impacts	7.27
i	Consider how the attractiveness of the local area to existing and new residents will be impacted by the Project	7.26
j	Consider incentives for youth education, training and development for entering the mining workforce	7.26
k	Provision of employment of women as part of the Project employment strategy	7.26
l	Detail how landowners impacted by dust and other environmental issues as a result of the Project will be compensated	7.6
m	Explain who will own the land post-mining	7.21
2	Surface Water and Groundwater	
a	Assess the impact to groundwater aquifers	7.1
b	Assess the interaction of surface water and groundwater	7.1 and 7.3
c	Assess surface water and groundwater quality	7.1 and 7.3
d	Assess the impacts to flow and water quality of the Mooki River as a result of the Project	7.1 and 7.3
e	Assess drinking water quality	7.1 and 7.3
f	Consider the impact of water flows, volume and direction	7.1 and 7.3
g	Provide details on water demands, availability and allocation	7.1 and 7.3
h	Consider the Namoi Catchment Water Study	7.1 and 7.3
i	Develop a flood management plan	7.4
j	Explain whether those impacted by changes to groundwater will be compensated	7.1
k	Explain the impacts on surface water quality from CHPP washing	7.3
3	Ecology	
a	Present the impacts of the Project on flora and fauna	7.10
b	Provide the ecology survey detail and methodology	7.10
c	Detail the impacts of removing native ecological communities	7.10
d	Describe the net loss of Critically Endangered Ecological Communities	7.10 and 7.11
e	Detail the impact of the Project on Koala populations and habitats	7.10
f	Where feasible ensure the preservation of tree hollow habitats	7.11
g	Implement ecological corridors	7.10 and 7.11
h	Assess the impacts of the Project on critically endangered species	7.10 and 7.11
4	Air Quality and Greenhouse Gas	
a	Assess the impacts of dust generation and associated health impacts from mining	7.6
b	Consider dust generation and associated health impacts from trains	7.6
c	Assess whether contaminants will occur in dust generated as a result of the Project	7.6
d	Assess the impact of the accumulation of dust, including coal dust in drinking water	7.6
e	Determine feasibility of installing $PM_{2.5}$ monitors at each air quality monitoring station including next to the rail line	7.6

Ref	Issue Raised	EIS Section
4	Air Quality and Greenhouse Gas cont.	
f	Consider and assess the impact of dust accumulation on residential infrastructure	7.6
g	Assess the potential for greenhouse gas generation and by-products from coal extraction	7.7
h	Provide the dust monitoring and air quality assessment methodology and reliability of data compilation	7.6
i	Suggestion for Shenhua to promote use of renewable energy sources	7.7
j	Ensure dust suppression procedures are effective by continued monitoring and reporting	7.6
5	Rehabilitation and Final Landform	
a	Detail the rehabilitation plan and mine closure procedures	7.21
b	Explain how the final void will be managed	7.21
c	Explain whether underground mining is feasible following the cessation of open cut mining	3.12 and 7.21
d	Recommendation to revegetate the final landform to regenerate habitat for threatened species	7.11 and 7.21
e	Explain the post-mining impacts and whether environmental monitoring will continue post-mining	7.21 and 8
f	Seed stocks for rehabilitation should be sourced locally	7.21
g	Provide the mine closure criteria and assurance that Shenhua Watermark will meet the criteria	7.21
6	Noise	
a	Model the levels of noise generation from Project operations	7.8
b	Identify background noise levels as part of the EIS	7.8
c	Consider noise generation from train movements	7.8
7	Blasting and Vibration	
a	Undertake a blasting impact assessment	7.9
b	Assess the impact from blasting and subsequent vibration on residential structures	7.9
c	Assess the impact of blasting on Koalas	7.10
8	Visual and Lighting	
a	Identify the visual impacts of the mine on nearby roads	7.17
b	Assess the visual impacts of mine on nearby residences	7.17
c	Detail the visual impacts following mine closure	7.17
d	Identify and assess the impact of lighting during night operations	7.17
9	Soils and Land Capability	
a	Provide the land capability of soils in the final landform	7.19
b	Assess the potential for soil contamination due to the Project	7.23
10	Agriculture	
a	Assess the impact of dust on crop quality	7.6 and 7.20
b	Consider the immediate and long term loss of agricultural production as a result of the Project	7.20
c	Detail how the Project will interact and cooperate with surrounding agricultural communities	7.20
d	Assess the impact of traffic on agricultural transportation including rail transportation	7.16 and 7.20
e	Assess the impact of the Project on productive cropping soils	7.19 and 7.20
f	Detail how the availability of water for agriculture will be impacted	7.1, 7.3 and 7.21
g	Detail the impact of the Project on livestock	7.1, 7.6, 7.20 and 7.3
11	Aboriginal Archaeology and Cultural Heritage	
a	Explain how Aboriginal heritage sites will be managed	7.13 and 7.14
b	Detail how Aboriginal stories will be preserved for future generations	7.13 and 7.14
c	Detail how damage to Aboriginal artefacts due to erosion will be prevented	7.13 and 7.14
d	Detail how impacts on Aboriginal culture and heritage will be mitigated, considering the potential for Aboriginal offset lands	7.13 and 7.14
e	Detail how Aboriginal knowledge holders can participate in archaeological surveys	7.13 and 7.14
f	Where feasible, provide compensation for impacts to Aboriginal sites and objects	7.13 and 7.14
g	Provision of employment opportunities for local Aboriginals	7.11, 7.14 and 7.26
12	Traffic and Transport	
a	Assess the impact of rail and road traffic generation	7.16

Ref	Issue Raised	EIS Section
12	Traffic and Transport cont.	
b	Consider the entire life of the mine in the traffic assessment	7.16
c	Assess the cumulative impacts on rail traffic	7.16
d	Assess the impact of permanent road closures	7.16
e	Consider harvest traffic and seasonal traffic within the traffic assessment	7.16
f	Coordinate with RMS and GSC when determining road improvement requirements for the Project	7.16
g	Assess the impact of increased train movements resulting in road traffic delays at road-rail intersections	7.16
h	Consider the impact of rail and port availability for agriculture and other industries	7.16
i	Consider the potential damage to roads in the traffic assessment	7.16
13	Waste Management	
a	Consider the opportunity for reuse of waste products (e.g. tailings)	7.25
14	Other	
a	Detail community input into the EIS	5
b	Ensure meteorological stations are picking up wind splitting around Breeza Mountain	2.4.4
c	Assess the cumulative impacts of mining projects in the region	7
d	Ensure environmental risk identification and the methodology of assessing risk is transparent	6
e	Assess the general health impacts which may occur as a result of the Project	7.6, 7.7, 7.8 and 7.9
f	Disclose air and water data accumulated since Project inception	2.6, 7.1, 7.3 and 7.6

5.5 Aboriginal Community Consultation

The Aboriginal consultation for the Project was conducted by a team from Hansen Bailey, AECOM, Shenhua Watermark and Connect for Effect in accordance with the ***Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010*** (Cultural Heritage Guidelines) (DECCW, 2010a) and the ***Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation*** (DEC, 2005a). Hansen Bailey and AECOM conducted consultation in four stages:

- Stage 1 - Notification and registration (commenced 31 January 2011);
- Stage 2 - Project information (commenced 21 February);
- Stage 3 - Survey strategy and conservation values (commenced 21 February); and
- Stage 4 – Draft assessment review.

Further information regarding consultation undertaken with the Registered Aboriginal Parties (RAPs) is detailed in the Aboriginal Archaeological Impact Assessment and the Aboriginal Cultural Heritage Values Assessment (see Appendix N, Appendix O and Appendix P).



5.5.1 Stage 1 Notification and Registration

In accordance with Section 4 of the Cultural Heritage Guidelines, the following organisations were notified of the Project in writing on 31 January 2011 to identify, notify and register Aboriginal people who hold cultural knowledge relevant to determining the cultural significance of the Project:

- OEH;
- Walhallow Local Aboriginal Land Council (WLALC);
- Red Chief Local Aboriginal Land Council (RCLALC);
- National Native Title Tribunal;
- NSW Department of Aboriginal Affairs – Office of the Registrar;
- Native Title Services Corporation Limited (NTSCorp);
- GSC; and
- Namoi CMA.

Letters were sent to the agencies requesting the contact details of known Aboriginal stakeholder groups who:

- May possess cultural knowledge required to determine the cultural significance of Aboriginal objects or places in the area; and
- May desire to be consulted regarding the Project.

Following responses from the above agencies, letters were sent to all Aboriginal individuals / groups identified inviting them to register interest in the Project.

Newspaper Advertisement

On 1 and 3 February 2011, a public notice of the Project was published in the Namoi Valley Independent. The notice invited Aboriginal individuals / groups to register their interest in the Project so that they could be consulted during the preparation of the Aboriginal Archaeological Impact Assessment and Aboriginal Cultural Heritage Values Assessment for the Project.

Notification of Registration

At the close of registration on 15 February 2011, a total of 21 Aboriginal stakeholder individuals / groups had registered their interest in the Project. In accordance with Section 4.1.5 of the Cultural Heritage Guidelines, each RAP was provided the opportunity to withhold their information from being provided to OEH and WLALC and RCLALC. No RAP made this request and as such a comprehensive list was sent to OEH, WLALC and RCLALC on 17 March 2011.

Additionally a copy of the following documentation was provided to OEH, WLALC and RCLALC:

- A copy of the public notice advertised in the Namoi Valley Independent on 1 and 3 February 2011; and
- A copy of the letter issued to all identified Aboriginal groups providing notification of the assessment for the Project.

Additional Registrations

Since the close of registrations on 15 February 2011, an additional 108 Aboriginal stakeholder individuals / groups registered an interest in the Project during the course of the assessment process. This subsequently resulted in registrant numbers rising to 54 RAPs by November 2011 and to 132 RAPs by January 2012. The increased interest in the Project by Aboriginal community members related to a number of factors, which included:

- Gathering of Aboriginal people for the purposes of a regional Native Title claim resulting in sharing of projects and proposed projects in the region by RAPs;
- Distribution of Project information through community newsletters and Project information provided to Aboriginal parties already registered;
- Connect for Effect's cultural consultation approach; and
- Location of the Project.

As a result of additional RAPs registering their interest in the Project after the close of registrations, letters were sent to OEH, WLALC and RCLALC on 11 April, 2 May and 7 June 2011 advising of the additional registrations.

5.5.2 Stage 2 Project Information

The aim of Stage 2 of the consultation process was to provide RAPs with information about the scope of the Project and the cultural heritage assessment process.

Planning Meeting

In accordance with Section 4.2.1 of the Cultural Heritage Guidelines, a letter was provided on 21 February 2011 by Hansen Bailey inviting all RAPs to attend a planning meeting to discuss the various aspects of the Project. The meeting was held at the Mackellar Motel in Gunnedah on Thursday, 10 March 2011. In total, 19 Aboriginal stakeholders representing 18 of the 21 RAPs attended. The Aboriginal consultation program, draft field survey methodology and associated field survey involvement were discussed during the meeting, which was followed by a site visit. A copy of the presentation provided during the planning meeting was sent to all RAPs on 16 March 2011.

5.5.3 Stage 3 Survey Strategy and Conservation Values

Archaeological Field Assessment Methodology

In accordance with Section 4.3.1 and 4.3.2 of the Cultural Heritage Guidelines, all RAPs were sent a copy of the draft field survey methodology on 21 February 2011. All RAPs were encouraged to provide comment on the draft methodology.

Comments on the draft methodology and field work were received at the planning meeting held on 10 March 2011 and both verbally and in writing until 23 March 2011.

On 16 March 2011, a letter was issued by Hansen Bailey to all 21 RAPs confirming the dates for the upcoming field work, providing a copy of the presentation given at the planning meeting, a Project layout figure and a request for the provision of relevant insurances in order to participate in the field survey.

The comments received regarding the draft methodology were incorporated into the revised methodology, which was presented to all RAPs on 24 March 2011 prior to the commencement of fieldwork.

Summary of Responses to Draft Field Survey Methodology

Five written responses to the draft field survey methodology were received from the RAPs. Written acceptances of the field survey methodology were provided by 12 RAPs. Key concerns cited by the five written comments related to survey coverage, stone artefact recording, archaeological predictions, scar tree recording, sharing of information regarding findings, the consultation approach and acknowledgement of the significant Aboriginal history and presence in the area.

A search was conducted of the Aboriginal Heritage Information Management System (AHIMS) database to identify registered Aboriginal archaeology within a 22,500 ha area centred on the Project Boundary. The search resulted in six registered sites. The comments from RAPs noted that the AHIMS results reflected the lack of surveys completed in the region, rather than the lack of Aboriginal places or objects of significance. Concerns relating to the consultation approach, social and cultural values assessment and cultural heritage information exchange were also noted.

Community comments regarding the field survey methodology were sought via letters and through the planning meeting and the revised survey methodology meeting held on 24 March 2011 in Gunnedah. All concerns raised in response to these methods were acknowledged and where practicable incorporated into the revised field survey methodology. Following this process, no RAPs registered at the time cited concerns associated with the revised field survey methodology.

Archaeological Field Assessment

All RAPs registered at the time were provided the opportunity to participate in the archaeological field assessment. A total of 21 RAPs registered their acceptance of the methodology and indicated they would like to participate in the field survey component of the Aboriginal Archaeology Impact Assessment and the Aboriginal Cultural Heritage Values Assessment (see Appendix N, O and P).

Following the receipt of relevant insurances, each RAP was incorporated into a rotating roster for the field work. Two RAPs requested no involvement in the field work due to work commitments and conflicts of interest. Both RAPs indicated they would like to continue to be consulted in relation to the Project. In total, 22 Aboriginal RAPs provided a representative for scheduled field survey.

The field survey was scheduled to be completed over the 18 working days from 28 March to 20 April 2011. Each RAP was scheduled six days of survey. Group 1 had six RAP representatives present for the first week commencing 28 March and finishing 1 April 2011. Group 2 had seven RAP representatives present for the second week commencing 4 April to 8 April 2011. Group 3 commenced field survey on 11 April and ended 15 April 2011. Group 3 had six RAP representatives present Monday and Tuesday and seven RAP representatives on Wednesday through to Friday. From 18 April to 20 April each group completed one additional day of survey. Survey was completed via primarily pedestrian transects combined with vehicular transects in areas of lower visibility.

On Friday, 8 April 2011, a meeting was held at Curlewis with all RAPs where a presentation of the artefact sites found in the first two weeks was given.

On 15 April 2011, an invitation was provided to all RAPs to attend a post survey meeting to be held 21 April 2011 to discuss the results of the surveys undertaken. At this meeting a presentation of the findings of the field work was given.

As a result of discussion at the meeting, a final week of field survey was agreed to in response to RAP concerns over potential culturally sensitive areas such as creek lines and mountains. The fifth and final week of field survey was conducted between 2 May and 6 May 2011 with each of the 22 RAPs completing one day of survey work.

As a result of consultation with all RAPs following the completion of field survey, it was agreed to complete a second round of survey with the Senior Elders and Elders group formed in January 2012. This survey was conducted from 27 February 2012 to 2 March 2012 via limited pedestrian transects and primarily vehicular transects.

Cultural Heritage Exchange

In accordance with Section 4.3.3, 4.3.4 and 4.3.5 of the Cultural Heritage Guidelines, cultural heritage information was sought from the RAPs. This process commenced on 20 May 2011 when letters were sent to all RAPs offering to hold culture and heritage information exchange meetings with Hansen Bailey. A total of five culture and heritage meetings were held with seven RAPs between 21 April and 9 June 2011. Additional cultural heritage meetings were undertaken by Connect for Effect from October 2011 and are detailed in the Aboriginal Cultural Heritage Values Assessment (see Appendix P).

Cultural Heritage Consultation

In October 2011, Connect for Effect were engaged by Hansen Bailey on behalf of Shenhua Watermark to complete the targeted Aboriginal Cultural Heritage Value Assessment as requested by the community and to further facilitate consultation between RAPs and Shenhua Watermark. Key consultation activities are provided in Table 21. The consultation approach undertaken by Connect for Effect included workshop discussions, archival investigation, Senior Elders and Elders Walks on Country and RAP self-assessment of cultural, historic, scientific and landscape values.

Further detail is provided in the Aboriginal Cultural Heritage Values Assessment (see Appendix P).



Table 21 Summary of Stage 3 Aboriginal Cultural Heritage Consultation

Date	Activity
26 October 2011	Letter to all RAPs. Invitation to attend workshops scheduled on 31 October, 16 and 17 November
31 October 2011	Workshop 1 cancelled due to Sorry Business. Workshops scheduled on 16 and 17 November postponed
14 November 2011	Letter to all RAPs. Briefing session in Gunnedah scheduled on 21 November
21 November 2011	Briefing session in Gunnedah
7 December 2011	Meeting with DP&I in Sydney to discuss the draft Aboriginal Archaeology Impact Assessment and the Aboriginal Cultural Heritage Values Assessment methodology
7 December 2011	Letter to all RAPs. Invitation to attend workshops scheduled on 19, 20 and 21 December
19 December 2011	Workshop 1, Gunnedah Town Hall
20 December 2011	Workshop 2, Curlewis Hall and Walk on Country (Project Boundary)
21 December 2011	Workshop 3, Gunnedah Town Hall (Social Impact Assessment focus)
25 January 2012	Meeting with Senior Elders and Elders Group in Gunnedah
14 February 2012	Meeting with WLALC Social Impact Assessment and permission to speak on Country
21 February 2012	Walk on Country and Scar Tree Assessment with Senior Elders and Elders Group
27 February 2012	Field survey with Senior Elders and Elders Group
2 March 2012	Meeting with Senior Elders and Elders Group. Field survey close out meeting in Curlewis
12 March 2012	Letter to all RAPs. Distribution of briefing session (November 2011) and workshop minutes (December 19, 20 and 21 2011)
11 April 2012	Letter to all RAPs. Three new sites identified via due diligence, including WM-GG3-12, and notification that Senior Elders and Elders Group to undertake inspection
23 April 2012	Site inspection with Senior Elders and Elders Group of the three new sites
21 May 2012	Letter and report sent to all RAPs. Senior Elders and Elders Group inspection of the three new sites
14 June 2012	Letter sent to all RAPs. Notification of grinding groove geotechnical investigation (WM-GG1-11 and WM-GG3-12)
18 to 20 June 2012	Observation of grinding groove geotechnical investigation by Senior Elders and Elders Group
4 July 2012	Letter to OEH. Response to email regarding grinding groove site (WM-GG3-12)
5 July 2012	Letter to all RAPs. Grinding groove geotechnical investigation methodology letter
3 August 2012	Letter to all RAPs. Delay in Aboriginal Cultural Heritage Values Assessment distribution

5.5.4 Stage 4 Draft Assessment Review

In accordance with Section 4.4 of the Aboriginal Consultation Guidelines, the draft ***Aboriginal Archaeological Impact Assessment*** (AECOM, 2012), draft ***Aboriginal Cultural Heritage Values Assessment*** (Connect for Effect, 2012) and ***Geotechnical of Geomorphology Investigation of WM-GG1-11 and WM-GG3-12 Grinding Groove sites*** (SCT, 2012) was issued to all RAPs on 16 August 2012 for a period of 28 days. Due to the complexity of the Project and the assessments prepared, this review period was extended for an additional 20 days (for a combined 48 day review period).

Table 22 outlines the consultation activities undertaken with RAPs during this review period to discuss the report findings and draft mitigation and management strategies.

The consultation activities listed in Table 22 facilitated the feedback from RAPs on the reports. Concerns and recommendations identified during the draft comment period were incorporated, where practicable, into the final Aboriginal Archaeological Impact Assessment and Aboriginal Cultural Heritage Values Assessment. At workshops the draft reports were modified immediately which enabled RAPs to identify areas where they sought additional comment and further development of cultural values, historic referencing and suggested management recommendations. A final copy of the reports will be provided to all RAPs upon finalisation.

Table 22 Review of Draft Aboriginal Archaeology Impact Assessment and Aboriginal Cultural Heritage Values Assessment

Date	Activity
15 August 2012	Letter to all RAPs. Provision of draft assessment reports on CD, and hard copy executive summaries
16 August to 3 October 2012	Review of draft Aboriginal Archaeological Impact Assessment and Aboriginal Cultural Heritage Values Assessment
24 August 2012	Letter to all RAPs. Notification of and invite to group overview meeting scheduled for 31 August
29 August 2012	Draft assessment and mitigation strategies workshops
30 August 2012	Draft assessment and mitigation strategies workshops
31 August 2012	Draft assessment and mitigation strategies workshops
31 August 2012	Group meeting on draft Aboriginal Archaeological Impact Assessment and Aboriginal Cultural Heritage Values Assessment and mitigation strategies and mitigation strategies
4 September 2012	Letter to all RAPs, OEH & DP&I. Invitation to site visits and follow up meeting
10 & 11 September 2012	Site visit for all RAPs
12 September 2012	Group meeting to discuss Aboriginal Archaeological Impact Assessment and Aboriginal Cultural Heritage Values Assessment and mitigation strategies
17 September 2012	Letter to all RAPs, OEH & DP&I. Invitation to attend Aboriginal Cultural Heritage Assessment Report discussion sessions
25 September 2012	Elders and Senior Elders meeting to discuss changes to Aboriginal Archaeological Impact Assessment and Aboriginal Cultural Heritage Values Assessment and mitigation strategies
26 to 27 September 2012	Group meeting to discuss changes to Aboriginal Archaeological Impact Assessment and Aboriginal Cultural Heritage Values Assessment and mitigation strategies
3 October 2012	Group meeting to present final Aboriginal Archaeological Impact Assessment and Aboriginal Cultural Heritage Values Assessment

5.6 Ongoing Stakeholder Engagement

Shenhua Watermark is committed to the continuation of the stakeholder engagement plan developed for the Project and is seeking to achieve the best possible outcomes for all Project stakeholders.

Various mechanisms will be implemented to ensure the effective ongoing engagement with Project stakeholders, including:

- Regular consultation with neighbouring land owners;
- Regular meetings with the Environment, Water and Koala CRGs;
- Project updates to the Watermark CCC;
- Distribution of regular Community Information Sheets;
- Regular Community Information Sessions; and
- Provision of management plans and monitoring data via the Shenhua Watermark website.

An Annual Review will continue to be prepared for the Project. This document will summarise company activities and performance in the areas of health, safety, environment and community. A copy of the Annual Review will be made available to the public in hard copy upon request or via the Shenhua Watermark website.

WATERMARK
COAL PROJECT
ENVIRONMENTAL IMPACT STATEMENT

February 2013



6
Risk Assessment



Risk Assessment 6

6.1 Preliminary Risk Assessment

A preliminary risk assessment was undertaken as part of the Background Document which accompanied the Request for DGRs from DP&I, which identified potential environmental and socio-economic issues (in the absence of controls or mitigation) associated with the Project. The primary purpose of the risk assessment process was to prioritise and focus the required environmental and socio-economic assessments for the Project. Each of the environmental and socio-economic issues was addressed to a relevant extent and where appropriate, necessary management and mitigation options were developed.

Table 23 summarises findings from the preliminary risk assessment.

Table 23 Summary of Preliminary Risk Assessment

Category	Project Issue(s)
High	Ecology
Significant	Aboriginal Archaeology and Cultural Heritage, Air Quality and Greenhouse Gas, Surface Water, Flooding and Groundwater
Medium	Acoustics, Traffic and Transport, Visual and Lighting, Historical Heritage, Social and Economics
Low	Soils and Land Capability, Geochemical, Rehabilitation and Final Landform, Agricultural Productivity, Waste Management and Hazards

In the absence of controls, several aspects associated with the Project potentially posed a medium to significant environmental and socio-economic risk. Aspects identified throughout the risk assessment process have each been assessed as part of this EIS with higher environmental and socio-economic risks forming the primary focus of the document.



6.2 Revised Risk Assessment

Following stakeholder engagement, a revision of the preliminary risk assessment was undertaken to incorporate additional requirements. As a component of the revision process, environmental and socio-economic risk management workshops were held for the Project on 22 July 2010 and 16 February 2012. The aim of these workshops was to involve a range of personnel in the Project team with differing perspectives in the risk identification process.

The EIS was also reviewed in order to gain a detailed understanding of the environmental and socio-economic risks posed by the Project and mitigation and management measures to be implemented to minimise these risks. The revised risk assessment is presented in full in Appendix F and summarised in Table 24.

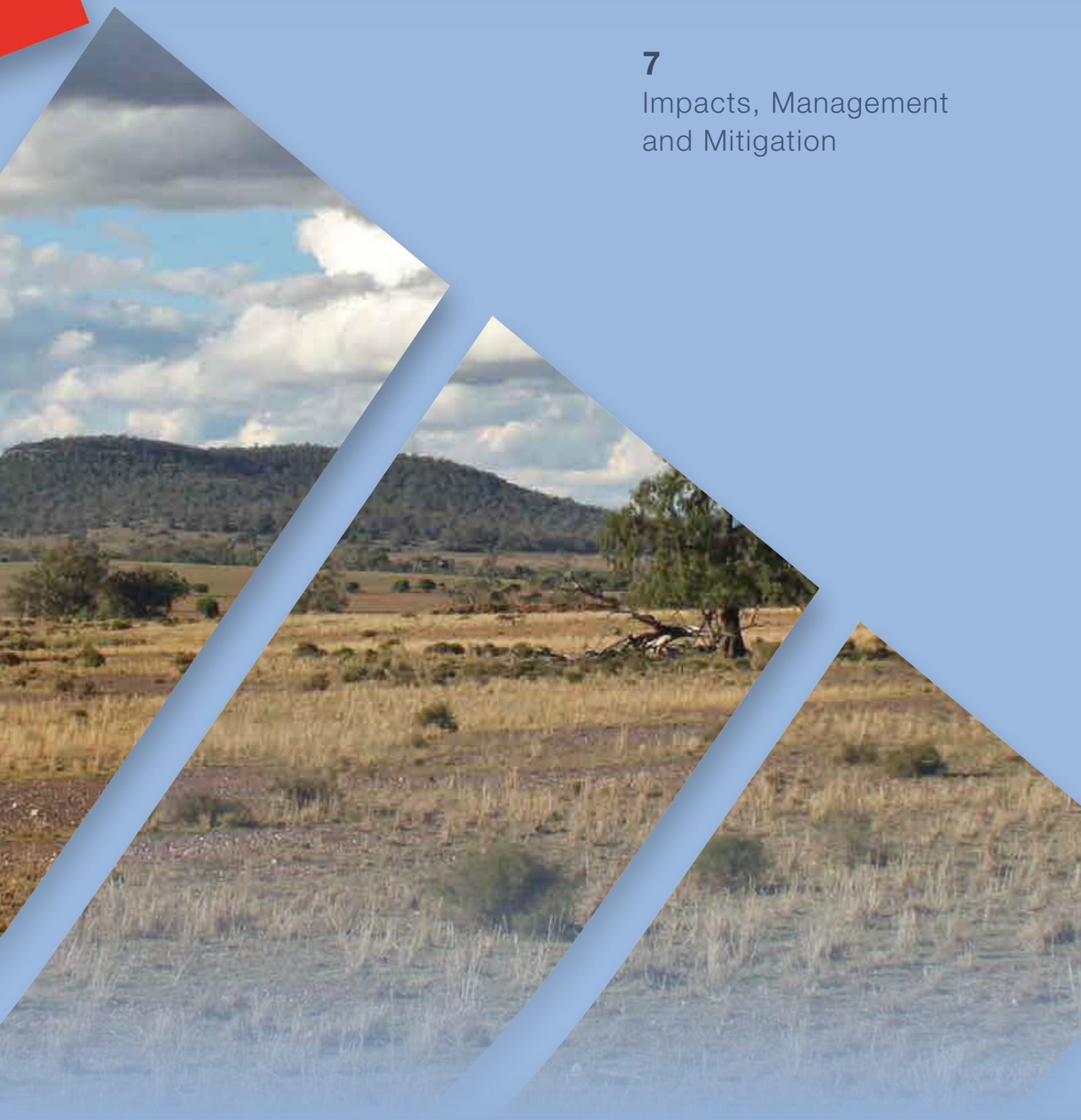
Table 24 Summary of Revised Risk Assessment

Category	Project Issue(s)
High	None
Significant	None
Medium	Ecology, Aboriginal Archaeology and Cultural Heritage, Groundwater, Surface Water, Flooding, Geochemical, Acoustics, Rehabilitation and Final Landform
Low	Historical Heritage, Visual and Lighting, Air Quality and Greenhouse Gas, Social and Economics, Soils and Land Capability, Traffic and Transport, Agricultural Productivity, Waste Management and Hazards

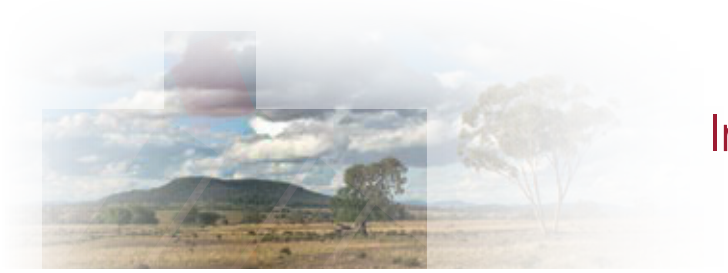
The key risks identified for the Project were analysed in accordance with the Shenhua Watermark Risk Assessment Matrix (which meets Standards Australia requirements) and is based on likelihood and potential consequences. Each environmental and socio-economic risk was ranked as either having a low, medium, significant or high level of risk. Risk rankings identified for each aspect of the Project were further evaluated based on the outcomes of the stakeholder engagement program, as required.

WATERMARK
COAL PROJECT
ENVIRONMENTAL IMPACT STATEMENT

February 2013



7
Impacts, Management and Mitigation



Impacts, Management and Mitigation 7

This section provides a summary of potential environmental and social impacts of the Project and the measures that will be implemented to mitigate and manage these impacts. The issues have been prioritised in accordance with the DGRs, the risk assessment and outcomes of the stakeholder engagement program.

7.1 Groundwater

7.1.1 Background

A Groundwater Impact Assessment was undertaken by Australasian Groundwater and Environmental Consultants (AGE) and is provided in **Appendix T**. The purpose of the assessment was to:

- Characterise the existing groundwater sources, regimes and water users;
- Predict inflows into the mining areas throughout the life of the Project;
- Predict groundwater recovery levels and conditions post-mining;
- Assess the impacts of the Project on groundwater sources, including the potential for depressurisation, water quality contamination and cumulative effects; and
- Recommend measures to mitigate and manage impacts.

The relevant water legislation, WSPs and AIP are discussed in **Section 4.4.5**.

Previous Groundwater Investigations

Government and research organisations have completed numerous hydrogeological investigations within the region surrounding the Project Boundary. These investigations predominately focused on determining the characteristics and behaviour of the Upper Namoi alluvium system and defining the regional groundwater systems within the Mooki River catchment. No hydrogeological investigations of the Permian fractured rock aquifer systems had previously been completed within the Project Boundary or surrounds.

On 1 September 2010, Schlumberger Water Services (Australia) Pty Ltd were appointed as the Independent expert to conduct the Namoi Catchment Water Study in accordance with the Terms of Reference set by the NSW Government. The Namoi Water Study involved the development of an integrated suite of surface water and groundwater models to assess the potential effects from existing and proposed coal mining and coal seam gas developments, including the Project, on water resources in the Namoi catchment (Schlumberger, 2012).

As a component of the Namoi Catchment Water Study, three-dimensional groundwater flow models were developed to quantify the potential cumulative influence of existing and proposed developments on the groundwater regime within the Namoi catchment over time.

The relevant investigative reports were reviewed and consulted throughout the iterative process of developing a conceptual model of the hydrogeological regime and subsequent mathematical model (see **Section 7.1.2**).

Field Investigation Program

Due to the lack of site specific data within EL 7223, Shenhua Watermark commenced an extensive hydrogeological investigation program in 2009, including:

- Installation a network of 103 groundwater monitoring sites (see **Figure 8**), including 96 monitoring bores and 32 vibrating wire piezometers (some at nested sites);
- Routine monitoring of groundwater levels and quality within the 103 groundwater monitoring sites:
  - Water quality was analysed on a quarterly basis and groundwater levels were monitored fortnightly when accessible or more frequently following significant rainfall events;
  - Nine groundwater bores were also equipped with down hole data loggers recording groundwater levels on a continuous basis; and
  - Over three years of groundwater monitoring data across the Permian and alluvial formations within EL 7223 is available and incorporated into the groundwater model.
- Measurement of hydraulic conductivity of the key hydrogeological units via 79 slug tests, 29 rising head tests, eight short term pumping tests and 60 straddle packer tests in 12 exploration holes;
- Completion of a census of private farm bores in the Project Boundary;
- Installation of additional monitoring bores in the weathered Permian including the Clare Sandstone;
- Laboratory measurement of the vertical/horizontal hydraulic conductivity and porosity in 32 core samples;
- Radiocarbon and tritium age dating of 28 monitoring bores;
  - The aim of the testing was to enhance the understanding of recharge mechanisms occurring within the region of the groundwater model; and

  - The samples were collected from bores located in the ridge areas, at the break of slope, from the Liverpool Range basalts, and from the Narrabri and Gunnedah Formations.

- Site survey for groundwater fed springs and soaks throughout the Project Boundary;
- Installation of 16 additional monitoring bores to characterise the hydrogeological properties of the buffer zone between the mining areas and the aquifers underlying the black soil plains; and
  - Quaternary alluvium delineation study by GHD (2009 and 2010) using geology and soils mapping, digital terrain data, airborne radiometrics, borehole logs and site inspections.
- Geophysical survey within EL 7223 (Groundwater Imaging, 2011) to define the extent of Upper Namoi alluvium and any other potential conduits or barriers for groundwater flow into the mining areas (see **Section 7.2** for further detail).

Further, all data from the NOW PINNENA database and Shenhua Watermark exploration program was reviewed and incorporated into the model (see **Section 7.1.2**).

Existing Groundwater System

Within EL 7223, groundwater occurs within the following two main systems:

- The Quaternary / Tertiary alluvial systems of the Upper Namoi alluvium; and
- The older, deeper and poorer quality bedrock that contains localised aquifers within weathered rock, porous sandstones, fractured zones, volcanics and coal seams of the Gunnedah Basin (Permian Formations).

A conceptual cross section of the aquifer systems and how they are anticipated to interact is shown on **Figure 26**. Each system is further discussed below in relation to the Project Boundary.

Upper Namoi Alluvium

The Upper Namoi alluvium comprises of two major formations, the Narrabri Formation and the Gunnedah Formation (see **Figure 28** and **Figure 29**). The Narrabri Formation is the uppermost unit and is typically a brown clay dominated aquitard, with occasional lenses of coarser sands and gravels. The underlying Gunnedah Formation is composed of thicker beds of porous sand and gravel separated by clays.

As part of the field investigations, a multidisciplinary study (GHD, 2009) was undertaken to define the boundary limits of the Upper Namoi alluvium within and adjacent to the Project Boundary. The assessments found that the Gunnedah Formation does not exist within the Project Boundary, as shown on **Figure 27**. The closest occurrence of this aquifer is 900 m from the north-eastern corner of the Eastern Mining Area. To the south, the aquifer is more than 1.3 km from the Project Boundary.

The assessments also found that the limit of the Narrabri Formation is generally represented by the Quaternary alluvium soil boundary of Banks (1995). Accordingly, the Eastern and Southern Mining Areas are set back by a minimum of 150 m from the Narrabri Formation.

The regional direction of groundwater flow in the Upper Namoi alluvium typically follows topography, flowing from the highlands of the Liverpool Ranges to the north along the alignment of Quirindi Creek and Mooki River.

Fluctuations in groundwater levels within the Upper Namoi alluvium correlate with local cropping practices. Irrigation of cotton is undertaken during November to February, resulting in increased extraction from the Gunnedah Formation. Recharge from rainfall during these months appears to be limited as the more transmissive Gunnedah Formation aquifer is capped by the clay dominant Narrabri Formation. As a result, recharge through the Narrabri Formation is less than the pumping rate from the Gunnedah Formation during the growing season and as such, water levels decline at this time of year.

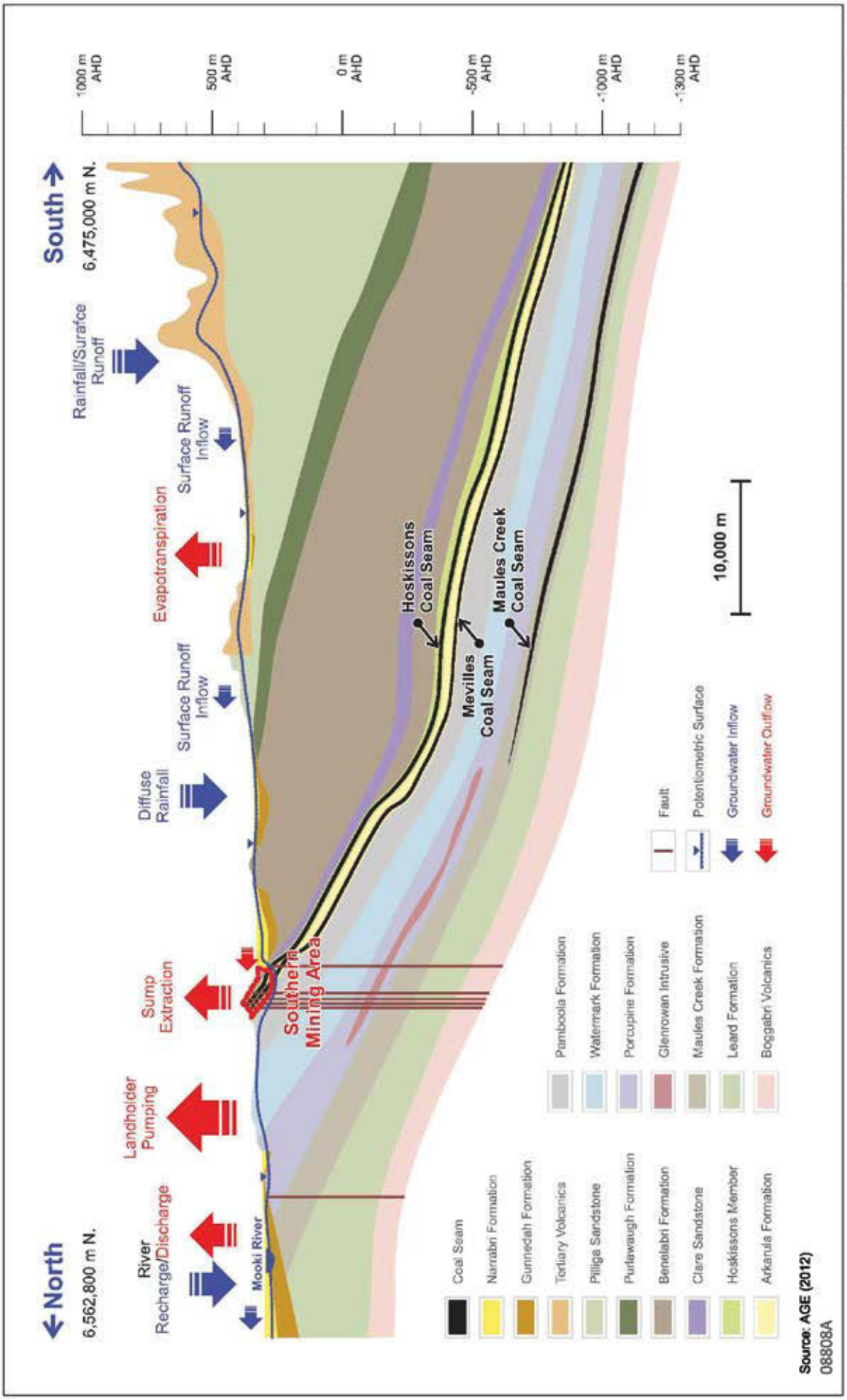
Recharge to the Upper Namoi alluvium occurs predominantly along break of slope areas at the base of the Liverpool Ranges and from river leakage, particularly the Mooki River and Quirindi Creek.

The average yield from the Narrabri Formation is approximately 50 litres per second (L/s). Groundwater in the Narrabri Formation to the south of the Project Boundary is brackish to saline, with Total Dissolved Solids (TDS) concentrations greater than 10,000 milligrams per litre (mg/L), which is not suitable for beef cattle. Sheep can tolerate salinity up to 13,000 mg/L indicating a small proportion of groundwater from the Narrabri Formation is suitable for livestock consumption.

Water quality in the underlying Gunnedah Formation is significantly better and typically fresh to slightly brackish. Water quality records from NOW indicate groundwater within the Gunnedah Formation to the west of the Mooki River (i.e. towards the Project Boundary) is typically slightly brackish at between 1,200 mg/L to 3,000 mg/L TDS. To the east of the Mooki River, groundwater is much fresher with TDS less than 500 mg/L. All samples from the Gunnedah Formation indicate the water is suitable for stock watering.

The Gunnedah Formation typically has high permeability and yield and is commonly referred to as the primary aquifer system in the region (GHD, 2009). Groundwater from the Gunnedah Formation is used extensively for irrigation, stock and domestic use and for the town water supply at Gunnedah, Breeza, Curlewis and Quirindi.

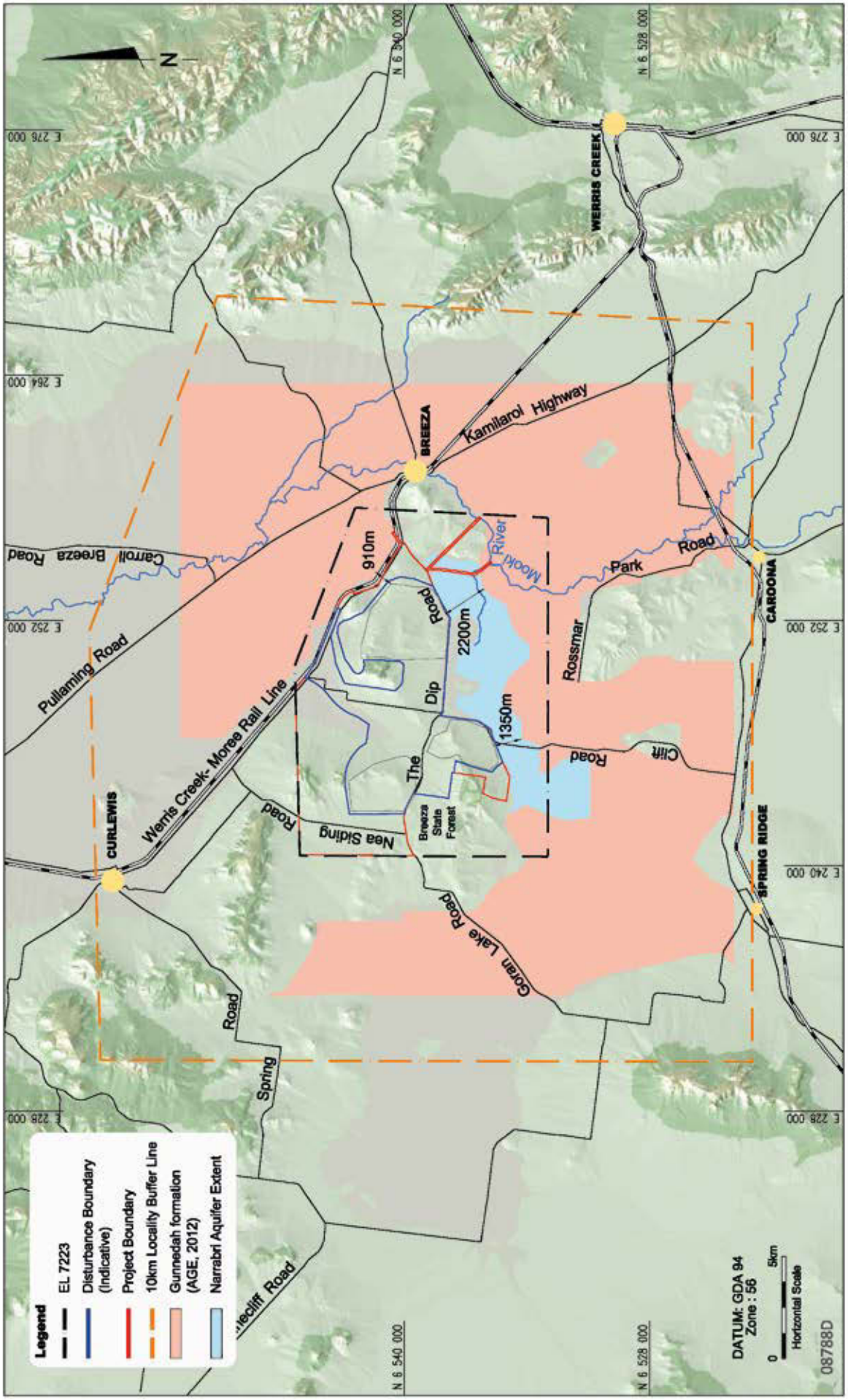
A review of the NOW groundwater data (GHD, 2011a) indicates a substantial variation in yield of the Gunnedah Formation. The highest yielding bores are located in the thick gravel sediments to the east of the Mooki River. Broughton (1984) identified a high yield zone (greater than 50 L/s) to the east of the Project Boundary. The yields decrease to between 5 to 50 L/s to the south-east of the Project Boundary and further reduce to 0.5 L/s to 5 L/s to the south and north-east of the Project Boundary.

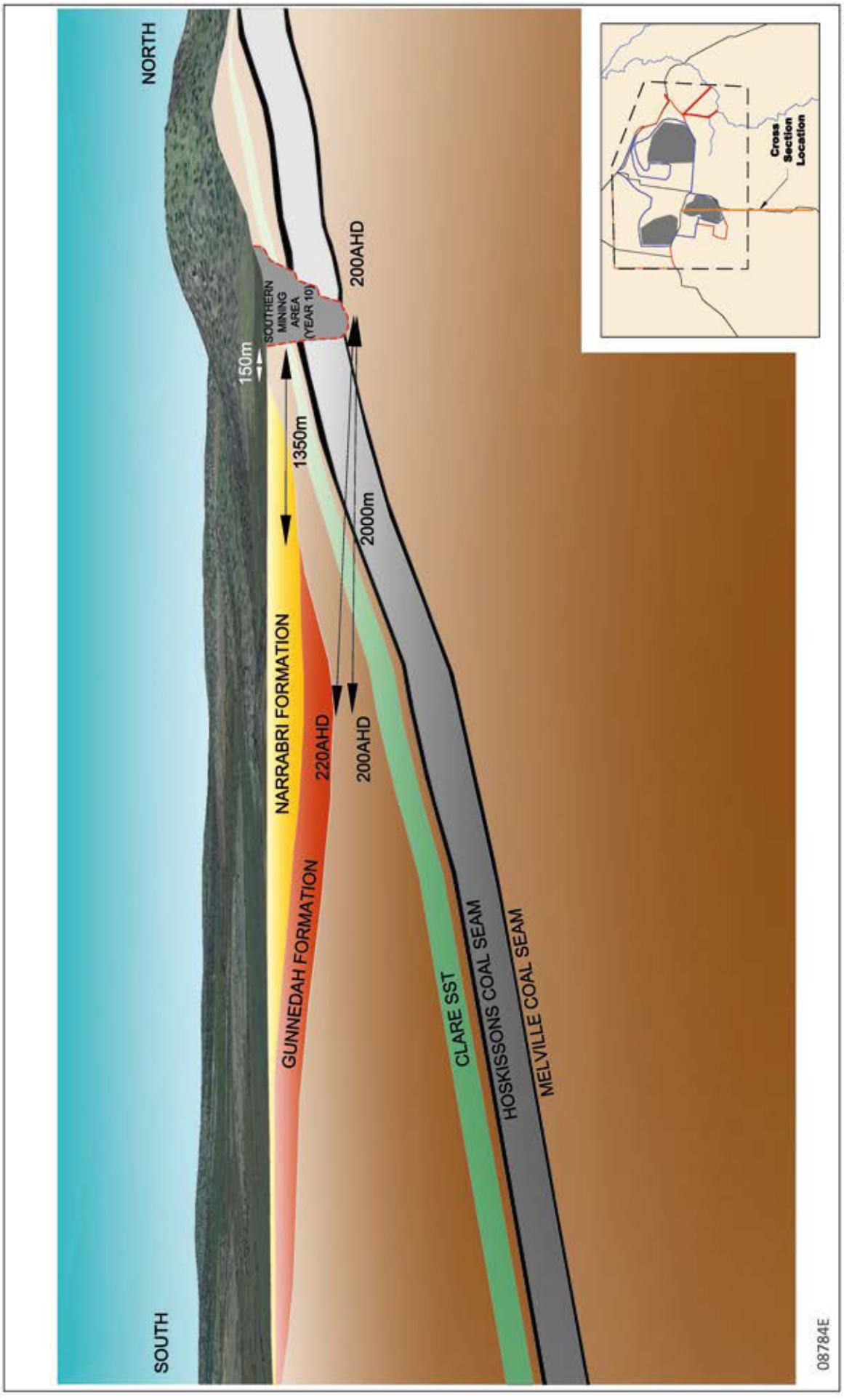


WATERMARK COAL PROJECT

Conceptualised Groundwater Section

FIGURE 26


WATERMARK COAL PROJECT
Gunnedah Formation
FIGURE 27
N
Legend
EL 7223
Disturbance Boundary (Indicative)
Project Boundary
10km Locality Buffer Line
Gunnedah formation (AGE, 2012)
Narrabri Aquifer Extent
DATUM: GDA 94
Zone : 56
0
5km
Horizontal Scale
087888D
Hansen Bailey
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BREEZA
WERRIS CREEK
CURLEWIS
CARDONA
SPRING RIDGE
Kamilaroi Highway
Carroll Breeza Road
Pullaming Road
Werris Creek- Moree Rail Line
Nea Siding Road
Goran Lake Road
Spring Road
Park Road
Rossmar Road
Cliff Road
The Dip Road
910m
2200m
1350m
Mooki River
Breeza State Forest
E 276 000
E 264 000
E 252 000
E 240 000
E 228 000
N 6 540 000
N 6 528 000

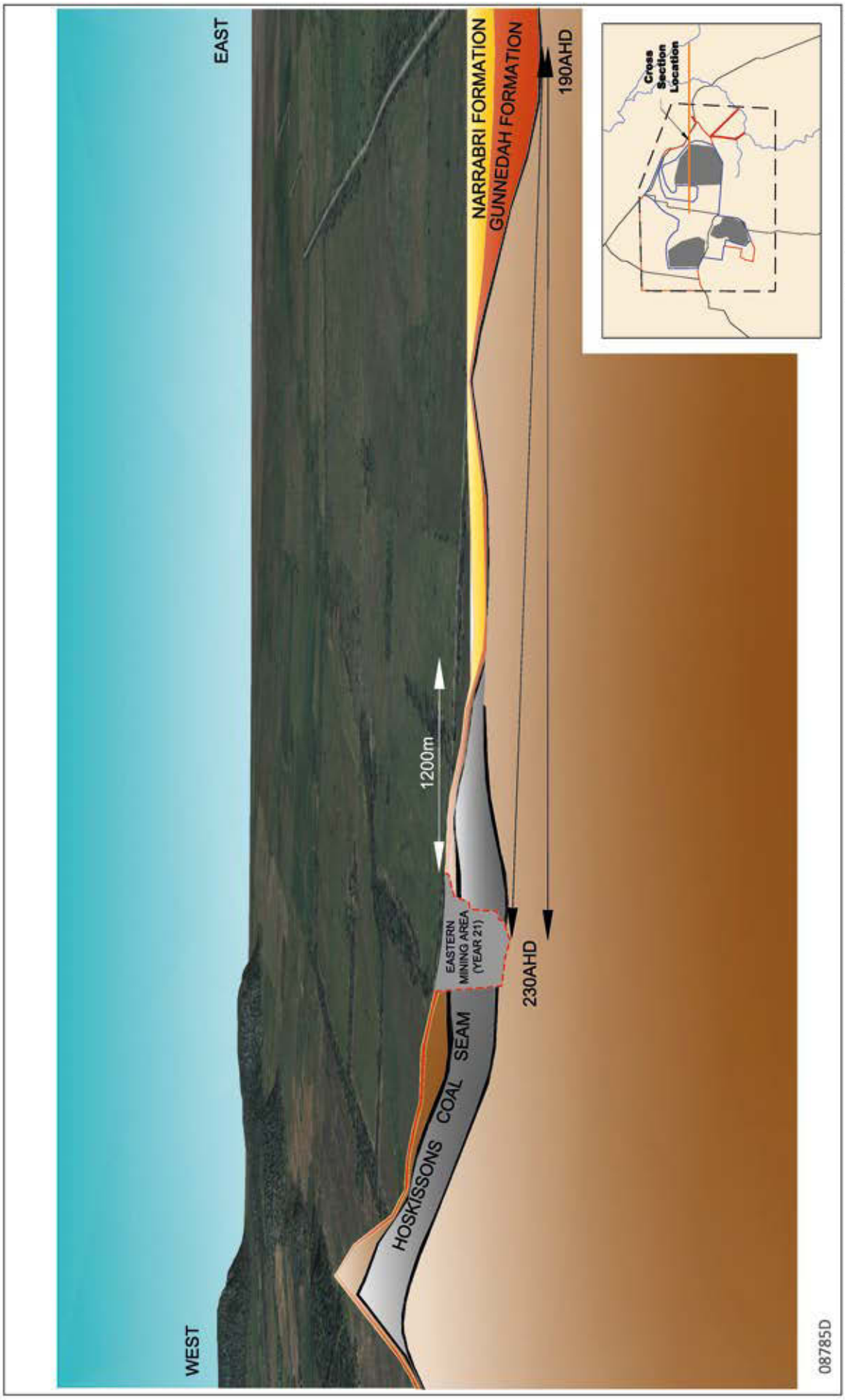


WATERMARK COAL PROJECT

Alluvial N-S Cross Section

FIGURE 28

Hansen Bailey
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WATERMARK COAL PROJECT

Alluvial E-W Cross Section

FIGURE 29

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The gateway criteria for BSAL require a consideration of the Project's impacts on highly productive groundwater. The term *'highly productive groundwater'* is not defined in the SRLUP; however the term is defined in the AIP as:

> *"A groundwater source that is declared in the Regulations and will be based on the following criteria:*
>
> *a) has total dissolved solids of less than 1,500 mg/L, and*
>
> *b) contains water supply works that can yield water at a rate greater than 5 L/sec."*

Based on the above, the Gunnedah Formation is considered to satisfy the highly productive groundwater criteria for yield and total dissolved solids. The Narrabri Formation is not considered to satisfy the highly productive groundwater criteria for TDS.

Permian Formations

The Permian coal measures throughout the Project Boundary form a low yielding localised fractured rock groundwater system.

A bore census of the Project Boundary indicated the presence of stock and domestic bores (GHD, 2010b). General observations from the census show that many of the older bores in the western and central areas of the Project Boundary are no longer in use due to poor water quality and yields. Twenty-one of the registered bores were abandoned. The census showed that better groundwater quality and more consistent yields from the Permian formations were found on the eastern side of the Project Boundary.

Recharge to the Permian formations within the Project Boundary occurs via rainfall infiltration into weathered sandstone outcrops and fractured zones within elevated areas. There is some evidence within the Project Boundary of shallow groundwater levels increasing in response to rainfall whilst the deeper monitoring bores show a stable to steady decline in groundwater level. This trend indicates a limited vertical hydraulic connection between the shallow and deeper groundwater systems within the Project Boundary (GHD, 2011a, b).

Groundwater flow within the Permian formations across the Project Boundary typically occurs from the elevated terrain (ridgelines and peaks) to the central drainage lines and plains. Saline and brackish water seeps occur at the break of slope where Narrabri Formation clays interact with hill slope colluvium.

Groundwater yields from bores in the Permian Formations are typically low at less than 1 L/s (GHD, 2010a).

Groundwater quality is variable in the Permian Formations with generally saline groundwater found in the deeper sediments (GHD, 2010a). Data from the groundwater monitoring program for the Project shows that around ridgelines in the Project Boundary, groundwater salinity in the Permian formations is less than 3,000 mg/L TDS. However, down gradient from the ridgelines, the groundwater becomes more saline (5,000 to 10,000 mg/L TDS).

Away from the elevated terrain and toward the alluvial plains, Permian Formation bores with shallow groundwater levels (less than 3 m below ground surface) typically yield highly saline groundwater (10,000 to 20,000 mg/L TDS) (GHD, 2011a, b).

The suitability of groundwater from the Permian Formations in the Project Boundary for beef cattle is highly variable. All aquifers range from being suitable to unsuitable for stock. This highlights that the environmental value and beneficial use of the groundwater within the Permian formations also varies depending on local factors.

Based on the above, the Permian formations are not considered to satisfy the highly productive groundwater criteria for yield and TDS.

Existing Users

There are a number of land users that make use of the groundwater systems within and adjacent to the Project Boundary, in particular the Gunnedah Formation, for irrigation, stock, domestic and industrial purposes. A total of 508 groundwater monitoring and pumping bores are registered with NOW within a 10 km radius of the Project Boundary. Seventy-one of these bores are licensed and metered by NOW for water allocation (see **Figure 24**). The majority of these licensed bores abstract groundwater from the Gunnedah Formation for irrigation purposes.

7.1.2 Methodology

Data Review

A desktop assessment was undertaken to review data collected as part of the field investigation program and previous hydrogeological investigations, as described above. The information acquired from the desktop assessment was considered as inputs in the development of the groundwater model.

Predictive Groundwater Model

A three-dimensional groundwater flow model (MODFLOW SURFACT) was used to simulate the Project's impacts on the groundwater regime over time. The model was constructed in accordance with the approach recommended in the *Australian Groundwater Modelling Guidelines 2012* as required by the Aquifer Interference Policy. The model includes the current understanding of the interactions between the aquifers within the Project Boundary and the regional groundwater system. Eleven layers represented the hydrostratigraphic units within the Project Boundary.

The model grid is approximately 75 km in width (east to west) and 91 km in length (north to south). This domain was developed to minimise any modelling boundary effects within the immediate surrounds of the Project and to encapsulate the Liverpool Ranges, which are one of the primary recharge sources for the Upper Namoi alluvium.

Two separate models were constructed for the Project. The first model, referred to as the "*calibration model*" had a larger cell size, which reduces the total number of cells and therefore the time required to run the model. Once a satisfactory calibration was achieved the grid size in the model was refined around the Project Boundary to allow more detail in the geology and mining to be simulated, referred to as the "*predictive model*".

The "*calibration model*" domain was constructed using cell sizes of 500 m x 500 m, which further refined to 250 m x 250 m cells within the Project Boundary. The "*calibration model*" included a total of 305,921 cells, comprising 27,811 cells per layer (11 layers). The "*predictive model*" was based on the "*calibration model*", however the cell size was further refined in the Project area to 50 m x 50 m. This refinement ensured the steeper hydraulic gradients that occur adjacent to the open cut mining areas were more accurately represented.

The groundwater model was calibrated via two processes; a steady state calibration and a transient calibration. The aim of the calibration process was to adjust aquifer parameters and stresses to produce the best match between the observed and simulated water levels and fluxes. The calibration of the model followed the objectives set out in the *Australian Groundwater Modelling Guidelines 2012* by Barnett et al (2012).

The model was calibrated to data over a 31.5 year period from the first quarter 1980 to the second quarter 2011. The model simulated water levels in all available monitoring bores within the Permian and alluvial aquifers. A total of 445 monitoring bores with time variant data readings were used to calibrate the model and were comprised of:

- 351 bores from the NOW PINNENA database, which are predominantly screened in the Narrabri and Gunnedah Formations and located within management Zones 1, 3, 6, 7, 8 and 10 of the *Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003*; and
- 94 bores from the Project Boundary which provided data on the Permian water levels.

Sensitivity Analysis

A sensitivity analysis was carried out to demonstrate the response of the groundwater model to input parameters. The objective of the sensitivity analysis was to rank the input parameters in terms of their influence on the predicted results.

Uncertainty Analysis

A Monte Carlo uncertainty analysis was also carried out to provide confidence intervals for the model predictions. The analysis addressed the level of uncertainty associated with the predictions of seepage rates, loss of flow into alluvial systems, Mooki River leakage changes, and the predicted zone of depressurisation.

Seepage Water Quality Assessment

A Seepage Water Quality Impact Assessment was undertaken by Terrenus Earth Sciences and is provided as an appendix to the Groundwater Impact Assessment (**Appendix T**).

The assessment predicted the water quality associated with seepage from the three mining areas of the Project to:

- Understand the likely water quality characteristics associated with run-off and seepage from the OEA (mining areas) after mining ceases and post-closure;
- Discuss the potential impacts to surface water and groundwater resulting from run-off and seepage from mining areas; and
- Assist with the management of potential surface water and groundwater impacts from these mining areas.

Independent Peer Review

An independent peer review of the Groundwater Impact Assessment and 3D groundwater modelling was undertaken by Dr Noel Merrick of Heritage Computing. Dr Merrick is a groundwater modeller, hydrogeologist and geophysicist with 40 years experience in groundwater management and policy development. Dr Merrick is suitably qualified to complete the independent peer review in accordance with Condition 49 of EL 7223. A copy of the peer review report is provided in **Appendix T**.

The independent peer review assessed the groundwater model against the criteria in the *Australian Groundwater Modelling Guidelines 2012* and the *Murray Darling Basin Commission Groundwater Flow Modelling Guideline 2000*.

The peer review examined the content of the Groundwater Impact Assessment with a key focus on the model design, calibration, verification, predictions, sensitivity and uncertainty analysis. Outcomes from the peer review were considered in the preparation of the assessment.

7.1.3 Impact Assessment

The groundwater model simulated the existing groundwater conditions and provided predictions of the potential changes in the local and regional groundwater regimes as a result of future mining activities.

Mining Area Seepage

It is predicted that seepage will vary throughout the mine life, which is due to the mine depth, strata being mined and hydraulic gradients induced by the depressurisation. Groundwater seepage into the mining areas is estimated at approximately:

- Less than 0.5 Mega litres per day (ML/day) (183 Mega litres per year (ML/yr)) in the Eastern Mining Area until Year 17 (derived mainly from weathered interburden layers);
- 2.1 ML/day (756 ML/yr) in the Southern Mining Area from Year 17 to Year 24 (derived mainly from saturated weathered to fresh Clare Sandstone); and
- Up to 1.2 ML/day (430 ML/yr) in the Western Mining Area from Year 24 until closure (derived mainly from saturated weathered to fresh Clare Sandstone).

The contribution of seepage from the coal seams is relatively low. This is due to the low hydraulic conductivity determined from the field investigation program and adopted in the model.

The groundwater seepage from the Permian Formations into the mining areas averages 0.5 ML/day (180 ML/yr) over the life of the Project. The peak annual average seepage into the mining areas is estimated at 2.1 ML/day (756 ML/yr) in Year 23 as mining advances through higher permeability material such as the Clare Sandstone unit. Groundwater seepage reduces as the mining area is backfilled following mining.

The predicted cumulative inflow of groundwater over the life of mine is approximately 5,500 ML, which represents less than 0.1% of the extraction limits set for the Gunnedah–Oxley Basin Murray Darling Basin Zone (Other) as prescribed under the *Water Sharing Plan for the Murray-Darling Basin Porous Rock Groundwater Sources*.

Changes in Potentiometric Surface / Water Table Levels

Permian Drawdown

Figure 30 presents the predicted zone of depressurisation for the Melvilles seam for Years 12.5, 21, 25.5 and 30. The movement of the mining areas gradually changes the extent zone of depressurisation over the 30 year Project life. These years represent periods where the zone of depressurisation is most extensive. The depressurisation in the other Permian units, including the Clare Sandstone is similar to that shown for the Melvilles Coal Seam.

The depressurisation induced by operations in the Eastern Mining Area extends to a maximum of 1.8 km in Year 21. Groundwater levels are predicted to reduce by 3 m or less in the Permian underlying the Narrabri Formation, laterally extending up to 0.7 km. The model does not predict drawdown of greater than 1 m in the Permian underlying the Gunnedah Formation due to the Eastern Mining Area.

The depressurisation induced by operations in the Southern Mining Area is more extensive and extends to a maximum of 3.2 km in Year 25. The model predicts a drawdown of 25 m or less in the Permian underlying the Narrabri Formation. The depressurisation in the Permian extends to the south where the overlying Gunnedah Formation is present. At this distance, drawdown is predicted to be less than 2 m.

The depressurisation induced by operations in the Western Mining Area is less significant than the Eastern and Southern Mining Areas as it is located in an elevated area where groundwater levels are deeper and the operating life is short (6 years). The zone of depressurisation extends to a maximum of 1 km in Year 30, however, does not extend in the Permian under the alluvial aquifers.

The model indicates groundwater levels begin to recover after the backfilling of the Eastern Mining Area and Southern Mining Area. This is due to seepage into the OEA from the mining area walls and from rainfall recharge. In the Southern and Eastern Mining Area, this results in groundwater levels recovering to higher than pre-mining levels which prevents a water deficit post-mining.

Alluvial Drawdown

The mining areas do not directly intersect the alluvial aquifers of the Narrabri and Gunnedah Formations. The groundwater model indicates depressurisation in the underlying Permian strata will reduce upward water pressure from the Permian, and close to the mining areas will induce downward vertical flow from the overlying alluvial aquifers into the underlying Permian.

This change in Permian water pressures therefore induces changes in groundwater levels in the alluvial aquifers. The groundwater model predicts a zone of depressurisation that extends into the Narrabri Formation adjacent to the Eastern Mining Area and Southern Mining Area. **Figure 31** presents the predicted zone of depressurisation in the Narrabri Formation for Years 12.5, 21, 25.5 and 30.

The zone of drawdown around the Southern Mining Area is more extensive and extends towards the south and into the underlying Gunnedah Formation. The groundwater model predicts drawdown in the Gunnedah Formation to be 1 m to 2 m at Year 21. **Figure 32** presents the predicted zone of depressurisation in the Gunnedah Formation for the Years 12.5, 21, 25.5 and 30. Depressurisation in the alluvium extends to a maximum of 3.9 km from the Southern Mining Area in Year 25. As seasonal variation can be in the range of ±1 m to 2 m it is possible the groundwater drawdowns could be masked during periods of significant sustained recharge.

Interaction with Groundwater Management Zones

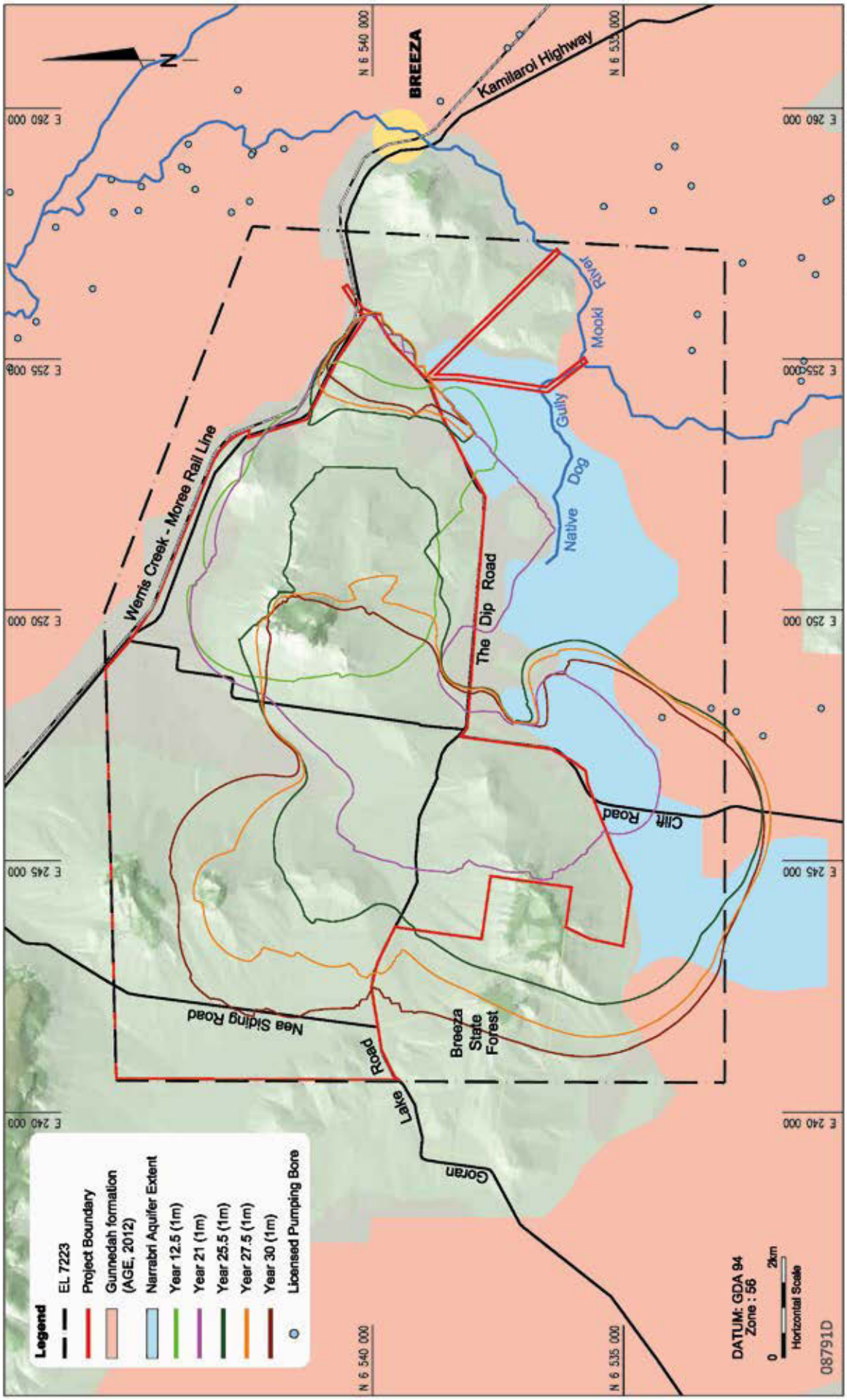
Porous Bedrock

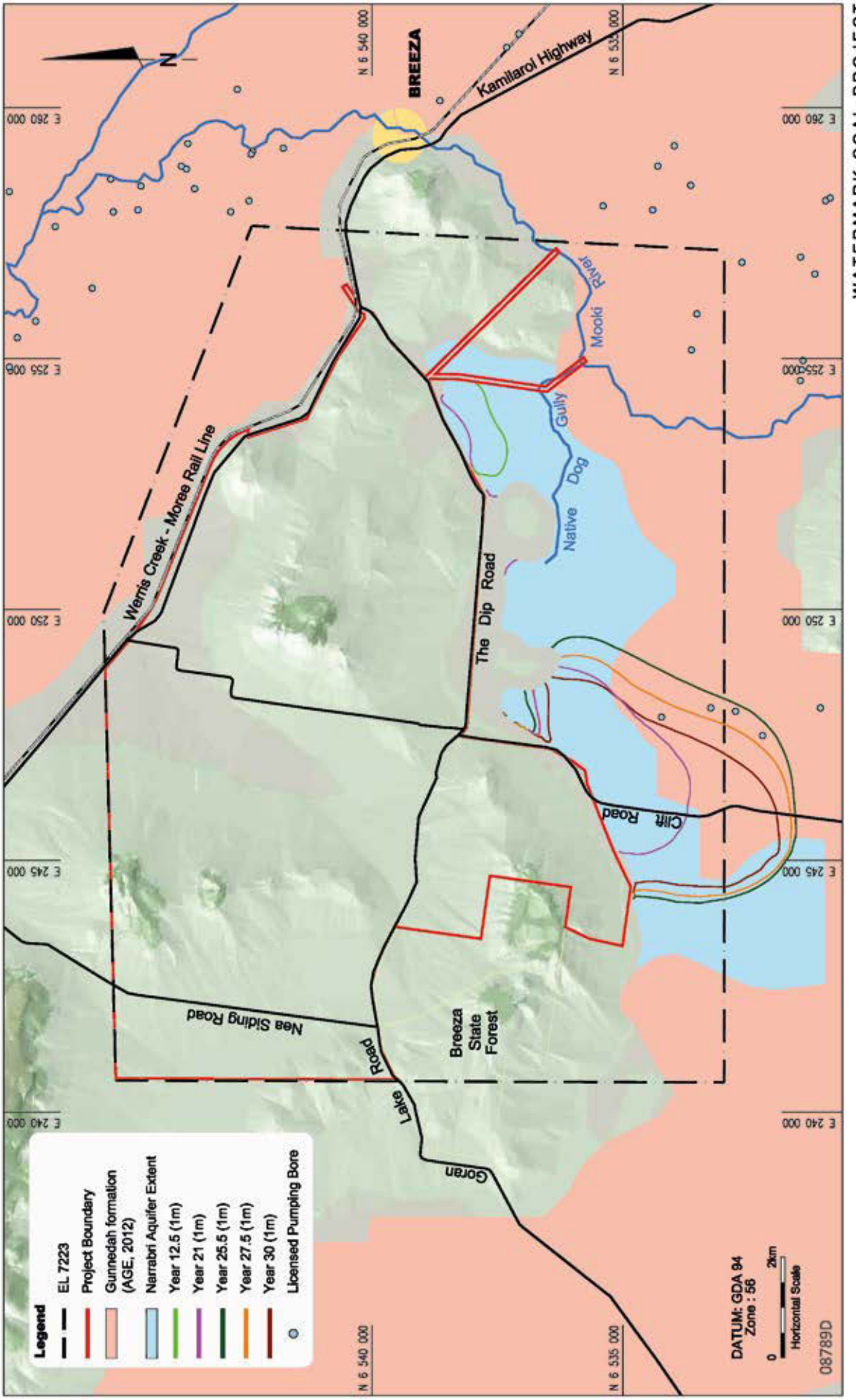
As noted above, the groundwater model predicts an average groundwater seepage rate into the mining areas of 0.5 ML/day (180 ML/yr) with a peak of up to 756 ML/yr. The groundwater seepage to the mining areas is largely sourced from the *Water Sharing Plan for the Murray-Darling Basin Porous Rock Groundwater Sources*. As the zone of depressurisation increases, there is a net transfer of water from the 'Spring Ridge' management zone of this WSP into the 'Other' management zone which peaks at 32.7 ML/year in Year 25. Groundwater seepage into the mining areas represents less than 0.1% of the extraction limits for this groundwater source.

Upper Namoi Alluvium

A 150 m buffer zone of bedrock will remain in place between the mining areas and the black soil plains, and the mining areas do not directly intersect the alluvial aquifers of the Narrabri and Gunnedah Formations, therefore any impacts to the alluvial aquifer systems will result from a reduction in pressure and water transfer rates from the Permian to the alluvial aquifer system.

Table 25 summarises the cumulative reduction in flow from the Permian to the alluvium for each relevant groundwater management zones identified under the *Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003*. The change in upward flow from the Permian to the alluvium due to mining is negligible beyond the immediately adjacent Zone 7. Zones 3 and Zone 8 report only a very small change. No change in flow rates is predicted for Zones 1, 6 and 10, which are relatively distant from the Project.


WATERMARK COAL PROJECT
Groundwater Depressurisation Zone - Melvilles Coal Seam
FIGURE 30
Hansen Bailey
ENVIRONMENTAL CONSULTANTS
N
BREEZA
Kamilaroi Highway
Werris Creek - Moree Rail Line
Mooki River
Gully
Dog
Native
The Dip Road
Cliff Road
Nea Siding Road
Breeza State Forest
Road
Lake
Goran
E 260 000
E 255 000
E 250 000
E 245 000
E 240 000
N 6 540 000
N 6 535 000
Legend
EL 7223
Project Boundary
Gunnedah formation (AGE, 2012)
Narrabri Aquifer Extent
Year 12.5 (1m)
Year 21 (1m)
Year 25.5 (1m)
Year 27.5 (1m)
Year 30 (1m)
Licensed Pumping Bore
DATUM: GDA 94
Zone : 56
0
2km
Horizontal Scale
087910


WATERMARK COAL PROJECT
Groundwater Depressurisation Zone - Narrabri Formation
FIGURE 31
Hansen Bailey
ENVIRONMENTAL CONSULTANTS
N
BREEZA
Kamilaroi Highway
Wernis Creek - Moree Rail Line
The Dip Road
Native Dog Gully
Mooki River
Cliff Road
New Siding Road
Breeza State Forest
Lake Goran Road
N 6 540 000
N 6 535 000
E 260 000
E 255 000
E 250 000
E 245 000
E 240 000
Legend
EL 7223
Project Boundary
Gunnedah formation (AGE, 2012)
Narrabri Aquifer Extent
Year 12.5 (1m)
Year 21 (1m)
Year 25.5 (1m)
Year 27.5 (1m)
Year 30 (1m)
Licensed Pumping Bore
DATUM: GDA 94
Zone : 56
0
2km
Horizontal Scale
087890

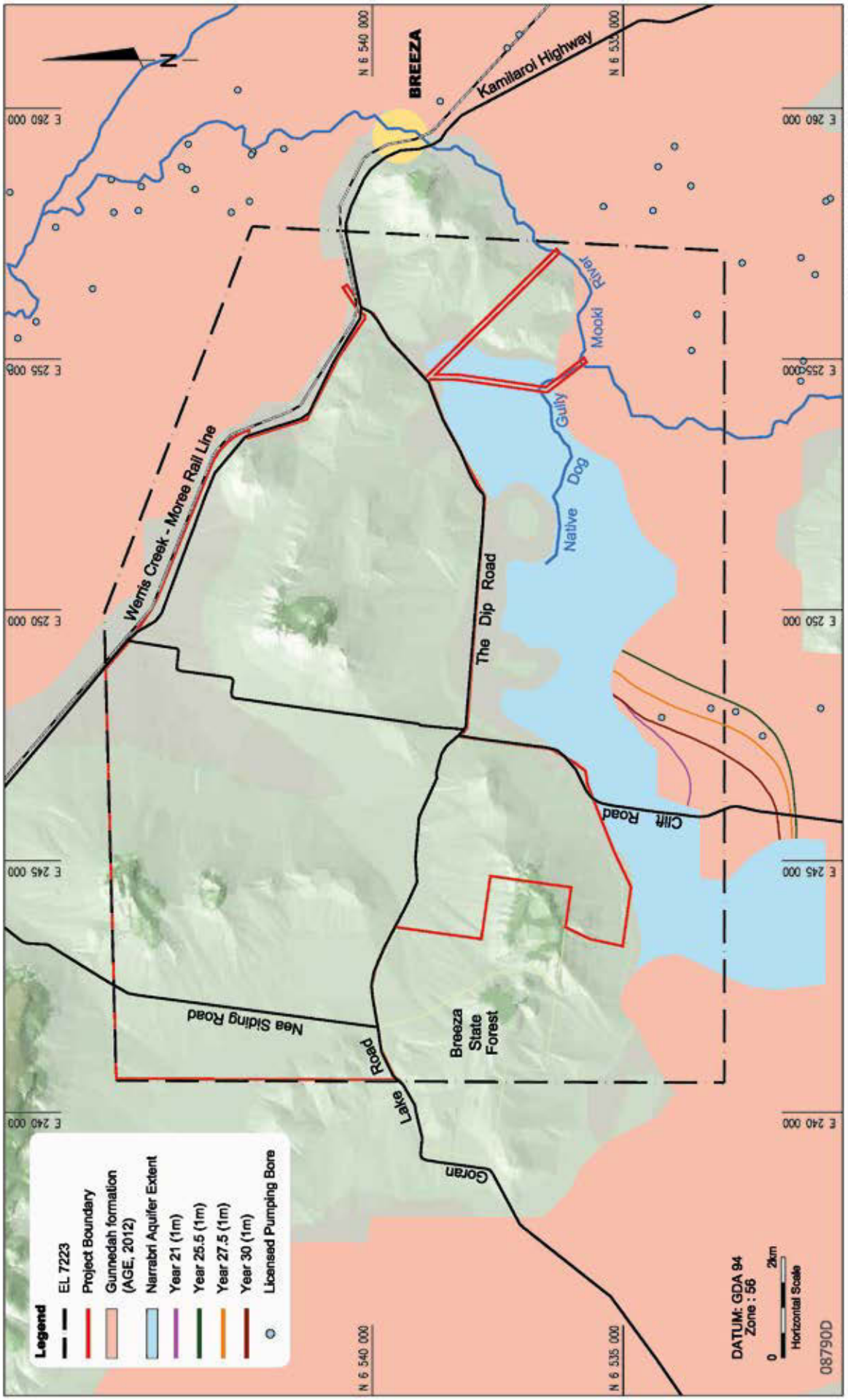

WATERMARK COAL PROJECT
Groundwater Depressurisation Zone - Gunnedah Formation
FIGURE 32
N
BREEZA
Kamilaroi Highway
Wernis Creek - Moree Rail Line
The Dip Road
Native Dog Gully
Mooki River
Cliff Road
New Siding Road
Breeza State Forest
Road
Lake
Goran
Legend
EL 7223
Project Boundary
Gunnedah formation (AGE, 2012)
Narrabri Aquifer Extent
Year 21 (1m)
Year 25.5 (1m)
Year 27.5 (1m)
Year 30 (1m)
Licensed Pumping Bore
DATUM: GDA 94
Zone : 56
0
2km
Horizontal Scale
087900
N 6 540 000
N 6 535 000
E 260 000
E 255 000
E 250 000
E 245 000
E 240 000
Hansen Bailey
ENVIRONMENTAL CONSULTANTS

Table 25 Reduction in Transfer Rate from Permian to Alluvium

Groundwater Management Zone	Reduction in Transfer Rate from Permian to Alluvium over 30 years		
	Cumulative over Project Life (ML)	Average (ML/yr)	Peak (ML/yr)
3	14.0	0.5	1.1
7	1,020.8	34.0	101.8
8	35.5	- 1.2	0.4

Note - negative numbers indicate an increase in transfer rate from Permian to alluvium above pre-mining conditions

Table 25 does not account for the additional groundwater that enters the system through the overburden recharge. When this is considered, there is no net take of groundwater post mining.

The groundwater flow from the underlying Permian formations to the alluvium reduces by a maximum rate of 0.3 ML/day in Zone 7, with the maximum annual loss at 101.8 ML/year. The rate of transfer of water from the Permian to the alluvium reduces as the zone of depressurisation increases and reaches a peak when mining in the Southern Mining Area is most extensive in Year 24.

The average pumping rate from a single licensed agricultural bore in the Upper Namoi alluvium (within 10 km of the Project Boundary) is 142 ML/yr. The groundwater model predicts that the volume of water removed from the Zones 3, 7 and 8 is a very small quantity of water (peaking at 98.1 ML/yr), which is equivalent to no more than the average usage from a single bore in the peak years or mining.

Under post-mining conditions, the water levels in these areas recover and the surrounding Permian regains pressure. The emplacement of overburden in the mining areas and the associated enhanced recharge rapidly reverses the effects of groundwater depressurisation on the alluvial aquifer system. The model indicates that 15 years after mining ceases, upward flow to the alluvium will be returned to pre-mining rates. Beyond 15 years of recovery, the enhanced OEA recharge causes a net gain of 0.1 ML/day to the alluvial groundwater management areas, which means there is no long term deficit of water post mining.

It is important to note that **Table 25** presents the predicted change in the groundwater transfer rate from the Permian bedrock to the alluvium due to the Project. The majority of this water does not flow into the proposed open cut mining areas, but it simply remains in the underlying Permian bedrock and is therefore is not lost from the larger groundwater system. When mining is completed in the Southern Mining Area and Eastern Mining Areas, the Triassic/ Permian basement starts to repressurise and the predicted flow rate from the Permian basement to the overlying alluvium increases to pre-mining rates within 15 years. Beyond 15 years, there is a net increase in the transfer from the Permian to the alluvium due to the mounding of groundwater within the backfilled Southern and Eastern Mining Areas caused by enhanced increased recharge.

The change in upward flow from the Permian to the individual alluvial units (i.e. Narrabri and Gunnedah Formations) is dependent on the proximity of the units to the mining areas. Ninety percent of the alluvial transfer loss occurs from the Permian to the Narrabri Formation Aquifer, while just 10% of transfer loss occurs from the Permian to the Gunnedah Formation Aquifer. This is an important point to note because although the Narrabri and Gunnedah Formations are managed as a single aquifer unit under the *Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003*, the Narrabri Formation contains poor quality water and is not targeted by surrounding users for agricultural purposes. The modelling indicates the impact will be largely limited to the Narrabri Formation where the yields and water quality are poorer.

Impacts to Highly Productive Groundwater

The Gunnedah Formation is considered to satisfy the highly productive groundwater criteria of the SRLUP and AIP for yield and salinity; however, it does not occur beneath BSAL impacted by the Project nor elsewhere within the Project Boundary. The Narrabri Formation is not considered to satisfy the highly productive groundwater criteria and does not occur beneath land impacted by the Project. The Permian formations are also not considered to satisfy the highly productive groundwater criteria.

As noted above, the groundwater model indicates that the Project will create a zone of depressurisation induced by mining in the Permian formations underlying the Upper Namoi alluvium. Groundwater flow from the underlying Permian to the Upper Namoi alluvium will be reduced by a maximum rate of 0.3 ML/day.

Aquifer Interference Policy

The AIP requires proponents to hold water licences to account for all water taken from groundwater and surface water sources as a result of the Project. **Section 7.1.4** summarises the predicted water take due to the Project and water licences required for the Project.

The AIP sets out "minimal impact considerations" and indicates that "*if the predicted impacts are less than the Level 1 minimal impact considerations, then these impacts will be considered as acceptable*". The Project complies with the AIP as the predicted impacts of the Project are all less than the Level 1 requirements as discussed below:

- **AIP Requirement** - For both highly and less productive groundwater sources, changes in pressures and water tables due to the Project should not induce a decline of more than 2m at any water supply work (i.e. a bore or a well).
  - The modelling for the Project predicted a maximum drawdown in a private bore of 1.4 m, which is less than the 2 m maximum specified by the AIP. There are no known Groundwater Dependent Ecosystems (GDEs) within the zone of depressurisation and therefore the criteria set out in the AIP for GDEs are not applicable.

- **AIP Requirement -** The AIP minimal impact considerations protect water quality by requiring "*any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40m from the activity*".
  - The beneficial use of the groundwater in the Project area varies spatially depending of the salinity of the local groundwater. Generally the groundwater is brackish to saline and of limited agricultural use, but can be suitable for cattle or sheep in some areas. At mine closure, it is considered likely the backfilled mining areas will capture more water than pre-mining, and this would likely lead to a slow reduction in salinity of groundwater around the mined areas. The beneficial use of the groundwater under this scenario would improve over time.
- **AIP Requirement** - To protect surface water, the AIP requires "*no increase of more than 1% per activity in the long term average salinity in a highly connected surface water source at the nearest point to the activity*".
  - During operations, the predicted depressurisation will increase the rate of seepage from the Mooki River into the underlying aquifer. As the flow of water is from the river into the underlying aquifer, there is no potential for a change in salinity in the surface water source during operations.
  - Post mining, the project is expected to slowly reduce the salinity of groundwater around the mined area due to the increased rate of recharge through the backfilled materials. There is no potential for an increase in salinity in surface water sources for this scenario and the Project complies with this requirement.
- **AIP Requirement -** The AIP also sets out set back distances for mining activities from a highly connected water source that is defined as a reliable water supply. The AIP states "*no mining activity to be below the ground surface within 200m laterally from the top of high bank or 100m vertically beneath (or the three dimensional extent of the alluvial water source – whichever is the lesser distance) of a highly connected surface water source that is defined as a reliable water supply.*"
  - The proposed mining footprint complies with this requirement.
- **AIP Requirement -** The AIP also limits the amount of alluvial material that can be excavated by an activity by requiring "*not more than 10% cumulatively of the three dimensional extent of the alluvial material in this water source to be excavated by mining activities…*"
  - No mining of alluvial material is proposed and therefore the Project complies with this requirement.

Changes to Surface Water Flow

In the absence of mining, the Mooki River and Quirindi Creek network have both losing and gaining characteristics (i.e. lose water to the underlying groundwater formations along some reaches, or gain water via groundwater flow on other reaches depending on the depth to the water table). Once mining commences the Permian becomes depressurised, and within the zone of influence, upward flow from the Permian to the alluvium is predicted to reduce. The resultant lowering of groundwater levels in the Narrabri Formation, although very small, does increase the hydraulic gradient between the bed of the Mooki River and the underlying aquifer. The higher gradient potentially increases the rate of surface water flow from the river to the aquifer.

The groundwater model found a small increase (0.13 ML/day in Year 24) in the net flow from the Mooki River to the underlying aquifer (i.e. an increase in 'losing' conditions). The other surface water features do not show any significant response to mining. The increase in seepage from the Mooki River to the underlying alluvium of 0.13 ML/day represents an undetectable proportion of the total river leakage along the Mooki River of 0.4%.

There is no significant impact on Lake Goran as the groundwater level drawdown is not predicted to exceed 0.01 m. Lake Goran is an ephemeral lake and does not receive a significant contribution from groundwater and therefore will not be impacted by the Project.

The total additional flow from the Mooki River to the underlying aquifer totals 323 ML at the end of the Project life.

The model demonstrates that as the zone of depressurisation reduces post-mining, predicted flow from the river to the underlying aquifer also reduces. By approximately Year 60 (30 years post mining), the zone of depressurisation has fully retracted and there is no further cumulative transfer from the Mooki River to the underlying aquifer. When the post-mining loss is considered the total additional flow through the Mooki River to the underlying aquifer due to the Project is 489 ML (i.e. an additional 166 ML between Year 30 and Year 60). This is equivalent to an average of 16.3 ML/yr over the Project life or less than 0.02% of the mean flow along the river at Breeza.

The groundwater model indicates an increase in net flow to the Mooki River post mining of 0.02 ML/day due to the additional recharge through the spoil material in the Southern and Eastern Mining Areas. This is a very small proportion of the net modelled flow to the Mooki River from the aquifers of 27.3 ML/day, or approximately 0.07% of the net flow. This indicates the Project will comply with the AIP requirement of no increase of more than 1% in the long term average salinity.

Impacts on Existing Groundwater Users

Within 10 km of the Project Boundary, 35 bores are predicted to experience maximum groundwater level reductions of greater than or equal to 0.1 m. Of these, four bores adjacent to the Southern Mining Area have a maximum predicted drawdown between 1 and 2 m.

The largest predicted reduction in water level of 1.4 m is limited to bore GW15505, which is the closest bore to the Southern Mining Area. When operations in the Southern Mining Area and Eastern Mining Area cease, the model predicts that groundwater levels in the depressurised zone recover relatively rapidly within approximately five years.

As described previously, groundwater flow from the underlying Permian to the alluvium will be reduced by a maximum rate of 0.3 ML/day. This represents less than 0.5% of the flow from registered bores within 10 km of the Project Boundary and is due to predicted pressure transmission between the fractured rock and alluvial systems. If this occurs, it represents a negligible change in groundwater availability to adjacent groundwater users.

Changes to Water Quality

The Seepage Water Quality Impact Assessment undertaken by Terrenus Earth Sciences (see appendix to Groundwater Impact Assessment (**Appendix T**) confirmed that existing groundwater aquifers within and adjacent to the Project Boundary have salinity concentrations equal to or significantly greater (up to 10 times greater) than the seepage predicted to be produced from overburden and interburden.

The Geochemical Assessment of Overburden/ Interburden and Coal Reject Materials (**Appendix W**) found that leachate from mixed spoil materials, comprising fine to coarse-grained overburden and interburden and a small proportion of coal rejects, was conservatively estimated to have an initial salt concentration of up to 5,000 mg/L. This was based on a series of Static and Kinetic Leach Column tests (see **Section 7.18**). The Geochemical Assessment (via the Static and Kinetic Leach Column tests) also found that the concentration of seepage/leachate/run-off was expected to decrease over time (as readily available salt is flushed during the early years).

Seepage in the Eastern Mining Area is predicted by the groundwater model to occur in a zone of approximately 214 ha along the southern boundary of the mining area and a smaller zone of approximately 16 ha (combined area) along the northern boundary of the Eastern Mining Area. Applying the estimated maximum salt concentration (5000 mg/L) produces a salt load contribution of less than 1 kg of salt per ha of seepage zone per day (on average).

Seepage in the Southern Mining Area is predicted by the groundwater model to occur in a zone of approximately 53 ha along the south-eastern boundary. Applying the estimated maximum salt concentration (5000 mg/L) produces a salt load contribution of about 5.6 kg of salt per ha of seepage zone per day. No seepage will occur from the Western Mining Area at any time during mining operations or post-closure.

The change in upward flow from the Permian to the individual alluvial units (i.e. Narrabri and Gunnedah Formations) is dependent on the proximity of the units to the mining areas. Ninety percent of the alluvial transfer loss occurs from the Permian to the Narrabri Formation Aquifer, while just 10% of transfer loss occurs from the Permian to the Gunnedah Formation Aquifer.

Although the Narrabri and Gunnedah Formations are managed as a single aquifer unit under the *Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003*, only upward flows to the Narrabri Formation will be impacted by the Project. The Narrabri Formation contains poor quality water, and is generally not targeted by surrounding users to supply agriculture.

Therefore overburden seepage / leachate is expected to have a low to negligible impact on local groundwater resources.

Post mining as the groundwater level recovers; flow from the Southern and Eastern Mining Areas to the adjacent Narrabri Formation will increase and likely exceed pre-mining rates. The water quality released from the Southern and Eastern Mining Areas will likely be of a better quality than typically encountered in the Narrabri Formation and therefore no deterioration in the beneficial use of the alluvial groundwater is expected.

Impacts to Groundwater Dependant Ecosystems

The majority of the vegetation to be retained in the Project Boundary, including Mt Watermark is located in areas where the depth to groundwater is greater than 20 m. As such, any potential groundwater drawdown resulting from the Project is considered unlikely to affect these vegetation communities as the groundwater is already beyond the reach of their roots. Therefore none of the vegetation communities within the Project Boundary are considered to be completely dependent on groundwater.

Furthermore, the Stygofauna Impact Assessment undertaken by Eco Logical (see **Appendix U** and **Section 7.12**) did not identify any stygofauna within the Project Boundary and assessed that it was unlikely to occur.

Post-Mining Recovery of Groundwater Levels

The model indicates groundwater levels begin to recover after the backfilling of the Eastern Mining Area and Southern Mining Area eventually exceeding pre-mining levels. This is due to a higher recharge rate on the overburden material than the pre-mining condition. The higher recharge rate and rehabilitated landform mean that a zone of seepage occurs at spill points, which are topographic low points at the base of OEAs.

The predicted groundwater levels within the Western Mining Area final void will slowly recover and reach equilibrium at approximately 303 m AHD after approximately 2,000 years post-mining. Groundwater levels remain below the regional water table by 1-2 m, indicating the pit lake void will act as a groundwater sink, not a source. The water budget for the final void is dominated by rainfall and evaporation, with only a very small contribution from groundwater seepage.

WRM (2013) also assessed the recovery of water levels in the final void and the final void water quality using the OPSIM software. WRM predicted the water level in the final void would stabilise at between 280 m AHD and 290 m AHD. The OPSIM model recovered much more quickly than the groundwater model.

The more rapid recovery is because the OPSIM model simulates daily rainfall which includes storm events. During these events, the pit lake recovers faster than the groundwater model which uses annual average rainfall rates. Another factor contributing to the more rapid recovery time in the OPSIM model is the representation of the open void.

Despite the difference in the predicted recovery rate, both the groundwater model and the OPSIM model indicate that the water level in the final void will stabilise well below the crest of the open cut mining area, and therefore spillage of water into the environment will not occur.

Cumulative Impacts

Other proposed mining and gas projects within the Liverpool Plains area may also result in the depressurisation of the Permian. If the zones of depressurisation due to open cut and underground coal mining, as well as groundwater extraction for coal seam gas mining occur concurrently there will be enhanced drawdown in these zones.

The Namoi Water Study Model (Schlumberger, 2012) has assessed the potential cumulative impacts associated with proposed mining and coal seam gas projects within the Namoi catchment, including the Project. The Namoi Water Study Model indicated the zone of depressurisation in the Gunnedah Formation aquifer extends slightly further than that of the Project with the 1 m drawdown contour increasing to 5 km from the Southern Mining Area. The more extensive zone of depressurisation is presumably due to the cumulative impact of the adjacent conceptual Caroona Coal Project and the Project.

Peer Review

A Peer Review of the AGE Groundwater Impact Assessment was undertaken by Heritage Computing in accordance with the Murray-Darling Basin Commission's (MDBC's) *Flow Modelling Guideline* (MDBC, 2001) and the *Australian Groundwater Modelling Guidelines* (Barnett, et al, 2012). A copy of the Peer Review report is provided in **Appendix T**. The Peer Review concluded that the *"groundwater model has been developed competently and is regarded as "fit for purpose" for addressing the potential environmental impacts from the three open cut mining areas and for estimating indicative dewatering rates. The stated objectives of the modelling study have been addressed satisfactorily."*

The review acknowledges that *"substantial sensitivity analysis has demonstrated that the calibration of the model is robust, and substantial perturbation of model properties will have only a mild impact on predicted environmental impacts. The sensitivity analysis results are confirmed by a more robust Monte Carlo uncertainty analysis."* The review continues to note that *"drawdown predictions indicate that the Project will not have significant impacts external to the mined area. This conclusion is well substantiated. No private bores are expected to be affected by more than 2 m drawdown, the minimal harm criterion in the NSW Aquifer Interference Policy. The model anticipates negligible effect on neighbouring stream flows. This conclusion is well substantiated."*

7.1.4 Mitigation and Management

As part of the Environmental Management System (EMS) for the Project, a Water Management Plan will be prepared to include the mitigation and management measures outlined below.

Monitoring Network

The existing groundwater monitoring network for the Project is deemed adequate and will continue to be utilised. However, additional monitoring bores will be installed within the predicted zone of depressurisation to assess the extent and rate of depressurisation against model predictions. Specific targets include the weathered zone, alluvium, Clare sandstone and coal seams. Monitoring of accessible key private bores within the predicted zone of depressurisation will also be considered.

Monitoring Program

Groundwater Levels

Shenhua Watermark manually monitors groundwater levels on a monthly basis through the current groundwater monitoring network. Selected boreholes will be converted to electronic level loggers with water levels recorded automatically for the life of the Project. Yearly audits of the performance of the monitoring network will be included as part of the Annual Review and optimisation of the monitoring sites and frequency will be undertaken, where required.

Groundwater Quality

Shenhua Watermark currently collect groundwater samples from the groundwater monitoring network on a quarterly basis for laboratory analysis of pH, EC, TDS, major and minor ions and trace elements. This monitoring regime will continue for the life of the Project. Yearly audits of the performance of the monitoring network will be included as part of the Annual Review and optimisation of the monitoring sites and frequency will be undertaken, where required.

Trigger levels for water quality parameters will be developed as part of the Water Management Plan. The aim of trigger levels will be to provide mine management with an early warning mechanism that identifies water quality trends departing from historical values. A unique trigger for each bore will be required due to the variability in the groundwater quality of the aquifers within and adjacent to the Project Boundary.

Development of the trigger levels will include analysis of historical pre-mining water quality data. Statistical data for each monitoring bore such as maximum, minimum, average and standard deviation for key parameters such as TDS (EC), sulphate, and pH will be determined as part of the Water Management Plan. Once mining commences, monitoring results for each indicator parameter will be plotted against time and control criteria, with trends above the criteria constituting a trigger or alarm for remedial action.

Groundwater Seepage

Samples of pumped groundwater seepage into the mining areas will be collected as part of the seepage monitoring program for the Project with the objective of providing an early indication of any mixing of shallow alluvial groundwater with the Permian. The seepage monitoring program will include:

- Recording of the time, location and volume of any unexpected increased groundwater outflow from the highwall and endwall;
- Monitoring of water pumped from the mining areas for the same analytical suite outlined in the groundwater quality monitoring program;
- Correlation of rainfall data with mining area seepage to be able to distinguish groundwater and surface water sources; and
- Monitoring of coal moisture content.

Management of Existing Groundwater Users

If requested by the landowner, all private bores within the zone of depressurisation with a predicted drawdown of greater than 0.25 m as a consequence of the Project will be monitored, for flow, water level and quality to validate model predictions and/or provide early warning of anomalous results.

Water Licensing

The relevant water licences will be required to account for water taken as a result of the Project. These requirements are summarised in **Table 26**. Shenhua Watermark has secured part of these required licences and is in discussions with a number of Water Access Licence holders for acquisition of their share component. Shenhua Watermark has undertaken a comprehensive study of the water licences available or issued for each of the water sources from which water will be taken as a result of the Project. The Long Term Annual Average Extraction Limits (LTAAEL) for each Water Sharing Plan have also been identified. This is reflected in **Table 26**.

Table 26 Water Allocations

Water Source	Predicted Peak Annual Water Take (During Mining)	Predicted Peak Annual Water Take (After Mining)	AWD Factor	Total Share Component Requirement for Project (Units)	Share Component Already held by Shenhua (Units)	Total Number of Licences Issued	Total Share Component Issued (Units)	LTAAEL
Namoi Groundwater Zone 3	1.1	0*	1.1	1.2	Nil	60 aquifer 28 supplementary water 1 local water utility	17,101 aquifer 8,065 supplementary water 198 local water utility	At least 17,300 ML/yr
Namoi Groundwater Zone 7	101.8	0*	1.1	112	42	16 aquifer 1 supplementary water	3,697 aquifer 7 supplementary water	At least 3,700 ML/yr
Namoi Groundwater Zone 8	0.4	0*	1.1	0.4	164	64 aquifer 35 supplementary water 1 local water utility	16,122 aquifer 4,898 supplementary water 50 local water utility	At least 16,000 ML/yr
Porous Rock (Gunnedah-Oxley Basin - Other)	756	0*	1.25	940	Nil	120 aquifer** 2 local water utility**	16,784 aquifer** 420 local water utility**	199,893 ML/yr**
Porous Rock (Gunnedah-Oxley Basin – Spring Ridge)	33	0*	1.25	42	Nil	120 aquifer** 2 local water utility**	16,784 aquifer** 420 local water utility**	199,893 ML/yr**
Mooki River	47.5	0*	1.1	53	Nil	29 unregulated river 9 domestic and stock 3 domestic and stock (stock)	29,589.5 unregulated river 23.5 domestic and stock 82 domestic and stock	As calculated under clause 35 of the WSP
Lake Goran	0	0*	1.1	0	1,223 (subject to issuance of certificate of title)	7 unregulated river 2 domestic and stock	32,171 unregulated river 88 domestic and stock	As calculated under clause 29 of the WSP
3, 7 or 8 or Mooki River^	600	0	1:1	660	Nil	As above	As above	As Above

^ Required for make-up water supply for operation on the Project – see Section 7.3.3
** Long term net gain exceeds predicted losses immediately following mining*
*** Other and Spring Ridge Management Zones combined*
LTAAEL – Long Term Average Annual Extraction Limit.
AWD – Available Water Determination

The value of share component (units) attached to a water licence is dependent on "available water determinations" (AWDs) made by the Minister for Water each July. In adverse weather conditions, the value of one unit may be decreased below the usual 1 ML with the result that more share component is required to authorise the necessary take of water. **Table 26** presents the AWD factor for each water source, based on historical data since 2006. As shown in **Table 26**, the AWD for all water sources has been the maximum entitlement (i.e. 1:1), even during drought periods.

Each of the water sources of which licences are required for the Project have a readily available market of share component which is available to be transferred / purchased by Shenhua Watermark. The identified share component can be traded under the terms of the relevant Water Sharing Plans and the WM Act. As noted in **Table 26**, in the Upper Namoi Groundwater Zone 3 groundwater management zone, there are 25,364 units of share component on issue, including 17,101 aquifer share components (according to NOW). Shenhua Watermark requires the acquisition of 1.2 units from the Upper Namoi Groundwater Zone 3 groundwater management zone for the Project.

In the Upper Namoi Groundwater Zone 7 groundwater management zone, there are 3,704 units of share component on issue, including 3,697 aquifer share components (according to NOW). Shenhua Watermark has already acquired 42 units in this zone and requires the further acquisition of 70 units from the Upper Namoi Groundwater Zone 7 groundwater management zone for the Project. In the Upper Namoi Groundwater Zone 8 groundwater management zone, Shenhua Watermark has secured all of the water licences necessary for the Project.

In regard to the Mooki River water source, there are 29,695 units of share component on issue, including 29,589.5 units of unregulated river share components (according to NOW). Shenhua Watermark requires the acquisition of 53 units from this water source for the Project. In the Gunnedah – Oxley Basin (Other and Spring Ridge zones combined) MDB Porous Rock Groundwater Source, there are 17,204 units of share component on issue, including 16,784 aquifer share components (according to NOW). Shenhua Watermark requires the acquisition of 940 units from the 'Other' management zone of this water source and 42 units from the 'Spring Ridge' management zone of this water source for the Project.

Clause 32 of the *Water Sharing Plan for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2011* provides that "The Minister may grant an access licence where the right to apply for the licence has been acquired in accordance with an order made under section 65 of the Act". Section 65 of the WM Act authorises the Minister administering the WM Act to "declare that the right to apply for an access licence for a specified water management area or water source".

The Report Card (NOW) for the Gunnedah–Oxley Basin MDB (Other) Management Zone of the Gunnedah–Oxley Basin MDB Groundwater Source indicates that there is sufficient water available in this water source to facilitate the making of a controlled allocation. Therefore, it is anticipated that Shenhua Watermark will make an application for a controlled allocation from this water source in order to fulfil the licensing requirements under the *Water Sharing Plan for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2011* if the required share components cannot be secured.

In summary, the Project will take only a very small proportion of the available share components from the surrounding Groundwater Management Zones. This study demonstrated the ability for the Project to obtain the necessary water access licences on an open market to authorise the take of water by the Project.

7.2 Geophysics

7.2.1 Background

A Transient Electromagnetic Geophysical Survey was undertaken by Groundwater Imaging Pty Ltd (Groundwater Imaging), in collaboration with AGE and is provided in **Appendix V**. The purpose of the survey was to define the extent of alluvial material within and adjacent to the Project Boundary and identify any other potential conduits or barriers for groundwater flow from the mining areas. This assessment has assisted Shenhua Watermark in the design of the mine plan and mining sequence for the Project.

7.2.2 Methodology

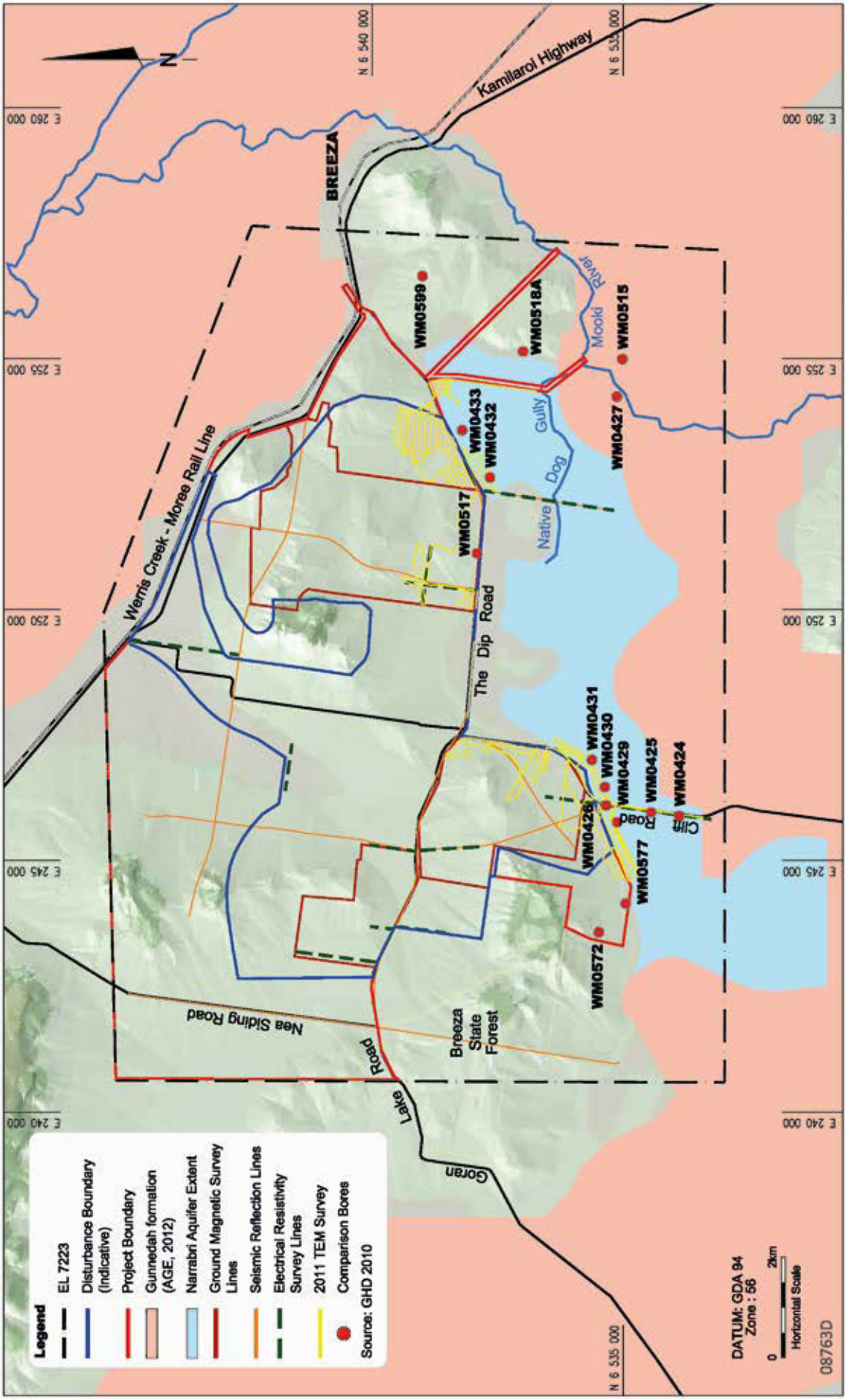
Desktop Assessment

A desktop assessment was undertaken to characterise the geology and surrounding environment within and adjacent to the Project Boundary. The assessment involved a review of aerial photography, topographic maps, geological maps and an array of previous hydrogeological and geophysical investigations specific to the area. In particular, previous geophysical, hydrogeological and geological investigations undertaken by GHD throughout the Project Boundary were reviewed.

Field Assessment

A multi-depth resistivity survey was conducted within and adjacent to the Project Boundary in September 2011 (see **Figure 33**). The survey used the Time Domain Electromagnetics Method (TDEM) with a TerraTEM unit and a trailer mounted loop system which provided images to a depth of 70 m below the ground surface.

The survey focused on selected zones within the Project Boundary along the edge of the Liverpool Plains. The survey was divided into two main areas; Clift Road to the west and Duddy Road to the east, both connected by The Dip Road.


WATERMARK COAL PROJECT
Geophysics Survey Locations
FIGURE 33
Hansen Bailey
ENVIRONMENTAL CONSULTANTS
N
Kamilaroi Highway
BREEZA
Werris Creek - Moree Rail Line
The Dip Road
Native Dog Gully
Mooki River
Cliff Road
New Siding Road
Breeza State Forest
Goran Lake Road
WM0599
WM0518A
WM0515
WM0433
WM0432
WM0427
WM0517
WM0431
WM0430
WM0429
WM0425
WM0424
WM0426
WM0577
WM0572
N 6 540 000
N 6 535 000
E 260 000
E 255 000
E 250 000
E 245 000
E 240 000
Legend
EL 7223
Disturbance Boundary (Indicative)
Project Boundary
Gunnedah formation (AGE, 2012)
Narrabri Aquifer Extent
Ground Magnetic Survey Lines
Seismic Reflection Lines
Electrical Resistivity Survey Lines
2011 TEM Survey
Comparison Bores
Source: GHD 2010
DATUM: GDA 94
Zone : 56
0
2km
Horizontal Scale
087630

Data Analysis

The electrical magnetic signals received from the substrata during the field assessment were processed and converted to electrical resistivity images. The resultant images reveal the proportion of ions in solution in the groundwater and rock at various depths, however, the resistivity signal can be ambiguous with several physical properties producing similar responses. As such, the resistivity images have been correlated with other available geophysical data and all previously collected geological and hydrogeological data sets to determine the nature of the electrical response.

Low resistivity responses are indicative of clays, high saturation, saline pore water, weathered rock or a combination. High resistivity is indicative of a lack of clays, low saturation, fresh pore water, impervious fresh rock or a combination.

7.2.3 Upper Namoi Alluvium Boundary Definition

The geophysics survey successfully identified the Upper Namoi alluvium boundary (Narrabri and Gunnedah formations) as represented by a very low resistivity layer on the flood plains. Within this alluvium, there is a contrast between heavy clay and light and coarse sediment. The Narrabri Formation conforms to the characteristics of the heavy clay, saline, unconsolidated material identified within the alluvium. Underlying these materials is a resistive layer consisting of coarse sediment, palaeochannels and fresh water, which is representative of the Gunnedah Formation.

In the ridge country surrounding the plains, some moderately low resistivity features have been identified as weathered Permian bedrock or palaeochannels. Some steeply dipping low resistivity features were identified as likely to be faults hosting saline groundwater. Along the plains margin, intersections of sandstone mixed with clay and sand layers are also considered likely to represent weathered Permian rock or colluvial Permian boulders among colluvium and alluvium.

Based on the imagery and geophysical characteristics identified during the survey, the Upper Namoi alluvial boundary is inferred as being restricted to the south of the Project Boundary and in the north-eastern corner of EL 7223 (see **Figure 27**). This work has confirmed that the Project will not intercept the Gunnedah Formation. The Eastern and Southern Mining Areas are set back from the Upper Namoi alluvium by a minimum distance of 150 m and approximately 900 m from the Gunnedah Formation. This buffer prevents the direct connection of water between the Gunnedah Formation aquifer and the mining areas.

Further, the survey did not suggest the presence of any large scale bedrock structures or faults that could connect the mining areas with the Gunnedah Formation and act as conduits.

7.2.4 Mitigation and Management

Further drilling, borehole geophysics and lithological logging will be undertaken to verify the interpretations from the geophysics survey as a component of a future exploration program.

7.3 Surface Water

7.3.1 Background

A Surface Water Impact Assessment was undertaken by WRM Water and Environment (WRM) and is provided in **Appendix S**. The purpose of the assessment was to:

- Characterise the existing catchments;
- Develop a water balance for the Project with consideration of the proposed water management system;
- Determine the impacts to surface water as a result of the Project; and
- Recommend measures to mitigate and manage impacts.

Existing Catchment

The Project Boundary is located within the catchment of the Mooki River, a tributary of the Namoi River. The Mooki River is classified as at least a 4th order stream under the Strahler Stream Classification System. Surface runoff drains in one of three general directions; north to the Mooki River floodplain via Watermark Gully or other smaller unnamed flow paths, south to Native Dog Gully or west towards Lake Goran.

The headwaters of the Mooki River originate on the northern slopes of the Liverpool Ranges and Coolah Tops, flowing in a northerly direction to the Namoi River north-east of Gunnedah. In the upper catchment, creek channels are typically well defined with an incised main channel and a gravel or cobble bed. Active erosion is evident along the banks of the river and contour banks are used broadly in the foothills of the Liverpool Ranges at the transition between the steeper upper catchment and the extensively cropped alluvial plains. The Mooki River has numerous tributary creeks, including Quirindi Creek and Native Dog Gully.

The upper and mid reaches of Watermark Gully have a small but well defined main channel within a wide floodplain. Watermark Gully is classified as a 2nd order stream. The northern portion of the land within the Project Boundary drains northwards to the Mooki River floodplain via Watermark Gully where the main channel essentially disappears to become a very wide, shallow flow path.

Native Dog Gully is a tributary of the Mooki River which drains the southern portion of the land within the Project Boundary. At its confluence with the Mooki River, Native Dog Gully is considered a 3rd order stream. During major flood events, Native Dog Gully is affected by backwater from the Mooki River. The floodplain area between Native Dog Gully and Lake Goran is very flat with flow direction during flood events being affected by the relative levels and flows in these watercourses / bodies.

Lake Goran is a naturally occurring ephemeral lake situated west of the Project Boundary. During periods of intense rainfall, the lake overflows to the east via Native Dog Gully.

The catchment of Lake Goran is drained by Coomoo Coomoo Creek, Moreduval Hut Gully and Lever Gully from the south and some unnamed watercourses from the north and west.

Existing Water Use Entitlements

The Project has the potential to interact with the Mooki River Water Source and the Lake Goran Water Source.

The Mooki River Water Source is identified in the *Water Sharing Plan for the Phillips Creek, Mooki River, Quirindi Creek, and Warrah Creek Water Sources 2003*, which commenced 1 July 2004. The majority of licences issued under the WSP are associated with irrigation, domestic and stock purposes. The estimated entitlement for the Mooki River Water Source under a WAL is 27,449 ML/yr. Extractions from the Mooki River are subject to total daily extraction limits, which restrict the extraction volume depending upon the river flow rate. Shenhua Watermark does not hold licences under this WSP to extract from the Mooki River Water Source.

The Lake Goran Water Source is part of the *Namoi Unregulated and Alluvial Water Sources Water Sharing Plan 2012* which commenced in October 2012. The plan comprises 23 unregulated water sources in the Namoi catchment and four alluvial water sources (Manilla, Curabubula, Quipolly, Quirindi) that are relatively distant from the Project Boundary. The total licensed water entitlement for the Lake Goran Water Source is 32,259 ML/yr. Almost all of this entitlement is for irrigation purposes with the remainder for stock and domestic. Water access from Lake Goran is limited by a cease to pump level of 294.7 m AHD.

Existing Water Quality

Shenhua Watermark has an established surface water monitoring network, comprising 12 sites within and adjacent to EL 7223. Routine surface water monitoring across the network commenced in October 2009 and is ongoing. The network records on a monthly basis salinity, pH, temperature, TDS, Total Suspended Solids (TSS) and a number of metals and organic compounds.

Surface water quality data from the Shenhua Watermark monitoring network provides an indication of the state of the watercourses within and adjacent to the Project Boundary, including the Mooki River, Watermark Gully and Native Dog Gully.

The Mooki River is characterised by alkalinity (pH ranging from 6 to 12.2) and fresh to brackish waters (electrical conductivities ranging from 89 to 2,200 microsiemens per centimetre (μS/cm)). The Mooki River catchment is largely comprised of brown vertosol soils, resulting in high salinity. Generally major ions and trace elements are within the ANZECC trigger values for ecosystem protection and recreation and livestock purposes with the exception of elevated levels of phosphorous, chromium, copper and iron.

Watermark Gully is characterised by alkalinity (pH ranging from 6.3 to 8.8) and fresh waters (electrical conductivities ranging from 14 to 266 μS/cm). Generally major ions and trace elements are within the ANZECC trigger values for ecosystem protection and recreation and livestock purposes with the exception of elevated levels of phosphorous, chromium, copper, lead, zinc and iron. Additionally the level of turbidity in the system far exceeds the range for ecosystem protection.

Native Dog Gully is characterised by alkalinity (pH ranging from 7.7 to 9.7) and fresh to saline waters (electrical conductivities ranging from 3 to 48,200 μS/cm). Native Dog Gully is also characterised by high salinity, which is attributed to the presence of grey vertosol soils in a significant proportion of the catchment. Grey vertosol soils become very saline with depth. Major ions and trace elements are generally within the ANZECC trigger values for ecosystem protection and recreation and livestock purposes with the exception of elevated levels of sulphate, phosphorous, chromium, copper, zinc and iron. Additionally the level of turbidity and TDS in the system far exceeds the range for ecosystem protection and recreational and livestock purposes, respectively.

Proposed Water Management System and Infrastructure

The key objective of the water management system will be to keep fresh water separate from poorer quality mine water. Further, the poorer quality water will be prioritised for use over extracting water from external sources. As illustrated in **Figure 34**, the main components of water-related infrastructure for the Project include:

- Sediment dams to collect and treat runoff from the OEAs;
- Dirty water drains to divert sediment-laden runoff from the OEAs to sediment dams;
- Clean water drains to divert runoff from undisturbed catchments around areas disturbed by mining;
- A dirty water storage system to store water pumped out of the mining areas and to collect runoff from the CHPP and coal stockpile area. The mine water dams will be the first priority water source for road watering and CHPP water demands; and
- Raw water storage (the Main Dam) from the water supply pipeline.

All water management structures will be suitably engineered to the standard required to safely capture, store and divert water of various qualities and avoid adverse impacts to the neighbouring environment.

The sediment dams have been sized with a sediment basin settling zone volume based on 90th percentile 5-day duration rainfall in accordance with current recommended design standards in the following guidelines:

- *Managing Urban Stormwater, Soils and Construction* (Landcom, 2004); and
- *Managing Urban Stormwater, Soils and Construction, Mines and Quarries* (DECC, 2008).

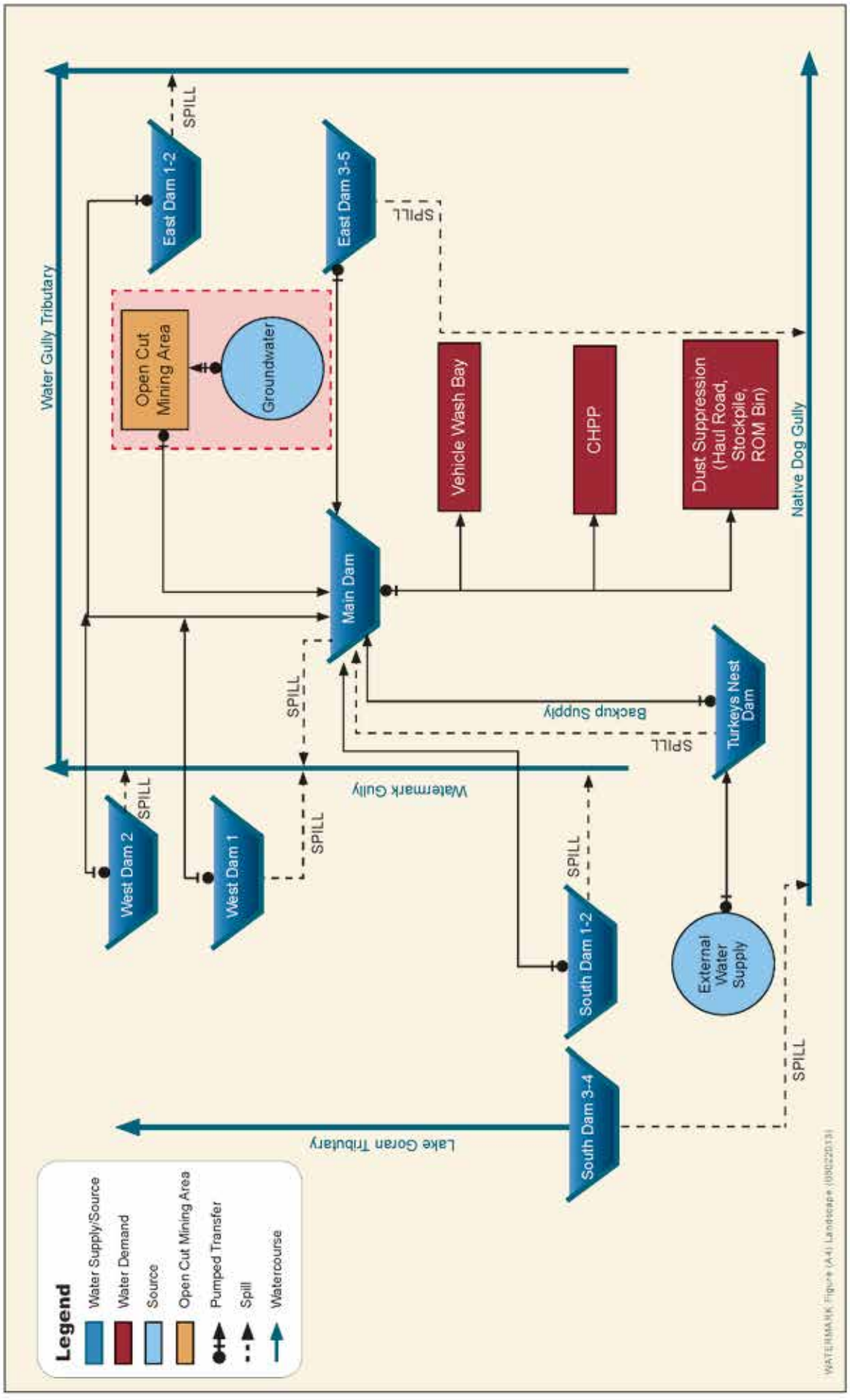

WATERMARK COAL PROJECT
Conceptual Water Management System
Water Gully Tributary
East Dam 1-2
East Dam 3-5
SPILL
Open Cut Mining Area
Groundwater
Vehicle Wash Bay
CHPP
Dust Suppression (Haul Road, Stockpile, ROM Bin)
Native Dog Gully
Main Dam
Backup Supply
Turkeys Nest Dam
Watermark Gully
West Dam 2
West Dam 1
South Dam 1-2
South Dam 3-4
External Water Supply
Lake Goran Tributary
Legend
Water Supply/Source
Water Demand
Source
Open Cut Mining Area
Pumped Transfer
Spill
Watercourse
SHENHUA WATERMARK COAL PTY LIMITED
Hansen Bailey

FIGURE 34

The Main Dam and Turkeys Nest Dam will be constructed to be available at the commencement of the Project. The east sediment dams will be established progressively with the development of the Eastern Mining Area, the south-east sediment dams will be established progressively with the development of the Southern Mining Area and so on. The indicative water storages adopted in the model are provided in **Table 27**.

One or more electric pump stations (or possibly a licensed bore field) and an associated water pipeline will be constructed on Shenhua Watermark owned land to transfer water from Groundwater Management Zones or unregulated surface water sources to the Main Dam. The pipelines and the pump station to Mooki River as shown on **Figure 9** may also be utilised as required, in accordance with the relevant licences. This will supplement water supplies required for the CHPP. Gravel access tracks and power lines will also be constructed to enable the ongoing operation and maintenance of the pump stations or bore field.

The relationships between the components of the water management system are illustrated in **Figure 34**.

7.3.2 Methodology

Site Water Balance

A computer-based simulation model (OPSIM) was used to assess the dynamics of the water balance (both volume and salt loads) under varying rainfall and catchment conditions. The OPSIM model works to dynamically simulate the operation of the water management system and in doing so keeps complete account of all site water volumes and representative water qualities on a daily time step. The model was configured to simulate the operations of all major components in the water management system. The simulated inflows and outflows included in the model are given in **Table 28**.

Table 27 outlines the storage details adopted in the site water balance model.

Water demands for dust suppression were calculated using known watering rates for mines in the Hunter Valley. The watering rate is typically 2.5 – 3.0 mm/day for mines in the Hunter Valley. Using the evapotranspiration rate for Watermark (approximately 4.1 mm/day), the watering rate required for the Project was determined to be 4.0 mm/day. A chemical dust suppressant agent will be used in Years 5 to 21. This will reduce the required watering rate to approximately 2.0 mm/day for this period.

The adopted net CHPP demand rate is 76 litres per ROM tonne (L/ROM t), based on estimates provided by CPG Resources for a coal processing facility using belt press filters (CPG, 2012). A chemical dust suppressant agent will be applied to haul roads to minimise dust and water usage. The reduced haul road watering rate is 1.92 ML/day (0.08 litres per square metre per hour (L/m^2/hr)), which represents a reduction in water demand for haul roads of about 50%.

The water demand for the vehicle washdown area was adopted at a net rate of 55 ML/yr (150 kilolitres per day (kL/day)) with a return rate of 90% (i.e. 5.5 ML/yr loss).

The water management system was modelled using static and forecast simulations. For the static simulation, each stage of Project was modelled separately from the other stages over a full historical climatic data set from 1889 to 2010. This provides an indication of the water balance at that stage of operation and allows for a comparison of inflows and outflows between the different stages.

The forecast simulation allows the model configuration to change over the modelled 30 year Project life, reflecting changes in the water management system over time. The different stages of the Project life are linked in the model to reflect variations over time such as changes to catchments, ROM coal production and groundwater seepage.

For both the static and forecast simulations, seven representative stages of the Project life (Years 2, 5, 10, 15, 21, 25 and 30) were modelled to reflect variations over time. Although the catchment areas will continuously change as the Project progresses, the adopted approach of modelling discrete stages will provide a reasonable representation of conditions over the 30 year period.

To assess the effects of varying climatic conditions, the model was run for 92 realisations with each realisation corresponding to the 30 year Project life. A different rainfall input sequence is applied to each realisation. The first realisation adopts climatic data from 1889 to 1919, the second from 1890 to 1920 and so on through the 122 years of historical climatic data.

Table 27 Indicative Water Storages for Modelling

Storage	Capacity (ML)	Maximum Catchment Area (ha)
Main Dam	2,000	N/A
Turkeys Nest Dam	50	N/A
Sediment Dam East 1	43	120
Sediment Dam East 2	167	450
Sediment Dam East 3	212	580
Sediment Dam East 4	179	490
Sediment Dam East 5	83	230
Sediment Dam South 1	87	240
Sediment Dam South 2	51	140
Sediment Dam South 3	37	100
Sediment Dam South 4	130	350
Sediment Dam West 1	146	400
Sediment Dam West 2	176	480
Total	2,471	3,580

Table 28 Simulated Inflows and Outflows to Water Management System

Inflows	Outflows
Direct rainfall on water surface of storages	Evaporation from water surface of storages
Catchment runoff	CHPP demand
Groundwater inflows	Dust suppression demand
Raw water supply	Vehicle wash down
	Offsite spills from storages

A statistical analysis of the resultant 92 realisations was then undertaken to assess the behaviour of the various storages over extended dry and wet periods.

The Australian Water Balance Model (AWBM) was relied upon to simulate catchment runoff inflows to the mine water management system. Separate AWBM model parameters were developed for the following catchment types:

- Natural (undisturbed catchments and fully rehabilitated overburden);
- Compacted areas (haul roads, pit floor, mine infrastructure); and
- Overburden (non-rehabilitated OEAs).

The model parameters adopted for compacted areas provide a volumetric runoff coefficient similar to an urban catchment with similar characteristics. The AWBM model parameters for OEAs were selected based on known runoff values for mine catchments in the Hunter Valley.

Further detail of modelling assumptions and calibration can be found in **Appendix S**.

Final Void Water Balance

The OPSIM model was used to assess the likely long term water level behaviour and salt balance of the final void. The historical rainfall and evaporation sequences were looped numerous times to create a long term climate record. A salinity of 800 mg/L for runoff from the rehabilitated catchment area draining to the final void and a salinity of 3,000 mg/L for groundwater inflows were adopted. It should be noted that the majority of surface runoff catchment is diverted away from the final void and into Watermark Gully. Long term groundwater inflow quality to the final void was provided by AGE groundwater consultants.

Surface Runoff Salinity Assessment

The OPSIM model was used to undertake an assessment of the likely impact of the Project on the salt load released to receiving waters as surface flow. Representative salinities (expressed as TDS) were assigned to runoff from various catchment types, as well as groundwater inflows to mining areas and raw water imported to the mine site. The adopted salinities for the different sources of water were based on an assessment of seepage water quality undertaken by Terrenus Earth Sciences (see appendix to **Appendix T** and **Section 7.1**). Terrenus Earth Sciences assessed seepage water quality based on a series of Static and Kinetic Leach Column Tests completed by RGS as part of the Geochemical Assessment of Overburden/ Interburden and Coal Reject Materials.

To assess the impacts of the Project on the receiving water salt balance, the OPSIM model was run as a static simulation. For the static simulation, each stage of mine development was modelled separately from the other stages, over the full historical climatic data set (1889 to 2010).

7.3.3 Impact Assessment

The potential surface water impacts of the Project include:

- Requirements for offsite water supplies;
- Uncontrolled spills;
- Impacts on surface water quality in the local and regional watercourses; and
- Loss of catchment areas.

Static Simulated Water Balance

Table 29 provides the long term daily average water balance for the Project for Year 2, Year 5, Year 10, Year 15, Year 21, Year 25 and Year 30.

The annual volumes of makeup water required vary for each year of operation from the 92 realisations modelled. During wet years, it may be possible to obtain all water requirements for the mining operations from local runoff and groundwater inflows. However, during average and dry years it is predicted that annual volumes up to 600 ML will be required to supplement the mine water supplies to ensure a reliable source of water to the CHPP.

Where water from external sources is required, WALs will be obtained under the relevant WSP (see **Section 7.3.4**).

Forecast Simulated Water Balance

The forecast simulation results found that the Main Dam would generally remain in equilibrium under median (50%) conditions, so as to allow for water to be pumped into it from the active pits. If the Main Dam storage capacity is exceeded, mining could be affected by pit inundation. In this regard, the forecast simulation identified the following:

- There is a 90% chance that the maximum pit inundation volume during the 30 year mine life will be at least 920 ML;
- There is a 50% chance that the maximum pit inundation volume during the 30 year mine life will be at least 1,690 ML; and
- There is a 10% chance that the maximum pit inundation volume during the 30 year mine life will be at least 2,330 ML.

Shenhua Watermark will actively manage the water retained in-pit during the Project. This will involve a dedicated pumping team and a daily review of water transfer requirements and usage, so as to reduce the amount of water retained in-pit. There are also other options available to manage in-pit water and continue mining operations, albeit at a lower intensity.

In extreme cases, Shenhua Watermark will utilise coal and interburden barrier pillars to separate active mining and inundated areas. As one area is mined, the water would be transferred into it, so as to allow mining to proceed in the area which was previously inundated (and vice versa). Mining operations would continue in this manner until the in-pit water is cleared. This method may be required following extreme rainfall events whilst mining within the Eastern Mining Area.

As mining proceeds to the Southern and Western Mining Areas, any surplus in-pit water (under the extreme wet conditions described above) would be transferred to the Eastern or Southern Mining Areas as they are in the process of being backfilled and rehabilitated and still maintain available areas of temporary water storage.

If the above strategies still necessitate active management to reduce in-pit water (under the extreme wet conditions described above), new areas would be excavated ahead of mining for temporary water storage (in accordance with the conceptual mine plan and within the Disturbance Boundary). Any dust emissions in this regard would be mitigated by the wet conditions and thus, Shenhua Watermark would still ensure all air quality predictions are met. Mining operations would also be curtailed as required.

External Water Supply

The forecast simulation results identified (consistent with the static simulated water balance) that during average and dry years, annual volumes up to 600 ML will be required to supplement the mine water supplies to ensure a reliable source of water to the CHPP. The forecast simulation found the following in this regard:

- There is a 50% chance that:
  - A total volume of at least 170 ML of offsite supplies will be required to supply operational demand in the first year;
  - A total volume of at least 143 ML of offsite supplies will be required to supply operational demand in Year 7; and
  - Approximately 20 - 40ML of offsite supplies will be required per year in Year 2 to Year 4 and Year 11 to Year 30.

Table 29 Long Term Daily Average Water Balance

Source	Source Description	Volume (ML/yr)						
		Year 2	Year 5	Year 10	Year 15	Year 21	Year 25	Year 30
Water Inputs								
Rainfall/runoff yield	Dirty water system	552	511	529	544	562	558	587
	Active mining area	378	485	634	629	399	606	359
	Turkeys Nest Dam	16	16	16	16	16	16	16
	Sediment dams	239	331	309	471	830	486	508
Total rainfall/runoff yield		1,185	1,342	1,487	1,660	1,807	1,666	1,470
Groundwater inflow to mining areas		0	14	57	43	175	371	132
Gross water inputs		**1,185**	**1,356**	**1,545**	**1,702**	**1,982**	**2,037**	**1,602**
Water Outputs								
Evaporation	Dirty water system	472	361	404	444	486	476	554
	Active mining area	39	21	75	101	70	113	209
	Turkeys Nest Dam	37	37	37	37	37	37	36
	Sediment dams	23	17	31	62	106	48	99
Total evaporation		570	436	548	643	699	674	898
Storage overflows (offsite)	Dirty water system	0	0	0	0	0	0	0
	Active mining area	0	0	0	0	0	0	0
	Turkeys Nest Dam	0	0	0	0	0	0	0
	Sediment dams	55	61	56	111	307	145	224
Total overflows		55	61	56	111	307	145	224
Net loss from CHPP		205	760	760	745	760	760	224
Vehicle wash down		5	5	5	5	5	5	5
ROM bin dust suppression		15	55	55	54	55	55	11
Stockpile dust suppression		10	37	37	37	37	37	7
Haul road dust suppression		342	150	189	174	156	393	266
Gross Water outputs		**1,203**	**1,504**	**1,650**	**1,769**	**2,020**	**2,069**	**1,555**
Water Retained (Onsite)								
Net inventory	Dirty water system	13	13	14	14	13	12	11
	Active mining area	9	1	7	12	4	21	52
	Turkeys Nest Dam	0	0	0	0	0	0	0
	Sediment dams	2	0	2	5	6	3	4
Gross water retained (onsite)		25	14	23	31	23	37	67
External water required (gross water deficit)		**43**	**162**	**128**	**98**	**61**	**68**	**21**

- There is at least a 10% chance (90th percentile results) that:
  - A total volume of 580 ML, at most, of offsite supplies will be required to supply operational demand in Year 5 and Year 7; and
  - 30 ML, at most, of offsite supplies will be required per year at the end of mine life (Year 28 to Year 30).
- There is 1% chance (99th percentile results) that:
  - A total volume of approximately 900 ML to 920 ML of offsite supplies will be required per year to supply operational demand between Year 5 to Year 17; and
  - Less than 230 ML of offsite supplies will be required per year for the last 4 years of mine life.

In order to access the required external water supplies, one or more electric pump stations (or possibly a licensed bore field) and an associated water pipeline will be constructed on Shenhua Watermark owned land to transfer water from Groundwater Management Zones or unregulated surface water sources to the Main Dam. Any water transfer would be conducted in accordance with the rules of the relevant WSPs. The pipelines and the pump station to Mooki River as shown on **Figure 9** may also be utilised as required, in accordance with the relevant licences.

Shenhua Watermark will continue to assess the feasibility and reliability of external water supply options during the development approval and construction phase of the Project. This will include establishing bores within the potential bore field on Shenhua Watermark owned land (in accordance with the relevant approvals) and conducting pumping and yield tests to determine water reliability and quantity. Any relevant licences would be sought as required in this regard.

As discussed in **Section 4.4.5**, Shenhua Watermark has undertaken a comprehensive study of the water licences which are available or issued for each of the water sources from which water will be taken as a result of the Project (**Table 26**). As shown in **Table 26**, the AWD since 2006 for all water sources was the maximum entitlement (i.e. 1:1), even during drought periods. The water licences study discussed in **Section 4.4.5** demonstrates the ability for the Project to obtain the necessary water access licences and security for the external water supply on an open market.

Uncontrolled Spills

Based on the configuration and capacity of the proposed water management system, there will be no uncontrolled offsite spills from mine water storages, including the Main Dam.

As described in **Section 7.3.1**, sediment-laden runoff will be collected and treated in sediment dams. The forecast simulation identified the potential for spills from the sediment dams throughout the life of the Project. However, Shenhua Watermark will ensure that if the quality of this water is not suitable for release to receiving waters, it will be pumped back into the mine water management system. This water will only be released from site if water quality is acceptable, or during a significant rainfall event that exceeds the design capacity of the sediment control system and will sufficiently dilute the water. **Section 7.3.4** provides further details on the proposed management of sediment-laden water.

Loss of Catchment Area

During the life of the Project, there is a potential for the reduction of catchment flows to surrounding waterways, including the Mooki River, Watermark Gully, Native Dog Gully and Lake Goran. A reduction in catchment area will decrease the volume of stormwater runoff. This will consequently result in a reduction of flood discharges. The maximum captured catchment areas during the Project represent:

- Less than 1% of the Mooki River catchment to the confluence with Watermark Gully;
- Approximately 17% of the catchment area of Watermark Gully to the Kamilaroi Highway;
- Approximately 29% of the catchment of Native Dog Gully; and
- Less than 0.4% of the catchment to Lake Goran.

At the completion of mining, surface runoff from rehabilitated OEAs will be released offsite. An area of approximately 108 ha, which originally drained to Lake Goran, will continue to drain to the final void of the Western Mining Area. The final landform at the completion of the Project will have the following impacts:

- The catchment draining north via Watermark Gully will increase by 5.2 km^2 (13%);
- The catchment draining to Lake Goran will be reduced by 6.0 km^2 (less than 0.5%), in practical terms, this will have no measureable impact on inflows to the lake;
- The catchment draining north to the Mooki River floodplain will be increased by 1.4 km^2; and
- The catchment draining south to Native Dog Gully and the Mooki River floodplain will be reduced by approximately 1.6 km^2 (2%).

Water Quality and Salinity

The water management system will be designed and operated to minimise the impacts of the Project on downstream water quality. Wherever possible, runoff from undisturbed areas will be diverted around the Project using diversion drains. This will minimise the volume of water collected in onsite storages and the impacts on downstream catchments.

Runoff will be collected, treated in sediment dams and released offsite. If the quality of this water is not suitable for release into receiving waters, it will be pumped back into the water management system for reuse.

Table 30 provides a summary of the salt balance for the pre-mine catchments and selected stages of the mine life. The model results show that the total average salt load released offsite in surface runoff is not significantly increased by the Project. The maximum total average salt load of 65.7 t/day occurs in Year 30 of the Project and represents an increase in the pre-mine salt load of about 0.8%.

The salt load released to Native Dog Gully is not significantly affected by the Project. The salt load drops by about 10% in Year 15.

The salt load released to Watermark Gully (including other unnamed tributaries draining north to the Mooki River) is reduced by 4% in Year 5 and Year 15. The salt load to Watermark Gully increases by 4% and 30% in Year 25 and Year 30 respectively. This represents a likely upper limit of the salt load impact since the quality of surface runoff from rehabilitated areas is likely to improve over time.

Final Void

The OPSIM model shows that the final void in the Western Mining Area will reach an equilibrium water level of approximately 280 to 290 m AHD, which is approximately 20 to 30 m below the overflow level of 310 m AHD. Based on the adopted model assumptions, salinity will slowly rise over time at a rate of approximately 5,000 mg/L per 150 years. In reality, the salinity of runoff inflows is expected to decrease over time, resulting in a slower rate of salinity rise than indicated by the model results.



Table 30 Long Term Average Surface Water Salt Balance

Source	Year (t/day)				
	Existing	5	15	25	30
Watermark Gully					
Catchment runoff	2.4	2.2	2.2	2.1	2.4
Sediment dam overflows	0.0	0.1	0.1	0.4	0.7
Total	2.4	2.3	2.3	2.5	3.1
Native Dog Gully					
Catchment runoff	3.0	2.7	2.4	2.7	2.8
Sediment dam overflows	0.0	0.2	0.3	0.2	0.2
Total	3.0	2.9	2.7	3.0	3.0
Lake Goran					
Catchment runoff	59.9	59.9	59.9	59.8	59.6
Sediment dam overflows	0.0	0.0	0.0	0.0	0.0
Total	59.9	59.9	59.9	59.8	59.6
Gross offsite salt load	**65.2**	**65.1**	**64.9**	**65.2**	**65.7**

7.3.4 Mitigation and Management

Surface Water Monitoring

The current surface water monitoring network will continue to be implemented through the life of the Project along with the development of a Water Management Plan. At commencement of operations, the surface water monitoring program will be expanded to include samples from key storages within the water management system, such as sediment dams and the primary mine water storages. The parameter suite and sampling frequency for surface water monitoring will be initially undertaken in accordance with the current monitoring program and then refined over time in accordance with the mine site's regulatory approved Water Management Plan.

Sediment and Erosion Control

As part of the EMS for the Project, a Sediment and Erosion Control Management Plan will be prepared in accordance with *Managing Urban Stormwater, Soils and Construction* (Landcom, 2004) and *Managing Urban Stormwater, Soils and Construction, Volume 2E Mine and Quarries* (DECC, 2008). The design of sediment control measures will be based on the principle of ensuring that runoff from disturbed areas is separated from clean area runoff and collected in sediment dams for treatment.

Sediment dams will be partially dewatered within five days after a runoff event to provide free storage capacity of at least the settling zone volume. Where the TSS concentration in sediment dams after a runoff event is less than the selected water quality objective, sediment dams may be dewatered to receiving waters with the appropriate licences. Where TSS exceeds the water quality objective, water will be:

- Pumped to another water storage with available capacity;
- Pumped in to the water management system; or
- Flocculated to reduce TSS to less than the water quality objective.

Minimising erosion of OEAs is important in establishing a stable final landform. The final rehabilitated OEAs will include contour drains, which direct runoff across the emplacement slope at non-erosive velocities, and rock-lined chutes to convey inflows from contour drains down the face of the emplacement. Rock chutes will discharge to a sediment dam to reduce suspended sediment concentrations.

Water Licensing Requirements

The Project will require up to 600 ML annually of water from external sources to supply operational demands during dry periods. One or more electric pump stations (or possibly a licensed bore field) and an associated water pipeline will be constructed on Shenhua Watermark owned land to transfer water from Groundwater Management Zones or unregulated surface water sources to the Main Dam. The pipelines and the pump station to Mooki River as shown on **Figure 9** may also be utilised as required, in accordance with the relevant licences. This will supplement water supplies required for the CHPP. Gravel access tracks and powerlines will also be constructed to enable the ongoing operation and maintenance of the pump stations or bore field.

As discussed in **Section 7.1.4**, Shenhua Watermark is in discussions with a number of Water Access Licence holders for acquisition of their share component. As discussed in **Section 4.4.5**, Shenhua Watermark has undertaken a comprehensive study of the water licences available or issued for each of the water sources from which water will be taken as a result of the Project. This study demonstrated the ability for the Project to obtain the necessary water access licences on an open market to authorise the take of water by the Project.

7.4 Flood

7.4.1 Background

A Flood Study was undertaken by WRM as part of the Surface Water Impact Assessment and is provided in **Appendix S**. The purpose of the assessment was to assess the potential of the Project to interact with flood flows along Watermark Gully and the Mooki River, thereby representing local and regional flood regimes.

7.4.2 Methodology

Mooki River

The RAFTS runoff routing model was used to estimate flood discharges along the Mooki River catchment based on design rainfall Intensity–Frequency–Duration data from *Australian Rainfall and Runoff* (IEAust, 1998). Design flood discharge hydrographs were estimated for a range of storm durations up to 72 hours for the 5, 10, 20, 50 and 100 year Average Recurrence Interval (ARI) events. The discharges estimated by the RAFTS model were reconciled with discharges estimated by flood frequency analyses at two gauging locations within the Mooki River catchment.

The TUFLOW fully two-dimensional hydrodynamic model was used to estimate design flood levels and velocities along the Mooki River and its floodplains, including Native Dog Gully, for the 100 year ARI event. TUFLOW estimates flood levels and velocities on a fixed grid pattern by solving the full two-dimensional depth averaged momentum and continuity equations for free surface flow.

Watermark Gully

The RAFTS runoff routing model was used to estimate the 2, 5, 10, 20, 50 and 100 year ARI design event flood discharges along Watermark Gully. In the absence of historical stream gauge data, the model was calibrated by matching peak discharges with discharges estimated using the Rational Method. A separate RAFTS model was developed for pre-mining conditions and Year 30 of the Project life to provide a representation of the reduction in the catchment area.

The Hydrologic Engineering Centres River Analysis System (HEC-RAS) hydraulic model was used to estimate the design flood extents, levels and velocities along Watermark Gully to the Kamilaroi Highway for pre-mining conditions and Year 30 of the Project life.

The OPSIM model was used to simulate the flow duration relationship for Watermark Gully for pre-mining conditions, for the maximum catchment area impact (Year 30) and for post-mining conditions. To assess the effects of varying climatic conditions, the model was run for 92 realisations with each realisation corresponding to the 30 year Project life through the 122 years of historical climatic data. A statistical analysis of the resultant 92 realisations was then undertaken to assess the behaviour of the various storages over extended dry and wet periods.

7.4.3 Impact Assessment

Mooki River

Figure 35 shows the extent of flooding and the flood depths for the 100 year ARI design flood. Under a 100 year ARI design flood event along the Mooki River, a small area at the south-east corner of the Disturbance Boundary will be inundated to a depth of up to 1.7 m. The area of inundation is located in a backwater area with very low flow velocities of less than 0.1 m/s. Placement of overburden on this small area will not affect flood behaviour on the floodplain; however, it will reduce the flood storage by approximately 235 ML. This represents 2% of the flood storage volume in the northern Native Dog Gully floodplain, part of the larger Mooki River floodplain, during a 100 Year ARI event.

A shaped levee embankment may be required to be constructed within the Disturbance Boundary to prevent flooding of the mining areas. A flood model simulation of this levee confirmed that the construction of such a levee has the potential to increase flood levels in the adjacent floodplain by less than 5 mm.

The remaining area within the Disturbance Boundary will be flood free during a 100 year ARI design flood event along the Mooki River. Therefore, the Project will not impact flood behaviour on the Mooki River floodplain.

Watermark Gully

Figure 36 shows the 100 year ARI flood event in Watermark Gully under predicted pre-mining conditions. The Project will impact Watermark Gully through a reduction in the contributing catchment area by approximately 25% consequently affecting the magnitude and frequency of flows along the watercourse. Under all catchment configurations, Watermark Gully is dry for approximately 98% of the time. In Year 25, the maximum reduction in associated catchment area will be reached resulting in a 1 percentile low flow of 15.8 ML/day at the downstream boundary. This is a decline of 10.7 ML/day from the pre-mining flow conditions. Following cessation of mining, the catchment area draining to Watermark Gully will exceed pre-mining conditions increasing the 1 percentile flow to 31.6 ML/day.

There is a measurable change in the flow-duration relationship for Watermark Gully given the high variability of runoff in natural watercourses in the area. However, it is considered unlikely that these flow frequency changes will significantly alter the hydraulic characteristics of Watermark Gully, which will readjust to the altered flow regime.

A Geomorphology Impact Assessment on Watermark Gully has been undertaken by GHD (see **Appendix X** and **Section 7.5**).

In addition, the Project will partially fill the main channel in the upper reaches of Watermark Gully for the development of the OEA associated with the Western Mining Area. This will result in a relocation of the main channel further to the east. Detailed design of the channel cross section in the modified reach will be undertaken as part of the detailed design phase to provide a stable channel configuration. The general principles of the design will be to mimic the natural channel features, as far as practical and to convey frequent flows at non-erosive velocities. A preliminary concept for the diversion of a reach of Watermark Gully was considered in this assessment. In Year 30, flood levels along Watermark Gully will generally decrease due to the reduction in catchment area. Flood levels will only increase in the upper reaches, with the 2 year ARI, 100 year ARI and Probable Maximum Flood levels increasing by up to 0.65 m, 0.88 m and 1.24 m respectively. These impacts occur on land owned by Shenhua Watermark.

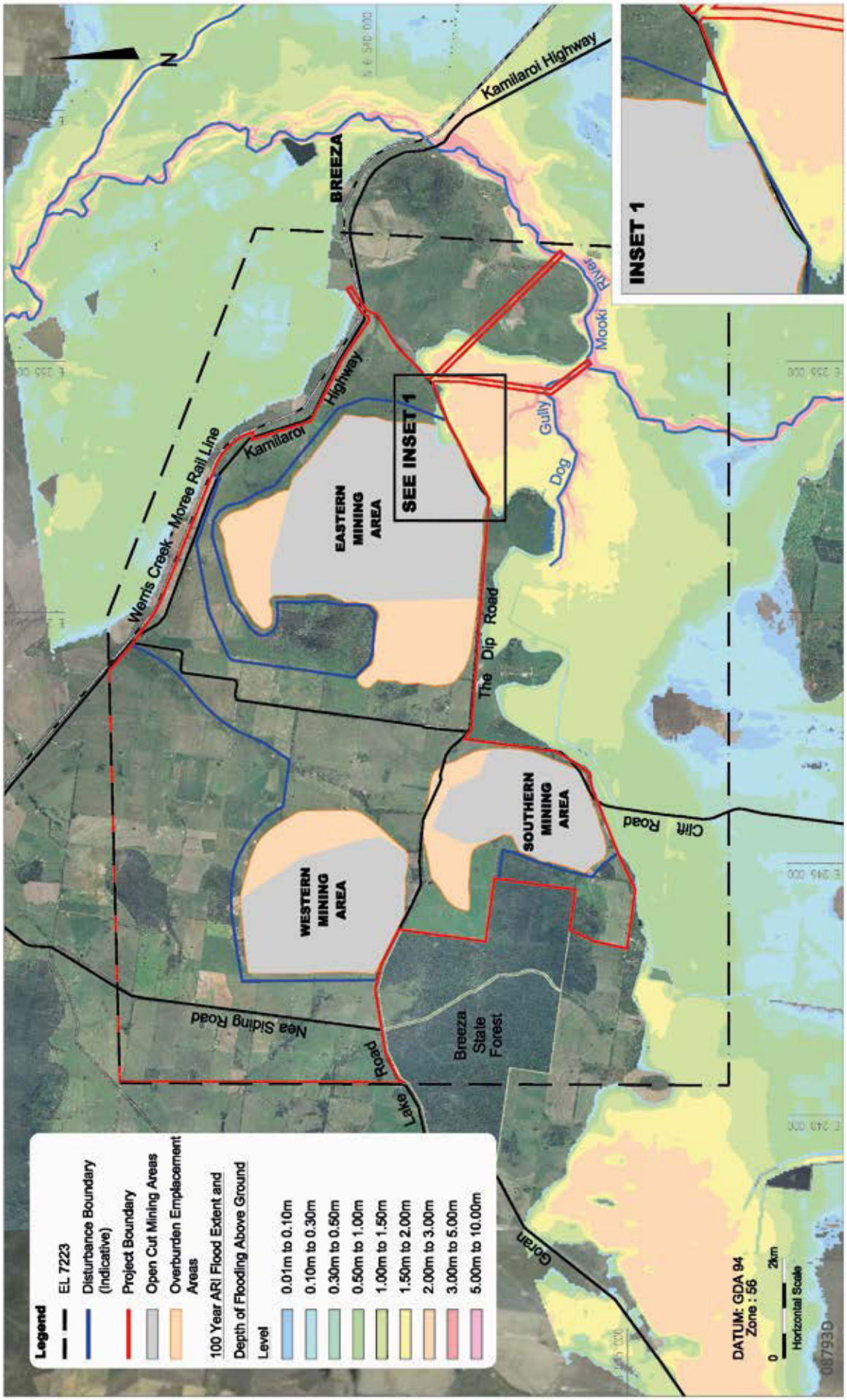
7.4.4 Mitigation and Management

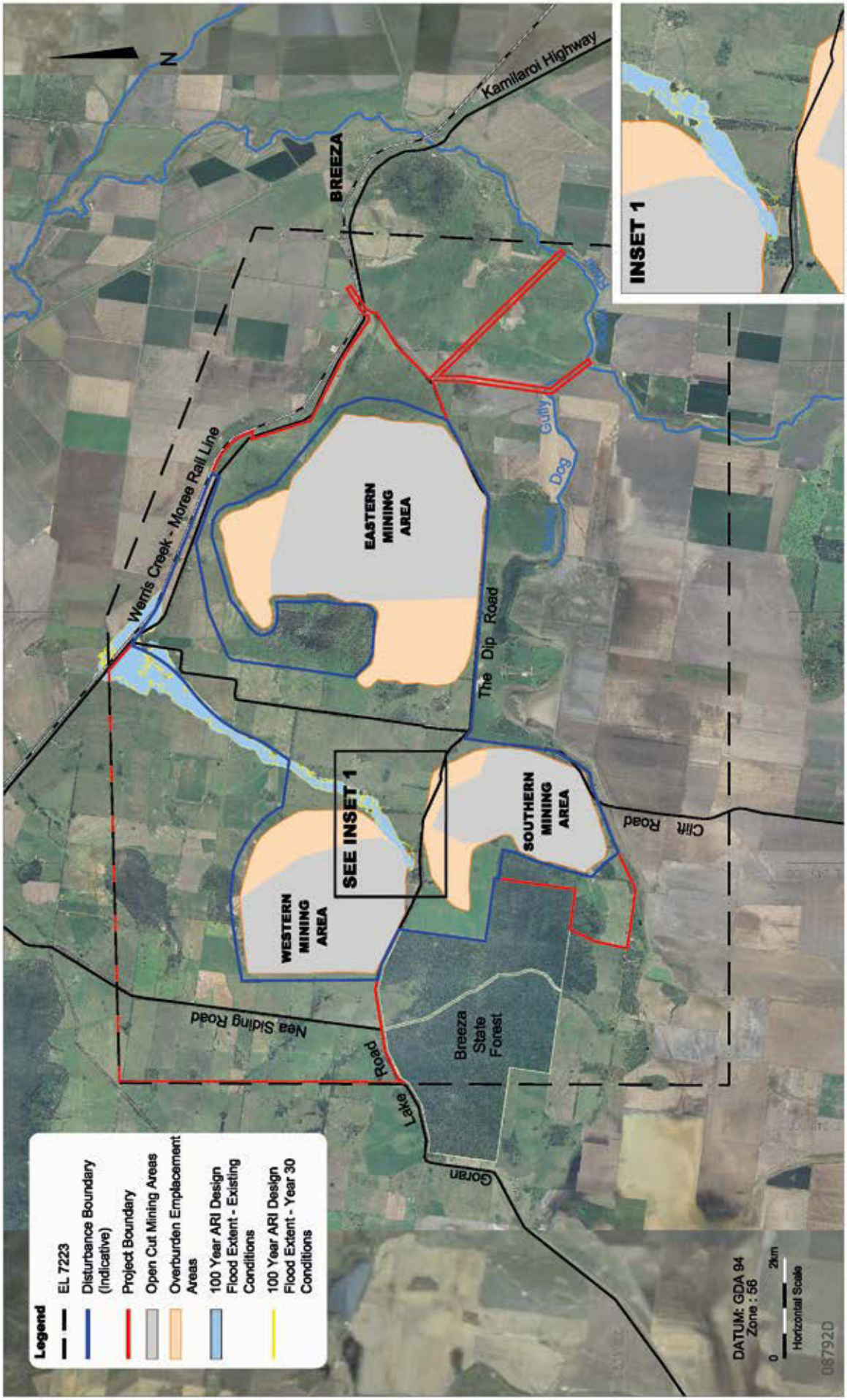
The water management system will segregate clean runoff, dirty runoff, mine water and contaminated water generated from rainfall events and mining operations as well as ensuring no uncontrolled discharges from mine site storages.

Design of the site drainage infrastructure, such as clean and dirty water diversion drains, as well as erosion and sediment control measures, will be based on the recommended design standards in *Managing Urban Stormwater, Soils and Construction* (Landcom, 2004) and *Managing Urban Stormwater, Soils and Construction, Volume 2E Mines and Quarries* (DECC 2008a) (see **Section 7.3**).

Changes in flow velocity and flood levels will be accommodated in the detailed design of the site drainage system. Limited and minor flood levees will be constructed as required in potential inundation areas, in accordance with the relevant approvals.




WATERMARK COAL PROJECT
Flood Modelling - Mooki River
FIGURE 35
Hansen Bailey
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INSET 1
SEE INSET 1
N
BREEZA
Kamilaroi Highway
Werris Creek - Moree Rail Line
Kamilaroi Highway
EASTERN MINING AREA
WESTERN MINING AREA
SOUTHERN MINING AREA
Mooki River
Gully
Dog
The Dip Road
Cliff Road
Nea Siding Road
Breeza State Forest
Lake Road
Goran
Legend
EL 7223
Disturbance Boundary (Indicative)
Project Boundary
Open Cut Mining Areas
Overburden Emplacement Areas
100 Year ARI Flood Extent and Depth of Flooding Above Ground
Level
0.01m to 0.10m
0.10m to 0.30m
0.30m to 0.50m
0.50m to 1.00m
1.00m to 1.50m
1.50m to 2.00m
2.00m to 3.00m
3.00m to 5.00m
5.00m to 10.00m
DATUM: GDA 94
Zone : 56
0
2km
Horizontal Scale



WATERMARK COAL PROJECT

Flood Modelling - Watermark Gully

FIGURE 36

Hansen Bailey | ENVIRONMENTAL CONSULTANTS

7.5 Geomorphology

7.5.1 Background

A Geomorphology Impact Assessment was undertaken by GHD Pty Ltd (GHD) and is provided in **Appendix X**. The purpose of the assessment was to characterise the type, geomorphic condition and stream order of watercourses within EL 7223, determine the potential impacts of the Project on the geomorphology of these watercourses and recommend measures to mitigate and manage these impacts.

7.5.2 Methodology

Desktop Assessment

A desktop assessment was undertaken to map and characterise the geomorphology of watercourses within EL 7223. The assessment involved a review of geographic information system data, aerial imagery and the Surface Water Impact Assessment prepared for the Project (see **Appendix S**).

The geomorphology of each watercourse was assessed in accordance with:

- The Strahler stream classification system (Strahler, 1952), which defines stream order based on a hierarchy of tributaries;
- The River Styles framework (Brierley and Fryirs, 2005), which describes physical form and function of watercourses; and
- The *Definitions of Geomorphic Condition Categories for Streams* (Outhet and Cook, 2004).

Field Assessment

A field assessment was undertaken to validate the findings of the desktop assessment, including:

- Geomorphic type and condition of waterways;
- Nature, location and extent of waterway instabilities;
- Nature and location of waterway controls (e.g. bedrock and logs); and
- Nature of channel and bedload materials.

In addition, the banks of the Mooki River were inspected at the proposed pump station site to identify any potential impacts on geotechnical stability.

7.5.3 Impact Assessment

Three primary watercourses were identified within the Project Boundary, including Watermark Gully, Native Dog Gully and the Mooki River. These watercourses are classified as first and second order streams, with exception of the downstream reach of Native Dog Gully and the Mooki River, which are third and fourth order streams, respectively (see **Figure 2**).

Each watercourse is characterised by a number of the four stream types, including undefined drainage lines, low sinuosity, fine grained systems, channelised fill systems and valley fill systems.

Undefined drainage lines are ephemeral, very slight depressions without a defined channel. This stream type is geomorphologically stable with no visible signs of erosion or instability. This stream type is not associated with local floodplains and has often been altered by agricultural activities and contour banks. Undefined drainage lines occur along the upstream extent and to the east and west of Watermark Gully.

Low sinuosity, fine grained systems exhibit a low sinuosity channel surrounded by continuous floodplains. The banks of this stream type are relatively cohesive and stable due to the presence of fine grained materials. During periods of low rainfall, the stream type typically holds isolated pools of water. Low sinuosity, fine grained systems occur along the Mooki River and the downstream reach of Watermark Gully and Native Dog Gully.

Channelised fill systems are generally laterally stable channels of low sinuosity incised within flat and featureless floodplains. During periods of high flow, unprotected banks are prone to erosion. This stream type occurs along the upstream reaches of Native Dog Gully and the upstream and central reaches of Watermark Gully and some associated tributaries.

Valley fill systems are relatively flat, featureless valley floor surfaces, lacking a continuous, well defined channel. Typically, the substrate comprises of fine alluvial silts and muds vertically deposited out of suspension as flow velocity decreases. Valley fill systems occur along some tributaries of Native Dog Gully, sections of Watermark Gully and some associated tributaries and the Mooki River.

Due to historical disturbances associated with agricultural practices, the watercourses within EL 7223 generally have a poor to moderate geomorphic condition with the exception of the downstream extent of Watermark Gully, which is in good geomorphic condition.

As each mining area advances over the life of the Project, there will be minor losses to the catchments draining Watermark Gully, Native Dog Gully and the Mooki River. This will result in minor changes to the flow regime and the capacity for sediment transportation (see **Section 7.3**). As the predicted reduction is minimal when compared to the overall catchment area of each watercourse, the impact on associated geomorphic processes will generally be negligible with the exception of a section of Watermark Gully.

Additionally, following the cessation of mining, catchment areas and geomorphic processes will largely be restored.

The eastern extent of the Western Mining Area encroaches on a section of Watermark Gully. This is predicted to alter or impede the existing flow regime of Watermark Gully potentially causing erosion along the channel and increased sediment deposition upstream.

A pump station may be constructed on the Mooki River to supply water to the Project. The banks of the Mooki River are composed of alluvial silt materials and highly prone to bank erosion. Without appropriate bank stabilisation measures, construction of the pump station may exacerbate existing erosion issues within the localised area. However, no significant change in stream form and functioning is expected.

The Project will also require temporary or permanent waterway vehicle crossings for access purposes. The construction of these crossings has the potential to exacerbate bed and bank instability in localised areas along the relevant watercourses if not carefully planned and designed.

7.5.4 Mitigation and Management

To minimise the impacts of the Project on the geomorphology of watercourses identified in EL 7223, the following mitigation and management measures will be implemented:

- Erosion controls will be established on the river bank in the vicinity of the pump station(s) on the Mooki River, if constructed. These controls will be outlined in the Sediment and Erosion Control Management Plan;
- A Channel Diversion Plan (a component of the overarching Water Management Plan) will be developed for the portion of Watermark Gully directly affected by the Western Mining Area;
- Temporary and permanent vehicle crossings will be appropriately designed and constructed over straight portions of waterways to minimise the risk of erosion;
- Vehicle crossings will be designed and constructed in a manner to avoid impeding on watercourse flows and minimise vegetation clearing;
- Watercourse flows will not be redirected or concentrated on crossing outlets. Where this is not possible, appropriate scour protection will be provided; and
- Areas disturbed for construction activities will be revegetated as soon as practical following construction to minimise erosion.



7.6 Air Quality

7.6.1 Background

An Air Quality and Greenhouse Gas Impact Assessment was completed by PAEHolmes and is provided in **Appendix G**. The purpose of the assessment, in part, was to predict the Project's air quality impacts on receivers in the vicinity of the Project and to recommend measures to mitigate and manage these impacts.

7.6.2 Methodology

Meteorological Data

Meteorological data was examined from two monitoring stations within Shenhua Watermark's existing EMP and a BoM monitoring site at Tamworth Airport. Data from these sources were compiled for use in a meteorological monitoring program known as CALMET to provide a full year (November 2010 to November 2011) of representative data for the purposes of modelling the Project.

Background Air Quality

As part of the existing EMP, Shenhua Watermark conducts air quality monitoring at the locations shown on **Figure 8**. Data from these sites has been collected since 2010. The network consists of 13 deposited dust gauges and six HVAS, which are used to collate a comprehensive dataset for the following particulates:

- TSP;
- PM_{10}; and
- $PM_{2.5}$.

Two Tapered Element Oscillation Microbalances (TEOMs) are scheduled to be installed for the Project in 2013.

A detailed review of all available background monitoring data from the Shenhua Watermark air quality monitoring network was completed for the Project and is provided in **Appendix G**. The review concluded that:

- 24-hour PM_{10} concentrations remain generally below the EPA air quality criterion of 50 micrograms per cubic metre ($\mu g/m^3$). Experience shows that the worst-case 24-hour PM_{10} concentrations are strongly influenced by regional dust sources, such as bushfires and dust storms;
- Annual average PM_{10} concentrations remain well below the EPA criterion of 30 $\mu g/m^3$;
- 24-hour $PM_{2.5}$ concentrations remain generally below the *Ambient Air Quality National Environment Protection Measure* (Ambient Air-NEPM) (NEPC, 2003) Advisory Reporting Standards of 25 $\mu g/m^{3;}$
- Annual average $PM_{2.5}$ concentrations remain below the Ambient Air-NEPM Advisory Reporting Standards of 8 $\mu g/m^3$;
- Annual average TSP concentrations remain well below the EPA criterion of 90 $\mu g/m^3$; and

- Annual average deposited dust levels at all monitoring locations are generally below the EPA criterion of 4 g/m^2/month with the exception of one dust deposition gauge (DM5), which had a high annual average of 8.3 g/m^2/month. For this location, there were a number of months during 2010 where high dust depositional levels were recorded, likely as a result of a localised temporary dust source from agricultural activities. Dust deposition levels in subsequent years, at this location, were significantly lower and below the assessment criterion.

Existing background levels of nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and carbon monoxide (CO) have been collected from the EPA monitoring stations at Wallsend, Newcastle, Beresfield, Muswellbrook and Singleton since November 2010. These monitoring stations are the closest available to the Project Boundary. Although distant from the Project Boundary, this data provides an indication of the pollutant levels currently experienced in highly populated and industrial settings and thus application of this data for the Project ensures this assessment is conservative. At all monitoring locations, where data was available, background levels of NO_2, SO_2 and CO were well below the EPA impact assessment criteria.

Background NO_2 levels at all five monitoring stations were well below the EPA 1-hour average impact assessment criterion of 246 μg/m^3. The maximum hourly concentration recorded at the Muswellbrook site was 94 μg/m^3. It is noted that the Muswellbrook site is located within a high population density area and also within proximity to various Hunter Valley mines such as Bengalla and Mt Arthur Coal.

Background SO_2 levels at all five monitoring stations were well below the EPA 1-hour average impact assessment criterion of 570 μg/m^3. The Wallsend, Newcastle and Beresfield sites show very low SO_2 concentrations over the monitoring period typically below 100 μg/m^3. The maximum concentrations recorded at the Singleton and Muswellbrook sites were 237 μg/m^3 and 415 μg/m^3 respectively. Higher concentrations at these sites than around Newcastle are expected due to the number of coal-burning power stations in the area.

Background CO levels were collected at the EPA monitoring station at Newcastle. Out of the five stations discussed above, this was the only one that had available CO data. The CO concentrations measured at the Newcastle site were well below the 8-hour average impact assessment criterion of 10 mg/m^3. The maximum value recorded was 1.8 mg/m^3 which occurred in June 2011.

The assessment of air quality impacts for the Project requires consideration of the contributions from other local sources, including traffic along major transport routes, domestic wood fires, local unsealed roads and exposed areas.

Assessment Criteria

Air quality modelling for the Project has been prepared in accordance with the procedures outlined in the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (Approved Method) (DEC, 2005a). **Table 31** and **Table 32** summarise the air quality assessment criteria relevant to the Project. Generally, these air quality criteria relate to the total dust burden in the air and not just the dust generated by the Project. As such, consideration of background levels needs to be made when using these criteria to assess impacts.

In addition to the consideration of possible health impacts, airborne dust also has the potential to cause nuisance impacts by depositing on surfaces. **Table 32** shows the maximum acceptable increase in dust deposition over the existing dust levels. The criteria for dust fallout levels are set to protect against nuisance impacts on a cumulative basis from all dust sources (DEC, 2005a).

The Approved Methods criteria are typically consistent with the Ambient Air-NEPM (NEPC, 1998). In May 2003, the Ambient Air-NEPM was amended to include Advisory Reporting Standards for $PM_{2.5}$. The purpose of the amendment was to gather sufficient data nationally to facilitate the review of the Ambient Air-NEPM, which is currently underway. The Ambient Air-NEPM $PM_{2.5}$ advisory reporting standards are not impact assessment criteria (see **Table 33**).

Table 34 summarises the air quality criteria for concentrations of NO_2, SO_2 and CO that are relevant to the diesel fume and blast assessments for the Project. NSW EPA has not set any air quality goals for nitric oxide (NO).

Air Quality Modelling

Air dispersion modelling conducted for the Project was based on an advanced system of models, including TAPM and CALMET / CALPUFF. Modelling was undertaken for Years 1, 2, 5, 10, 15, 21, 25 and 30 of the Project. These representative years were identified as the periods most likely to contain the worst case dust levels from a range of mining activities in various locations within the Project Boundary. They were selected to ensure the maximum potential impacts associated with wind erosion, mining intensity, coal and overburden haulage were modelled, including the transition between mining areas.

The conceptual mine plans and operational schedules for the Project have been used to determine haul road distances and routes, the location of stockpile and open cut mining areas, activity operating hours, truck sizes, blasting activities and other details that are necessary to predict dust emissions for each modelled year. A full inventory of emission sources is outlined in **Appendix G**.

The dispersion model was used to predict the maximum 24-hour PM_{10} concentrations (Project only), annual average PM_{10} concentrations, 24-hour $PM_{2.5}$ concentrations (Project only), annual average $PM_{2.5}$ concentrations, annual average TSP concentrations and annual average dust deposition concentrations. In addition, the potential cumulative impacts of dust emissions from other neighbouring sources were assessed. A separate, hypothetical sensitivity cumulative analysis including a conceptual Caroona Coal Project was undertaken and is presented in **Appendix G**.

Blast Fume Assessment

In order to estimate the potential NO_2 concentration at private receivers, CALPUFF dispersion modelling was completed at 14 of the closest private residences to the Project. The largest blast size was modelled with a release height of 20 m, and an initial vertical spread of 10 m to give an equivalent plume height of 40 m.

The nitrogen oxide (NO_x) emissions from the blast, which comprises both NO and NO_2, were calculated based on data presented in the Queensland Guidance Note for the *Management of Oxides in Open Cut Blasting* (DEEDI, 2011). There is currently no NSW guidance document regarding the management of oxides during open cut mining blast events. The initial NO_2 concentration in the plume was converted to a total NO_x emission rate based on a detailed measurement program of NO_x in blast plumes in the Hunter Valley made by Attalla et. (2008). It was assumed that the blast emissions will be present for a 10-minute period and only occur between the hours 9:00 am and 5:00 pm, where blasting is permitted. It is important to note that the modelling assumes blasting could take place on any day of the week, when in reality blasting may only occur Monday to Saturday and not on Sunday and public holidays, consistent with ANZECC guidelines and similar project approvals.

Diesel Fume Assessment

In order to estimate the impact of diesel fume emissions from the Project at the private receptors, CALPUFF dispersion modelling was completed for Years 1, 5, 10, 15, 21, 25 and 30 at 14 of the closest private residences to the Project.

7.6.3 Impact Assessment

Air Quality Predictions – Construction Phase

An assessment of emissions generated from construction activities confirmed that with utilisation of standard operational management and mitigation techniques, the construction phase of the Project will have negligible impacts on air quality. Further, these activities will remain within the air quality predictions for the operation of the Project.

Air Quality Predictions – Operations Phase

Figure 37 illustrate the predicted air quality contours for annual average TSP concentrations, annual average dust deposition concentrations, annual average PM_{10} concentrations and annual average $PM_{2.5}$ concentrations in relation to neighbouring private receivers for all modelled operation years.

Table 35 presents the maximum air quality impacts predicted at each private receiver.

The results from the dispersion modelling indicate that the Project considered alone and cumulatively with other sources is not predicted to contribute to exceedances of the annual average TSP, dust deposition, PM_{10} and $PM_{2.5}$ criteria at privately owned receivers (within 5 km of the Project) over the life of the Project. The Caroona Village and Walhallow Aboriginal community are over 9 km from the Project and as such, are also are all expected to receive dust concentrations within the relevant criteria.

Table 31 Particulate Matter Assessment Criteria

Pollutant	Criteria ($\mu g/m^3$)	Averaging Period	Agency
TSP	90	Annual mean	National Health and Medical Research Council
PM_{10}	50	24-hour maximum*	OEH
	30	Annual mean	OEH

** Applies for each of i) Project alone and ii) cumulative, provided the Project is implementing best practice dust controls.*

Table 32 Dust Deposition Assessment Criteria

Pollutant	Averaging Period	Maximum Increase in Deposited Dust Levels (g/m^2/month)	Maximum Total Deposited Dust Levels (g/m^2/month)
Deposited Dust	Annual mean	2	4

Table 33 Advisory Reporting Standards for $PM_{2.5}$

Pollutant	Averaging Period	Standard / Goal ($\mu g/m^3$)	Agency
$PM_{2.5}$	Annual mean	8	Ambient Air-NEPM Advisory Reporting Standards
	24-hour average	25	

Table 34 Air Quality Criteria for Nitrogen Dioxide, Carbon Monoxide and Sulphur Dioxide

Pollutant	Standard	Averaging Period	Source
NO_2	246 $\mu g/m^3$ (0.12 ppm)	1-hour	EPA Impact Assessment Criteria
	62 $\mu g/m^3$ (0.03 ppm)	Annual	
CO	10 mg/m^3 (9 ppm)	8-hour	
SO_2	570 $\mu g/m^3$ (0.2 ppm)	1-hour	
	228 $\mu g/m^3$ (0.08 ppm)	24-hour	
	60 $\mu g/m^3$ (0.02 ppm)	Annual	

ppm: parts per million

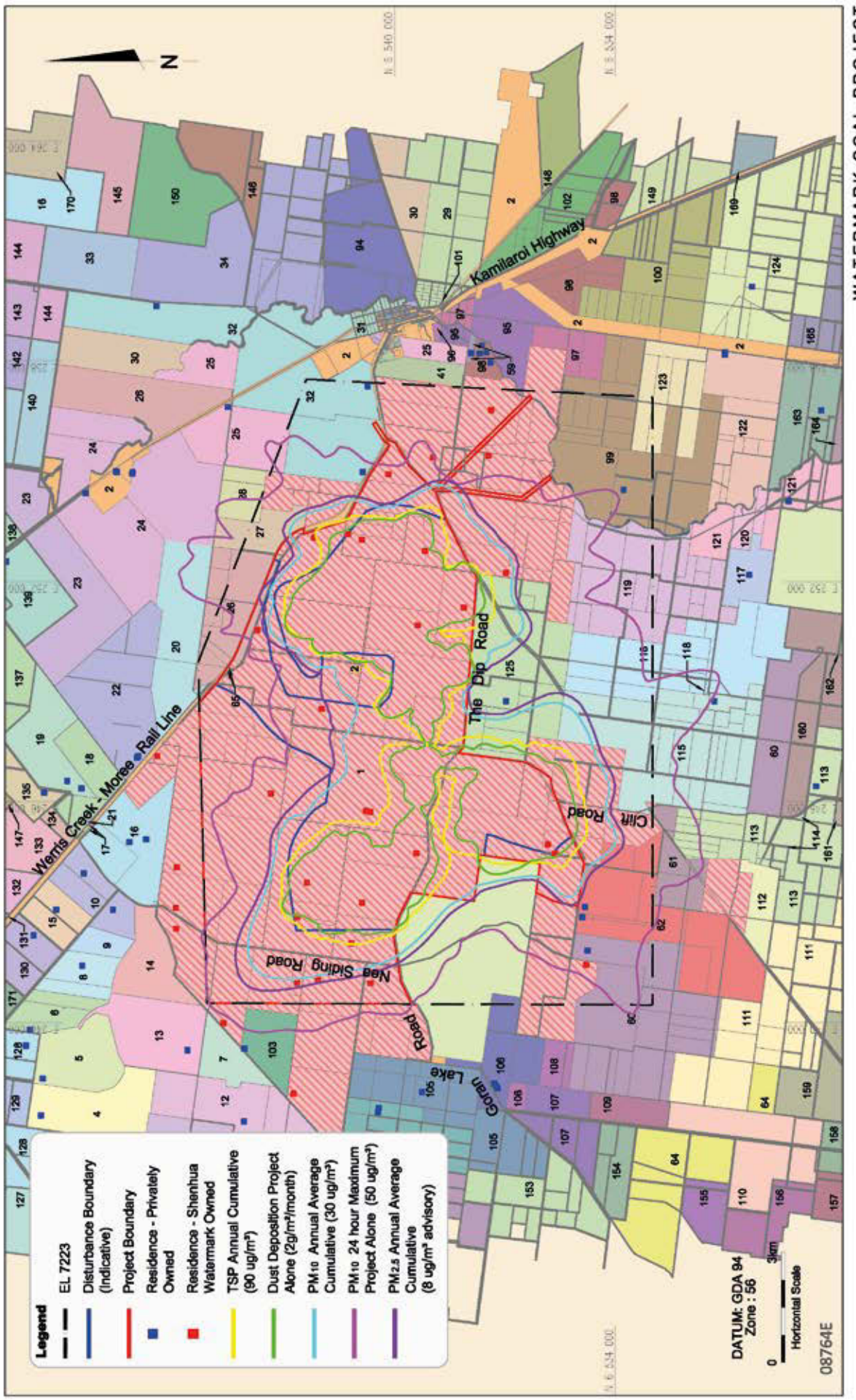

WATERMARK COAL PROJECT
Indicative Air Quality Contours (Worst Case Envelope All Years)
FIGURE 37
N
Kamilaroi Highway
Wenis Creek - Moree Rail Line
The Dip Road
Cliff Road
New Siding Road
Goran Lake Road
Legend
EL 7223
Disturbance Boundary (Indicative)
Project Boundary
Residence - Privately Owned
Residence - Shenhua Watermark Owned
TSP Annual Cumulative (90 ug/m³)
Dust Deposition Project Alone (2g/m²/month)
PM10 Annual Average Cumulative (30 ug/m³)
PM10 24 hour Maximum Project Alone (50 ug/m³)
PM2.5 Annual Average Cumulative (8 ug/m³ advisory)
DATUM: GDA 94
Zone : 56
0
3km
Horizontal Scale
087664E
Hansen Bailey
ENVIRONMENTAL CONSULTANTS

Table 35 Maximum Modelled Air Quality Impacts for Privately Owned Receivers, All Years

Receiver	PM_{10}		$PM_{2.5}$		TSP		Dust Deposition	
	24 hour Project Alone (Days per year above criteria)	Annual – Project & other sources	24 hour Project Alone	Annual – Project & other sources	24 hour Project Alone	Annual – Project & other sources	Annual – Project Alone	Annual – Project & other sources
	50 $\mu g/m^3$	30 $\mu g/m^3$	25 $\mu g/m^3$	8 $\mu g/m^3$	-	90 $\mu g/m^3$	2 g/m^2/month	4 g/m^2/month
2a	26	14	3	6	3	28	0.1	2
2b	26	14	3	6	3	28	0.1	2
2c	40	14	5	6	4	29	0.03	2
2d	40	14	5	6	4	29	0.03	2
3	29	14	4	6	4	29	0.1	2
4	16	14	2	6	3	28	0.1	2
5	16	14	2	6	3	28	0.1	2
6	15	14	2	6	3	28	0.1	2
8	15	14	2	6	3	28	0.1	2
10a	14	14	2	6	3	28	0.1	2
10b	15	14	2	6	4	29	0.1	2
12	21	16	3	6	5	30	0.1	2
13	32	19	4	6	10	35	0.2	2
14	30	18	4	7	9	34	0.2	2
15	11	14	1	7	3	28	0.1	2
16a	21	15	3	6	4	29	0.11	2
16b	24	15	3	6	5	30	0.11	2
19a	22	15	3	6	5	30	0.13	2
19b	23	15	3	6	5	30	0.13	2
22a	30	16	4	7	7	32	0.2	2
22b	30	17	4	7	7	32	0.2	2
24a	43	15	6	6	4	29	0.03	2
24b	43	15	6	6	4	29	0.03	2
24c	37	15	5	6	4	29	0.03	2
25a	27	15	4	6	4	29	0.1	2
25b	**57** (1 day)	15	7	6	4	29	0.1	2
32a	28	13	4	6	2	27	0.02	2
32b	31	15	4	6	5	30	0.1	2
32c	**82** (5 days)	20	11	7	13	38	0.3	2
35	27	14	4	6	4	29	0.1	2
36a	27	14	4	6	4	29	0.1	2
36b	27	14	4	6	4	29	0.1	2
38	26	14	3	6	3	28	0.1	2
39	32	15	4	6	4	29	0.1	2
40	29	14	4	6	4	29	0.1	2
41	31	15	4	6	4	29	0.1	2
44	29	14	4	6	4	29	0.1	2
45	28	14	4	6	4	29	0.1	2
47	28	14	4	6	4	29	0.1	2
48	28	14	4	6	4	29	0.1	2
51	27	14	4	6	4	29	0.1	2
52	27	14	4	6	4	29	0.1	2
54	29	14	4	6	4	29	0.1	2

Receiver	PM_{10}		$PM_{2.5}$		TSP		Dust Deposition	
	24 hour Project Alone (Days per year above criteria)	Annual – Project & other sources	24 hour Project Alone	Annual – Project & other sources	24 hour Project Alone	Annual – Project & other sources	Annual – Project Alone	Annual – Project & other sources
	50 $\mu g/m^3$	30 $\mu g/m^3$	25 $\mu g/m^3$	8 $\mu g/m^3$	-	90 $\mu g/m^3$	2 g/m^2/month	4 g/m^2/month
59	33	15	4	6	4	29	0.1	2
60	**80 (7 days)**	18	11	7	9	34	0.1	2
62a	**172 (36 days)**	25	22	8	20	45	0.3	2
62b	**148 (26 days)**	24	19	8	17	42	0.2	2
63	23	14	3	7	3	28	0.1	2
66	22	14	3	6	3	28	0.1	2
72	23	14	3	6	3	28	0.1	2
78	24	14	3	6	3	28	0.1	2
82	23	14	3	6	3	28	0.1	2
83	23	14	3	6	3	28	0.1	2
85	24	14	3	6	3	28	0.1	2
86	25	14	3	6	3	28	0.1	2
88	25	14	3	6	4	29	0.1	2
90	23	14	3	6	3	28	0.1	2
91	22	14	3	6	3	28	0.1	2
93	23	14	3	6	3	28	0.1	2
98a	36	15	5	6	4	29	0.1	2
98b	35	15	4	6	4	29	0.1	2
98c	32	14	4	6	4	29	0.1	2
98d	35	15	4	6	4	29	0.1	2
99	48	15	6	6	5	30	0.1	2
103	40	20	5	6	12	37	0.2	2
104a	22	14	3	7	3	28	0.1	2
104b	27	15	3	6	4	29	0.1	2
105	29	15	4	6	4	29	0.1	2
106a	19	14	2	6	3	28	0.01	2
106b	20	14	3	6	3	28	0.1	2
106c	19	14	3	6	3	28	0.01	2
113	24	14	3	6	3	28	0.1	2
115	48	15	6	6	4	29	0.1	2
117	28	14	4	6	3	28	0.1	2
121	15	13	2	6	2	27	0.03	2
122a	15	13	2	6	2	27	0.02	2
122b	15	13	2	6	2	27	0.02	2
124	9	13	1	6	1	26	0.02	2
125	**107 (19 days)**	23	14	7	19	44	0.4	2
128	15	14	2	7	3	28	0.1	2
130	10	14	1	6	2	27	0.1	2
135	19	15	3	6	4	29	0.11	2
139	26	15	3	6	4	29	0.03	2
163	13	13	2	6	1	26	0.02	2
171	12	13	2	6	2	27	0.1	2

Note: a, b, c refers to multiple residences on the one property

The 24-hour average PM_{10} concentrations present the maximum air quality levels predicted from the operation of the Project at any location. Of the Shenhua-owned receptors, only 1e, 1f and 1g were predicted to exceed the maximum 24-hour average PM_{10} criteria and in Year 25 only.

There are six private receivers (on five properties) that are predicted to experience exceedances of the assessment criterion (50 $\mu g/m^3$) between one and 36 days per year due to operations of the Project alone. These maximum impacts represent the worst case operation of the Project under adverse prevailing weather conditions. It is expected that the proactive management of operations will result in modifications to operations so that these impacts will not be experienced at suggested receivers. There are a further seven properties that will experience maximum PM_{10} concentrations exceeding the 24 hour criteria of 50 $\mu g/m^3$ over an area greater than 25% of the property.

Figure 37 illustrates the predicted air quality contours for maximum 24-hour average PM_{10} concentrations in relation to neighbouring private receivers for all modelled years.

Blast Fumes

Blasting activities have the potential to result in fugitive fume and particulate matter emissions. Particulate matter emissions from blasting are included in the dispersion modelling results presented above. However there is also potential for emissions of NO_x.

A summary of the number of hours per year predicted to exceed the 1-hour average NO_2 impact assessment criteria of 246 mg/m^3 is presented in **Table 36**. It is important to note that the predicted impacts include existing background concentrations obtained from the EPA monitoring stations which are the closest to the Project. The use of this data allows for a conservative assessment.

It is apparent from **Table 36** that the vast majority of predicted impacts are significantly below the impact assessment criteria.

There are a maximum of 8 hours in a year (from a possible 2,920 available blasting hours) when the 1-hour average criterion is predicted to be exceeded, even when existing levels of NO_2 are included. As discussed in **Section 7.6.1**, the approach taken to assess the impacts is considered to be very conservative.

A review of the date and time at which the exceedances occurred showed that all the exceedances occurred between 4:00 pm and 5:00 pm when there was a rapid drop in the mixing height and hence the atmospheric stability increases, resulting in poor dispersion conditions.

As discussed in **Section 7.6.4**, management measures will be implemented to firstly minimise the potential for the formation of NO_x emissions and secondly ensure blasting does not occur under the conditions predicted to exceed the impact assessment criteria.

Diesel Combustion

Dispersion modelling of diesel fume emissions due to the Project showed that that the predicted impacts for PM_{10}, $PM_{2.5}$, NO_2 and SO_2 at all receptors were significantly below their respective assessment criteria / standard. Further, there were no additional exceedances of the criteria at the residences when the NO_2 impacts from the diesel fumes were included with the predicted impacts from blast fumes and the existing background levels.

Spontaneous Combustion

Spontaneous combustion in coal and other carbonaceous materials is the result of self-heating which can occur from an exothermic reaction such as oxidisation. Spontaneous combustion can result in the release of toxic and/or odorous gases, such as NO_2 and SO_2.

Coal and coal rejects derived from the Lower Hoskissons seam typically have a higher sulphur content, which could represent a risk for spontaneous combustion. As coal rejects will be well mixed across the operation, the small amount of coal rejects with high sulphur content will be diluted to produce a composite material thereby reducing the potential for spontaneous combustion.

Table 36 Nitrogen Dioxide Assessment

Receiver	Year 1	Year 2	Year 5	Year 10	Year 15	Year 21	Year 25	Year 30
	No. of hours per year predicted to exceed 1-hour NO_2 assessment criteria (246 $\mu g/m^3$)							
14	1	1	0	0	0	0	6	8
16b	0	0	1	1	0	0	6	2
22b	0	0	0	1	0	0	0	0
24a	0	0	0	4	1	0	0	0
25b	0	0	0	3	2	0	0	0
32b	0	1	1	4	2	0	0	0
32c	0	1	2	8	5	0	0	0
62a	0	0	0	0	0	0	0	0
98a	0	0	1	1	2	0	0	0
99	0	0	0	0	1	0	0	0
103	0	0	0	0	0	0	1	5
104b	0	0	0	0	0	0	0	0
105	0	0	0	0	0	0	0	0
125	0	0	0	0	0	3	0	0

This is described further in the Geochemistry Assessment of Overburden/Interburden and Coal Rejects Materials, which is provided in **Section 7.18** and provided in **Appendix W**. In this regard, the risk of spontaneous combustion and consequently the likelihood of NO_2 and SO_2 emissions are low.

Coal Transportation

The Project will transport product coal to the Port of Newcastle via rail for export. The fugitive dust emissions from coal wagons has the potential to cause nuisance and health impacts.

Queensland Rail commissioned an environmental evaluation of coal dust emissions from rolling stock in the Central Queensland Coal Industry (Connell Hatch, 2008). The purpose of the study was to determine the extent of the issue and identify any potential environmental harm caused by fugitive dust from coal wagons, in the context of nuisance and health impacts and to identify the potential reasonable and feasible measures that could reduce any environmental harm.

In terms of impacts on human health and amenity, the study concluded that:

- There appears to be minimal risk of adverse impacts due to fugitive coal emissions from trains throughout the network; and
- Fugitive coal dust at the edge of the rail corridor was below levels that are known to cause adverse impacts on amenity.

The findings of the study are generally applicable to the NSW rail network.

A recent report was prepared for the ARTC which assessed particulate emissions from coal trains (Environ, 2012). The study compared particulate matter (PM) emissions from coal trains (loaded and unloaded) with passenger trains and freight trains. The study found that at one site there were no statistical differences in concentrations across all particulate size fractions for all train types. At the other site, it was concluded that concentrations coinciding with loaded and unloaded coal train passes are statistically higher for PM_{10} than concentrations recorded during passenger train passes. There was no statistical difference between loaded coal trains and unloaded coal trains. It is noted that PM concentrations were recorded at 3 m from the track and for short averaging periods to coincide with train passes, therefore no assessment of impact can be inferred from the study.

ARTC manages the rail network that will be used to deliver coal from the Project to market. Emissions from ARTC operated rail lines are regulated under their EPL 3142, which includes a requirement to prepare a Pollution Reduction Program. As part of this program, ARTC are required to evaluate coal dust issues from rail transport and provide a work plan outlining how appropriate technology will be adopted to significantly reduce coal emissions from the freight rail network, in consultation with relevant stakeholders. Shenhua Watermark has and will continue to consult with ARTC in regard to the status of their Pollution Reduction Program and leading practice dust control measures.

Given the evidence and current Pollution Reduction Program in place, the Project is unlikely to cause health and amenity impacts at neighbouring receivers through coal train movements.

Potential Effects of Dust on Cotton

Due to stakeholder concerns regarding potential impacts of dust on cotton as a result of the Project, a desktop assessment has been completed by Scott Barnett and Associates Pty Ltd on this potential impact (see **Appendix Z**). This assessment stated that:

- In a previous study, CSIRO found that Australia had the lowest levels of contaminants of all crops (2006/2007) imported by an international spinning mill, with no mention of dust, dirt or sand;
- Discussions with Australian cotton industry professionals (including Australian Cotton Ginners Association, Queensland Cotton's Moura Gin, Cotton Seed Distributer Wee Waa, Auscot Warren and CSIRO Geelong) largely indicated that dust impacts on cotton was not a known phenomenon. Where there had been incidental cases of road dust on crops, it was concluded that dust was easily and effectively removed at the pre-cleaning phase of the ginning process and did not affect cotton quality; and
- Significant dust loads for extended periods of time are required for a plant to experience any adverse impacts.

Given that predicted Project dust deposition levels are significantly lower than the EPA assessment criteria; measureable effects of Project-related dust on cotton production are not anticipated.

7.6.4 Mitigation and Management

Feasible and Reasonable Air Quality Control

The air quality controls for the Project are based on recommendations of the *NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining* (Donnelly et al., 2011) (the Best Practice Report), a study that was commissioned by the NSW EPA.

Best practice management measures adopted include:

- Use of water sprays, fabric filters, cyclone and dust aprons when drilling will be employed to deliver practical and safe operations;
- Minimisation (to the extent practicable) of the drop heights from equipment associated with loading and dumping operations for coal and overburden;
- Use of speed control signage, water carts and/or suppressants to control emissions from haul roads, working areas and ROM pad;
- Delay of blasts in unfavourable weather conditions to avoid dust and blast fume emissions;
- Progressive rehabilitation to minimise exposure of disturbed surfaces;
- Adoption of the largest truck size possible within the constraints of the restricted mine plan working areas;
- Temporary seeding of overburden areas where practical;

- Application of water at the crusher and on conveyor transfer points, as required;
- Enclosing conveyor transfers points, where operationally practicable and safe;
- Design and construction of a partially enclosed ROM coal hopper;
- Combined use of water, vegetative breaks and other chemical agents at coal handling areas and stockpiles and
- The installation of a water spray / dust suppressant system at the train load out facility for use as deemed necessary.

As noted above, the largest truck size possible for the Project has been adopted so as to reduce vehicle trips and dust emissions. Selection of the truck size for the Project involved a consideration of the available working room within the active mining areas, reliability and maintenance requirements and overburden/ rehabilitation scheduling. The extent of active mining areas was deliberately restricted as far as practicable during the mine scheduling process so as to reduce the disturbed areas subject to wind erosion (which was identified as the greatest dust emitter). This in turn limited the truck sizes to those adopted for the Project.

Air Quality Monitoring Network

Real-Time Dust Monitoring

A real-time dust monitoring and management system will be installed for the Project.

As discussed in **Section 7.6.2**, Shenhua Watermark intends to install two TEOM's during 2013. The TEOMs are proposed to be located in the proximity of most impacted private receptors in Breeza and to the west of the Project Boundary. Additional real-time boundary monitoring may also be installed as required during the operational phase of the Project.

The real-time monitors will continuously log short-term dust concentrations (15-minute, 30-minute and 1-hour averages) and report the data via a global positioning system or GRSM modem to a web based recording system. When certain short-term trigger levels are reached or exceeded, a message is delivered to appropriate Project personnel, alerting them to the high dust levels. The onsite weather station(s) could also report wind conditions at the time, allowing appropriate personnel to determine the origin of the elevated dust levels.

A short-term average performance indicator (approximately 1-hour) will be set at a level that allows proactive dust management if dust levels are expected to approach the 24-hour PM_{10} impact assessment criteria in the upcoming 24 hours. During the life of the Project, should more suitable technology become available, this system may be modified and enhanced if required.

A procedural response will facilitate the day-to-day management of dust emissions triggered if the performance indicator is exceeded. The procedure will include identifying the source of excessive dust, determining the controls used to minimise dust, implementing such controls and reviewing the effectiveness of controls.

Predictive Meteorological Forecasting System

The real-time dust monitoring and management system for the Project will include a meteorological forecasting system. This system will predict meteorological conditions for the coming day to determine, one day in advance, where the risk of dust emissions may occur (e.g. based on wind speed, direction, rainfall and atmospheric stability).

The predictive meteorological forecasting system will work in conjunction with the real-time monitoring system, providing an alert for appropriate Project personnel to review the real-time data and manage the intensity of activities for that day, increase controls or limit activity to various areas of the Project Boundary. The predictive meteorological forecasting system will also assist in identifying meteorological conditions which may cause blast fume impacts.

Air Quality Management Plan

Shenhua Watermark will develop an Air Quality Management Plan for the construction and operation of the Project. The Air Quality Management Plan shall incorporate the feasible and reasonable air quality controls described above as well as additional practical air quality management including measures to facilitate first flush systems on the rainwater tanks of private receivers who are predicted to experience air quality impacts due to the Project. The plan will also include the air quality monitoring network described above.

Blast Fume

Measures to minimise or avoid imperfect blasts will be implemented in accordance with *Code of Good Practice: Prevention and Management of Blast Generated NO_x Gases in Surface Blasting* (Australian Explosives Industry and Safety Group Inc., 2011), and these measures will be incorporated into the Blast Management Plan for the Project. Similarly, fumes from blasting will be managed through:

- Formulation of explosive products to an appropriate oxygen balance to reduce the likelihood of fumes;
- Reviewing geological conditions in the formulation of blast designs;
- Reviewing ground conditions (e.g. presence of clay or loose / broken ground);
- Minimising the time between drilling and loading, and loading and shooting of the blast; and
- Consideration of meteorological conditions in blast scheduling using a predictive meteorological forecasting tool to avoid blasting in poor dispersion conditions.

7.7 Greenhouse Gas

7.7.1 Background

An Air Quality and Greenhouse Gas Impact Assessment was undertaken by PAEHolmes and is provided in **Appendix G**. The purpose of the assessment, in part, was to estimate the greenhouse gas emissions generated by the Project and recommend measures to mitigate and manage these emissions.

7.7.2 Methodology

The greenhouse gas assessment has been based upon the methods outlined in the following documents:

- *The Greenhouse Gas Protocol* (World Resources Institute and World Business Council for Sustainable Development, 2004);
- The *National Greenhouse and Energy Reporting (Measurement) Determination* (Department of Climate Change and Energy Efficiency (DCCEE, 2008); and
- The *National Greenhouse Accounts Factors July 2010* (DCCEE, 2010).

Consideration was also given to the *Guidelines for Energy Savings Action Plans* (DUES, 2005).

Three '*scopes*' of emissions (scope 1, scope 2 and scope 3) are defined for greenhouse gas accounting and reporting purposes and were considered for the Project in relation to the following greenhouse gases:

- Carbon dioxide (CO_2);
- Methane (CH_4);
- Nitrous oxide (N_2O); and
- Synthetic gases (HFC_s, SF_6, CF_4, $C2F_6$).

Emission factors are standardised and expressed as a carbon dioxide equivalent (CO_2-e) which is calculated by multiplying the individual gas emission factor by its respective Global Warming Potential.

7.7.3 Impact Assessment

The main sources of greenhouse gas emissions from the Project have been identified as resulting from electricity consumption, fugitive emissions of CO_2 and CH_4, diesel usage, and the transport and end use of the product coal. The average annual emissions from these sources for the Project are summarised in **Table 37**.

The direct greenhouse gas emissions generated by the Project (Scope 1) (0.25 million tonnes per annum (Mt) CO_2-e) represents approximately 0.04% of Australia's commitment under the Kyoto Protocol (591.5 Mt CO_2-e) and a very small portion of global greenhouse emissions. These emissions will not individually have any significant impact on global warming.

Emissions from the shipping of product coal are not included in this assessment due to the uncertainties in emission estimates, including uncertainty in future export destinations and limited data on emission factors and/or fuel consumption for ocean going vessels.

The commitment from the Australian government to reduce greenhouse gas emissions is proposed to be achieved through the introduction of the carbon pricing mechanisms. This will involve a fixed price on greenhouse gas emissions, with no cap on Australia's greenhouse gas emissions, or emissions from individual facilities. It is expected that the Project will exceed the facility threshold of 25,000 t CO_2e per annum for participation in the carbon pricing mechanisms. As such, scope 1 greenhouse gas emissions from the Project will be subject to the carbon pricing mechanism (Commonwealth of Australia, 2011).

7.7.4 Mitigation and Management

As part of the EMS for the Project, Shenhua Watermark will develop an Energy Savings Action Plan in accordance with the *NSW Energy Administration Amendment (Water and Energy Savings) Act, 2005* and the *Guidelines for Energy Savings Action Plans* (DUES, 2005). The action plan will provide reasonable and feasible measures that will be implemented to minimise the greenhouse gas emissions of the Project and to ensure it is energy efficient, including:

- Assist in the research and promotion of low emission coal technologies;
- Improving energy use and efficiency;

Table 37 Total Greenhouse Gas Emission Predictions

Activity	Emissions (t CO_2-e)^
Fuel consumption (diesel generators and mobile equipment) during construction and operation – scope 1*	4,023,572
Release of fugitive CH_4 during Project operations – scope 1*	3,024,914
Explosives consumption (ANFO) during Project operations – scope 1*	140,961
Emissions associated with the loss of carbon through vegetation clearing – scope 1*	485,391
Indirect emissions associated with electricity use – scope 2	741,576
Indirect emissions associated with the production and transport of fuels – scope 3	458,520
Emissions from coal transportation – scope 3	1,135,820
Emissions from the use and combustion of the product coal – scope 3	402,137,483

** Scope 1 emissions only are covered by the Commonwealth Government's Carbon Pricing Mechanism*
^ Emission predictions for the 30 year Project life (Commonwealth of Australia, 2011).

- Consideration of the use of alternative fuels where economic to do so;
- Ensuring mining practices minimise double handling of materials and ensuring that coal and overburden haulage is undertaken using the most efficient methods;
- Conduct regular reviews of haul road maintenance and materials used in main haul roads to reduce rolling resistance and decrease fuel consumption;
- Ongoing scheduled and preventative maintenance to ensure that diesel and electrically powered plant operate efficiently;
- Development of targets for greenhouse gas emissions and energy use and monitoring and reporting against these;
- Implementation of a detailed energy monitoring program. This will include monitoring the electricity and diesel usage on-site to identify the main sources of greenhouse gas emissions and apply appropriate reduction mechanisms where possible; and
- Assess lighting plant efficiency.

The effectiveness of these reasonable and feasible measures to reduce GHG emissions (and energy consumption) will be monitored, as Shenhua Watermark will annually estimate GHG emissions and energy consumption in accordance with National Greenhouse and Energy Reporting and Energy Efficiency Operations requirements.

7.8 Noise

7.8.1 Background

An Acoustics Impact Assessment was undertaken by Bridges Acoustics and is provided in **Appendix H**. The purpose of the assessment was to predict the Project's construction, operational and transport noise impacts on receivers in the vicinity of the Project Boundary. The assessment also recommends reasonable and feasible measures to mitigate noise impacts as well as outlining monitoring and management measures.

The assessment was conducted in accordance with the following policies and guidelines:

- The *NSW Industrial Noise Policy* (INP) (EPA, 2000) for operational and construction noise criteria;
- The *Interim Construction Noise Guideline* (ICNG) (DECC, 2009) for assessing construction noise;
- The *NSW Road Noise Policy* (RNP) (DECCW, 2011) for road traffic noise criteria and assessment procedures;
- The *Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects* (Interim Rail Noise Guideline) (DECC, 2007) for criteria and assessment procedures regarding noise from rail movements on the Werris Creek – Moree Railway Line; and
- The *Draft Rail Infrastructure Noise Guideline* (Draft RING) (OEH, 2012) for criteria and assessment procedures regarding noise from rail movements on the Werris Creek – Moree Railway Line.

7.8.2 Methodology

Introduction

Predicted noise levels at receivers within the vicinity of the Project Boundary were modelled using RTA Technology's Environmental Noise Model (ENM). ENM is considered the most appropriate choice for situations involving complex terrain, a large number of noise sources and variable weather conditions, which can influence noise propagation. The model has previously been endorsed by the EPA for assessing noise from mining developments.

Modelling was undertaken for Year 1, 2, 5, 10, 15, 21, 25 and 30 of the Project life. These representative years were identified as the periods most likely to contain the worst case noise levels. All operating scenarios included normal mining activities, coal handling and processing activities, operation of the rail loading facility, idling locomotives and operation of the product conveyor.

Noise from trains travelling along the rail spur from the loading loop to the Werris Creek to Moree Railway Line was also considered in the worst case scenarios. Additional model scenarios were used to determine construction and sleep disturbance noise levels to ensure these issues were comprehensively assessed.

The modelling also took into account the noise mitigation and management measures incorporated into the Project design (see **Section 7.8.4**). The noise control strategy adopted in this assessment is the result of seven major iterations and approximately five minor iterations involving combinations of the following strategies:

- Selection of the quietest available equipment;
- Equipment noise control, particularly for mobile mining machines;
- Noise barriers such as walls and bunds, particularly to shield noise from mining areas;
- No mining in exposed areas or areas too close to receiver properties, particularly at night; and
- Restrictions on operating hours, such as daytime-only operation.

Apart from a reduction in mining areas and restrictions in operating hours, which will have the undesired effect of sterilising coal resources, the mine plan has adopted all feasible and reasonable noise mitigation measures that are available with current technology. Further information regarding this issue is presented in **Section 3.12.8** and **7.8.4**.

Background Noise Levels

In order to define the intrusive criteria prescribed by the INP, it was necessary to determine the background noise levels for the Project's receivers.

Background noise surveys were completed at five representative receiver locations from July to December 2010 by GHD. Background noise surveys were completed in winter, autumn and summer, with spring noise surveys omitted as sufficient data had already been collected to determine representative background noise levels at each location.

Short term operator attended noise surveys were also completed by GHD at all monitoring locations and in all time periods. The attended survey identified that the main sources of noise included Kamilaroi Highway traffic, agricultural activity, aircrafts, wind, cattle, birds, insects and frogs.

These results were then evaluated in accordance with the INP assessment procedures in order to confirm existing Rating Background Levels (RBL).

Background noise monitoring completed for the Project has indicated background levels regularly occur at or below 30 dBA during all time periods (day, evening and night) at all monitoring locations. As required by the INP, an RBL of 30 dBA was adopted for all receivers and time periods within the vicinity of the Project.

Meteorological Conditions

Atmospheric conditions including temperature, relative humidity, wind speed, wind direction and vertical temperature gradient can all affect noise propagation and received noise levels at some distance from a source. The INP recommends that noise enhancing winds or temperature inversions that occur for at least 30% of the time in any season or time period should be considered when predicting noise levels.

Meteorological data for 2010/2011, which is the most recent full year for which there is high quality data, were processed in accordance with the INP to determine the prevailing weather conditions. Data was sourced from Shenhua Watermark meteorological monitoring sites WS1 and WS2. The meteorological conditions adopted are outlined in **Table 38**.

Winds and temperature inversions tend to increase noise levels for downwind receivers and the effects are cumulative. A 3 degrees/100 m temperature inversion with a 2 m/s wind from source to receiver is (according to ENM) equivalent to a strong 8 degrees/100 m temperature inversion. The weather conditions utilised in the assessment as shown in **Table 38** therefore represent strong noise enhancing conditions and will cause increased noise levels at downwind receivers compared to a 3°/100 m temperature inversion alone.

Dominant winds at night generally flow from the south and are assumed to be drainage flows caused by the regional Project setting.

To ensure the noise assessment remained conservative, assessed night weather conditions include the noise enhancing effect of drainage flows from all directions indicated by the weather stations. The evening and night periods have been combined given the similarity between prevailing weather conditions in these two time periods.

Operational Noise Criteria

The INP prescribes two criteria which apply to noise during the operations phase of the Project; intrusive criteria and amenity criteria. The intrusive criteria are 5 dBA above the background noise levels for the day, evening and night periods. The intrusive criteria are designed to limit the audibility of an industrial noise source above other noise sources. Consequently, the intrusive criteria apply to noise from the Project alone.

The amenity criteria impose a limit on the total cumulative noise produced by industrial developments in an area. The amenity criteria are determined by the nature of the area in which the receiver is located, and the level of existing industrial noise. All of the Project's receivers have been conservatively assigned to the '*rural residence*' amenity category. The amenity criteria for rural residences are 50 dBA for the day period, 45 dBA for the evening period, and 40 dBA for the night period.

The noise criteria for the operations phase of the Project are listed in **Table 39**.

Cumulative Operational Noise

Cumulative noise impacts may potentially be caused by concurrent operations of the Project and other operations within the vicinity. Cumulative noise levels have been assessed to the amenity criteria presented in **Table 39**.

Construction Noise

Construction noise levels for developments are generally assessed in accordance with the ICNG. Section 1.2 of the ICNG states it does not apply to industrial sources, including construction associated with quarrying and mining which suggests this activity be assessed under the INP. As such, the assessment for construction noise for the Project has been compared to the operational criteria provided in **Table 39**.

Sleep Disturbance

Sleep disturbance can occur when a short, sharp noise is noticeably louder than the background noise level. Historically, a sleep disturbance criterion of 15 dBA above the background noise level is adopted for the night period. Sleep disturbance criteria apply at a point 1 m outside a bedroom window during the night period and are shown in **Table 40**.

The RNP also contains guidance on noise induced sleep disturbance. The RNP states that:

- Maximum internal noise levels below 50 to 55 dBA are unlikely to awaken people from sleep; and
- One or two noise events per night, with maximum internal noise levels of 65 to 70 dBA are not likely to significantly affect health and wellbeing.

The RNP awakening criteria of 50 to 55 dBA is the noise level inside a bedroom, and is equivalent to an external noise level of 60 to 65 dBA, assuming that bedroom windows are partially opened for ventilation. Similarly, the RNP health criteria of 65 to 70 dBA are equivalent to an external noise level of 75 to 80 dBA.

Road Traffic Noise

The Project will generate traffic on the Kamilaroi Highway during the construction and operation phases of the Project. Traffic noise criteria primarily apply to operational traffic, as construction related traffic only occur for a relatively brief period compared to the life of the Project.

Criteria for road traffic noise are provided by the RNP. For receivers that currently experience noise from traffic on the Kamilaroi Highway, the criteria that applies are "*Existing residences affected by additional traffic on existing freeways / arterial / sub-arterial roads generated by land use developments*" (Situation 3 under the RNP). As a result, the relevant criteria are 60 $LA_{eq\ (15hr)}$ for the day period and 55 $LA_{eq\ (9hr)}$ for the night period. This means that the average noise level over the 15 hour day period must not exceed 60 dBA, and the average noise level over the 9 hour night period must not exceed 55 dBA.

These noise criteria apply to the cumulative noise generated by both traffic associated with the Project and traffic generated by other sources.

Rail Traffic Noise

The Interim Rail Noise Guideline prescribes noise criteria of 65 $LA_{eq\ (15hr)}$ for the day, 60 $LA_{eq\ (9hr)}$ for the night, and 85 LA_{max} at any time. This means that average rail noise levels are limited to 65 dBA and 60 dBA for the day and night periods respectively, and the loudest noise that is permissible at any moment is 85 dBA. These criteria apply to train movements on publicly owned rail lines, such as the Werris Creek – Moree Railway Line.

The Interim Rail Noise Guideline further requires that the assessment of rail traffic noise is undertaken up to where Project-related train movements represent less than 10% of all train movements. Therefore, this assessment has considered train movements (including project-related train movements) on the Werris Creek – Moree Railway Line and Main Northern Railway to the Muswellbrook junction.

Noise generated by train movements on the privately owned rail spur to be constructed as part of the Project is assessed under the INP.

Table 38 Modelled Meteorological Conditions

Atmospheric Parameter	Day				Evening / Night			
	Neutral	Prevailing Wind			Neutral	Prevailing Wind		
Wind Direction	N/A	East	South	West	N/A	East	South	South-west
Temperature (°C)	20				10			
Relative Humidity (%)	70				90			
Wind Speed (m/s)	0	3			0	2		
Temp Gradient (°C/100 m)	-2				3			
Effective Inversion (°C/100 m)	-2	5.5	5.5	5.5	3	8	8	8

Table 39 Operational Noise Criteria

Noise Criteria	Noise Criteria		
	Day 7:00 am to 6:00 pm	Evening 6:00 pm to 10:00 pm	Night 10:00 pm to 7:00 am
Rating Background level $LA_{90,15min}$	30	30	30
Intrusive criteria $LA_{eq,\ 15min}$ ($LA_{90\ +\ 5}$)	35	35	35
Amenity limit $LA_{eq,\ period}$ (INP, rural)	50	45	40
Existing industrial level	N/A	N/A	N/A
Amenity criteria $LA_{eq,\ period}$ (INP)	50	45	40

Note: Night ends, and day begins, at 8:00 am on Sundays and public holidays

Table 40 Sleep Disturbance Criteria

Noise Criteria	Noise Criteria $LA_{1,\ 1min}$, 10:00 pm to 7:00 am
Background level $LA_{90,\ 15min}$	30
Historical Criteria $LA_{1,\ 1min}$ ($LA_{90\ +\ 15}$)	45
RNP Awakening Criteria	60 to 65
RNP Health Criteria	75 to 80

Low Frequency Noise

Section 4 of the INP recommends that low frequency noise levels should be considered in the normal operational noise criteria by the addition of a 'modifying factor' to a source sound power level.

Modifying factors that are relevant to the assessment, including low frequency penalties, have been applied to the adopted sound power levels for mining and transportation equipment and the CHPP. As a result, no separate assessment of low frequency noise levels is required.

7.8.3 Impact Assessment

Construction Noise

The construction noise assessment indicates predicted construction noise levels will be within acceptable limits with the exception of Receiver 125 under all assessed weather conditions. Receiver 125 is expected to receive construction noise levels of up to:

- 39 $LA_{eq,\ 15min}$ under day neutral conditions;
- 42 $LA_{eq,\ 15min}$ under day prevailing conditions; and
- 47 $LA_{eq,\ 15min}$ under evening / night prevailing conditions.

Receiver 125 is also predicted to be affected by operational noise from the Project.

Exceedances of the assessment criteria are primarily associated with construction of the Mine Access Road, Kamilaroi Highway realignment and the rail spur.

Operational Noise

Figure 38 shows the worst case predicted noise levels for the Project for all modelled scenarios. Operational key assumptions utilised for the purposes of modelling and detailed predicted noise levels for all receivers are presented in **Appendix H**.

Predicted noise levels for operational activities include all feasible and reasonable noise management and mitigation measures (see **Section 7.8.4**). The scenarios modelled also represent select worst case scenarios with all equipment assumed to be operating under noise enhancing weather conditions. While this situation may occur occasionally, noise levels will generally be lower than the predicted levels. **Table 41** outlines the maximum predicted noise levels at all receivers during the operations phase of the Project. Where residences are not listed there is no predicted exceedance of the intrusive criteria.

A receiver is deemed to be significantly impacted if the predicted operational noise level exceeds the intrusive criteria by greater than 5 dBA. There are six receivers that will experience significant noise impact at residences (14, 32, 60, 62, 103 and 125). There are a further seven vacant properties that will be subject to significant noise impacts over an area greater than 25% of the property (20, 26, 27, 28, 61, 65 and 116).

If the predicted operational noise level exceeds the intrusive criteria by 2 to 5 dBA, the receiver is deemed to experience moderate noise impacts.

There are four receivers (13, 25, 39 and 41) that will experience moderate noise impacts at residences. There are a further three vacant properties that will be subject to moderate noise impacts over an area greater than 25% of the property (7, 114 and 119).

A receiver is deemed to experience a mild noise impact if the intrusive criteria are exceeded by less than 2 dBA. There are 13 receivers (10, 12, 16, 22, 35, 40, 43, 44, 99, 104, 105, 106, and 115) that will experience a mild noise impact at residences. There are a further six vacant properties that will be subject to mild noise impacts over an area greater than 25% of the property (21, 31, 42, 108, 112 and 118).

Cumulative Operational Noise

For the purposes of the assessment, agricultural equipment such as tractors or harvesters are not considered to be industrial noise sources. There are no existing significant sources of industrial noise in the vicinity of the Project that have the potential to contribute to cumulative noise levels at any receiver. A separate, hypothetical sensitivity cumulative analysis including the conceptual Caroona Coal Project was undertaken and is presented in **Appendix H**. The assessment found that cumulative noise levels, with simultaneous operation of the Project and the adjoining Caroona Coal Project, are unlikely to occur given the extended distance to the conceptual location of the Caroona Coal Project's surface infrastructure.

Sleep Disturbance

The predominant noise source associated with mining operations is the utilisation of diesel powered machines, which generally produce continuous noise. There are, however, some activities that can produce sharp, intermittent noises that cause sleep disturbance, such as dozers reversing and train wagon bunching on the rail spur. Given Shenhua Watermark's commitment to adopt industry best practice noise control measures for the Project (see **Section 7.8.4**), exceedances of the historical sleep disturbance criteria are unlikely to occur.

Under a worst case scenario (without noise control measures), the maximum noise levels generated by the Project in night conditions are predicted to generally be significantly less than the sleep disturbance criterion at all receivers, with the exception of residences 14, 32, 103, and 125. Residences 14, 32, 103, and 125 will also experience significant impact from operational noise (see **Table 41**).

Road Traffic Noise

The Project will generally cause an increase in road traffic noise of up to 0.6 dBA during construction and up to 0.5 dBA during operation at receivers close to the Kamilaroi Highway. The Project will also generally cause an increase in road traffic noise of up to 5.6 dBA during construction at receivers located close to Cull Road, The Dip Road, and the northern section of Clift Road due to construction works associated with the Cull Road upgrade.

An assessment of road traffic noise during construction and operational phases of the Project has concluded that the predicted worst case operational and construction traffic noise levels will remain within the 60 $LA_{eq,\ 15hr}$ traffic noise criterion at all private receivers.

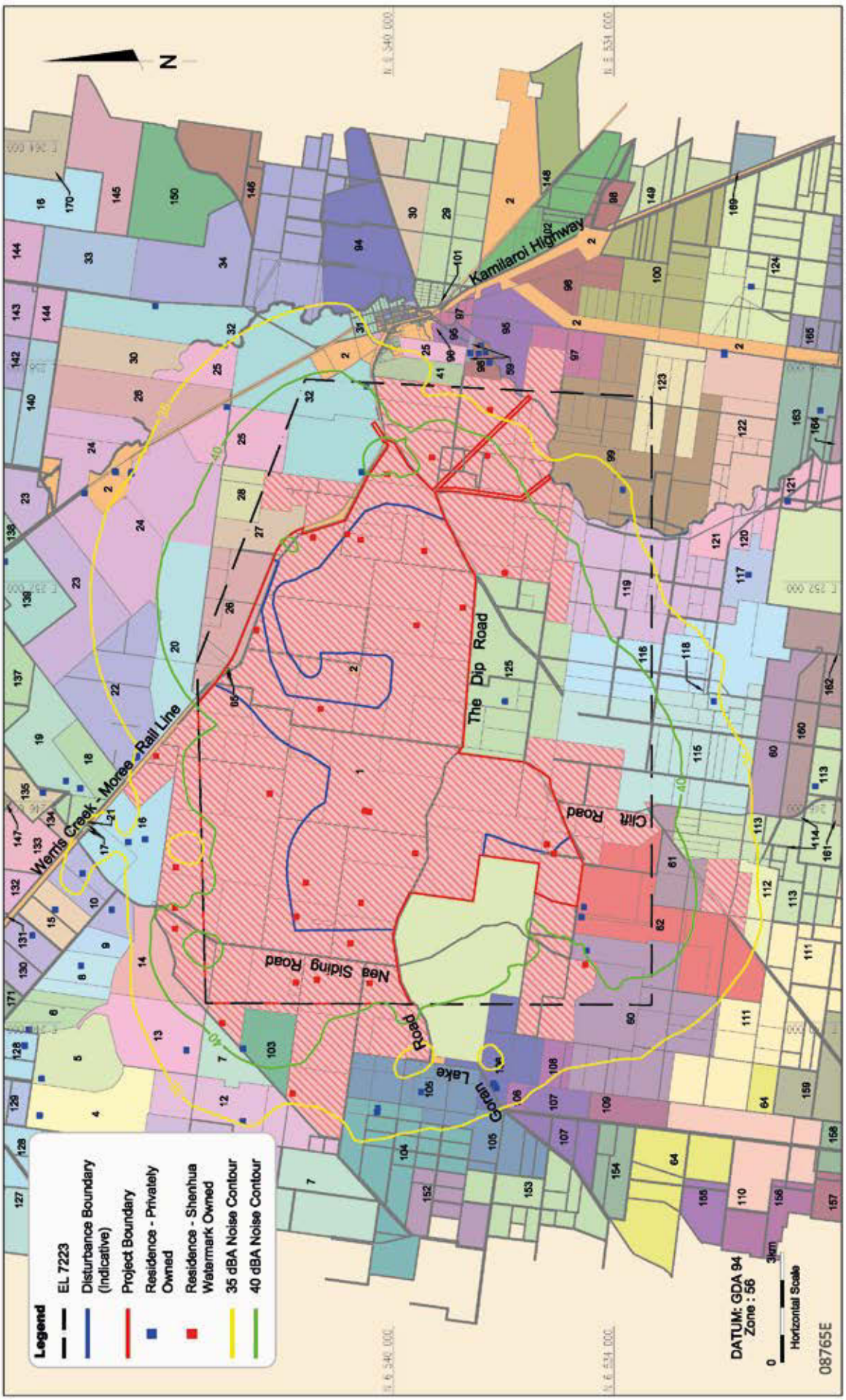

N
Kamilaroi Highway
Wemis Creek - Moree Rail Line
The Dip Road
Cliff Road
New Siding Road
Road
Gordon Lake
Legend
EL 7223
Disturbance Boundary (Indicative)
Project Boundary
Residence - Privately Owned
Residence - Shenhua Watermark Owned
35 dBA Noise Contour
40 dBA Noise Contour
DATUM: GDA 94
Zone : 56
Horizontal Scale
0
3km
087655E
WATERMARK COAL PROJECT
Indicative Noise Contours (Worst Case Envelope All Years) (Evening/Night)
FIGURE 38
Hansen Bailey
ENVIRONMENTAL CONSULTANTS

Table 41 Maximum Predicted Operational Noise Levels

Receiver	Day Neutral	Day Prevailing	Evening / Night	Intrusive Criteria ($LA_{eq, 15\ min}$)
Noise Level at Residence ($LA_{eq, 15\ min}$)				
10a	12.0	33.1	35.7	35
10b	15.0	31.0	32.2	35
12	21.6	31.8	35.4	35
13 ^	23.7	33.8	37.8	35
14 ^	25.5	36.6	**40.1**	35
16a	14.4	32.1	35.5	35
16b	15.9	32.9	36.0	35
22	18.3	32.0	35.2	35
24a	19.4	30.7	33.2	35
24b	20.8	32.1	34.9	35
25a	22.1	32.6	35.0	35
25b	21.8	33.0	38.4	35
32a	15.1	27.4	30.5	35
32b	22.3	36.3	40.0	35
32c	29.7	**42.4**	**40.9**	35
35	19.8	32.9	35.7	35
39	21.6	35.3	38.6	35
40	20.5	33.3	36.2	35
41	21.2	34.4	37.3	35
43	20.6	33.2	35.9	35
44	20.3	32.5	35.2	35
60	25.4	37.6	**40.3**	35
62a	31.5	**41.6**	**42.4**	35
62b	29.5	**40.1**	**41.5**	35
99	25.4	33.1	35.4	35
103	25.8	36.4	**40.8**	35
104	18.9	33.4	36.2	35
105	19	33.7	35.6	35
106	17.3	32.6	35.6	35
115	29.4	34.2	35.9	35
125	38.8	**45.8**	**48.2**	35
25% Continuous Vacant Land Under Contiguous Ownership ($LA_{eq, 15\ min}$)				
7	25	35.5	39.9	35
20	27.3	38.4	**42.2**	35
21	13.6	32.3	35.1	35
26	32.8	**43**	**46**	35
27	28.4	41.4	**45.7**	35
28	25.8	39.6	**44.2**	35
31	18.6	32.7	35.5	35
42	21.3	34.1	36.7	35
61	34.6	36.5	**41.8**	35
65	29.5	**40.2**	**43.7**	35

Receiver	Day Neutral	Day Prevailing	Evening / Night	Intrusive Criteria ($LA_{eq, 15 min}$)
108	16.3	32.8	35.9	35
112	25.8	29.6	35.5	35
114	31.3	32	37.5	35
116	29.8	39.5	**40.8**	35
118	28.8	35	36.8	35
119	29.2	35.6	38.7	35

Bold text denotes noise levels exceeding intrusive criteria by more than 5 dBA.
Where two houses are present on a property, the maximum noise levels predicted are presented
^ Contract exchange for purchase by Shenhua Watermark pending as at Jan 2013.

Court Lane is currently a public road and would remain a public road while being temporarily used to access the Project during construction of the Mine Access Road. It is noted that the nearest privately owned receiver is approximately 2.8 km north west of the Kamilaroi Highway intersection with Court Lane. All noise sensitive receivers would receive noise levels within INP noise criteria if the INP noise criteria were applied to Court Lane traffic noise.

Rail Traffic Noise

Noise produced by the loading of trains and train movements along the rail spur have been considered in the assessment of operational noise. The assessment of rail traffic noise considers noise generated as the train travels on the Werris Creek – Moree Railway Line and Main Northern Railway to the Muswellbrook junction (see **Section 7.8.2**).

An assessment of background rail traffic noise, considering cumulative train movements from other proposed or recently approved coal mine developments, has concluded that approximately 24 residences would currently receive noise levels over the night noise criterion or the maximum noise level criterion from existing train movements not associated with the Project. Additional background rail traffic, from known coal mining projects in the Gunnedah Basin (but excluding the Project) would result in average rail noise level exceedances of the night noise criterion at a total of approximately 39 residences. Additional train movements associated with the Project will increase train noise levels by approximately 0.6 to 0.7 dBA compared to noise from background rail traffic and will contribute towards an average noise level exceedance of 0.6 dBA above the night time criterion at three receivers located between Breeza and Willow Tree.

Maximum passby noise levels would not change as a result of the Project, as coal trains associated with the Project are assumed to produce the same maximum noise level as other coal trains.

Project-related train movements on the Main Northern Railway from Muswellbrook to the Port of Newcastle would represent less than 10% of all train movements, which is considered insignificant and does not require specific assessment according to the Draft Rail Infrastructure Noise Guideline.

Noise Levels Experienced by Livestock

Noise levels from the Project will be audible over areas of grazing land owned by Shenhua Watermark and private land owners. Predicted noise levels experienced by livestock will vary depending on the location of livestock within each property. The noise levels experienced over 25% of a property, as indicated in **Table 41**, provide an indication of typical noise levels that will be experienced by livestock (i.e. between 35 and 40 dBA).

Mining operations within the region and abroad have for many years used company-owned land within close proximity to open cut mining to raise beef cattle and operate dairy farms. This suggests that livestock are not sensitive to environmental noise. As such it is unlikely that livestock on privately owned grazing properties within the locality of the Project will be affected by noise. Similarly, livestock quickly become accustomed to vibration from blast events, which will limit the potential for impacts on livestock health.

7.8.4 Mitigation and Management

Reasonable and Feasible Noise Control

Numerous noise modelling investigations have been undertaken during the initial planning and mine plan development stages of the Project. These investigations looked at the application of various levels of noise management and control to the Project in order to minimise adverse noise impacts on neighbouring receivers. These noise controls have been considered in the modelling of the Project's operational noise levels and are provided in **Appendix H**. The key noise controls that will be implemented include:

- Fitting mobile plant with commercially available equipment modifications, to result in the lowest mobile plant sound power levels that can reasonably be achieved;
- Designing the CHPP in consideration of the potential for floor, wall and roof vibration;
- The CHPP will be clad with steel sheeting on all sides from approximately 4 m above the ground to the roof, with less than 15% of translucent sheeting on each wall to minimise noise transmission;

- The CHPP roof will be clad with steel sheeting with no more than 20% translucent sheeting and the minimum of roof vents required to provide adequate ventilation;
- Where practical and safe to do so, elevated conveyors will be enclosed;
- Regularly monitor the condition of the idler bearings and repair or replace noisy bearings to maintain the adopted conveyor sound power level;
- Design the points and crossovers on the rail loop and spur in consideration of wheel impact noise; and
- Large radius bends will be used in the design of the rail loop and spur to minimise wheel and flange noise.

Active management of equipment operating locations during periods of strong noise enhancing weather conditions will also be implemented. The active management strategy includes the following measures which were reflected in the noise model:

- Mobile machines including trucks, dozers, graders and water carts will operate on elevated and exposed sections of the OEA during the day and early evening and on lower and more shielded sections of the OEA during the sensitive night period;
- In-pit haul roads will be located in acoustically shielded areas where possible;
- Out of pit haul roads will be located as far from sensitive receivers and through low elevation and shielded areas where possible;
- During the sensitive night periods, mining machines (excavators and shovels) will work below the natural ground level. Vegetation clearing, topsoil stripping, stockpiling and rehabilitation will be completed during the day; and
- During evening and night, drilling and drill pad preparation will occur at least 6 m below the natural surface.

Additional noise control options, beyond those listed above, were considered but have not been adopted due primarily to the technical limitations of each option. This is described in detail in **Appendix H**.

In particular, a day-only or day and evening-only operation was considered. Restricting mining activity to the day only will require an increase in the equipment fleet to compensate for the lack of evening and night production. As the day covers 11 hours of a 24 hour period, approximately double the number of mining machines will be required to maintain the annual production rate. In principle, doubling the number of machines will result in an increase of 3 dBA at all receivers. As a result, predicted noise levels for day-only operation will be similar to, or slightly higher than, the night noise levels. Daytime-only operation will therefore increase the number of residences and properties affected by noise from the Project.

Restricting mining activity to the day and evening period will also require an increase in the equipment fleet. As the day and evening cover 15 hours of a 24 hour period, a 60% increase in the number of mining machines will be required to maintain the annual production rate. In principle, such an increase in the number of machines will result in an increase of 2 dBA at all receivers during the day and evening. Day and evening operation will therefore cause increased noise levels to receivers during these time periods and will increase the number of residences and properties affected by noise from the Project.

The day-only option will result in one additional affected residence and the same number of affected properties, while the day and evening-only case will result in a significant increase in the number of affected residences and properties. These results clearly indicate restricted working hours will not provide an acoustic benefit to receivers and thus, have not been implemented as part of the Project.

As discussed in **Section 3.12.4**, a reduction in the intensity of mining during the night, with a corresponding reduction in annual production to avoid an increase in day and evening noise levels, was also considered. A moderate 3 dBA reduction in night noise levels would result from two out of four mining fleets remaining idle during the night, with a resulting reduction of approximately 50 full time equivalent staff, a loss of revenue of $144 – $184 Million per annum and loss of government royalties from an estimated reduction of 1.47 Mtpa of product coal per annum.

A significant noise reduction of 6 dBA in night noise levels would result from three out of four mining fleets remaining idle during the night, with a resulting reduction of approximately 75 full time equivalent staff, a loss of revenue of $233 - $297 Million per annum and loss of government royalties from an estimated reduction of 2.38 Mtpa of product coal per annum.

Rail Traffic Noise

ARTC manages the rail network that will be used to deliver coal from the Project to market. Noise emissions from ARTC operated rail lines are regulated under their EPL 3142, which includes a requirement to prepare a Pollution Reduction Program to minimise noise emissions. In accordance with EPL 3142, ARTC are required to monitor locomotive noise levels, audit noise performance of locomotives, maintain an environmental hotline and implement all reasonable and feasible noise mitigation and management measures to reduce rail noise impacts. Shenhua Watermark has and will continue to consult with ARTC in regard to the status of their Pollution Reduction Program and leading practice noise control measures.

Further, Shenhua Watermark will procure and utilise the quietest rolling stock where practicable and utilise scheduling opportunities where possible to minimise train movements during the more sensitive night time periods.

Construction Noise Management Plan

Construction activities, primarily associated with construction of the Mine Access Road, Kamilaroi Highway realignment and the rail spur, are predicted to cause exceedances of the night time intrusive criteria at receiver 125. As such, a Construction Noise Management Plan will be developed by Shenhua Watermark, which will include the following construction noise criteria and management measures:

- Noise criteria for each time period;
- Time restrictions for noisy activities such as heavy earthmoving, rock or concrete removal and concrete pouring;
- Scheduling of quieter activities, such as installation of mechanical and electrical equipment and excavation using small machines in the evening and night; and
- A construction noise monitoring program will be implemented, addressing evening and night activities, to identify any noise sources that may exceed relevant noise criteria. The program will include a communication protocol and response protocol to maximise the effectiveness of the noise surveys and to minimise the potential for ongoing exceedances of the noise criteria (particularly at receiver 125).

Noise Monitoring Program

Ongoing monitoring will be undertaken to confirm the predicted noise levels. Shenhua Watermark will develop a noise monitoring network surrounding the Project Boundary, which is representative of the closest receivers, and will include:

- A weather prediction system to identify potentially noise enhancing weather conditions up to 24 hours in advance;
- A noise prediction system, linked with the weather prediction system, to provide advanced warning of potential exceedances of relevant noise criteria and advice regarding available equipment relocation options;
- Real time noise monitors will be deployed in representative receiver areas or at reference locations closer to the Project to enable ongoing noise management. Data from the real time noise monitors will be transmitted to an onsite office or control room for monitoring and action. A Triggered Action Response Plan (TARP) will be developed and implemented as part of the updated noise management plan to detail the actions required upon detection of noise levels over the intrusive criteria, taking into account factors such as time of day, equipment operating locations and weather conditions;
- Quarterly operator attended noise monitoring will occur at a minimum of four locations during normal mining operations to confirm Project noise levels. The monitoring locations will vary from time to time as the mine progresses and will be reviewed annually. Noise surveys will include two non-consecutive 15 minute noise measurements, and associated observations to identify and quantify dominant sources of noise during the day, evening and night at each location; and
- Results from real time noise monitoring and quarterly noise surveys will be reported annually in the Annual Review.

Operational Noise Management Plan

As part of the EMS for the Project, a Noise Management Plan will be developed by Shenhua Watermark, which will include active noise management strategies which will vary from year to year as the mine plan progresses.

The Noise Management Plan shall incorporate the feasible and reasonable noise controls described above as well as additional practical noise management initiatives, including:

- Vehicle warning devices (e.g. reverse alarms, horns and start alarms) will be selected and installed to produce the lowest possible noise levels consistent with safe operation;
- Mobile and coal handling equipment will be maintained in good condition to minimise unnecessary noise;
- Acoustic shielding, including earth bunds, where such shielding is potentially effective;
- Specific measures for the rail load-out system to minimise noise from this activity, including measures to minimise or avoid train wagon bunching noise during train movements; and
- Notification will be provided to all landholders listed in **Table 41** that are predicted to exceed the relevant assessment criteria.

Upon written request from a private landholder predicted to receive noise impacts (as shown in **Table 41**), Shenhua Watermark will install noise mitigation measures at the receiver where no Private Agreement is in place. Such measures will be undertaken in consultation with the landholder in accordance with the conditions of Development Consent.

For all other privately owned receivers not listed in **Table 41**, proactive and reactive noise minimisation practices will be implemented to ensure that the Project does not exceed the intrusive noise criteria.

7.9 Blasting

7.9.1 Background

An Acoustics Impact Assessment was undertaken by Bridges Acoustics and is provided in **Appendix H**. The purpose of the assessment, in part, was to predict the Project's blasting impacts on receivers in the vicinity of the Project Boundary, and to recommend measures to mitigate and manage these impacts.

The assessment was conducted in accordance with the following policies and guidelines:

- The *Technical Basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration* (Blasting Guideline) (ANZECC, 1990) for blasting criteria; and
- The *Assessing Vibration – a Technical Guide* (Vibration Guideline) (DEC, 2006) for ground vibration criteria and assessment procedures.

In conjunction with the Acoustics Impact Assessment, a Blasting Impacts on Landforms and Slopes assessment was undertaken by SCT Operations Pty Ltd (SCT) and is provided in **Appendix I**. The purpose of the assessment was to identify the risks associated with mining activities, including blasting, on sensitive sites, landforms and slopes in each mining area, and recommend measures to mitigate and manage these risks.

7.9.2 Methodology

The Acoustics Impact Assessment calculated the likely ground vibration and overpressure levels generated by blasting required for the Project for each of the nearby receivers and other sensitive natural features for comparison with the relevant criteria.

As described in **Section 3**, the Project is likely to require an average of five blast events per week required once mining rates reach steady state to prepare overburden for removal and for coal recovery. Blasting effects to neighbouring receivers depend on the following factors:

- Ground conditions including rock types, groundwater and layers;
- Distance from the blasting site to a receiver;
- Maximum Instantaneous Charge (MIC) for the blast event;
- Topography between the blast site and receivers; and
- Atmospheric conditions including wind speed, wind direction and vertical temperature gradient.

Air blast overpressure and ground vibration levels for blast events closest to the receiver locations were calculated utilising the methods set out in *Australian Standard (AS) 2187.2 – 2006 Explosives – Storage and use, Part 2: Use of explosives* (AS 2187.2:2006) for comparison with the relevant criteria.

The analysis was conducted using predicted vibration coefficients based on patterns observed in previous mining operations, although some site specific adjustment to these parameters may be appropriate based on initial blast monitoring results.

The Blasting Impacts on Landforms and Slopes assessment was undertaken as a desktop assessment. Aerial orthophotographs, contour maps, geology maps and geological features identified during the Shenhua Watermark exploration program were reviewed to identify areas which will be more susceptible to vibration impacts.

Blasting Criteria

Current noise and vibration criteria for occupied residences are derived from the *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* prepared by the Australian and New Zealand Environment and Conservation Council (ANZECC 1999) and reproduced in **Table 42**.

Recommended blasting criteria apply during the hours 9 am to 5 pm Monday to Saturday, excluding public holidays, and is typically relevant to non-mine owned and occupied buildings such as residences, schools and hotels. Accordingly, for buildings owned by Shenhua Watermark, the annoyance criteria do not apply.

There are a number of Aboriginal and historic heritage items (see **Section 7.14** and **7.15**) and other structures including the Central Ranges Gas Pipeline, that are in proximity to the Project.

Table 43 indicates the criteria applicable to historic heritage sites owned by Shenhua Watermark, which will not be directly impacted by mining activities. The recommended criteria are consistent with Appendix J4 and J5 of AS 2187.2-2006, which provides guidance on relevant procedures for assessing the blast-induced noise and vibration on buildings and occupants. Therefore the criteria are considered adequate to protect Shenhua Watermark owned historic heritage buildings from superficial or cosmetic damage.

Three Aboriginal grinding groove sites have been identified within the Project Boundary; WM-GG1-11, WM-GG2-11 and WM-GG3-12. Two of these sites have been identified as occurring within the open cut mining areas (WM-GG1-11 and WM-GG3-12) and are therefore required to be relocated during the Project life. Nonetheless, prior to the relocation of these sites, a 100 m buffer from blasting activities is considered sufficient to protect the sites from overbreak or cracking (see **Appendix I**). WM-GG2-11 is located outside the open cut mining areas, however, is adjacent to the Eastern Mining Area and may be subject to blasting vibration. Breeza Cemetery was also incorporated into the assessment based on Aboriginal community concerns.

7.9.3 Impact Assessment

The results of the vibration and overpressure assessment for each of the closest receivers are provided in **Table 43**.

These results indicate that blasting associated with the Project is predicted to produce ground vibration and overpressure levels well below the relevant amenity criteria at all privately owned residences and structures.

Slopes, landforms and Aboriginal grinding groove sites associated with underlying bedrock have a low sensitivity to vibration as these features are able to naturally fluctuate with ground movements. In this regard, the impacts generated from blasting on these features is limited to overbreak, which is a breakage beyond the excavation limits in the immediate area surrounding blast holes. As such the enforcement of a 100 m buffer from these features is deemed effective in reducing the potential for overbreak until effective risk management measures are established (see **Appendix I**).

Table 42 Blasting Amenity Criteria

Criteria	Overpressure (dBL)	Ground Vibration (mm/s)
Less than 5% of total blasts to exceed	115	5
No blasts to exceed	120	10

Note: Criteria do not apply where an agreement is in place with the land owner.

7.9.4 Mitigation and Management

As part of the EMS for the Project, Shenhua Watermark will develop a Blast Management Plan which will include appropriate management and mitigation measures to ensure that landform stability is maintained and the relevant criteria are met for all privately owned residences and Aboriginal and historic heritage items. The following measures will be included:

- Blasting will not occur closer than 500 m to any occupied or sensitive building or structure unless adequate controls are implemented to minimise the risk of fly rock;
- Notification of blast events prior to the blast event with establishment of appropriate signage, as required;
- Blast events will be designed to meet the relevant overpressure and ground vibration criteria;
- The risk of flyrock damage to the grinding grooves will be controlled by covering the grooves with flexible mats, sand or other suitable materials during blast events within 500 m of the grooves;
- Development of a risk management plan for blasting in close proximity to high risk slopes, landforms and Aboriginal grinding groove sites;
- Use of pre-split face batter or trim blasting where required to increase slope and highwall stability, particularly in areas of high risk;
- Adequate burden relief to control overbreak;
- Prior to commencement of mining operations a dilapidation assessment will be undertaken for all identified historic heritage items listed in **Table 43**;
- A qualified geotechnical, building or engineering expert will inspect historic heritage buildings (within farm complexes 3, 7, 12, 13), owned by Shenhua Watermark to confirm appropriate ground vibration and overpressure limits for each building and structure;
- The development of a blast monitoring program which will include:
  - Monitoring at representative receivers to ensure compliance with the relevant blast criteria;
  - Video recording of selected blasting events;
  - Three dimensional recording of the wall advance in all open cut mining areas; and
  - Regular inspections of the active highwall by a qualified geologist and / or geotechnical engineer to identify areas of potential instability.

Table 43 Predicted Blast Impacts

Receiver	Approximate Distance to Open Cut Mining Area (m)	Adopted Impact Criteria	Ground Vibration (mm/s)			Overpressure (dBL)		
			MIC (kg)			MIC (kg)		
		Ground Vibration (mm/s) / Overpressure (dBL)	1000	1500	2000	1000	1500	2000
25	4,900	5, 115	0.4	0.5	0.6	98	99	100
32	1,450	5, 115	2.5	3.5	4.4	111	112	113
62	1,850	5, 115	1.7	2.4	3.0	108	109	110
103	4,250	5, 115	0.5	0.6	0.8	100	101	102
105	4,450	5, 115	0.4	0.6	0.7	99	100	101
125	1,650	5, 115	2.0	2.8	3.6	109	111	112
Farm Complex 3 – The Wilgas*	730	15, 133	7.5	10.4	13.1	118	119	120
Farm Complex 7 – Inverness*	2,050	15, 133	1.4	2.0	2.5	107	108	109
Farm Complex 12 – Tilbrook*	1,730	15, 133	1.9	2.6	3.3	109	110	111
Farm Complex 13 – Wattle Vale*	1,350	15, 133	2.8	3.9	4.9	112	113	114
Breeza Cemetery	4,000	2, N/A	0.5	0.7	0.9	N/A	N/A	N/A
Central Ranges Gas Pipeline	970	25, N/A	4.8	6.6	8.3	N/A	N/A	N/A

** Owned by Shenhua Watermark*

7.10 Ecology

7.10.1 Background

An Ecological Impact Assessment was undertaken by Cumberland Ecology Pty Ltd (Cumberland Ecology) and is provided in **Appendix K**. The purpose of the assessment was to characterise the terrestrial and aquatic flora and fauna within the Project Boundary, including threatened species, populations and ecological communities.

General Impact Summary

The Disturbance Area for the Project (as shown on **Figure 39**) will result in the clearance of 4,084 ha vegetation within the Project Boundary, as outlined in **Table 44**. Of the total area to be disturbed, 738 ha consists of vegetation communities consistent with Box Gum Woodland C/EEC, 51 ha includes forest and woodland vegetation of other EEC and 148 ha is made up of other forest and woodland communities.

The remaining lands of approximately 3,147 ha consist of low diversity grassland, planted and exotic pasture and areas that have previously been cleared for roads, dams and other infrastructure.

The assessment also considered the effects of the Project on other threatened flora and fauna species and habitat with the potential to occur in the locality and recommended measures to mitigate and manage these impacts. Threatened species with the potential to be impacted by the Project and those that have the potential to occur in the proposed biodiversity offset areas are outlined in **Table 45**.

The key mechanism to mitigate the residual impacts on biodiversity resulting from the Project will be the development of a comprehensive Biodiversity Offset Strategy, which is discussed further in **Section 7.11**.

A separate Koala Plan of Management for the Project and Report on Matters of National Environmental Significance as listed under the EPBC Act were also prepared by Cumberland Ecology and are provided in **Appendix L** and **Appendix M**, respectively.

Koala Impact Summary

Of the threatened species known to occur within the Project Boundary, it is considered that the local Koala population and habitat has the potential to experience significant impacts in the absence of adequate management and mitigation measures implemented.

Predicted impacts to the Koala and Koala habitat over the life of the Project are summarised in **Table 46**. The survey methodology, Koala impact assessment and mitigation measures to be utilised for the species is discussed further below in **Section 7.10.3**.

7.10.2 Methodology

Desktop Assessment

A desktop assessment was undertaken to review the available information relevant to ecology. The assessment considered published information from several ecological surveys (GHD, 2009; Umwelt, 2009; DECC, 2009b) undertaken within the Project Boundary and in the general vicinity, the *Atlas of NSW Wildlife* (OEH, 2012) and the EPBC Act Protected Matters Search Tool (SEWPaC, 2012). A range of strategic and planning documents were also reviewed to guide the assessment, including:

- *Proposed Framework for Assessing the Cumulative Risk of Mining on Natural Resource Assets in the Namoi Catchment* (Eco Logical Australia, 2011);
- *Draft Namoi Catchment Action Plan* (Namoi CMA, 2011); and
- *Namoi Catchment Management Authority Biodiversity Offsets Policy* (Namoi CMA, 2011).

Field Surveys

In order to understand the key biodiversity values within the Project Boundary and to validate findings from the desktop assessment, field surveys were conducted between November 2010 and March 2012. Surveys included comprehensive flora, fauna and aquatic investigations over a range of seasons to maximise opportunities of recording migratory and breeding species and accurately identify plants in flower or with fertile material. The survey effort within the Project Boundary is detailed in **Table 47**.

Flora Survey

The *EPBC Act Policy Statement for the identification and assessment of Box Gum Woodland and Derived Grasslands* (DEH, 2006) was used to develop the flora field survey methodology. This policy statement provides a prescriptive methodology for determining the presence of a CEEC. The identification of other TSC Act listed EECs occurring within the Project Boundary was guided by the final determinations prepared by the NSW Scientific Committee (2004) and OEH threatened species profiles.

Techniques applied during the flora survey included quadrat sampling, meander transects and targeted searches for threatened species. Vegetation community boundaries and identified flora individuals or assemblages were recorded using a global positioning system.

A total of 90 quadrats were sampled in 20 x 50 m plots as recommended by the *EPBC Act Policy Statement for the identification and assessment of Box Gum Woodland and Derived Grasslands* (DEH, 2006). The locations of these quadrats were chosen so that sampling was conducted in areas most representative of the condition and composition of the vegetation patch. Biobanking data was also collected within each quadrat in accordance with the *Biobanking Assessment Methodology and Credit Calculator Operational Manual* (DECC, 2009).

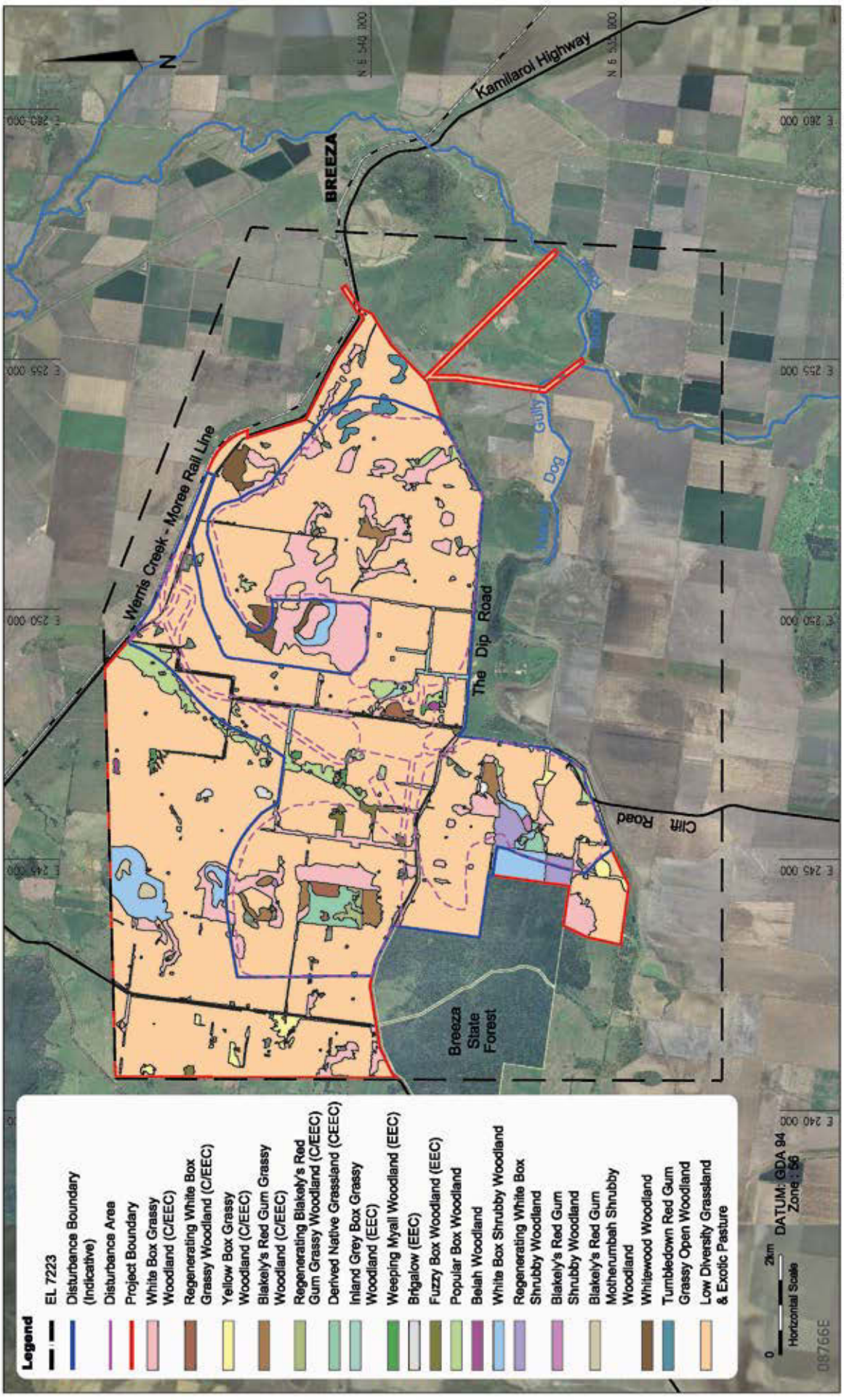

WATERMARK COAL PROJECT
Vegetation Communities
FIGURE 39
Hansen Bailey
ENVIRONMENTAL CONSULTANTS
N
BREEZA
Kamilaroi Highway
Werris Creek - Moree Rail Line
The Dip Road
Cliff Road
Gully
Dog
Breeza State Forest
E 280 000
E 260 000
E 255 000
E 250 000
E 245 000
E 240 000
N 6 540 000
N 6 535 000
Legend
EL 7223
Disturbance Boundary (Indicative)
Disturbance Area
Project Boundary
White Box Grassy Woodland (C/EEC)
Regenerating White Box Grassy Woodland (C/EEC)
Yellow Box Grassy Woodland (C/EEC)
Blakely's Red Gum Grassy Woodland (C/EEC)
Regenerating Blakely's Red Gum Grassy Woodland (C/EEC)
Derived Native Grassland (CEEC)
Inland Grey Box Grassy Woodland (EEC)
Weeping Myall Woodland (EEC)
Brigalow (EEC)
Fuzzy Box Woodland (EEC)
Popular Box Woodland
Belah Woodland
White Box Shrubby Woodland
Regenerating White Box Shrubby Woodland
Blakely's Red Gum Shrubby Woodland
Blakely's Red Gum Motherumbah Shrubby Woodland
Whitewood Woodland
Tumbledown Red Gum Grassy Open Woodland
Low Diversity Grassland & Exotic Pasture
0
2km
Horizontal Scale
DATUM: GDA 94
Zone : 56
08766E

Table 44 Indicative Project Vegetation Disturbance

Vegetation Community (Status)	Disturbance Location	Yr 0 (ha)	Yr 1 (ha)	Yr 2-5 (ha)	Yr 6-10 (ha)	Yr 11-15 (ha)	Yr 16-21 (ha)	Yr 22-25 (ha)	Yr 26-30 (ha)	Total (ha)
White Box Grassy Woodland (C/EEC)	All Mining and Infrastructure Areas	20	34	118	35	73	91	139	7	517
Regenerating White Box Grassy Woodland (C/EEC)	Western Mining Area and Infrastructure Areas	12	0	0	0	0	0	16	0	28
Blakely's Red Gum Grassy Woodland (C/EEC)	All Mining Areas	0	0	15	0	4	18	52	0	89
Regenerating Blakely's Red Gum Grassy Woodland (C/EEC)	Western Mining Area	0	0	0	0	0	0	17	0	17
Yellow Box Grassy Woodland (C/EEC)	Southern Mining Area	0	0	0	0	0	14	0	0	14
Derived Native Grassland (C/EEC)	Western and Southern Mining Areas	0	0	0	0	0	16	57	0	73
Inland Grey Box Grassy Woodland (EEC)	Eastern Mining Area and Infrastructure Areas	11	4	14	0	0	1	0	0	30
Weeping Myall Woodland (EEC)	Infrastructure Areas	3	0	0	0	0	0	0	0	3
Brigalow (EEC)	N/A	0	0	0	0	0	0	0	0	0
Semi-evergreen Vine Thicket (EEC)	N/A	0	0	0	0	0	0	0	0	0
Fuzzy Box Woodland (EEC)	Eastern and Western Mining Areas and Infrastructure Areas	1	0	5	0	0	1	11	0	18
Poplar Box Woodland	Eastern and Southern Mining Areas and Infrastructure Areas	7	1	4	0	17	16	0	0	45
Belah Woodland	Infrastructure Areas	1	0	0	0	0	0	0	0	1
Whitewood Woodland	Infrastructure Areas	0	0	13	0	0	0	0	0	13
Tumbledown Red Gum Grassy Open Woodland	Eastern Mining Area	0	0	0	8	8	0	0	0	16
White Box Shrubby Woodland	Southern Mining Area	0	0	0	0	0	24	0	0	24
Regenerating White Box Shrubby Woodland	Southern Mining Area	0	0	0	0	0	43	0	0	43
Blakely's Red Gum Shrubby Woodland	Western and Southern Mining Areas	0	0	0	0	0	4	2	0	6
Low Diversity Grassland, Planted & Exotic Pasture	All Mining and Infrastructure Areas	239	194	612	272	370	697	501	199	3,084
Cleared Areas	All Mining and Infrastructure Areas	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	64
Total		**294**	**233**	**781**	**315**	**472**	**925**	**795**	**206**	**4,084**

Table 45 Threatened Species with Potential to Occur in Project Boundary and Biodiversity Offsets

Species	Conservation Status		Impact Potential	Potential to Occur in Biodiversity Offsets
	TSC Act	EPBC Act		
Birds				
Little Lorikeet (*Glossopsitta pusilla*)	Vulnerable	N/A	Present	Present
Brown Treecreeper (*Climacteris picumnus*)	Vulnerable	N/A	Present	Present
Speckled Warbler (*Pyrrholaemus saggitatus*)	Vulnerable	N/A	Present	Present
Grey-crowned Babbler (*Pomatostomus temporalis*)	Vulnerable	N/A	Present	Potential to occur
Diamond Firetail (*Stagonopleura guttata*)	Vulnerable	N/A	Present	Potential to occur
Spotted Harrier (*Circus assimilis*)	Vulnerable	N/A	Present	Potential to occur
Little Eagle (*Hieraaetus morphnoides*)	Vulnerable	N/A	Present	Potential to occur

Species	Conservation Status		Impact Potential	Potential to Occur in Biodiversity Offsets
	TSC Act	EPBC Act		
Barking Owl (*Ninox connivens*)	Vulnerable	N/A	Present	Potential to occur
White-bellied Sea Eagle (*Haliaeetus leucogaster*)	N/A	Migratory	Present	Potential to occur
Black-chinned Honeyeater (*Melithreptus gularis*)	Vulnerable	N/A	Potential to occur	Potential to occur
Painted Honeyeater (*Grantiella picta*)	Vulnerable	N/A	Potential to occur	Potential to occur
Regent Honeyeater (*Anthochaera phrygia*)	Critically Endangered	Endangered, Migratory	Potential to occur	Potential to occur
Swift Parrot (*Lathamus discolour*)	Endangered	Endangered	Potential to occur	Potential to occur
Hooded Robin (*Melanodryas cucullata*)	Vulnerable	N/A	Potential to occur	Known
Varied Sittella (*Daphoenositta chrysoptera*)	Vulnerable	N/A	Potential to occur	Potential to occur
Turquoise Parrot (*Neophema pulchella*)	Vulnerable	N/A	Potential to occur	Present
Superb Parrot (*Polytelis swainsonii*)	Vulnerable	Vulnerable	Potential to occur	Potential to occur
Bush Stone-curlew (*Burhinus grallarius*)	Endangered	Endangered	Potential to occur	Potential to occur
Square-tailed Kite (*Lophoictinia isura*)	Vulnerable	N/A	Potential to occur	Potential to occur
Black-breasted Buzzard (*Hamirostra melanosternon*)	Vulnerable	N/A	Potential to occur	Potential to occur
Masked Owl (*Tyto novaehollandiae*)	Vulnerable	N/A	Potential to occur	Potential to occur
White-throated Needletail (*Hirundapus caudacutus*)	N/A	Migratory	Potential to occur	Potential to occur
Fork-tailed Swift (*Apus pacificus*)	N/A	Migratory	Potential to occur	Potential to occur
Rainbow Bee-eater (*Merops ornatus*)	N/A	Migratory	Potential to occur	Potential to occur
Cattle Egret (*Ardea ibis*)	N/A	Migratory	Potential to occur	Potential to occur
Great Egret (*Ardea alba*)	N/A	Migratory	Potential to occur	Potential to occur
Mammals				
Koala (*Phascolarctos cinereus*)	Vulnerable	Vulnerable	Present	Present
Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)	Vulnerable	N/A	Present	Potential to occur
Spotted-tailed Quoll (*Dasyurus maculatus*)	Vulnerable	Endangered	Potential to occur	Potential to occur
Eastern Freetail-bat (*Mormopterus norfolkensis*)	Vulnerable	N/A	Potential to occur	Potential to occur
Little Pied Bat (*Chalinolobus picatus*)	Vulnerable	N/A	Potential to occur	Potential to occur
Eastern Cave Bat (*Vespadelus troughtoni*)	Vulnerable	N/A	Potential to occur	Potential to occur
Large-eared Pied Bat (*Chalinolobus dwyeri*)	Vulnerable	Vulnerable	Potential to occur	Potential to occur
South-eastern Long-eared Bat (*Nyctophilus corbeni*)	Vulnerable	Vulnerable	Potential to occur	Present
Squirrel Glider (*Petaurus norfolcensis*)	Vulnerable	N/A	Potential to occur	Potential to occur
Reptiles				
Border Thick-tailed Gecko (*Underwoodisaurus sphyrurus*)	Vulnerable	Vulnerable	Potential to occur	Potential to occur
Five-clawed Worm-skink (*Anomalopus mackayi*)	Endangered	Vulnerable	Potential to occur	Potential to occur
Pink-tailed Legless Lizard (*Aprasia parapulchella*)	Vulnerable	Vulnerable	Potential to occur	Potential to occur
Pale-headed Snake (*Hoplocephalus bitorquatus*)	Vulnerable	N/A	Potential to occur	Potential to occur
Flora				
Lobed Blue Grass (*Bothriochloa biloba*)	N/A	Vulnerable	Present	Potential to occur
Bluegrass (*Dichanthium setosum*)	Vulnerable	Vulnerable	Potential to occur	Potential to occur
Finger Panic Grass (*Digitaria porrecta*)	Endangered	Endangered	Potential to occur	Potential to occur
Ooline (*Cadellia pentastylis*)	Vulnerable	Vulnerable	Potential to occur	Potential to occur
Murray Swainson-pea (*Swainsona murrayana*)	Vulnerable	Vulnerable	Potential to occur	Potential to occur

Table 46 Predicted Impacts to Koala Habitat

Koala Habitat	Koala Impact								
	Current	Year 0	Year 0-1	Years 2-5	Years 6-10	Years 11-15	Years 16-21	Years 22-25	Years 26-30
Total Habitat Available (ha)*	2,647	2,596	2,557	2,401	2,358	2,256	2,044	1,807	1,800
Habitat Impacted (ha)	0	51	39	156	43	102	212	237	7
Current Habitat in Onsite Offset Areas (ha)	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800
Offset Ratio**	-	35.3	20.0	7.3	6.2	4.6	3.0	2.1	2.1
Number of Koalas requiring staged translocation [1, 2, 3]	-	16	12	48	13	32	66	73	2

** Includes habitat retained in the Disturbance Area and Onsite Offset Areas*

*** Offset ratio is for retained habitat in Onsite Offset Areas only*

1. *The estimates of Koala population above are based on the density estimate of 0.309 Koalas/ha of woodland, with a 95% Confidence Interval +/- 0.079, which was calculated from the area searches within the primary sampling grid.*
2. *Please see Section 6.1.2.iii of* Appendix L *which discusses how the data above compares to an earlier estimate of Koala in Gunnedah LGA in 2010. As outlined in Section 6.1.2.iii, the 2010 estimate gives a density of 0.07 Koalas/ha of woodland and an estimate of 59 Koalas within the Disturbance Area.*
3. *The figures in the above table are based on surveys carried out in 2011 and 2012 and we note that koala populations fluctuate depending on climatic conditions, fire, disease and other factors. Also the measured number of koalas depends upon survey techniques. As noted in Section 6.1.2 of* Appendix L, *whilst the data collected provides a good basis for calculating density and population estimates, (and hence is a suitable method for determining appropriate mitigation measures at this stage of the assessment process) additional surveys or further techniques could be considered to refine the estimates. Further use of the area search method could include survey sites within a smaller sampling grid (e.g. survey sites located at 250 m intervals). Other techniques that could be used include strip or line transects (see Dique et al. (2003)), spotlighting searches, mark and recapture and radio-tracking.*

Table 47 Field Survey Effort

Survey Period	Task
3 – 5 November 2010	• General flora and fauna reconnaissance
8 – 11 November 2010	• Flora quadrat surveys • Koala Spot Assessment Technique surveys
29 November – 2 December 2010	• Flora quadrat surveys
13 – 15 December 2010	• Flora quadrat surveys • Koala Spot Assessment Technique surveys
21 – 30 March 2011	• Fauna surveys (terrestrial fauna trapping, harp trapping, Anabat echolocation recordings, diurnal and nocturnal searches, and call play back)
28 March – 1 April 2011	• Koala Spot Assessment Technique surveys
2 – 6 May 2011	• Flora quadrat surveys, fauna surveys (arboreal fauna trapping, hair tubes, infra-red cameras, Anabat echolocation recordings, diurnal and nocturnal searches and call playback)
10 – 14 May 2011	• Fauna surveys (arboreal fauna trapping, hair tubes, infra-red cameras, Anabat echolocation recordings, diurnal and nocturnal searches and call playback)
30 May – 3 June 2011	• Flora quadrat surveys • Koala Spot Assessment Technique surveys
5 – 10 June 2011	• Aquatic surveys
11 – 15 July 2011	• Vegetation mapping
19 – 23 September 2011	• Koala Spot Assessment Technique surveys
10 – 14 October 2011	• Koala Spot Assessment Technique surveys
19 – 23 December 2011	• Targeted Threatened flora surveys
13 – 17 February 2012	• Flora quadrat surveys
26 – 28 March 2012	• Fauna surveys (harp trapping, Anabat echolocation recordings, diurnal and nocturnal searches and call playback)



The resultant information was synthesised using a Geographical Information System to create a spatial database that was used to interpret the data so as to produce a detailed vegetation map of the Project Boundary. Aerial, topographical and geological mapping were also reviewed to assist in interpreting the survey data.

All vascular plants recorded or collected were identified. Where any specimens were not readily identifiable, they were lodged for identification with the National Herbarium of NSW at the Royal Botanic Gardens, Sydney. Eucalypt samples were identified by Dr Ian Brooker, a plant taxonomist with specialist knowledge in the identification of Eucalypt samples.

Fauna Habitat Assessment

Habitat condition was assessed by noting ground, shrub / understorey and canopy cover, the number and size of hollows present, habitat features such as rocky outcrops and coarse woody debris, and signs of fauna usage such as scats and scratches.

The fauna habitat assessments also included consideration of important indicators of habitat condition and complexity including the occurrence of microhabitats such as tree hollows, coarse woody debris, rocky outcrops and wetland areas such as creeks and soaks. An assessment of the structural complexity of vegetation, the age structure of the forest and the nature and extent of human disturbance throughout the Project Boundary was also undertaken.

Fauna Survey

Fauna surveys were conducted in accordance with the OEH working draft *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC, 2004) and the various SEWPaC *Survey Guidelines for Nationally Threatened Species* (DEWHA, 2010a, b; 2011a, b). Fauna survey methods and effort for the Project are summarised below in **Table 48**.

Terrestrial fauna surveys were undertaken over several survey seasons within the Project Boundary to enhance the range of detection (see **Table 48**). Due to the relatively large area of land to be assessed, the Project Boundary was divided into eight habitat zones to guide the fauna survey effort. The fauna survey work cumulated in 1,424 trap nights and over 260 person hours of fauna surveys and included:

- Microchiropteran bat surveys, including Anabat echolocation recordings and harp trapping;
- Reptile surveys, including diurnal searching, funnel traps with drift nets, and nocturnal spotlighting;
- Amphibian surveys, including diurnal searching and nocturnal spotlighting;
- Diurnal bird surveys, including systematic grid based census;
- Nocturnal bird surveys, including spotlighting and call playback at night and habitat searches in daylight hours;
- Small terrestrial and arboreal mammals, including spotlighting, Elliott and cage trapping, scat sample collection and Faunatech hair tubes;
- Infrared cameras on fauna pathways;
- Fauna habitat assessment, including hollow-bearing trees; and
- Koala surveys, including Spot Assessment Technique (SAT).

Any fauna species that were incidentally observed, heard calling, or otherwise detected on the basis of tracks or signs during any survey work for the Project were recorded and added to the total species list.

Koala Assessment

Field surveys of vegetation and estimation of Koala activity levels and population density were completed within the Project Boundary and Onsite Biodiversity Offset Areas between 2010 and 2012.

The Spot Assessment Technique (SAT), developed by Dr Stephen Phillips was utilised for survey of the Koala populations within and around the Project Boundary. This methodology was utilised as it allows for quantification of habitat utilisation by free-ranging Koalas. The sampling regime entailed the completion of 168 SAT plots across the Project Boundary and Breeza State Forest and recording details of tree species, occurrence of Koala faecal pellets and occurrence of any observed individual animals. The location of woodland plots was pre-determined using a 750 m x 750 m primary sampling grid.

Some sites were also sampled at 500 m x 500 m secondary grid points where additional data was required between 750 m sample points. Each SAT plot was assigned a usage level of High, Medium, or Low based upon the number of trees observed to have faecal pellets at their base. The area search method was then used for the prediction of koala populations, which involved counting the number of individual koalas present within a 25 m radial search at each SAT survey site. Calculation of density was determined using only those results from the primary sampling grid. Other incidental sightings were also noted but not used in the density calculation. Data from the sample plots was analysed by Dr Stephen Phillips to obtain a population estimate for the Project Boundary and proposed Onsite Biodiversity Offset Areas.

A number of leading Koala specialists were consulted during assessment and preparation of the Koala Plan of Management. Dr Stephen Phillips was consulted regarding the development of a suitable methodology for determining Koala activity levels and population density estimates within the Project Boundary and surrounding lands. A peer review of the Koala Plan of Management was conducted by Dr Katherine Handasyde from Melbourne University and Dr Mathew Crowther from the University of Sydney and their comments and recommendations were incorporated into the Koala Plan of Management for the Project (see **Appendix L**).

Aquatic Habitat Assessment

Aquatic surveys were conducted in accordance with *The Australia Wide Assessment of River Health: NSW AusRivAS Sampling and Processing Manual* (Turak and Waddel, 2002). This approach involved undertaking habitat assessments, in-situ water quality measurements and collecting aquatic macro-invertebrate samples to provide an indication of the current condition of the local aquatic environment. The aquatic survey did not include vertebrate sampling (e.g. fish) as no permanent watercourses occur throughout the Project Boundary. A total of 13 sites were surveyed within the Project Boundary, along the Mooki River and Native Dog Gully and at Lake Goran.



Table 48 Fauna Survey Effort

Survey Technique	Recommended Survey Effort* (DEC, 2004)	Project Survey Effort
Amphibians		
Systematic day habitat search	1 hour	66 x 30 min census points within suitable habitat on multiple days
Night habitat search of damp and watery sites	30 minutes on two separate nights	Walking and driving - 41 hours on multiple nights
Reptiles		
Habitat search	10 x 30min searches on separate days targeting specific habitat	66 x 30 min census points on multiple days
Spotlighting	10 x 30min searches on separate days targeting specific habitat	Walking and driving - 41 hours on multiple nights
Funnel traps**	N/A	192 trap nights
Diurnal Birds		
Area search	Throughout survey period – no total effort specified	66 x 30 min census points during multiple days
Nocturnal Birds		
Call playback	8 call playback nights per site	11 sites for one night over multiple nights
Day habitat search	Throughout survey period	Throughout survey period
Nocturnal spotlight search**	N/A	Walking and driving - 41 hours
Non-flying Mammals		
Arboreal Elliott traps	504 trap nights	320 trap nights (complemented by the use of hair tubes)
Wire cage traps	504 trap nights	96 trap nights (this was complemented by the use of IR cameras and extra hair tubes)
Pitfall traps with drift nets	504 trap nights	Funnel traps - 192 trap nights (this was complemented by the use of extra hair tubes).
Hair tubes	1,680 trap nights (840 small and 840 large sizes)	600 trap nights using Faunatech hairtubes which comprise both small and large sizes
Spotlighting on foot	20 x 1 hour (1km) over separate nights	Walking and driving - 41 hours over multiple nights
Spotlighting from vehicle	20 x 1km tracks over separate nights	See above
Call playback	Playback on two nights for 11 sites	11 sites for one night over multiple nights (for the Koala; this was also complemented by the Koala SAT/Area Searches)
Search for scats and signs	21 x 30min searching each relevant habitat, including trees for scratch marks	Throughout survey period (this was also complemented by the SAT technique for Koala, which surveyed koala scats over 168 sites)
Collection of predator scats	Opportunistic collection of predator scats for hair analysis	Throughout survey period
Koala SAT surveys**	N/A	168 SAT sites
IR camera detection**	N/A	30 survey nights
Bats		
Harp trapping	1 harp for 2 nights at 40 sites (80 trap nights)	24 trap nights (complemented by ultrasonic call recordings)
Ultrasonic call recording	1 Anabat for 2 nights at 40 sites (80 trap nights)	31 trap nights (complemented by hard trapping)

** Based on 1,997 ha of woodland habitat*

*** Survey technique not described within survey guidelines for targeted fauna group*

Groundwater Dependent Ecosystem Assessment

The presence of GDEs in the Namoi Catchment has been addressed by two main studies; Eco Logical (2011) and Sinclair Knight Merz Pty Ltd (SKM) (2010). SKM developed GDE mapping of the Namoi Catchment (SKM, 2010) using remote sensing and rainfall data to categorise areas of vegetation as having a potential high, moderate, low, or very low dependency on groundwater. Vegetation communities in the Namoi Catchment that are considered to comprise GDEs were identified by Eco Logical (2011).

Eco Logical (2011) and SKM (2010) were reviewed in consideration of the model developed by AGE as part of the Groundwater Impact Assessment for the Project (see **Section 7.1**) to identify any regions within the Project Boundary that are:

- Identified as having woodland vegetation;
- Identified as having a moderate to high potential to be a GDE; and
- Situated in areas where the groundwater is less than 20 m below the surface.

This approach was used to guide the site inspection and an assessment of the impacts on potential GDEs.

7.10.3 Existing Environment

Vegetation Communities

Table 49 lists the vegetation communities that have been identified within the Project Boundary and provides the status of each as prescribed under the TSC or EPBC Act, as relevant. **Figure 39** illustrates the spatial distribution of vegetation communities within the Project Boundary and a summary of the impacts to each over the life of the Project is provided in **Table 44**.

Land within the Project Boundary is dominated by low diversity grassland derived from previous clearing of woodland to accommodate cattle grazing and exotic pastures for agricultural production. Decades of grazing the land has resulted in a variety of ecological impacts, including weed invasion, nutrient enrichment and soil erosion.

Remnant and regrowth open forest and woodland occur as fragmented, narrow tracts along boundary fences and road verges and in isolated patches on hills, steep slopes and in paddocks within the Project Boundary.

Table 49 Vegetation Communities

Vegetation Community	TSC Act	EPBC Act	Area in Project Boundary (ha)
White Box Grassy Woodland	EEC	CEEC	988
Regenerating White Box Grassy Woodland	EEC	CEEC	28
Blakely's Red Gum Grassy Woodland	EEC	CEEC	90
Regenerating Blakely's Red Gum Grassy Woodland	EEC	CEEC	17
Yellow Box Grassy Woodland	EEC	CEEC	69
Derived Native Grassland	EEC	CEEC	73
Inland Grey Box Grassy Woodland	EEC	EEC	55
Weeping Myall Woodland	EEC	EEC	22
Brigalow	EEC	EEC	9
Semi-evergreen Vine Thicket	EEC	EEC	N/A*
Fuzzy Box Woodland	EEC	N/A	36
Poplar Box Woodland	N/A	N/A	223
Belah Woodland	N/A	N/A	7
Whitewood Woodland	N/A	N/A	76
Tumbledown Red Gum Grassy Open Woodland	N/A	N/A	50
White Box Shrubby Woodland	N/A	N/A	234
Regenerating White Box Shrubby Woodland	N/A	N/A	72
Blakely's Red Gum Shrubby Woodland	N/A	N/A	6
Blakely's Red Gum Motherumbah Shrubby Woodland	N/A	N/A	15
Low Diversity Grassland, Planted and Exotic Pasture	N/A	N/A	7,290
Cleared Areas (existing roads, dams, buildings, etc)	N/A	N/A	141
Total			**9,501**

**Area of occurrence is <0.1ha and has therefore not been mapped*

A substantial area of vegetation conforming to the description of Box Gum Woodland CEEC occur within the Project Boundary, including White Box Grassy Woodland, Regenerating White Box Grassy Woodland, Blakey's Red Gum Grassy Woodland, Regenerating Blakey's Red Gum Grassy Woodland and Yellow Box Grassy Woodland.

Flora

One threatened flora species, Lobed Blue Grass (*Bothriochloa biloba*), has been recorded within the Project Boundary (see **Figure 40**). This species is listed as vulnerable under the EPBC Act. Despite intensive survey effort and targeted searches, no other threatened flora species were identified. However, given the availability of suitable habitat, a number of threatened species are considered likely to occur within the Project Boundary, including:

- Bluegrass (*Dichanthium setosum*);
- Finger Panic Grass (*Digitaria porrecta*);
- Slender Darling-pea (*Swainsona murrayana*); and
- Ooline (*Cadellia pentastylis*).

Fauna Habitat

Vegetation within the Project Boundary provides potential habitat for a range of native fauna species, including amphibians, reptiles, birds, bats and arboreal and terrestrial mammals. Key habitat features within the Project Boundary include:

- Dams;
- Ground cover, leaf litter, coarse woody debris and rocky outcrops;
- Tree hollows;
- Blossom-producing trees;
- Feed tree species; and
- Caves, culverts and other shelter.

Fauna

The faunal assemblage within the Project Boundary is dominated by mobile fauna including a suite of bird species, and some bats. A list of the threatened fauna species identified or having the potential to occur within the Project Boundary are presented in **Table 50**. The location of threatened fauna identified within the Project Boundary is illustrated in **Figure 40**.

Table 50 Threatened Fauna Species

Common Name (Latin name)	TSC Act	EPBC Act	Status
Birds			
Little Lorikeet (*Glossopsitta pusilla*)	Vulnerable	N/A	Present
Brown Treecreeper (*Climacteris picumnus*)	Vulnerable	N/A	Present
Speckled Warbler (*Pyrrholaemus saggitatus*)	Vulnerable	N/A	Present
Grey-crowned Babbler (*Pomatostomus temporalis*)	Vulnerable	N/A	Present
Diamond Firetail (*Stagonopleura guttata*)	Vulnerable	N/A	Present
Spotted Harrier (*Circus assimilis*)	Vulnerable	N/A	Present
Little Eagle (*Hieraaetus morphnoides*)	Vulnerable	N/A	Present
Barking Owl (*Ninox connivens*)	Vulnerable	N/A	Present
White-bellied Sea Eagle (*Haliaeetus leucogaster*)	N/A	Migratory	Present
Black-chinned Honeyeater (*Melithreptus gularis*)	Vulnerable	N/A	Potential to occur
Painted Honeyeater (*Grantiella picta*)	Vulnerable	N/A	Potential to occur
Regent Honeyeater (*Anthochaera phrygia*)	Critically Endangered	Endangered, Migratory	Potential to occur
Swift Parrot (*Lathamus discolour*)	Endangered	Endangered	Potential to occur
Hooded Robin (*Melanodryas cucullata*)	Vulnerable	N/A	Potential to occur
Varied Sittella (*Daphoenositta chrysoptera*)	Vulnerable	N/A	Potential to occur
Turquoise Parrot (*Neophema pulchella*)	Vulnerable	N/A	Potential to occur
Superb Parrot (*Polytelis swainsonii*)	Vulnerable	Vulnerable	Potential to occur
Bush Stone-curlew (*Burhinus grallarius*)	Endangered	Endangered	Potential to occur
Square-tailed Kite (*Lophoictinia isura*)	Vulnerable	N/A	Potential to occur
Black-breasted Buzzard (*Hamirostra melanosternon*)	Vulnerable	N/A	Potential to occur
Masked Owl (*Tyto novaehollandiae*)	Vulnerable	N/A	Potential to occur

Common Name (Latin name)	TSC Act	EPBC Act	Status
White-throated Needletail (*Hirundapus caudacutus)*	N/A	Migratory	Potential to occur
Fork-tailed Swift (*Apus pacificus)*	N/A	Migratory	Potential to occur
Rainbow Bee-eater (*Merops ornatus)*	N/A	Migratory	Potential to occur
Cattle Egret (*Ardea ibis)*	N/A	Migratory	Potential to occur
Great Egret (*Ardea alba)*	N/A	Migratory	Potential to occur
Mammals			
Koala (*Phascolarctos cinereus*)	Vulnerable	Vulnerable	Present
Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris)*	Vulnerable	N/A	Present
Spotted-tailed Quoll (*Dasyurus maculatus)*	Vulnerable	Endangered	Potential to occur
Eastern Freetail-bat (*Mormopterus norfolkensis*)	Vulnerable	N/A	Potential to occur
Little Pied Bat (*Chalinolobus picatus*)	Vulnerable	N/A	Potential to occur
Eastern Cave Bat (*Vespadelus troughtoni*)	Vulnerable	N/A	Potential to occur
Large-eared Pied Bat (*Chalinolobus dwyeri)*	Vulnerable	Vulnerable	Potential to occur
South-eastern Long-eared Bat (*Nyctophilus corbeni)*	Vulnerable	Vulnerable	Potential to occur
Squirrel Glider (*Petaurus norfolcensis*)	Vulnerable	N/A	Potential to occur
Reptiles			
Border Thick-tailed Gecko (*Underwoodisaurus sphyrurus)*	Vulnerable	Vulnerable	Potential to occur
Five-clawed Worm-skink (*Anomalopus mackayi)*	Endangered	Vulnerable	Potential to occur
Pink-tailed Legless Lizard (*Aprasia parapulchella)*	Vulnerable	Vulnerable	Potential to occur
Pale-headed Snake (*Hoplocephalus bitorquatus*)	Vulnerable	N/A	Potential to occur

Historical clearing from agricultural production and relative isolation from more extensive forest and woodland areas has influenced the fauna assemblage within the Project Boundary and its surrounds. As a result, the Project Boundary now supports mostly highly mobile species resilient to disturbance and isolation. However, land within the Project Boundary continues to provide suitable foraging, shelter and breeding habitat for a range of fauna, including those listed under the EPBC Act and the TSC Act.

Koala

Koalas have been consistently detected across the Project Boundary and Breeza State Forest in all eucalypt dominated woodland. An analysis of sightings and scat data via SAT surveys were adopted to understand Koala activity. Approximately half of the SAT plots (48%) yielded low activity levels, however, the remaining plots yielded medium (11%) and high (41%) activity, indicating core Koala habitat. From the results of the surveys it is evident that Koalas are utilising the majority of wooded habitats within the Project Boundary. However, an increase in shrubby understorey, which is indicative of a decrease in soil nutrient levels, tends to correspond with a decrease in Koala activity level (see **Figure 41**).

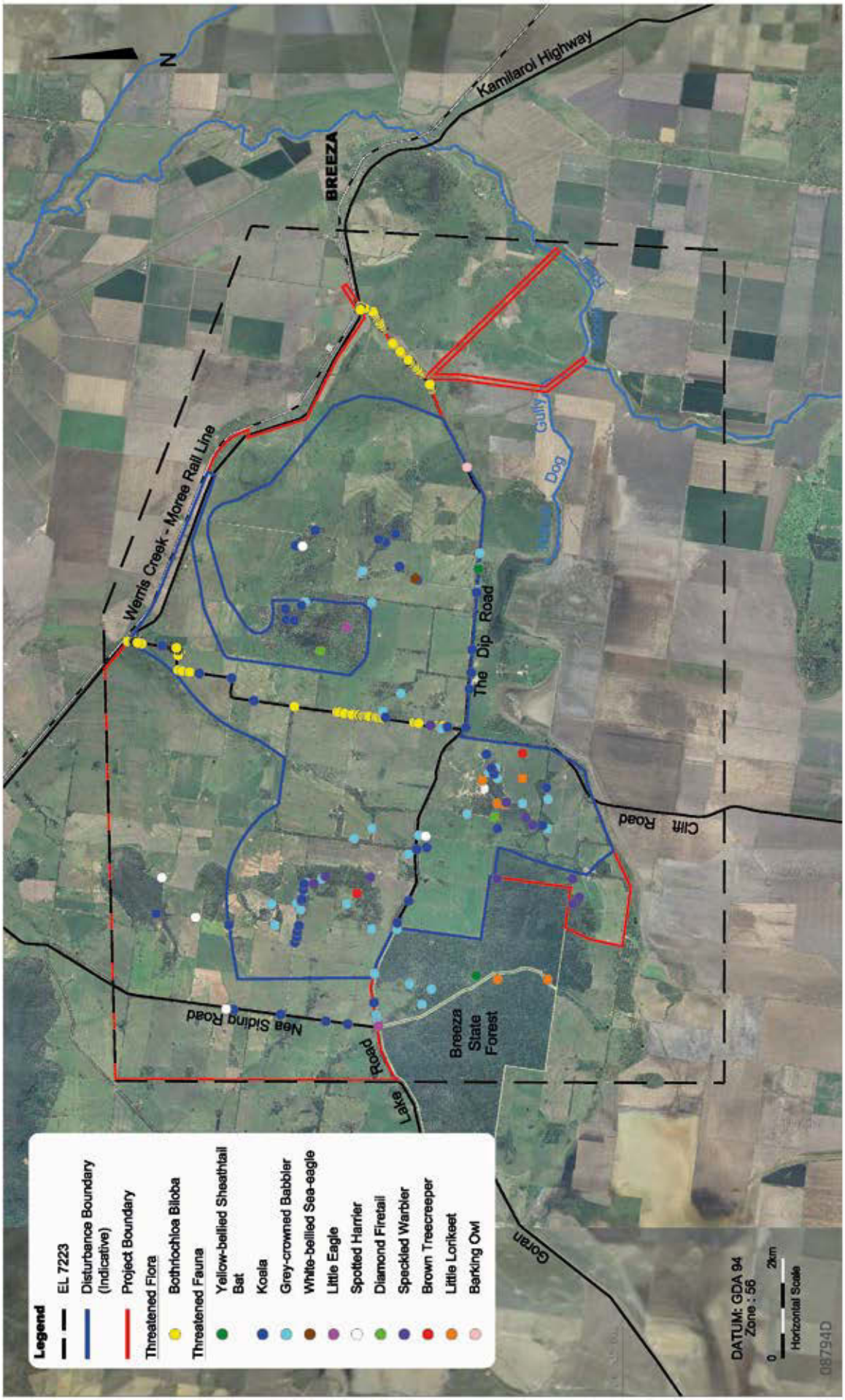
On the basis of the field survey results, population density of Koalas in the Project Boundary is calculated at approximately 0.309 individuals / ha of woodland, with a 95% confidence interval of ±0.079. This equates to approximately 262 individuals located within the Disturbance Area.

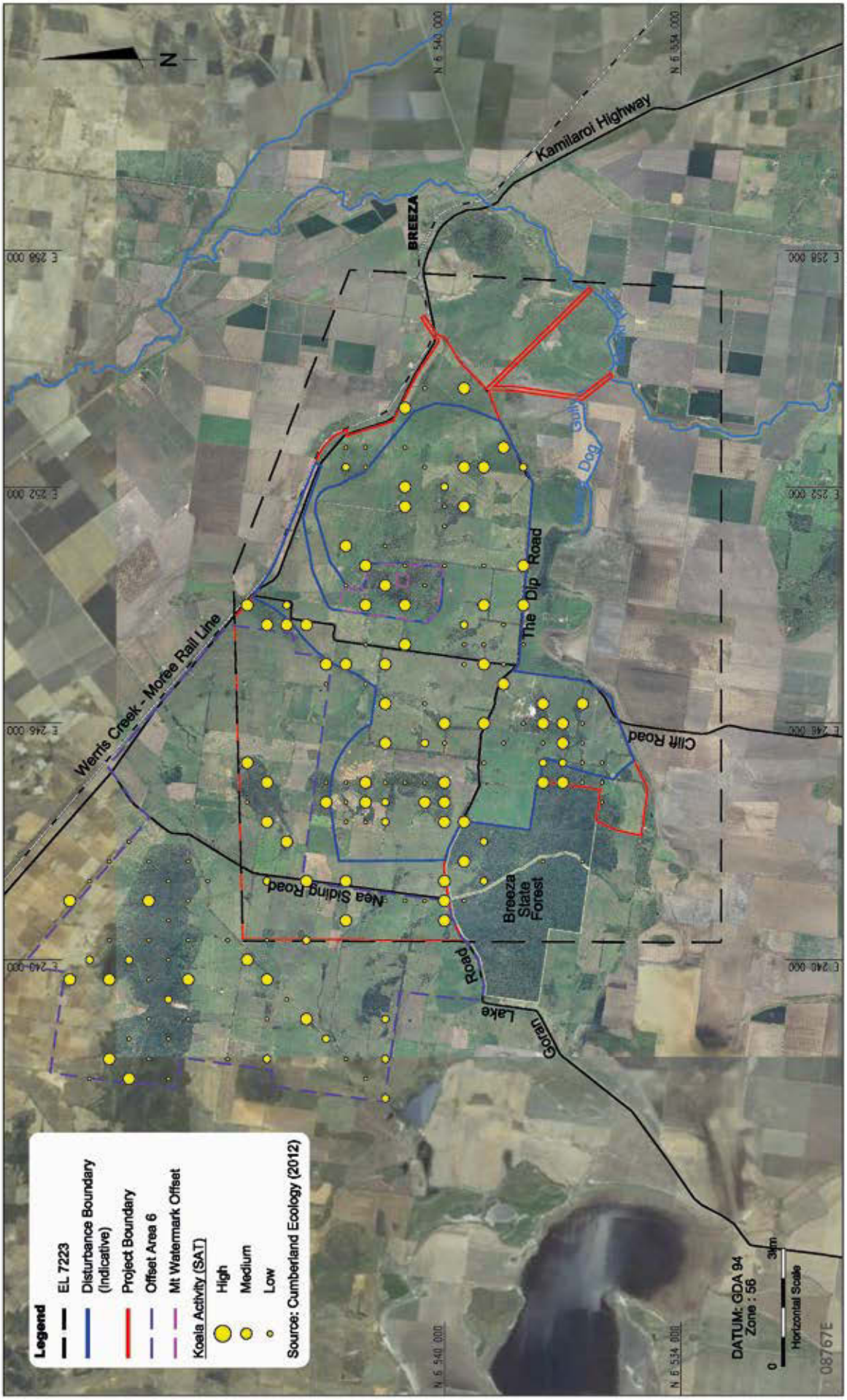
Aquatic Habitat

Several farm dams occur within the Project Boundary. The farm dams present are typically small and shallow with a tendency to dry up during periods of low rainfall. Limited habitat is available for aquatic fauna in the Project Boundary, mostly due to the lack of fringing vegetation, habitat features such as rocks or snags, and connectivity within open, highly disturbed land.

The Mooki River and Native Dog Gully, which is a tributary of the Mooki River, are ephemeral watercourses to the south-east of the Project Boundary that only flow following sufficient rainfall. The aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River is listed as an EEC under the FM Act. The Mooki River is a tributary of the Namoi River, which in turn is a tributary of the Darling River and consequently conforms to the definition of an EEC.

Aquatic habitat along the Mooki River and Native Dog Gully is highly degraded and is considered to be in a poor physical condition. Native riparian and floodplain vegetation has been historically cleared for agriculture and is now practically non-existent with the exception of a few scattered paddock trees. These watercourses provide only highly simplified aquatic habitat with little or no in-stream vegetation or rocks and snags required for aquatic fauna habitation, including macroinvertebrates and fish.


WATERMARK COAL PROJECT
Threatened Flora and Fauna Species
FIGURE 40
Hansen Bailey
ENVIRONMENTAL CONSULTANTS
N
Kamilaroi Highway
BREEZA
Wems Creek - Moree Rail Line
Gully
Dog
The Dip Road
Cliff Road
New Sliding Road
Road
Lake
Breeza State Forest
Goran
Legend
EL 7223
Disturbance Boundary (Indicative)
Project Boundary
Threatened Flora
Bothriochloa Biloba
Threatened Fauna
Yellow-bellied Sheathtail Bat
Koala
Grey-crowned Babbler
White-bellied Sea-eagle
Little Eagle
Spotted Harrier
Diamond Firetail
Speckled Warbler
Brown Treecreeper
Little Lorikeet
Barking Owl
DATUM: GDA 94
Zone : 56
0
2km
Horizontal Scale
08794D


WATERMARK COAL PROJECT
Koala Activity
FIGURE 41
Hansen Bailey
ENVIRONMENTAL CONSULTANTS
N
Kamilaroi Highway
BREEZA
Werris Creek - Moree Rail Line
The Dip Road
Cliff Road
New Siding Road
Breeza State Forest
Lake Goran
Road
Legend
EL 7223
Disturbance Boundary (Indicative)
Project Boundary
Offset Area 6
Mt Watermark Offset
Koala Activity (SAT)
High
Medium
Low
Source: Cumberland Ecology (2012)
DATUM: GDA 94
Zone : 56
Horizontal Scale
3km
0
08767E

Lake Goran is an extensive but shallow ephemeral lake located to the west of the Project Boundary. The land surrounding the lake is generally used for agriculture and has been cleared of trees and shrubs. The lake intermittently provides habitat for a number of water birds, however, as it is periodically cropped and the mud is abrasive as the lake dries up it is unlikely that it offers suitable habitat for benthic macroinvertebrates.

Aquatic macroinvertebrates are used as biological indicators of freshwater ecosystem health due to their sensitivity to changes in water quality, flow regime and general habitat condition. Based on the significant loss in diversity and abundance of invertebrates, all aquatic survey locations within the Project Boundary, along the Mooki River and Native Dog Gully and at Lake Goran are classified as Band B (significantly impaired) or Band C (severely impaired) under the AUSRIVAS Ecological Integrity Bands classification system. This analysis indicates that aquatic habitats within and adjacent to the Project Boundary have been significantly altered or affected by surrounding land practices such as agricultural pollution or the downstream effects of dams.

Aquatic Fauna

A low diversity and abundance of macroinvertebrates were recorded in locations within the Project Boundary, along the Mooki River and Native Dog Gully and at Lake Goran. No threatened aquatic fauna species listed under the EPBC Act, TSC Act or FM Act were recorded during the survey and none are considered likely to occur due to the poor quality of available habitat.

Groundwater Dependent Ecosystems

Four main GDEs have been classified throughout NSW (Hatton, 1998), including:

- Terrestrial vegetation;
- River base flow systems;
- Aquifer and cave ecosystems; and
- Wetlands.

Of these GDEs, the ecosystem with the most relevance to the land within the Project Boundary is terrestrial vegetation, where forest and woodland may be sustained, either permanently or periodically, by shallow but high quality groundwater. For most terrestrial ecosystems, the critical depth and characteristic dynamics is unknown (Hatton and Evans, 1998).

7.10.4 Impact Assessment

The Project will remove forest and woodland comprising of non-listed woodland communities and the listed CEEC Box Gum Woodland and Derived Native Grassland within the Disturbance Boundary. Some of these vegetation communities contain threatened flora species or provide suitable habitat for threatened fauna species.

Vegetation Communities

Table 51 summarises the vegetation communities within the Disturbance Area that will be directly impacted by the Project (also see **Figure 39**). A total of 4,084 ha of vegetation will be removed progressively over the life of the Project, including 738 ha of Box Gum Woodland and Derived Native Grassland and 51 ha of other communities listed under the EPBC Act and TSC Act.

The direct removal of vegetation communities is likely to result in the following impacts:

- Removing or reducing the availability of important habitat features that may offer forage, shelter or breeding opportunities for fauna, thus putting more pressure on the remaining habitat to provide these features;
- Exacerbating the degree of fragmentation and isolation of woodland areas;
- Reducing connectivity by removing areas of woodland and forest that will serve as 'stepping stones' for mobile fauna in an otherwise cleared landscape;
- Increasing edge effects, particularly along linear patches;
- Potentially affecting the physiology and behaviour of fauna through ongoing noise and light generation;
- Potentially affecting the physiological processes of flora, including photosynthesis, respiration and transpiration, through ongoing generation of dust;
- Increasing the risk of vehicle strike;
- Altering habitat conditions, which could potentially favour weeds and feral animals; and
- Erosion leading to sedimentation and turbidity.



Table 51 Indicative Project Vegetation Disturbance

Vegetation Community	TSC Act	EPBC Act	Project Boundary (ha)	Disturbance Area (ha)
White Box Grassy Woodland	EEC	CEEC	988	517
Regenerating White Box Grassy Woodland	EEC	CEEC	28	28
Blakely's Red Gum Grassy Woodland	EEC	CEEC	90	89
Regenerating Blakely's Red Gum Grassy Woodland	EEC	CEEC	17	17
Yellow Box Grassy Woodland	EEC	CEEC	69	14
Derived Native Grassland	EEC	CEEC	73	73
Inland Grey Box Grassy Woodland	EEC	EEC	55	30
Weeping Myall Woodland	EEC	EEC	22	3
Brigalow	EEC	EEC	9	0
Semi-evergreen Vine Thicket	EEC	EEC	N/A*	0
Fuzzy Box Woodland	EEC	N/A	36	18
Poplar Box Woodland	N/A	N/A	223	45
Belah Woodland	N/A	N/A	7	1
Whitewood Woodland	N/A	N/A	76	13
Tumbledown Red Gum Grassy Open Woodland	N/A	N/A	50	16
White Box Shrubby Woodland	N/A	N/A	234	24
Regenerating White Box Shrubby Woodland	N/A	N/A	72	43
Blakely's Red Gum Shrubby Woodland	N/A	N/A	6	6
Blakely's Red Gum Motherumbah Shrubby Woodland	N/A	N/A	15	0
Low Diversity Grassland and Exotic Pastures	N/A	N/A	7,290	3,084
Cleared Areas	N/A	N/A	141	63
Total			**9,500**	**4,084**
EPBC Act	**C/EEC**		**1,351**	**771**
TSC Act	**EEC**		**1,387**	**789**

**Area of occurrence is <0.1ha and has therefore not been mapped*

Threatened Flora

One threatened flora species, Lobed Blue Grass (*Bothriochloa biloba*), has been recorded within the Project Boundary. A portion of the population is situated within the Disturbance Boundary and will be removed as a result of the Project.

There are large areas of similar habitat occur in the locality outside of the Disturbance Boundary that will not be affected by the Project. An assessment of significance indicates that the Project is considered unlikely to result in a significant impact to *Bothriochloa biloba* on a broader scale.

No other threatened flora species were identified within the Disturbance Boundary or Project Boundary.

Threatened Fauna

A total of 11 threatened fauna species were positively recorded in the Project Boundary, including nine species of avifauna and two species of mammal. A further 28 threatened fauna species are considered likely to occur within the Project Boundary based on the availability of suitable habitat.

The clearance of a large proportion of woodland within the Disturbance Boundary is likely to represent a loss of locally important foraging and roosting habitat for various birds.

The likely increase in habitat fragmentation as a result of the Project is also likely to reduce the dispersal capacity of more sedentary species to remnant woodland elsewhere in the locality. Many of the larger trees in woodland communities of the Project Boundary contain hollows. As such, the loss of these sites will reduce the availability of nesting sites and in turn exert a strong influence on habitat use. Woodland birds that are sedentary or dependent on specific habitat features are also likely to have difficulty successfully relocating due to competition from existing residents in new areas.

The woodland communities within the Project Boundary are likely to provide forage, roosting and breeding habitat as well as potential movement corridors for a number of microbat species. Removal of woodland will influence the availability of food sources, and suitable habitat for tree-roosting or hollow-dependent species. This may affect the capacity of some individuals to disperse and relocate to surrounding habitat elsewhere in the locality.

A number of reptiles, none of which are threatened species, utilise woodland communities within the Project Boundary as foraging and shelter habitat. The Project will remove known habitat for reptiles resulting in an increase in habitat fragmentation. This will likely reduce the dispersal capacity of reptiles to remnant woodland elsewhere in the locality.

Koala

The Project will result in the staged clearance of Koala habitat within the Disturbance Area, including 847 ha of the species' preferred eucalypt dominated habitat, resulting in a sizeable loss of foraging resources for Koalas in the Project Boundary. In particular, the Project will result in the removal of secondary tree species, particularly White Box. Remaining habitat within the Project Boundary will be subject to further fragmentation as a direct result of habitat removal. This impact is accentuated by the general paucity of robust corridor functionality in the existing landscape. Based on the population estimates obtained from the field survey, it is anticipated that the Project will require the translocation of 2.1% (95% Confidence Interval: 1.5% – 2.6%) of the total population within the Gunnedah LGA over 30 years which equates to approximately 0.07% per annum. In total, approximately 262 Koalas would therefore require translocation over the 30 year life of the Project (see **Table 46**).

Aquatic Habitat

The Project includes two pipeline options to the Mooki River for external water supply. The construction of pipelines and pump stations or possibly a bore field will not entail clearance of native or threatened flora as it will be located in areas covered mainly by exotic grasses and herbaceous plants on the floodplain. This is the key Project interaction with an aquatic environment, with the exception of several degraded farm dams. Despite the unlikelihood of native species occurring in the portion of the Mooki River proximate to the Project, general mitigation measures have also been considered for threatened fish species, as described in **Section 7.10.4**.

No significant ecological impacts are predicted to occur to aquatic fauna or its habitat as a result of water extraction from the Mooki River or water bores on the floodplain.

Groundwater Dependent Ecosystems

Typical GDE communities such as wetlands and riparian vegetation do not occur within the Project Boundary, and there are no obvious areas of heavy groundwater dependence. Analysis of groundwater depth and site inspections has indicated that none of the vegetation communities within the Project Boundary are GDEs that are completely dependent on groundwater. Additionally, large areas of groundwater within the Project Boundary are highly saline and this would preclude reliance upon it by native vegetation (see **Appendix T** and **Section 7.1**).

Furthermore, the Stygofauna Impact Assessment undertaken by Eco Logical (see **Appendix U** and **Section 7.12**) did not identify any stygofauna and assessed it was unlikely that they occur within the Project Boundary or immediate surrounds.

Indirect Impacts

In addition to the direct impacts predicted for the Project as described above, indirect ecological effects will also occur due to impacts associated with habitat disturbance and fragmentation, edge effects, noise and dust emissions, night lighting, erosion, increased vehicle traffic and introduced species. The potential for indirect impacts was considered for each of the threatened species assessed for the Project.

Cumulative Impacts

Extensive vegetation clearing has already and continues to occur in the locality (20 km radius of the Project Boundary) as a result of agriculture, forestry, and other mining projects. The primary impact of the previous clearing is the loss of extensive areas of habitat and fragmentation of wildlife corridors. The scale of vegetation clearance that will occur as a result of the Project and other existing and proposed mining operations will exacerbate these existing ecological impacts if left unmitigated by the establishment of ecological offsets (see **Section 7.11**).

Cumulative impacts are expected to as a result of several mine leases that occur within the locality and wider region, with the closest active mine, Sunnyside Mine, located 15 km west of Gunnedah (although this operation has recently been placed on 'care and maintenance' mode). Coal mining is currently taking place in several places in the wider region and there is potential for other large-scale operations to occur within the locality (see **Table 1**). The impacts of any future mining operations will be similar to those described for this Project.

The Project is unlikely to threaten the overall occurrence of the vegetation communities recorded from within the Project Boundary. Large areas of such vegetation will remain both within and surrounding the Project Boundary, including areas within the Breeza State Forest and surrounding areas. Some vegetation communities that will be impacted by the Project, particularly the CEEC Box Gum Woodland and Derived Native Grasslands, are not well represented within secure tenures, including conservation reserves.



7.10.5 Mitigation and Management

Management measures for the Project have followed the NSW Government Principles for the use of Biodiversity Offsets in NSW (DECC, 2008) and the *Commonwealth Draft Policy Statement: Use of environmental offsets under the Environment Protection and Biodiversity Conservation Act 1999* (DEWR, 2007) with the aim to avoid, mitigate or compensate for all identified impacts, as follows:

- Avoid: to the extent possible, developments will be designed to avoid or minimise ecological impacts;
- Mitigate: where certain impacts are unavoidable through design changes, mitigation measures will be introduced to ameliorate the ecological impacts of the Project; and
- Compensate: the residual impacts of the Project, following the implementation of mitigation measures, will be compensated to offset what will otherwise be a net loss of habitat.

Each of these principles have been applied to the Project and addressed where feasible and reasonable, as discussed below.

Avoid

Avoiding environmental impacts has been incorporated, where possible, throughout the Project planning and design phases to improve biodiversity outcomes. This included restricting mining operations from the Breeza State Forest, Watermark Gully, Mt Watermark and the alluvial black soil plains. In particular, the OEA of the Eastern Mining Area was modified to avoid impacts to 143 ha of CEEC. The mine plan and MIA adopted for the Project achieves the minimum practical Disturbance Boundary whilst still allowing access to the minable coal resource. Pipelines and other water management infrastructure will also be designed to avoid potential impacts to fish and larvae.

Further avoidance of impacts will be achieved, where possible, during the detailed design phase of the Project infrastructure layout.

Mitigate

Biodiversity Management Plan

As part of the EMS for the Project, Shenhua Watermark will develop and implement a Biodiversity Management Plan that will be prepared to the approval of DP&I. The plan will incorporate a number of management and mitigation measures to minimise any adverse impacts to flora and fauna, including:

- Limiting the disturbance of vegetation to the minimum necessary for each stage of pre-strip clearing;
- Delineated clearance areas to avoid unnecessary vegetation and habitat removal;
- Progressively rehabilitating mined areas;
- Implementing a vegetation monitoring strategy, which will provide information to quantify the change in biodiversity over time within the Project Boundary to improve the outcomes of rehabilitation;
- Implementing a threatened flora and flora monitoring program, which will identify impacts and changes in threatened species populations over time, determine the success of impact mitigation and conservation measures and highlight areas for improvement;
- Establishing reference sites;
- Fencing;
- Soil conservation;
- Pre-clearance surveys and vegetation clearing protocols;
- Fauna rescue or translocation processes;
- Control and ongoing management of environmental and noxious weeds; and
- Control and ongoing management of feral animals.

Compensate

A Biodiversity Offset Strategy has been developed to compensate for the loss of Box-Gum Woodland and other native vegetation as a result of the Project. **Section 7.11** provides a detailed overview of the Biodiversity Offset Strategy for the Project.

Koala Impacts

Management strategies specific to the predicted impacts to Koalas as a result of the Project are provided below.

Avoid

Avoidance of impacts to the Koala has been achieved to some extent by modification of the Project mine plan design and the location of mine associated infrastructure away from known and potential habitat, where feasible.

The Project mine plan has been adjusted specifically to reduce the potential for adverse impacts to Koala and its habitat. Avoidance measures which have been included into the Project and that are relevant to the Koala and its habitat include the following:

- No disturbance of Breeza State Forest which also represents a large intact patch of vegetation known to support the local Koala population;
- Exclusion of 218 ha of woodland habitat on Mt Watermark, which includes 192 ha of preferred Koala habitat;
- Strategic positioning of the Mine Infrastructure Area to avoid preferred Koala habitat;
- No disturbance on the black soil plains, which represents potential high quality revegetation areas for Koala habitat; and
- Further avoidance of impacts may be achieved during the detailed design phase of the Project.

Mitigation & Management

A suite of general environmental control measures to be implemented for the Project will also assist in mitigating impacts to the local population of the Koala and their habitat. These include:

- Due diligence inspections of proposed disturbance areas in advance of clearing;
- Minimisation of dust emissions;
- Minimisation of noise emissions;
- Surface water management and erosion control structures;
- Night lighting management; and
- Weed and feral animal controls.

Koala Plan of Management

In addition to the more general mitigation measures outlined above, a Koala Plan of Management has been prepared for the Project and is provided in **Appendix L**. The Koala Plan of Management includes detail on the following range of mitigation and management measures for the species:

- **General Koala protection.** Including the appointment of an Environmental Officer and/or Supervising Ecologist responsible for the implementation of the Koala Plan of Management and establishment of signage;
- **Installation of Koala proof fencing,** where necessary;
- **Road design standards.** The design of mine access roads and management strategies for vehicle and machinery movements associated with the Project will take into consideration the potential risks to Koalas, such as speed, and likely road usage levels;
- **Vertebrate pest management.** Vertebrate pests, particularly wild dogs and foxes are potential threats to the local Koala population occurring within the Project Boundary. As such, vertebrate pests will be managed according to the procedures to be developed as part of the Biodiversity Management Plan for the Project;
- **Fire management.** The aim of fire control is to avoid severe fires that could cause significant adverse impacts on individual Koalas. Fire protection will be managed according to the procedures to be developed as part of the Bushfire Management Plan for the Project in consultation with the NSW Rural Fire Service;
- **Monitoring of health.** Monitoring of selected individuals of the Koala population within the Project Boundary and Onsite Biodiversity Offset Areas will be undertaken yearly as part of a scientific study to ensure early detection of an increase in the incidence of disease;
- **Drought protection.** If required, water points or ponds will be installed in areas of retained vegetation and in the Onsite Biodiversity Offset Areas to provide a stable water source for Koalas during droughts;
- **Public education.** Information sheets will be prepared for employees, contractors and their families about their responsibilities to minimise impacts to the Koala at work and home. Funding will also be indirectly offered as part of the Biodiversity Offset Strategy to establish and support research on the Koala in the local area;
- **Staged movement of Koalas.** Pre-clearance surveys and the establishment of suitable barriers (where practicable) will be implemented prior to clearing activities. It is anticipated that these actions will facilitate the natural gradual movement of individuals into movement corridors and rehabilitated habitat patches away from the mining areas;
- **Staged translocation of Koalas.** In the event that some individuals do not relocate voluntarily or various habitat and/or population issues develop, translocation to Offset Biodiversity Areas may be necessary. As clearing rates for Koala habitat may vary due to the fragmented nature of the landscape (see **Table 46**), translocation estimates and areas will need to be reviewed and revised each year;
  - Offset Area 6 (part of the proposed Onsite Biodiversity Offset Areas) has been identified as a suitable translocation area as it contains suitable habitat for Koalas and significant revegetation is proposed, which will create large areas of additional Koala habitat over time. Other areas will be utilised as they become available.
- Any translocation of individuals will follow well defined protocols set out in a Staged Koala Translocation Plan that will be prepared for the Project, including:
  - Staged vegetation clearing plans;
  - Monitoring and analysis of Koala populations dynamics, habitat use patterns or degradation within the Project Boundary;
  - Establishment of timeframes for development of habitats based on population and habitat usage data;
  - Monitoring of threats to individual Koalas and local populations;
  - Assessment of Biodiversity Offset Areas to confirm availability of suitable habitat prior to translocation;
  - Health assessment of Koalas proposed for translocation; and
  - Tagging and monitoring of translocated individuals.
- **Habitat protection.** Conservation and ongoing management of existing vegetation will occur within the Mt Watermark Offset Area and Offset Area 6 (see **Section 7.11**) in order to maintain and improve ecological value and facilitate regeneration of native vegetation that currently contributes to Koala habitat. The objectives for the management of existing vegetation within the Onsite Biodiversity Offset Areas relevant to the Koala are:
  - Maintenance and improvement of the condition of existing preferred habitat;

  - Improvement of derived native grassland to promote natural succession towards woodland or open forest comprising preferred Koala habitat;
  - Revegetation of areas of low diversity native grassland and exotic pasture by replanting trees and shrubs to promote a more rapid regeneration towards forest or woodland comprising preferred Koala habitat; and
  - Improvement of habitat connectivity across offset lands, and from offset lands to adjacent native vegetation, such as Breeza State Forest, and mine rehabilitation in order to improve Koala movement in the long term.

- **Habitat revegetation and enhancement.** Significant revegetation will occur within the Onsite Biodiversity Offset Areas in order to establish extensive areas of Koala habitat (3,947 ha), including revegetation along the Mooki River. A key objective of this revegetation is to provide future habitat for the local population of the Koala, including planting feed trees to enhance existing movement corridors and developing additional corridor options;
  - Revegetation of the Mooki River Offset Area will assist in the provision of habitat in proximity to water resources. Provision of habitat in proximity to water resources is considered a significant contribution as studies have shown that during drought conditions, Koalas move from drier areas to the vegetation along creeklines and rivers where soil moisture is higher (Reed et al., 1990).
- **Mine Site rehabilitation.** Mine site rehabilitation will be an important component in the management of the populations of the Koala on the Liverpool Plains (Lunney et al., 2012b). Significant portions of the Eastern, Western and Southern Mining Areas disturbed by mining activities will be progressively rehabilitated over the life of the Project as Koala habitat (2,357 ha). The principle objective of the Rehabilitation and Mine Closure Strategy will be to recreate and establish, as best as possible, a self-sustaining post-mining landscape that resembles the original vegetation communities that are able to support the local population of the Koala. Such revegetation has been shown to provide habitat for Koalas in the Gunnedah region within 10 to 20 years after planting;
- **Population monitoring and reporting.** The Koala population within the Project Boundary and Onsite Biodiversity Offset Areas will be monitored (yearly) over the life of the Project. The objectives of the monitoring program will be to establish robust baseline population levels, identify changes in population and monitor the effectiveness of the mitigation and offset measures. Monitoring will involve radio tracking, SAT plots surveys, reporting of injuries and habitat assessments; and
- **Key performance indicators.** To measure the effectiveness of the Koala Plan of Management, key performance indicators have been defined, including:
  - Clear and supportable evidence of a self-sustaining Koala population during operation and post-mining;
  - Nil or minimal evidence of adverse impacts on the local Koala population as a direct or indirect result of the Project during the life of the Project;
  - A measurable increase in the extent of known and potential Koala habitat within the Project Boundary and Onsite Biodiversity Offset Areas;
  - An increase in the proportion of Core Koala Habitat within the Project Boundary and Onsite Biodiversity Offset Areas following completion of the Project;
  - Increased connectivity between areas of Koala habitat in the Project Boundary and Onsite Biodiversity Offset Areas; and
  - No increase in threats to Koalas with any threats appropriately managed within the Project Boundary and Onsite Biodiversity Offset Areas.

Onsite Revegetation

Significant revegetation is proposed to occur within the Onsite Biodiversity Offset Areas in order to establish extensive areas of woodland and add to habitat in the local area. An estimated total of 5,770 ha of land is proposed to be revegetated within the Onsite Biodiversity Offset Areas. One the key objectives of this revegetation effort is to develop future habitat suitable for the local population of the Koala.

The initial priority of the revegetation works will be the planting of feed and shelter trees to enhance existing movement corridors and develope additional corridor options. Feed tree species utilised within revegetation works will primarily be comprised of those species currently occurring within the Project Boundary, including *Eucalyptus populnea* (Poplar Box) and *E. albens* (White Box).

Within the Mooki River Offset Area, the primary canopy species to be planted will be *E. camaldulensis* (River Red Gum) which is a primary feed tree species. Works will be undertaken in conjunction with the Namoi CMA or Liverpool Plains Land Management Committee (or similar group) to enhance the riparian corridor and plant River Red gums along the river. These are preferred trees for the Koala and riparian vegetation is highly important as refuges from drought and severe weather conditions.

Over time, the provision of additional areas of habitat within the revegetated areas would facilitate the movement of Koalas from areas subject to disturbance by the Project to more favourable and potentially less stressful habitat, such as Mt Watermark or Breeza State Forest. These plantings will be undertaken early in the Project life using advanced tree stock and will focus on known Koala feed tree species in the area. All such plantings will be actively managed to maximise both survival and growth rate.

Revegetation of the Mooki River Offset Area will assist in the provision of habitat in proximity to water resources. Provision of habitat in proximity to water resources is considered a significant contribution as studies have shown that during drought conditions, Koalas move from drier areas to the vegetation along creek lines and rivers where soil moisture is higher (Reed et al. 1990).

The proposed revegetation measures are expected to be highly effective in providing significant areas of habitat for Koalas in the medium term (from approximately Year 10 of the Project). Studies in the area have shown that local Koalas frequently utilise planted trees as young as 10 years old (Lunney et al. 2012b), which indicate that planted trees are capable of providing habitat for Koalas in a relatively short period of time. Although there will be a time lag of approximately 10 years between the establishment of tree plantings and use of these areas by Koalas, not all the habitat in the Disturbance Area will be cleared in the first 10 years of the Project (see **Table 46**). As habitat will be progressively cleared within the Disturbance Area over the 30 year life of Project mining operations, the impact of time lag between tree planting and vegetation maturation will be minimised. In the period of time between planting and usage of these areas by Koalas, other habitat within the Project Boundary that is already present and is being protected will be available for use by the Koalas on the site. Accordingly, it is likely that the planting of known feed and shelter trees will be successful in creating large areas of habitat for the Koala as well as linkages between existing areas of habitat. The onsite revegetation works proposed will assist in connecting existing areas of habitat, including old growth trees.

Mine Site Rehabilitation

As discussed in **Section 3** and illustrated on **Figure 10** to **Figure 17**, rehabilitation of active mining areas and OEAs will be undertaken progressively over the life of the Project. A key objective of the rehabilitation strategy will be to recreate and establish, as far as possible, a self-sustaining post-mining landscape that is consistent with the original vegetation communities present within the Disturbance Area and that is able to support the local population of the Koala in the long term.

Biodiversity Offsets

It was assessed that in the absence of other compensatory management measures, the avoidance and mitigation measures described above would be insufficient to ameliorate all anticipated impacts of the Project to the local Koala population. The conservation of existing Koala habitat and the revegetation of other areas suitable for the re-establishment of additional habitat areas was therefore a key consideration in selecting lands to make up the Biodiversity Offset Strategy proposed for the Project (see **Section 7.11**).

In general, the establishment and ongoing management of Onsite Biodiversity Offset Areas will assist in mitigating impacts resulting from threats such as habitat loss, fragmentation and degradation, climate change and over-browsing. Onsite Biodiversity Offset Areas were also considered as sites for the translocation of Koalas from within the Disturbance Area are also considered.

Specifically, the Onsite Biodiversity Offset Areas comprise four areas that will be managed for conservation, to progressively increase the ecological values of the land. These areas are located both within and immediately adjacent to the Project Boundary and include the following values relevant to conservation of the Koala:

- **Mt Watermark Offset Area**: The Mt Watermark Offset Area contains approximately 192 ha of preferred Koala habitat, with several areas within the area having recorded High Koala activity levels. The eastern portion of this offset area will be fenced to protect Koalas and vegetation from mining activities in the Eastern Mining Area. Revegetation of low diversity native grassland/ exotic pastures within the Mt Watermark Offset Area is scheduled to commence prior to the start of mining operations. Once revegetation works are completed, this offset will provide an estimated 239 ha of preferred Koala habitat;
- **Offset Area 6**: Offset Area 6 will be the primary offset for Koalas impacted by the Project. It is located to the north west of the Project Boundary (including some non-impact areas within the Project Boundary) and has direct connectivity to Breeza State Forest. This offset area currently contains approximately 1,608 ha of preferred Koala habitat. Substantial revegetation of low diversity native grassland/exotic pastures within Offset Area 6 is scheduled to commence prior to the start of mining operations; however, there will be a lag time (approximately 10 years) before new areas of Koalas habitat will be of an age suitable for use by the local Koala population. Once revegetation works are completed, there will be an estimated 5,464 ha of preferred Koala habitat in this area. The restoration of this Offset Biodiversity Area represents a significant increase in Koala habitat in the locality, given the majority of this habitat has previously been cleared for agriculture. Combined with improved corridor linkages to Breeza State Forest, the restoration of Offset Area 6 will help support the persistence of Koala populations in the locality;
- **Mooki River Offset Area**: This offset area is along the Mooki River and currently does not support Koala habitat. Once revegetation works are completed, the offset area will contain an estimated 44 ha of preferred Koala habitat. Although a relatively small area, restoration will include planting of *Eucalyptus camaldulensis* (River Red Gum) which is a primary feed tree species for the Koala. Such revegetation has been shown to provide habitat for Koalas in the Gunnedah region, within 10 to 20 years after planting. The Mooki River Offset Area is particularly important because it is likely to comprise key refuge habitat during times of drought; and
- **Mine Rehabilitation Area**: Significant portions of the Eastern, Western and Southern Mining Areas disturbed by mining activities will be progressively rehabilitated over the life of the Project. The Mine Rehabilitation Area will provide an estimated 2,357 ha of preferred Koala habitat in the long term once revegetation is complete. This area will be monitored over time and the results used to enhance local research into Koala usage of revegetation areas.

7.11 Biodiversity Offset Strategy

7.11.1 Background

A Biodiversity Offset Strategy for the Project has been developed to mitigate the residual impacts on biodiversity in addition to the avoidance and mitigation measures listed in **Section 7.10.5**. Details of the Biodiversity Offset Strategy are provided in **Appendix K**.

Biodiversity Offsets Summary

As discussed above in **Section 7.10**, the Project will result in a Disturbance Area of 4,084 ha of vegetation within the Project Boundary. In order to provide further compensation of the predicted ecological impacts in addition to the direct avoidance, management and mitigation measures described above, a comprehensive Biodiversity Offset Strategy has been developed for the Project to maintain and substantially improve biodiversity values and outcomes at a local and regional scale in the medium to long term, in accordance with relevant State and Commonwealth offsetting principles and guidelines.

To offset the anticipated disturbance to vegetation communities summarised in **Table 44**, Shenhua Watermark is committed to developing a Biodiversity Offset Strategy that maintains and improves biodiversity within the Namoi CMA. The current version of the Biodiversity Offset Strategy includes the acquisition of offset properties for permanent conservation of flora and fauna species, including those predicted to be impacted by the Project, and by provision of indirect offsets. The Offset Strategy targets Box Gum Woodland and Derived Native Grassland and other habitats for all threatened fauna known to occur within the Project Boundary.

The three main components of the Project Biodiversity Offset Strategy include:

- Onsite Biodiversity Offset, comprising:
  - Conservation and ongoing management of existing vegetated land within the Mt Watermark Offset Area and Offset Area 6;
  - Restoration of vegetation communities and associated habitat within the aforementioned offset areas and the Mooki River Offset Area; and
  - Rehabilitation of mined areas.
- Offsite Biodiversity Offset Areas, comprising:
  - Conservation of existing vegetated areas on land near Barraba, NSW; and
  - Restoration of vegetation communities and associated habitat on land near Barraba, NSW.
- Indirect offsets, such as funding for Landcare, targeted research or recovery planning.

The specific values of each component of the Biodiversity Offset Strategy in addressing the regulatory offsetting principles, 'like for like' values and long-term objectives and targets are discussed further below in **Section 7.11.12.**

A summary of the offsets for each vegetation community within the Project Boundary provided by the Biodiversity Offset Strategy is presented in **Table 52**, with direct offset ratios over the life of the Project presented in **Table 53**. An overview of the predicted development of the total offset ratio (i.e. including indirect offsets, rehabilitation areas and Onsite Biodiversity Offset Areas) is provided in **Section 7.11.13**.

In total, the biodiversity offsets will protect 4,647 ha of woodland and derived native grassland, revegetate 6,028 ha of woodland and derived native grassland and rehabilitate 2,384 ha of woodland. This 13,059 ha Biodiversity Offset Strategy includes a total of 6,366 ha of Box Gum Woodland and Derived Native Grassland, 1,759 ha of other listed EECs and 4,890 ha of other woodland vegetation, with the remainder consisting of areas that have previously been disturbed for roads, dams and other infrastructure. The proposed biodiversity offsets also include significant areas of known and potential habitat for the suite of species predicted to be impacted by the Project.

In order to secure the tenure of the lands occupied by each offset, Shenhua Watermark either owns, or is in negotiations to acquire the relevant properties. In order to put a mechanism in place to permanently protect each offset for conservation, one of the following options will be put in place, in consultation with relevant regulatory agencies:

- Conservation agreements between landowners and the Minister for the Environment under the NPW Act;
- Conservation covenants under Section 88 of the *Conveyancing Act 1919*;
- Application to change the zoning regulation that dictates land use; and
- Land acquisition and management of the land under private ownership with conditions of commitment.



Table 52 Summary of Biodiversity Offsets

Vegetation Community (Status)	Location	Impact (ha)	Project Offsets						Offset Ratios			Total Ratio*
			Like for Like	Onsite Offsets - Retained (ha)	Onsite Offsets – Revegetated (ha)	Onsite Offsets – Rehabilitation (ha)	Offsite Offsets – Retained (ha)	Offsite Offsets – Revegetation (ha)	Direct Offsets	Revegetation	Rehabilitation**	
Box Gum Woodland and Derived Native Grassland (C/EEC)*	All Mining and Infrastructure Areas	738	Yes	757	2,801	1,975	575	258	1.8	4.1	1.3	7.3
Inland Grey Box Grassy Woodland (EEC)	Eastern Mining Area, Infrastructure Areas	30	Yes	21	640	46	0	0	0.7	21.3	0.8	22.8
Weeping Myall Woodland (EEC)	Infrastructure Areas	3	Yes	10	461	0	0	0	3.3	153.7	0.0	157.0
Brigalow (EEC)	N/A	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Semi-evergreen Vine Thicket (EEC)	N/A	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fuzzy Box Woodland (EEC)	Eastern and Western Mining Areas, Infrastructure Areas	18	Yes	4	190	36	0	0	0.2	10.6	1.0	11.8
Poplar Box Woodland	Eastern and Southern Mining Areas, Infrastructure Areas	45	Yes	49	293	73	0	0	1.1	6.5	0.8	8.4
Belah Woodland	Infrastructure Areas	1	Yes	37	970	0	0	0	37.0	970.0	0.0	1007.0
Whitewood Woodland	Eastern Mining Area	13	Yes	125	31	27	0	0	9.6	2.4	1.0	13.0
Tumbledown Red Gum Grassy Open Woodland	Eastern Mining Area	16	Yes	0	0	39	0	0	0.0	0.0	1.2	1.2
White Box Shrubby Woodland	Southern Mining Area	24	Yes	941	0	171	0	0	39.2	0.0	3.6	42.8
Regenerating White Box Shrubby Woodland	Southern Mining Area	43	Yes	0	0	0	0	0	0.0	0.0	0.0	0.0
Blakely's Red Gum Shrubby Woodland	Western and Southern Mining Areas	6	Yes	0	0	17	0	0	0.0	0.0	1.4	1.4

* *Note: all Box Gum Woodland vegetation community forms have been combined in this table*

** *Rehabilitation offsets have been discounted by 50%*

Table 53 Direct Project Offsets

Vegetation Community (Status)	Direct Offset Ratios**							
	Year 0	Year 1	Year 5	Year 10	Year 15	Year 21	Year 25	Year 30
Box Gum Woodland and Derived Native Grassland (C/EEC)*	41.6	20.2	6.7	5.7	4.3	3.0	1.8	1.8
Inland Grey Box Grassy Woodland (EEC)	1.9	1.4	0.7	0.7	0.7	0.7	0.7	0.7
Weeping Myall Woodland (EEC)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Brigalow (EEC)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Semi-evergreen Vine Thicket (EEC)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fuzzy Box Woodland (EEC)	4.0	4.0	0.7	0.7	0.7	0.6	0.2	0.2
Poplar Box Woodland	7.0	6.1	4.1	4.1	1.7	1.1	1.1	1.1
Belah Woodland	37.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0
Whitewood Woodland	-	-	9.6	9.6	9.6	9.6	9.6	9.6
Tumbledown Red Gum Grassy Open Woodland	-	-	-	0.0	0.0	0.0	0.0	0.0
White Box Shrubby Woodland	-	-	-	-	-	39.2	39.2	39.2
Regenerating White Box Shrubby Woodland	-	-	-	-	-	0	0	0
Blakely's Red Gum Shrubby Woodland	-	-	-	-	-	0	0	0

** Note: all Box Gum Woodland vegetation community forms have been combined in this table*
*** Offset ratios include retained vegetation only*

7.11.2 Principles and Assessments for Biodiversity Offsets

The State and Commonwealth governments have developed principles for the use of offsets to compensate for impacts of development on biodiversity. The relevant policies and guidelines that are applicable to these principles include:

- The *Principles for the Use of Biodiversity Offsets in NSW* (DECCW, 2008); and
- The *Draft Policy Statement: Use of environmental offsets under the Environment Protection and Biodiversity Conservation Act 1999* (DEWR, 2007).

The Biodiversity Offset Strategy for the Project has been developed to generally comply with these principles and will maintain and substantially improve the biodiversity values at a local and regional scale in the medium to long term.

The NSW government has developed the BioBanking and Offsets Scheme to assist in addressing the loss of biodiversity values, including threatened communities and species, throughout NSW. The BioBanking and Offset Scheme and associated tools (DEC, 2008), along with recent precedents and Commonwealth and State offsetting principles have been used to guide the biodiversity offset requirements for the Project.

7.11.3 Biodiversity Offset Strategy Overview

The Biodiversity Offset Strategy has been developed to address the ecological impacts of the Project in a strategic and meaningful way that will deliver a real biodiversity outcome. The strategy consists of three main components which work together to ensure that the best compensatory outcomes are achieved with the most efficient utilisation of resources and to meet State and Commonwealth offsetting requirements. This involves the targeted acquisition of properties for use as biodiversity offsets, as well as rehabilitation and restoration efforts and provision of indirect offsets.

The three main components of the Biodiversity Offset Strategy are:

- Onsite Biodiversity Offset Areas, comprising:
  - Conservation and ongoing management of existing vegetated land within the Mt Watermark Offset Area and Offset Area 6;
  - Restoration of vegetation communities and associated habitat within the aforementioned offset areas and the Mooki River Offset Area; and
  - Rehabilitation of mined areas.
- Offsite Biodiversity Offset Areas comprising:
  - Conservation of existing vegetated areas on land near Barraba, NSW; and
  - Restoration of vegetation communities and associated habitat on land near Barraba, NSW.
- Indirect offsets, such as funding for Landcare, targeted research or recovery planning.

7.11.4 Onsite Biodiversity Offset Areas

The Onsite Biodiversity Offset Areas are located within or immediately adjacent to the Project Boundary (see **Figure 42**). The land required for the Onsite Biodiversity Offset Areas is currently owned by Shenhua Watermark with exception to the western portion of Offset Area 6. Shenhua Watermark is progressing negotiations with land owners to acquire the remainder of Offset Area 6 prior to the commencement of the Project. If this is not achievable other offset areas of comparable ecological value will be secured. Several strategic values of the Onsite Biodiversity Offset Areas have been identified and include:

- They are proximate to the location of the Project;
- They contain comparable, or "like for like" vegetation community types to the vegetation within the Disturbance Boundary. These vegetation communities are currently in reasonably good condition but are currently not managed for conservation and their ecological value could be improved;
- They contain areas of CEECs, including Box Gum Woodland;
- They contain known habitat for the local population of the Koala and areas proposed for revegetation of habitat to ensure a maintain or improve outcome is met;
- They contain known habitat for a number of threatened fauna species;
- They contain reasonably large areas of woodland that:
  - Constitute valuable habitat for native flora and fauna, particularly those that will be impacted by the Project;
  - Increase the natural regeneration of nearby derived native grasslands and pastures by providing a seed source for recruitment; and
  - Can secure valuable "stepping stone" patches of remnant forest in a largely cleared, agricultural landscape.
- A significant portion of the properties have the potential to be improved and revegetated to provide additional areas of CEECs and habitat for threatened fauna species.

Revegetation and rehabilitation strategies, techniques and management measures are discussed further in **Section 7.21** and in **Appendices K** and **AA**.

A detailed field survey of the Onsite Biodiversity Offset Areas was undertaken by Cumberland Ecology between November 2010 and March 2012 consistent with the work undertaken within the Project Boundary to assess the adequacy of the biodiversity values present.

The majority of the vegetation communities and threatened flora and fauna species occurring within the Onsite Biodiversity Offset Areas are identical to those recorded within the Project Boundary (see **Figure 42** and **Figure 43**). The vegetation communities present in the Onsite Biodiversity Offset Areas represent significant *'like for like'* habitat for threatened flora and fauna species known or considered likely to occur within the Disturbance Boundary.

An additional vegetation community, Dwyer's Red Gum Woodland, was identified within Offset Area 6 and encompasses an area of approximately 13 ha. This community does not conform to any of the vegetation assemblage within the Project Boundary.

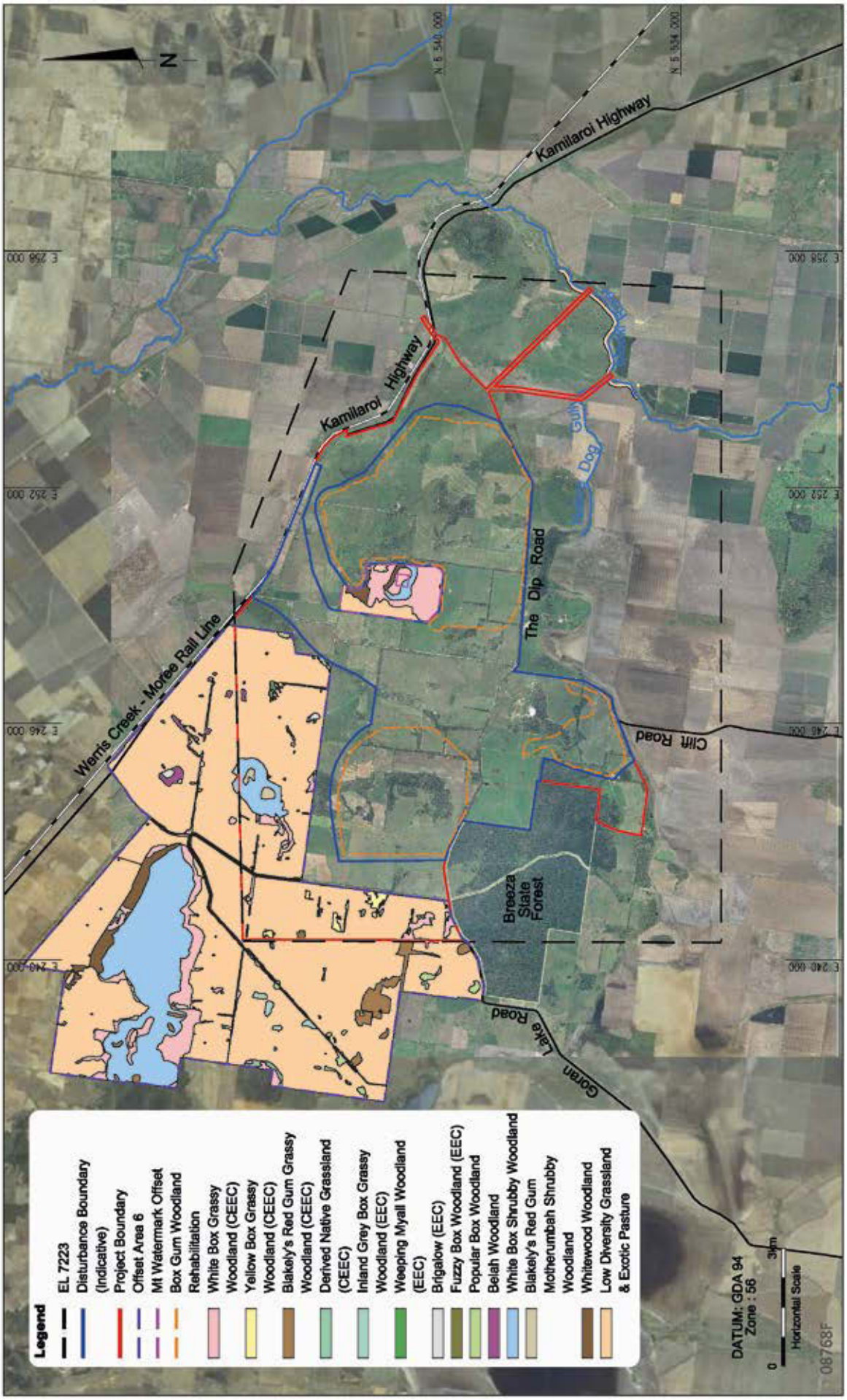
The Onsite Biodiversity Offset Areas offer a combined area of 7,797 ha (excluding rehabilitation of mined areas), including 757 ha of remnant Box Gum Woodland, 46 ha of other remnant EEC listed under the EPBC Act and/or the TSC Act, 1,180 ha of remnant non-listed woodland, and 5,814 ha of low diversity grassland, planted and exotic pasture or cleared areas. The vegetation communities within the Onsite Biodiversity Offset Areas are outlined in **Table 54** and **Figure 42**. Additional revegetation efforts within the Onsite Biodiversity Offset Areas will also assist in improving ecological values.

7.11.5 Offsite Biodiversity Offset Areas

The Offsite Biodiversity Offset Areas are situated adjacent to one another, nestled within the northern reaches of the Nandewar Ranges; approximately 30 km west of the township of Barraba and approximately 100 km north of the Project Boundary (see **Figure 44**). The Offsite Biodiversity Offset Areas connect to the proposed Northern Offset Area for the Maules Creek Coal Project and are indirectly connected to Mount Kaputar National Park and Horton Falls National Park through these offsets.

Several strategic values of the Offsite Biodiversity Offset Areas have been identified and include:

- They contain areas of Box Gum Woodland CEEC;
- They contain known habitat for a number of threatened fauna species;
- The vegetation communities are currently in reasonably good condition but are currently not managed for conservation and as such the ecological value of these properties could readily be improved;
  - They contain reasonably large areas of woodland and forest that constitute valuable habitat for native flora and fauna, including those that will be impacted by the Project;
  - Increase the natural regeneration of nearby derived native grasslands and pastures by providing a seed source for recruitment;
  - Can secure valuable "stepping stone" patches of remnant woodland and forest in a modified landscape;
- Portion of the properties have the potential to be improved and revegetated to provide additional areas of CEECs and habitat for threatened fauna species;
- They build onto existing proposed offset areas (Maules Creek Coal Project – Northern Offsets); and
- They are indirectly connected to Mount Kaputar National Park and Horton Falls National Park through the proposed Maules Creek Coal Project Northern Offsets.

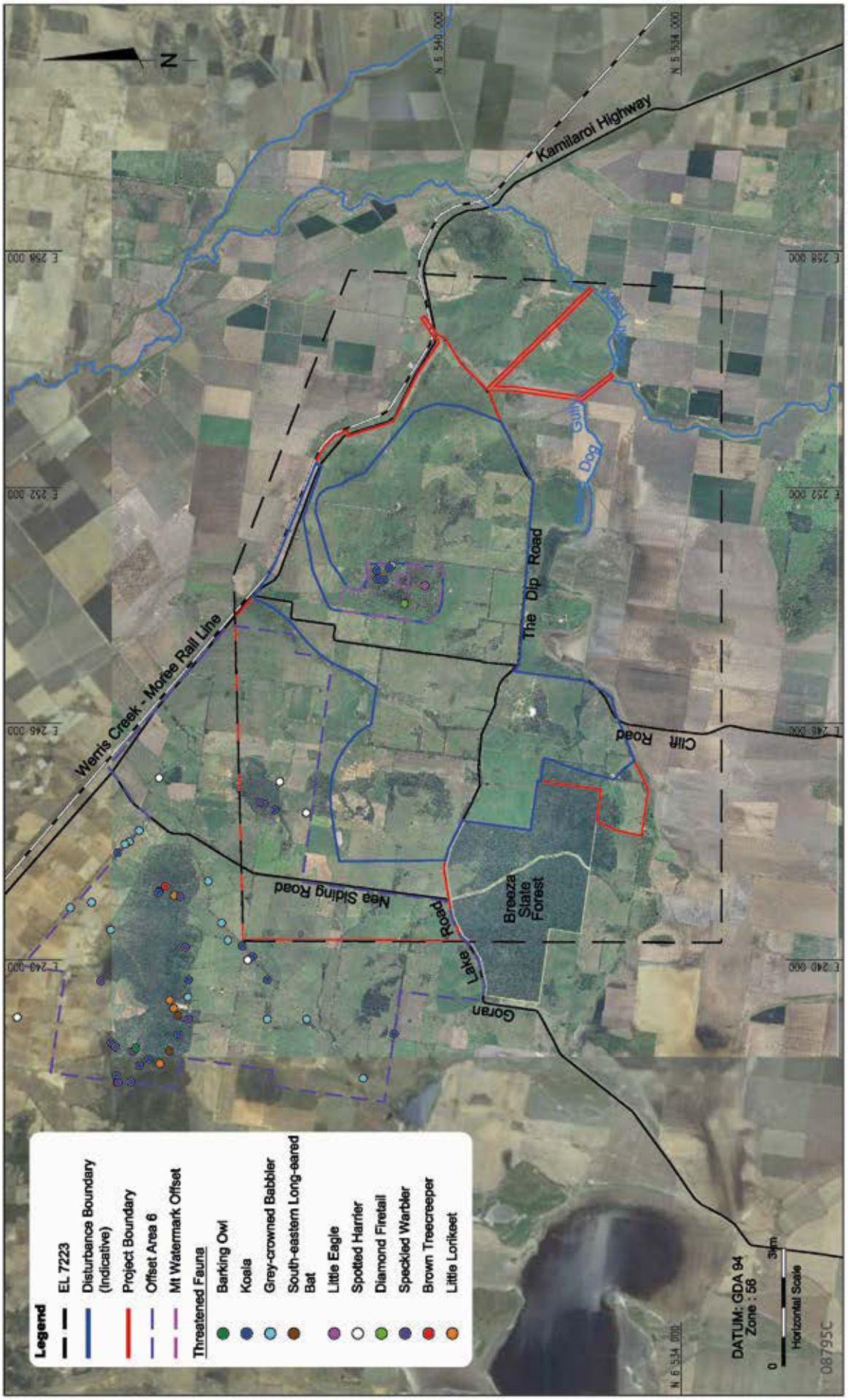


WATERMARK COAL PROJECT

Onsite Biodiversity Offset Areas - Vegetation Communities

FIGURE 42

Hansen Bailey | ENVIRONMENTAL CONSULTANTS

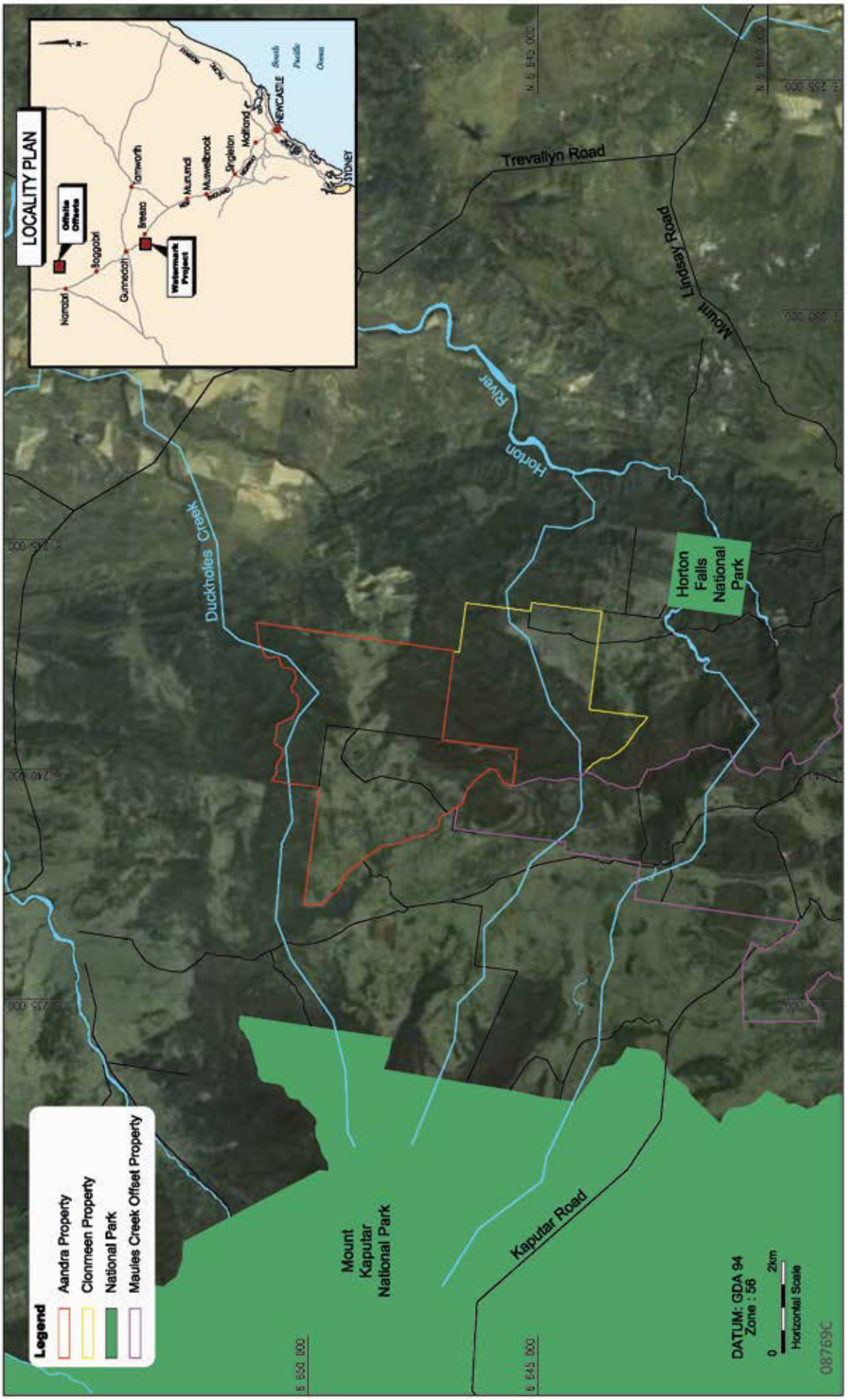


WATERMARK COAL PROJECT

Onsite Offsets - Threatened Flora and Fauna Species

FIGURE 43

Hansen Bailey
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Offsite Biodiversity Offset Areas

FIGURE 44

Hansen Bailey
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Surveys of the Offsite Offset Areas was undertaken by Cumberland Ecology in July 2012 which included preliminary vegetation mapping, quadrat surveys, rapid grassland assessments and diurnal bird survey to assess the adequacy of the biodiversity values present.

Assessment of Offsite Biodiversity Offset Areas

Table 55 lists the vegetation communities that have been identified within the Offsite Biodiversity Offset Areas and provides the status of each as prescribed under the TSC or EPBC Act, as relevant. **Figure 45** illustrates the spatial distribution of vegetation communities within the Offsite Biodiversity Offset Areas.

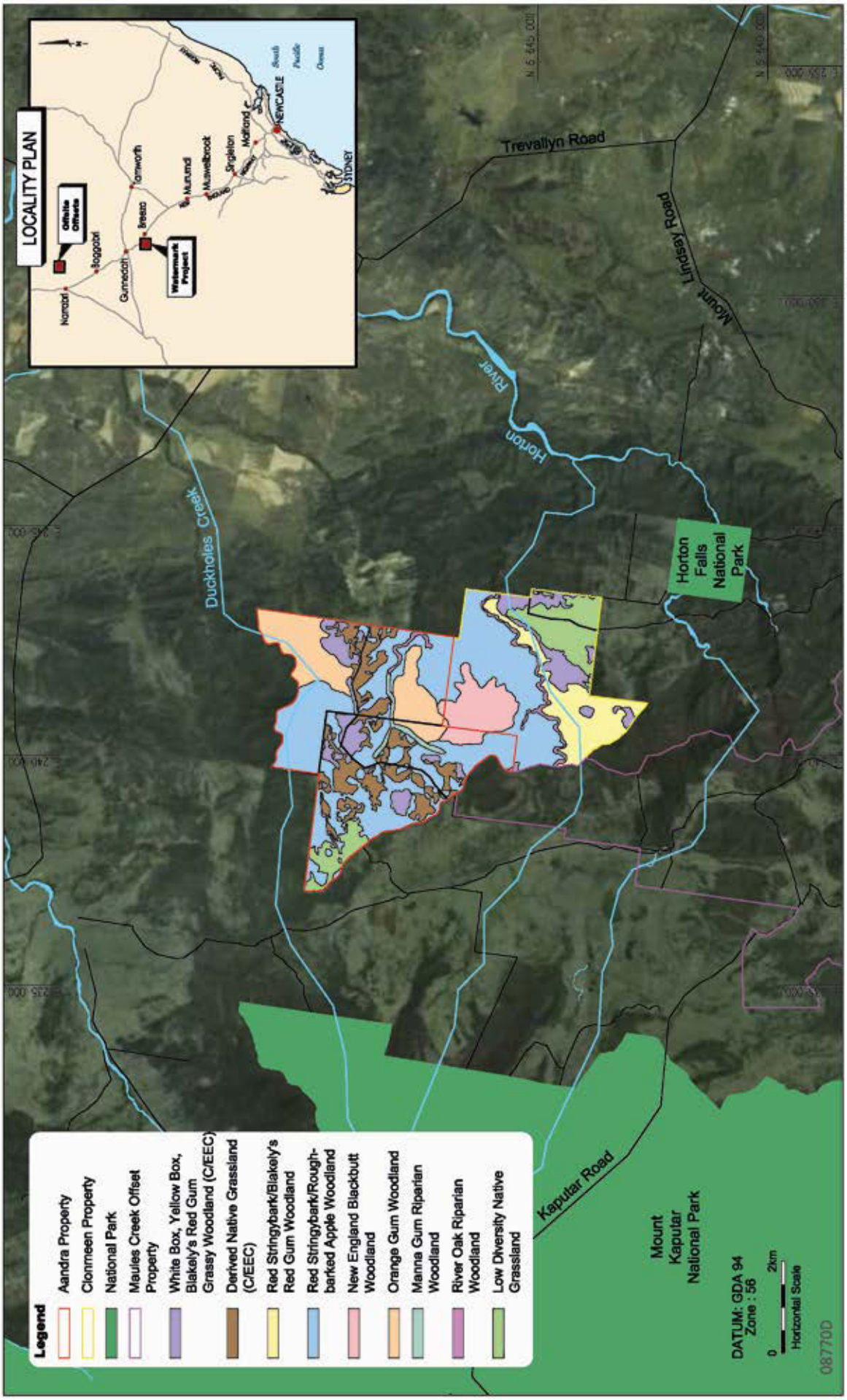
Table 54 Vegetation Types within the Onsite Biodiversity Offset Areas

Vegetation Community	TSC Act	EPBC Act	Onsite Biodiversity Offset Areas (ha)			
			Mt Watermark Offset Area	Offset Area 6	Mooki River Offset Area	Total
White Box Grassy Woodland	EEC	CEEC	166	451	0	617
Blakely's Red Gum Grassy Woodland	EEC	CEEC	0	103	0	103
Yellow Box Grassy Woodland	EEC	CEEC	0	37	0	37
Inland Grey Box Grassy Woodland	EEC	EEC	0	21	0	21
Weeping Myall Woodland	EEC	EEC	0	10	0	10
Brigalow	EEC	EEC	0	11	0	11
Semi-evergreen Vine Thicket	EEC	EEC	N/A*	0	0	N/A*
Fuzzy Box Woodland	EEC	N/A	0	4	0	4
Poplar Box Woodland	N/A	N/A	0	49	0	49
Belah Woodland	N/A	N/A	0	37	0	37
Whitewood Woodland	N/A	N/A	26	99	0	125
Tumbledown Red Gum Grassy Open Woodland	N/A	N/A	0	0	0	0
White Box Shrubby Woodland	N/A	N/A	26	915	0	941
Blakely's Red Gum Motherumbah Shrubby Woodland	N/A	N/A	0	15	0	15
Dwyer's Red Gum Woodland	N/A	N/A	0	13	0	13
Low Diversity Grassland, Planted and Exotic Pasture	N/A	N/A	78	5,648	44	5,770
Cleared Areas	N/A	N/A	0	44	0	44
Total			**296**	**7,457**	**44**	**7,797**

**Area of occurrence is <0.1ha and has therefore not been mapped*

Table 55 Vegetation Types within the Offsite Biodiversity Offset Areas

Vegetation Community	TSC Act	EPBC Act	Total (ha)
White Box/Blakely's Red Gum/Yellow Box Grassy Woodland	EEC	CEEC	274
Derived Native Grassland	EEC	CEEC	301
Red Stringybark / Blakely's Red Gum Woodland	N/A	N/A	244
Red Stringybark / Rough-barked Apple Woodland	N/A	N/A	1,217
New England Blackbutt Woodland	N/A	N/A	181
Orange Gum Woodland	N/A	N/A	322
Manna Gum Riparian Woodland	N/A	N/A	29
River Oak Riparian Woodland	N/A	N/A	52
Low Diversity Grassland, Planted and Exotic Pasture	N/A	N/A	258
Total			**2,878**



WATERMARK COAL PROJECT

Offsite Biodiversity Offset Areas - Vegetation Communities

FIGURE 45

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The Offsite Biodiversity Offset Areas offer a combined area of 2,878 ha, including 575 ha of remnant Box Gum Woodland and Derived Native Grassland, 2,045 ha of remnant non-listed woodland and 258 ha of low diversity grassland, planted and exotic pasture.

Red Stringybark / Rough-barked Apple Woodland dominates the landscape covering almost half of the Offsite Offset Areas. Box Gum Woodland is present to a lesser extent. Although some areas of this community remain intact, historic land use has resulted in the clearing of large areas, which is reflected by occurrences restricted to small pockets at the edge of Derived Native Grassland. This community is dominated or co-dominated by one or a combination of several eucalypt species, including *Eucalyptus albens* (White Box), *E. melliodora* (Yellow Box) and *E. blakelyi* (Blakely's Red Gum).

There are extensive areas of well-connected woodland within the Offsite Biodiversity Offset Areas that provide good quality habitat for a wide variety of threatened species, including those that are predicted to be impacted by the Project. Structural diversity varies across the area with a combination of grassy and shrubby understoreys and both smooth and rough-barked species forming the canopy layer.

The habitat features available are numerous and provide potential foraging, shelter and breeding opportunities for a variety of threatened fauna species. Key habitat features recorded within the Offsite Biodiversity Offset Areas include fallen timber, permanent and ephemeral drainage lines such as Second Water Creek and Noogera Creek, hollow-bearing trees of various sizes, stags, extensive rocky outcrops, nectar-producing trees, mistletoes and primary (*Eucalyptus viminalis*) and secondary (*E. melliodora, E. albens, E. blakelyi, E. prava* and *E. bridgesiana*) Koala feed trees.

The habitats available within the Offsite Biodiversity Offset Areas provide potential habitat for a suite of species listed under the TSC Act and EPBC Act. The following fauna species, listed as Vulnerable under the TSC Act, have been recorded during surveys of the Offsite Biodiversity Offset Areas:

- Little Lorikeet (*Glossopsitta pusilla*);
- Brown Treecreeper (*Climacteris picumnus victoriae*);
- Speckled Warbler (*Chthonicola sagittatus*);
- Varied Sittella (*Daphoenositta chrysoptera*); and
- Scarlet Robin (*Petroica boodang*).

Foraging and nesting resources are also available for a range of threatened bird species, such as the Regent Honeyeater (*Anthochaera phrygia*) and Swift Parrot (*Lathamus discolor*), that are considered likely to occur within the area.

The tree hollows and stags within the Offsite Biodiversity Offset Areas provide potential shelter, roosting and nesting habitat for threatened microbats that are likely to frequent the area, including the Large-eared Pied Bat (*Chalinolobus dwyeri*), Greater Long-eared Bat (*Nyctophilus timoriensis*) and Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*).

7.11.7 Conservation and Ongoing Management of Existing Vegetation

Conservation and ongoing management of existing vegetation will occur within the Onsite and Offsite Biodiversity Offset Areas in order to maintain and improve their ecological value and facilitate regeneration of native vegetation and associated fauna habitat. This will include weed and feral animal management, phased reduction of livestock management, active replanting and reseeding of vegetation and monitoring.

Derived Native Grassland within the Onsite and Offsite Biodiversity Offset Areas has significant floral diversity, including scattered trees and shrubs. It is intended that grazing management, combined with the management of weeds and feral animals would accelerate regeneration of Derived Native Grassland to forest and woodland areas.

Full details of the proposed management activities to be conducted within the Onsite and Offsite Biodiversity Offset Areas will be provided as part of the Biodiversity Management Plan (see **Section 7.10.5**).

7.11.8 Revegetation

Significant revegetation is proposed to occur within the Onsite and Offsite Biodiversity Offset Areas in order to establish extensive areas of woodland. The objectives for the management of existing vegetation within the Onsite and Offsite Biodiversity Offset Areas are:

- Provide future habitat for the local population of the Koala;
- Restore extensive areas of CEEC vegetation, including Box Gum Woodland; and
- Restore extensive areas of habitat for the suite of threatened species impacted by the Project.

Low diversity native grasslands have low diversity of native ground covers and essentially no trees and shrubs. Trees and shrubs will be planted into such areas to form nuclei of regenerating woody habitats that would then be able to progressively grow back into woodland or open forest. Replanting of such areas will take place early in the life of the Project (within the first five years) and it is expected that substantial regeneration of woody plants will occur within the life of the Project.

Local provenance plant species will be utilised when required for revegetation, and additional seed will be collected from native vegetation in the Project Boundary to ensure genetic diversity is maintained. Where possible, topsoil will be translocated from active mining areas to areas being rehabilitated/ revegetated to conserve the native seed bank of local ecological communities. This will improve the quality and diversity of native growth in rehabilitation areas and maximise the establishment of a diversity of native species, particularly the understorey species that maintain the ecological function of native vegetation communities.

7.11.9 Mining Area Rehabilitation

The principle objective of the Project Rehabilitation and Mine Closure Strategy will be to recreate and establish, as best as possible, a self-sustaining post-mining landscape that resembles the original vegetation communities prior to clearing for agricultural purposes and is able to support a diverse range of viable flora and fauna populations. As such, it will focus on the establishment of the threatened ecological communities, including Box Gum Woodland and Derived Native Grassland, Inland Grey Box Grassy Woodland and Fuzzy Box Woodland. Further details on the rehabilitation of the mining areas are provided in **Section 7.21**.

7.11.11 Indirect Offsets

As described in **Section 7.10**, funding will be indirectly offered as part of the biodiversity offset package to establish and support research on the Koala in the local area. Other initiatives that will be funded include:

- Research into improving restoration and management of Box Gum Woodland or other woodland impacted by the Project; and
- Landcare projects or similar that are aimed at restoring flora and fauna habitats within the Namoi catchment.

7.11.12 Consideration of Offsetting Principles

The Biodiversity Offset Strategy has been developed to meet State and Commonwealth offsetting requirements, as specified in **Table 56** and **Table 57**. The tables have been derived from the *NSW Government principles for the use of biodiversity offsets in NSW* (DECC 2008b) and the *Commonwealth Draft Policy Statement: Use of environmental offsets under the Environment Protection and Biodiversity Conservation Act 1999* (DEWR 2007).

7.11.13 Adequacy of the Biodiversity Offset Strategy

The Biodiversity Offset Strategy will provide a total of 6,366 ha of Box Gum Woodland and Derived Native Grassland, 1,759 ha of EECs and 4,890 ha of other woodland vegetation. Rehabilitation of the open cut mining areas is included in these totals; however, a discount factor of 50% has been applied to these areas when calculating the effective offset ratios. This results in the following offset ratios:

- 7.3:1 for Box Gum Woodland and Derived Native Grassland, which is listed as EEC under the TSC Act and CEEC under the EPBC Act;
- 33.7:1 for woodland listed as EEC under the EPBC Act and/or the TSC Act; and
- 31.9:1 for woodland which is not listed under the EPBC Act or the TSC Act.

A summary of the biodiversity offset ratios and commitments to compensate for the impacts on biodiversity values are provided in **Table 58**.

The active management of Onsite and Offsite Biodiversity Offset Areas will substantially increase the biodiversity values of the land for fauna and flora in the medium to long term.

The Project is not relying on a BioBanking compensatory process for offsetting its ecological impacts, however, a comprehensive BioBanking analysis of both the ecological loss and Biodiversity Offset Strategy has been undertaken to confirm its robustness.

The results of the BioBanking assessments for the Disturbance Boundary and the Onsite and Offsite Biodiversity Offset Areas indicate that the Project would require 71,272 ecosystem credits to offset the impacts within the Disturbance Boundary and that the proposed Onsite and Offsite Biodiversity Offset Areas offer a total number of ecosystem credits of 160,770. The offset strategy provides a substantial amount of ecosystem credits beyond the amount required for the Project. The results of the BioBanking assessment indicate that the offset strategy provides:

- 27,853 more ecosystem credits for Box Gum Woodland and Derived Native Grassland than is required;
- 20,195 more ecosystem credits for other EECs than is required; and
- 41,450 more ecosystem credits for other woodland vegetation than is required.

The results indicate that the proposed revegetation and rehabilitation will contribute a substantial amount of ecosystem credits due to the amount of improvement.

7.11.14 Management of Onsite and Offsite Offset Areas

As described in **Section 7.10**, Shenhua Watermark will develop a Biodiversity Management Plan, which provides a framework for the implementation of the mitigation and offset measures, including those required for the Onsite and Offsite Biodiversity Offset Areas. Key objectives of the Biodiversity Management Plan for the management of offsets will be to:

- Maintain and improve the condition of existing forest and woodland;
- Maintain and improve habitat for threatened flora and fauna;
- Improve derived native grassland to promote, natural succession towards woodland and or open forest;
- Revegetate areas of low diversity native grassland by replanting trees and shrubs to promote a more rapid regeneration towards forest or woodland; and
- Improve habitat connectivity across Onsite and Offsite Biodiversity Offset Areas and from these areas to adjacent native vegetation and mine rehabilitation in order to improve wildlife movement in the long term.

Table 56 Consideration of NSW Offsetting Principles

Offset Principles	Comment
1. Impacts must be avoided first by using prevention and mitigation measures. Offsets are then used to address remaining impacts. This may include modifying the proposal to avoid an area of biodiversity value or putting in place measures to prevent offsite impacts.	Changes have been made to the design of the Project to minimise disturbance to established woodland areas, in particular Mt Watermark and Breeza State Forest. The predicted impacts of the Project will be offset by the proposed Biodiversity Offset Areas.
2. All regulatory requirements must be met. Offsets cannot be used to satisfy approvals or assessments under other legislation, e.g. assessment requirements for Aboriginal heritage sites, pollution or other environmental impacts (unless specifically provided for by legislation or additional approvals).	All regulatory requirements for the Biodiversity Offset Strategy will be met.
3. Offsets must never reward ongoing poor performance. Offset schemes should not encourage landholders to deliberately degrade or mismanage offset areas in order to increase the value from the offset.	The offset areas will be managed in accordance with the Biodiversity Management Plan (BMP) to increase their ecological values over time and will not be deliberately degraded or mismanaged.
4. Offsets will complement other government programs. A range of tools is required to achieve the NSW Government's conservation objectives, including the establishment and management of new national parks, nature reserves, state conservation areas and regional parks and incentives for private landholders.	The Biodiversity Offset Strategy will complement other government programs for conservation in that it will address the goals of recovery plans for threatened species and recommendations for management of weeds and feral animals.
5. Offsets must be underpinned by sound ecological principles. Biodiversity management actions, such as enhancement of existing habitat and securing and managing land of conservation value for biodiversity, can be suitable offsets. Reconstruction of ecological communities involves high risks and uncertainties for biodiversity outcomes and is generally less preferable than other management strategies, such as enhancing existing habitat.	The Biodiversity Offset Strategy will: • Enhance and manage existing habitat and secure these habitats for biodiversity; • Regenerate new areas of habitat that will be strategically located near existing habitat to effectively provide larger intact areas of habitat in the longer term; and • Reconstruct and enhance new and existing woodland corridors to connect offset areas.
Offsets must: • Include the consideration of structure, function and compositional elements of biodiversity, including threatened species	The Biodiversity Offset Strategy will enhance, regenerate and protect woodland community types that will be lost, thus ensuring that ecological structure and function of representative communities in the locality will be maintained and improved. This includes replanting with local or endemic species, and protecting and enhancing habitat for a range of threatened species including threatened flora and fauna.
• Enhance biodiversity at a range of scales	The Biodiversity Offset Strategy will enhance biodiversity at a landform scale. The proposed Offset Areas, in conjunction with areas of regenerated woodland, will form a large viable woodland area supporting habitat for a wide variety of species. The Biodiversity Offset Strategy will link the proposed Offset Areas to existing conservation areas and to other habitat areas in the locality to enhance ecological function of habitats. The Biodiversity Offset Strategy will also enhance biodiversity at the local scale by protecting a diversity of habitat types across the Project Boundary, including riparian, forest and woodland vegetation. Under the Biodiversity Offset Strategy, understorey complexity and other habitat features such as logs, stags and tree hollows will be preserved and protected to encourage fauna and flora use of these habitats.
• Consider the conservation status of ecological communities	The Biodiversity Offset Strategy will maintain and improve occurrences of endangered ecological communities and regionally significant plant communities and includes targeted preservation of remaining and regenerated Box Gum Woodland and Derived Native Grassland.
• Ensure the long-term viability and functionality of biodiversity	Offsets will be conserved in perpetuity and will be actively managed during the life of the Project.
6. Offsets should aim to result in a net improvement in biodiversity over time. Enhancement of biodiversity in offset areas should be equal to or greater than the loss in biodiversity from the impact site. Setting aside areas for biodiversity conservation without additional management or increased security is generally not sufficient to offset against the loss of biodiversity. Factors to consider include protection of existing biodiversity (removal of threats), time-lag effects, and the uncertainties and risks associated with actions such as revegetation. Offsets may include enhancing habitat, reconstructing habitat in strategic areas to link areas of conservation value, or increasing buffer zones around areas of conservation value and removal of threats by conservation agreements or reservation.	The Biodiversity Offset Strategy will result in a net improvement in woodland and open forest communities over time, with commensurate benefits to threatened species. The Biodiversity Offset Strategy will protect areas of intact vegetation via an appropriate land zoning or other alternative means for the life of the impact. The Biodiversity Offset Strategy will also enhance existing vegetation through management actions that include removal of grazing, translocation of threatened species to protected areas, and reconstructing habitat corridors to link areas of habitat. The Biodiversity Offset Strategy makes provisions for the regeneration of ecological communities, strategically placed to add to the areas of existing habitat to be protected and enhanced. Under the Biodiversity Offset Strategy, revegetation and rehabilitation works will be implemented progressively over the life of the Project to minimise the impacts of progressive mining across the Disturbance Boundary.

Offset Principles	Comment
7. Offsets must be enduring – they must offset the impact of the development for the period that the impact occurs. As impacts on biodiversity are likely to be permanent, the offset should also be permanent and secured by a conservation agreement or reservation and management for biodiversity. Where land is donated to a public authority or a private conservation organisation and managed as a biodiversity offset, it should be accompanied by resources for its management. Offsetting should only proceed if an appropriate legal mechanism or instrument is used to secure the required actions.	The proposed Biodiversity Offset Areas will be secured by an appropriate land zoning or other alternative means for the life of the impact.
8. Offsets should be agreed prior to the impact occurring. Offsets should minimise ecological risks from time-lags. The feasibility and in-principle agreements to the necessary offset actions should be demonstrated prior to the approval of the impact. Legal commitments to the offset actions should be entered into prior to the commencement of works under approval.	The nature and extent of the Biodiversity Offset will be agreed prior to commencement of the Project. The disturbance will be staged over the life of the Project. Thus, the Biodiversity Offset Strategy will be progressively implemented over the life of the Project to ensure that at every stage of disturbance, impacts are minimised.
9. Offsets must be quantifiable – the impacts and benefits must be reliably estimated.	The Project impacts and Biodiversity Offset Strategy have been assessed using Geographic Information Systems and ortho-rectified aerial photography. The methodology uses ground truthed data to allow for accurate and reliable quantification of the biodiversity losses and gains for the Project.
Offsets should be based on quantitative assessment of the loss in biodiversity from the clearing or other development and the gain in biodiversity from the offset. The methodology must be based on the best available science, be reliable and used for calculating both the loss from the development and the gain from the offset. The methodology should include: • The area of impact; • The types of ecological communities and habitat/species affected; • Connectivity with other areas of habitat/corridors; • The condition of habitat; • The conservation status and/or scarcity/rarity of ecological communities; • Management actions; and • Level of security afforded to the offset site.	The area of impact, types of communities and species to be impacted, extent of existing and future connectivity, condition of habitat and conservation status of ecological communities have been documented. The Biodiversity Offset Strategy makes provisions for the management of the offset areas to ensure that there will be a net benefit in biodiversity values. The proposed Biodiversity Offset Areas will be conserved in perpetuity and will be actively managed during the life of the Project, ensuring that there is a net gain in biodiversity in the wider locality in the long term.
The best available information/data should be used when assessing impacts of biodiversity loss and gains from offsets. Offsets will be of greater value where: • They protect land with high conservation significance;	The proposed Biodiversity Offset Areas have high conservation significance in that they contain endangered ecological communities, habitat for threatened species, known occurrences of threatened species and significant riparian habitats.
• Management actions have greater benefits for biodiversity;	The management actions that are proposed, such as cessation or reduction of cattle grazing, revegetation, weed control and feral animal control have a high probability of providing a significant conservation benefit.
• The offset areas are not isolated or fragmented; and	The habitat within the locality is largely fragmented in its current state. The Biodiversity Offset Strategy aims to reverse fragmentation effects by locating the Offset Areas strategically to effectively provide larger areas of habitat.
• The management for biodiversity is in perpetuity (e.g. secured through a conservation agreement).	The proposed Biodiversity Offset will be secured by an appropriate land zoning or other alternative means for the life of the impact.
10. Offsets must be targeted. They must offset impacts on the basis of like-for-like or better conservation outcome. Offsets should be targeted according to biodiversity priorities in the area, based on the conservation status of the ecological community, the presence of threatened species or their habitat, connectivity and the potential to enhance condition by management actions and the removal of threats. Only ecological communities that are equal or greater in conservation status to the type of ecological community lost can be used for offsets. One type of environmental benefit cannot be traded for another: for example, biodiversity offsets may also result in improvements in water quality or salinity but these benefits do not reduce the biodiversity offset requirements.	The offsets are targeted and will deliver a like-for-like or better conservation outcome for endangered ecological communities and threatened species. Under the Biodiversity Offset Strategy, Endangered Ecological Communities will be targeted, including Box Gum Woodland. Derived grassland will be offset by their woodland community types as woodland habitats have a higher conservation value. Habitat for threatened species identified within the Project Boundary will also be targeted, including the Koala.
11. Offsets must be located appropriately. Wherever possible, offsets should be located in areas that have the same or similar ecological characteristics as the area affected by the development.	The proposed Biodiversity Offsets are located appropriately within the landscape. The Biodiversity Offset Strategy includes offset areas that are located adjacent to the Project Boundary. Thus, the ecological characteristics of these offset areas will be the same as, or very similar to that of the impact areas. Other offsets are located further away, but share the same general characteristics as the Project Boundary and support a similar suite of threatened species.

Offset Principles	Comment
12. Offsets must be supplementary. They must be beyond existing requirements and not already funded under another scheme. Areas that have received incentive funds cannot be used for offsets. Existing protected areas on private land cannot be used for offsets unless additional security or management actions are implemented. Areas already managed by the government, such as national parks, flora reserves and public open space cannot be used as offsets.	The proposed Biodiversity Offsets are supplementary in that they are proposed exclusively for Biodiversity Offset Project and are not already funded or being managed for biodiversity value for another development proposal.
13. Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract. Offsets must be audited to ensure that the actions have been carried out, and monitored to determine that the actions are leading to positive biodiversity outcomes.	The proposed Biodiversity Offsets will be enforceable through development consent conditions and will be auditable to ensure that actions have been carried out.

Table 57 Consideration of Commonwealth Offsetting Policy

Offset Principles	Comment
1. Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action.	The proposed Biodiversity Offsets contain the same EPBC Act listed ecological communities that will be cleared for the proposed action. The regeneration and proposed re-vegetation of the offset areas will increase the area of Box Gum Woodland and Derived Native Grassland currently conserved. They also contain similar habitat for the listed threatened flora/ fauna and migratory species that are known or may potentially occur within the Project Boundary. The offsets will provide extensive areas of ecological communities and habitat that will be managed for long term conservation outcomes, thereby maintaining the viability of the species and communities that will be affected.
2. Suitable offsets must be built around direct offsets but may include other compensatory measures.	The large majority of the proposed offset package consists of direct offsets, however a suite of other compensatory measures are also proposed.
3. Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter.	The proposed offsets are proportionate to the Critically Endangered status of Box Gum Biodiversity Offsets and offer in excess of five times the area of this community to be cleared. This area will also provide habitat for other threatened species, however none have a higher level of statutory protection than Box Gum Woodland. Therefore, the offsets will provide a very high level of protection even for species that have a lower level of statutory protection.
4. Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter.	The Biodiversity Offset Strategy provides over five times the area of Box Gum Woodland and Derived Native Grassland to be cleared as well as at least the same area of habitat for threatened species that will be removed.
5. Suitable offsets must effectively account for and manage the risks of the offset not succeeding.	The risks of the offset not succeeding have been minimised by the provision of a large proportion of direct offsets, and also the advance provision of offsets.
6. Suitable offsets must be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action).	The proposed Biodiversity Offsets are proposed to be used as offsets under the EP&A Act.
7. Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable.	The proposed Biodiversity Offsets are considered to be efficient and effective, as measurable conservation gains will be achieved with reasonable investment of time and money. They are timely as they are being provided in advance of the disturbance (with the exception of rehabilitation which would occur progressively) and are proposed to be long lasting. They are transparent, in that measurable conservation gains will be achieved and monitoring of results will be conducted. They are scientifically robust, and are known to produce conservation outcomes. They are reasonable, and utilise well known approaches for biodiversity conservation.
8. Suitable offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.	A comprehensive BMP has been prepared for monitoring and auditing the performance of the offset lands and rehabilitation undertaken within the Project Boundary.
9. In assessing the suitability of an offset, government decision-making will be informed by scientifically robust information and incorporate the precautionary principle in the absence of scientific certainty.	Not relevant to this assessment.
10. In assessing the suitability of an offset, government decision-making will be conducted in a consistent and transparent manner.	Not relevant to this assessment.

Table 58 Biodiversity Offset Ratios

Collective Vegetation Community	Disturbance Area (ha)	Onsite and Offsite Biodiversity Offset Areas (ha)				Offset Ratio*
		Retained	Revegetated	Rehabilitated	Total	
Box Gum Woodland and Derived Native Grassland	738	1,332	3,059	1,975	6,366	7.3:1
Other Listed Woodland	51	46	1,631	82	1,759	33.7
Non-listed Woodland	148	3,225	1,338	327	4,890	31.9
Low Diversity Grassland, Planted and Exotic Pasture	3,084	N/A	N/A	N/A	N/A	N/A
Cleared Areas	63	44	N/A	N/A	44	N/A
Total	**4,084**	**4,647**	**6,028**	**2,384**	**13,059**	**N/A**

* *Rehabilitation offsets have been discounted by 50%*

Conservation and ongoing management of existing vegetation will occur within the Onsite and Offsite Biodiversity Offset Areas to maintain and improve their ecological value and facilitate regeneration of native vegetation and associated fauna habitat. This will include weed and feral animal management, phased reduction of livestock management, active replanting and reseeding of vegetation and ongoing monitoring.

Security of Onsite and Offsite Biodiversity Offset Areas

The Onsite and Offsite Offset Areas will be permanently protected using an appropriate mechanism. There are a number of options that are available to permanently protect land for conservation, including:

- Conservation agreements between land owners and the Minister for the Environment under the NPW Act;
- Conservation covenants under Section 88 of the *Conveyancing Act 1919*;
- Application to change the zoning regulation that dictates land use; and
- Land acquisition and management of the land under private ownership with conditions of commitment.

A final decision on the method of security for Onsite and Offsite Biodiversity Offset Areas will be made by Shenhua Watermark in consultation with the relevant agencies.



7.12 Stygofauna

7.12.1 Background

A Stygofauna Impact Assessment was undertaken by Eco Logical and is provided in **Appendix U**. The purpose of the assessment was to determine the potential impacts on stygofauna and to recommend measures to mitigate and manage these impacts.

7.12.2 Methodology

Desktop Assessment

A desktop assessment was undertaken to determine the likelihood of stygofauna occurring within the Project Boundary and immediate surrounds. This involved a review of available hydrogeological, geological and water quality monitoring data and previous stygofauna studies.

The Narrabri and Gunnedah Formations within the Upper Namoi alluvium were identified as potentially suitable aquifers in the vicinity of the Project Boundary to host stygofauna. The Narrabri Formation is the uppermost aquifer and is a typical clay dominated aquitard with highly variable salinity concentrations. The underlying Gunnedah Formation is composed of porous sand and gravel with fresh to slightly brackish groundwater.

Sampling Program

As no previous stygofauna studies had been undertaken within the Project Boundary or the immediate surrounds, the occurrence of suitable aquifer habitat was used as a guide to develop a sampling program in conjunction with the specifications described in the *Sampling methods and survey considerations for subterranean fauna in Western Australia* (WA EPA, 2007). Electrical conductivity (EC) was also considered during development of the sampling program with preference given to bores with favourable EC values for stygofauna occupation (i.e. EC < 5,000 uS/cm).

A total of 20 bores were sampled within the Project Boundary and the immediate vicinity. For all cased bores with an internal diameter of 50 mm to 150 mm, samples were collected using the combined net and pump method, where suitable (Hancock and Boulton, 2009). For wells and unlined bores, samples were collected with a net only.

The water level at each bore was recorded prior to sampling followed by the measurement of pH, EC, temperature and dissolved oxygen concentration after pumping 10 L, 50 L and then every 50 L thereafter.

Samples collected were sorted, counted and identified to a species level, where possible.

7.12.3 Impact Assessment

There was no occurrence of stygofauna within the Project Boundary and its surrounds recorded during the sampling program. However, in following the precautionary principle, a review of the potential impacts on stygofauna as a result of the Project was undertaken.

The measured parameter most likely to influence stygofauna survival is EC (less than 5000 μS/cm). The EC measured in groundwater from the Permian aquifers ranged from 1,396 to 32,350 μS/cm. The EC of groundwater collected from the weathered Permian aquifer ranged between 4,509 and 33,010 μS/cm. The EC of groundwater collected from the Narrabri Formation alluvial aquifer ranged between 4,012 and 26,430 μS/cm. The EC of groundwater collected from the Gunnedah Formation ranged between 1,618 and 4,897 μS/cm.

Therefore, the Gunnedah Formation alluvial aquifer was considered to be the most likely aquifer to potentially contain stygofauna because of the low EC measurements and coarse sediments that provide space for stygofauna occupation, however neither of the samples collected from these bores contained stygofauna.

Hydrogeological modelling indicates that the Project will have maximum drawdown of 3.5 m in the Gunnedah Formation. The majority of this drawdown is less than 2 m and extends to a maximum radial extent of less than 4 km from the Project (see **Section 7.1**). This level of drawdown is within the natural fluctuating range of the water table and will be unlikely to significantly impact on any stygofauna if they occurred in the Project Boundary or in the immediate vicinity. Further, no significant change to groundwater quality is predicted to potentially impact on any stygofauna if they occurred in the Project Boundary or in the immediate vicinity (see **Section 7.1**).

7.12.4 Mitigation and Management

As it is unlikely that significant stygofauna communities occur within the Project Boundary or immediate surrounds, and as the Project is unlikely to cause major changes to the groundwater conditions of the Gunnedah Formation, no mitigation and management measures for stygofauna are required.

7.13 Aboriginal Archaeology

7.13.1 Background

An Aboriginal Archaeology Impact Assessment was undertaken by AECOM Australia Pty Ltd (AECOM) and is provided in **Appendix O**. The purpose of the assessment was to identify Aboriginal archaeological resources within the Project Boundary, assess the potential impacts of the Project on these resources and, in consultation with RAPs suggested recommendations to mitigate and manage these impacts.

In conjunction with AECOM's Aboriginal Archaeology Impact Assessment, an Aboriginal Cultural Heritage Values Assessment was undertaken by Connect for Effect and is provided in **Appendix P**. The purpose of the assessment was to gain an understanding of cultural values associated with the land in the Project Boundary. Both assessments involved extensive consultation with the RAPs (see **Section 7.14**).

A synopsis of the Aboriginal Archaeology & Cultural Heritage Assessments completed for the EIS is presented in **Appendix N** which provides a succinct summary of each of the studies undertaken to assess the Aboriginal Archaeological and Cultural Heritage values and impacts associated with the Project.

A consolidated list of the Aboriginal Archaeological and Cultural Heritage management recommendations and commitments is also presented in **Appendix N**.



7.13.2 Methodology

Desktop Assessment

A comprehensive desktop assessment was undertaken and involved:

- A review of existing Aboriginal archaeological assessment reports and publications, to assess the current status of Aboriginal archaeology relevant to the region and local area. This was used to provide a basis for developing a predictive model for the land within the Project Boundary;
- A search of the OEH AHIMS database for all registered sites within the vicinity of the Project Boundary; and
- A review of landscape character and land use history, which influences patterning of sites.

The desktop review revealed that previous Aboriginal archaeological investigations within the Project Boundary were limited to a series of targeted field inspections carried out as part of a due diligence assessment for exploratory drilling activities within EL 7223. As part of this assessment, six putative Aboriginal archaeological sites were identified within the Project Boundary. All of these sites are currently registered on the AHIMS database.

Further afield, a number of Aboriginal archaeological assessments have previously been undertaken in the Gunnedah Basin, with the majority concentrated in areas to the north of Gunnedah. These assessments were identified as relevant to the local area in terms of understanding the potential Aboriginal archaeological resources of land within the Project Boundary.

An initial search of the AHIMS database was undertaken to identify registered Aboriginal sites within a 22,500 ha area centred on the Project Boundary. A separate search of the AHIMS database was later undertaken to assess the cumulative impacts of the Project. This assessment quantified the impact of the Project on the known Aboriginal archaeological resource of an arbitrary 160,000 ha study region centred on the Project Boundary and encompassing the townships of Spring Ridge, Curlewis, Breeza and Caroona. An arbitrary study region was employed in view of the significant limitations imposed by the quantity and quality of Aboriginal archaeological data available on the AHIMS database for the North West Slopes and Plains region of NSW.

The AHIMS database represents only a fraction of the total Aboriginal archaeological resource within the region as it relies on previous Aboriginal archaeology assessments, which have been limited in the area to date. As such, a review of aerial photographs, topographic maps and Geographical Information System data was undertaken to identify the potential Aboriginal archaeological resource of the study region and also to provide a better understanding of the cumulative impact of the Project.

Information sourced from the review of previous assessments and the AHIMS database was used to develop a predictive model of site types and associated content, distribution and integrity within the Project Boundary for which the field survey focused on.

Field Survey

Field surveys were undertaken throughout the Project Boundary to:

- Test the predictive model;
- Locate and re-record all AHIMS registered Aboriginal sites;
- Identify unrecorded Aboriginal sites;
- Identify areas that may contain Aboriginal archaeological deposits, irrespective of the presence or absence of surface archaeology;
- Achieve a survey coverage that adequately reflects the variable archaeological potential of differing landform types within the Project Boundary; and
- Obtain sufficient data to facilitate the development of management and mitigation measures for the Project.

Archaeological survey of the Project area was undertaken in two blocks between March 2011 and April 2012. The first and primary block of survey was conducted over a period of 25 days between March and May 2011. The second block was conducted over a period of six days between March and April 2012 and provided an opportunity for the Senior Elders and Elders group to visit key sites.

A targeted survey strategy was adopted for the Project, which involved the division of the Project Boundary into its constituent landform types. A proportional field emphasis was then placed on those considered to have higher archaeological potential (i.e. level-to-gently inclined undulating/inclined flood/drainage plains, gently inclined footslopes and level-to-gently-undulating hills on plateau surfaces). The survey effort across the Project Boundary was guided by the predictive model developed on the basis of the desktop review.

The survey was completed by a combined team of two AECOM archaeologists and up to eight RAPs at any one time on foot and by vehicle. The pedestrian survey involved individuals walking a series of linear transects, generally 80 m wide, within the Project Boundary.

In recognition of disturbance, visibility and access issues, the number, placement and length of each transect were assigned once in the field. Vehicle transects were undertaken in response to poor ground surface visibility and occupational health and safety concerns. Each transect was recorded using a handheld differential global positioning system. Landform characteristics, such as soil type, vegetation and surface visibility, were recorded through descriptive notes and photographs along transects.

All Aboriginal archaeological sites, including areas of subsurface potential and scar trees identified during the survey were recorded to a standard comparable to that required by the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW, 2010). Open artefact sites were defined based on the '*artefacts within 100 m of each other*' concept. Associated site attribute data (e.g. location, type and content) was also documented using AECOM's standard open site recording form in conjunction with photographic records.

Effective coverage data for AECOM's survey suggest that limited surface visibility was a constraint in assessing the surface Aboriginal archaeological record of the Project Boundary. Nonetheless, observations made during survey suggest that a reasonably high sample of exposed ground within the Project Boundary was achieved. Accordingly, AECOM propose that the results of their survey provide a valid basis from which to assess the known and potential Aboriginal archaeological resource of the Project Boundary, to determine probable impacts and formulate appropriate management/mitigation options.

Aboriginal Stakeholder Consultation

Aboriginal stakeholder consultation was conducted in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW, 2010). Aboriginal community consultation for the Project was conducted by a team from Hansen Bailey, AECOM, Shenhua Watermark and Connect for Effect. Hansen Bailey and AECOM conducted consultation for Stages 1 and 2 of the Aboriginal Archaeology Impact Assessment from 31 January 2011 and also conducted ongoing Stage 3 consultation in collaboration with Connect for Effect. This process involved the development and implementation of the methodology for the field survey and guidance for the overall assessment in conjunction with the Aboriginal community. Stage 4 consultation was undertaken by Connect for Effect, Hansen Bailey and AECOM in order to prepare and finalise the assessment reports with input from the RAPs. Further information regarding consultation undertaken with RAPs is presented in **Section 5.5**.

7.13.3 Impact Assessment

Archaeological Resource

A total of 51 new Aboriginal archaeological sites have been identified within / directly adjacent to the Project Boundary (see **Figure 46** and **Table 59**). These comprise 17 artefact scatters, 23 isolated finds, eight potential Aboriginal scarred trees and three grinding groove sites. Six scar-bearing trees identified during the survey were subsequently assessed as being likely non-Aboriginal in origin by a professional Aborist. As such, these are not considered in AECOM's assessment. Pending the results of a third party review these six trees will not be registered on AHIMS nor managed as Aboriginal archaeological sites.

Of the six AHIMS registered sites identified in the desktop assessment, only three were located during the field survey. The unidentified three remaining sites can be considered 'unverified'. One site was validated as an artefact scatter (29-1-0156) whilst the other two sites (29-1-0155 and 29-1-0157) were reassessed as natural stone occurrences. In recognition of the precautionary principle, the assessment considered the unverified three sites representing artefact scatters (29-1-0154, 29-1-0158 and 29-1-0159) that could not be located in the field survey to avoid causing harm to potential Aboriginal archaeology.

Therefore, a total of 55 Aboriginal archaeological sites were identified in the Project Boundary, consisting of the 51 new sites and four AHIMS sites (excluding the two sites which have been reassessed as natural stone occurrences).

Artefact counts for scatter sites range from two to 358 artefacts, with most sites containing less than ten artefacts. Scatters containing more than 100 artefacts are rare, with only two examples (WM-AS1-11 and WM-AS9-11) identified during the field survey.

Potential scar trees were identified as mature natives with various scar forms, including four curved (pre-form) scars, three bark slab (sheet) scars, and one resource extraction scar. Of these scar forms, the resource extraction scar is considered rare on a local and regional scale.

The identified grinding groove sites are associated with exposed sandstone bedrock. WM-GG1-11 is the largest of the three grinding grooves consisting of up to 60 grooves at its southern extent and 14 potential grooves at its northern extent. WM-GG2-11 is a single isolated grinding groove atop Mt Watermark. WM-GG3-12 consists of 20 grooves.

As a result of the Project, a total of 29 archaeological sites within the Disturbance Boundary will be directly impacted, including 27 open artefact scatters and two grinding groove sites. All remaining 26 sites will be conserved (see **Table 59**). No scarred trees will be impacted by the Project.

Cumulative Impacts

The cumulative impact assessment considered the 29 Aboriginal archaeological sites that will be directly impacted with regard to the total known Aboriginal archaeological resource of an arbitrary 160,000 ha study 'region' centred on the Project Boundary (148 sites). This resource comprises of 97 known registered AHIMS sites identified within the broader region and the 51 new Aboriginal archaeological sites identified within the Project Boundary during the field survey.

The impacted sites represent 19.6% of all known Aboriginal archaeological sites within the region, including 42.9% of all known open artefact sites, 8.7% of all known grinding groove sites. Assuming, for the purpose of the cumulative impact assessment, that all 29 Aboriginal archaeological sites are directly impacted as a result of the Project, the loss of these sites would constitute a significant impact to the known identified Aboriginal archaeological resource of the region. However, given that only a fraction of the study region has been subject to archaeological survey, the true impact of the Project on the Aboriginal archaeological resource of the study region is likely to be significantly lower than the percentages derived from calculations involving the AHIMS site data.

The AHIMS database provides only a fraction of the total Aboriginal archaeological resource within the study region. As such, an assessment was undertaken to estimate the potential archaeological resource that may be present in this region.

Following a review of available digital land use data for the study region, AECOM conclude that over 95% of the land within this region has the potential to retain evidence of past Aboriginal occupation.

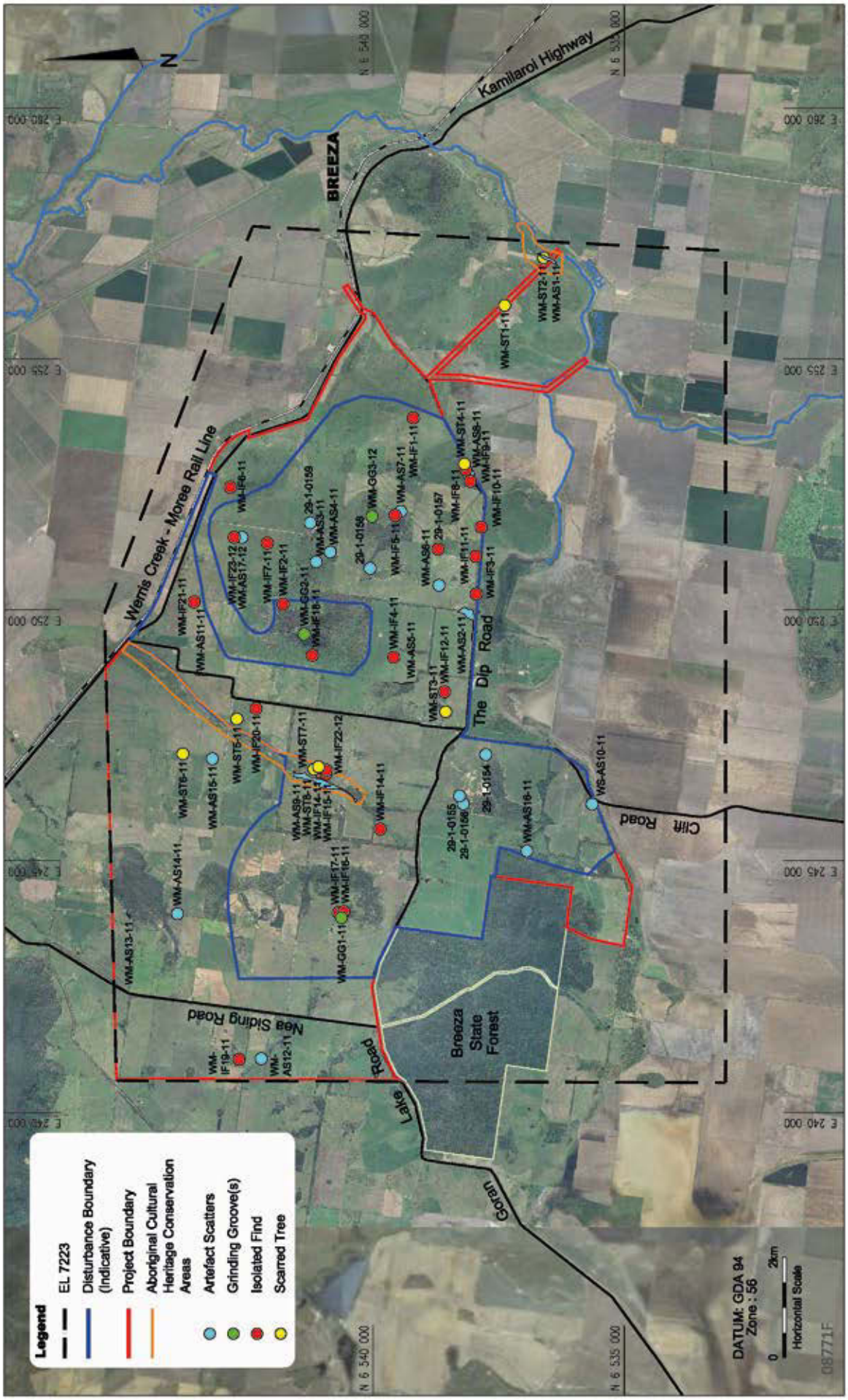

WATERMARK COAL PROJECT
Aboriginal Cultural Heritage Sites and Conservation Areas
FIGURE 46
Hansen Bailey
ENVIRONMENTAL CONSULTANTS
Legend
EL 7223
Disturbance Boundary (Indicative)
Project Boundary
Aboriginal Cultural Heritage Conservation Areas
Artefact Scatters
Grinding Groove(s)
Isolated Find
Scarred Tree
Werris Creek - Moree Rail Line
Kamilaroi Highway
BREEZA
The Dip Road
Cliff Road
New Siding Road
Lake Road
Goran
Breeza State Forest
DATUM: GDA 94
Zone : 56
Horizontal Scale
0
2km
08771F

Table 59 Aboriginal Archaeology and Management

Site ID	Site Type	Scientific Significance
Surface Collection		
WM-AS11-11, WM-AS4-11, WM-AS6-11, WM-AS7-11	Artefact Scatter	Moderate
WM-IF21-11	Isolated Find	Moderate
WM-AS3-11, WM-AS10-11, WM-AS16-11, WM-AS17-12, 29-1-0154, 29-1-0156, 29-1-0158, 29-1-0159	Artefact Scatter	Low
WM-IF1-11, WM-IF3-11, WM-IF4-11, WM-IF5-11, WM-IF7-11, WM-IF10-11, WM-IF11-11, WM-IF13-11, WM-IF16-11, WM-IF17-11, WM-IF20-11, WM-IF23-12	Isolated Find	Low
Surface Collection and Excavation		
WM-AS5-11	Artefact Scatter	High
WM-AS2-11	Artefact Scatter	Moderate
Relocation		
WM-GG1-11	Grinding Groove	High
WM-GG3-12	Grinding Groove	Moderate
Conservation		
WM-AS9-11*, WM-AS1-11†	Artefact Scatter	High
WM-ST4-11, WM-ST7-11*, WM-ST8-11*, WM-ST2-11†	Scar Tree	High
WM-AS13-11, WM-AS15-11	Artefact Scatter	Moderate
WM-IF9-11	Isolated Find	Moderate
WM-ST3-11	Scar Tree	Moderate
WM-GG2-11	Grinding Groove	Moderate
WM-AS8-11, WM-AS12-11, WM-AS14-11	Artefact Scatter	Low
WM-IF2-11, WM-IF6-11, WM-IF8-11, WM-IF12-11, WM-IF18-11, WM-IF19-11, WM-IF14-11*, WM-IF15-11*, WM-IF22-12*	Isolated Find	Low
WM-ST1-11, WM-ST5-11, WM-ST6-11	Scar Tree	Low

** To be conserved in the Watermark Gully Aboriginal Cultural Heritage Conservation Area*
† To be conserved in the Mooki River Aboriginal Cultural Heritage Conservation Area

For the purpose of their assessment, AECOM assumed that there is a complete loss of archaeological potential within the indicative Disturbance Boundary (5,630 ha) for the Project, which comprises 59% of the land within the Project Boundary. AECOM note that there will be an approximate 3.6% decline in the region's potential Aboriginal archaeological resource.

Upon completion of the Project, approximately 94% of land within the region will have the potential to retain Aboriginal archaeology, offering opportunity for the further research, conservation and education. Given the magnitude of the loss, it is concluded that the Project will have a reasonably low impact on the potential Aboriginal archaeological resource of the region.

Significance Assessment

The significance assessment was based on the relevant criteria from the *Burra Charter* (Australia ICOMOS, 1999). A significance assessment attempts to ascertain a relative value of heritage sites. The significance of Aboriginal archaeological sites and places can be determined through two avenues; the assessment of scientific significance by archaeologists and the assessment of cultural or social significance by Aboriginal people.

The cultural significance of Aboriginal archaeological sites identified within the Project Boundary was determined through consultation with RAPs, which is reflected in the Aboriginal Cultural Heritage Values Assessment as described in **Section 7.14** and **Appendix P**.

Scientific value refers to the contribution that the Aboriginal archaeological resource can make to knowledge and understanding of the past. A resource is assessed according to three criteria; rarity, representativeness and research potential. The degree to which it can contribute to knowledge is denoted by a significance rating.

A total of eight sites identified within the Project Boundary were assigned high scientific significance, including three artefact scatters, four scarred trees and a grinding groove site. The most expansive site was that of WM-AS9-11, an artefact scatter located in Watermark Gully, with 358 artefacts identified over an area of approximately 10 ha. WS-AS9-11 is currently the largest and most complex Aboriginal archaeological site known within the 160,000 ha study region assessed by AECOM.

A total of 12 sites identified within the Project Boundary were assigned a moderate scientific significance, including 7 artefact scatters, two isolated finds, one scarred tree and two grinding groove sites. The remaining 35 sites, which are mostly small artefact scatters, isolated flakes and cores and poorly preserved scarred trees common to the study region, were assigned a low scientific significance.

Table 59 lists the scientific significance rating associated with each archaeological site identified in the Project Boundary.

7.13.4 Mitigation and Management

As a result of the Project, a total of 29 Aboriginal archaeological sites within the Project Boundary will be directly impacted. To manage these impacts, Shenhua Watermark will develop an Aboriginal Archaeology and Cultural Heritage Management Plan (ACHMP) in consultation with RAPs, OEH and DP&I. The plan will include:

- Establishment of Watermark Gully and Mooki River Aboriginal Cultural Heritage Conservation Areas;
- A detailed research design for salvage methodologies;
- Detailed salvage methodologies to be carried out, including:
  - Surface collection of select archaeological sites;
  - Combined surface collection and excavation of select archaeological sites;
  - A program of archaeological test pitting and open area excavation in selected areas of low and high archaeological sensitivity within the Project's indicative Disturbance Boundary, as determined through consultation with RAPs; and
  - Relocation of select archaeological sites.
- A staged Aboriginal heritage clearance process for all areas to be disturbed;
- Provision for all archaeological salvage work to be undertaken by, or under the supervision of qualified archaeologists and RAPs;
- Protection and conservation of archaeological sites that are not impacted by the Project by means of fencing and signage;
- Requirements for annual monitoring of protected sites by a qualified archaeologist and RAPs;
- Third party review of aborist assessment of scarred trees (as per RAPs request);
- Identification of the storage location (keeping place) and procedure for the care of salvaged artefacts in accordance with the *Code of Practice for Archaeological Investigation for Aboriginal Objects in New South Wales* (DECCW, 2010);
- Provisions to facilitate continuing access to non-salvaged Aboriginal archaeological sites within and outside of the Disturbance Boundary for archaeological research purposes; and
- Periodic review of the Aboriginal Archaeology and Cultural Heritage Management Plan.

Surface Collection

A surface collection will be undertaken for 25 artefact scatters and isolated finds, which will be directly impacted by the Project, in consultation with the RAPs. This will occur prior to the disturbance of sites.

Surface Collection and Excavation

A surface collection and excavation program will be undertaken at two significant artefact scatter sites; WM-AS2-11 and WM-AS5-11. The program will include topographic surveys and a detailed geomorphological assessment, followed by surface collection and test and open area excavations, which will occur prior to the disturbance of sites.

Relocation

A Geotechnical and Geomorphological Investigation Grinding Grooves Sites was undertaken by SCT and is provided in **Appendix Q**. The purpose of the assessment was to evaluate the effectiveness of relocating two significant grinding groove sites, including WM-GG1-11 and WM-GG3-12, identified as being directly impacted by the Project.

Each site was characterised through the application of 3D photogrammetric imaging, soil hand auguring surveys and bedrock coring.

Based on the composition of the grinding groove slab and the surrounding soil profile, the assessment concluded that the site could effectively be relocated from its current location through manual excavation. The relocation will occur prior to the disturbance of sites.

Detailed salvage methodologies for each site will be developed in consultation with the RAPs and outlined in the ACHMP.

Conservation

In order to reduce the loss of archaeological resources further, Shenhua Watermark has committed to in-situ conservation of 26 sites during the life of the Project. These sites will be identified on site plans and fenced under the supervision of an archaeologist and RAPs, where appropriate.

Shenhua Watermark will commit to the establishment of the Watermark Gully Aboriginal Cultural Heritage Conservation Area (165.7 ha) and the Mooki River Aboriginal Cultural Heritage Conservation Area (40.7 ha) (see **Figure 46**). These areas offer both known and potential Aboriginal archaeological resources and cultural values on land owned by Shenhua Watermark within and adjacent to the Project Boundary.

Provisions for the Aboriginal Cultural Heritage Conservation Areas will be included in the ACHMP.

7.14 Cultural Heritage

7.14.1 Background

An Aboriginal Cultural Heritage Values Assessment was undertaken by Connect for Effect and is provided in **Appendix P**. The purpose of the assessment was to:

- Capture the views, cultural values and statements of RAPs and the broader Aboriginal community relating to site specific cultural heritage and landscape features, land within the Project Boundary and its regional cultural landscape;
- Identify, where possible, ethno historic and historic narrative recording of Aboriginal land use to inform the understanding of past and present Aboriginal associations relating to land within the Project Boundary;
- Provide an assessment of the cultural significance of land within the Project Boundary, considering cultural, historic, aesthetic and scientific values, Aboriginal consultation and research; and
- Recommend Aboriginal cultural heritage management measures.

A synopsis of the Aboriginal Archaeology & Cultural Heritage Assessments completed for the EIS is presented in **Appendix N** which provides a succinct summary of each of the studies undertaken to assess the Aboriginal Archaeological and Cultural Heritage values and impacts associated with the Project. A consolidated list of the Aboriginal Archaeological and Cultural Heritage management recommendations and commitments is also presented in **Appendix N**.

The Burra Charter defines cultural significance as the *"aesthetic, historic, scientific or social value for past, present or future generations"* (Australia ICOMOS, 1999). Cultural significance is thus a subjective concept that helps in understanding why places or objects are important to people today, and why these places or objects will be important to future generations. Aboriginal cultural significance is understood to exist in a variety of forms, including traditional and contemporary perspectives (NPWS, 2002).

The social or cultural value of an Aboriginal place or object can only be identified by Aboriginal people. There is not always consensus regarding the social or cultural value of a place as people experience places or experiences differently. Expressions of cultural or social values vary and in some instances may be in direct conflict.

Land within the Project Boundary is located within Kamilaroi Country, the traditional homelands of the Gomeroi People. On a smaller scale the Project is located wholly within the WLALC boundary. The Project Boundary contains sites and landforms of cultural value to Gomeroi People and to RAPs who identify a range of connections to both Country and community.

7.14.2 Methodology

The assessment of cultural significance was undertaken in accordance with:

- The *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC, 2005);
- The *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW, 2010);
- The *Interim Community Consultation Requirements for Applicants* (DEC, 2004);
- The *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH, 2011); and
- The principles of the *Burra Charter* (Australia ICOMOS, 1999).

Aboriginal consultation regarding the Project commenced in January 2011. As at January 2012, a total of 132 RAPs were involved in the consultation program for the Project. Consultation was undertaken through a range of inclusive engagement approaches, including a series of RAP workshops, site visits, face to face discussions and telephone discussions.

In December 2011, community workshops, family meetings and Local Aboriginal Land Council discussions were held to provide the opportunity for all RAPs, in particular Senior Elders, to participate in the Aboriginal Cultural Heritage Values Assessment process.

RAPs involved identified cultural values and heritage information considering various facets of Aboriginal cultural heritage including:

- The spiritual and social association with the area;
- Historical associations and information passed down through families;
- Flora and fauna and ecosystem considerations;
- Spatial ethnography and use of the land and ecosystems over time;
- Shared land use and unique contributions of Aboriginal people in shaping the current rural context of the region today; and
- Cultural interpretation of the archaeological evidence of the Project Boundary, and its scientific values.

Consultation for the Aboriginal Cultural Values Assessment continued between January 2012 to October 2012 through various Senior Elder and Elder meetings and site visits and RAP workshops. As at October 2012, 144 RAPs were involved in consultation over the Project.

Cultural significance and values expressed by RAPs in relation to the land in the Project Boundary were recorded with respect of Aboriginal cultural sensitivity, diversity and levels of attachment. Details of the consultation undertaken are presented in **Appendix P**.

7.14.3 Cultural Significance

The cultural significance of the land within the Project Boundary was drawn from an analysis of values identified by RAPs, including:

- Aboriginal people retained a strong connection to Country, cultural practices and memories relating to the land;
- Spiritual interactions continue through connection to Country and cultural identity;
- The land was historically used as a traditional camping area by Gomeroi people;
- The land continues to be used for cultural hunting and gathering of medicinal plants and vegetation for bush tucker purposes and gathering of materials for cultural arts;
- Active Aboriginal contributions of the frontier pastoral economy and contemporary pastoral landscape within the Project Boundary, including environmental transformation of the cultural landscape. Pastoralism provided opportunity for communities to retain cultural practices and ceremony;
- The general region has a history of Kamilaroi resistance and organised frontier warfare and as such holds cultural, historic and contemporary significance;
- Water sources, flora and fauna in the Project Boundary are culturally, socially and economically important in traditional and contemporary times;
- Cultural resources associated with the land are identified as having cultural value; and
- Generational connections and local cultural knowledge are ongoing.

The values described demonstrate that RAPs have retained a significant connection to the land within the Project Boundary and its surrounds. The historic, cultural, economic spiritual and societal importance of the land relates specifically to the unique and distinctive culture of the Gomeroi and Kamilaroi people.

Archival and archaeological research also provides tangible evidence that Aboriginal people have continued and enduring cultural connection to the land within the Project Boundary and its surrounds. In this context, RAPs affirm that the land is of high cultural and historical significance, on the basis of:

- The pre-contact cultural landscape that sustained and enriched the Gomeroi people; and
- The shared post-contact experiences of Gomeroi people, other Aboriginal people with historic and contemporary connections to the local area and non-Aboriginal people.

The RAPs assert that the land in the Project Boundary is of high archaeological significance; particularly given the sites identified during the archaeological field survey (see **Section 7.13**). The following sites were deemed to be of high cultural significance and value by Aboriginal people:

- The Watermark Gully area and known sites, including WM-IF14-11, WM-IF15-11, WM-IF22-12, WM-AS9-11, WM-ST8-11 and WM-ST9-11. Three of the sites were also assessed by AECOM to be of high scientific significance;
- Grinding groove complexes;
- Scarred trees; and
- Camping areas along the Mooki River and its significance in terms of the relationship to cultural and ceremonial importance.

Parts of the land within the Project Boundary are also considered to be of moderate to high aesthetic significance, particularly relating to major natural features such as Mt Watermark and the Mooki River and more generally relating to areas that have been less disturbed by agricultural activity.

RAPs expressed concerns regarding the differences between the scientific significance ranking assigned to archaeological sites as described in **Section 7.13** and the cultural significance ranking determined by Aboriginal people.

7.14.4 Impact Assessment

Aboriginal cultural heritage and landscape features of cultural value were identified to have the potential to be impacted. Concerns raised during the consultation regarding the perceived impact of the Project include:

- The Project will impact on recorded cultural sites or landscape features of significant cultural value;
- The Project will impact directly on two sets of grinding grooves identified as having high cultural value;
- The Project may impact unrecorded subsurface cultural sites or items;
- The Project may increase the threat to cultural values, including the loss of animal habitats and the drawdown of watercourses;
- Loss of bush foods, medicinal plants, cultural resources (for art and ceremony), animals and plants;
- Regional inability to access land on which to hunt or gather bush foods and medicinal plants due to changed land tenure. This reflects a core concern regarding the loss of opportunities for knowledge to be passed down from older to younger generations and the inability to retain fundamentally important cultural practices on Country;
- Reassessment of six potential scarred trees and development of management measures relating to these areas;

- Development of protocols for specific areas of heightened cultural sensitivity, particularly the Mooki River Conservation Area; and
- The landscape as a whole becoming unrecognisable as a result of the Project and cumulative development in the region. Such loss of known landscapes is perceived to be a serious threat to Aboriginal cultural heritage, both traditionally and contemporarily, as stories and knowledge are linked to Country.

7.14.5 Mitigation and Management

RAPs suggested mitigation and management recommendations throughout the consultation period for consideration in the development of the ACHMP. Additional input and comments were received during the extended draft comment period. The suggested recommendations reflect the importance of Aboriginal communities having a greater involvement in managing cultural heritage. Key RAP suggested recommendations include:

- Active RAP participation in protection and management of Aboriginal cultural heritage sites and places;
- Developing practical measures for protecting, salvaging or enhancing cultural heritage and environmental values;
- Provision of information to the RAPs on the potential long-term impacts of the Project on the natural environment and recommended management measures; and
- Access to land via a 'Walk on Country' program developed in consultation with RAPs to manage access to known Aboriginal heritage sites and landscape features of Aboriginal cultural heritage value.

Shenhua Watermark will continue to consult with the RAPs throughout the development of the ACHMP for the Project. The consultation will be undertaken and conducted in accordance with the guiding principle of mutual respect for all cultures.

Measures to mitigate and manage the impact on archaeological resources within the Project Boundary will be included in the ACHMP as described in **Section 7.13.4**.



7.15 Historic Heritage

7.15.1 Background

A Historic Heritage Impact Assessment was undertaken by AECOM and is provided in **Appendix R**. The purpose of the assessment was to identify and determine the impacts on historic heritage items and areas of archaeological potential within the Project Boundary and to recommend measures to mitigate and manage these impacts, as required.

Settlement

John Oxley was the first European to explore the area now known as Breeza. In 1818, he and his party passed east, through what is now known as Curlewis; describing the region as "*beautiful and fertile*".

Two of the earliest and most influential runs established in the area were 'Doona' and 'Breeza'. In 1832, 'Breeza' was established by Donald McLaughlin on behalf of Thomas Potter Macqueen. McLaughlin drove bullocks to the current location of Breeza Station and turned operations over to the management of Mr Freeman and William Mitchell. In 1835, Macqueen's agent ordered that 'Breeza' be abandoned, leaving ownership of the property in dispute for the remainder of the century. In 1837, 'Doona' was established by Samuel Clift although he may have selected the land as early as 1835. Clift died in 1862 and his runs were subdivided and transferred to his sons.

Land Use History

The land within the Project Boundary and the surrounding area was historically used for pastoral and cropping purposes. Oral testimony provided by the Bailey and Gaynor families indicated that in recent years, wheat, barley, sorghum, sunflowers, dryland cotton and Durham wheat have been produced in the area.

Coal Mining History

John Perry and a group of Quirindi businessmen established the Wilga Coal and Coke Company in 1914 in the Project Boundary. The mine was approximately 1 km south of The Wilgas Homestead. The mine was forced to close shortly after in 1916 as a result of poor coal quality, and loss of the tender to supply coal to the local railway combined with the impact of World War I.

7.15.2 Methodology

The methodology for the assessment consisted of several components to ensure that all relevant historic heritage items that had a potential to be impacted by the Project were identified and assessed. This included:

- Review of historical and archival research and searches of the relevant Commonwealth and State heritage lists to identify any known heritage items of significance within 5 km of the Project Boundary that may have the potential to be impacted by the Project:
  - One site was located within the 5 km buffer zone. This site is listed as 'Plains Grass' and comprises 12 ha of grassland on the Liverpool Plains.

  - The grassland is dominated by native plains grass *Austrastipa aristiglumis* along with other native species, and a limited number of exotic species. This site is outside of the Project Boundary and will not be impacted by the Project. As such this has not been discussed further in the assessment.

- Discussions with local residents, GSC and members of the Gunnedah District Historical Society to ascertain knowledge in relation to the historical significance of the area within the Project Boundary; and
- Field surveys in April 2011 and February 2012 to identify, record and assess historic heritage sites within and adjacent to the Project Boundary.

The following guidelines have been adopted for this assessment:

- *NSW Heritage Manual* (NSW Heritage Office and NSW Department of Urban Affairs and Planning, 1996a);
- *The Burra Charter* (the Australia ICOMOS charter for places of Cultural Significance) (ICOMOS (Australia), 1999);
- *Assessing Heritage Significance* (NSW Heritage Office, 2001);
- *Heritage Curtilages* (NSW Heritage Office and NSW Department of Urban Affairs and Planning, 1996b); and
- *Levels of Heritage Significance* (NSW Heritage Office, 2008).

7.15.3 Impact Assessment

A total of 18 sites were identified within the Project Boundary, 14 of which were identified as being of historical significance (see **Figure 47**). These sites were not listed on any heritage inventory. An overview of each site and its associated local historical significance are provided in **Table 60**. The development of the Project will result in direct impacts (i.e. removal) to 10 historic heritage sites identified within the Disturbance Boundary as listed in **Table 60**.

Blasting Impacts

Ground vibrations and overpressure associated with blasting have the potential to indirectly impact the structural integrity of the identified historic heritage sites. Findings from the Acoustics Impact Assessment undertaken by Bridges Acoustics concluded that the blast vibration and overpressure generated by the Project will not exceed the recommended criteria at any of the identified heritage sites (see **Section 7.9**).

Visual Impacts

The construction of the Project, including OEAs, rehabilitation and tree screening, will modify the existing visual environment and potentially the visual aesthetics of the landscape surrounding historic heritage items. The Visual Impact Assessment undertaken by JVP Visual Planning and Design describes the likely visual impacts associated with the Project on sensitive receivers in the surrounding area (see **Section 7.17**). Findings from the assessment confirmed that Farm Complex 3, 7, 12 and 13 will experience visual impacts to various degrees over the life of the Project due to the proximity to the Disturbance Boundary:

- Farm Complex 7 – Inverness will experience views to the Southern and Western Mining Areas from approximately Year 21 and the MIA for the life of the Project;
- Farm Complex 3 – The Wilgas will experience views to the Eastern Mining Area during the initial years of operations; and
- Farm Complex 12 – Tilbrook and Farm Complex 13 – Wattle Vale will experience views to the Western Mining Area from approximately Year 25.

When the Project is visible from each of the historic heritage sites it will result in a high visual impact. This impact will be reduced to moderate once OEAs are fully constructed and low to very low as rehabilitation progresses and matures. Once successfully rehabilitated, the elements of the Project will be substantially integrated into the existing landscape and the overall visual impact will be negligible.

7.15.4 Mitigation and Management

The development of the Project will result in direct impacts to 10 historic heritage sites within the Project Boundary. These sites will be removed prior to disturbance subject to the following measures being implemented at each site, where appropriate:

- Archival recordings, including scaled drawings and photographs, prepared in accordance with *How to Prepare Archival Records of Heritage Items* (Heritage Office, 1998) and *Photographic Recording of Heritage Items using Film or Digital Capture* (Heritage Office, 2006);
- Archaeological test excavation to determine nature, extent and significance of archaeological deposits; and
- Archaeological salvage, if warranted by testing.

Blast Management

To ensure all relevant blast vibration and overpressure remain with the recommended criteria, Shenhua Watermark will prepare a Blast Management Plan as described in **Section 7.9**. Prior to disturbance, a dilapidation assessment will be undertaken for the identified historic heritage items listed in **Table 43**.

Visual Impact Management

Several mitigation measures to reduce visual impacts at sensitive viewing locations, including historic heritage sites, have been incorporated into the design and operation of the Project, including:

- Maintaining existing topography (i.e. Mt Watermark, Smokey Point, Black Mountain and a significant hill on the Springhurst property); and
- Progressive rehabilitation of OEA and other disturbed areas.

If required, offsite mitigation measures, such as tree screening or plantings, can be implemented at the site to reduce the visual impact further.

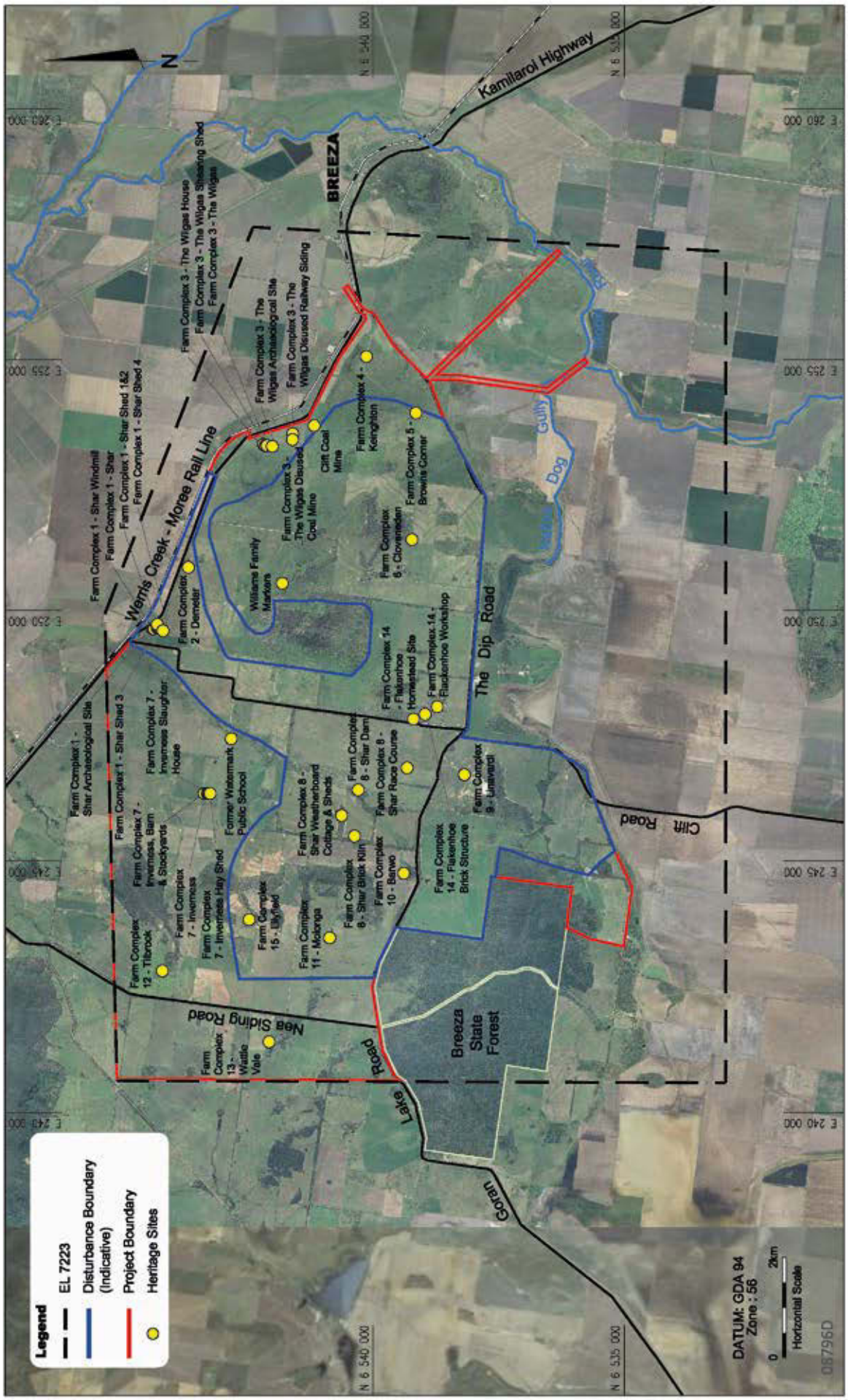

WATERMARK COAL PROJECT
Historic Heritage Sites
FIGURE 47
Hansen Bailey
ENVIRONMENTAL CONSULTANTS
Legend
EL 7223
Disturbance Boundary (Indicative)
Project Boundary
Heritage Sites
N
BREEZA
Kamilaroi Highway
Wenis Creek - Moree Rail Line
The Dip Road
Cliff Road
Nea Siding Road
Lake Goran
Breeza State Forest
Gully
Dog
Farm Complex 1 - Shar Windmill
Farm Complex 1 - Shar
Farm Complex 1 - Shar Shed 1&2
Farm Complex 1 - Shar Shed 4
Farm Complex 3 - The Wilgas House
Farm Complex 3 - The Wilgas Shearing Shed
Farm Complex 3 - The Wilgas
Farm Complex 3 - The Wilgas Archaeological Site
Farm Complex 3 - The Wilgas Disused Railway Siding
Farm Complex 4 - Kerrighton
Farm Complex 5 - Browns Corner
Farm Complex 3 - The Wilgas Disused Coal Mine
Cliff Coal Mine
Farm Complex 6 - Cloverndale
Williams Family Markers
Farm Complex 2 - Demeter
Farm Complex 1 - Shar Archaeological Site
Farm Complex 1 - Shar Shed 3
Farm Complex 7 - Inverness Slaughter House
Farm Complex 7 - Inverness, Barn & Stockyards
Farm Complex 7 - Inverness
Farm Complex 7 - Inverness Hay Shed
Farm Complex 12 - Tilbrook
Farm Complex 15 - Lilyfield
Farm Complex 11 - Molonga
Former Watermark Public School
Farm Complex 8 - Shar Weatherboard Cottage & Sheds
Farm Complex 8 - Shar Brick Kiln
Farm Complex 8 - Shar Dam
Farm Complex 8 - Shar Race Course
Farm Complex 10 - Barwo
Farm Complex 14 - Flakenhoe Homestead Site
Farm Complex 14 - Flackenhoe Workshop
Farm Complex 14 - Flakenhoe Brick Structure
Farm Complex 9 - Unalvardi
Farm Complex 13 - Wattle Vale
DATUM: GDA 94
Zone : 56
0
2km
Horizontal Scale
08796D
E 260 000
E 255 000
E 250 000
E 245 000
E 240 000
N 6 540 000
N 6 535 000

Table 60 Historic Heritage Sites

Site	Description	Significance	Impact Assessment
Farm Complex 1 - Shar	The complex consists of the potential archaeological site of a former homestead, four corrugated iron sheds and a Southern Cross windmill	Historical, research	Direct Impact
Farm Complex 2 – Demeter	The complex consists of a house (including the original 'Vine cottage'), corrugated iron shearing shed, sheep shower, domestic rubbish dump and the (assumed) location of the former Breeza Station boundary rider's hut	Historical, research	Direct Impact
Williams' Family Markers	The site included two boulders in a rock outcrop near the top of Mt Watermark with a northerly aspect. Each boulder has a brass plaque with commemorative details	Significant to the Williams family	Direct Impact
Farm Complex 3 – The Wilgas	The complex consists of a house, corrugated iron shearing shed, potential archaeological site marked by a scatter of glass, metal artefacts and bricks surrounding a mature Kurrajong tree and a disused coal mine and railway siding	Historical, association, research	Indirect Impact
Clift Coal Mine	The site consists of a depression (probably the shaft / tunnel entrance) with adjacent waste rock pile. The depression has been used as a rubbish tip and a collection of c.1970-80s material is visible in the depression	Not of heritage significance	No Impact
Farm Complex 4 - Keinghton	The complex consists of a house and collection of c. 1970s farm buildings	Not of heritage significance	No Impact
Farm Complex 5 – Browns Corner	The complex consists of an open sided shed of modern bush timbers. Adjacent is a stockyard with loading ramp of bush timbers, wire and geo-grid	Not of heritage significance	No Impact
Farm Complex 6 – Cloveneden	The complex consists of a house, earlier cottage, ice house and modern farm buildings	Historical, research, representative	Direct Impact
Farm Complex 7 – Inverness	The complex consists of house, a slaughtering shed, hayshed, barn and stockyards	Historical, research, representative	Indirect Impact
Farm Complex 8 – Watermark	The complex consists of a house, weatherboard cottage, farm buildings, dams, brick kiln and race course	Research	Direct Impact
Farm Complex 9 – Linavaroi Hut	The complex consists of Linarvaroi hut, the outbuildings of Linavaroi house, poultry shed and scattered refuse	Research	Direct Impact
Farm Complex 10 – Barwo	The complex consists of a clad wood cottage, house and farm buildings	Historical, research, representative	Direct Impact
Farm Complex 11 – Molonga	The complex consists of a clad wood cottage, house and farm buildings	Historical, research, representative	Direct Impact
Farm Complex 12 – Tilbrook	The complex includes a two roomed structure likely constructed in the first quarter of the 20th century	Research, representative	Indirect Impact
Farm Complex 13 – Wattle Vale	The Complex includes a modern house, farm buildings, avenue of Osage Orange trees and dams	Rarity	Indirect Impact
Farm Complex 14 – Flakenhoe	The complex consists of the former Flakenhoe homestead, brick rubble and corrugated iron workshop	Historical, research,	Direct Impact
Farm Complex 15 – Lilyfield	The complex consists of a homestead, a collection of farm buildings, including a shearing shed and an existing dwelling and shed that existed on the property approximately 60 years ago	Historical, Research, representative	Direct Impact
Watermark Public School (former)	The School building was a weatherboard structure that was removed from the site sometime after 1918. The former location was covered in dried grass during the field survey, which limited ground visibility. No evidence of the site could be identified	Historical, research	No Impact

Historic Heritage Management Plan

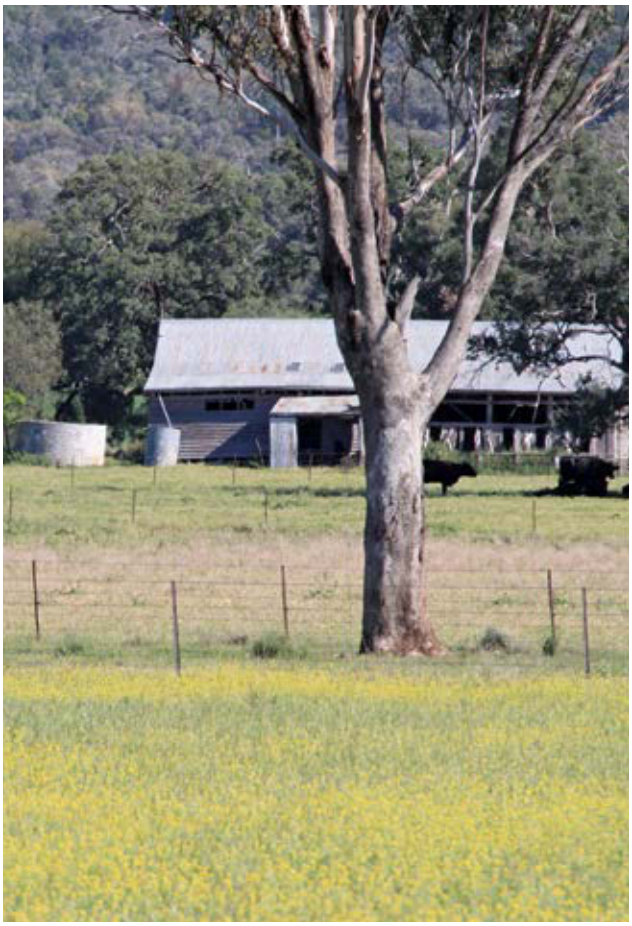
As part of the EMS for the Project, Shenhua Watermark will prepare an Historic Heritage Management Plan, which will include:

- A list and map indicating the location of historic heritage sites identified within to the Project Boundary and the 5 km buffer zone that are subject to the plan;
- A significance assessment and Statement of Significance for each historic heritage site;
- Management and mitigation measures for the visual and blasting impacts, including dilapidation surveys, of historic heritages within 2 km of active mining; and
- Unexpected finds procedure, including a specific procedure for human remains.

Historic Heritage Conservation Management Plan

A Historic Heritage Conservation Management Plan (a component of the overarching Historic Heritage Management Plan) will be prepared to guide the conservation of the following:

- Farm Complex 3 – The Wilgas (plan will be oriented towards the continued occupation of the houses in order to preserve and maintain the Complex); and
- Farm Complex 7 – Inverness (plan will investigate the potential for restoration of the house on the basis of a dilapidation and white ant survey).



7.16 Traffic And Transportation

A Traffic and Transport Impact Assessment was undertaken by DC Traffic Engineering and is provided in **Appendix AB**. The purpose of the assessment was to:

- Quantify road and rail traffic generated during the construction and operation phases of the Project;
- Assess potential impacts on the capacity, efficiency and safety of the road and rail network;
- Identify and assess temporary and permanent road closures as a result of the Project; and
- Recommend measures to mitigate and manage the identified impacts.

7.16.1 Background

Existing Road Network

The regional transport network in the vicinity of the Project is shown on **Figure 1**.

The Kamilaroi Highway is an undivided rural main road under the care and jurisdiction of RMS, which provides an important regional link between Quirindi and Willow Tree in the south and Walgett in the north-west. From the intersection with the New England Highway near Willow Tree, the Kamilaroi Highway passes through the village of Breeza before continuing north-west towards Gunnedah and Narrabri. As at July 2012, the section of the Kamilaroi Highway near the Project Boundary carried approximately 1,500 vehicles / day (RTA, 2004).

The Dip Road is a 15.5 km unsealed local road that runs east - west along the southern portion of the Project Boundary. It extends from the Kamilaroi Highway to Nea Siding Road passing along the northern fringe of the Breeza State Forest. One approach and one departure lane has been provided at each intersection. As at July 2012, The Dip Road carried approximately 30 vehicles / day.

Court Lane is a 7.5 km unsealed local road that passes north to south through the Project Boundary from the Kamilaroi Highway to The Dip Road. One approach and one departure lane has been provided at each intersection. As at July 2012, Court Lane carried approximately 35 vehicles / day.

Nea Siding Road is a local road extending 10 km from the Kamilaroi Highway to The Dip Road. One approach and one departure lane has been provided at each intersection. As at July 2012, the section of Nea Siding Road between the Kamilaroi Highway and The Dip Road carries approximately 50 vehicles / day.

A number of other existing local roads occur within the Project Boundary and the immediate vicinity, including Clift Road, Cull Road, Goran Lake Road, Whitby Road, Rowarth Road, Duddy Road and several unnamed roads.

Existing Rail Network

The Werris Creek-Moree Railway Line connects to the Hunter Valley Rail Corridor and extends in a south-easterly direction meeting the Muswellbrook-Ulan Railway Line at Muswellbrook. South of this junction, the rail corridor continues in a south-easterly direction to the Port of Newcastle via Singleton, Branxton and Maitland.

The current state of the Hunter Valley Rail Corridor is described by ARTC (2012) as having a maximum theoretical capacity for coal haulage of 189 Mtpa. However, when maintenance requirements, surge volume and system reliability are taken into account, the actual capacity of the network is approximately 95 Mtpa (ARTC, 2012).

The Hunter Valley Rail Corridor is currently serviced by a fleet comprised of 43 trains of varying wagon sizes and quantities. There are currently seven train movements per direction per day between Gunnedah and Werris Creek, nine between Werris Creek and Scone, and 12 between Scone and Newcastle. These movements account for coal, other freight and passenger trains.

The Liverpool Ranges at Ardglen present a significant constraint to coal train operations. The steep grades require loaded trains to be "banked" when ascending the grade. This involves the use of additional locomotives. The coupling and re-coupling of wagons and the return paths of the banker locomotive are all factors affecting travel time and hence capacity of this section. At the time of writing, the DP&I had released the DGRs for the Liverpool Ranges Duplication Project. This Project will broadly involve the duplication of 13km of rail track across the Liverpool Ranges including new loops and turnouts, as well as signalling upgrades (DP&I, 2012).

7.16.2 Methodology

The Traffic and Transport Impact Assessment for the Project comprised of the following:

- A review of the existing traffic data, assessments and reports completed in the vicinity of the Project Boundary;
- Forecasts of the road and rail traffic volumes generated by the Project;
- An assessment of the likely traffic impacts during the construction and operational phases of the Project;
- Predicted potential impacts on traffic conditions, level of service and intersection operation;
- An assessment of the cumulative impacts of future traffic, and increased rail movements due to increased coal production within the region;
- An assessment of the potential road safety issues of relevant parts of the road network surrounding the Project;
- A detailed assessment of the potential impacts on road / rail level crossings; and
- Identification of any management and mitigation measures that may be necessary for the Project.

Road Network Conditions

Existing road traffic conditions were ascertained through a review of previous traffic surveys. The Roads and Maritime Service (RMS) conducted numerous traffic surveys between 1980 and 2004 at two locations on the Kamilaroi Highway. The traffic volumes were expressed as annual average daily traffic values, which represent the number of vehicle movements in both directions per day. Annual traffic growth rates were calculated using the data from these traffic surveys. This includes seasonal traffic fluctuations experienced in the region due to agricultural activities. From 1980 to 2004, traffic volumes increased at an average rate of 1.9% per year. The traffic modelling has adopted this growth rate for forecasting increases in background traffic.

To validate the growth rate and measure traffic volumes on local roads in the vicinity of the Project Boundary, an automated traffic survey was undertaken on the Kamilaroi Highway in November 2009, along with midblock tube surveys conducted at three locations along the Kamilaroi Highway and on local roads in July 2012. These results validated the annual growth rate applied in the traffic modelling.

A review of the existing and proposed road and rail infrastructure was undertaken to assess any safety deficiencies in the network. This involved, in part, a review of crash data between 1 July 2005 and 30 June 2011, which is the latest six-year period for which there is fully validated, non-provisional data.

Construction work will be carried out 24 hours a day, seven days a week by 600 full-time equivalent employees and contractors. Of the total construction workforce, 240 employees and contractors will be required on site in any one shift. Transport to and from the site will be via private transfers and shuttle bus.

Mining operations will be carried out 24 hours a day, seven days a week by 600 full-time equivalent employees and contractors. Of the total operations workforce, 150 employees and contractors will be required on site in any one shift. Transport to and from the site will be via private transfers and will typically coincide with shift changes at 7:00 am and 7:00 pm.

The performance of key intersections during the peak construction and operation phase was modelled using SIDRA. The results of the SIDRA model provide an explanation of the key traffic performance indicators, including level of service (LoS), average delay and maximum queue length.

The criteria for intersection performance are outlined in **Table 61**. The investigation of four key intersections was undertaken considering the following indicators of intersection performance:

- Level of service (LoS) which is a criteria related to the average intersection delay. The LoS categories describe the conditions in terms of factors including speed and travel time, freedom to manoeuvre, traffic interruptions, comfort, convenience and safety;
- Degree of saturation (DoS) which is the ratio of demand flow to capacity and therefore the closer to 1.0, the greater the delays and queue length;
- Average intersection delay, which is the difference between interrupted and uninterrupted travel times through the intersection including deceleration, static delays and acceleration; and
- Maximum queue length, which is the greatest number of vehicles waiting at the hold line at any point in time.

Table 61 Intersection Performance Criteria

Level of Service	Average Delay (Seconds per Vehicle)	Description
A	Less than 14	Good
B	15 to 28	Acceptable
C	29 to 42	Satisfactory
D	43 to 56	Near capacity
E	57 to 70	At capacity
F	Greater than 71	Unsatisfactory

Rail Network Assessment

The rail capacity and haulage requirements for the Project have been calculated based on maximum coal production and proposed infrastructure operating rates. With regard to this, the rail requirements for existing and mining operations have provided an indication of the potential cumulative impacts on the rail network.

The assessment also assessed 28 railway level crossings on the Werris Creek – Moree Railway Line and Main Northern Railway to the Muswellbrook junction for their performance and level of safety.

Cumulative Impacts

Approved and proposed projects in the surrounding area were taken into consideration in the assessment of possible future traffic and rail network volumes.

The Liverpool Plains Region has a substantial yield in grain products, cotton, cattle and sheep. Port-bound product is transported by rail or road to either the Port of Newcastle or Port Kembla. Product bound for domestic customers is primarily transported by truck. As such, road and rail traffic movements from agricultural activities were also included in the cumulative assessment.

7.16.3 Impact Assessment

Road Traffic Generated by the Project

Construction Phase

The peak of the Project construction phase will likely occur six months after the start of construction, when up to 240 workers would attend site in any one shift. Thirty percent of the workers would be transported to site by bus, from a central pick up point to the south of the Project (i.e. Werris Creek). The remaining 70% of workers would travel to work by private transport with a 100% car usage factor (i.e. 1 person / vehicle occupancy). Of the workers that would travel to work by private transport, 60% (100 workers) would travel from the north (Gunnedah, Curlewis, and Tamworth via Gunnedah) and 40% (68 workers) would travel from the south (Quirindi, Werris Creek, and Tamworth via Currabulbula and Breeza).

There would be up to 35 one-way heavy vehicle trips generated per day during the peak construction period. The anticipated heavy vehicle movements have been calculated by GHD (2010) for the Project based on the construction activities proposed.

Using the above information, the corresponding traffic volume generation due to construction of the Project at the AM and PM peak is shown in **Table 62**.

Operational Phase

All product coal from the Project will be transported by rail. Therefore the road traffic volumes generated by the Project during the operational period are likely to be due to (i) workers arriving/ departing from work at the start/ end of the work shift, (ii) service vehicles (iii) deliveries including machinery parts, fuel, explosives, and (iv) visitors. The arrival and departure of workers from site is expected to be the dominant source of traffic.

A workforce of up to approximately 600 full-time equivalent employees is anticipated during the peak operational phase of the Project. Maintenance activities, deliveries, coal processing, coal transport and mining operations are proposed to be undertaken 24 hours a day, seven days a week. It is assumed that 25% of the total workforce would work in each shift (i.e. workers would generally work four days on, and have four days off). Sixty percent of the workforce is assumed to travel to the site from the north (Gunnedah, Curlewis, and Tamworth via Gunnedah) and 40% would travel to the site from the south (Quirindi, Werris Creek, and Tamworth via Currabulbula and Breeza) with a conservative 100% car usage factor (i.e. 1 person / vehicle occupancy).

The corresponding traffic volume generation during operation of the Project at the AM and PM peak is shown in **Table 63**.

Regional Road Impacts

Quirindi - West Tamworth Road

A traffic counter indicated that this route carries approximately 2,600 vehicles/day (RTA, 2004). Up to 300 vehicles/hour are estimated to use this road during the highest volume hour of the day.

A midblock level of service analysis for the Quirindi-West Tamworth Road indicated that under a peak hour traffic volume of 300 vehicles/hour, the road would operate under a midblock Level of Service (LoS) of B.

This route offers a reasonable level of safety for the traffic volumes it carries and for its function as a regional link road between Quirindi and Tamworth as major regional towns. It is generally consistent in the design and form of other rural routes of similar function.

Two sensitivity tests were carried out for this road in accordance with the Highway Capacity Manual method (TRB, 2000) to determine how much spare capacity the route has before dropping to a LoS of D or worse. Sensitivity test 1 involved reducing the average travel speed until the outputted LoS became D. This test indicated that the average travel speed would need to drop to less than 70km/h and that this would result if the traffic volume on the road increased to 813 vehicles/hour or more.

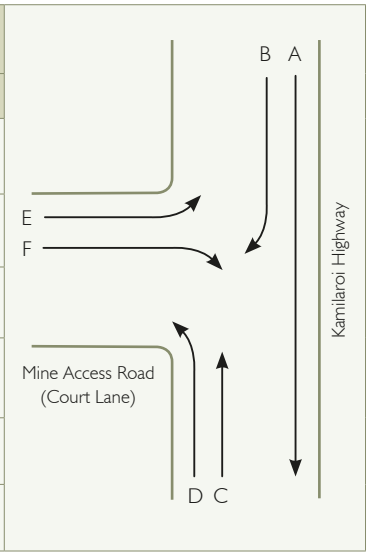
This represents a safety margin of 513 vehicles/hour (difference between 813 and 300 vehicles/hour). As such, there is ample spare capacity along this road to absorb more traffic before conditions deteriorate to LoS D or worse.

Sensitivity test 2 involved increasing the percentage of time that a driver spends following another vehicle until the outputted LoS became D or worse. This test indicated that the driver would need to spend more than 65% of their time following another vehicle for this to occur. This would be experienced if the traffic volumes increased to 452 vehicles/hour or greater. As such, there is sufficient spare capacity (i.e. 152 vehicles/hour) to ensure that midblock LoS remain better than D even under the operational phase of the Project.

As outlined in **Table 63**, the Project would generate approximately 120 vehicles per hour to/from the south of the Project during the operational phase. Furthermore, it is unlikely that all of this traffic would use Quirindi-West Tamworth Road.

Table 62 Kamilaroi Highway/ Mine Access Road – Construction Period Traffic Generation

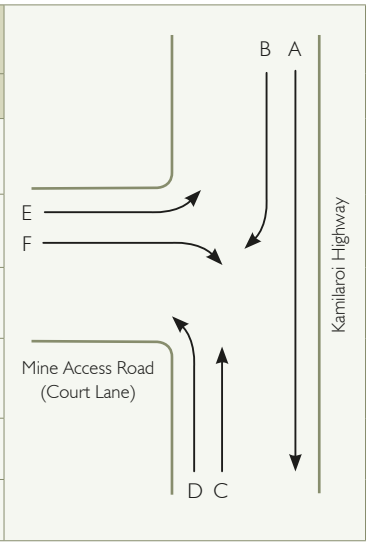
Turning movement code		Background Traffic*		Project Construction Traffic		Total	
		AM	PM	AM	PM	AM	PM
A	↓	191 (27)	159 (23)	0 (0)	0 (0)	191 (27)	159 (23)
B	↘	0 (0)	0 (0)	105 (5)	5 (5)	105 (5)	5 (5)
C	↑	191 (27)	159 (23)	0 (0)	0 (0)	191 (27)	159 (23)
D	↖	0 (0)	0 (0)	77 (9)	9 (9)	77 (9)	9 (9)
E	↗	0 (0)	0 (0)	5 (5)	105 (5)	5 (5)	105 (5)
F	→	0 (0)	0 (0)	9 (9)	77 (9)	9 (9)	77 (9)



Note: Top number is total number of vehicles/hour. Number in brackets is total number of heavy vehicles/hour. 2012 baseline traffic forecast plus 1.9% growth

Table 63 Kamilaroi Highway/ Mine Access Road – Operational Period Traffic Generation

Turning movement code		Background Traffic*		Project Operational Traffic		Total	
		AM	PM	AM	PM	AM	PM
A	↓	255 (36)	210 (30)	0 (0)	0 (0)	255 (36)	210 (30)
B	↘	N/A^	N/A^	92 (2)	92 (2)	92 (2)	92 (2)
C	↑	255 (36)	210 (30)	0 (0)	0 (0)	255 (36)	210 (30)
D	↖	N/A^	N/A^	62 (2)	62 (2)	62 (2)	62 (2)
E	↗	N/A^	N/A^	92 (2)	92 (2)	92 (2)	92 (2)
F	→	N/A^	N/A^	62 (2)	62 (2)	62 (2)	62 (2)



Note: Top number is total number of vehicles/hour. Number in brackets is total number of heavy vehicles/hour.
** 2028 baseline traffic forecast including 1.9% growth*
^ The 2028 volumes for these turning movements are in fact due to the "operational traffic" in the next column. All existing land uses within the Project Boundary will cease to generate traffic, so it is only the Project that will generate these turning movements.

As such, there is sufficient capacity to absorb the Project's traffic and even allow for additional travel demand based on seasonal fluctuations.

Werris Creek-Gap Road

Traffic counts collected in 2004 (RTA) indicate that the Werris Creek – Gap Road carries approximately 500 vehicles/day. With an estimated peak hour traffic volume of 50 vehicles/hour, this road would have substantially more spare capacity (i.e. in excess of 400 additional vehicles/hour) compared with Quirindi – West Tamworth Road. This is more than adequate to absorb the additional Project-related traffic as well as any seasonal fluctuations.

The sensitivity analysis described above for the Quirindi – West Tamworth Road indicated that the hourly traffic volume on a two-lane-two-way rural road in this environment would need to exceed 452 vehicles/hour before the road exhibits a poor LoS of D or worse. As Werris Creek-Gap Road is a similar road type and hence has a similar midblock capacity, there is ample spare capacity in this road to ensure that the midblock LoS remains better than D under the operational phase of the Project.

Breeza - Currabubula Road

There is no traffic volume information available for the Breeza – Currabubula Road. However, from site observations it carries a similar volume of traffic as Werris Creek-Gap Road. It also has a similar configuration (two-lane-two-way, high-speed rural road) and hence midblock capacity as Quirindi-West Tamworth Road and Werris Creek-Gap Road. As such, it can also be concluded from the sensitivity analysis described above that there is ample spare capacity in this route to sustain a midblock LoS better than D even with the Project-related traffic and seasonal fluctuations accounted for.

Road Intersection Performance

Construction Phase

Construction of the Mine Access Road and its intersection with the Kamilaroi Highway will occur early in the construction phase, thus offering improved access to the Project for construction-generated traffic from a safety and traffic performance perspective. The SIDRA analysis indicates that if the Kamilaroi Highway/ Mine Access Road was built and opened to traffic early in the construction program, the new configuration is predicted to primarily maintain a good to adequate LoS (A and B) (see **Table 64**).

Occasionally, the west approach along the Mine Access Road will experience a satisfactory LoS (C) with average delays of 28.7 seconds. However, this is typically a dynamic delay due to slowing down to negotiate the turn before speeding up again to reach the cruise speed of the road being entered.

In the event that the Mine Access Road and associated intersection at the Kamilaroi Highway is not constructed early in the construction program, then construction traffic will need to use Court Lane to enter the Project Boundary. It should be noted that this is not Shenhua Watermark's preferred approach, however has been conservatively assessed here to present the worst-case scenario. A SIDRA model of the existing Kamilaroi Highway / Court Lane intersection was prepared for the AM peak period for comparison purposes (see **Table 65**).

The SIDRA analysis indicates that overall, the traffic performance of the existing Kamilaroi Highway/ Court Lane intersection will be acceptable for traffic generated by the Project during the construction phase. This is reflected by the marginal differences between the modelled average delays and LoS (see **Table 65**).

However, despite the modelled satisfactory traffic performance, the current intersection layout poses a safety concern. With the Kamilaroi Highway signposted at 110km/h, any queued traffic waiting to turn right into Court Lane will be at risk of a major rear-end collision. Furthermore, this existing Court Lane intersection offers no physical protection for queued or decelerating right-hand turning traffic. Therefore, mitigation measures for the Court Lane intersection to be implemented whilst construction of the Kamilaroi Highway / Mine Access Road intersection is underway are presented in **Section 7.16.4**.

Road Intersection Performance – Operational Phase

During the peak operations phase, the upgraded Kamilaroi Highway / Mine Access Road intersection is predicted to maintain a good to adequate LoS (A and B). The performance of the Kamilaroi Highway / Mine Access Road intersection is presented in **Table 66**.

The SIDRA analysis confirmed that the traffic generated by the Project during both the construction and operation phases will be efficiently absorbed into the existing traffic stream. This is largely due to the substantial spare capacity available in the network.

Table 64 Kamilaroi Highway / Mine Access Road Intersection Performance – Construction Period

Approach	Turning Movement	Degree of Saturation		Average delay (sec/vehicle)		Level of Service		Maximum queue length (m)	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
South: Kamilaroi Highway	Left	0.047	0.009	15.0	22.8	N/A	N/A	N/A	N/A
	Through	0.113	0.092	0.0	0.0	A	A	0.0	0.0
North: Kamilaroi Highway	Through	0.113	0.092	0.0	0.0	A	A	0.0	0.0
	Right	0.117	0.012	15.5	24.3	B	B	4.0	0.7
West: Mine Access Road	Left	0.071	0.222	28.7	10.7	C	A	3.9	8.4
	Right	0.072	0.222	28.7	11.1	C	A	3.9	8.4

Road Safety

The existing road network within the vicinity of the Project maintains a high level of safety with only five crashes recorded on the Kamilaroi Highway and one crash on The Dip Road. There were no crashes recorded for Nea Siding Road and Court Lane from 2005 to 2011. The number of incidents on the Kamilaroi Highway is equivalent to 8.3 crashes per 100 million-vehicles-kilometres-travelled (MVKT), which is significantly lower than the state average of 32.8 crashes per 100 MVKT. Although the crash risk is low, the Project will result in a significant increase in new traffic on the road network.

A road safety review was also carried out for Quirindi-West Tamworth Road, Werris Creek Gap Road and Breeza-Currabubula Road. Quirindi-West Tamworth Road offers a reasonable geometric alignment and pavement conditions for its function as a regional link road between Quirindi and Tamworth. Werris Creek-Gap Road and Breeza-Currabubula Road also have reasonable alignment and clear zone conditions. However, the width of pavement seal on these two roads is variable and may increase risks of left wheelpath tracking over the unsealed shoulder.

As such, it is recommended that the respective road authorities (RMS, Gunnedah and Liverpool Plains Councils) continue to carry out the necessary pavement condition surveys to identify any pavement maintenance or upgrade needs along these two routes from time to time.

During the early stages of the construction phase, the existing Kamilaroi Highway / Court Lane intersection poses a safety concern for the increase in queued turning vehicles approaching the site and high-speed through vehicles along the highway. As such, mitigation measures for the Court Lane intersection to be implemented whilst construction of the Kamilaroi Highway / Mine Access Road intersection is underway are presented in **Section 7.16.4**.

New Road Infrastructure

As discussed above, the construction of a new T intersection will be required at the intersection of the Mine Access Road and the Kamilaroi Highway. The final design of the intersection will be developed in consultation with GSC and RMS. However, preliminary modelling indicates that a channelised T intersection with an indented right-turn lane for southbound traffic will be required. The right-turn lane will provide sufficient length for deceleration and queue storage. The modelling indicated that the right-turn lane will be 140 m long.

The Kamilaroi Highway will be realigned in the vicinity of the current intersection with Court Lane. This will involve a minor (170 m) deviation of the highway to the south of the existing alignment (see **Figure 20**).

The closure of The Dip Road will be required in Year 15 of the Project. This will require an alternative route via Cull Road, Werner Road and Clift Road. The alternative route and its detailed design will be developed in consultation with GSC.

Table 65 Kamilaroi Highway / Court Lane Intersection Performance – Construction Period

Approach	Turning Movement	Degree of Saturation	Average delay (sec/vehicle)	Level of Service	Maximum queue length (m)
		AM Peak	AM Peak	AM Peak	AM Peak
South: Kamilaroi Highway	Left	0.160	14.7	B	0.0
	Through	0.160	0.0	A	0.0
North: Kamilaroi Highway	Through	0.243	2.3	A	15.3
	Right	0.242	16.6	B	15.3
West: Mine Access Road	Left	0.076	30.0	C	4.1
	Right	0.076	30.4	C	4.1

Table 66 Kamilaroi Highway / Mine Access Road Intersection Performance – Operational Period

Approach	Turning Movement	Degree of Saturation		Average delay (sec/vehicle)		Level of Service		Maximum queue length (m)	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
South: Kamilaroi Highway	Left	0.036	0.036	14.2	14.2	N/A	N/A	N/A	N/A
	Through	0.150	0.124	0.0	0.0	A	A	0.0	0.0
North: Kamilaroi Highway	Through	0.150	0.129	0.0	0.0	A	A	0.0	0.0
	Right	0.112	0.105	15.8	15.5	B	B	3.7	3.5
West: Mine Access Road	Left	0.234	0.215	12.1	11.5	A	A	8.1	7.5
	Right	0.235	0.215	12.2	11.6	A	A	8.1	7.5

A separate planning approval will be sought for the construction of the alternative route.

Road Closures

Permanent Road Closures

Table 67 outlines the roads that will be permanently closed due to the Project (also see **Figure 48**), alternative routes and subsequent increases in travel times.

Temporary Road Closures

Any public roads that are within 500 m of blasting activities undertaken for the Project will be required to be temporarily closed for approximately 15 to 20 minutes. Blasting activities will occur during the hours of 9:00 am to 5:00 pm Monday to Saturday. Roads that may be temporarily affected by blasting include The Dip Road, Clift Road and Werner Road.

To minimise road closures along the Kamilaroi Highway, the realigned section of the highway and Mine Access Road will be constructed offline. Minor disruptions are only anticipated during the construction of the new alignment connections to the existing highway.

Rail Traffic

The assessment of rail network impacts has considered the direct and cumulative rail movement impacts on the Werris Creek - Moree Railway Line and the Main Northern Railway Line.

The existing rail network currently caters for a grain exports and number of existing mining operations. The rail requirements of these operations with consideration of the Project and other mining proposals will have a cumulative impact on the rail network.

Together, these existing and proposed operations will generate a total of 47 train movements per haul day. This equates to an average of one southbound laden train and one northbound non-laden train every hour on the section of the Werris Creek-Moree Railway Line between Narrabri and Muswellbrook.

ARTC (2012) have proposed a number of network upgrades to increase the capacity and operational flexibility for existing rail users. These initiatives will assist in relieving the impact of the Project and other existing and proposed rail users on the haulage requirements of the agricultural industry.

Railway Level Crossing Performance

The assessment found that the existing configuration of the Currabubula Road railway level crossing at Breeza is sufficient to safely accommodate any additional queued traffic due to the Project.

The existing configuration of the Hogarth Street railway level crossing at Breeza presents a safety risk in regard to the increase in Project traffic utilising these routes. The crossing only has a 50 m storage length between the Kamilaroi Highway and the railway line, which could result in short stacking crash risks. A queue generated by a passing train could spill back into the control area of the Kamilaroi Highway / Hogarth Street intersection thereby increasing crash potential with through traffic on the Kamilaroi Highway. Furthermore, the steep grade of Hogarth Street in approach to its intersection with the Kamilaroi Highway may restrict visibility and inhibit drivers from assessing the extent of queued traffic.

Four railway level crossings on the Werris Creek – Moree Railway Line and Main Northern Railway to the Muswellbrook junction were identified to have potential safety and performance risks due to the cumulative rail movements. These were:

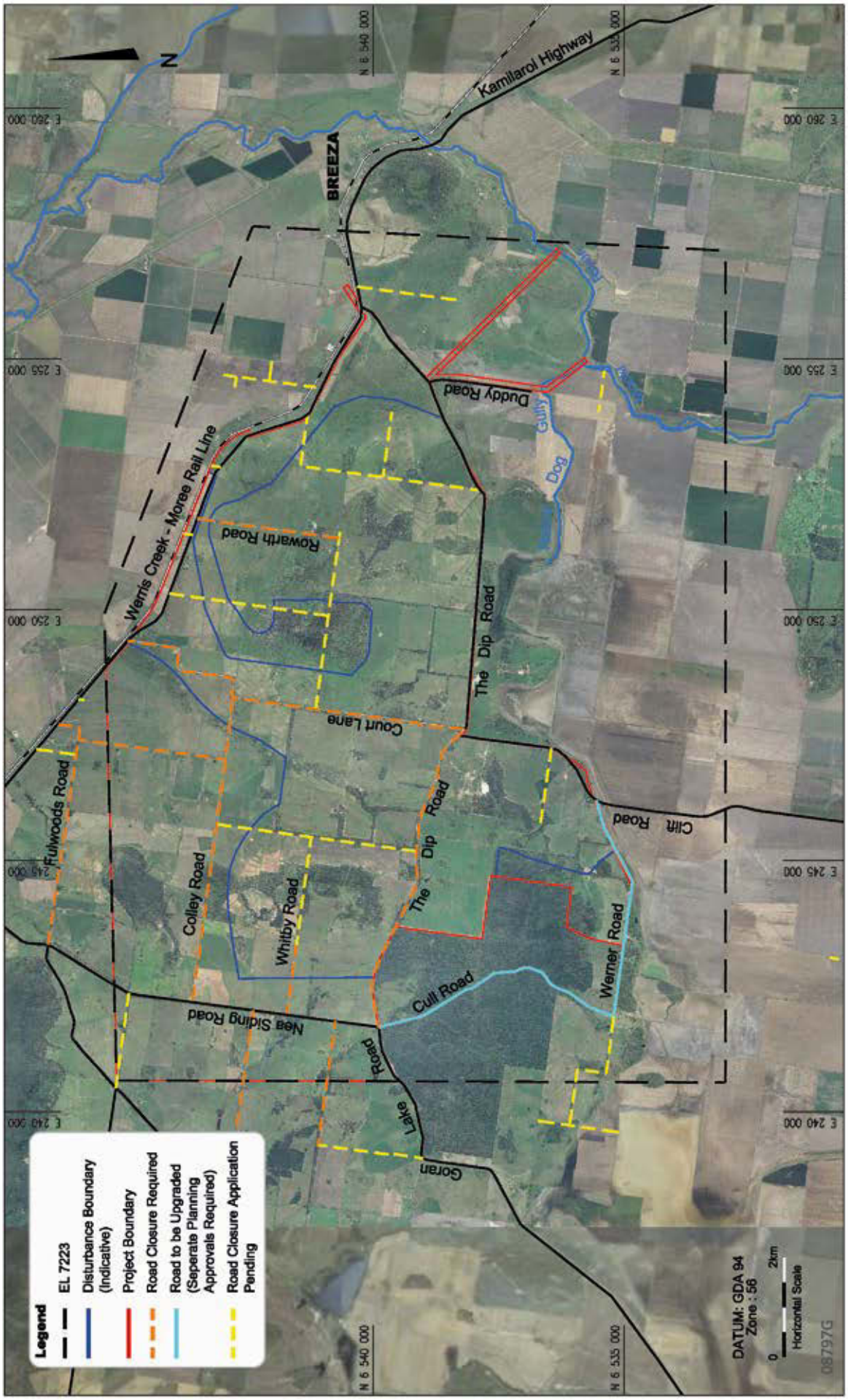
- White Street, 20 m south of New England Highway, Blandford;
- Livingston Street, 25 m east of New England Highway, Wingen;
- Gateleys Road, 35 m east of New England Highway, Wingen; and
- Halcolm Road, 25 m east of New England Highway, north of Aberdeen.

These sites all contain short stacking risks under the existing traffic conditions, whereby traffic queued at nearby intersections may queue back over the railway line. The queues would be due to the close proximity of the crossings to a major highway which carries a relatively high volume of traffic. This may leave vehicles stranded on the crossing when a train approaches. Furthermore, there are very few "escape paths" available for stranded vehicles at these locations.

The Australian Transport Council (ATC) regularly assesses the safety of all railway level crossings on public roads under a systematic and structured approach known as the Australian Level Crossing Assessment Model (ALCAM). This routine assessment helps to inform ATC on the relative priority for upgrade of each railway level crossing.

Table 67 Permanent Road Closures

Road	Section of Road Closed			Alternative Routes	Travel Time
	From	To	Length (km)		
Court Lane	Kamilaroi Highway	The Dip Road	7.5	Via The Dip Road to the Kamilaroi Highway. The length of this alternative route is 18.5 km	Five minute increase to existing travel time
Rowarth Road	Kamilaroi Highway	Southern cul-de-sac	6.3	No alternative route. Road will be closed to all public access	N/A
Whitby Road	Nea Siding Road	Unnamed road	3.6	No alternative route. Road will be closed to all public access	N/A
The Dip Road	Clift Road	Nea Siding Road	6.3	Via Clift Road-Werner Road-Cull Road. The length of this alternative route is 13 km	Five minute increase to existing travel time
Unnamed roads in Project Boundary			Entire route	No alternative route. Road will be closed to all public access	N/A


WATERMARK COAL PROJECT
Proposed Road Closures and Upgrades
FIGURE 48
Hansen Bailey
ENVIRONMENTAL CONSULTANTS
N
BREEZA
Kamilaroi Highway
Wemis Creek - Moree Rail Line
Rowarth Road
Duddy Road
Gully
Dog
The Dip Road
Court Lane
Fullwoods Road
Colley Road
Whitby Road
Cliff Road
Werner Road
Cull Road
New Siding Road
Lake Goran
Legend
EL 7223
Disturbance Boundary (Indicative)
Project Boundary
Road Closure Required
Road to be Upgraded (Separate Planning Approvals Required)
Road Closure Application Pending
DATUM: GDA 94
Zone : 56
0
2km
Horizontal Scale
08797G

7.16.4 Mitigation and Management

As part of its EMS, Shenhua Watermark will prepare a Traffic and Transport Management Plan to manage possible impacts resulting from construction and to ensure the traffic network can be managed throughout the Project in consideration of the management and mitigation measures discussed below.

Road Closures

Temporary road closures will be required for any road within 500 m of blasting activities and during the construction of the Kamilaroi Highway realignment. As such, the following measures will be implemented to manage traffic safely during these periods:

- The boundaries of each road closure will be positioned in a manner:
  - Where there are clear and traversable verges and clear sight lines to allow drivers to safely U-turn if desired; and
  - To minimise the risk of queue spillback onto main roads.
- Long-term signage will be installed at the boundaries of the road closure at key intersections upstream of the closure to advise road users of:
  - Roads that are subject to regular, short-term closures;
  - Alternative routes;
  - Blast schedules; and
  - Contact numbers for Shenhua Watermark personnel.
- Affected residents will be notified of temporary road closures in advance of a blast event; and
- A Construction Traffic Management Plan and stage drawings will be prepared in consultation with RMS and GSC in relation to the construction of the Kamilaroi Highway realignment.

Rail Traffic

ARTC (2012) have identified a number of deficiencies in the existing rail network and proposes upgrades to accommodate the predicted increase in coal production. Shenhua Watermark will continue to consult with ARTC regarding forecast production rates to assist in the planning and scheduling of infrastructure upgrades.

Road and Rail Safety

In order to minimise road and rail safety risks for Project-related traffic, Shenhua Watermark has committed to the following mitigation and management measures:

- The Kamilaroi Highway / Mine Access Road intersection will include:
  - A channelised T intersection with an indented right-hand turn lane for southbound traffic; and
  - An indented left-hand turn lane for northbound traffic.
- The Kamilaroi Highway / Mine Access Road intersection and the Kamilaroi Highway realignment will be undertaken early in the construction phase to minimise safety risks associated with queued right-turning traffic and through traffic continuing along the highway;
- Installation of additional signage including reduced speed, curve warnings, give way and T intersection warning (including large electronic signage), particularly whilst the Court Lane / Kamilaroi Highway intersection is being utilised during construction of the Kamilaroi Highway / Mine Access Road intersection;
- Project-related traffic will be discouraged from using Hogarth Street to access Breeza-Currabubula Road as a result of short stacking risks at the Hogarth Street level crossing;
- Installation of signage to provide warning against short stacking risks at Hogarth Street level crossing;
- Continue to liaise with the Australian Transport Council to inform them over the forecasted train volumes as well as any scheduling issues that may reduce risks along the network; and
- Consultation with GSC, RMS and other local authorities as necessary prior to the movement of oversize loads on public roads.



7.17 Visual and Lighting

7.17.1 Background

A Visual Impact Assessment was undertaken by JVP and is provided in **Appendix J**. The purpose of the assessment was to define the character of the surrounding landscape, assess the visual impacts of the Project and recommend measures to mitigate and manage these impacts.

7.17.2 Methodology

The assessment methodology was designed to determine the level of visual impact the Project will have on receivers in surrounding areas. The methodology involved the following key steps:

- Delineation of the visual study area;
- Definition of the existing landscape setting;
- Definition of the development, its visual character and visual effects;
- Selection of representative viewing locations for the assessment;
- A combined consideration of the visual sensitivity of representative viewing locations and the visual effect of the Project components in order to determine the level of visual impacts; and
- An assessment of night lighting impacts.

Visual Study Area

The visual study area is the extent of the surrounding landscape that potentially has the most critical views of the Project. It was delineated based on a review of topographic plans, high resolution aerial photography and confirmed through observations in the field. The visual study area formed the focus of the visual impact assessment. The visual study area contains a diverse range of landscape settings, which vary as a result of topography, vegetation, and land use.

The visual study area can be divided into four distinct viewing sectors namely the southern, northern, eastern and western sectors (see **Figure 49**).

In addition to the visual study area a consideration has been given to the potential to impact on the operability of the Siding Springs Observatory. This facility is located approximately 122 km due west of the Project boundary. Due to the intervening topography it is not in direct line of sight. A consideration of this key national observatory is warranted due to the deleterious impact that light spill and dust particles can have on its performance.

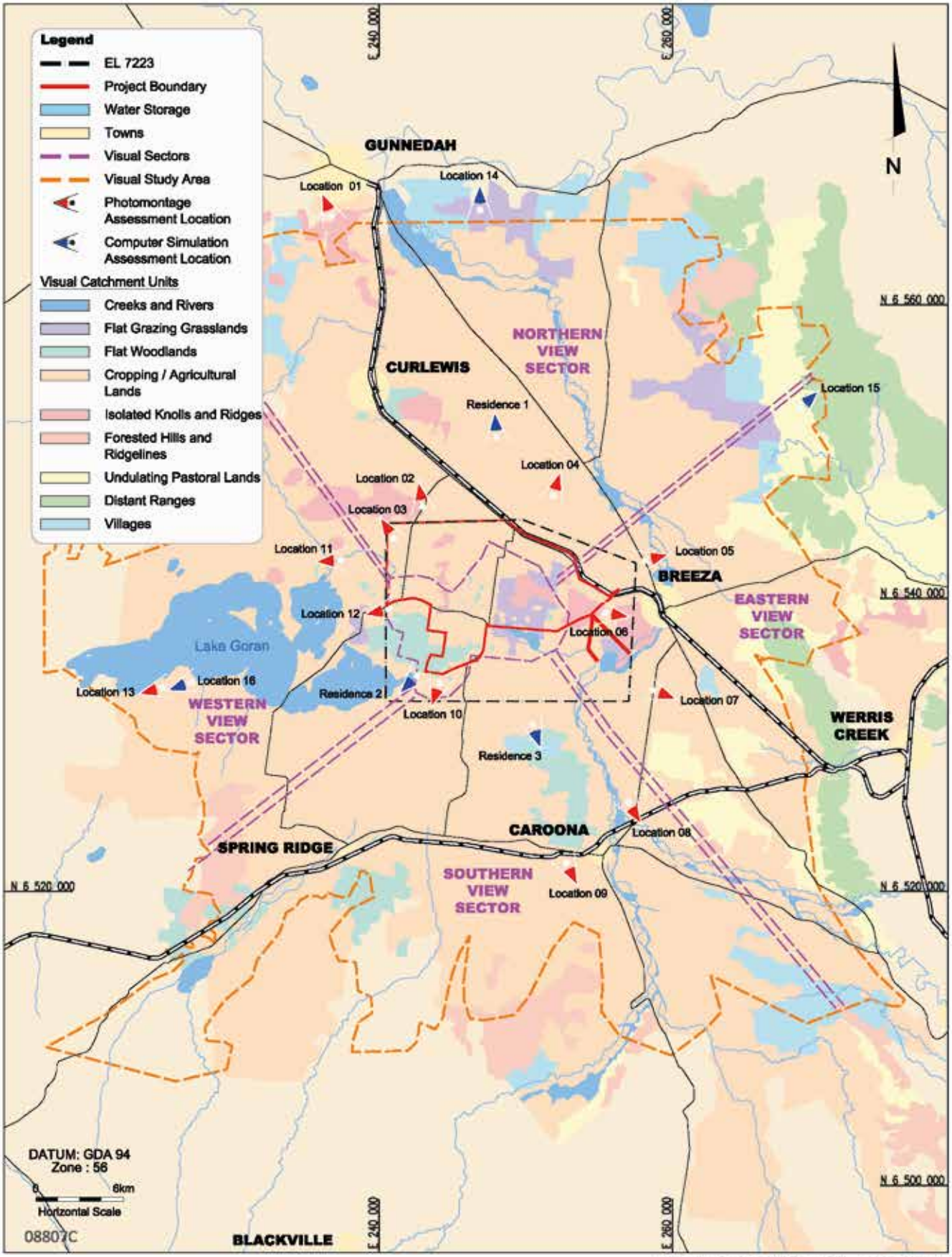
Representative Viewing Locations

There are numerous locations within the visual study area such as homesteads and roads that may experience views of the Project. For the assessment, the representative viewing locations were selected in consultation with neighbouring stakeholders. The viewing locations adopted for the visual impact assessment are shown in **Figure 49** and include:

- Northern sector:
  - Location 1 – Porcupine Lookout;
  - Location 2 – Kamilaroi Highway;
  - Location 3 – Boori Road; and
  - Location 4 – Pullaming Road.
- Eastern sector:
  - Location 5 – Breeza – Pillaway Road;
  - Location 6 – Breeza; and
  - Location 7 – Kamilaroi Highway.
- Southern sector:
  - Location 8 – Werris Creek – Caroona Road;
  - Location 9 – Caroona; and
  - Location 10 – Clift Road.
- Western sector:
  - Location 11 – Boori Road West;
  - Location 12 – Nea Siding Road; and
  - Location 13 – Howe Hill Road.

Photographs of the view toward the Project Boundary were taken at standing eye level from the representative viewing locations. Three-dimensional computer modelling was used to generate a conceptual view of the Project from each of the representative viewing locations.

A photomontage brings the computer model of the Project as seen from a particular view point and the photograph from that view point together (photomontage). A conceptual view of the Project (photomontage) was generated for Years 1, 2, 5, 10, 15, 21, 25 and 30 of the Project. The photomontages were used to accurately illustrate the level of visual contrast between the existing environment and the visible aspects of the Project. A complete set of the photomontages for each representative viewing location is presented in **Appendix J** with a selection also provided in **Section 7.17.4**.



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Visual Study Area and Assessment Locations

FIGURE 49

Where access to sensitive receptors, in particular nearby residences, was not attainable, computer simulations were developed to illustrate likely visual effects as seen from representative viewing locations, including:

- Northern sector:
  - Residence 1 – Pullaming Road; and
  - Location 14 – Oxley Highway.
- Eastern sector:
  - Location 15 – Fig Tree Mountain.
- Southern sector:
  - Residence 2 – Werner Road; and
  - Residence 3 – Rossmar Road.

The computer simulations undertaken do not account for foreground vegetation or garden landscape intercepting views to the Project Boundary and as such are a conservative assessment tool. Further, the computer simulations will assist in the development of management and mitigation measures presented in **Section 7.17.5**. The computer simulations for each representative viewing location are provided in **Appendix J**.

Visual Sensitivity

Visual sensitivity is a measure of how critically a change to the landscape is perceived by persons occupying the surrounding land. Viewing locations situated in residential, tourist and/or recreation areas rely on the scenic amenity values of the surrounding landscape and as such will generally have a higher visual sensitivity than locations in an industrial or agricultural setting.

Visual sensitivity is affected by factors such as screening, distance and orientation of the receiver in relation to the Project. However, if views are completely shielded from a particular location, a visual sensitivity score will not be assigned.

Visual Effect

Visual effect is the measure of the visual contrast between the Project and the surrounding environment. If there is significant contrast between the elements of the Project and surrounding landscape, the visual effect will be high. Conversely, if the elements of the Project can be substantially integrated into the existing landscape, the visual effect will be low.

Visual effect is also dependent upon the proportion of the primary viewing zone that is occupied by elements of the Project. If aspects of the Project feature prominently in the view from a location, the visual effect on that location is high. In contrast, if the Project occupies only a small portion of the total view, the visual effect will be low.

Visual effect also depends in part on existing topography and vegetation, both of which can increase visual integration and or screening and hence reduce visual effect. If the project is not visible from a particular location a visual effect score will not be assigned.

Visual Impact

The visual impact of the Project is assessed using a qualitative assessment of the visual sensitivity of the viewing locations and the visual effect caused by activities associated with the Project. The relationship between visual sensitivity, visual effect and visual impact is depicted in **Table 68**.

Lighting Impact

Lighting impacts were evaluated qualitatively with consideration to both direct lighting effects and diffuse light effects during the night period. Direct lighting effects occur where there is a direct line of sight between the light source and the viewing location. Indirect lighting effects or diffuse light refers to the night glow created when light is reflected into the atmosphere.



Table 68 Visual Impact Assessment Matrix

Visual Sensitivity	Visual Effect			
	High	Moderate	Low	Very Low
High	High Impact	High Impact	Moderate Impact	Low Impact
Moderate	High Impact	Moderate Impact	Low Impact	Low Impact
Low	Moderate Impact	Low Impact	Low Impact	Low Impact

7.17.3 Existing Landscape Setting

The visual character of the regional and local landscape in the vicinity of the Project is created by the mosaic of topographic form, vegetation and land cover, hydrology and various land use patterns. These landscape features combine in various ways to create areas of relative visual uniformity that can be defined as Visual Character Units (VCUs). The VCUs combine in various vistas that are obtained from viewing locations such as residences and roadways.

Figure 49 illustrates the VCUs within the visual study area and includes:

- Creeks and Rivers VCU;
- Ephemeral Lakes VCU;
- Flat Grazing Lands VCU;
- Open Woodlands VCU;
- Cropping / Agricultural Lands VCU;
- Isolated Knolls and Ridges VCU;
- Forested Hills and Ridgelines VCU;
- Undulating Pastoral Lands VCU;
- Distant Ranges VCU; and
- Villages VCU.

Further details on the aesthetic features of the VCUs are described in **Appendix J**.

7.17.4 Impact Assessment

Visual Impacts

Northern Sector

The northern sector contains the village of Curlewis, scattered rural residences, Porcupine Lookout, the Kamilaroi Highway and local roads. These receivers vary in sensitivity based on distance, landscape setting and existing screens. As such, sensitivity for each receiver is as follows:

- Residences that are situated within 7.5 km of the Project Boundary will have a high sensitivity to changes in the existing landscape, where views are available. Sensitivity then decreases with increasing distance from the Project Boundary;
- All roads have a low sensitivity based on current landscape settings. The exception to this is the portion of the Kamilaroi Highway that is within 2.5 km and 7.5 km of the Project Boundary, which has a high to moderate sensitivity, respectively;
- Porcupine Lookout is a sensitive viewing location, however, has low sensitivity due to the distance (greater than 20 km) from the Project Boundary; and
- The village of Curlewis is not visually sensitive as a result of screening vegetation and distance restricting all views to the Project.

Visual effects on the northern sector will be created primarily by views to the Eastern Mining Area. During the initial years of operation, views to the Project will be shielded by existing topography. Between Year 3 and 5, the northern portion of the OEA will be constructed creating a high visual effect. The visual effect for the northern sector is illustrated in **Figure 50** to **Figure 52** from two representative locations; the Kamilaroi Highway and Pullaming Road.

The visual sensitivity and effect experienced within the northern sector consequently may result in:

- A high visual impact on the section of the Kamilaroi Highway within 2.5 km of the Project Boundary;
- A moderate to high visual impact on the section of the Kamilaroi Highway within 7.5 km of the Project Boundary;
- A high visual impact on rural residences up to 7.5 km away from the Project Boundary;
- A moderate to high visual impact on rural residences up to 12.5 km away from the Project Boundary; and
- A low to moderate visual impact on local roads and rural residences beyond 12.5 km of the Project Boundary.

The initial impact levels defined above depend on open visibility to Project areas. This is often not the case due to view orientation or intervening topography or vegetation.

High and moderate visual impacts will be reduced to moderate and low following completion and rehabilitation of the northern OEA by approximately Year 5. These impacts will further be reduced to very low as rehabilitation matures. By Year 30, the final landform will be integrated with the existing landscape.

Eastern Sector

The eastern sector contains the village of Breeza, scattered rural residences, the Kamilaroi Highway and local roads. These receivers vary in sensitivity based on distance, landscape setting and existing screens. As such, sensitivity for each receiver is as follows:

- Residences that are situated within 7.5 km of the Project Boundary will have a high sensitivity to changes in the existing landscape, where views are available. Sensitivity then decreases with increasing distance from the Project Boundary;
- The village of Breeza has a high sensitivity to the Project due to its distance from the Project Boundary. Some residences situated on the eastern face of Breeza Hill are shielded from the Project Boundary by the hill itself and in turn have a low sensitivity; and
- All roads have a low sensitivity based on current landscape settings. The exception to this is the portion of the Kamilaroi Highway that is within 2.5 km and 7.5 km of the Project Boundary, which has a high to moderate sensitivity, respectively.

Visual effects on the eastern sector will be created primarily by views to the Eastern Mining Area and to a lesser extent the Southern Mining Area.



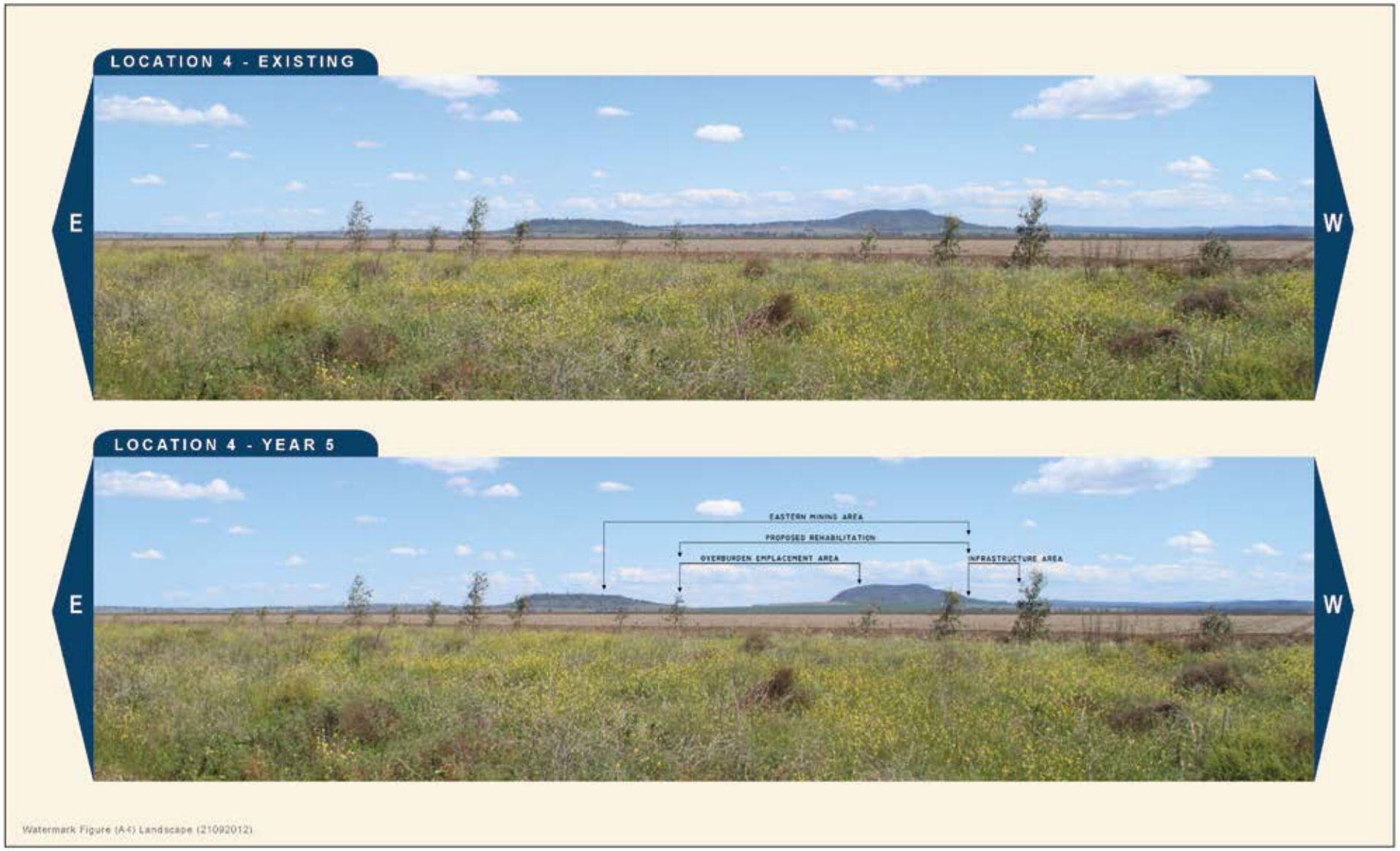
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Photomontage Location 2

FIGURE 50



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FIGURE 51



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Photomontage Location 4

FIGURE 52

During the initial years of operations, the Eastern Mining Area will create high visual effects on this sector, until shaping is complete along the northern and eastern faces of the OEA by Year 5 and 15, respectively. High visual effects will also be experienced from the Southern Mining Area, when some views of raw overburden are available over the adjoining tree canopies. The visual effect for the eastern sector is illustrated in **Figure 53** to **Figure 54** from a representative location at Breeza.

The visual sensitivity and effect experienced within the eastern sector consequently results in:

- A high visual impact on the section of the Kamilaroi Highway within 2.5 km of the Project Boundary;
- A moderate to high visual impact on the section of the Kamilaroi Highway within 7.5 km of the Project Boundary;
- A moderate to high visual impact on the section of The Dip Road within 2.5 km of the Project Boundary;
- A high visual impact on the village of Breeza and rural residences up to 7.5 km away from the Project Boundary;
- A moderate to high visual impact on rural residences up to 12.5 km away from the Project Boundary; and
- A low to moderate visual impact on local roads and rural residences beyond 12.5 km of the Project Boundary.

Again visibility is a prerequisite to the above impacts occurring.

Views of the Project from the Eastern Sector are significantly reduced following completion of operations and rehabilitation of the landform in the Eastern Mining Area. This previous mining area acts in part as a visual shield for some sensitive receptors to the Southern Mining Area.

Operations in the Southern Mining Area during the mid-phases (approximately Year 17 to Year 24) of the Project will result in:

- A low to moderate visual impact on the section of the Kamilaroi Highway up to 12.5 km of the Project Boundary;
- A moderate to high visual impact on a section of Clift Road up to 2.5 km of Project Boundary;
- A moderate to low visual impact on sections of local rural roads up to 7.5 km of Project Boundary such as Breeza - Caroona Road and Clift Road;
- A low to moderate visual impact on local rural roads up to 12.5 km of Project Boundary such as Werris Creek - Caroona Road and Clift Road;
- A high visual impact on the village of Breeza and rural residences up to 7.5 km away from the Project Boundary;
- A moderate to high visual impact on rural residences up to 12.5 km away from the Project Boundary; and
- A low to moderate visual impact on local rural roads and residences beyond 12.5 km of Project Boundary.

High and moderate visual impacts will be reduced to moderate and low following completion of the Eastern and Southern Mining Areas in approximately Year 21 and 26, respectively. These impacts will further be reduced to very low as rehabilitation matures. By Year 30, the final landform will be integrated with the existing landscape.

Southern Sector

The southern sector contains the village of Spring Ridge and Caroona, scattered rural residences and local roads. These receivers vary in sensitivity based on distance, landscape setting and existing screens. As such, sensitivity for each receiver is as follows:

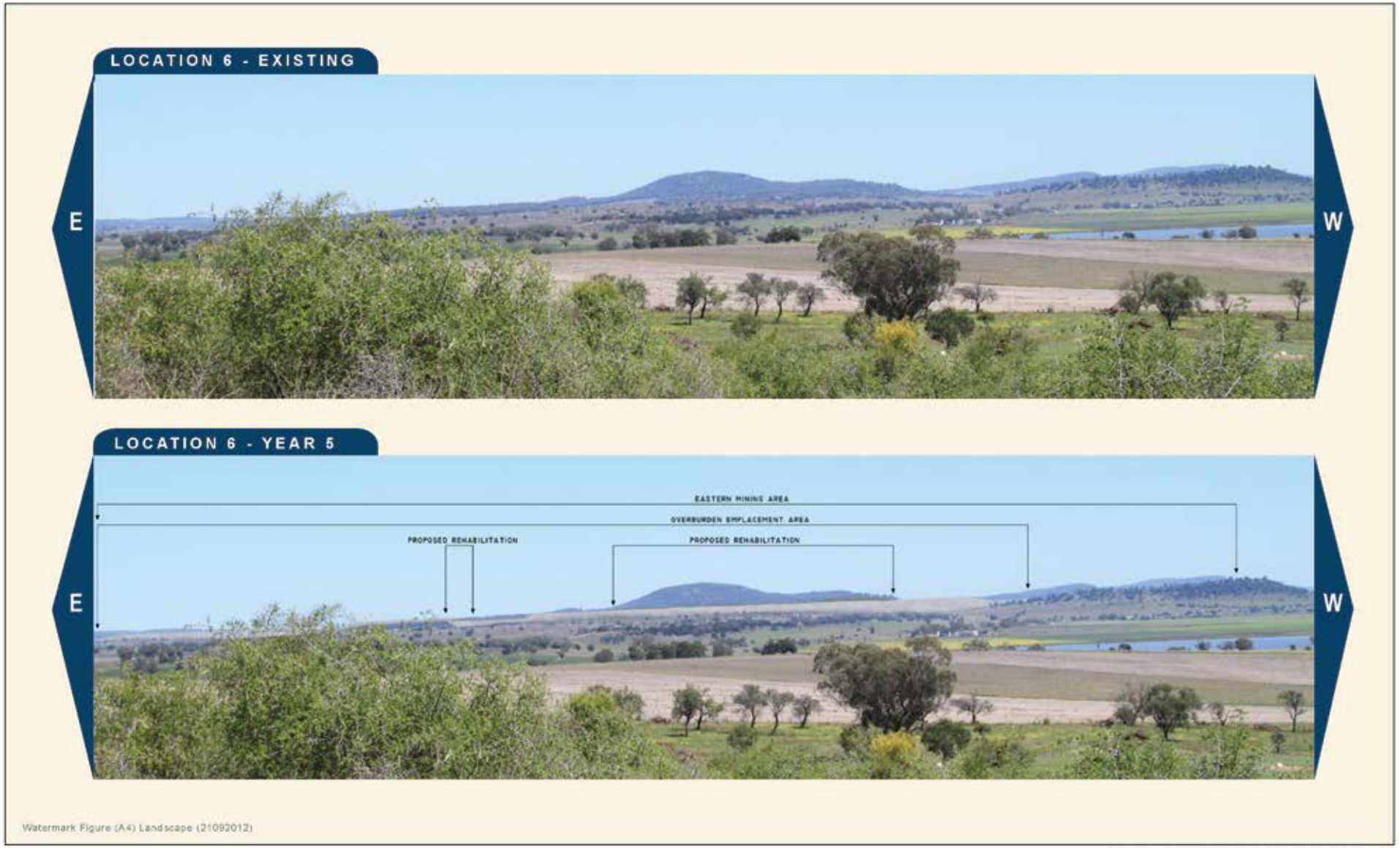
- Residences that are situated within 7.5 km of the Project Boundary will have a high sensitivity to changes in the existing landscape, where views are available. Sensitivity then decreases with increasing distance from the Project Boundary;
- All roads have a low sensitivity based on current landscape settings. The exception to this is the portion of Clift Road and The Dip Road that is within 2.5 km of the Project Boundary, which has a moderate sensitivity;
- The village of Spring Ridge has a low sensitivity as a result of screening vegetation and distance restricting some views to the Project; and
- The village of Caroona is not visually sensitive as a result of screening vegetation and distance restricting all views to the Project.

Visual effects on the southern sector will be created primarily by views to the Eastern and Southern Mining Areas. Operations will create moderate to high visual effects in the southern sector when views of OEAs are available over the adjoining tree canopies. The visual effect for the southern sector is illustrated in **Figure 55** to **Figure 56** from a representative location on Clift Road.

The visual sensitivity and effect experienced within the southern sector consequently results in:

- A high visual impact on rural residences up to 7.5 km away from the Project Boundary;
- A moderate to high visual impact on rural residences up to 12.5 km away from the Project Boundary;
- A low to moderate visual impact on local roads and rural residences beyond 12.5 km of the Project Boundary;
- A moderate to high visual impact on the section of The Dip Road and Clift Road within 2.5 km of the Project Boundary; and
- A low visual impact on Spring Ridge.

High and moderate visual impacts will be reduced to moderate and low following completion of the Eastern and Southern Mining Areas. These impacts will further be reduced to very low as rehabilitation matures. By Year 30, the final landform will be integrated with the existing landscape.



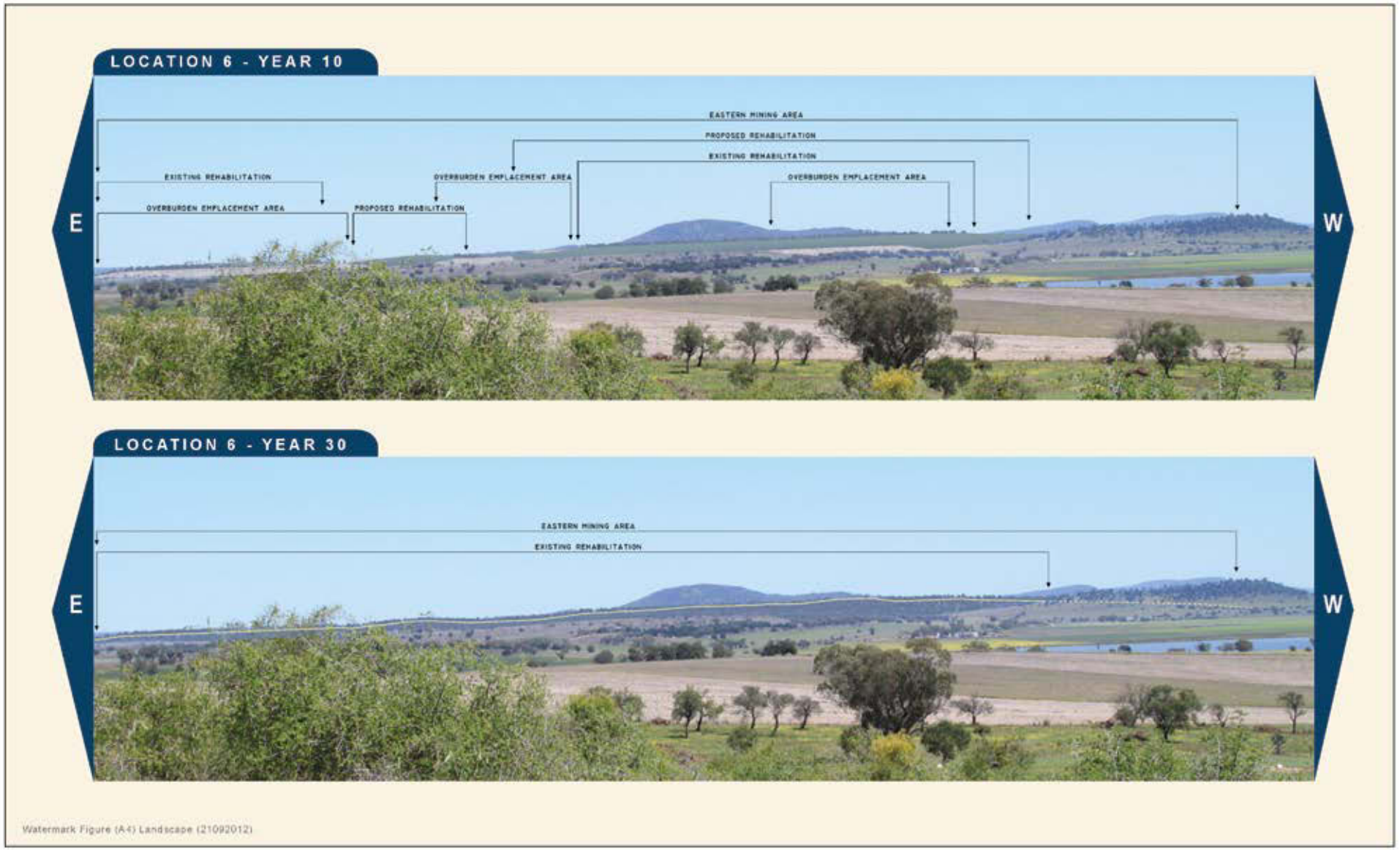
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Photomontage Location 6

FIGURE 53



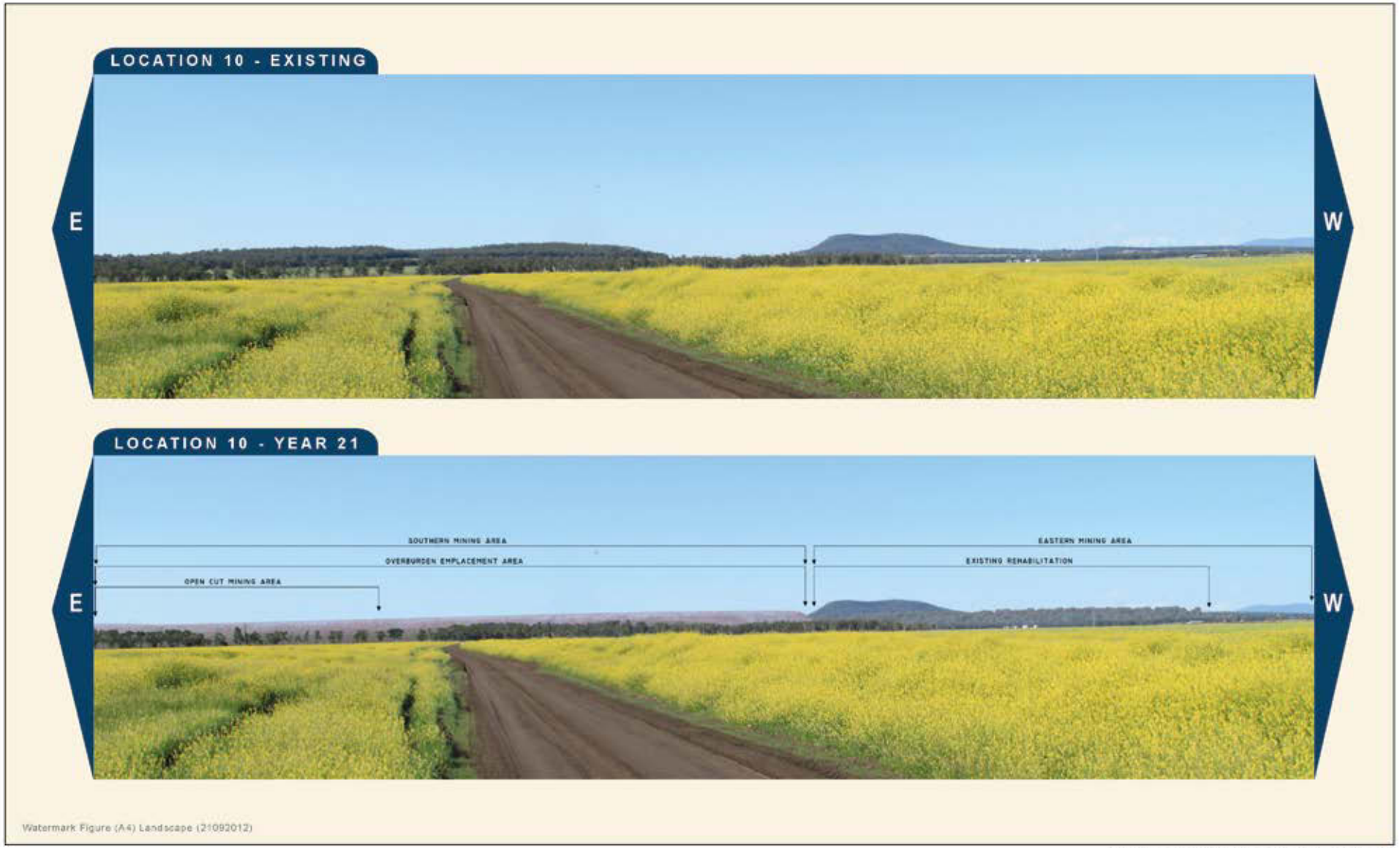
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Photomontage Location 6

FIGURE 54



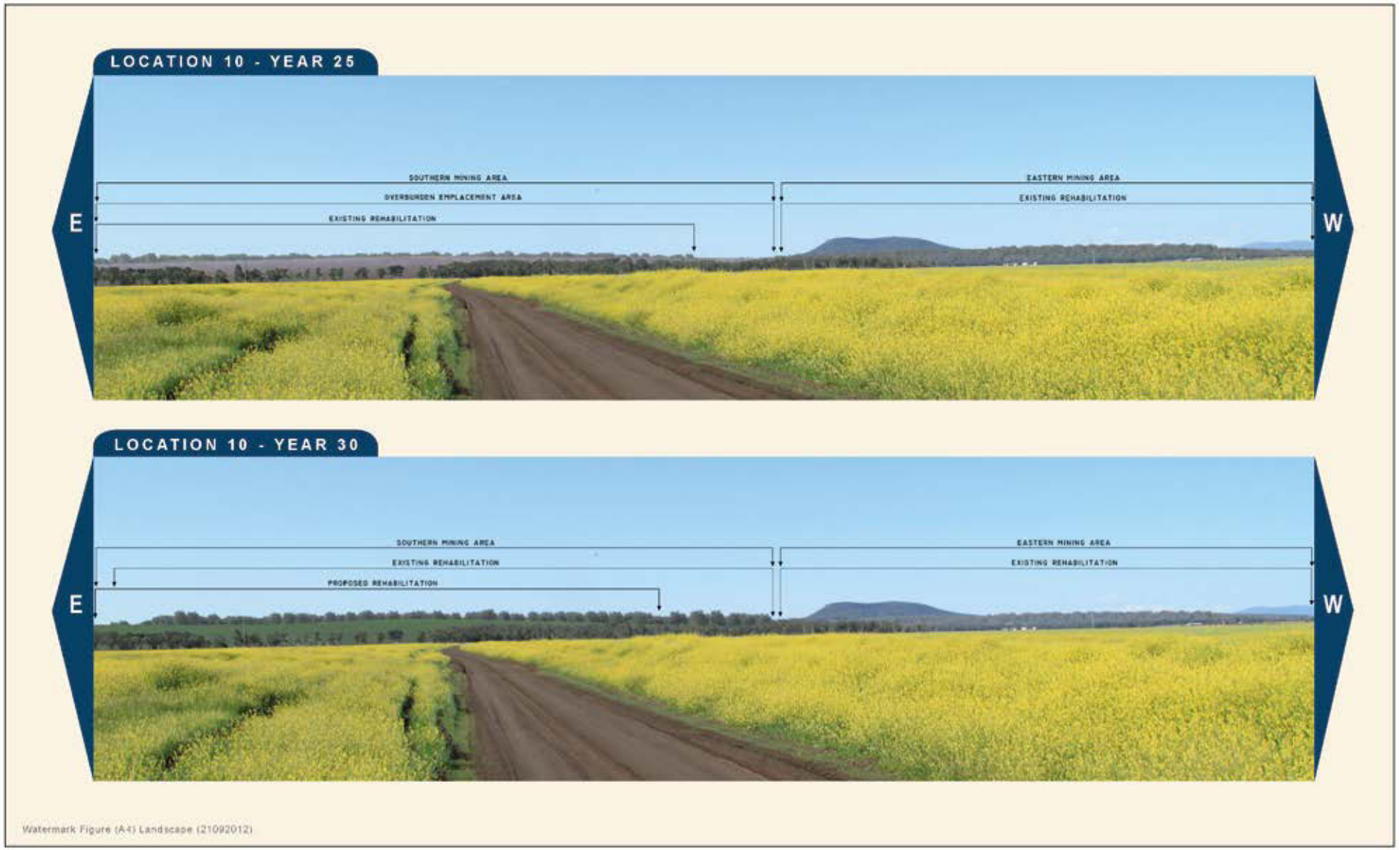
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Photomontage Location 10

FIGURE 55



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Photomontage Location 10

FIGURE 56

Western Sector

The western sector contains scattered rural residences and local roads. These receivers vary in sensitivity based on distance, landscape setting and existing screens. As such, sensitivity for each receiver is as follows:

- Residences that are situated within 7.5 km of the Project Boundary will have a high sensitivity to changes in the existing landscape, where views are available. Sensitivity then decreases with increasing distance from the Project Boundary; and
- All roads have a low sensitivity based on current landscape settings. The exception to this is the portion of Nea Siding Road that is within 2.5 km of the Project Boundary, which will have a moderate sensitivity.

Visual effects on the western sector will be created primarily by views to the Western Mining Area. This mining area is developed from east to west and therefore the active face of the OEA will be orientated to the west, which will create high visual effects during the operational period from approximately Year 24 to Year 30. The visual effect for the western sector is illustrated in **Figure 57** to **Figure 58** from a representative location on Nea Siding Road.

The visual sensitivity and effect experienced within the western sector consequently results in:

- A high visual impact on rural residences up to 7.5 km away from the Project Boundary that are not shielded by Breeza State Forest;
- A moderate to high visual impact on rural residences up to 12.5 km away from the Project Boundary that are not shielded by Breeza State Forest;
- A low to moderate visual impact on local roads and rural residences beyond 12.5 km of the Project Boundary that are not shielded by Breeza State Forest; and
- A moderate to high visual impact on the section of Nea Siding Road within 2.5 km of the Project Boundary.

High and moderate visual impacts will be reduced to moderate and low following completion of the Eastern and Southern Mining Areas. These impacts will further be reduced to very low as rehabilitation matures. By Year 30, the final landform will be integrated with the existing landscape.

Lighting Impacts General

Direct lighting effects are generally restricted to vehicles and equipment outside the open cut mining areas. In most cases, direct light will be limited as a result of existing topography, OEA and vegetation. However, there may be intermittent direct light effects in the northern and southern sector from the Eastern and Western Mining Areas. The effects experienced in the northern sector will be reduced significantly once the northern OEA is constructed.

Diffuse lighting effects will be produced by the collective operations of the Project, including the light generated by the MIA and mobile plant. Generally, the glow associated with diffuse lighting will not create a significant visual effect; however, it may be apparent from time to time.

Siding Springs Observatory

The Siding Springs Observatory is some 122 km from the Project Boundary. Further, it is not in direct line of sight. Due to the distance from the facility the Project does not fall within the area relevant to the Orana Regional Environmental Plan No.1. However, in recognition of the importance of the Siding Springs Observatory and its sensitivity to light spill additional monitoring and management measures are warranted to ensure no deleterious impacts on it. The measures proposed are discussed in **Section 7.17.5**.

7.17.5 Mitigation and Management

Numerous mitigation measures have been incorporated into the design and operating plans for the Project that will reduce the visual effect and mitigate the visual impact of the Project on sensitive viewing locations, including:

- Timely construction and implementation of progressive OEA rehabilitation during mining operations to reduce dust and other visual effect levels;
- Placement of the MIA between existing topographic features to screen it from the external view;
- Orientation of all fixed exterior lighting such that it does not face above the horizontal plane; and
- Retention of iconic high points and topography in the local landscape setting (such as Mt Watermark).

As part of the EMS for the Project, Shenhua Watermark will develop a Visual and Lighting Management Plan. The plan will include provisions for additional onsite mitigation and management measures to reduce visual impacts further, such as:

- Creating landscape plans to establish visual and ecological landscape patterns that emulate existing forest, woodland and grassland;
- Shaping the tops of the OEAs to achieve a more natural fit with surrounding landscape as opposed to an extensive 'flat top' development;
- Constructing infrastructure in forest tones (i.e. green, grey, cream) to blend with the surrounding natural environment, as far as practical;
- Using hoods on lights or ensuring lights are directed away from sensitive receivers;
- Retrofitting mobile equipment to prevent light being directed above the horizontal, where possible; and
- Conducting activities in compliance with *AS4282 (INT) 1997 – Control of Obtrusive Effects of Outdoor Lighting*.



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Photomontage Location 12

FIGURE 57



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Photomontage Location 12

FIGURE 58

The development of the above plan will be undertaken in consultation with the Australian National University and the Australian Astronomical Observatory to ensure that lighting from the Project does not deleteriously impact on the Siding Springs Observatory. Further, the plan will be revised to take into account and new requirements that may become appropriate from the introduction of the proposed State Environmental Planning Policy being developed to govern lighting requirements around Siding Springs Observatory.

Where deemed necessary through consultation within relevant stakeholders, offsite mitigation and management measures will be implemented, including:

- Where requested by the owner of a primary residence which has a moderate to high visual impact from the Project, Shenhua Watermark will provide landscaping treatments or vegetation screens in a reasonable time frame to reduce the visual impacts. Other than in exceptional circumstances, this is not expected to be required for primary residences located more than 7.5 km from mining operations;
- Developing and implementing a landscape plan for relevant sections of the Kamilaroi Highway in long term impact areas; and
- Establishing tree screens along relevant sections of Clift Road, The Dip Road and Nea Siding Road.



7.18 Geochemical

7.18.1 Background

A Geochemical Assessment of Overburden/Interburden and Coal Reject Materials was undertaken by RGS and is provided in **Appendix W**. The purpose of the assessment was to:

- Characterise the overburden, interburden and coal rejects (including coarse rejects and tailings) associated with open cut mining of the target coal seams for the Project; and
- Develop and recommend any necessary environmental management measures related to overburden, interburden and coal reject emplacement and the Project's rehabilitation program.

In conjunction with the Geochemical Assessment of Overburden/ Interburden and Coal Reject Materials and the Groundwater Impact Assessment (see **Appendix W** and **Appendix T**) prepared for the Project, a Seepage Water Quality Impact Assessment was undertaken by Terrenus Earth Sciences and is provided in an appendix to **Appendix T**. The purpose of the assessment was to characterise the water quality associated with runoff and seepage from OEAs, determine the potential impacts to surface water and groundwater quality as a result of runoff and seepage from mining areas and to recommend measures to mitigate and manage these impacts.

7.18.2 Methodology

Desktop Assessment

A desktop assessment was undertaken to review the available geochemical and geological data associated with the Project to assist in the development of a suitable sampling and testing program for overburden, interburden and coal reject materials. Technical guidelines for the geochemical assessment of mine waste in Australia (Australian Minerals Industry Research Association, 2002; NSW Department of Industry, Tourism and Resources, 2007 and Australian Coal Association Research Program, 2008) and worldwide (International Network on Acid Prevention, 2009) were used as the framework for developing the sampling and testing program.

Sampling Program

Drill core materials from the exploration program for the Project were selected from 14 drill holes to provide lateral and vertical coverage of the overburden, interburden and coal rejects likely to be generated by the Project. The sampling strategy was based on existing knowledge of the geology and stratigraphy from the results of existing and ongoing exploration drilling programs.

A total of 213 samples were collected representing a range of overburden, interburden and coal rejects. This consisted of 104 overburden / interburden samples, 91 potential coal reject (coal seam roof, parting and floor) and 18 coarse reject and tailings samples.

Samples were subjected to a series of static geochemical tests at Australian Laboratory Services and Kinetic Leach Column tests by RGS. The geochemical testing program was designed to assess the degree of risk from the oxidation of pyrite, acid generation, and

leaching of soluble metals and salts.

All of the 213 samples collected were subjected to Acid Base Account geochemical testing as part of an initial screening process. Forty selected samples were also tested for sulphur speciation (Chromium Reducible Sulphur) to determine the sulphur content of the samples. After the results of the Acid Base Account tests were received and reviewed, selected composite samples were used for multi-element testing of solid and soluble fractions. A total of 12 Kinetic Leach Column tests were also completed on various composite overburden, interburden and coal reject materials.

In order to quantitatively assess the potential for coal rejects to spontaneously combust, three samples of coal from the Melvilles (A and F) seams were subjected to adiabatic self-heating tests at Australian Laboratory Services.

7.18.3 Impact Assessment

Overburden, Interburden and Coal Rejects

The majority of overburden, interburden and coal rejects are expected to have a low sulphur content, significant excess acid buffering capacity and be classified as non-acid forming. These characteristics indicate that the materials are likely to have a high factor of safety with respect to potential acid generation.

A small proportion of the interburden and coal rejects derived from the Lower Hoskissons seam (roof and floor) has potential acid forming capacity.

Most overburden and interburden material also has significant excess buffering capacity that will be available to more than adequately buffer the negligible amount of acid that could theoretically be produced. Mitigation and management measures will be implemented to avoid the potential for acid generation when handling of the Lower Hoskissons seam.

The concentration of total metals detected in most overburden, interburden and coal rejects is below the applied guideline criteria for soils and is unlikely to present any environmental issues associated with revegetation and rehabilitation. Some overburden, interburden and coal rejects are sodic and prone to dispersion and erosion. These materials are generally unsuitable for reuse in revegetation and rehabilitation activities and will be selectively handled.

Seepage Water Quality

Groundwater inflow is a key input during mining, but once mining ceases and the mining areas are filled with overburden and interburden (in the case of the Eastern and Southern Mining Areas) plus rainwater (in the case of the Western Mining Area final void), groundwater inflow is reversed and the saturated overburden and interburden becomes a source of water to the aquifers and seepage to land.

As discussed in **Section 7.1.3**, Terrenus (2013) identified that the average salt seepage rate for the Eastern Mining Area was less than 1 kg of salt per ha of seepage zone per day (on average), whilst the average salt seepage rate for the Southern Mining Area was approximately 5.6 kg of salt per ha of seepage zone per day.

No seepage will occur from the Western Mining Area at any time during mining operations or post-closure.

Existing groundwater aquifers within and adjacent to the Project Boundary have salinity concentrations equal to or (in some cases) significantly greater than the seepage predicted to be produced from overburden and interburden. As such, the seepage salt load is unlikely to present any significant impacts to groundwater quality of local water sources.

The runoff and seepage generated by overburden, interburden and coal rejects are anticipated to have concentrations of dissolved trace metals below that of applied water quality guideline criteria. These concentrations are unlikely to present any significant impacts to surface water and groundwater quality.

Spontaneous Combustion

Spontaneous combustion typically occurs when pyrite (iron sulphide) oxidises in the presence of a combustible material, such as coal. Most overburden, interburden and coal rejects that are associated with the Project have low sulphur content and consequently a low propensity for spontaneous combustion. However, coal and coal rejects derived from the Lower Hoskissons seam typically have a higher sulphur content, which could represent a risk for spontaneous combustion. As coal reject materials will be well mixed across the operation, the small amount of coal rejects with high sulphur content will be diluted to produce a composite material thereby reducing the potential for spontaneous combustion.

7.18.4 Mitigation and Management

The following management measures will be implemented:

- Confirmation of the occurrence and distribution of any potential acid forming material via a sulphur grid / layer geological model with updated exploration data;
- Selective handling and capping of potential acid forming material with non-acid forming material;
- Pre stripping topsoil from areas to be mined for use in final rehabilitation activities (surface cover or vegetation growth medium) consistent with that described in **Section 7.19**;
- Implementing practical site rehabilitation practices for potentially sodic materials to limit the risk of dispersion and erosion of surface materials at emplacement areas (e.g. utilise a topsoil cover as part of final rehabilitation);
- Conduct testing to confirm spontaneous combustion propensity of selected mine materials as required during the operations phase of the Project; and
- Monitoring of runoff and seepage from overburden, interburden and coal rejects on a regular basis during the operations phase of the Project to ensure key water quality parameters, including pH, EC, TSS, dissolved metals (including selenium and molybdenum) and sulphate, are maintained within relevant criteria.

7.19 Soils and Land Capability

7.19.1 Background

A Soil Survey and Land Capability Impact Assessment was undertaken by GSS Environmental (GSSE) and is provided in **Appendix Y**. The purpose of the assessment was to:

- Define the soil types present within the Project Boundary;
- Determine the boundary of the alluvial black soils derived from the Mooki River catchment;
- Provide a description of the pre and post-mining land capability and agricultural land suitability within the Project Boundary;
- Identify the extent of BSAL in the Project Boundary and biodiversity offset areas with consideration of the SRLUP;
- Determine the available topsoil resource for post-mining rehabilitation; and
- Provide selective topsoil and subsoil management recommendations.

7.19.2 Methodology

Soil Survey

A preliminary soil landscape map for the Project Boundary was developed using aerial photography, topographic maps and previous soil assessments, including the *Soil Landscapes of the Curlewis 1:100,000 Sheet* (Banks, 1995). The mapping was used to predict the distribution of all soil landscape attributes and guide the field survey.

The field survey was undertaken at a medium to high intensity scale of between 1:50,000 and 1:25,000. A total of 131 reference soil profile sites were assessed, comprising of 62 sites for the desktop component and 69 sites for the three GSSE field programs. In total, 103 samples were tested from 36 separate test pits within the Project Boundary (see **Figure 59**). The soil types were classified in accordance with the nomenclature outlined in the Australian Soil Classification system. The procedures devised by Elliot and Veness (1981) (revised by Elliot and Reynolds, 2007) were adopted to assess the grading, texture, structure, consistency, mottling and root presence of soil profiles. This assessment was undertaken in conjunction with the practices described in the *Australian Soil and Land Survey Field Handbook* (National Committee on Soil and Terrain, 2009).

The samples were sent for laboratory analysis to determine physical (coarse fragments, particle size distribution and aggregate stability) and chemical (pH, EC and Cation Exchange Capacity) characteristics of the soil types in the Project Boundary.

The chemical fertility of a soil refers to the potential of a soil to provide the nutrients necessary for plant growth. The ability of the soil to absorb and retain important nutrients is related to the soils cation exchange capacity (CEC). The CEC of a soil is largely dependent on the quantity and nature of the clays and humus present.

The soils component of this assessment documents the results of investigation into soil fertility through the *Soil Landscapes of the Curlewis 1:100,000 Sheet* along with laboratory results of field samples for Cation Exchange Capacity, Exchangeable Cations, pH, Electrical Conductivity, Nitrogen, Phosphorus and Organic Carbon.

BSAL Site Verification

On 11 September 2012, the government formally released the SRLUP. As described in **Section 4.6.1**, Map 6 of the SRLUP identified areas as being BSAL throughout the New England North West region. **Figure 25** illustrates the location of the Project Boundary and Disturbance Boundary relative to areas mapped as BSAL. There are 96 ha of land mapped in the SRLUP as BSAL within the Disturbance Boundary. BSAL was also mapped within the Onsite Offset Areas.

The mapping of BSAL (Map 6 of the SRLUP) is merely indicative of areas that constitute BSAL. As such, site verification is required to determine whether or not the land actually constitutes BSAL. Site verification involves assessing the land against the range of criteria listed in **Table 11**. The land is only verified as being BSAL if the criteria are satisfied.

The BSAL criteria relevant from a Soils Survey and Land Capability assessment and site verification perspective include:

- If the land that falls under soil fertility classes 'high' or 'moderately high' under the Draft Inherent General Fertility of NSW (OEH); and
- If the land is of land capability classes I, II or III under the Land and Soil Capability Mapping of NSW (OEH).

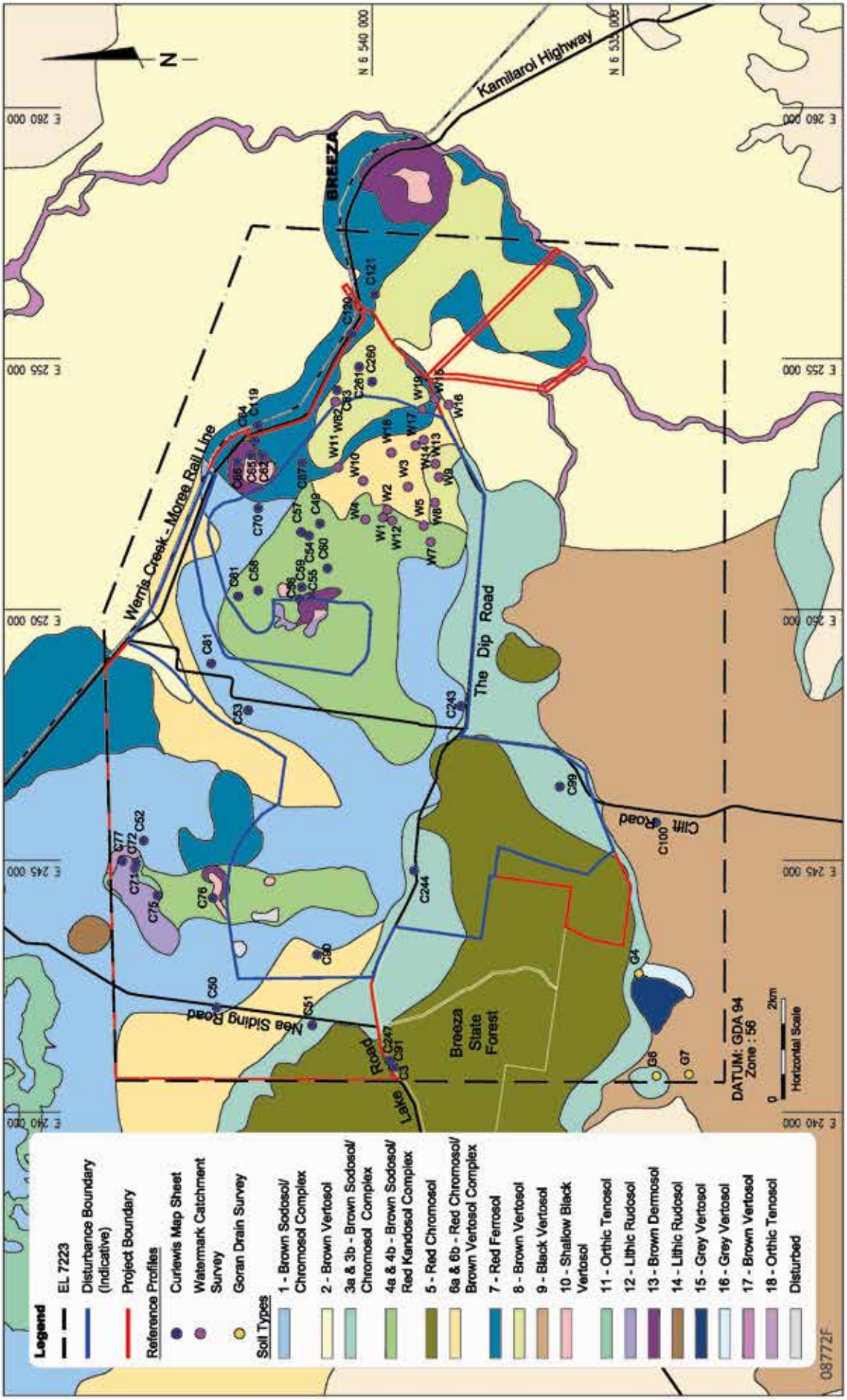
A targeted field visit of the Project Boundary, Onsite Biodiversity Offset Areas and Offsite Biodiversity Offset Areas was completed between 18 – 20 September 2012 to verify the extent of BSAL in consideration of the SRLUP criteria. **Section 7.19.3** outlines the results of the site verification.

Alluvial Black Soil Assessment

One of the key aims of the assessment was to delineate the extent of alluvial black soils (Black Vertosols) within the Project Boundary and to understand how this may interact with the mine plan.

For this assessment, alluvial black soils are defined as soils derived from alluvial flows from the Mooki River catchment. Generally, alluvial soils are defined as soils formed by recent deposition along rivers and streams, normally characterised by little or no modification of the deposited material by soil forming processes, particularly with respect to soil horizon development (Charman and Murphy, 2007). Recent deposition refers to alluvium that has been deposited within the last 5,000 to 10,000 years.

A desktop assessment was undertaken which included a review of satellite imagery, topographic maps, geological and hydrological data and previous assessments, including *The Watermark Coal Project – Quaternary Alluvial Boundary Definition Report* (GHD, 2009).


WATERMARK COAL PROJECT
Soil Types
FIGURE 59
N
Kamilaroi Highway
Wenis Creek - Moree Rail Line
The Dip Road
Cliff Road
Nea Siding Road
Lake Road
Breeza State Forest
BREEZA
DATUM: GDA 94
Zone : 56
Horizontal Scale
2km
Hansen Bailey
ENVIRONMENTAL CONSULTANTS
Legend
EL 7223
Disturbance Boundary (Indicative)
Project Boundary
Reference Profiles
Curlewis Map Sheet
Watermark Catchment Survey
Goran Drain Survey
Soil Types
1 - Brown Sodosol/ Chromosol Complex
2 - Brown Vertosol
3a & 3b - Brown Sodosol/ Chromosol Complex
4a & 4b - Brown Sodosol/ Red Kandosol Complex
5 - Red Chromosol
6a & 6b - Red Chromosol/ Brown Vertosol Complex
7 - Red Ferrosol
8 - Brown Vertosol
9 - Black Vertosol
10 - Shallow Black Vertosol
11 - Orthic Tenosol
12 - Lithic Rudosol
13 - Brown Dermosol
14 - Lithic Rudosol
15 - Grey Vertosol
16 - Grey Vertosol
17 - Brown Vertosol
18 - Orthic Tenosol
Disturbed
08772F

Transect surveys were undertaken in January and August 2011 to confirm the distribution of alluvial black soils in the Project Boundary and immediate surrounds.

A total of nine transects were established in areas where mining activities could potentially encroach on alluvial black soils. A series of survey points were established along each transect, with 20 soil profiles later selected for chemical analysis (see **Figure 59**).

Land Capability Assessment

The land capability assessment was conducted in accordance with *Systems Used to Classify Rural Lands in New South Wales* (Cunningham et.al, 1988). The system consists of eight classes, which classifies land generally based on soil erosion, stability hazard and decreasing versatility of use. These classes correspond to land suitability for cultivation, grazing and rural production.

Agricultural Suitability Assessment

The agricultural land suitability assessment was conducted in accordance with the *Agricultural Land Classification* (NSW Agriculture, 2002) and the *Agricultural Suitability Maps – Uses and Limitations* (Agriculture and Fisheries, 1990). The system consists of five classes, which have been designed to assess land on the basis of increasing suitability and potential for agricultural production. As well as assessing land capability, agricultural suitability considers industry specific factors that may influence potential production.

7.19.3 Impact Assessment

Soil Types

Table 69 provides an overview and a quantitative distribution of each soil type identified within the Project Boundary. **Figure 59** provides an illustration of the spatial distribution of each soil type. Eighteen soil types were identified within the Project Boundary.

Soil Type 1

Soil type 1 generally comprises of dark brown clay loams overlying strong brown heavy clays. The soil type is typically characterised by poor drainage, an alkaline trend, high salinity and moderate to high fertility.

The topsoil has moderate structure, whilst the subsoil has a strong structure. The subsoil tends to be marginally sodic to sodic and is slightly dispersive in wet conditions leading to hard setting surfaces and erodible topsoil. The topsoil is suitable for stripping to 0.25 m and reuse as topdressing in rehabilitation. The subsoil is not recommended for reuse in rehabilitation due to its dispersion and sodicity properties.

Soil Type 2

Soil type 2 generally comprises of dark brown to strong brown heavy clays. The soil type is typically characterised by poor drainage, an alkaline trend, high salinity and high fertility.

Table 69 Soil Types

Soil Type	Soil Landscape Unit	Australian Soils Classification	Project Boundary	
			ha	%
1	Fullwoods Road (fr)	Brown Sodosol	2,725	28.7
2	Conadilly (cd)	Brown Vertosol	150	1.6
3a	Goscombes Road (go)	Brown Sodosol	881	9.3
3b		Brown Chromosol		
4a	Watermark (wa)	Brown Sodosol	1,758	18.5
4b		Brown Kandosol		
5	Stafford Gap (sg)	Red Chromosol	1,006	10.6
6a	Booloocooroo (bo)	Sodic Brown Dermosol	1,541	16.2
6b		Brown Vertosol		
7	Ponderosa (po)	Red Ferrosol	663	7.0
8	Carinya (cr)	Brown Vertosol	438	4.6
10	Black Jack (bj)*	Shallow Black Vertosol	53	0.6
11	East Lynne (el)*	Orthic Tenosol	15	0.2
12	Long Mountain (lm)*	Lithic Rudosol	137	1.4
13	Pit Hill (ph)*	Brown Dermosol	96	1.0
17	Mooki River (mo)*	Brown Vertosol	14	0.1
18	Mount Wilga (mw)*	Orthic Tenosol	7	0.1
n/a	Disturbed Terrain*	Disturbed	17	0.2
Total			**9,500.0**	**100.0**

* *Soil type occurs in small and isolated fringes of the Project Boundary. Fieldwork did not target these soil landscape units as they were either outside of the Disturbance Boundary or made up less than 1% of the area within the Disturbance Boundary*

Structure of this soil type varies from moderate in the topsoil and subsoil, to strong in the mid profile. The subsoil tends to be marginally sodic to sodic and are highly dispersive in wet conditions leading to hard setting surfaces and severe erosion.

Due to the high clay content and sodic nature of the soil, it is not suitable for reuse in rehabilitation without treatment. The topsoil is suitable for stripping to 0.25 m and reuse as topdressing in rehabilitation if suitable blending is applied.

Soil Type 3a

Soil type 3a generally comprises of dark brown to medium brown loams overlying strong brown light medium clays, with a bleached A2 horizon situated between the topsoil and the subsoil. The soil type is typically characterised by poor drainage, an acid to alkaline trend, low salinity and low fertility.

The topsoil and subsoil has a massive structure, where the entire soil horizon appears cemented in one great mass. The subsoil has sodic properties and a tendency to be dispersive. The topsoil is suitable for stripping to 0.25 m and reuse as topdressing in rehabilitation. The subsoil (up to 1.2 m) is suitable for reuse in rehabilitation as an intermediate layer.

Soil Type 3b

Soil type 3b generally comprises of dark brown silty loams to silty clay loams overlying yellowish brown clays. The soil type is typically characterised by well drained upper horizons, poorly drained clay subsoils, an acid to alkaline trend, low salinity and low to very low fertility.

The topsoil consists of a hard setting, stony veneer. It has strong acidity and weak structure with aggregates exhibiting limited soil stability; leading to sheet erosion. The subsoil generally has non-sodic properties, a moderate structure with aggregates exhibiting a degree of soil stability and a tendency to be slightly dispersive.

The topsoil is suitable for stripping to 0.5 m and reuse as topdressing in rehabilitation, provided lime is applied in respreading. The subsoil (up to 1.2 m) is suitable for reuse in rehabilitation as an intermediate layer if suitable blending is applied.

Soil Type 4a

Soil type 4b generally comprises of brown to strong brown silty loam horizons overlying reddish brown clay loams. The soil type is typically characterised by well drained upper horizons, poorly drained clay subsoils, alkaline trend, non-saline and moderate to high fertility. The upper horizons tend to be marginally sodic to sodic, while the subsoil is non sodic, and dispersivity throughout the profile varies from negligible to slight.

The soil type (topsoil and subsoil) is suitable for stripping and reuse as topdressing in rehabilitation. The topsoil will be a suitable blending medium for clays that may require treatment before reuse.

The topsoil is suitable for stripping to 0.25 m and reuse as topdressing in rehabilitation. The subsoil (up to 1.2 m) is suitable for reuse in rehabilitation as an intermediate layer.

Soil Type 4b

Soil type 4b generally comprises of brown to strong brown silty loam horizons overlying yellowish brown clay loams. The soil type is typically characterised by good drainage, an acid to alkaline trend, non-saline and low fertility. The profile is consistently non sodic, and is slightly dispersive. The gravelly surface of this soil is subject to sheet erosion.

The topsoil is suitable for stripping to 0.25 m and reuse as topdressing in rehabilitation. The subsoil (up to 1.2 m) is suitable for reuse in rehabilitation as an intermediate layer.

Soil Type 5

Soil type 5 generally comprises of dark brown loam and clay loam horizons overlying yellowish red clays. The soil type is typically characterised by well drained topsoil, poorly drained subsoil, high alkalinity, low salinity and low to moderate fertility. The surface condition is scalded with a high presence of stones and evidence of sheeting and rill erosion. The subsoil has non-sodic properties and limited dispersivity.

The topsoil is suitable for stripping to 0.30 m and reuse as topdressing in rehabilitation. The subsoil (up to 1.2 m) is suitable for reuse in rehabilitation as an intermediate layer if suitable blending is applied.

Soil Type 6a

Soil type 6a generally comprises of uniform brown to strong brown heavy clay. The soil type is typically characterised by well drained topsoil, poorly drained subsoil, high alkalinity, high salinity and high fertility. The topsoil and subsoil has sodic properties and a tendency to be moderately to highly dispersive; leading to seasonally hard setting surface conditions. Due to the high clay content and sodic nature of the soil type (topsoil and subsoil), it is not suitable for reuse in rehabilitation.

Soil Type 6b

Soil type 6b generally comprises of uniform dark brown to brown heavy clays. The soil type is typically characterised by moderately drained topsoil, poorly drained subsoil, high alkalinity, low salinity and low to high fertility.

The topsoil has sodic properties and a tendency to be slightly dispersive; leading to seasonally hard setting surface conditions. The underlying subsoil has sodic properties and limited dispersivity.

The topsoil is suitable for stripping to 0.35 m and reuse as topdressing in rehabilitation. The subsoil (up to 1.2 m) is suitable for reuse in rehabilitation as an intermediate layer if suitable blending is applied.

Soil Type 7

Soil type 7 generally comprises of uniform very dark brown light medium clays overlying red heavy clays. The soil type is typically characterised by well drained soils, high alkalinity, low salinity and high fertility.

The topsoil and subsoil has non-sodic properties and a tendency to be slightly dispersive. The surface condition is friable and there is evidence of sheet erosion.

The topsoil is suitable for stripping to 0.60 m and reuse as topdressing in rehabilitation if suitable blending is applied. The subsoil (up to 1.2 m) is suitable for reuse in rehabilitation as an intermediate layer if suitable blending is applied.

Soil Type 8

Soil type 8 generally comprises of brownish black clay loams overlying dark reddish brown heavy clays. The soil type is typically characterised by well drained upper horizons, poorly drained subsoil, moderate alkalinity to slight acidity and high fertility. The surface condition is hard setting with evidence of sheet and gully erosion.

The topsoil is suitable for stripping to 0.25 m and reuse as topdressing in rehabilitation. The subsoil is not suitable for reuse in rehabilitation as an intermediate layer.

Soil Type 9

Soil type 9 generally comprises of shallow black vertosols on crests and benches. The soil type is characterised by low wet bearing strength, stoniness, low permeability, and high skink swell potential (Banks, 1995). The topsoil and subsoil is not recommended for reuse in rehabilitation.

Soil Type 10

Soil type 10 generally comprises of orthic tenosols. The soil type is characterised by steep slopes, mass movement hazard, rock outcrops and high water erosion hazards (Banks, 1995). The topsoil and subsoil is not recommended for reuse in rehabilitation.

Soil Type 11

Soil type 11 generally comprises of lithic rudosols. The soil type is characterised by shallow soils, rocky outcrops, water erosion, localised hard setting surfaces and shrink / swell hazards (Banks, 1995). This soil type will not be disturbed due to the Project.

Soil Type 12

Soil type 12 generally comprises of brown dermosols. The soil type is characterised by steep slopes, mass movement hazard, water erosion hazard, stoniness and shallow soils (Banks, 1995). The topsoil and subsoil is not recommended for reuse in rehabilitation.

Soil Type 13

Soil type 13 generally comprises of brown vertosols. The soil type is characterised by extreme flooding hazard, water erosion hazard, salinity hazard, localised seasonal and permanent water logging, low soil wet bearing strength, high shrink-swell potential and low permeability (Banks, 1995). This soil type will not be disturbed due to the Project.

Soil Type 14

Soil type 14 generally comprises of orthic tenosols. The soil type is characterised by steep slopes, water erosion hazard, shallow soils, rocky outcrops, sporadic shrink / swell hazard and low wet bearing strength (Banks, 1995). This soil type will not be disturbed due to the Project.

Soil Type 15

Soil type 15 is characterised by land that has been disturbed by human activity whereby the original soil has been removed, greatly disturbed or buried. The topsoil and subsoil is not recommended for reuse in rehabilitation.

Alluvial Black Soil

The alluvial soils of the Mooki River catchment typically comprises of black and grey clayey self-mulching topsoil with deep yellowish brown mottled clayey subsoils. The soil type is typically characterised by high salinity and sodicity at increasing depths. These constraints therefore limit the land capability associated with these soils.

The colluvium typically comprises of lighter brown and yellow soils lacking gilgai formations. Any material identified as colluvium was excluded from the alluvial boundary. However, the colluvium was used to confirm the change from alluvial to transferral soils. Changes in soil type indicated a minimised degree of alluvial influence away from the source points of the Mooki River and the Native Dog Gully tributary.

Based on soil characteristics, topography, and observations on vegetation and infrastructure, a boundary between alluvial soils and transferral soils was defined and mapped at the point where the alluvial soils were greater than 75 cm deep. Due to the gradual change between alluvial soils and transferral soils, this boundary is to be regarded with a 20 m buffer.

As part of the Project, Shenhua Watermark has maintained a 150 m buffer from the open cut mining areas to the Alluvial Black Soils and thus, no disturbance of this soil type is anticipated.

Topsoil and Subsoil Balance

Disturbance of the topsoil and intermediate soil layers will be confined within the Eastern, Southern and Western Mining Areas. The recommended stripping depth for each of the soil types within the mining areas and the soil balance for the Project are shown in **Table 70**.

The estimated volume of suitable topsoil available from the mining areas is 10,145,000 m^3. Allowing for a 10% handling loss, approximately 9,130,500 m^3 of suitable topsoil is considered to be available.

The estimated volume of suitable intermediate subsoil available from the mining areas is 21,277,000 m^3. Allowing for a 10% handling loss, approximately 19,149,300 m^3 of suitable intermediate soil is considered to be available.

To achieve the desired post-mining land capability, the total volume of material required for rehabilitation (topsoil and subsoil) is 24,578,000 m^3. The total volume of suitable material available for reuse in rehabilitation is 28,279,800 m^3, which results in a surplus of 3,701,800 m^3.

Table 70 Soil Balance

Soil Type	Soil Landscape Unit	Australian Soils Classification Name	Mining Areas (ha)	Topsoil Stripping Depth (m)	Volume of Topsoil (m^3)	Volume of Topsoil (10% Handling Loss) (m^3)	Intermediate Soil Stripping Depth (m)	Volume of Intermediate Soil (m^3)	Volume of Intermediate Soil (10% Handling Loss) (m^3)
1	Fullwoods Road	Brown Sodosol	890	0.20	1,780,000	1,602,000	0.0	0	0
3a	Goscombes Road	Brown Sodosol	225	0.25	562,500	506,250	1.2	2,137,500	1,923,750
3b		Brown Chromosol	225	0.50	1,125,000	1,012,500	1.2	1,575,000	1,417,500
4a	Watermark	Brown Sodosol	452	0.25	1,130,000	1,017,000	1.2	4,284,000	3,855,600
4b		Red Kandosol	453	0.55	2,491,500	2,242,350	1.2	2,944,500	2,650,050
5	Stafford Gap	Red Chromosol	417	0.30	1,251,000	1,125,900	1.2	3,753,000	3,377,700
6a	Booloocooroo	Sodic Brown Dermosol	212	0.0	0	0	1.2	2,544,000	2,289,600
6b		Brown Vertosol	213	0.35	745,500	670,950	1.2	1,810,500	1,629,450
7	Ponderosa	Red Ferrosol	107	0.60	642,000	577,800	1.2	642,000	577,800
8	Carinya	Brown Vertosol	167	0.25	417,500	375,750	1.2	1,586,500	1,427,850
10	Black Jack	Shallow Black Vertosol	7	0.0	0	0	0.0	0	0
13	Pit Hill	Brown Dermosol	4	0.0	0	0	0.0	0	0
n/a	Disturbed Land	Disturbed	12	0.0	0	0	0.0	0	0
Total			**3,384**	-	**10,145,000**	**9,130,500**	-	**21,277,000**	**19,149,300**

Table 71 lists the volume of topsoil and subsoil material required to achieve target land capability classes in the rehabilitated post mining landform. The mine disturbance footprint has been used to calculate the area requiring rehabilitation. For areas disturbed by infrastructure, the topsoil and subsoil should be stripped and stockpiled separately nearby, for the reinstatement of the soil profile following decommissioning of the mine infrastructure.

Using the reinstated sub soil and topsoil depths to achieve the desired land capability classes as shown in **Table 72**, and the potential stripping depths as shown in **Table 70**, there is a surplus of both topsoil (573,500m^3) and subsoil (3,128,300m^3) resources. This surplus may be utilised in rehabilitation to potentially increase the soil depth and water holding capacity of the rehabilitated areas. The demonstrated capacity to achieve Class III land post mining is outlined in **Appendix AA**.

Land Capability

Impacts to the land as a result of the Project will remain within the Disturbance Boundary. Areas outside this are expected to maintain its existing pre-mining class, including all Class II land. The current land capability classification within the Disturbance Boundary ranges from Class II to Class VII, with Class VII dominating the existing environment. No Class II land will be disturbed as a result of the Project.

Following the completion of mining, land capability classes within the Disturbance Boundary are predicted to range from Class II to Class VIII. It is proposed that 1,000 ha of rehabilitated land with Class III characteristics within the Disturbance Boundary will be reinstated for agricultural purposes. The remaining 4,630 ha will be used for ecological conservation through the restoration of native woodland and grassland.

The creation of gentle slopes within the final landform and the availability of excess topsoil and subsoil resources will ensure the recreation of 3,233 ha of Class III land capability as part of the mine rehabilitation program.

The post mining landform contains relatively gentle slopes compared to the majority of mines within NSW and QLD, which allows for the potential establishment of land capability Class III on the rehabilitated landform. Furthermore these relatively gentle slopes will contain slope lengths and suitable soil depth designed to minimise erosion risk and ensure the land meets criteria for land capability Class III.

A comparison of the pre-mining and post-mining rural land capability classifications of the Disturbance Boundary are provided in **Table 72** and **Figure 60** and **Figure 61**.

Agricultural Suitability

Impacts to the land as a result of the Project will remain within the Disturbance Boundary. Areas outside this are expected to maintain its existing pre-mining class. The current agricultural suitability classification within the Disturbance Boundary ranges from Class 1 to Class 5, with Class 2 dominating the existing environment.

Following the completion of mining, agricultural suitability classes within the Disturbance Boundary will remain similar to pre-mining conditions ranging from Class 1 to Class 5. No Class 1 land will be disturbed as a result of the Project.

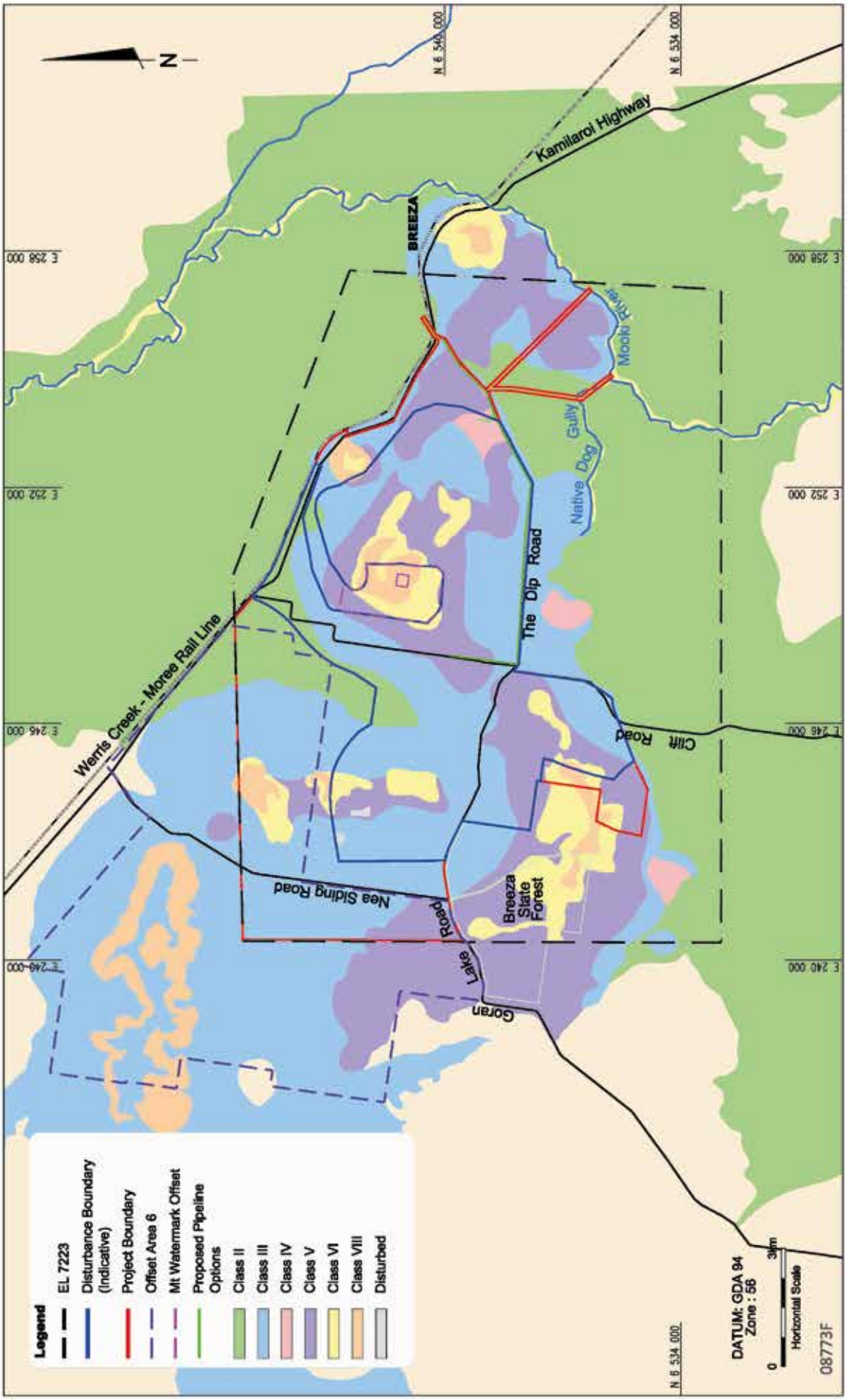
A comparison of the pre-mining and post-mining agricultural suitability classifications of the Disturbance Boundary are provided in **Table 73**.

Table 71 Soil Balance for Land Capability Targets

	Land Capability Class	Area to be Rehabilitated (ha)	Minimum Topsoil Depth (m)	Topsoil Volume (m^3)	Minimum Subsoil Depth	Subsoil Volume (m^3)
Volume of material required for rehabilitation (according to final land capability classes)	I	0	0	0	0	0
	II	0	0	0	0	0
	III	1,963	0.3	5,889,000	0.5	9,815,000
	IV	0	0.2	N/A	0.5	0
	V	1,102	0.2	2,204,000	0.5	5,510,000
	VI	232	0.2	464,000	0.3	696,000
	VII	0	0.1	N/A	0.0	0
	VIII	87	0	0	0.0	0
Total volume of material required for rehabilitation			_	8,557,000	_	16,021,000
Total volume of material proposed to be stripped (incl. 10% loss)			_	9,130,500	_	19,149,300
Deficit or surplus volume			_	**573,500**	_	**3,128,300**

Table 72 Pre and Post-mining Land Capability

Land Class	Pre-mining		Post-mining	
	ha	%	ha	%
Class II	351.3	6.2	351.3	6.2
Class III	2,948.4	52.4	3,233.0	57.4
Class IV	80.5	1.4	22.7	0.4
Class V	1,751.0	31.1	1,649.5	29.3
Class VI	426.8	7.6	273.0	4.9
Class VII	55.4	1.0	9.7	0.2
Class VIII	0.0	0.0	86.8	1.5
Disturbed Land	**16.6**	**0.3**	**4.0**	**0.1**
Total	**5,630.0**	**100**	**5,630.0**	**100**


WATERMARK COAL PROJECT
Pre Mining Land Capability
FIGURE 60
N
Kamilaroi Highway
BREEZA
Werris Creek - Moree Rail Line
The Dip Road
Native Dog Gully
Mooki River
Cliff Road
Nea Siding Road
Breeza State Forest
Goran Lake Road
Legend
EL 7223
Disturbance Boundary (Indicative)
Project Boundary
Offset Area 6
Mt Watermark Offset
Proposed Pipeline Options
Class II
Class III
Class IV
Class V
Class VI
Class VIII
Disturbed
DATUM: GDA 94
Zone : 56
Horizontal Scale
3km
0
08773F
Hansen Bailey
ENVIRONMENTAL CONSULTANTS

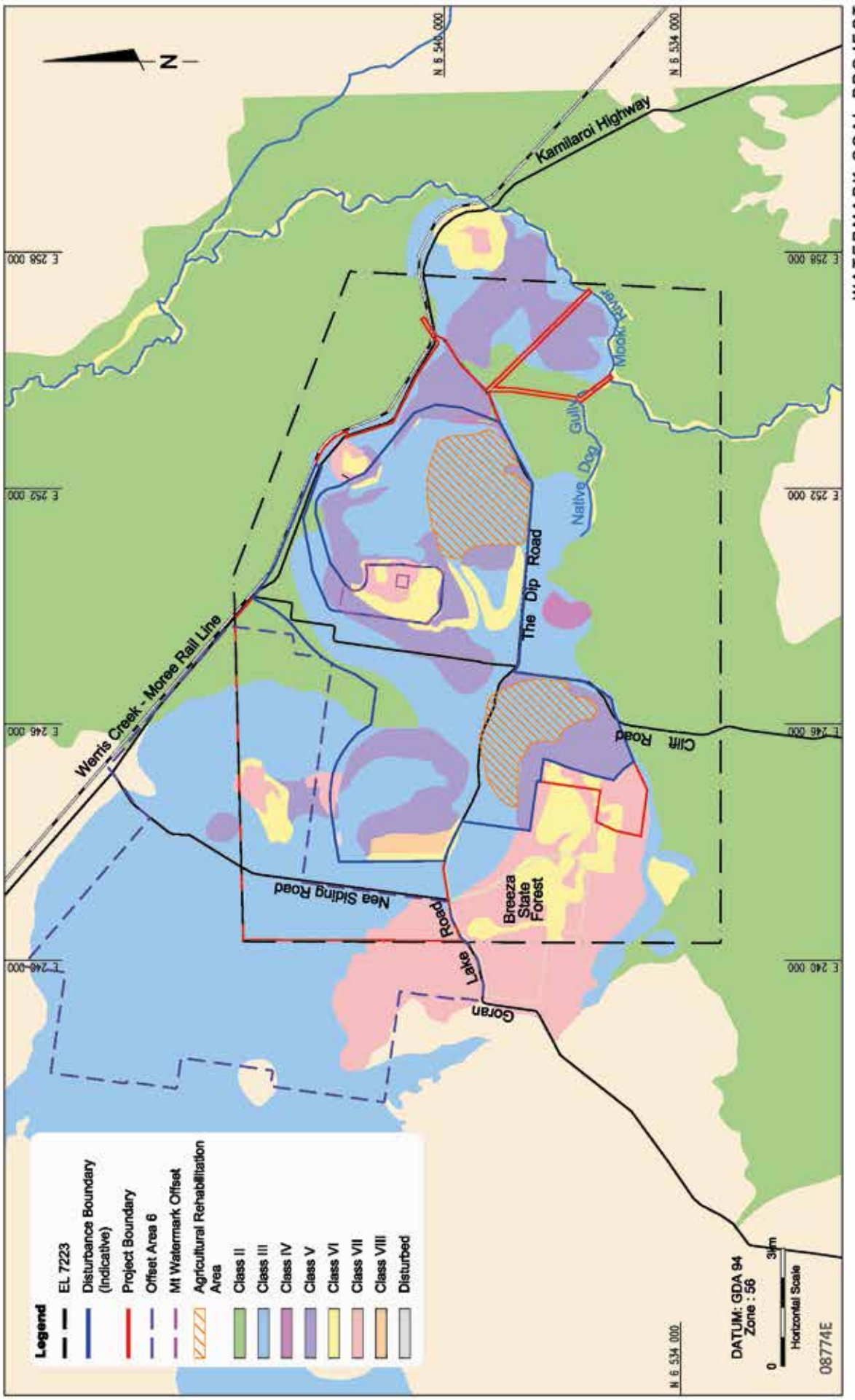

WATERMARK COAL PROJECT
Post Mining Land Capability
FIGURE 61
N
Kamilaroi Highway
Werris Creek - Moree Rail Line
The Dip Road
Native Dog Gully
Mooki River
Cliff Road
Nea Siding Road
Breeza State Forest
Road
Lake
Goran
Legend
EL 7223
Disturbance Boundary (Indicative)
Project Boundary
Offset Area 6
Mt Watermark Offset
Agricultural Rehabilitation Area
Class II
Class III
Class IV
Class V
Class VI
Class VII
Class VIII
Disturbed
DATUM: GDA 94
Zone : 56
Horizontal Scale
0
3km
08774E
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Table 73 Pre and Post-mining Agricultural Suitability

Land Class	Pre-mining		Post-mining	
	ha	%	ha	%
Class 1	351.3	6.2	351.3	6.2%
Class 2	2,948.4	52.4	3,233.0	57.4%
Class 3	1,831.5	32.5	1,672.2	29.7%
Class 4	426.8	7.6	273.0	4.8%
Class 5	55.4	1.0	96.5	1.7%
Disturbed Land	16.6	0.3	4.0	0.1%
Total	**5,630**	-	**5,630**	-

Biophysical Strategic Agricultural Land

The SRLUP mapping indicates approximately 96 ha of BSAL is potentially present in the Disturbance Boundary. Site verification of this area in consideration of the SRLUP criteria, found that the soil landscape within the Project Boundary considered most likely to fulfil the criteria for fertility and land capability was Ponderosa (soil type 7). Details of soil fertility are outlined above and discussed in detail in **Appendix Y**. The area of this soil landscape within the mining areas was calculated to be 96.1 ha as shown in **Figure 25**.

As part of the Biodiversity Offset Strategy for the Project, Shenhua Watermark has and continues to acquire land holdings (Onsite and Offsite Biodiversity Offset Areas) containing substantial amounts of vegetation to compensate for any potential ecological impacts from the Project. The SRLUP mapping indicates approximately 375 ha BSAL may occur within the proposed Onsite Biodiversity Offset Areas. Site verification of this area in consideration of the SRLUP criteria, found that a further 321 ha was identified, thereby increasing the total area of BSAL in the Offsite Biodiversity Offset Areas to 696 ha.

There is no BSAL situated within the Offsite Biodiversity Offset Areas. The AIS provides an assessment of impacts on BSAL as a result of the Project (see **Section 7.20**).

7.19.4 Mitigation and Management

In order to reduce the potential for soil degradation within the Project Boundary, the following strategies will be implemented during operations and rehabilitation to achieve the desired post-mining land capability and agricultural suitability:

- Materials will be stripped to indicated levels in a slightly moist condition and placed directly onto reshaped areas (i.e. to avoid the requirement for stockpiling), where practical;
- Where topsoil resources allow, topsoil will be spread to a minimum depth of 100 mm on all re-graded OEA or disturbance areas. Topsoil will be spread, treated with fertiliser and seeded in one consecutive operation, to reduce the potential for topsoil loss to wind and water erosion;
- Where materials must be stockpiled, efforts will be made to reduce compaction by keeping soil in as coarsely textured a condition as possible;
- Stockpiles will be a maximum of 3 m in height and if stored for greater than 12 months, seeded and fertilised and treated for weeds prior to respreading;
- An inventory of designated areas and available soil will be maintained to ensure adequate topsoil and subsoil materials are available for planned rehabilitation activities;
- Thorough seedbed preparation will be undertaken to ensure optimum establishment and growth of vegetation with all topsoiled areas lightly contour ripped to create a *"key"* between the soil and the overburden. Ripping will be undertaken on the contour, preferably when soil is moist. The respread topsoil surface will be scarified prior to, or during seeding, to reduce runoff and increase infiltration;
- Regrading will be undertaken where required to produce slope angles, lengths and shapes that are compatible with the land use and not prone to an unacceptable rate of erosion. This will be done in integration with drainage structures and dams capable of conveying runoff from the newly created catchments whilst minimising the risk of erosion and sedimentation (including contour furrows or contour banks at intervals down the slope, contour ripping across the grade, and graded banks where required); and
- Engineered waterways, spillways and sediment control dams (using erosion blankets, ground cover vegetation and/or rip rap) will also be implemented to capture sediment laden runoff.

As part of its EMS, Shenhua Watermark will develop a Land Management Plan in consideration of the above mitigation and management measures.

7.20 Agriculture

7.20.1 Background

An AIS was undertaken by Scott Barnett and Associates and is provided in **Appendix Z**. The purpose of the assessment was to:

- Identify agricultural resources and enterprises within the Project Boundary, biodiversity offset areas and surrounding locality;
- Identify the agricultural domains with the Project Boundary and Biodiversity Offset Areas;
- Assess the current and maximum agricultural potential for each agricultural domain in the Project Boundary and Biodiversity Offset Areas in terms of the quantum, gross value and net value of production;
- Assess the loss of agricultural production within the Project Boundary and Biodiversity Offset Areas;
- Assess potential impacts on the agricultural resources and enterprises within the locality; and
- Recommend appropriate mitigation and management measures.

The AIS considered the agricultural productivity of all land owned by Shenhua Watermark, along with the remaining parts of the Biodiversity Offset Areas which are not owned by Shenhua Watermark (called residual lands). This ensured that all land affected by the Project (either via open cut mining disturbance or Biodiversity Offset Areas) is considered.

Regional Setting

Surrounding Locality

For the purposes of the AIS, the locality was defined as the area within a 10 km radius of the Project Boundary.

A significant area of highly productive agricultural soils associated with the black soil plains is situated predominantly outside of and adjacent to the Project Boundary. These soils meet the criteria and are mapped as BSAL under the SRLUP. The land overlying these soils is primarily used for cropping enterprises, with some beef and sheep grazing operations. Other significant agricultural resources in the locality of the Project Boundary include:

- The Mooki River Water Source (part of the Phillips Creek, Mooki River, Quirindi Creek and Warrah Creek Water Sources);
- Lake Goran Water Source (part of the Namoi Unregulated Rivers Water Sources);
- Zone 3 of the Upper and Lower Namoi Groundwater Sources;
- Zone 7 of the Upper and Lower Namoi Groundwater Sources;
- Zone 8 of the Upper and Lower Namoi Groundwater Sources; and
- Soils associated with the black earth foot slopes, central black earth floodplains and central mixed soil floodplains.

Other more intensive enterprises within the locality include the Baiada Poultry breeder sheds located to the north of the Project Boundary and the Caroona Feedlot, located approximately 12.5 km south of the Project Boundary.

Shenhua Watermark Owned Land

There are several existing agricultural enterprises within Shenhua Watermark owned land, which includes the Project Boundary, Mt Watermark Offset Area and a portion of Offset Area 6. Shenhua Watermark owned land is currently managed as agricultural land and operated by nine licensees. The licensees operate extensive grazing and/or cropping operations on these properties. The predominant agricultural land use on Shenhua Watermark owned land is extensive beef cattle grazing with the major enterprise being beef cattle breeding for the domestic weaner market.

Cropping within Shenhua Watermark owned land is dominated by dryland wheat enterprises (durum and bread).

As discussed in **Section 7.19.3**, a small of area of BSAL (96.1 ha) has been identified and site verified within the Disturbance Boundary. A further 696 ha of BSAL has been identified and site verified within the Onsite Biodiversity Offset Areas, including a portion of Offset 6 not currently owned by Shenhua Watermark. The potential impacts of the Project on the agricultural productivity of BSAL are discussed in **Section 7.20.4.**

Residual Onsite Biodiversity Offset Areas

The portion of Offset Area 6 (see **Section 7.11**) which is not owned by Shenhua Watermark is primarily used for extensive beef cattle and sheep grazing and dryland winter cropping. Grazing enterprises in this area include:

- Beef cattle breeding for weaner and vealer production;
- Cattle trading and fattening; and
- Cross bred ewes and fat tail sheep for fat lamb production.

Cropping enterprises in the portion of Offset Area 6 which is not owned by Shenhua Watermark include wheat (bread and durum), canola and barley (malt and feed grain) growing.

Offsite Biodiversity Offset Areas

The Offsite Biodiversity Offset Areas (see **Section 7.11**) are primarily used for extensive grazing for breeding cattle and sheep (merino ewes and wethers and first cross ewes). The Offsite Biodiversity Offset Areas are largely densely timbered.

There are no significant agricultural resources in the locality of the offsite biodiversity offset areas and no BSAL is present.

7.20.2 Methodology

Field Assessment

A field assessment was undertaken as part of the AIS to inspect Shenhua Watermark owned land and the land within the Project Boundary, residual Onsite Biodiversity Offset Areas, and Offsite biodiversity Offset Areas. The purpose the field assessment was to assess the existing and potential agricultural production of the land. Interviews were conducted with property managers to ascertain details of the agricultural enterprises currently in operation and potential levels of agricultural production.

Desktop Assessment

Using the information gathered during the field assessment for the AIS and the Soil Survey and Land Capability Impact Assessment (see **Section 7.19** and **Appendix Y**), agricultural domains were developed for Shenhua Watermark owned land, the land within the Project Boundary, the residual Onsite Biodiversity Offset Areas and the Offsite Biodiversity Offset Areas (see **Figure 62** and **Figure 63**). Agricultural domains were used to reflect the current land practices as they align to the various land classification systems within the limitations of individual land manager's management style and choices and the variance between individual land managers.

The current and maximum value of each agricultural enterprise was then calculated by domain using the Gross Margin Budgets prepared by DTIRIS – Primary Industries (2011). These values were then reviewed against the regional, state and national agricultural production outputs to understand the total contribution of each enterprise.

The assessment of the potential impacts was undertaken in consideration of the SRLUP and the *Guidelines for Agricultural Impact Statements* (DP&I, March 2012b). Issues and concerns identified throughout the stakeholder consultation program for the Project were also included. Inputs from various other EIS impact assessments were used to draw conclusions regarding the impact of the Project on agriculture, particularly BSAL, including:

- The Groundwater Impact Assessment (see **Appendix T** and **Section 7.1**);
- The Surface Water Impact Assessment (see **Appendix S** and **Section 7.3**);
- The Air Quality and Greenhouse Gas Impact Assessment (see **Appendix G** and **Section 7.6** and **7.7**);
- The Acoustics Impact Assessment (see **Appendix H** and **Section 7.8** and **7.9**);
- The Visual Impact Assessment (see **Appendix J** and **Section 7.17**);
- The Traffic and Transport Impact Assessment (see **Appendix AB** and **Section 7.16**); and
- The Social Impact Assessment (see **Appendix AE** and **Section 7.26**).

Further, as part of the AIS, Gillespie Economics undertook an assessment of the potential economic implications of the Project on agricultural resources (see Appendix 7 of **Appendix Z**). This assessment provided a comparison of the economic efficiencies of coal mining and the agricultural industry, including the consideration of the use of land and resources.

7.20.3 Existing Agricultural Domains, Production and Value

This section presents the existing quantum and value of the agricultural production from Shenhua Watermark owned land, the Project Boundary, residual Onsite Biodiversity Offset Areas and Offsite Biodiversity Offset Areas.

Shenhua Watermark Owned Land

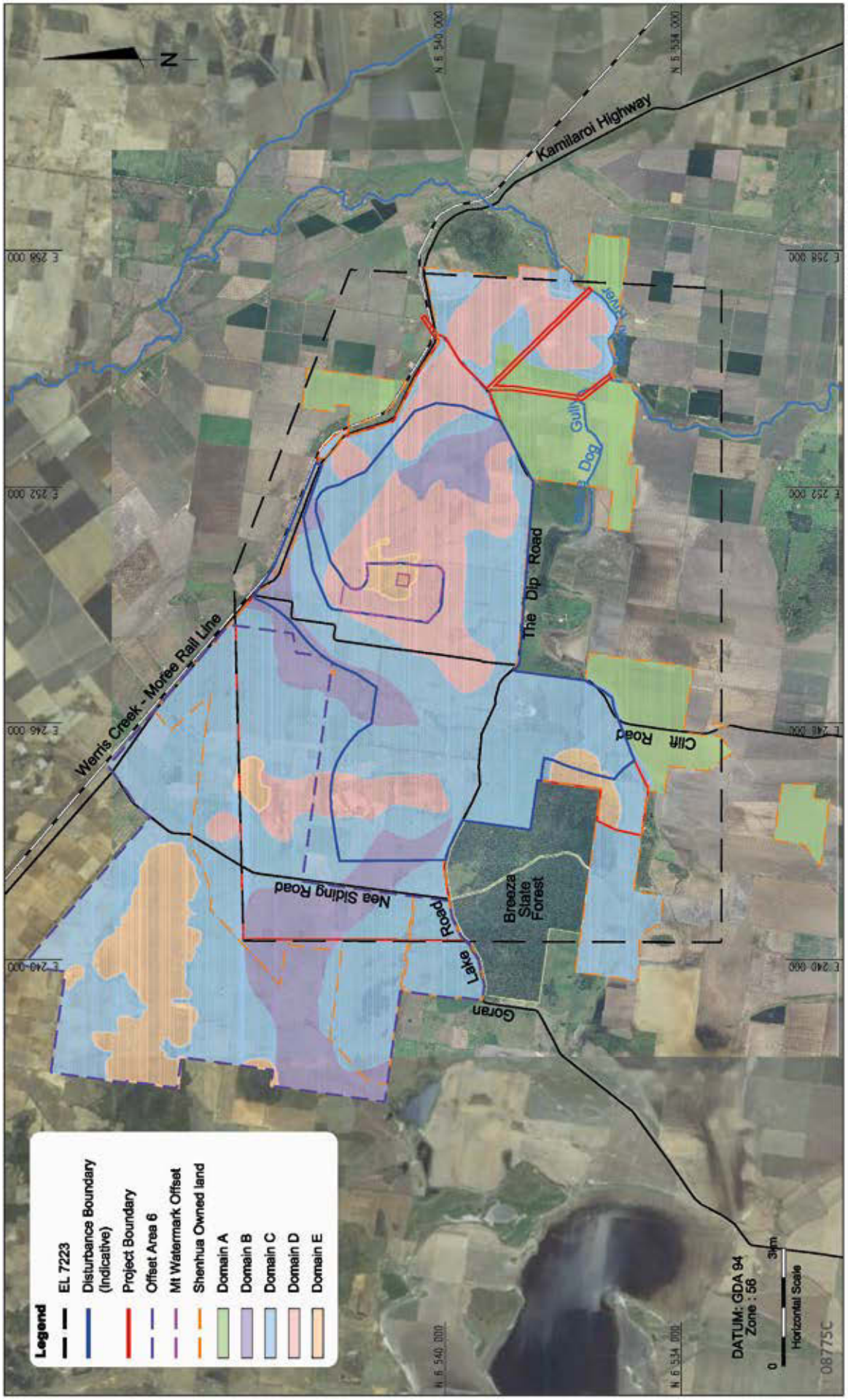
Shenhua Watermark owned land was dissected into five agricultural domains as outlined in **Table 74**, which were confirmed via site verification as part of the Soil Survey and Land Capability Impact Assessment for the Project. **Table 74** also presents the domain areas as relevant to the Project Boundary and Disturbance Boundary, which are both wholly located on Shenhua Watermark owned land.

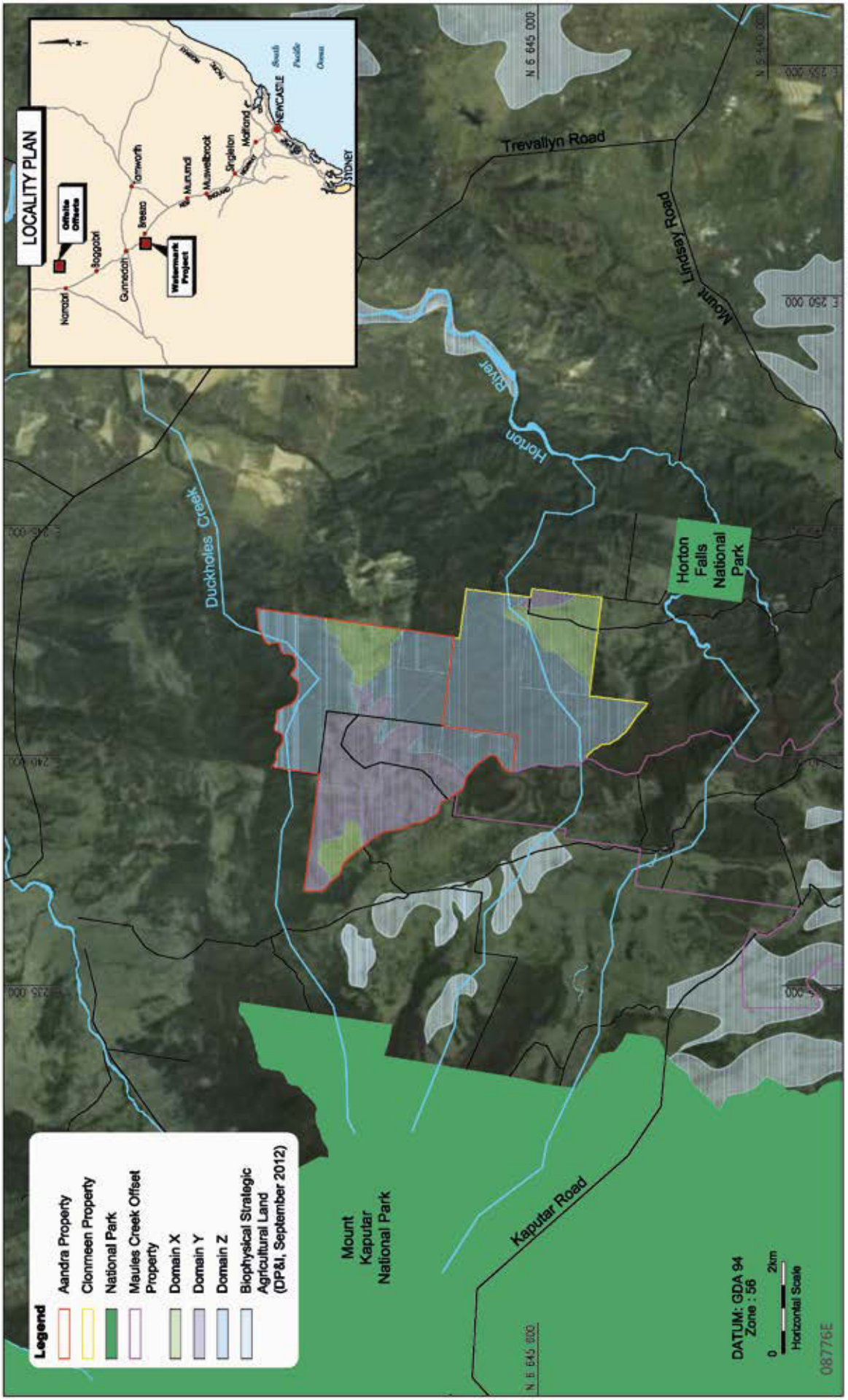
The land capability classes within Shenhua Watermark owned land range from Class II to Class VII (see **Section 7.19**). The vast majority of Shenhua Watermark owned land (7,612 ha or 51.3% of the total area) and the Project Boundary (5,151 ha or 54.2%) is composed of land classed as Domain C. This land is suited to grazing by beef cows for weaner or vealer production and trade steers or sheep grazing (prime lamb and wool production). It can also be used for dryland cropping (summer and winter), provided that appropriate soil conservation techniques are utilised. Land classified as Agricultural Domain C is typically associated with land capability Class III and IV, and agricultural land suitability Classes 2 and 3.

The agricultural enterprises that are currently operating within Shenhua Watermark owned land is provided in **Table 75** and the value of agricultural production from these enterprises is summarised in **Table 76**. The predominant agricultural enterprise operating within Shenhua Watermark owned land is beef cattle breeding for the weaner and domestic market. The gross value and net value of production from Shenhua Watermark owned land, based on current land use, is approximately $5.5 M per annum and $2.8 M per annum respectively.

Residual Onsite Biodiversity Offset Areas

The portion of Offset Area 6 which is not owned by Shenhua Watermark was divided into three agricultural domains as outlined in **Table 77**. Similar to land owned by Shenhua Watermark, the majority of the residual Onsite Biodiversity Offset Areas (2,127 ha or 55.6%) is composed of land classed as Domain C. This land is suited to grazing by beef cows for weaner or vealer production and trade steers or sheep grazing (prime lamb and wool production). It can also be used for dryland cropping (summer and winter) provided appropriate soil conservation techniques are utilised. Land classified as Agricultural Domain C is typically associated with land capability Class III, and agricultural land suitability Classes 2 and 3.


WATERMARK COAL PROJECT
Agricultural Domains
FIGURE 62
Hansen Bailey
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N
Kamilaroi Highway
Werris Creek - Moree Rail Line
The Dip Road
Cliff Road
New Siding Road
Lake Goran Road
Breeza State Forest
Gully
Dog
River
Legend
EL 7223
Disturbance Boundary (Indicative)
Project Boundary
Offset Area 6
Mt Watermark Offset
Shenhua Owned land
Domain A
Domain B
Domain C
Domain D
Domain E
DATUM: GDA 94
Zone : 56
Horizontal Scale
0
3km
08775C



WATERMARK COAL PROJECT

Offsite Biodiversity Areas - Agricultural Domains

FIGURE 63

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Table 74 Agricultural Domains in Shenhua Watermark Owned Land

Agricultural Domain	Description	Area owned by Shenhua Watermark		Area in Project Boundary		Area in Disturbance Area (ha)	
		Area (ha)	Area (%)	Area (ha)	Area (%)	Area (ha)	Area (%)
A	Area suited to irrigation though only a limited area has been irrigated. Land in this domain is generally situated outside of the Project Boundary, with the exception of a small area contained within the pipeline corridors	2,226	15.0	47	0.5	3	0.05
B	Area suited to rotational dryland cropping including pasture phases	1,674	11.2	1,614	17.0	756	13.4
C	Area suited to pasture and occasional cropping. Potential for soil erosion during cropping phase without suitable precautions	7,612	51.3	5,151	54.2	3,214	57.1
D	Area suited to extensive grazing with potential for pasture improvement with limited soil disturbance. Slope and stoniness prevent cropping	2,964	20.0	2,318	24.4	1,570	27.9
E	Area suited to timber and hill grazing. Low carrying capacity, slope and stoniness prevent pasture improvement. Includes areas of no or limited agricultural value, including timbered areas and the cliffs of Long Mountain	367	2.5	370	3.9	87	1.5
Total		**14,843**	**100.0**	**9,500**	**100.0**	**5,630**	**100**

Table 75 Current Enterprises within Shenhua Watermark Owned Land

Enterprise	Area / Heads	Market	Average Carrying Capacity / Yield	Agricultural Domain
Cotton	40	Carroll Gin	10 bale/ha	A
Sorghum	838	Grain Traders, end users (feedlots, stockfeed manufacturers)	4.5 t/ha	A, B and C
Sunflowers	120	Processor Newcastle	1.6 t/ha	A and B
Mung Beans	120	Local agent	1.2 t/ha	A and B
Dryland wheat (Durum)	1,100	Grain Corp Silos, On farm storage then local agent, AWB	2.7 t/ha	A, B and C
Dryland wheat (bread)	1,001	On farm storage then local agent, Grain Corp Silos, AWB	2.5 t/ha	B and C
Irrigated wheat (Durum)	70	Grain Corp Silos	7.0 t/ha	A
Barley (feed)	87	Local Agent	3.7 t/ha	B and C
Barley (Malt)	689	Local Agent, Grain Corp,	2.9 t/ha	B and C
Canola	248	Processor Newcastle	2.5 t/ha	B
Beef breeders for local trade	740	Gunnedah saleyard	16.7 DSE	B, C and D
Beef breeders for heavy feeder steers	50	Gunnedah saleyard	16.9 DSE	B and C
Grow out steers 240-460 kg	440	Gunnedah saleyard, Direct to feedlot	8.6 DSE	C and D
Fatten steers 340 - 580 kg	500	Gunnedah saleyard	11.0 DSE	C, D and E
Grow out early weaned calves	900	Direct to feedlot or abattoir	7.1 DSE	C, D and E
Background feeder steers 280 – 350 kg	2,334	To feedlot	6.4 DSE	C and D
Merino with terminal sire replacing	200	Tamworth saleyard, Wool through agent at Tamworth	2.4 DSE	C, D and E
Merino ewes self replacing	2,575	Tamworth saleyard, Wool through agent at Tamworth	2.2 DSE	D and E

DSE – Dry Sheep Equivalent, the equivalent daily energy requirement of a 50 kg wether not losing or gaining weight

Table 76 Current Value of Agricultural Production within Shenhua Watermark Owned Land

Enterprise	Crop Production	Animals Sold [1]	Wool Sold	Gross Value of Production	Net Value of Production
Cotton	400 bales	N/A	N/A	$247,003	$132,138
Sorghum	3,738 t	N/A	N/A	$672,746	$242,031
Sunflowers	192 t	N/A	N/A	$108,096	$50,892
Mung Beans	144 t	N/A	N/A	$110,477	$59,521
Wheat	5,923 t	N/A	N/A	$1,628,263	$644,471
Barley	2,349 t	N/A	N/A	$452,097	$186,977
Canola	615 t	N/A	N/A	$307,520	$181,720
Beef Breeding	N/A	848	N/A	$560,837	$270,749
Beef fattening/grow out	N/A	4,091	N/A	$1,394,074	$961,481
Sheep	N/A	253	1,560 kg	$43,493	$24,351
Total				**$5,524,606**	**$2,754,330**

1 – Not all sold through sale yards

Table 77 Agricultural Domains in Residual Onsite Biodiversity Offsets

Agricultural Domain	Description	Area (ha)	Area (%)
B	Area suited to rotational dryland cropping including pasture phases	610	16.0
C	Area suited to pasture and occasional cropping. Potential for soil erosion during cropping phase without suitable precautions	2,127	55.6
E	Area suited to timber and hill grazing. Low carrying capacity, slope and stoniness prevent pasture improvement. Includes areas of no or limited agricultural value, including timbered areas and the cliffs of Long Mountain	1,090	28.4
Total		**3,827**	**100.0**

The agricultural enterprises that currently operated within the residual Onsite Offset Biodiversity Areas are provided in **Table 78** and the value of agricultural production from these enterprises is summarised in **Table 79**. The predominant agricultural enterprise operating within the residual Onsite Offset Biodiversity Areas is beef cattle breeding for the weaner and domestic market. The gross value and net value of production from lands within the residual Onsite Offset Biodiversity Areas, based on current land use are approximately $1.6 M per annum and $0.7 M per annum respectively.

Offsite Biodiversity Offset Areas

The Offsite Biodiversity Offset Areas were divided into three agricultural domains as outlined in **Table 80**. The majority of the Offsite Biodiversity Offset Areas (1,761 ha or 61.2%) are composed of land classed as Domain Z. This land is generally heavily timbered and not suited to agricultural use.

The Offsite Biodiversity Offset Areas are currently being used to produce beef cattle, sheep (wethers) and wool as outlined in **Table 80** and **Table 81**. The gross value and net value of production from lands within the Offsite Biodiversity Offset Areas, based on current land use, are $0.4 M per annum and $0.2 M per annum respectively.

Value of Agricultural Water

Shenhua Watermark currently holds 206 share units of Upper Namoi alluvium Zone 7 and 8 groundwater (see **Table 26**) and 1,223 ML entitlement of surface water. If it is assumed that a one unit share is equivalent to one ML entitlement, Shenhua Watermark holds entitlements for a total of 1,329 ML of potential water.

The agricultural value of this water was determined by calculating the value (crop yield, gross value and net return) this water could gain by irrigating cotton (which is the highest value crop per ML of irrigation water for crops grown in the locality), compared to the production and return from a similar area used for dryland cotton.

Table 78 Current Enterprises within Residual Onsite Biodiversity Offset Area

Enterprise	Area / Heads	Market	Average Carrying Capacity / Yield	Agricultural Domain
Sorghum	54 ha	Grain trader	2.3 t/ha	C
Wheat (Durum)	352 ha	Grain Corp silos, AWB	3.0 t/ha	B and C
Wheat (Bread)	307 ha	Agent, Grain Corp silos	2.1 t/ha	B and C
Barley (feed)	100 ha	Local Agent	3.2 t/ha	B
Barley (Malt)	60 ha	Local Agent, Grain Corp silo	2.5 t/ha	C
Canola	70 ha	Processor Newcastle	2.0 t/ha	C
Beef breeding (weaners)	78 hd	Gunnedah saleyard	14.9 DSE	C
Beef Breeding (vealers)	724 hd	Gunnedah Saleyard, Direct to Abattoir	16.7 DSE	B, C, D and E
Beef fattening (225-550 kg)	250 hd	Gunnedah saleyard, Direct to feedlot	8.7 DSE	C and E
Beef fattening (300-550 kg)	180 hd	Gunnedah saleyard	10.2 DSE	B and C
Beef fattening (340-580 kg)	363 hd	Gunnedah saleyard	11.0 DSE	B and C
Dorper ewes	100 hd	Tamworth	2.7 DSE	C and E
Merino ewes self replacing	66 hd	Tamworth	2.1 DSE	C
XB ewes	300 hd	Tamworth	2.7 DSE	C and E

DSE – Dry Sheep Equivalent, the equivalent daily energy requirement of a 50 kg wether not losing or gaining weight
hd – head of livestock

Table 79 Current Value of Agricultural Production within Residual Onsite Biodiversity Offset Area

Enterprise	Crop Production (t)	Animals Sold (Heads)[1]	Wool sold (kg)	Gross Value of Production	Net Value of Production
Sorghum	124	N/A	N/A	$43,351	$15,596
Wheat	1,709	N/A	N/A	$471,688	$182,045
Barley	466	N/A	N/A	$100,023	$42,072
Canola	140	N/A	N/A	$86,800	$51,260
Beef Breeding	N/A	854	N/A	$553,838	$266,719
Beef fattening / grow out	N/A	777	N/A	$262,428	$17,506
Sheep	N/A	546	1,883	$78,653	$40,427
Total				**$1,596,780**	**$715,657**

1 – not all sold through sale yards

Table 80 Agricultural Domains in Residual Offsite Biodiversity Offsets

Agricultural Domain	Description	Area (ha)	Area (%)
X	Extensive grazing on natural and naturalised pasture, potential for further development	394	13.7
Y	Extensive grazing on natural and naturalised pasture, limited potential further development	722	25.1
Z	Unclear heavily timbered land with steep terrain and gorges – no agriculture use	1,761	61.2
Total		**2,877**	**100.0**

Table 81 Current Enterprises and Value within Offsite Biodiversity Offsets

Enterprise	Agricultural Domain	Number Animals Sold (Heads)[1]	Wool Sold (kg)	Gross Value of Production (per annum)	Net Value of Production (per annum)
Beef Breeding	X and Y	120	-	$63,888	$48,111
Sheep	X and Y	1,268	16,155	$295,895	$162,870
Total				**$359,783**	**$210,981**

1 – not all sold through sale yards

Table 82 Value of Production of Irrigated and Dryland Cotton

Enterprise	Bales of cotton	Tonnes of cotton seed	Gross value of production[1] (per annum)	Net Value of Production (per annum)
203 ha irrigated cotton	1,827	658	$1,240,789	$621,251
203 ha dryland cotton	812	292	$485,089	$209,388
Difference	1,015	365	$755,700	$411,863

1 - DTIRIS – PI Gross margins assume a $20 per discount for quality from dryland cotton relative to irrigated cotton

The total water entitlement of 1,329 ML is enough water to irrigate approximately 203 ha of cotton. A comparison of the value of production from 203 ha of irrigated cotton and 203 ha of dryland cotton is provided in **Table 82**. The difference in gross value and net value of production for this land when comparing irrigated to dryland cotton production is $0.8 M per annum and $0.4 M per annum respectively.

Availability and Productivity of Agricultural Land

The gross value of production from the combined Shenhua Watermark owned land, residual Onsite Biodiversity Offset Area, Offsite Biodiversity Offset Areas, and Shenhua Watermark water entitlements is $6.7 M per annum. As shown in **Table 83**, this value represents 5.3% of the total agricultural production of the Gunnedah LGA, 2.9% of the combined Gunnedah LGA and Liverpool Plains LGA, 0.07% of NSW and 0.02% of Australia.

As the overall agricultural contribution of the land for the Project is small when compared to the total agricultural production on a regional, State and National scale, the reduced availability and productivity of this land will have a minimal impact to the agricultural industry.

The Project will not materially reduce the availability of land for agricultural purposes or affect the productivity of existing agricultural land within the surrounding locality.

Potential Agricultural Production

With superior management practices and / or capital investment, the total potential agricultural production from Shenhua Watermark owned land, the residual Onsite Biodiversity Offset Area, the Offsite Biodiversity Offset Area, and Shenhua Watermark water entitlements have a gross value of $12.4 M per annum and a net value of production of $7.9 M per annum.

Table 83 Value of Total Agricultural Production

Enterprise	The Project [1] ($ Gross Value)	Gunnedah LGA ($ Gross Value)	Gunnedah LGA & Liverpool Plains LGA ($ Gross Value)	NSW ($ Gross Value)	Australia ($ Gross Value)
Cotton [2]	1.2 M	31.1 M	32.1 M	572.9 M	950.0 M
Sorghum	0.1 M	16.8 M	40.8 M	117.9 M	286.1 M
Wheat	1.5 M	27.0 M	42.8 M	1,432.9 M	5,194.3 M
Barley	0.4 M	8.2 M	15.9 M	279.4 M	1,445.1 M
Canola	0.3 M	2.2 M	2.5 M	92.8 M	4,857 M
Beef	2.7 M[3]	25.0 M	110.4 M	1,603.3 M	6,550.5 M
Sheep	0.7 M	2.7 M	7.5 M	1,142.2 M	5,834.7 M
Total agricultural production	**$6.7 M**	**$125.5 M**	**$232.1 M**	**$9,034.5 M**	**$39,645.1 M**

1 - includes Shenhua Watermark owned land, residual onsite biodiversity offset area, the offsite biodiversity offset area, and Shenhua Watermark water entitlements
2 - gross value of irrigated cotton
3 - net of landed cost for non-breeding stock
Source: ABS, 2008

7.20.4 Impact Assessment

This section assesses the potential impacts on agricultural land within the Disturbance Boundary, Onsite and Offsite Biodiversity Offset Areas and water resources removed from agriculture as a result of the Project. As part of the AIS, Gillespie Economics were engaged to undertake an economic review of the potential agricultural impacts of the Project. A summary of the findings of this review are presented throughout this section.

Assessment of Direct Impacts from the Project

Disturbance Boundary

Any agricultural land that is situated within the Disturbance Boundary will be removed from production as a result of the Project. Sustainable farming practices will continue in available areas owned by Shenhua Watermark not required as Biodiversity Offset Areas outside of the Disturbance Boundary throughout the life of the Project.

Table 84 provides an estimated on the annual agricultural production that will be impacted within the Disturbance Boundary.

Conservatively assuming that agricultural production from the entire Disturbance Boundary ceases at the commencement of the Project for perpetuity, the present value of the gross and net value of production foregone is $45.2 M and $26.9 M, respectively (using a 7% discount rate) (Gillespie Economics, 2012) (see Appendix 7 of **Appendix Z**).

Rehabilitation of 1,000 ha land with Class III land capability characteristics will be undertaken as part of the Project. Assuming this area will be returned to wheat, canola and beef cattle production at the end of the Project it will result in a gross value of production of $0.7 M per annum and a net value of production of $0.3 M per annum following the cessation of mining (Year 30). In consideration of this, the present value of the gross and net value of production foregone is $43.0 M and $26.0 M, respectively (using a 7% discount rate).

Onsite Biodiversity Offset Areas

Pending further land management arrangements, land within the Onsite Biodiversity Offset Areas will no longer be available for agricultural purposes as it will be reserved in perpetuity for the conservation of ecological values.

Table 84 Quantum and Value of Agricultural Production Affected within the Disturbance Boundary

Enterprise	Production within Disturbance Boundary
Sorghum (tonnes) per annum	44
Wheat (tonnes) per annum	1,809
Barley (tones) per annum	898
Canola (tonne) per annum	332
Wool sold (kg) per annum	19,928
Sheep sold per annum	2,220
Beef cattle sold per annum	4,506
Gross value of production per annum	$2.69 M
Net value of production per annum	$1.56 M

Table 85 provides an estimate of the annual agricultural production that will be impacted within the Onsite Biodiversity Offset Areas.

Conservatively assuming that agricultural production from the Onsite Biodiversity Offset Areas ceases at the commencement of the Project for perpetuity, the present value of the gross value of production foregone is $24.0 M (using a 7% discount rate) and the present value of the net value of agricultural production foregone is $10.7 M (using a 7% discount rate) (Gillespie Economics, 2012) (see Appendix 7 of **Appendix Z**).

Offsite Biodiversity Offset Areas

Pending further land management arrangements, land within the Offsite Biodiversity Offset Areas will no longer be available for agricultural purposes as it will also be reserved in perpetuity for the conservation of its ecological values.

Table 86 provides an estimated on the annual agricultural production that will be impacted within the Offsite Biodiversity Offset Areas.

Conservatively assuming that agricultural production from the Offsite Biodiversity Offset Areas cease at the commencement of the Project in perpetuity, the present value of the gross value of production foregone is $5.6 M and the present value of the net value of agricultural production foregone is $2.3 M (using a 7% discount rate) (Gillespie Economics, 2012) (see Appendix 7 of **Appendix Z**).

Table 85 Quantum and Value of Agricultural Production Affected within the Onsite Biodiversity Offset Areas

Enterprise	Production within Onsite Biodiversity Offset Areas
Sorghum (tonnes) per annum	124
Wheat (tonnes) per annum	1,708
Barley (tones) per annum	466
Canola (tonne) per annum	140
Wool sold (kg) per annum	1,883
Sheep sold per annum	546
Beef cattle sold per annum	1,554
Gross value of production per annum	$1.60 M
Net value of production per annum	$0.70 M

Table 86 Quantum and Value of Agricultural Production Affected within the Offsite Biodiversity Offset Areas

Enterprise	Production within Offsite Biodiversity Offset Areas
Wool sold (kg) per annum	16,155
Sheep sold per annum	1,268
Beef cattle sold per annum	120
Gross value of production per annum	$ 359,782
Net value of production per annum	$ 148,809

Total Land Resources

In total, foregone gross value and net value of agricultural production from land resources required for the Project is estimated at a present value of $73.4 M and $39.3 M, respectively (using a 7% discount rate) (Gillespie Economics, 2012) (see Appendix 7 of **Appendix Z**).

Water Resources

Within 10 km of the Project Boundary, 35 privately owned bores are predicted to experience maximum groundwater level reductions of greater than or equal to 0.1 m. Of these, four bores adjacent to the Southern Mining Area have a maximum predicted drawdown between 1 m and 2 m.

The largest predicted reduction in water level of 1.4 m is limited to bore GW15505, which is the closest privately owned bore to the Southern Mining Area. When operations in the Southern Mining Area and Eastern Mining Area cease, the model predicts that groundwater levels in the depressurised zone recover relatively rapidly within approximately five years.

As described previously, groundwater flow from the underlying Permian to the alluvium will be reduced by a maximum rate of 0.3 ML/day. This represents less than 0.5% of the flow from registered bores within 10 km of the Project Boundary and is due to predicted pressure transmission between the fractured rock and alluvial systems. If this occurs, it represents a negligible change in groundwater availability to adjacent groundwater users.

The Project is predicted to result in the annual average relocation of approximately 194 ML/yr of water from agricultural purposes to coal mining purposes consisting of:

- Average reduction in the rate of groundwater flow from the Permian into the overlying Gunnedah Formation of 33.3 ML/yr;
- Average annual additional transfer of water from the Mooki River to the underlying alluvium of 10.7 ML/yr; and
- Average of approximately 150 ML/yr of external water supply.

The water take from the Porous Bedrock Aquifer due to the Project has not been included in the above, as the aquifer is very deep, poor quality and yielding and is not commonly used for intensive agricultural purposes.

The impact of removing 194 ML from agricultural use results in a gross value loss of $0.1 M per annum. The net value lost is $0.06 M per annum.

This level of annual water requirement implies that potentially 28 ha of cotton will be converted from irrigated to dryland production. This represents a loss in cotton production of 140 bales of cotton with a gross value loss of $104,234 per annum and a net value loss of $56,809. Over the life of the Project, the present value of the gross value of production foregone is $1.4 M and the present value of the net value of agricultural production foregone is $0.9 M (using a 7% discount rate) (Gillespie Economics, 2012) (see Appendix 7 of **Appendix Z**).

Regional Impacts of Agriculture Foregone

The regional impacts of the level of annual agricultural production foregone as a result of the Project (including the Disturbance Boundary, the Onsite biodiversity Offset Area, the Offsite biodiversity Offset property and water diverted from agricultural activities) were estimated from the sectors in the local region by Gillespie Economics (see Appendix 7 of **Appendix Z**).

Table 87 compares the annual regional production and economic impacts associated with the Project with the annual agricultural production that will be foregone as a result of the Project.

The direct annual output of the Project is estimated at $744 M per annum. In contrast, the direct annual output of future use of agricultural lands and water that will be utilised by the Project is estimated at $5 M per annum. The direct and indirect regional employment provided by the Project will be up to 908 compared to up to 41 agricultural-related jobs that would be forgone as a result of the Project.

Table 87 Economic Impacts of the Foregone Agriculture and the Project

Production Type	Agricultural Land			Water	Total Agricultural Production	Project
	Disturbance area	Onsite Offset	Offsite Offset			
	Beef, Grains, Sheep	Beef, Grains, Sheep	Beef, Sheep	Cotton		Coal
Direct Impacts						
Output ($M)	3	2	0	0	5	744
Value-added ($M)	2	1	0	0	3	424
Household income ($M)	1	0	0	0	1	45
Employment (No.)	18	9	4	1	31	369
Direct and indirect impacts						
Output ($M)	4	2	1	0	8	902
Value-added ($M)	2	1	0	0	4	493
Household income ($M)	1	1	0	0	2	80
Employment (No.)	24	12	4	1	41	908

Gillespie Economics also undertook a Benefit Cost Analysis (BCA) which included an estimation of the present value of production costs and benefits of the Project over a 30 year period (see **Appendix AF**). The present value of net production benefits of the Project to Australia are estimated at $1,310 M (7% discount rate). In contrast, the present value of future use of agricultural lands and water that will be utilised by the Project is estimated at $40 M (7% discount rate). Based on these comparative values, the Project is considered to be a significantly more efficient land use than continued agricultural production.

Assessment of Indirect Impacts on Agricultural Enterprises

Groundwater

As described in **Section 7.1**, the Upper Namoi alluvium is a primary source of agricultural water in the region. The Gunnedah Formation is considered to satisfy the highly productive groundwater criteria of the SRLUP and AIP. The Narrabri Formation and Permian Formations are not considered to satisfy the highly productive groundwater criteria.

As noted in **Section 7.1.3**, the groundwater model indicates that the Project will create a zone of depressurisation induced by mining in the Permian formations underlying the Upper Namoi alluvium. Groundwater flow from the underlying Permian to the Upper Namoi alluvium will be reduced by a maximum rate of 0.3 ML/day.

The average pumping rate from a single licensed agricultural bore in the Upper Namoi alluvium (within 10 km of the Project Boundary) is 142 ML/yr. The groundwater model predicts that the volume of water removed from the Zones 3, 7 and 8 is a very small quantity of water, peaking at 98.1 ML/year, which is equivalent to no more than the average usage from a single bore in the peak years or mining.

Within 10 km of the Project Boundary 35 privately owned bores are predicted to experience maximum groundwater level reductions of greater than or equal to 0.1 m. Of these, four bores adjacent to the Southern Mining Area have a maximum predicted drawdown greater than 1 m. The largest predicted reduction in water levels of 1.4 m is limited to bore GW15505, which is the closest bore to the Southern Mining Area. When operations in the Eastern Mining Area and Southern Mining Area cease, the model predicts that groundwater levels in the depressurised zone recover relatively rapidly within approximately five years.

Therefore, the Project is not considered to reduce the agricultural productivity of BSAL within the Project Boundary and surrounds due to impacts to highly productive groundwater.

Surface Water

As described in **Section 7.3**, the Project will require up to 600 ML of water from external sources to supply operational demands (average of 150 ML/yr). Shenhua Watermark proposes to take water from nearby available water sources under appropriate water access licences or private commercial arrangements with holders of appropriate water access licences.

At the completion of mining, surface runoff from rehabilitated OEAs will be released from the Project Boundary. An area of approximately 108 ha, which originally drained to Lake Goran, will continue to drain to the mine final void.

The mine water management system will be operated to fully contain mine water and to preferentially reuse this water to meet mine site demands. The results of the mine water balance modelling show that under the full range of historical rainfall conditions, the proposed mine water management system will have sufficient capacity to contain all mine water on the site without the need for offsite releases. The water quality of the surrounding environment will therefore be maintained.

Overall the surface water impact assessment has determined that the Project will not impact on receiving waters in the locality and as such will not impact on agricultural resources in the region.

Air Quality

As discussed in **Section 7.6**, the potential for significant impact of dust on agricultural resources and enterprises in the locality are considered to be minimal and will meet all the relevant air quality criteria. The establishment of progressive rehabilitation as mining progresses and the implementation of real-time monitoring systems will also ensure that dust emission targets are not exceeded.

Kannegieter (2006) stated that most reports would indicate that feed, bedding, manure or urine contamination of dust is responsible for the majority of respiratory problems seen in production and racing animals. Kannegieter then concluded that: *"Given the absence of this additional contamination (feed, manure and urine) in coal dust, it would seem unlikely that an increase in dust deposition would adversely affect grazing horses and dairy cattle"*. Kannegieter also concluded that the ingestion of dust-contaminated pasture *"would be considered unlikely to create problems"*.

Dooley and Rossato (2010) report that "*Deposition of mining, quarry and road dust on vegetation canopies has been observed to inhibit plant growth when dust burdens exceed 7 g/m^2*". They also reported that there is a linear relationship of increased plant dry matter (production) and net dust deposition of up to 1 g/m^2/day while in cotton (which matures in hot sunny weather) estimated net rates of dust deposition of 0.5g/m^2/day reduced canopy photosynthesis by 11% and cotton yield by 3%. A dust deposition rate of 0.5g/m^2/day is equivalent to a monthly deposition rate of 15g/m^2/month, greatly above the levels predicted by the Project.

Due to stakeholder concerns regarding potential impacts of dust on cotton as a result of the Project, an assessment of the potential impacts of dust generation on cotton production in the surrounding locality was undertaken (see Appendix 8 of **Appendix Z**). The assessment concludes that the predicted dust deposition rates generated by the Project will have a minimal impact on the productivity of cotton production in the surrounding locality.

Noise and Vibration

As described in **Section 7.8**, the Project's operational noise levels will be audible over areas of land owned by Shenhua Watermark and neighbouring private land owners. Some of this land is used for grazing, with the majority utilised for cropping.

Mining operations within the region and abroad have for many years used company-owned land within close proximity to open cut mining to raise beef cattle and operate dairy farms. This suggests that livestock are not sensitive to environmental noise. As such it is unlikely that livestock on privately owned grazing properties within the locality of the Project will be affected by noise. Similarly, livestock quickly become accustomed to vibration from blast events, which will limit the potential for impacts on livestock health. As such, noise and blasting impacts on agricultural resources and enterprises in the locality is anticipated to be minimal.

Visual

As discussed in **Section 7.17**, the visual impacts associated with the Project will affect viewing locations to the north, south, east and west of the Project Boundary; however, such impacts vary in significance and in time during the life of the Project until rehabilitation is completed.

As part of the visual impact assessment due consideration was given to the Gateway Criteria as prescribed under the SRLUP. It is recognised that scenic and landscape diversity is a key resource base for tourism and associated agricultural pursuits such as viticulture and thoroughbred horse breeding. No sensitive receptors will experience significant visual impacts as a result of the Project.

Further, the productivity or the marketability of products from surrounding enterprises will not be affected by the visual impact of the Project.

Traffic and Support Infrastructure and Services

As described in **Section 7.16**, the Project's impacts on traffic and support infrastructure and services are anticipated to be minimal. Permanent road closures will be required for the Project, including all roads within the Disturbance Boundary, Court Lane, and the section of The Dip Road between Clift Road and Nea Siding Road. The modelled increase in travel times due to these road closures is approximately five minutes per vehicle, which is considered to be acceptable.

As described in **Section 7.16**, modelling undertaken by DC Engineering indicates that the traffic generated by the construction and operation (peak) phase of the Project will be absorbed into the existing traffic stream. This is largely due to the substantial spare capacity available in the road network even with an assumed conservative 1.9% per annum growth in background traffic.

Agricultural enterprises in the locality utilise the road network to transport products to domestic markets or to intermediate delivery locations. As described in **Section 7.16**, it is anticipated that any growth in traffic demands from the local agricultural industry will be accounted for in the assumed growth in background traffic and therefore no adverse impacts are predicted.

The Project will transport coal to the Port of Newcastle Port by rail on the Werris Creek - Moree Railway Line. This rail line is also used for the transport of agricultural commodities, primarily grain, for export also to Newcastle. An average of eight train movements, with a peak of 16 movements, will be required by the Project each day.

ARTC (2012) have proposed a number of network upgrades to increase the capacity and operational flexibility for existing rail users. These initiatives will assist in relieving the impact of the Project and other existing and proposed rail users on the haulage requirements of the agricultural industry.

Labour Supply

As described in **Section 7.26**, the Gunnedah, Liverpool Plains and Tamworth Regional LGAs have an economy that is dominated by the agricultural sector. Close to 50% of the regional economy in the Namoi Valley is directly or indirectly dependent on agriculture (Parsons Brinckerhoff, 2010).

In June 2012, the rates of unemployment within the Gunnedah (6.7%), Liverpool Plains (6.6%) and Tamworth Regional (6.3%) LGAs were higher than neighbouring LGAs, including the Upper Hunter LGA (1.7%) and Narrabri LGA (5.2%). Rates were also higher than the NSW average (5.2%) (DEEWR, 2012b).

The 'agriculture, fishing and forestry' sector accounted for 17% of total employment of people over 15 within the Gunnedah LGA in 2011, 24% in the Liverpool Plains LGA and 7% in the Tamworth Regional LGA. These were the highest proportions of industry sector employment for the Gunnedah and Liverpool Plains LGAs, while the highest proportion for the Tamworth Regional LGA was the 'health care and social assistance' sector at 14% (ABS, 2012g).

The 'mining' sector more than doubled in employment in the Liverpool Plains LGA between 2006 and 2011 and more than tripled in the Gunnedah LGA in that period. In 2011, this equated to 3% and 7% of the total employed people in those LGAs respectively. The number of people employed in the 'mining´ sector in Tamworth Regional LGA almost tripled between 2006 and 2011, representing 0.8% of the total employed people in the LGA in 2011.

The Social Impact Assessment undertaken for the Project (Hansen Bailey, 2013) (see **Appendix AE** of the EIS) showed that in 2012 there is a labour supply surplus within the regional area of the Project, including:

- 2,595 unemployed people living in the Sub Regional Study Area;
- An available labour supply of 1,010 people in the Gunnedah LGA (up from 921 in 2006), including a labour surplus of 591 (427 in 2006);
- An available labour supply of 734 people in the Liverpool Plains LGA (up from 612 in 2006), including a labour surplus of 477 (422 in 2006); and
- An available labour supply of 4,674 people in the Tamworth Regional LGA (up substantially from 2,575 in 2006), including a labour surplus of 2,755 (1,634 in 2006).

As there is more than adequate labour supply within the regional area to source workforce personnel (600 personnel for construction phase and 600 personnel for operation phase), the Project is not anticipated to impact on the labour supply available for the operation of agricultural enterprises (Hansen Bailey, 2013) (see **Appendix AE**).

Further, there is anecdotal evidence in the Upper Hunter that any movement of employment from agriculture to mining is in primary employment only with a high proportion of farmers moving to mining continuing to operate there agricultural enterprises while being in full time employment within the mining industry. This trend of off farm wage and salary income supporting agricultural enterprises and farm families is reflective of a trend across Australian agriculture as a whole (Laguna and Ronan, 2009).

In addition to increasing employment opportunities generally, it is also expected that the Project will assist in improving the current high rates of youth and Indigenous unemployment in the study area. The Project also has the potential to assist in improving women's labour force participation rates.

Impact to Biophysical Strategic Agricultural Land

Site Verification

The SRLUP mapping indicates approximately 96 ha of BSAL is potentially present in the Disturbance Boundary. Site verification of this area in consideration of the SRLUP criteria, found that the soil landscape within the Project Boundary considered most likely to fulfil the criteria for fertility and land capability was Ponderosa (soil type 7). Details of soil fertility are outlined above and discussed in detail in **Appendix Y**. The area of this soil landscape within the mining areas was calculated to be 96.1 ha as shown in **Table 88**.

As part of the Biodiversity Offset Strategy for the Project, Shenhua Watermark has and continues to acquire land holdings (Onsite and Offsite biodiversity Offset Areas) containing substantial amounts of vegetation to compensate for any potential ecological impacts from the Project. The SRLUP mapping indicates approximately 375 ha BSAL may occur within the proposed Onsite Offset Areas. Site verification of this area in consideration of the SRLUP criteria, found that a further 321 ha was identified, thereby increasing the total area of BSAL in the Offsite Offset Areas to 696 ha.

No BSAL is identified to likely occur within the Offsite Biodiversity Offset Areas.

Gateway Criteria

The gateway criteria require an assessment on the potential impacts of the Project to BSAL. The gateway criteria for BSAL are listed in **Section 4.6.1** and addressed below:

- *Impacts on the land through surface area disturbance and subsidence.*

The Project will impact 96.1 ha of BSAL through surface disturbance associated with open cut mining.

The Project is proposing to utilise the Onsite and Offsite biodiversity Offset Areas for ecological conservation purposes by excluding agricultural activities and actively regenerating the land to native woodland and grassland. As such, the Onsite and Offsite biodiversity Offsets Areas will experience a change in land use as a result of the Project; however the inherent agricultural productivity of the land will not be affected or reduced. Therefore, the Project is not considered to significantly reduce the agricultural productivity of potential BSAL within the Onsite and Offsite Biodiversity Offset Areas.

- *Impacts on:*
  - *Soil fertility;*
  - *Rooting depth, or*
  - *Soil profile materials and thicknesses.*

The Project will not impact on soil fertility, rooting depth or soil profile materials and thickness outside of the Disturbance Boundary.

- *Increases in land surface microrelief or soil salinity, or significant changes to soil pH.*

The Project will not impact on the landform or soils outside of the Disturbance Boundary.

- *Impacts on Highly Productive Groundwater, including the provisions of the Aquifer Interference Policy and advice of the Minister for Primary Industries.*

As explained above, the Project is not anticipated to reduce the agricultural productivity of BSAL within the Project Boundary and surrounds through impacts to highly productive groundwater.

No advice has been received to date from the Commonwealth Independent Expert Scientific Committee.

7.20.5 Mitigation and Management

Minimisation of Disturbance to Agricultural Lands

The area of agricultural land disturbed by the Project at any one time will be minimised so that agricultural uses can continue where practicable. Detailed mine planning will minimise land disturbance in advance of operations and include provisions for progressive rehabilitation. This will assist in reducing impacts to agricultural lands.

Continued Use of Existing Agricultural Lands

Shenhua Watermark will continue to work with land managers on Shenhua Watermark owned land to ensure the continued productivity of agricultural land not directly impacted by the Project.

A Land Management Plan will be prepared to guide the management of Shenhua Watermark owned land, including provisions for grazing and cropping management, erosion and sediment controls and weed and pest controls. This will be communicated and enforced with land managers to ensure the ongoing agricultural productivity of Shenhua Watermark owned land.

Soil Management

In order to reduce the potential for soil degradation within the Project Boundary, the strategies outlined **Section 7.19.4** will be implemented during operations and rehabilitation to achieve the desired post-mining land capability and agricultural suitability.

Re-establishment of Agricultural Land

To compensate for the loss in available agricultural land as a result of the Project, not less than 1,000 ha of the post-mining landform will be rehabilitated with the aim of achieving Class III rural land capability. This area will be reserved for agricultural purposes following the cessation of mining and is described and shown in **Figure 64**.

The soil profile of the lands rehabilitated to Class III land capability will be reconstructed to be suitable for occasional cultivation and for the establishment of crops and pasture (both native and introduced).

Introduction of agriculture onto the rehabilitated mine land will be undertaken as soon as practicable having consideration of the relevant safety and legislative requirements relating to mine operations.

It is difficult to prescribe the style of agricultural enterprise to be carried on this land in the future due to the ongoing evolution of farming systems with increased knowledge, changing agricultural technology (machinery, crop monitoring) and changing market returns over the medium to longer term. However farming systems that incorporate aspects of minimal tillage farming, pasture cropping, permanent pasture and combined cropping/grazing practices are anticipated to be most likely to be used. As such, issues relating to paddock size and workability will be determined relevant to technology and knowledge applicable to agricultural enterprises at the post mining and rehabilitation phase.

This rehabilitated land shall be returned to private ownership by Shenhua Watermark at the end of the Project as per any conditions of approval given to Shenhua Watermark when the land was initially purchased.

The Rehabilitation Management Plan will include specific strategies and management measures to achieve the desired rehabilitated land capability.

Table 88 Site Verification

Value	Criteria	Site Verification
Biophysical Strategic Agricultural Land	Land that falls under soil fertility classes 'high' or 'moderately high' under the Draft Inherent General Fertility of NSW (OEH), and	GSSE (2013) determined that soils within the Ponderosa and Carinya soil landscapes are expected to fulfil the criteria of 'high' to 'moderately high' fertility, whilst the soils within the Booloocooroo soil landscape is considered marginal.
	Land capability classes I, II or III under the Land and Soil Capability Mapping of NSW (OEH), and	GSSE (2013) determined that the soil landscapes which were considered to fulfil the land capability criteria were Fullwoods Road, Goscombes Road, Booloocooroo and Ponderosa. The soil landscape within the Project area considered fulfils the first two BSAL criteria for fertility and land capability was Ponderosa. The area of this soil landscape within the Disturbance Boundary was calculated to be 96.1 ha.
Biophysical Strategic Agricultural Land	Reliable water of suitable quality, characterised by land having rainfall of 350mm or more per annum (9 out of 10 years); or properties within 150 m of a regulated river, or unregulated rivers where there are flows for at least 95% of the time (i.e. the 95th percentile flow of each month of the year is greater than zero) or 5th order and higher rivers; or groundwater aquifers (excluding miscellaneous alluvial aquifers, also known as small storage aquifers) which have a yield rate greater than 5L/s and total dissolved solids or less than 1,500 mg/L	The Project area receives an average rainfall of 640 mm per annum and therefore is characterised as having reliable water of suitable quality. The small area of BSAL identified within the Project area identified to fulfil the criteria for soil fertility and land capability is not located within 150 m of a regulated river or unregulated river. The Gunnedah Formation is considered to satisfy the BSAL criteria for yield and total dissolved solids. However, the Gunnedah Formation does not occur within the Project area. The closest occurrence of the Gunnedah Formation to the Project area is approximately 900m. The Narrabri Formation is not considered to satisfy the BSAL criteria for TDS.
	OR	
	Land that falls under soil fertility classes 'moderate' under the Draft Inherent General Fertility of NSW (OEH), and	No Class I or II land will be disturbed due to the Project and therefore, this criterion does not apply.
	Land Capability classes I or II under the Land and Soil Capability Mapping of NSW (OEH), and	As above.
	Reliable water of suitable quality, characterised by land having rainfall of 350mm or more per annum (9 out of 10 years); or properties within 150 m of a regulated river, or unregulated rivers where there are flows for at least 95% of the time (i.e. the 95th percentile flow of each month of the year is greater than zero) or 5th order and higher rivers; or groundwater aquifers (excluding miscellaneous alluvial aquifers, also known as small storage aquifers) which have a yield rate greater than 5L/s and total dissolved solids or less than 1,500 mg/L	As above.

The Rehabilitation Management Plan will incorporate learning's from previous examples and projects where agricultural land rehabilitation has been successfully achieved, such as the 'Alluvial Lands Project' carried out by Coal & Allied in 1994. The 'Alluvial Lands Project' was performed to validate recommended soil rehabilitation techniques to reinstate Class I and II land within a mining disturbance footprint, compared to nearby undisturbed control land.

In order to measures the success of the Project, productivity yield monitoring and soil chemical attribute analysis was conducted from 2003 to 2007 and soil structure and fertility monitoring was conducted from 2003 to 2006 (Nelson & Stewart, 2007). The study reported that the rehabilitated land contained optimal nutrient levels for lucerne crops, and exhibited higher than average yield for the district. The observed rehabilitated soil showed no significant difference in physical and chemical structure compared to control land, with a minor reduction in organic carbon that would naturally increase following correct pasture management techniques.

Air Quality and Noise

To ensure that air quality and noise impact targets are not exceeded, real time monitoring systems within the vicinity of the Project will be implemented. A specific focus of the real time monitoring system for the Project will be ensuring that air quality and noise targets are not exceeded. Additional mitigation and management measures specific to air quality and noise are highlighted in **Section 7.7.4** and **Section 7.8.4**, respectively.

Weed and Pest Management

A Weed and Pest Management Plan will be developed for the Project, which will provide management and monitoring procedures to control the distribution of invasive species and feral animals within the Project Boundary. All monitoring will also be detailed in the EMP to be developed for the Project.

Similar measures will be included in the Biodiversity Management Plan to be developed for the Project as described in **Section 7.10** and **Section 7.11** to manage specific weed or pest issues at the Onsite and Offsite biodiversity Offset properties.

Shenhua Watermark will consult with the Central North Livestock Health and Pest Authority as to the appropriateness of management procedures and monitoring.

Sustainable Farming Practices

Sustainable farming practices, such as reduced till farming and rotational grazing, will be implemented in available areas within the Project Boundary that are situated outside of the Disturbance Boundary and the Onsite Biodiversity Offset Areas. This will be executed in accordance with measures proposed by the Namoi CMA for Best Management Practices of the appropriate land management units. In the event that the Offsite Biodiversity Offset Areas are managed in part for agricultural purposes, sustainable framing practices will be implemented that are consistent with Best Management Practices for the appropriate land capability and agricultural suitability class as set out by the Border Rivers Gwydir CMA.

If applicable, these practices will be incorporated into the Biodiversity Management Plan for the Project, as described in **Section 7.10** and **7.11**.

Shenhua Watermark will also ensure that as part of the Licences to Occupy, land managers will be required to commit to the implementation of the program as outlined in a collaboration agreement between Shenhua Watermark and the relevant CMA.

Avoidance

Based on the findings outlined in **Section 7.20.4**, the Project is not anticipated to have impacts on:

- Productivity or marketability of products from surrounding enterprises by means of changes to the landscape and visual amenity;
- Traffic regimes along support infrastructure routes;
- Labour supply; and
- Support services directly employed by agricultural enterprises.

As such, no other mitigation measures regarding these issues have been proposed.

7.21 Rehabilitation, Conceptual Final Landform and Mine Closure

A Rehabilitation and Mine Closure Strategy was prepared by GSSE and is provided in **Appendix AA**. The purpose of the strategy was to develop objectives for the rehabilitation of land that will be disturbed as a result of the Project, provide a strategy for mine closure and describe management measures to address the final void.

7.21.1 Rehabilitation Objectives

The rehabilitation and mine closure strategy for the Project has been developed generally in accordance with the following policies and guidelines:

- *EDG03 – Guidelines to the Mining, Rehabilitation & Environmental Management Process* (DTIRIS, 2012);
- *Strategic Framework for Mine Closure* (ANZECC MCA, 2000);
- *Mine Closure and Completion – Leading Practice Sustainable Development Program for the Mining Industry* (NSW Department of Industry, Tourism and Resource, 2006a); and
- *Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry* (DITR, 2006b).

The objectives of rehabilitation and mine closure for the Project include:

- Complying with the relevant regulatory requirements, including the relevant objectives of the GSC LEP, with the aim of regulatory consensus being attained on the successful closure and rehabilitation of the land within the Project Boundary;

- Re-establishment of native woodland and grassland, including White Box Grassy Woodland (CEEC);
- Integrating vegetation communities with undisturbed native vegetation to provide consolidated areas and wildlife corridors;
- Re-establishment of Class III rural land for agricultural production;
- Rehabilitating the land within the Project Boundary to a final land use which is compatible with the surrounding land fabric and land use requirements;
- Rehabilitating the land to a sustainable final land use and so that soils, hydrology and ecosystems have maintenance consistent with the surrounding land;
- Rehabilitating the land in a manner that does not present an unacceptable hazard to persons, stock or fauna;
- Ensuring an overall framework for mine closure including rehabilitation and decommissioning strategies are consistent with DTIRIS expectations;
- Completing works as quickly and cost effective as possible whilst ensuring that the objectives are achieved;
- Establishing clear criteria, which can be used to provide the standard against which the final mine rehabilitation and post-mining land use can be assessed;
- Ensuring mine closure is completed in accordance with industry best practice;
- Back filling, where ever practicable, any void areas created by the mining process, minimising the size of any void space that is unavoidable and positioning this in the most sensible area remote from the black soil plains and Gunnedah Formation; and
- Ensuring the land within the Project Boundary will be clean and tidy and any remaining structures will be left in a condition that provides for the safety of the public.

7.21.2 Rehabilitation Management

Progressive rehabilitation will be an integral component of the Project. As mining advances, progressive rehabilitation will be scheduled as shown in **Figure 10** to **Figure 17**. The rehabilitation program for the Project involves the infilling of the Eastern and Southern Mining Area voids, the establishment of a stable conceptual final landform, soil management and translocation, implementation of erosion and sediment controls, revegetation and relevant maintenance and monitoring to achieve a successful and self-sustaining landscape.

Landform Establishment

As mining advances, the OEAs will generally be shaped to create slopes with gradients less than approximately 10 degrees. Topsoil and intermediate soil layers will be placed above the overburden in order to provide a competent cover of material and to avoid the exposure of large rocks on the final surface.

The Geochemical Assessment of Overburden/Interburden and Coal Reject Materials undertaken by RGS (see **Appendix W** and **Section 7.18**) has confirmed that only a small portion of potential acid forming overburden, interburden and coal reject materials are likely to occur within the mining areas. As such, these materials will be selectively handled and covered with non-acid forming overburden and interburden to prevent acid leachate.

Prior to the re-establishment of vegetation cover, temporary control measures will be utilised for erosion and sediment control, including sediment fences, sand bag sediment traps and rip rap scour protection. Surface water management structures, such as contour banks and drains, will also be progressively installed on the conceptual final landform as shown in **Figure 64** in a manner which minimises erosion and safely disposes of surface water runoff down slope. **Figure 65** and **Figure 66** provide indicative final landform cross sections for overall, southern and eastern mining areas.

The post mining landform contains relatively gentle slopes compared to the majority of mines within NSW and QLD, which allows for the potential establishment of land capability Class III on the rehabilitated landform. Furthermore these relatively gentle slopes will contain slope lengths and suitable soil depth designed to minimise erosionrisk and ensure the land meets criteria for land capability Class III.

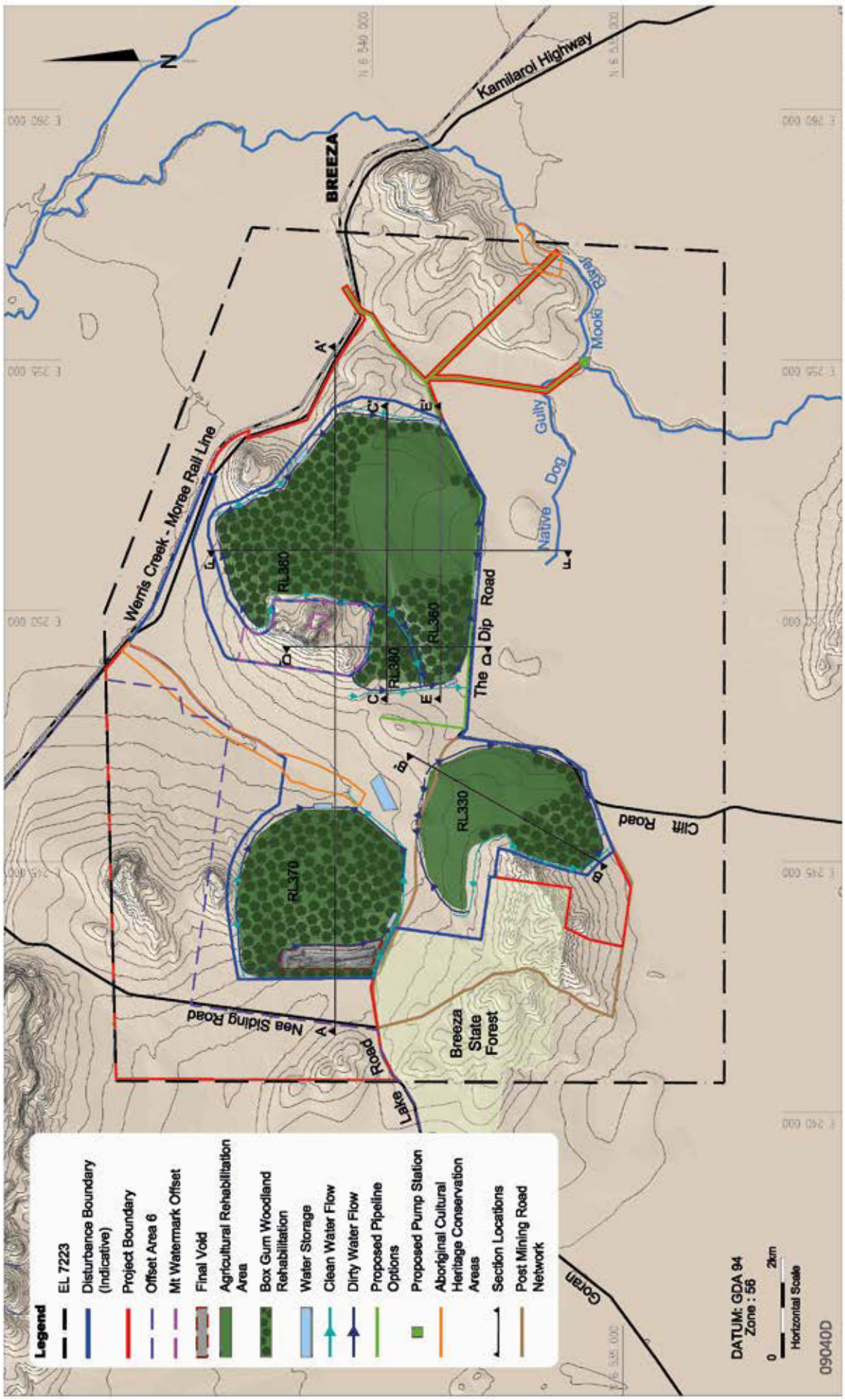
Soil Management

Topsoil and intermediate soil layers will be stripped to the recommended depth and stockpiled ahead of mining, in accordance with the measures outlined in **Section 7.19**. Topsoil stockpiles will be revegetated and managed to ensure the long term viability of the soil resource and the native seed bank. This resource will then be selectively returned to rehabilitate areas within the Disturbance Boundary. Where possible, topsoil and intermediate soil layers will be respread directly onto shaped landforms in accordance with the depths indicated in **Section 7.19**. All areas to be rehabilitated will undergo light contour-ripping in moist conditions, where practicable to improve seed contact with the soil and increase infiltration. This will consequently enhance germination and reduce erosive surface water runoff.

Revegetation

The revegetation strategy proposed for the Project includes a separate species mix for native vegetation areas versus designated agricultural production areas. Endemic species mixes should be utilised where possible for reforested areas. Fertiliser will be applied with mixes to increase the likelihood of initial revegetation success.

All revegetation operations are preferably undertaken immediately after ripping so that the ripped surface has minimal time to crust prior to seed application. The most effective way of controlling erosion will be to establish and/or maintain a healthy vegetation cover. Vegetation will provide effective surface protection against raindrop impact, bind the underlying soil to resist detachment by surface flows, and improve and maintain the soil's infiltration capacity, thereby decreasing the velocity and volume of runoff.


WATERMARK COAL PROJECT
Conceptual Final Landform
FIGURE 64
N
Kamilaroi Highway
BREEZA
Wernis Creek - Moree Rail Line
Native Dog Gully
Mooki River
Dip Road
The
Cliff Road
New Siding Road
Breeza State Forest
Lake Road
Gorran
RL380
RL360
RL330
RL370
A
A'
B
B'
C
C'
D
D'
E
E'
Legend
EL 7223
Disturbance Boundary (Indicative)
Project Boundary
Offset Area 6
Mt Watermark Offset
Final Void
Agricultural Rehabilitation Area
Box Gum Woodland Rehabilitation
Water Storage
Clean Water Flow
Dirty Water Flow
Proposed Pipeline Options
Proposed Pump Station
Aboriginal Cultural Heritage Conservation Areas
Section Locations
Post Mining Road Network
DATUM: GDA 94
Zone : 56
0
2km
Horizontal Scale
09040D
Hansen Bailey
ENVIRONMENTAL CONSULTANTS

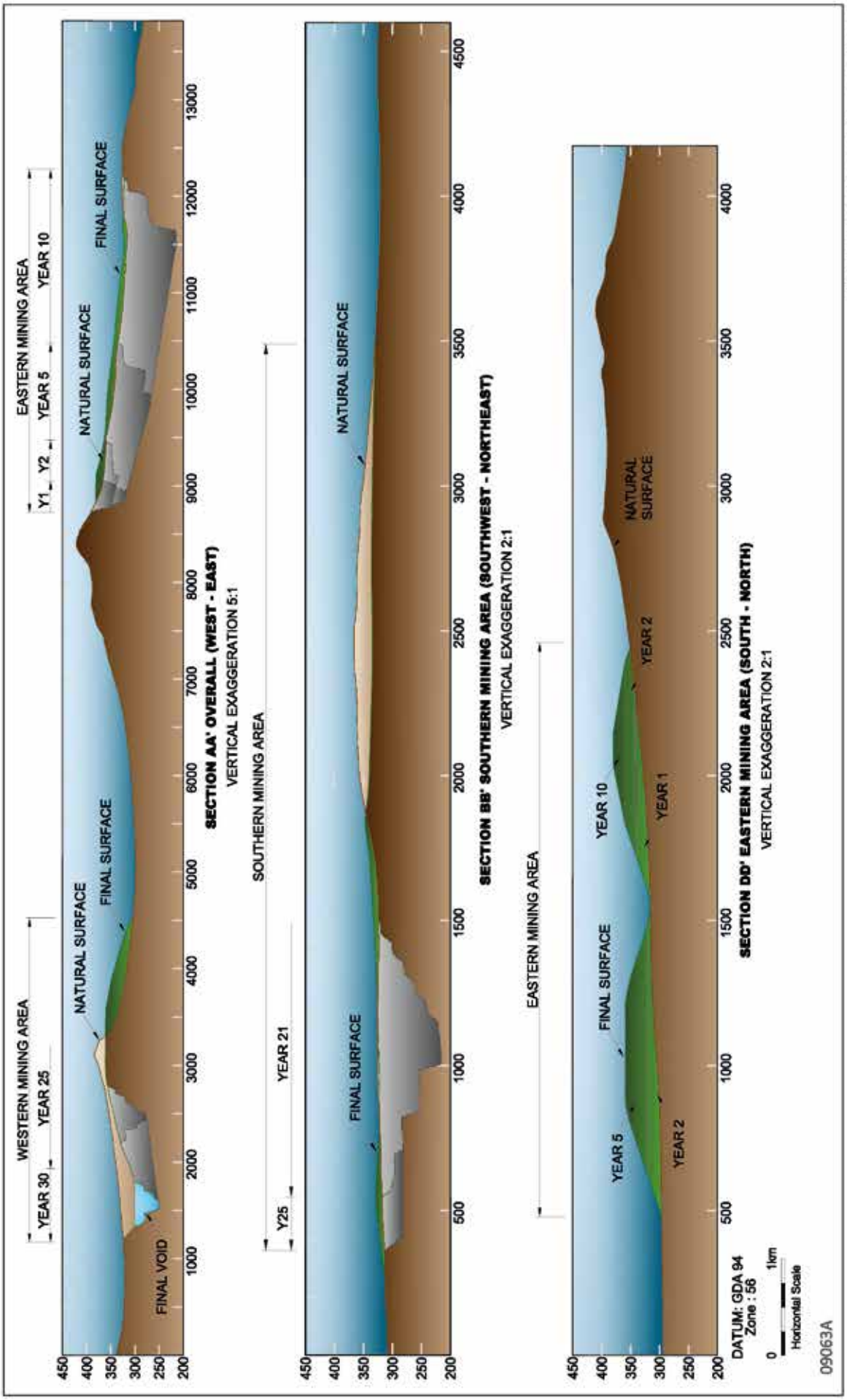
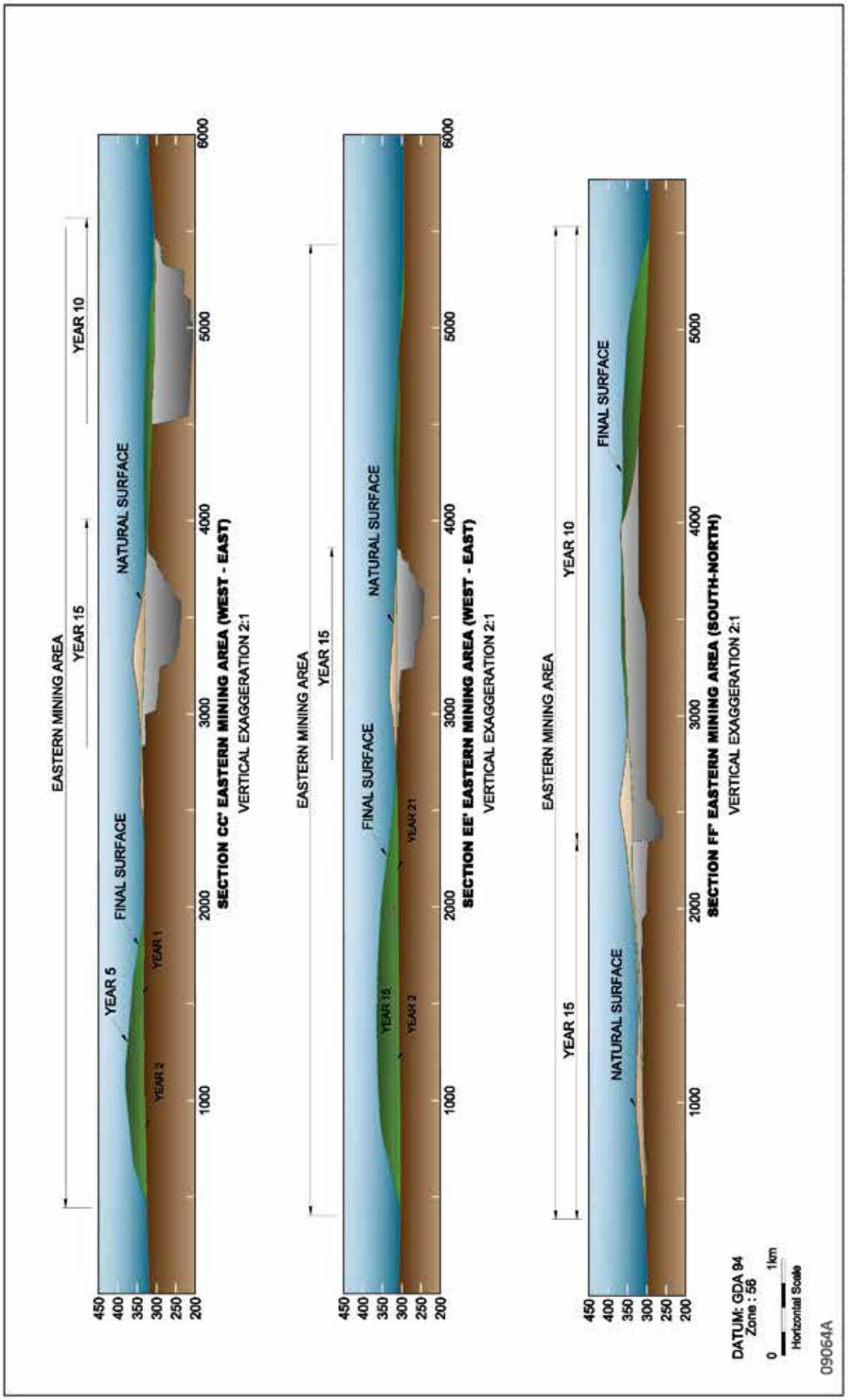

WESTERN MINING AREA
YEAR 30
YEAR 25
NATURAL SURFACE
FINAL SURFACE
FINAL VOID
EASTERN MINING AREA
Y1
Y2
YEAR 5
YEAR 10
NATURAL SURFACE
FINAL SURFACE
SECTION AA' OVERALL (WEST - EAST)
VERTICAL EXAGGERATION 5:1
SOUTHERN MINING AREA
Y25
YEAR 21
FINAL SURFACE
NATURAL SURFACE
SECTION BB' SOUTHERN MINING AREA (SOUTHWEST - NORTHEAST)
VERTICAL EXAGGERATION 2:1
EASTERN MINING AREA
YEAR 10
FINAL SURFACE
YEAR 5
YEAR 2
YEAR 1
YEAR 2
NATURAL SURFACE
SECTION DD' EASTERN MINING AREA (SOUTH - NORTH)
VERTICAL EXAGGERATION 2:1
DATUM: GDA 94
Zone : 56
0
1km
Horizontal Scale
09063A
WATERMARK COAL PROJECT
FINAL LANDFORM SECTIONS 1
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FIGURE 65


WATERMARK COAL PROJECT
FINAL LANDFORM SECTIONS 2
FIGURE 66
EASTERN MINING AREA
YEAR 15
YEAR 10
NATURAL SURFACE
FINAL SURFACE
YEAR 5
YEAR 1
YEAR 2
SECTION CC' EASTERN MINING AREA (WEST - EAST)
VERTICAL EXAGGERATION 2:1
EASTERN MINING AREA
YEAR 15
NATURAL SURFACE
FINAL SURFACE
YEAR 15
YEAR 2
YEAR 21
SECTION EE' EASTERN MINING AREA (WEST - EAST)
VERTICAL EXAGGERATION 2:1
EASTERN MINING AREA
YEAR 10
FINAL SURFACE
YEAR 15
NATURAL SURFACE
SECTION FF' EASTERN MINING AREA (SOUTH-NORTH)
VERTICAL EXAGGERATION 2:1
450
400
350
300
250
200
1000
2000
3000
4000
5000
6000
DATUM: GDA 94
Zone : 56
0
1km
Horizontal Scale
09064A
Hansen Bailey
ENVIRONMENTAL CONSULTANTS

Vegetation will also improve the aesthetic appearance of each area and the operational efficiency of structural sediment and erosion control measures employed.

To optimise growth across the land within the Project Boundary, the following rehabilitation methods and techniques will be implemented:

- Use of topsoil and intermediate subsoil to recreate the soil profile as far as practicable;
- Use of mulch for soil protection and mixing with topsoil;
- Use of brush matting to import seed into cleared areas;
- Use of open weave jute mesh pegged in with steel pegs;
- Brush harvesting from nearby areas;
- Placement of tree hollows and logs and the positioning of tree stags for fauna habitat; and
- Ripping of compacted wheel tracks.

Agriculture Land Pasture

The topsoiled surface of those areas designated for a post-mining agricultural land use (1,000 ha) will be sown with a mixture of pasture species appropriate for the season. Following establishment of these areas, it is anticipated rotational cropping of pasture and suitable crops will be undertaken at the discretion of the land manager.

Native Revegetation

Revegetation of native communities within the Project Boundary will focus on reinstating White Box Grassy Woodland with small areas of other species to enhance diversity across the conceptual final landform, as shown indicatively in **Table 89**.

The Biodiversity Management Plan, along with the Rehabilitation Management Plan, will include further details and delineation where each vegetation community is proposed to be re-established.

Tube stock seedlings will generally be propagated from locally-collected seed banks and strategically planted within and around the Project Boundary to encourage the reestablishment of the pre-agricultural vegetation communities and, in the medium to longer term, create habitat and corridors for native fauna. As agricultural operations remain viable outside of the native revegetation areas, fencing will be erected to prevent grazing pressures.

Rehabilitation Monitoring

Regular monitoring of the rehabilitated areas will be undertaken during the initial vegetation establishment period and beyond to demonstrate whether the objectives of the Rehabilitation and Mine Closure Strategy are being achieved and whether a sustainable and stable landform has been provided. Monitoring will be conducted periodically by independent, suitably skilled and qualified persons in accordance with **Table 90** at representative locations (one in every 100 ha of rehabilitation). Annual reviews of monitoring data to assess trends and monitoring program effectiveness will be conducted. The outcome of these reviews will be included in the Annual Review.

Rehabilitation Success Criteria

The preliminary success criteria (or completion criteria) for the rehabilitation areas are included in **Table 91**. The success criteria are performance objectives or standards against which rehabilitation success is demonstrated. The success criteria comprise indicators that reflect the nominated post-mine land uses, being native woodland and land capability Class III agricultural land.

Ongoing achievement of the success criteria (as indicated by monitoring results) will demonstrate that the rehabilitated landscape is in a productive and sustainable condition.

The final success criteria will be developed and agreed in consultation with the relevant government agencies and community. These criteria will be reviewed every five years with stakeholder participation to ensure the nominated success criteria achieve the desired rehabilitation outcomes. Progress against the rehabilitation success criteria will be regularly monitored and reported annually to all relevant stakeholders by way of the Annual Review.

Rehabilitated areas will be regularly inspected for the following key aspects:

- Evidence of any erosion or sedimentation;
- Success of initial establishment of crop or grass cover and tree and shrub seeding / plantings;
- Natural regeneration of native species;
- Weed infestation (primarily noxious weeds, but also where rehabilitation areas are dominated by other weeds);

Table 89 Indicative Native Revegetation Types

Vegetation Community	Indicative Rehabilitation Area (ha)
Box Gum Woodland Endangered Ecological Community	
White Box Grassy Woodland (C/EEC)	1,631
Blakely's Red Gum Grassy Woodland (C/EEC)	313
Yellow Box Grassy Woodland (C/EEC)	31
Sub-Total	**1,975**
Other Endangered Ecological Communities	
Inland Grey Box Grassy Woodland (EEC)	46
Fuzzy Box Woodland (TSC - EEC)	36
Sub-Total	**82**
Other Woodland	
Poplar Box Woodland	73
Whitewood Woodland	27
Tumbledown Red Gum Grassy Open Woodland	39
White Box Shrubby Woodland	171
Blakely's Red Gum Shrubby Woodland	17
Sub-Total	**327**
Total	**2,384**

Table 90 Rehabilitation Monitoring Program

Aspect of Rehabilitation	Elements to be Monitored	Frequency
Ecosystem Establishment		
General Description	• Describe the vegetation in general terms, e.g. mixed eucalypt woodland with grass understorey and scattered shrubs, dense Acacia scrub, etc	Six monthly for the first 12 months after establishment and then every 12 months
2 m x 2 m quadrats	• Count the number of plants of all species, excluding grass • Measure live vegetation cover for understorey and grasses (separately) using a line intercept method • Record details of ground cover (litter, logs, rocks etc.)	Six monthly for the first 12 months after establishment and then every 12 months
20 m x 10 m plots	• Count, by species, all trees >1.6 m tall • Tag and measure DBH of trees >1.6 m tall, to a maximum of 10 for any one species • Record canopy cover over the whole 20 m centreline when trees are tall enough • Subjectively describe tree health, by species if relevant, noting signs of drought stress, nutrient deficiencies, disease and severe insect attack. Where health problems are noted, record the percentage of unhealthy trees	Six monthly for the first 12 months after establishment and then every 12 months
	• Record any new plant species not present in the smaller plots, including any problem and declared noxious weeds • Take five surface soil samples (e.g. at approx. 5 m intervals along the centreline) and bulk these for analyses of: pH, EC, chloride and sulfate; exchangeable Ca/Mg/K/Na; cation exchange capacity; particle size analysis and R1 dispersion index; 15 bar and field capacity moisture content; organic carbon; total and nitrate nitrogen; total and extractable phosphorus; Cu, Mn and Zn	
50 m transect	• Along the 50 m erosion monitoring transect, record the location, number and dimension of all gullies >30 cm wide and/or 30 cm deep • Erosion pins will be established in plots located in newer rehabilitation to record sheet erosion if present	One year after establishment and then every two years
Rehabilitation in general	• When traversing between monitoring plots, note the presence of species of interest not previously recorded (e.g. key functional or structural species, protected species, noxious weeds), as well as obvious problems including any extensive bare areas (e.g. those greater than 0.1 ha) • Observations such as this can provide useful, broad scale information on rehabilitation success and problems	Six monthly for the first 12 months after establishment and then every 12 months
Photographic record	• For each 20 m x 10 m plot, a photograph will be taken at each end of the plot, along the centreline looking in	Six monthly for the first 12 months after establishment and then every 12 months
Habitat	• General observations relating to the availability and variety of food sources (e.g. flowering / fruiting trees, presence of invertebrates etc) • Availability and variety of shelter (e.g. depth of leaf litter, presence of logs, hollows etc.) • Presence / absence of free water in the rehabilitated areas	Six monthly for the first 12 months after establishment and then every 12 months
Fauna	• General observations of vertebrate species (including species of conservation significance) • Detailed fauna surveys including presence and approximate abundance and distribution of vertebrate species (focussing on species of conservation significance)	After rehabilitation is three years old undertake monitoring annually
Invertebrate	• Diversity and abundance of present species	Annually
Weeds and pests	• Species identity • Approximate numbers/level of infestation • Observations of impact on rehabilitation (if any)	Six monthly during the first two years and biennially after that. Inspections will be opportunistic after significant rainfall events
Geotechnical Stability		
	• Assessment of the stability of batters and also looking at surface settlements (sink holes). In particular where these features could impact on the performance of any surface water management system • Surface integrity of landform cover/capping (measurement of extent of integrity failure) • Presence / absence of landform slumping	Annually
Surface and Groundwater		
	• Groundwater quality and depth • Efficiency of landform surface water drainage systems (integrity of banks and drains) • Water quality including pH, EC and total suspended solids of water in water storages, and open cut mining areas, sedimentation dams	Quarterly or following significant rainfall events
Soils		
	• Profile development (Chemical analysis, structure, biotic evidence) • Land Capability Classification	One year after establishment and then every two years

Table 91 Preliminary Rehabilitation Success Criteria

Phases of Strategic Rehabilitation	Rehabilitation Element	Indicator	Criteria
Decommissioning Phase	Services & Structures	Site Services	All services including power, water, data and telephone communication for the entire site will be isolated, disconnected, terminated and or removed / buried to make them safe
		Infrastructure & Buildings	Equipment and buildings will be removed from the site unless these can be reused in situ to support nearby communities
		Roadways, Car parks and Hardstands	The unwanted bitumen roadways, car parks and hardstand areas will be ripped up and disposed of appropriately
		Surface Water Management Structures	All surface water structures will be removed, unless valuable to post-mining land use
Landform Establishment	Landform stability	Slope gradient	No less than 75% of the area has slopes <10°. Where the slopes are steeper, additional water management structures will be utilised (as required)
			Where reject layers are present and exposed, the landform is capped with a minimum of 3 m of inert material and be free-draining
		Erosion control	Erosion control structures are installed at intervals commensurate with the slope of the landform
			Dimensions and frequency of occurrence of erosion rills and gullies are generally no greater than that in reference sites that exhibit similar landform characteristics
		Surface Water Drainage	Use of contour banks and diversion drains to direct water into stable areas or sediment control basins
			All landforms will be free draining except where specific structures have been constructed for the storage of water as required for sediment and erosion control or some post-mining land use
Growth Media Development	Water quality	EC, pH, TSS and oil and grease	Ensure receiving waters affected by surface water runoff have contaminant limits of the EPL
	Topsoil	Salinity (electrical conductivity)	Soil salinity content is within the limits of the targeted land capability
		pH	Soil pH is within the limits of the targeted land capability
		Sodium content	Soil Exchange Sodium Percentage (ESP) is within the limits of the targeted land capability
		Nutrient cycling	Nutrient accumulation and recycling processes are occurring as evidenced by the presence of a litter layer, mycorrhizae and/or other microsymbionts. Adequate macro and micro-nutrients are present
Growth Media Development	Land and Soil Capability	Soil Survey	Soil survey and land capability assessment to be undertaken in accordance with relevant guidelines and Australian Standards to ensure post disturbance land meets the nominated land capability classes for the mining area, and pre-mining land capability classes for infrastructure area
Ecosystem Establishment	Vegetation	Surface cover	Minimum of 70% vegetative cover is present (or 50% if rocks, logs or other features of cover are present). No bare surfaces >20 m^2 in area or >10 m in length down slope
		Species composition	Subject to land use, comprise a mixture of native trees, shrubs and grasses representative of regionally occurring woodland
Ecosystem Development	Topsoil	Nutrient cycling	Nutrient accumulation and recycling processes are occurring as evidenced by the presence of a litter layer, mycorrhizae and/or other microsymbionts. Adequate macro and micro-nutrients are present
	Vegetation	Land use	Area accomplishes and remains as a healthy native woodland
		Resilience to disturbance	Established species survive and/or regenerate after disturbance. Weeds do not dominate native species after disturbance or after rain. Pests do not occur in substantial numbers or visibly affect the development of native plant species
		Sustainability	Species are capable of setting viable seed, flowering or otherwise reproducing. Evidence of second generation of shrub and understorey species
			Vegetation develops and maintains a litter layer evidenced by a consistent mass and depth of litter over subsequent seasons
			More than 75% of shrubs and/or trees are healthy when ranked healthy, sick or dead
	Fauna	Vertebrate species	Representation of a range of species characteristics from each faunal assemblage group (e.g. reptiles, birds, mammals), present in the ecosystem type, based on pre-mine fauna lists and sighted within the three-year period preceding mine closure
			The number of vertebrate species does not show a decrease over a number of successive seasons prior to mine closure
		Invertebrate species	Presence of representatives of a broad range of functional indicator groups involved in different ecological processes.

Phases of Strategic Rehabilitation	Rehabilitation Element	Indicator	Criteria
Ecosystem Development		Habitat structure	Typical food, shelter and water sources required by the majority of vertebrate and invertebrate inhabitants of that ecosystem type are present, including: • a variety of food plants; • evidence of active use of habitat provided during rehabilitation such as nest boxes, and logs; and • signs of natural generation of shelter sources including leaf litter

- Integrity of graded banks, diversion drains, waterways and sediment control structures; and
- General stability of the rehabilitation areas.

Where rehabilitation success criteria have not been met within the required timeframes, maintenance works will be undertaken, including:

- Re-seeding and, where necessary, re-topsoiling and/or the application of specialised treatments such as composted mulch or biosolids to areas with poor vegetation establishment;
- Installation of tree guards around planted seedlings or construction of temporary fencing suitable for excluding native and feral fauna species should grazing and browsing by animals be excessive;
- Replacement of drainage controls if they are found to be inadequate for their intended purpose, or compromised by vegetation or wildlife;
- De-silting or repair of sediment control structures; and
- Where monitoring indicates the presence of excessive weeds or the potential for noxious weed infestation, necessary precautions to prevent the development of weeds within the rehabilitated areas will be undertaken.

The Annual Review will detail monitoring results, any required maintenance activities and refinements of rehabilitation techniques.

Weed and Feral Animal Control

The presence of weed species and feral animals has the potential to have a major impact on revegetation outcomes and biodiversity values. As such, a combination of herbicide application and manual weeding will be primarily utilised to prevent or control weed infestations over the life of the Project. In targeting feral animals, including goats, foxes, cats, rabbits, pigs and wild dogs, controls will be implemented in accordance with Livestock Health and Pest Authority procedures.

Rehabilitation Trials and Research

A key component of successful rehabilitation is to regularly review performance and to identify areas for continuous improvement. In this regard, Shenhua Watermark will contribute to and actively participate in trials and research to improve mine site rehabilitation techniques and enhance performance outcomes. This may include trials and research into the re-establishment of native woodland, native grasses, Box Gum Woodland CEEC, riparian corridors and preferred Koala habitat. Consideration will also be applied to any trails and research into agricultural activities and performance indicators post-mining.

7.21.3 Conceptual Final Landform

Shenhua Watermark will maximise opportunities for a post-mining landscape that is generally consistent with pre-mining land use biodiversity. All mine areas will be rehabilitated except for the final void which will be shaped appropriately. A conceptual final landform is shown on **Figure 64**.

Approximately 3,233 ha of class III land will be reinstated as per of the final landform, of which approximately 1,000 ha will be dedicated for agriculture in order to maintain the high value production of the area. The indicative areas to be reserved for agricultural purposes and native revegetation are shown on **Figure 64**.

Three key rehabilitation domains have been identified in the Rehabilitation and Mine Closure Strategy based on the Project impacts, post-mine landform, future land use and biodiversity values. These include the open cut mining areas, final void and MIA, which are discussed in further detail below. The rehabilitation domains are discussed in further detail in **Appendix AA**.

Open Cut Mining Areas

The final landform has been developed to promote visual characteristics that generally conform to the existing landscape. To ensure long term stability and sustainability, the slopes of the final landform within the open cut mining areas will have a maximum slope of approximately 10 degrees. It is expected that the steeper slopes will develop greater biodiversity than the more easily accessible sites. Indicative cross sections of the final landform are shown on **Figure 65** and **Figure 66**.

The conceptual final landform will be free draining and designed to integrate with the surrounding catchments. The final landform will aim to provide relief with the surrounding environment and contain gentle slopes to allow drainage to preferential paths on the slopes.

As described above, the final land use of this area will comprise a mixture of the native vegetation communities (including grassy woodland (70%), shrubby woodland / open forest (25%) and riparian forest (5%) for conservation purposes) and a mixture of pasture species for agricultural purposes. Revegetation of native communities within the Project Boundary will focus on reinstating White Box Grassy Woodland with small areas of other species to enhance diversity across the conceptual final landform.

The OEAs will be progressively rehabilitated over the life of the mine as soon as practical. This staged approach will minimise the open cut mining disturbance area at any one time and reduce the environmental impacts from the open cut operations. The Rehabilitation and Mine Closure Strategy will be reviewed on a regular basis to ensure disturbed areas are kept to a minimum.

Final Void

Considerable effort and forethought has been invested in the mine plan to avoid, wherever possible, the creation of final mine voids. As discussed in **Section 3.12.8**, the two largest voids created by mining process in the Eastern Mining Area and the Southern Mining Area have been strategically located so that both can be completely backfilled and rehabilitated.

A third much smaller void will be engineered so that it is remote from the black soil plains and valuable groundwater aquifers. It will also be strategically placed such that if underground mining is entertained following the completion of open cut mining it will provide access for this purpose.

This void will be located on the western extremity of the Western Mining Area and will cover an area of approximately 100 ha. It will have a maximum depth of around 80 m below the natural ground surface, with a volume of approximately 76 bcm. As part of the final landform, it is planned that the final void will have the majority of the highwall blasted back and low wall graded to improve its safety and stability.

There are deeper coal resources present beyond the 30 year mining limit of the Project. Shenhua Watermark may, depending upon market factors and resource confirmation, seek further relevant approvals for the extraction of these. In this instance, the Western Mining Area final void will be ideally placed for underground access to this coal resource. Nonetheless, two approaches for the treatment of the Western Mining Area void were considered as follows:

- Option 1 – The Western Mining Area final void is left partly backfilled. Partial backfilling and rehabilitation represents a total cost of $42 Million, in conjunction with the use of 50% of the Project's annual mining capacity of the Project for an additional extra year of dozing and ancillary works; or
- Option 2 – The Western Mining Area final void is completely backfilled. Estimated costs to completely backfill and rehabilitate a total 76 Mbcm final void represents a total cost of approximately $461 Million. This total includes provision for $438 Million operating cost and $23 Million in capital cost. This option assumes the removal of overburden material from existing rehabilitated OEAs. One hundred percent of the Project's annual mining capacity and dozing and ancillary works will be utilised for more than one year to complete the activities required under Option 2.

In recognition of the further potential coal resources and the ability of the Western Mining Area void highwall to provide access to these resources, the cost / benefit analysis found that the retention of a safe and stable final void in the Western Mining Area (Option 1) was the most appropriate outcome.

In the event that no underground mining option is progressed in this area, surface water runoff and groundwater seepage will settle in the remaining void, creating a final void lake.

As discussed in **Section 7.3**, the final void water level as modelled by WRM (2013) will reach an equilibrium water level of approximately 280 to 290 m AHD, which is approximately 20 m to 30 m below the overflow level of 310 m AHD.

Mine Infrastructure Area

The MIA, including the CHPP, administration building, workshop, train loading facilities and rail loop will be decommissioned following the completion of mining. The landscape will then be rehabilitated as part of the mine closure strategy for the Project.

7.21.4 Mine Closure

A mine closure plan will be developed for the Project within five years of closure, which will reflect contemporary expectations including changes to the final mine plan, regulatory requirements, new technologies and stakeholder expectations.

Decommissioning and removal of mine site facilities and all infrastructure items will take place, if that infrastructure is not required post-mining or sold on for other industrial purposes. Any infrastructure including dams, levee banks, roads and buildings, which are beneficial for future use by post-mine landowners, will be left in place in accordance with the relevant stakeholder or landowner agreements. Land in the vicinity of mine site facilities will undergo remediation of any land contamination, ripping, topsoiling and seeding, as necessary.

7.22 Bushfire

7.22.1 Background

The majority of land within the Project Boundary consists of low diversity grassland and exotic pastures with highly fragmented patches of remnant and regenerating stands of eucalypt woodland. This patterning reflects the extensive agricultural practices of the region (see **Section 7.10** and **Appendix K**).

The Project Boundary is located immediately north-east of the Breeza State Forest which encompasses an area of 1,364 ha. It is dominated by dry eucalypt woodlands and open forests. The Doona State Forest and the Spring Ridge State Forest are situated approximately 8 km and 14 km to the south of the Project Boundary, respectively.

To the north-west lies the Goran State Forest and Wandoba State Conservation Area, approximately 15 km and 16 km, respectively from the Project Boundary. Further abroad is the Trinkey State Forest and Black Jack State Forest situated approximately 26 km to the south-west and 20 km north, respectively, from the Project Boundary.

A Bushfire Risk Management Plan for the Upper Hunter, Liverpool Plains, and Gunnedah LGAs (Liverpool Range area) was developed in 2010 by the Liverpool Range Bush Fire Management Committee (2010). The plan identifies areas within the Liverpool Range region and associated community assets subject to the risk of bushfire and recommends measures to reduce these risks.

7.22.2 Risk Assessment

The bushfire season in the Liverpool Range region occurs predominantly during the hotter months from October to the end of March. The prevailing weather conditions associated with the bushfire season are strong south-westerly to north-westerly winds, high daytime temperatures, and low relative humidity. Depending on factors such as temperature, available fuel loads and rainfall, the frequency and intensity of bushfires will vary. The main sources of bushfire ignition in the Liverpool Range region are dry lightning storms, escaped private burning fires, accidental ignition and arson.

The land within the Project Boundary poses a moderate to low bushfire risk to Project due to the limited fuel source, the existing vegetation composition and current agricultural land use practices.

During construction and operation of Project, a combination of select activities, equipment and fuel sources could lead to the ignition of a bushfire. However, based on a consideration of the mitigation and management measures outlined in **Section 7.22.3**, the risk of bushfire as a result of the Project is low.

The adjoining Breeza State Forest experiences build-up of high fuel loads over time from dense vegetation, leaf drop and tinder. A combination of relatively low rainfall, the dry nature of the landscape and high fuel loads suggests Breeza State Forest could pose a significant bushfire risk to the Project.

7.22.3 Mitigation and Management

As part of the EMS, Shenhua Watermark will develop a Bushfire Management Plan. This plan will be prepared in accordance with the Rural Fires Act and CMHS Act and regulated by the NSW Rural Fire Service.

The plan will include the following objectives:

- Maintain and monitor areas and equipment where bushfire hazards are present to prevent or minimise the outbreak of fire;
- Minimise the risk of bushfires spreading from the Project to adjacent private properties; and
- Control the outbreak of bushfires in an effective manner.

The plan will include but not be limited to the following mitigation and management measures:

- Induct all employees and contractors on bushfire awareness including emergency procedures and responses in event of a bushfire;
- Consult with the NSW Rural Fire Service and make sure they are aware of the Koala Plan of Management and Koala offset areas for the Project;
- Consult with GSC to ensure the Fire Risk Management Plan for Gunnedah LGA takes into account the location and significance of Koala habitat mapped for the Project;
- Manage and monitor fuel levels, via mowing, slashing and ploughing;
- Create and maintain firebreaks;
- Install general purpose fire extinguishers on all mobile equipment and at other appropriate locations;
- Undertake regular inspection and maintenance of all fire management equipment to ensure ongoing effectiveness;
- Ensure the storage and handling of all flammable materials is conducted in accordance with a valid Dangerous Goods Licence; and
- Undertake internal monitoring and communication of specific fire danger risks, including hot work.

Bushfire risks in the Breeza State Forest will continue to be managed by Liverpool Range Zone Rural Fire Service. Shenhua Watermark will assist the Liverpool Range Zone Rural Fire Service in monitoring and reporting any fires, suspect behaviour and fuel load in the Breeza State Forest.

7.23 Hazards Analysis

7.23.1 Background

A Preliminary Hazardous Analysis was undertaken by Hansen Bailey and is provided in **Appendix AC**. The purpose of the analysis was to identify potential hazards associated with the Project and identify potential risk levels.

7.23.2 Methodology

The hazard analysis was conducted in accordance with *SEPP 33 – Hazardous and Offensive Development Application Guidelines* (SEPP 33 Guidelines) (DUAP, 1994) and the *Hazardous Industry Planning Advisory Paper No. 6 – Hazard Analysis* (Guidelines for Hazard Analysis) (DOP, 2011).

The methodology applied as per the Guidelines for Hazard Analysis included:

- Identification of potential hazards associated with the Project;
- Assessment of the potential consequences of identified events using the Shenhua Watermark risk matrix;
- Qualitatively estimate the likelihood of events using the Shenhua Watermark risk matrix;
- Examine any mitigation measures;
- Qualitatively assess the risks to the environment, members of the public and their property arising from sudden and unexpected incidents and compare these to the applicable qualitative criteria; and
- Recommend further risk mitigation or remedial measures if required and repeat process.

Potentially Hazardous Materials

The main potentially hazardous materials identified will be stored within the fuel delivery, storage and refill area of the Dangerous Goods Store and include diesel, oils, coolant and other minor hazardous materials. Explosive products will also be stored onsite at a sufficient distance from adjoining property owners. A brief description of each potentially hazardous material associated with the Project is provided below.

Diesel Storage and Transport

Diesel (Class C1) is a combustible liquid as classified by *AS 1940:2004 The Storage and Handling of Flammable and Combustible Liquids* (AS 1940:2004). However, this material is not classified as a dangerous good under the *Australian Dangerous Goods Code* (National Transport Commission, 2007) (ADG Code).

Diesel for the Project will be stored in 11 above ground storage tanks, each with a 97,000 L capacity. These storage tanks will be located at the fuel delivery, storage and refill facility within a designated self-bunded area that is accredited to AS 1940:2004.

The transport of diesel to the site will be undertaken by a licensed contractor. Diesel will be delivered by trucks to the designated unloading area designed for the containment of spillages.

Explosives Storage and Transport

Shenhua Watermark will utilise a variety of explosive material, including initiating products, detonators, and emulsion explosives, to facilitate open cut mining methods.

In accordance with the ADG Code, an independent, licensed contractor will be appointed to supply and transport explosive materials to an onsite explosive storage magazine within a securely fenced and self-bunded Dangerous Goods Store. The explosive storage magazine will be designed in accordance with *AS 2187:1998 Explosives - Storage, Transport and Use – Storage* and located at an appropriate distance from onsite facilities and a sufficient distance from the Project Boundary.

Gases

Liquid Petroleum Gas (LPG) and oxy-acetylene are flammable gases (Class 2.1) and dangerous goods as classified by AS 1940:2004 and ADG Code, respectively. The Project will require minor volumes of LPG, oxy-acetylene and other flammable gases to supply operations.

All flammable gases will be stored within gas cylinders in accordance with *Australian and New Zealand Standard 1596:2008 The Storage and Handling of LP Gas* and AS 1940:2004. These gas cylinders will be located within a dedicated, securely fenced and self-bunded Dangerous Good Store.

Other Hazardous Material

A number of other hazardous materials including oil, grease, coolant, sealing and adhesive compounds, cleaning products, paints, flocculating agents and chemicals will be utilised during the construction and operation of the Project.

All chemicals listed as a dangerous good will be stored in a dedicated, securely fenced and self-bunded Dangerous Good Store. All other hazardous materials will generally be stored at workshops in locked storages or in above ground storage tanks at the fuel delivery, storage and refill facility.

Potentially Hazardous Processes

Based on a consideration of the potentially hazardous materials associated with the Project, the following processes were identified as potential risk events:

- Transportation of explosives, fuel, chemicals and general goods to the Project Boundary;
- Delivery of fuel, chemicals and general goods to the Project Boundary (i.e. drop off);
- Transportation of coal product out of the Project Boundary (rail loop and conveyor operations);
- Storage of explosives, fuel, chemicals and general goods;
- CHPP operations, including flocculation and management of reject materials;
- Transportation of explosives, fuel, chemicals and general goods to the Project Boundary;
- Blasting activities required for the removal of overburden and interburden materials;
- General Project operations including the construction phase of the Project; and
- Exploration and monitoring activities.

7.23.3 Impact Assessment

The Project will transport and store diesel fuel, explosives, gases and other substances, which may be considered to be potentially hazardous as outlined in **Section 7.23.2**. The risk assessment presented in the Preliminary Hazardous Analysis (**Appendix AC**) has identified management measures that will be implemented to ensure operations are undertaken safely. With these measures in place, there is no aspect of the Project that is considered to be hazardous or offensive.

7.23.4 Mitigation and Management

As part of the EMS, Shenhua Watermark will develop a Hazard Management Plan. The following measures will be implemented to prevent or minimise the occurrence of potential hazards:

- Ensure all hazardous materials associated with the Project will be transported to and from the Project by a licensed contractor in accordance with the relevant Australian Standards and the ADG Code;
- Ensure all onsite storage facilities for explosives, diesel and other hazardous materials will be designed in accordance with applicable Australian Standards and legislation;
- Ensure all onsite storage facilities, vehicles and transport vessels used on site are regularly inspected for leaks, spills and other damage or faults;
- Ensure spill kits are available onsite on all transport vehicles used on site for carrying hazardous materials;
- Ensure training is provided to onsite personnel regarding the handling and storage of hazardous materials;
- Ensure all dangerous goods are securely stored onsite are fenced with restricted access and located a minimum of 200 m from other onsite facilities; and
- Develop and maintain a database to assist in the recording and management of chemicals used within the Project Boundary in respect of the Project. The chemical management database will contain Material Safety Data Sheets for all chemicals used within the Project Boundary.

7.24 Contamination

7.24.1 Background

A Preliminary Contamination Assessment was undertaken by Hansen Bailey and is provided in **Appendix AD**. The purpose of the assessment was to identify all past and present potential contamination sources within the Project Boundary via a desktop analysis and assess the need for further investigations.

7.24.2 Methodology

The Preliminary Contamination Assessment was undertaken in accordance with Clause 7 of SEPP 55 and the *Guidelines for Consultants Reporting on Contaminated Sites* (OEH, 2011).

A desktop assessment was undertaken to identify past and present potential for contamination within the Project Boundary. The assessment involved a review of soil landscape maps, historical aerial photographs, Shenhua Watermark property condition inspection reports, OEH public registers and the Historic Heritage Impact Assessment prepared for the Project (see **Section 7.15** and **Appendix R**).

7.24.3 Desktop Assessment Results

The key sources of potential contamination identified within the Project Boundary are presented in **Table 92**. Associated landholdings referred to in **Table 92** are shown on **Figure 4**.

7.24.4 Mitigation and Management

The Preliminary Contamination Assessment has identified areas for further investigation by a licensed contractor. The detailed assessment will involve:

- A field investigation to validate the type, extent and level of contamination at each site identified in **Table 92**; and
- A discussion of the impacts as a result of the identified contamination sources on public health, the surrounding environment, including air, water, soil and biota.

If required, following the detailed site assessment, Shenhua Watermark will develop a Remedial Action Plan as part of its EMS to:

- Ensure the remediated site will be suitable for the development of the Project;
- Prevent or minimise unacceptable risk to human health or to the environment;
- Establish the environmental safeguards and procedures required to complete the remediation in an environmentally acceptable manner;
- Identify and include proof of the necessary approvals and licences; and
- Outline monitoring requirements, including location, parameters, frequency and reporting.



7.25 Waste

7.25.1 Background

Waste will be managed in accordance with the objectives of the *Waste Avoidance and Resource Recovery Act 2001* and the POEO Act along with other relevant legislative requirements including the Waste Classification Guidelines (DECCW 2008).

Waste streams that are likely to be generated for the Project will include general waste, hazardous waste and sewage.

7.25.2 Impact Assessment

Under the POEO Act, Shenhua Watermark is required to monitor, remove, track and report wastes on a regular basis. Activities associated with the Project will generate a range of wastes which will require management.

A key objective of the waste management system for the Project will be to encourage reuse and recycling of waste materials. In order to meet this objective, waste material will be separated into several streams and deposited in the appropriate receptacle for reuse, recycling or disposal. Likely predicted waste seams associated with the Project are described in the following sections.

General Waste

Scrap metal, batteries, empty drums, wooden pallets, timber, green waste and mixed recyclables (including paper cardboard, glass and aluminium cans) are typical of the general waste that will be generated by the Project. Each waste material will be separated into the appropriate receptacle for reuse, recycling or disposal. The Project is anticipated to generate approximately 300 t of domestic waste that is no longer usable or recyclable annually.

GSC has confirmed it will accept general waste from the Project.

Hazardous Waste

The handling and management of hazardous wastes generated by the Project will be conducted in accordance with the *Waste Classification Guidelines* (DECCW, 2008) and the ADG Code (National Transport Commission, 2007).

Contaminated materials generated at the workshop and vehicle wash down bay, such as grease and oil, will be held in storage tanks within a bunded area prior to removal from site by an independent waste contractor for treatment or disposal. On average, the Project is anticipated to generate approximately 4 ML of waste grease and oil annually. Any spills that occur in the collection areas will be contained within bunds and managed in accordance with pollution control systems. This waste will be collected by a licensed hydrocarbon facility operator.

Table 92 Potential Contaminant Sources

Type of Contaminant	Potential Sources of Contamination
Deregistered and concentrated chemical use	• Potential impact to all near-surface soils within the Project Boundary as a result of long term agriculture land use and the historical application of herbicides and pesticides that have since been deregistered for use in Australia • Potential chemical mixing, including herbicides, near chemical and machinery storage areas (Dixie[1], Tathra[1], Keinghton, Springhurst[1], Lilyfield, Boondah[1], Stafford / Part Stafford[1] and Urubula[1]) • Sheep showers / dips identified at Elsdon[1], Inverness, Springhurst[1], Lilyfield, The Wilgas, Demeter, Flakenhoe, Molonga, Elsdon, Gleneyre[1] and Lauriston[1] • Possible sheep dip sites (known woolsheds likely source) at Shar, Boondah[1] and Barwo
Imported filling and waste materials	• Rubbish tips at Linavardi, Keinghton, Cardington, Springhurst[1], Lochiel East[1] and Demeter, Monivae[1] and Urubula[1] • Scattered objects of various sizes (potential dumped waste) at The Wilgas and Urubula[1] • Potential quarries at Moondyne, Lilyfield, The Wilgas and Linavardi • Former coal mines, sidings, and associated stockpiled materials at The Wilgas and Cardington
Sewage / sewage treatment and disposal	• Septic tanks and disposal areas, notably the septic tanks in poor condition at Dixie[1] and Marney • The *"long drop"* toilet at Inverness and the sewage disposal location at Santa Capri
Livestock slaughter operations	• Former piggeries / pig sheds at Elsdon, Springhurst[1], Lilyfield, Monivae[1] and Lauriston[1] • Meat house at Marney • Slaughtering shed at Inverness • Poultry shed at Linavardi
Building materials	• Demolished brick kiln and associated shed at Watermark / Watermark Ridge • Stockpiled construction materials, including fibrous cement materials, at Flakenhoe • Fibrous cement shed at Lauriston[1]
Potential chemical leaks and spills	• Workshops, machinery sheds and chemical storage sheds at Linavardi, Dixie[1], Tathra1, Elsdon, Keinghton, Inverness, Springhurst[1], Shar, Lilyfield, Cardington, Boondah[1], The Wilgas, Hill 60, Monivae[1], Demeter, Barwo, Flakenhoe, Lochiel East[1], Stafford / Part Stafford[1], Watermark / Watermark Ridge, Urubula[1], Gleneyre[1], Roanoke[1] and Lauriston[1] • Above ground fuel storage tanks identified at Tathra[1], Inverness, Springhurst[1], Boondah[1] and The Wilgas • Underground fuel storage tank identified at Lauriston[1]

1 Property is partially within the Project Boundary. Identified contamination source may be situated outside of the Project Boundary.

Surface runoff from industrial areas, which may contain high levels of suspended sediment, detergents, oil and other chemicals, will be captured in sediment dams and treated prior to being reused in the water management system.

Sewage

Sewage will be managed via an onsite sewerage treatment facility. The treated effluent will be utilised as irrigation water supply for rehabilitation in accordance with *Environmental Guideline for the Use of Effluent by Irrigation* (DEC, 2003), reused within the mine water management system or pumped out regularly by a licensed contractor.

The Project is anticipated to generate approximately 600,000 L of sewage annually.

Coarse Rejects and Tailings

Coarse rejects and tailings waste is produced as a by-product of the coal preparation process. Coarse rejects and tailings will be co-disposed with OEAs and capped with inert material. The Project is anticipated to generate up to 86.6 Mt of coarse rejects and up to 38.6 Mt of tailings. Further details regarding rejects and tailings disposal are outlined in **Section 3.4.4**.

7.25.3 Mitigation and Management

As part of the EMS, Shenhua Watermark will develop a Waste Management Plan. The following measures will be implemented to manage and minimise the production of waste:

- Each major waste stream, where practicable, will be segregated in the appropriate receptacles for recycling, reuse and / or disposal;
- Waste will be classified and managed as recommended by relevant legislation, with all handling of waste and hazardous materials conducted by suitably qualified personnel;
- Training will be provided to personnel to improve efficiency in the minimisation of waste streams, reuse and recycling options and management strategies for each major waste stream relevant to key work areas;
- An independent waste contractor working within the provisions of the POEO Act will remove and report on wastes; and
- Regular inspections and monitoring will be conducted by qualified personnel to ensure adequate maintenance and operation of the waste facilities and to ensure management practices are sufficient to manage any waste products.

7.26 Social

7.26.1 Background

A Social Impact Assessment was undertaken by Hansen Bailey and is provided in **Appendix AE**. The purpose of the assessment was to provide:

- A review of the socio-economic profile and values of the communities within the Gunnedah, Liverpool Plains, Tamworth Regional, Narrabri and Upper Hunter LGAs (the study area for the Social Impact Assessment), with a specific focus on the Sub-regional study area of the assessment (being Gunnedah, Liverpool Plains and Tamworth Regional LGAs);
- review of the current community facilities and services provided in the Sub-regional study area, with a focus on the Gunnedah and Liverpool Plains LGAs;
- A review of the current housing market in the study area, with a focus on Gunnedah and Liverpool Plains LGAs;
- An analysis of the range of policies, documents, strategies and cooperative planning projects relating to local and regional social and economic planning issues, with a focus on the Gunnedah, Liverpool Plains and Tamworth Regional LGAs;
- A description of the estimated construction and operations workforce required for the Project;
- Projections of the size and final residential locations of the population expected as a result of the Project workforces;
- An assessment of potential impacts associated with the Project on the community profile, values and facilities and services;
- An assessment of cumulative impacts resulting from current and expected mining and resource projects in the region; and
- Measures to mitigate and manage impacts of the Project on the existing socio-economic environment.

7.26.2 Methodology

The methodology adopted for the preparation of the assessment involved the following key phases:

- Planning and Scoping;
- Baseline Profiling;
- Impact Identification and Assessment; and
- Development of Management Strategies.

Planning and Scoping

This phase involved the selection of the study area and Sub-regional study area for the assessment. The study area of the assessment includes the Gunnedah, Liverpool Plains, Tamworth Regional, Narrabri and Upper Hunter LGAs. These LGAs were included because the Project's influences, particularly those relating to accommodation, labour force demand and supply and economic benefits, are likely to extend into this regional area.

However, it is anticipated that the LGAs of the Gunnedah, Liverpool Plains and Tamworth Regional will be impacted most as a result of the Project. As such, these LGAs form the Sub-regional study area, which is the focus of the assessment.

Baseline Profiling

Baseline profiling was undertaken to understand the current socio-economic environment within the study area. The desktop assessment component of this profiling involved quantitative data collation, primarily demographic data from the 2006 and 2011 Censuses and a review of a wide range of other publically available information. Local and regional planning and community development documents and statistics that provide significant background and direction to issues relevant to the Project were also reviewed.

Qualitative information was gained from direct interviews with key staff in the Gunnedah, Liverpool Plains and Tamworth Regional LGAs and state government agencies as outlined in **Section 5**. The assessment also considered issues raised during the EIS stakeholder engagement program as described in **Section 5**.

Current community identity, values, aspirations and lifestyle were explored, focusing on the Gunnedah, Liverpool Plains and Tamworth Regional LGAs. Issues relating to community cohesion, health and wellbeing and social order and community safety were also investigated.

An Aboriginal Social and Community Wellbeing Assessment was also undertaken by Connect for Effect (2012) (see **Appendix P**). The assessment integrated socio-economic analysis with consultation of the local Aboriginal community to identify the current and emerging social issues and vulnerabilities. Management strategies were then identified to enhance the social wellbeing of the local Aboriginal community. The local Aboriginal community has actively reviewed and endorsed these recommendations and thus, are presented as part of the overall Aboriginal Cultural Heritage mitigation recommendations in **Section 5** and **7.14**.

Impact Identification and Assessment

Potential socio-economic impacts of the Project were then identified and assessed, with specific regard to the following characteristics:

- *Desirability* – whether the impact is positive, negative or neutral;
- *Project or Cumulative* – whether the impact is likely to be caused by the Project and/or as a result of cumulative activities in the study area;
- *Project phase* - whether the impact is likely to be as a result of the construction and/or operations phase of the Project;
- *Geographic extent* – the geographical area(s) which the impact will affect (it is noted previously that this assessment focuses on the impacts expected in the Sub-regional study area); and
- *Timing and duration* — whether the impact is likely to be immediate (either at the beginning of the Project construction or operations phase) or delayed (at certain years of the Project, which has a 30 year horizon).

Various assumptions were made to assist in the identification and assessment of Project population and housing impacts. These are discussed further in **Appendix AE.**

Development of Management Strategies

Proposed mitigations for the social impacts of the Project were developed. These detail how the proponent proposes to manage identified impacts in order to maximise positive impacts and to minimise negative impacts of the Project.

7.26.3 Existing Socio-Economic Environment

As at 2011, the study area contained a total population of 102,517 people including 12,066 people in the Gunnedah LGA, 7,480 people in the Liverpool Plains LGA, 56,292 people in the Tamworth Regional LGA, 12,925 people in the Narrabri LGA and 13,754 people in the Upper Hunter LGA (ABS, 2012b). The study area is characterised by the following key demographics:

- Gunnedah LGA's population declined 10% from 1996 to 2006 and then increased by almost 6% from 2006 to 2011;
- Liverpool Plains LGA's population fell marginally from 1996 to 2011;
- Tamworth Regional LGA's population increased by 5% in both periods 1996 to 2006 and 2006 to 2011;
- The median age in 2011 of most LGAs in the study area was above that of NSW's (37);
- In 2011, all LGAs in the study area (except Liverpool Plains LGA) had a higher proportion of younger people (under 15) than NSW (20%) and a higher proportion of older people (over 55) than NSW (27%), particularly Liverpool Plains LGA with 35%;
- All LGAs in the study area in 2011 had a higher proportion of indigenous people than NSW (2.5%), with Gunnedah, Liverpool Plains and Narrabri LGAs recording 11%;
- Median income indicators in 2011 were lower in all LGAs in the study area than for NSW, although Gunnedah LGA's indicators improved more significantly than the other LGAs from 2006; and
- Median individual income differences between indigenous and non-indigenous people in the study area were significant. In 2011, median incomes of indigenous people in all areas in the study area were lower than those of non-indigenous people (ABS, 2012b).

The urban settlements within the study area closest to the Project are outlined in **Table 93**.

The Gunnedah, Liverpool Plains and Tamworth Regional LGAs have an economy that is dominated by the agricultural sector. Close to 50% of the regional economy in the Namoi Valley is directly or indirectly dependent on agriculture (Parsons Brinckerhoff, 2010).

Table 93 Urban Settlements

Location	Distance to Corner of the Dip Road and Kamilaroi Highway*	Population**
Breeza	3 km	63***
Curlewis	22 km	589
Caroona	24 km	134***
Spring Ridge	30 km	120***
Werris Creek	31 km	1,437
Gunnedah	40 km	7,888
Quirindi	43 km	2,580
Currabubula	43 km (via Werris Creek), (31 km via Currabubula-Breeza Road)	98***
Carroll	54 km (via Gunnedah)	168
Willow Tree	58 km	168****
Tamworth	75 km (via Werris Creek)	32,131

** GoogleMaps, 2012*
*** Source: ABS, 2007; ABS, 2011b; ABS 2012b & aerial photo interpretation.*
**** Estimated population of defined urban settlement as interpreted from approximate count of dwellings using aerial photo interpretation and 2011 occupancy rate of 2.4 for Liverpool Plains LGA*

Coal mining activities previously operating in the region had mostly closed in the 1990s due to low profits. However, the mining and resources industry has recently resumed within the area, particularly in the last several years. Local government development statistics from 2007 to 2011 reflect this growth in Gunnedah, while developments in the same period in the Liverpool Plains LGA decreased and fluctuated in the Tamworth LGA (DP&I, 2008b; 2009; 2010).

Labour Force

In June 2012, the rates of unemployment within the Gunnedah (6.7%), Liverpool Plains (6.6%) and Tamworth Regional (6.3%) LGAs were higher than neighbouring LGAs, including the Upper Hunter LGA (1.7%), Narrabri LGA (5.2%). Rates were also higher than the NSW average (5.2%) (DEEWR, 2012b).

In 2011 in the Gunnedah, Liverpool Plains and Tamworth Regional LGAs, the rate of unemployment by age group was highest for 15-19 year olds (between 13% and 19%) and unemployment rates generally fell as the age groups increased (ABS, 2012b).

In 2011, there were significant differences in unemployment rates between Indigenous and non-Indigenous people across the study area with Indigenous unemployment rates often above 20%. Similarly, the labour force participation rate of Indigenous people was generally lower than that of non-Indigenous people in the study area in 2011 (ABS, 2012e).

The 'agriculture, fishing and forestry' sector accounted for 17% of total employment of people over 15 within the Gunnedah LGA in 2011, 24% in the Liverpool Plains LGA and 7% in the Tamworth Regional LGA. These were the highest proportions of industry sector employment for the Gunnedah and Liverpool Plains LGAs, while the highest proportion for the Tamworth Regional LGA was the 'health care and social assistance' sector at 14% (ABS, 2012g).

The 'mining' sector more than doubled in employment in the Liverpool Plains LGA between 2006 and 2011 and more than tripled in the Gunnedah LGA in that period. In 2011, this equated to 3% and 7% of the total employed people in those LGAs respectively. The number of people employed in the 'mining´ sector in Tamworth Regional LGA almost tripled between 2006 and 2011, representing 0.8% of the total employed people in the LGA in 2011.

Housing Market and Affordability

An assessment of the current housing market in the sub regional study area in the years of 2003, 2005, 2007, 2009, 2011 and 2012, with a particular focus on the Gunnedah and Liverpool Plains LGAs, shows that residential property prices increased substantially between 2003 and 2012, as did the number of properties on offer in most areas.

In Gunnedah, there were approximately 100 to 165 houses sold in each reported year from 2003 to 2012 with the median value of all houses increasing steadily from $108,000 to $280,000 in that period. This is an increase of almost $172,000 or approximately 160% (RPData, 2012 and 2013). In Curlewis, there were between 3 and 11 houses sold in each reported year, with the median and average values more than doubling between 2007 and 2011, and falling in 2012. The median and average value of houses in Curlewis in 2011 was approximately $100,000 less than for those in Gunnedah at that time (RPData, 2012 and 2013).

In Quirindi, there were approximately 35 to 48 houses sold in each reported year from 2003 to 2012 with the median value of all houses almost doubling from $87,000 to $170,000 during that time. Similarly in Werris Creek, there were approximately 32 to 38 houses sold in each reported year to 2011, with a fall to 19 in 2012. The median value of houses more than doubled from 2003 to 2012 from $58,000 to $143,500. Houses in Werris Creek were the cheapest of those analysed in the Sub-regional study area (RPData, 2012 and 2013).

Weekly rental prices in February 2012 were highest in Gunnedah at an average weekly price of $302, followed by Quirindi at $248 and Werris Creek at $201 (RPData, 2012). In comparison, in 2011 the highest median rent in the study area was $200 per week (for both Tamworth Regional LGA and Gunnedah Urban Centre). Other urban centres had lower median rents, including Curlewis ($198), Quirindi ($165) and Werris Creek ($160). All median rents were lower than that of NSW ($300) (ABS, 2012b). However, anecdotal evidence shows that the variations in rental prices can be severe, with prices of up to $1,400 per week in Gunnedah in 2011 being reported. From 2006 to 2011, the growth in median rents across the Sub-regional study area were significantly higher than the growth experienced in NSW (ABS 2007a and ABS 2012b).

The temporary housing market shows that typical 'tourist' accommodation is being heavily used by the construction and resources sector. Purpose-built Workforce Accommodation Facilities have either been constructed in the study area (MAC Narrabri), or been given approval (MAC Werris Creek and MAC Boggabri).

Gunnedah, Liverpool Plains and Tamworth Regional LGAs have planned for future population growth, with GSC particularly having made available a substantial supply of residential land for future development.

Community Services and Facilities

The Gunnedah, Liverpool Plains and Tamworth Regional LGAs are serviced by a range of education facilities, children's services, youth services and facilities, health services, emergency services, recreation, sporting and leisure services, cultural facilities and cultural development, social support services and community groups, commercial and retail services and public transport. Each LGA contains the level of services and facilities that are commensurate with the size of urban settlements and populations. There are also regional facilities that are provided mainly in Tamworth, and a number of outreach services, particularly in the health sector.

7.26.4 Impact Assessment

Construction Phase

The Project will require approximately 600 full-time equivalent employees during the 18 month construction phase. The construction workforce is expected to be predominantly sourced from outside the Gunnedah, Liverpool Plains and Tamworth Regional LGAs, with approximately 480 non-local hires and up to an accompanying 100 people (partners or families) expected to be temporarily relocated to the region. Single members of the construction workforce will be encouraged to reside in the local area within the Workforce Accommodation Village (MAC Werris Creek) to alleviate pressure on the local housing market.

In addition, it is predicted that approximately 318 people (some with partners and children) could move temporarily to the Sub-regional study area as a result of the flow on employment effects of the construction phase of the Project.

Operations Phase

The Project will require approximately 200 full-time equivalent employees from Year 1 with a peak of 600 employees expected at approximately Year 21. The operations workforce will be a combination of 'local hires' (i.e. those currently residing within the Sub-regional study area) or 'non-local hires' (i.e. those that are expected to be sourced from outside the Sub-regional study area). Shenhua Watermark would strongly prefer that non-local hires eventually settle locally in the Sub-regional study area, therefore avoiding a 'fly-in / fly-out' or 'drive-in / drive-out' workforce. The assessment therefore does not model a 'fly-in / fly-out' or 'drive-in / drive-out' workforce.

The potential impacts of the operations workforce have been assessed under three workforce hiring 'sensitivity' scenarios, being:

- Scenario 1 – 80% will be local hires and 20% non-local hires;
- Scenario 2 – 50% will be local hires and 50% non-local hires; and
- Scenario 3 – 20% will be local hires and 80% non-local hires.

In assessing the impacts of the Project operational workforce on future population and housing, two modelling estimates have been made.

The first estimate is based on the premise that each locality, village, town and city within the study area offers different opportunities to potential future residents – in the choice of:

- Settlement size;
- Housing cost;
- Housing types;
- Commuting distance;
- Lifestyle;
- Local services and facilities, including education, health and commercial; and
- Opportunities for employment for partners.

Therefore, for modelling purposes, the following have been chosen as the likely final residential LGA of the additional population expected as a result of the non-local hires of the operational phase of the Project, taking into account the range of 'choice' factors in the list above:

- Gunnedah LGA – 40%;
- Liverpool Plains LGA – 25%;
- Tamworth Regional LGA – 25%; and
- Other LGAs, particularly Narrabri and Upper Hunter – 10%.

Secondly, the following estimates have been made in relation to the likely current residential location of 'local hires' of the Project:

- Gunnedah LGA – 55% (including Gunnedah 45%, Curlewis 5% and rural Gunnedah LGA 5%);
- Liverpool Plains LGA – 20% (including Quirindi 10%, Werris Creek 5%, other Liverpool Plains LGA locations 5%); and
- Tamworth Regional LGA – 25%.

Population

The Project will result in an increase in population across the study area. The direct impacts of the operations workforce and their families on existing populations at Year 1 and Year 21 of the Project, as assessed under the three workforce hiring scenarios, are provided in **Table 94**.

Table 94 shows that the additional population in the study area as a result of the peak operational workforce will be between 300 and 1,200 people (depending on the sensitivity scenario selected). These figures conservatively assume that all non-local hires settle within the study area.

Table 94 Additional Population as a Result of Operations Workforce

Residential Location	Additional Population Expected as a Result of Operations Workforce					
	Year 1			Year 21		
	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
Gunnedah Urban	35	88	140	105	263	420
Curlewis	5	13	20	15	38	60
Quirindi	10	25	40	30	75	120
Werris Creek	10	25	40	30	75	120
Other rural areas in GSC or LPSC	5	13	20	15	38	60
Tamworth Regional LGA	25	63	100	75	188	300
Other areas outside GSC, LPSC and TRC	10	25	40	30	75	120
Total	**100**	**250**	**400**	**300**	**750**	**1,200**

Table 95 Additional Population as a Result of Flow on Employment

LGA	Percentage of flow on employment	Flow on employment	Total population as a result of flow on employment**
Gunnedah LGA	46%	269	673
Liverpool Plains LGA	22%	129	322
Tamworth Regional LGA	24%	140	351
Upper Hunter LGA	4%	23	59
Narrabri LGA	4%	23	59
Total	**100%**	**585***	**1,463**

** Total figure derived from Economics Assessment (Gillespie Economics, 2012)*
*** Based on an occupancy rate of 2.5 derived from Northern Statistical Division, 2006*

The growth of the incoming population across the study area is expected to be incremental between Year 1 and Year 21 of the Project. Under Scenario 1, the increase is likely to be 10 additional persons a year during that period. The increase is likely to be 25 persons per year under Scenario 2 and 40 persons per year under Scenario 3. The majority of the population increase is likely to be in the Gunnedah urban area, although this is expected to be only between four and 14 additional people annually, depending on the workforce hire scenario.

The *Namoi 2030 Regional Resource Strategy Final Report* (Namoi 2030) (Parsons Brinckerhoff, 2010) projects the population for the Namoi region to year 2030 under four different development scenarios. The additional population expected in the study area as a result of the Project's operations workforce varies by 0.2% to 6.1%, depending on the workforce hire scenario, from each of the Namoi 2030 development scenarios.

Estimates of flow on (indirect) employment predicted to be generated as a result of the Project are presented in the Economics Impact Assessment (see **Section 7.27** and **Appendix AF**). **Table 95** provides an estimate of the flow-on population that could be expected in the study area.

The flow on employment may be sourced from the existing population of the study area or migrate to it. If the population is apportioned over the life of the Project, approximately 50 people per year could be expected to be associated with flow on employment.

It is critical to note that it cannot be predicted what proportion of this flow on population are already living in the study area. Therefore, no conclusions can be made as to the likely increase in population in the study area or its component LGAs will arise as a result of flow on employment.

Labour Force

Analysis of the labour force in the Sub-regional study area shows that in 2012, there was predicted to be:

- 2,595 unemployed people living in the Sub-regional study area;
- An available labour supply of 1,010 people in the Gunnedah LGA (up from 921 in 2006), including a labour surplus of 591 (427 in 2006);
- An available labour supply of 734 people in the Liverpool Plains LGA (up from 612 in 2006), including a labour surplus of 477 (422 in 2006); and
- An available labour supply of 4,674 people in the Tamworth Regional LGA (up substantially from 2,575 in 2006), including a labour surplus of 2,755 (1,634 in 2006).

The Gunnedah, Liverpool Plains and Tamworth Regional LGAs also recorded relatively low employment participation rates in 2011 (ABS, 2012b).

Caution must be taken when applying this data to the Project, particularly as the skills and working intentions of the available labour force is not known. However, it appears that the Sub-regional study area will be able to absorb a substantial proportion of the jobs created by the Project.

In addition to increasing employment opportunities generally, it is also expected that the Project will assist in improving the current high rates of youth and Indigenous unemployment in the study area. The Project also has the potential to assist in improving women's labour force participation rates.

Housing Market and Affordability

The impacts of the Project on housing demand in the study area are expected to be incremental and spread across the study area, as the incoming workforce and their families are likely to settle in a variety of locations.

At Year 1 of the Project, between 40 and 160 additional dwellings could be required across the study area, depending on the workforce hiring scenario. At Year 21 (peak) of the Project, between 120 and 480 additional dwellings could be required across the study area, depending on the workforce hiring scenario.

Under Scenario 1, only four additional dwellings will be required annually across the Gunnedah, Liverpool Plains and Tamworth Regional LGAs between Year 1 and Year 21, which increases to 10 additional dwellings annually for Scenario 2 and 16 additional dwellings annually for Scenario 3.

The area likely to be impacted the most is the Gunnedah urban area, which could require between 14 and 56 additional dwellings at Year 1, and then between one and six dwellings annually between Year 1 and Year 21, depending on the workforce hiring scenario. Quirindi and Werris Creek could each require between 4 and 16 additional dwellings at Year 1, and then between one and two dwellings annually between Year 1 and Year 21. The Tamworth Regional LGA could require between 10 and 40 additional dwellings at Year 1, and then between one and four dwellings annually between Year 1 and Year 21.

It is estimated that 585 dwellings in the study area are likely to be occupied over the life of the Project as a result of flow on employment from the operational phase of the Project. However, as explained previously, no conclusion can be made as to the likely increase in dwelling demand in the study area that will arise as a result of flow on employment.

The impact on housing, land and rental costs across the study area is difficult to predict, with a general expectation that costs will continue to increase. However, the incremental nature of the growth in housing demand between Year 1 and 21 of the Project will not contribute to a rapid rise in costs, providing that new housing and rentals can be provided in a timely manner.

These gradual increases would appear compatible with the amount of land and redevelopment sites that are already available for future housing in the respective LGAs, and are within the levels of rates of housing development shown in the past by each of those areas. Consequently, the Project is not expected to place any undue pressure on planning for infrastructure required for that housing development (e.g. water, sewer and roads), which should be able to be absorbed by the LGAs as part of their incremental growth.

Community Services and Facilities

The expected impacts of the Project on existing community facilities and services in the Gunnedah, Liverpool Plains and Tamworth Regional LGAs (such as childcare, health, education and emergency services) will generally be incremental. Much of the population growth generated (particularly by the operations phase) will be absorbed by the natural growth of facilities and services. However, there may be a need to adjust the content of some services to account for the expected change in demographics, for example a focus on integrated health care. The most pronounced impacts on existing community facilities will be:

- The impact of the construction workforce on health facilities, especially facilities nearest to the proposed Workforce Accommodation Facility (MAC Werris Creek); and
- The impact of the construction and operational workforces on the requirement for appropriate skills training.

Cooperative efforts between the mining and resource companies in the study area and relevant local and state government agencies will ensure adequate facilities and services are available for the planned growth in population.

Community Identity and Values

Significant changes to current community identity and values are more likely to be as a result of cumulative developments across the study area as opposed to the Project alone. Perceived impacts on community identity and values include:

- Limited connection and affinity of the construction workforce with the community;
- Integration of new residents into the community;
- Stability of residency of the population;
- Potential positive or negative outcomes for local volunteering efforts;
- Decrease in social order and community safety;
- Fatigue management for employees;
- Family impacts resulting from shift and overtime patterns; and
- Mental health and drug and alcohol issues.

Cumulative Impact

Approved and proposed mining and coal seam projects in the study area were taken into consideration in the assessment of possible future cumulative social impacts. It is anticipated that in 2022, the Project has the potential to occur simultaneously with four existing mining projects, two coal seam gas projects and six potential mine projects. It is estimated that:

- In 2022, the Project operational workforce (383) will represent only 11% of the total personnel expected to be employed in mining and resource industry projects in the Gunnedah Basin; and
- The potential cumulative mining and resource industry workforce for the Gunnedah Basin in 2016 is estimated to be approximately three times the size of the estimated existing workforce, with a small decline by 2022.

The cumulative social and economic impacts of mining and resource developments in the study area are far more significant than the Project alone, and are likely to place considerable pressures on the study area's housing requirements and community infrastructure in the future. In particular:

- The potential population associated with the cumulative mining and resource sector workforce for the Gunnedah Basin in 2016 (8,410) is estimated to be approximately three times the size of the estimated population associated with the existing 2012 workforce (2,593), with a small decline by 2022 (5,200);
- There is the potential for an additional 5,817 people associated with mining and resource sector personnel in the study area by 2016 as a result of cumulative resource projects; and
- There is the potential need for 2,327 dwellings in the study area by 2016 as a result of cumulative resource projects.

It should be noted that the size of the additional population that could be expected as a result of the cumulative projects cannot be estimated, since comprehensive data regarding the proportion of local and non-local hires of the cumulative projects workforces is not available. Therefore an estimate of the additional cumulative dwelling demand (i.e. over and above those dwellings which are already being occupied by local hires of cumulative projects) also cannot be made.

The SRLUP acknowledges these impacts and states that the NSW government will *"develop a cumulative impact assessment methodology to manage the cumulative health and amenity impacts of mining and coal seam gas proposals. This methodology will consider whether cumulative impact thresholds or tipping points can be adequately described and predicted. It will also address cumulative impacts on agricultural lands and water resources"*, with a timeframe of March 2013. It is not clear as to whether this methodology will extend to social infrastructure, housing and related impacts.

Shenhua Watermark has committed to working with government in both the development of this new methodology and the implementation of any new mitigation initiatives required once the impacts are identified.

7.26.5 Mitigation and Management

Table 96 provides extensive measures to mitigate and manage the identified social impacts of the Project.

Voluntary Planning Agreement

Shenhua Watermark has made an offer to enter into a VPA with GSC, LPSC and TRC to provide in kind and monetary contributions to ensure the potential social effects of the Project on each LGA are mitigated. The VPA offers for each LGA are proportionate to the identified social and community impacts of the Project to each area. Discussions are progressing with each Council to finalise agreement over the terms of the VPA.

The offer that has been made to GSC includes:

- A lump sum payment of $6.0 M as a direct contribution towards the construction of a facility for the benefit of the community (community facility) in the local Council area and funding of an associated Steering Committee. The Steering Committee will undertake the community consultation as to the nature of the community facility and feasibility studies. Subject to the proposal being adopted by Council, the Steering Committee will implement all detailed engineering, tender preparation, letting of contracts and project management for the construction of the community facility;
- Shenhua Watermark undertaking detailed engineering and preparing tender documentation to Council for the community facility up to the value of $0.5 M; and
- Payment of $0.06 per tonne of product coal generated from the Project for the period of the Development Consent.

The offer that has been made to LPSC includes a lump sum payment of $1.2 M as a direct contribution towards the construction of a regional indoor sports centre to be located in Quirindi. Shenhua Watermark will undertake detailed engineering and prepare tender documentation to Council for the sports centre up to the value of $0.3 M.

The offer that has been made to TRC includes a lump sum payment of $0.35 M as a direct contribution towards the construction of a regional outdoor play/multipurpose centre and Stage 2 of the Marsupial Park.



Table 96 Social Mitigation and Management Measures

Ref	Mitigation and Management Measures
General	
1.	A Social Impact Management Plan will be prepared to the satisfaction of the Director-General to manage the potential social impacts of the Project.
Housing and Residential Land	
2.	Monitor housing affordability and availability in the local area and report in the regulatory required Annual Review.
3.	Implement an Employee Incentive Scheme which will include policies on items such as encouraging progressive re-location to the local area by provision of financial assistance to relocate.
4.	Facilitate the use of the Workforce Accommodation Facility (MAC Werris Creek) by 'non-local hires' of the construction workforce.
5.	Encourage the short term use of the Workforce Accommodation Facility (MAC Werris Creek) by 'non-local hires' of the operational workforce while they settle in to their work and familiarise themselves with the local housing market.
6.	Provide bus transport for the Project workforce during the construction phase between the Workforce Accommodation Facility (MAC Werris Creek) and the Project.
7.	Shenhua will, through the Gunnedah Basin Coal Developers Group & Namoi Mining Working Group, continue to work with local government and other mining companies to monitor workforce size, the workforce's previous and current residential location, local housing demand and supply, housing prices and affordability.
Labour Force	
8.	Provide the following employment options for Gunnedah, Liverpool Plains and Tamworth LGA residents: • Apprenticeships; • Traineeships; and • Graduate placement programs. The employment options will include: • Positions for suitable candidates from the Gunnedah, Liverpool Plains and Tamworth Regional LGAs based on merit; • Positions for suitable Indigenous candidates from the Gunnedah, Liverpool Plains and Tamworth Regional LGAs based on merit; and • Positions, including 'transitional employment opportunities', for young people from the Gunnedah, Liverpool Plains and Tamworth Regional LGAs.
9.	Continuation of Shenhua's School-based Trainee Program. This program will support 8 students per year for the life of the Project. This includes Indigenous and non-Indigenous students.
10.	Provide part time and / or flexible employment opportunities to encourage a higher rate of labour force participation.
11.	Contribute funds and assistance to the value of $5,000 per year for 20 years to relevant school programs currently offered throughout the region and to new programs. For public schools, this assistance will be delivered by coordination through the New England Regional Director of the Department of Education and Communities. For private schools, this assistance will be delivered in direct consultation with specific schools. For example, the following current programs could be assisted: • The Mooki Murris Program, currently at Quirindi High School; • The Clontarf Foundation program currently operating at Oxley High School, Tamworth; • The Quicksmart Program, currently at 30 schools within the New England Education Region; and • Other programs as appropriate and agreed to by the New England Regional Director of the Department of Education and Communities.
Tertiary Education	
12.	Provide an annual scholarship fund of $10,000 for 20 years for locally based students to study a mining related course at University.
13.	Provide seed funding of $250,000 towards the construction of the proposed Mining Skills Centre in Gunnedah. This will be in collaboration with other mining and resource companies in the Study Area.
Children's Services	
14.	Provide an annual scholarship fund of $5,000 for 10 years for locally based students to study a child care related course as well as sponsoring a traineeship program for child care workers.
Health Services	
15.	Commitment to financial contributions of up to $20,000 per year for 20 years to encourage retainment of medical staff at the Gunnedah Rural Health Centre.
16.	Provide information on mental health, counselling and family support programs to support the Project workforce and their families.
17.	Provide information to new employees about available health services in the community.
18	Partner with health agencies in promoting healthy lifestyles and disease prevention to the Project workforce.
19.	Provide health information on the impacts of mining to residents, including those living in mine owned houses, in the zone of mitigation or acquisition.
Emergency Services	
20.	Provide investment of approximately $50,000 per year for 20 years into capital equipment for services such as the bushfire brigade, ambulance and other valued community services in the Gunnedah and Liverpool Plains LGAs.
21.	Implement a salary sacrifice program among all employees with proceeds going to the Westpac Rescue Helicopter.
22.	Develop employee policies that enable emergency services personnel to be released from duties to attend emergency calls and to allow release of employees to perform crucial volunteer actions.

Ref	Mitigation and Management Measures
Recreation, Leisure and Sporting Facilities	
23.	Promote the Gunnedah, Liverpool Plains and Tamworth Regional LGAs' recreational, cultural and social support facilities and community organisations to the incoming workforce and their families.
Community Identity and Values	
24.	Assist new residents and families to integrate into the community by collaborating with GSC, LPSC, TRC and other mining and resource companies in the region to produce the following information, projects and policies: • Information for incoming residents, regarding their new community, region, facilities and services; • Welcoming events or programs for new residents; • Information for existing residents regarding information about the Project, it's likely workforce characteristics and their needs; • Holding 'family fun days' to help new families who have relocated here meet other families in the area and on the project; and • Enforcing, by company policy, employees to remove their high-visibility mining jackets if they intend to visit public places in the towns and villages of Gunnedah, Liverpool Plains and Tamworth Regional LGAs before and after work.
Health and Wellbeing	
25.	Provide detailed information about managing sleep cycles and the impact on lifestyle and relationships to employees and their families.
26.	Identify programs in the community and within local schools to involve working parents, especially fathers, in children's activities.
27	Implement zero tolerance drug and alcohol policies and testing regimes for the Project workforce.
28.	Encourage and support organisations to identify and address gaps in mental health, family support and domestic violence services in Gunnedah and surrounding areas.
Social Order and Community Safety	
29.	Participate in the Gunnedah *Crime Prevention Committee* and become a Partner in the *Gunnedah Liquor Accord*.

7.27 Economics

7.27.1 Background

An Economics Impact Assessment was undertaken by Gillespie Economics and is provided in **Appendix AF**. Further as part of the AIS, Gillespie Economics also undertook an assessment of the potential economic implications of the Project on agricultural resources. This assessment provided a comparison of the economic efficiencies of utilising the required land and water for the Project, including the biodiversity offsets, to that of utilising the same land for its most productive agricultural potential. The findings of this report are summarised in **Section 7.20** and provided in full in Appendix 7 of **Appendix Z**.

The economic impact assessment was primarily concerned with the determination of the following two issues:

- The economic efficiency of the Project (i.e. consideration of economic costs and benefits); and
- The economic impacts of the Project (i.e. the economic stimulus that the Project will provide to the regional or State economy).

7.27.2 Methodology

From an economic perspective there are two important aspects of the Project that can be considered:

- The economic efficiency of the Project (i.e. consideration of the economic costs and benefits of the Project); and
- The economic impacts of the Project (i.e. the economic activity that the Project will provide to the local, regional or NSW economy).

The *Draft Guidelines for Economic Effects and Evaluation in Environmental Impact Assessment* in 2002 (Economic EIA Guidelines) (James and Gillespie, 2002) identifies economic efficiency as the key consideration of economic analysis. BCA is the method used to consider the economic efficiency of proposals. The Economic EIA Guideline also identifies BCA as essential to undertaking a proper economic evaluation of proposed developments that are likely to have significant environmental impacts.

The Economic EIA Guideline indicates that economic impact assessment may provide additional information as an adjunct to the economic efficiency analysis. Economic stimulus to the local, regional and NSW economy can be estimated using input-output modelling (economic impact assessment).

It is important not to confuse the results of the economic impact assessment, which focuses on indicators of economic activity i.e. direct and indirect output (expenditure/revenue), value-added, income and employment, in a specific region, with the results of BCA which is concerned with the net benefits from the Project.

Benefit Cost Analysis

BCA is primarily concerned with comparison of the present value of aggregate benefits to society, as a result of a project, policy or program, with the present value of the aggregate costs. Provided the present value of aggregate benefits to society exceed the present value of aggregate costs (i.e. a net present value of greater than zero), the project is considered to improve the economic welfare of society and hence is desirable from an economic efficiency perspective.

BCA involves the following key steps:

- Identification of the base case;
- Identification of the Project and its implications;
- Identification and valuation of the incremental benefits and costs;

- Consolidation of value estimates using discounting to account for temporal differences;
- Application of decision criteria;
- Sensitivity testing; and
- Consideration of non-quantified benefits and costs.

Local, Regional and State Economics Impact Assessment

Predicted economic stimulus to the regional and State economies can be estimated using input output modelling. Input-output analysis essentially involves two steps:

- Construction of an appropriate input-output table (regional transaction table) that can be used to identify the economic structure of the region and multipliers for each sector of the economy; and
- Identification of the initial impact or stimulus of the Project (construction and/or operation) in a form that is compatible with the input-output equations so that the input-output multipliers and flow-on effects can then be estimated (West, 1993).

The regional economic impact assessment is primarily concerned with the effect of an impacting development on an economy in terms of a number of specific indicators, such as gross regional output, value added, income and employment. These indicators can be defined as follows:

- *Gross regional output* – the gross value of business turnover;
- *Value-added* – the difference between the gross regional output and the costs of the inputs of raw materials, components and services bought in to produce the gross regional output;
- *Income* – the wages paid to employees including imputed wages for self-employed and business owners; and
- *Employment* – the number of people employed (including full-time and part-time).

For this study, the economic impacts have been estimated for three regions:

- The local economy comprising the LGAs of Gunnedah, Tamworth and Liverpool Plains;
- The regional economy comprising the LGAs of Gunnedah, Tamworth, Liverpool Plains, Narrabri and Upper Hunter; and
- The NSW economy.

7.27.3 Impact Assessment

Benefit Cost Analysis

The Project will have the potential incremental economic benefits and costs shown in **Table 97**. The main potential economic benefit is the producer surplus (net production benefits) generated by the Project and any non-market employment benefits it provides, while the main potential economic costs relate to any environmental, social and cultural costs.

The main decision criterion for assessing the economic desirability of a Project to society is its net present value, which is the present value of benefits less the present value of costs. A positive net present value indicates that it will be desirable from an economic perspective for society to allocate resources to the Project, because the community as a whole will obtain net benefits from the Project.

The BCA confirms that when production costs (acquisition costs for affected land, opportunity cost of land, operating costs, decommissioning costs, etc.) and production benefits (revenues from production, residual values of land, etc.) are considered, the Project will have net production benefits of $3,047 M with a minimum of $1,310 M of these net production benefits accruing to Australia.

Table 97 Benefit Cost Analysis

Category	Costs	Benefits
Production	• Opportunity costs of capital • Opportunity cost of land • Capital costs of development including acquisition costs for impacted properties and offsets • Operating costs of mine including mitigation measures • Rehabilitation and decommissioning costs at end of the Project life	• Value of coal production • Residual value of capital and land at end of Project life
Potential Externalities	• Greenhouse gas impacts • Agricultural production • Noise impacts • Blasting impacts • Air quality impacts • Surface water impacts • Groundwater impacts • Ecology impacts • Road transport impacts • Aboriginal heritage impacts • Non-Aboriginal heritage impacts • Visual impacts	• Any non-market benefits of employment

This net production benefit is distributed amongst a range of stakeholders including:

- The local community in the form of voluntary contributions to community infrastructure and services;
- Shenhua Watermark and its shareholders;
- The Commonwealth government in the form of any Company tax payable ($745 M present value) or Minerals Resource Rent Tax from the Project, which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the local region; and
- The NSW government via royalties ($565 M present value) which are subsequently used to fund provision of government infrastructure and services across the State, including the local region.

The main external economic costs associated with the Project relate to Aboriginal heritage and greenhouse gas emissions and surface water and groundwater impacts. These impacts are estimated to cost $174 M globally or $65 M to Australia, considerably less than the estimated net production benefits of the Project.

Other environmental and social costs including air quality, noise, blasting, ecology, traffic and transport, historic heritage, visual and agricultural production were quantified and incorporated into the estimation of net production benefits via acquisition costs for affected properties and mitigation costs.

The external benefits associated with employment provided by the Project to the NSW economy have been estimated at $324 M.

Overall, the Project is estimated to have net social benefits to Australia of between $1,244 M and $1,568 M and hence is desirable and justified from an economic efficiency perspective.

Local, Regional and State Economics Impact Assessment

An economic impact analysis, using input-output analysis found that the operation of the Project is estimated to make up to the following contribution to the local economy:

- $902 M in annual direct and indirect regional output or business turnover;
- $493 M in annual direct and indirect regional value added;
- $80 M in annual direct and indirect household income; and
- 908 direct and indirect jobs.

The Project is estimated to make the following contribution to the regional economy:

- $913 M in annual direct and indirect regional output or business turnover;
- $507 M in annual direct and indirect regional value added;
- $91 M in annual direct and indirect household income; and
- 1,015 direct and indirect jobs.

The output, value added and income flow-on will be most pronounced on the regional basis. The contribution of the Project will extend to the ownership of dwellings sector, agricultural and mining machinery manufacturing sector, retail trade sector, wholesale trade sector, construction trade services sector, health services sector and education sector.

For the NSW economy, the operation of the Project is estimated to make up to the following contributions:

- $1,554 M in annual direct and indirect regional output or business turnover;
- $802 M in annual direct and indirect regional value added;
- $276 M in annual direct and indirect household income; and
- 3,260 direct and indirect jobs.

The contribution of the Project to the NSW economy is substantially greater than for the regional economy. The NSW economy is able to capture more mine and household expenditure and there is a greater level of intersectoral linkages.

7.27.4 Mitigation and Management

Cessation of the Project operation may lead to a reduction in economic activity. The significance of these Project cessation impacts will depend on:

- The degree to which any displaced workers and their families remain within the region;
- The economic structure and trends in the regional economy at the time; and
- Whether other mining developments or other opportunities in the region arise that allow employment of displaced workers.

Given the uncertain circumstances at the time of Project cessation, it is important for government to effectively utilise the economic benefits, skills and expertise generated by the Project to further strengthen and broaden the region's economic base.

Mitigation measures for the specific environmental issues are addressed within other sections throughout this EIS

WATERMARK
COAL PROJECT
ENVIRONMENTAL IMPACT STATEMENT
February 2013



8
Management and Monitoring Summary



Management and Monitoring Summary

8

In addition to the conditions of the Development Consent, Shenhua Watermark commits to the implementation of the operational controls outlined in Section 7 for all activities associated with the Project.

Table 98 summarises the major aspects of the Project and the key management and monitoring measures proposed in this EIS.

Table 98 Summary of Management and Monitoring Measures

Ref.	Item	Section
Mining Operations		
1.	Shenhua Watermark will extract coal at a rate of up to 10 Mtpa of ROM coal for 30 years, generally in accordance with this EIS.	3
2.	Prior to carrying out any development that requires a licence or approval listed in Table 12, Shenhua Watermark will ensure that such a licence is obtained.	4.8
Environmental Management		
3.	Shenhua Watermark will develop an EMS in consultation with the relevant regulators and to the satisfaction of DP&I. The EMS will include the following: • Construction Management Plan (including noise and any required archaeological clearances); • Water Management Plan; • Erosion & Sediment Control Plan; • Air Quality Management Plan (including a Trigger Action Response Plan); • Energy Savings Action Plan; • Operational Noise Management Plan (including a Trigger Action Response Plan); • Blast Management Plan; • Biodiversity Management Plan; • Biodiversity Offset Management Plan; • Koala Plan of Management (including translocation plan); • Aboriginal Archaeology and Cultural Heritage Management Plan (ACHMP); • Historic Heritage Management Plan; • Visual and Lighting Management Plan; • Weed and Pest Management Plan; • Land Management Plan; • Rehabilitation Management Plan; • Hazard Management Plan; • Mine Closure Management Plan; • Social Impact Management Plan; • Bushfire Management Plan; and • Waste Management Plan. *The EMS may be added to, amended and altered during the life of the project.*	7
Water		
4.	Shenhua Watermark will continue to monitor groundwater levels on a monthly basis and water quality on a quarterly basis in accordance with the Water Management Plan.	7.1.4
5.	Shenhua Watermark will monitor groundwater seepage into mining areas. Parameters monitored will include time, location and volume of flow.	7.1.4
6.	If requested by a landowner, Shenhua Watermark will monitor any licensed private bores that are predicted to have a drawdown of greater than 0.25 m as a consequence of the Project. Parameters monitored will include flow, water level and quality.	7.1.4
7.	Shenhua Watermark will obtain all necessary water licences for the Project as required.	7.1.4

Ref.	Item	Section
Water cont.		
8.	The Water Management System will be managed generally in accordance with the EIS and in accordance with the Water Management Plan.	7.3.4
9.	Shenhua Watermark will monitor surface water quality in accordance with the Water Management Plan.	7.3.4
10.	The Erosion and Sediment Control Plan will incorporate control measures to separate runoff from disturbed and undisturbed areas and to treat runoff from disturbed areas.	7.3.4
11.	The rehabilitated OEA will include the relevant sediment and erosion controls to maintain the water quality of the existing environment.	7.3.4
Geomorphology		
12.	Erosion controls will be established on the river bank in the vicinity of the pump station(s) on the Mooki River as per the Sediment and Erosion Control Management Plan.	7.5.4
13.	The Water Management Plan will include a Channel Diversion Plan for the portion of Watermark Gully directly affected by the Western Mining Area.	7.5.4
14	Temporary and permanent vehicle crossings will be appropriately designed and constructed over straight portions of waterways to minimise the risk of erosion.	7.5.4
15.	Vehicle crossings will be designed and constructed in a manner to avoid impeding on watercourse flows and to minimise vegetation clearing.	7.5.4
16.	Where practicable watercourse flows will not be redirected or concentrated at crossing outlets. Where this is not possible, appropriate scour protection will be provided.	7.5.4
17.	Areas disturbed for construction activities will be revegetated as soon as practical following construction to minimise erosion.	7.5.4
Air Quality and Greenhouse Gas		
18.	In accordance with the Air Quality Management Plan, Shenhua Watermark will implement the following air quality controls or other similar controls: • Use of water sprays, fabric filters, cyclone and dust aprons when drilling to deliver practical and safe operations; • Minimisation (to the extent practicable) of the drop heights from equipment associated with loading and dumping operations for coal and overburden; • Use of speed control signage, water carts and/or suppressants to control emissions from the haul roads, working areas and ROM areas; • Delay of blasts in unfavourable weather conditions to avoid dust and blast fume emissions; • Progressive rehabilitation to minimise exposure of disturbed surfaces; • Temporary seeding of overburden areas where practical; • Application of water at the crusher and on conveyor transfer points, as required; • Enclosing conveyor transfers points, where operationally practicable and safe; • Design and construction of a partially enclosed ROM coal hopper; • Combined use of water, vegetative breaks and other chemical agents at coal handling areas and stockpiles; and • The installation of a water spray / dust suppressant system at the train load out facility for use as deemed necessary.	7.6.4
19.	Shenhua Watermark will implement a real-time dust monitoring and management system for PM_{10} and $PM_{2.5}$, including a predictive meteorological forecasting system.	7.6.4
20.	Shenhua Watermark will (where feasible and practicable), implement the following greenhouse gas mitigation strategies: • Assist in the research and promotion of low emission coal technologies; • Improve energy use and efficiency; • Consider the use of alternative fuels where economic to do so; • Ensure mining practices minimise the double handling of materials and ensuring that coal and overburden haulage is undertaken using the most efficient methods; • Conduct regular reviews of haul road maintenance and materials used in main haul roads to reduce rolling resistance and decrease fuel consumption; • Conduct ongoing scheduled and preventative maintenance to ensure that diesel and electrically powered plant operate efficiently; • Develop and implement targets for greenhouse gas emissions and energy use and conduct monitoring and reporting against these; • Implementation of a detailed energy monitoring program. This will include monitoring the electricity and diesel usage onsite to identify the main sources of greenhouse gas emissions and apply the appropriate reduction mechanisms where possible; and • Assess lighting plant efficiency.	7.7.4

Ref.	Item	Section
Noise		
21.	In accordance with the Operational Noise Management Plan, Shenhua Watermark will implement the following noise controls: • Fitting mobile plant with commercially available equipment modifications, to result in the lowest mobile plant sound power levels that can reasonably be achieved; • Designing the CHPP in consideration of the potential for floor, wall and roof vibration; • The CHPP will be clad with steel sheeting on all sides from approximately 4 m above the ground to the roof, with less than 15% of translucent sheeting on each wall to minimise noise transmission; • The CHPP roof will be clad with steel sheeting with no more than 20% translucent sheeting and the minimum of roof vents required to provide adequate ventilation; • Where practical and safe to do so, elevated conveyors will be enclosed; • Regularly monitor the condition of the idler bearings and repair or replace noisy bearings to maintain the adopted conveyor sound power level; • Design the points and crossovers on the rail loop and spur in consideration of wheel impact noise; and • Large radius bends will be used in the design of the rail loop and spur to minimise wheel and flange noise.	7.8.4
22.	In accordance with the Operational Noise Management Plan, Shenhua Watermark will implement active management of equipment operating in exposed locations during periods of strong noise enhancing weather conditions including: • Mobile machines including trucks, dozers, graders and water carts will operate on elevated and exposed sections of the OEA during the day and early evening and on lower and more shielded sections of the OEA during the sensitive night period; • In-pit haul roads will be located in acoustically shielded areas where possible; • Out of pit haul roads will be located as far from sensitive receivers and through low elevation and shielded areas where possible; • During the sensitive night periods, mining machines (excavators and shovels) will work below the natural ground level; • Vegetation clearing, topsoil stripping, stockpiling and rehabilitation will be completed during the day; and • During evening and night, drilling and drill pad preparation will occur at least 6 m below the natural surface.	7.8.4
23.	In accordance with the Operational Noise Management Plan Shenhua Watermark will implement a real time noise monitoring network which is representative of the closest receivers, and will include: • A weather prediction system to identify potentially noise enhancing weather conditions up to 24 hours in advance; • A noise prediction system, linked with the weather prediction system, to provide advanced warning of potential exceedances of relevant noise criteria and advice regarding available equipment relocation options; • Real time noise monitors, of which the data will be transmitted to an onsite office or control room for monitoring and action; and • Quarterly operator attended noise monitoring at a minimum of four locations.	7.8.4
Blasting		
24.	Blasting will not occur closer than 500 m to any occupied or sensitive building or structure unless adequate controls are implemented to minimise the risk of fly rock.	7.9.4
25.	Shenhua Watermark will provide notification of blast events prior to the blast event with establishment of appropriate signage, as required.	7.9.4
26.	Shenhua Watermark will ensure blast events will be designed to meet the relevant overpressure and ground vibration criteria.	7.9.4
27.	Shenhua Watermark will cover the grinding grooves with flexible mats, sand or other suitable materials during blast events within 500 m of the grooves to minimise risk of flyrock damage.	7.9.4
28.	Shenhua Watermark will commission a qualified geotechnical, building or engineering expert to inspect historic heritage buildings (within farm complexes 3, 7, 12, 13), owned by Shenhua Watermark and confirm ground vibration and overpressure limits for each building.	7.9.4
29.	Shenhua Watermark will implement a blast monitoring program which will include: • Monitoring at sensitive receivers to ensure compliance with the relevant blast criteria; • Video recording of selected blasting events; • Three dimensional recording of the wall advance in all open cut mining areas; and • Regular inspections of the active highwall by a qualified geologist and / or geotechnical engineer to identify areas of potential instability.	7.9.4
Ecology		
30.	Shenhua Watermark will progressively rehabilitate mined areas, with an emphasis on re-establishing Box Gum woodland community.	7.10
31.	Shenhua Watermark will implement the Biodiversity Offset Strategy outlined in this EIS for the purposes of initially maintaining and ultimately improving the ecological values of the region.	7.11

Ref.	Item	Section
Ecology cont.		
32.	In accordance with the Koala Plan of Management Shenhua Watermark will implement the mitigation and management measures for the Koala as outlined in this EIS, including: • Installation of Koala proof fencing where necessary; • Road controls; • Vertebrate pest control; • Bushfire management; • Monitoring of health during translocation; • Promotion of public education; • Encourage staged natural movement of Koalas; • Staged relocation of Koalas if required; • Habitat protection; • Habitat enhancement and revegetation (including revegetation of the Mooki River Offset Area); • Mine site rehabilitation including species favourable for Koalas; • Population monitoring (SAT method) and reporting within the Project Boundary and Biodiversity Offset Areas; and • Monitoring of performance against Key Performance Indicators.	7.10
Aboriginal Archaeology and Cultural Heritage		
33.	In accordance with the Aboriginal Archaeology and Cultural Heritage Management Plan, Shenhua Watermark will complete a surface collection for 25 artefact scatters and isolated finds, which will be directly impacted by the Project, in consultation with the local Aboriginal stakeholders.	7.13.4
34.	In accordance with the Aboriginal Archaeology and Cultural Heritage Management Plan, Shenhua Watermark will complete a surface collection and excavation program at two significant artefact scatter sites (WM-AS2-11 and WM-AS5-11). The program will include topographic surveys and a geomorphological assessment, followed by surface collection and test and open area excavations.	7.13.4
35.	In accordance with the Aboriginal Archaeology and Cultural Heritage Management Plan, Shenhua Watermark will relocate grinding groove sites WM-GG1-11 and WM-GG3-12. The final resting location and detailed salvage methodologies for each site will be developed and outlined in the ACHMP.	7.13.4
36.	In accordance with the Aboriginal Archaeology and Cultural Heritage Management Plan, Shenhua Watermark will protect 26 sites which will be identified on site plans and fenced, where appropriate.	7.13.4
37.	In accordance with the Aboriginal Archaeology and Cultural Heritage Management Plan, Shenhua Watermark will establish the Watermark Gully Aboriginal Cultural Heritage Conservation Area and the Mooki River Aboriginal Cultural Heritage Conservation Area.	7.13.4
38.	Shenhua Watermark will develop an ACHMP in consultation with RAPs, OEH and DP&I. The plan will include: • A detailed research design for salvage methodologies; • A staged Aboriginal heritage clearance process for all areas to be disturbed; • Provision for all archaeological salvage work to be undertaken by, or under the supervision of qualified archaeologists and RAPs; • Requirements for annual monitoring of protected sites by a qualified archaeologist and RAPs; • Third party review of arborist assessment of scarred trees (as per RAPs request); • Identification of the storage location (keeping place) and procedure for the care of salvaged artefacts in accordance with the Code of Practice for Archaeological Investigation for Aboriginal Objects in New South Wales (DECCW, 2010); • Provisions to facilitate continuing access to identified non-salvaged Aboriginal archaeological sites on Figure 46 for archaeological research purposes; and • Periodic review of the ACHMP.	7.13.4
39.	Shenhua Watermark will continue to consult with the RAPs to develop the management measures and the ACHMP for the project. The consultation will be undertaken and conducted in accordance with the guiding principle of mutual respect for all cultures	7.14.5
Historic Heritage		
40.	Historic heritage items will be managed in accordance with a Historic Heritage Management Plan developed in consultation with OEH.	7.15.4
41.	In accordance with the Historic Heritage Management Plan Shenhua Watermark will implement the following at each historic heritage site to be impacted by the Project, where appropriate: • Archival recordings, including scaled drawings and photographs, prepared in accordance with *How to Prepare Archival Records of Heritage Items* (Heritage Office, 1998) and *Photographic Recording of Heritage Items using Film or Digital Capture* (Heritage Office, 2006); • Archaeological test excavation to determine nature, extent and significance of archaeological deposits; and • Archaeological salvage, if warranted by testing.	7.15.4

Ref.	Item	Section
Historic Heritage cont.		
42.	Shenhua Watermark will prepare a Historic Heritage Conservation Management Plan for Farm Complex 3 – The Wilgas and Farm Complex 7 – Inverness (as part of the Historic Heritage Management Plan).	7.15.4
Traffic and Transport		
43.	Shenhua Watermark will implement the following during temporary road closures associated with blasting: • The boundaries of each road closure will be positioned in clear locations; • Long-term signage will be installed at the boundaries of the road closure at key intersections; • Affected residents will be notified of temporary road closures in advance of a blast event; and • A Construction Traffic Management Plan and stage drawings will be prepared in consultation with RMS and GSC in relation to the construction of the Kamilaroi Highway realignment.	7.16.4
44.	Shenhua Watermark will also: • Implement the construction of the Kamilaroi Highway / Mine Access Road intersection in consultation with GSC and RMS as early as practicable; • Install additional signage including reduced speed, curve warnings, give way and T intersection warning (including large electronic signage) whilst the Court Lane / Kamilaroi Highway intersection is being utilised during construction; • Ensure that Project-related traffic will be discouraged from using Hogarth Street to access Breeza- Currabubula Road; and • Install signage to provide warning against short stacking risks at Hogarth Street level crossing.	7.16.4
45.	Shenhua Watermark will consult with GSC, RMS and other local authorities as necessary prior to the movement of oversize loads on public roads.	7.16.4
Visual and Lighting		
46.	Shenhua Watermark will create landscape plans to establish visual and ecological landscape patterns that emulate existing forest, woodland and grassland.	7.17.5
47.	Shenhua Watermark will shape the tops of the OEAs to achieve a more natural fit with surrounding landscape as opposed to an extensive 'flat top' development.	7.17.5
48.	Shenhua Watermark will construct infrastructure in forest tones (i.e. green, grey, cream) to blend with the surrounding natural environment, as far as practical.	7.17.5
49.	Shenhua Watermark will design and limit external fixed lighting from being directed above the horizontal.	7.17.5
50.	Shenhua Watermark will use hoods on lights and ensure lights are directed away from sensitive receivers.	7.17.5
51.	Shenhua Watermark will consult with the Australian National University and the Australian Astronomical Observatory during the preparation of its Visual and Lighting Management Plan.	7.17.5
52.	Where requested by the owner of a primary residence which has a moderate to high visual impacts from the Project, Shenhua Watermark will provide landscaping treatments or vegetation screens in a reasonable time frame to reduce the visual impacts. Other than in exceptional circumstances, this is not expected to be required for primary residences located more than 7.5 km from mining operations.	7.17.5
53.	As described in the Visual Impact Assessment, Shenhua Watermark will establish tree screens along relevant sections of Kamilaroi Highway, Clift Road, The Dip Road and Nea Siding Road.	7.17.5
Geochemical		
54.	Shenhua Watermark will confirm the occurrence and distribution of potential acid forming material via a sulphur grid / layer geological model which includes updated exploration data.	7.18.4
55.	Shenhua Watermark will selectively handle and cap potential acid forming material with non-acid forming material.	7.18.4
56.	Shenhua Watermark will implement practical site rehabilitation practices for potentially sodic materials to limit the risk of dispersion and erosion of surface materials at emplacement areas (e.g. utilise a topsoil cover as part of final rehabilitation).	7.18.4
57.	Shenhua Watermark will conduct testing as required to confirm spontaneous combustion propensity during the operations phase of the Project.	7.18.4
58.	Shenhua Watermark will monitor runoff and seepage from overburden, interburden and coal rejects on a regular basis.	7.18.4

Ref.	Item	Section
Soils and Land Capability		
59.	Shenhua Watermark will ensure that all soil materials are stripped to levels specified in this EIS in a slightly moist condition and placed directly onto reshaped areas (i.e. to avoid the requirement for stockpiling), where practical.	7.19.4
60.	Shenhua Watermark will where practicable ensure topsoil is spread to a minimum depth of 100 mm on all re-graded spoil or disturbance areas. Topsoil will be spread, treated with fertiliser and seeded in one consecutive operation, to reduce the potential for topsoil loss to wind and water erosion.	7.19.4
61.	Where materials must be stockpiled, Shenhua Watermark will ensure that all reasonable efforts will be made to reduce compaction by keeping soil in as coarsely textured a condition as possible.	7.19.4
62.	Shenhua Watermark will ensure that any topsoil stockpiles will be a maximum of 3 m in height and if stored for greater than 12 months, seeded and fertilised and treated for weeds prior to respreading.	7.19.4
63.	Shenhua Watermark will develop and maintain an inventory of designated areas and available soil to ensure adequate topsoil and subsoil materials are available for planned rehabilitation activities.	7.19.4
64.	Shenhua Watermark will ensure thorough seedbed preparation is undertaken to ensure optimum establishment and growth of vegetation with all topsoiled areas lightly contour ripped to create a “key” between the soil and the overburden.	7.19.4
65.	Shenhua Watermark will conduct regrading where required to produce slope angles, lengths and shapes that are compatible with the land use and not prone to an unacceptable rate of erosion.	7.19.4
66.	Shenhua Watermark will implement the necessary engineered waterways, spillways and sediment control dams (using erosion blankets, ground cover vegetation and/or rip rap) to capture sediment laden runoff.	7.19.4
Agriculture		
67.	In accordance with the Rehabilitation Management Plan, Shenhua Watermark will: • Restore not less than 1,000 ha of the post-mining landform with the aim of achieving Class III rural land capability. This land will be reserved for agricultural purposes. • Manage invasive species and feral animals in accordance with a Weed and Pest Management Plan; and • Enable or establish sustainable farming practices in available agricultural areas within the Project Boundary that are situated outside of the Disturbance Boundary and the Onsite Biodiversity Offset Areas.	7.20.5
Rehabilitation and Final Landform		
68.	In accordance with the Rehabilitation Management Plan, Shenhua Watermark will: • Rehabilitate all mined areas and implement best industry standard soil management measures to minimise degradation of soil reserved for rehabilitation; • Conduct the required rehabilitation and weed/ feral animal management to ensure compliance with the preliminary rehabilitation criteria; and • Conduct the rehabilitation monitoring as specified in Section 7.21.2 of this EIS.	7.21
69.	Shenhua Watermark will contribute to and actively participate in trials and research to improve mine site rehabilitation techniques and enhance performance outcomes.	7.21
Bushfire		
70.	In accordance with the Bushfire Management Plan, Shenhua Watermark will: • Induct all employees and contractors on bushfire awareness including emergency procedures and responses in event of a bushfire; • Consult with the NSW Rural Fire Service and make sure they are aware of the Koala Plan of Management and Koala offset areas for the Project; • Consult with GSC to ensure the Fire Risk Management Plan for Gunnedah LGA takes into account the location and significance of Koala habitat mapped for the Project; • Manage and monitor fuel levels within the Project Boundary, via mowing, slashing and ploughing; • Create and maintain firebreaks within the Project Boundary; • Install general purpose fire extinguishers on all mobile equipment and at other appropriate locations; • Undertake regular inspection and maintenance of all fire management equipment to ensure ongoing effectiveness; • Ensure the storage and handling of all flammable materials is conducted in accordance with a valid Dangerous Goods Licence; and • Undertake internal monitoring and communication of specific fire danger risks, including hot work.	7.22.3

Ref.	Item	Section
Hazards		
71.	In accordance with the Hazard Management Plan, Shenhua Watermark will: • Ensure all hazardous materials associated with the Project are transported to and from the Project by a licensed contractor in accordance with the relevant Australian Standards and the ADG Code; • Ensure all onsite storage facilities for explosives, diesel and other hazardous materials will be designed in accordance with applicable Australian Standards and legislation; • Ensure all onsite storage facilities, vehicles and transport vessels used on site are regularly inspected for leaks, spills and other damage or faults; • Ensure spill kits are available on all transport vehicles used onsite for carrying hazardous materials; • Ensure training is provided to onsite personnel regarding the handling and storage of hazardous materials; • Ensure all dangerous goods are securely stored onsite, fenced with restricted access and located a minimum of 200 m from other onsite facilities; and • Develop and maintain a database to assist in the recording and management of chemicals used within the Project Boundary in respect of the Project. The chemical management database will contain Material Safety Data Sheets for all chemicals used within the Project Boundary.	7.23.4
Contamination		
72.	A detailed contamination assessment will be undertaken prior to any disturbance of potential contamination risk areas identified in this EIS.	7.24.4
Waste		
73.	In accordance with the Waste Management Plan, Shenhua Watermark will: • Ensure where practicable that each major waste stream is segregated in the appropriate receptacles for recycling, reuse and / or disposal; • Ensure training is provided to onsite personnel to improve efficiency in the minimisation of waste streams, reuse and recycling options; • Ensure an independent waste contractor working within the provisions of the POEO Act will remove and report on wastes; and • Ensure regular inspections and monitoring is conducted by qualified personnel to ensure adequate maintenance and operation of the onsite waste facilities.	7.25.3
Social		
74.	If the Project is approved Shenhua Watermark shall use its best endeavours to: (a) enter into negotiations with GSC, LPSC and TRC to establish a VPA in accordance with Division 6 of Part 4 of the EP&A Act; and (b) conclude this VPA on mutually agreed terms within 6 months of the date of this approval. The purpose of the VPA is to mitigate any increase in the demand for public amenities and public services within the Gunnedah, Liverpool Plains and Tamworth LGAs caused by the Project.	7.26.5
75.	Shenhua Watermark will implement the social management and mitigation measures listed in Table 96 of Section 7.26.5.	7.26.5
Reporting		
76.	Shenhua Watermark will prepare an Annual Review (which reports monitoring results and evaluates performance), to be distributed to the relevant regulatory authorities and the Watermark CCC.	7

WATERMARK
COAL PROJECT
ENVIRONMENTAL IMPACT STATEMENT
February 2013



9
Project Justification



Project Justification 9

9.1 Overview

This EIS has assessed the environmental planning context of the Project as is required by the EP&A Act, its regulations and in accordance with the DGRs issued on 19 April 2012. All relevant regulatory requirements and the findings from the stakeholder consultation program undertaken for the Project have also been considered in that assessment.

The Project as designed, after considering all feasible options, balances the social and economic benefits from the extraction of the coal resource within EL 7223 against the potential deleterious impacts of coal mining. In particular it maximises the material economic and social benefits for local and regional communities and the economies of NSW and Australia which are increasingly reliant on revenue from mining whilst at the same time it avoids unacceptable environmental impacts and minimises any residual impacts to the natural and man-made environment. The Project will not materially impact on either the surface or groundwater regime within or beyond the Project Boundary and will not significantly affect the agricultural productivity of the region.

The Project is consistent with the objects of the EP&A Act and the applicable environmental planning instruments. The Project is permissible with development consent under the Gunnedah LEP and does not conflict with any of the relevant State Environmental Planning policies. The Project will result in substantial social and economic benefits which have been weighed carefully against its predicted social and environmental costs. When the management and mitigation measures committed to in this EIS are adopted, the residual environmental impacts of the Project are well within acceptable limits. These impacts are acceptable when considered against the need for the Project and its social and economic benefits.

There are and will continue to be actions to manage climate change which include different approaches in different jurisdictions, the objective being to reduce reliance on carbon by making it more expensive and by developing alternate non carbon based sources of energy such as wind, solar, geothermal and others.

However, an alternative source of input materials to reliably and cost effectively replace metallurgical coal in the steel making process and to satisfy base load electricity demand has not yet been sufficiently developed. In fact the demand for both steel and carbon based energy is predicted to continue to increase with growing population and the expectations in the developing world for a higher standard of living.

While there will be an increased reliance on non-carbon based energy, the political, technological and infrastructure challenges associated with its development dictate that there will, for some time, continue to be a need for low cost, good quality, thermal coal for electricity generation. It is considered that, regardless of Australia's production of coal, the world will continue to use coal. Any constraint on Australia's coal production will simply promote the exploitation of coal in other jurisdictions.

9.2 Project Need

9.2.1 The World

The Project will result in the production of approximately 133 Mt of PCI or semi-soft coking coal with low ash content (10%) and 26 Mt of thermal coal with a high ash content (18%) over its 30 year mine life.

According to the World Coal Association there was a 78% increase in steel use worldwide between 2001 and 2011. In 2011, world crude steel production was 1,518 million metric tons. This was an increase of 6% compared to 2010 and a new record for global crude steel production. Today most of the world's steel is produced in China (45.5% in 2011 in comparison to only 20.5% in 2001).

The demand for steel products, particularly in Australia's close Asian markets is forecast to continue to grow. Global steel production is dependent on coal. Approximately 70% of the total global steel production relies on the inputs of coal. According to the World Coal Association in 2011, 761 Mt of coking coal and PCI coals were used in global steel production, which is around 12% of total hard coal consumption worldwide. As demand for steel production around the world continues to increase so too will the demand for metallurgical coal.

Further, there is general acceptance, including from the United Nations sponsored International Energy Agency (International Energy Agency, 2011) and Australian Energy Market Operator (2011), that there will be a continuing need for thermal coal to meet anthropological basic energy needs, in particular electricity generation. International and local predictions are that the need for coal as a source of energy for electricity production will increase for some years to come, despite an expectation of an increase in energy generated by alternate sources.

Whilst there are steps being taken across the world to reduce the reliance on the use of fossil fuels generally, and particular for electricity production, the forecasts are that increasing energy production from alternate energies, such as wind and solar, and energy saving actions will not match the anticipated increased demand for electricity particularly from the developing countries of south east Asia, Africa and South America. The result will be an increase in demand for energy and electricity over (at least) the next 20 years.

Whilst there is expected to be an increase in the contribution of alternate sources of energy in the form of wind and solar as well as the lesser greenhouse contributing natural gas it is predicted that the substantial source of the required energy will continue to be coal.

The United States Energy Information Agency predicts that world energy consumption will increase by 53% from 2008 to 2035 from 505 quadrillion British Thermal Units in 2008 to 770 quadrillion British Thermal Units in 2035 (United States Energy Information Administration, 2011).

The International Energy Agency of the United Nations projects that the worlds demand for coal will increase at an average annual rate of 1.9% between 2007 and 2030. The share of coal-fired electricity generation is projected to increase from 42% in 2007 to 45% in 2030 (Geosciences Australia and the Australian Bureau of Agricultural and Resource Economics, 2010).

9.2.2 Australia

Although Australia is a very minor producer of steel and thus consumer of metallurgical coal, at 140 Mtpa production of coking coal in 2011 it is by far the world's largest exporter of this highly sought after product.

Coal's contribution to Australia's electricity generation was at around 75% in 2007-2008, but is projected to decrease to around 43% in 2029–30.

Australia is fortunate in its relatively abundant quantities of energy sources in the form of coal, natural gas and even wind, solar and uranium. Australia has 8.9% of the world's recoverable coal reserves as compared to 27.6% possessed by the United States, 18.2% by Russia, 13.3% possessed by China, and 7.0% by India (World Energy Council, 2010). Australia, because of its relatively smaller population has the largest per capita coal reserves in the world and, unlike other jurisdictions, more coal than it needs for its own use.

Being a politically stable society with its coal reserves being close to the coast Australia is a desirable and low cost provider of coal to the world markets resulting in material economic benefits for Australia. With relatively stable agricultural production and diminishing manufacturing, mining (including coal mining) is increasingly important to Australia's economy and the maintenance of Australia's standard of living.

9.2.3 NSW and the Gunnedah Basin

New South Wales' demand for electricity is met 89% from locally mined thermal coal. NSW has a recoverable coal resource of approximately 16,640 Mt (Montoya and Wales, 2011) of which currently some 157 Mt is produced annually.

Of this, approximately 122 Mt is exported and 33 Mt is used domestically and primarily for electricity generation for the State (NSW Minerals Council Ltd, 2011). In 2009 the known coal reserve resource of the Gunnedah Basin was 1,270.88 Mt of which 4.99 Mt was produced in that year (DTIRIS – DRE, 2011). It is estimated that there is approximately 1.48 billion tonnes of recoverable coal reserves in the Gunnedah coalfield, equating to approximately 13% of NSW total coal reserves (NSW Minerals Council Ltd, 2011).

The majority of coal product from the Gunnedah Basin is exported, with an average of 0.17 Mt of product used domestically and primarily for electricity generation for the State per year since July 2009 (Whitehaven Coal Mining Ltd, 2009, 2010a, 2010b, 2010c, 2010d, 2011a, 2011b, 2011c, 2011d, 2012a, 2012b). In addition to the critical function of supporting the production of electricity, the coal mining of the State and the region provide significant economic contributions to the respective communities and underpin the economy of particularly New South Wales and increasingly the Gunnedah Basin.

9.3 Economics

The Australian and NSW economies are increasingly reliant on mining in a world that is experiencing, and will continue to experience fiscal and economic challenges. The Project will result in material beneficial effects on the economies of Australia, New South Wales and the Gunnedah Basin. The economic consequences of the Project are assessed in Appendix AF and reported on in Section 7.27.

9.3.1 Australia

Australia's coal production is projected to increase at an average annual rate of 1.8% to 13,875 PJ between 2007–08 and 2029–30. Over the same period, domestic coal consumption is projected to decline at an average annual rate of 0.8% to around 1,763 PJ in 2029–30. Exports are projected to increase at an average annual rate of 2.4% to 12,100 PJ (450 Mt) in 2029–30 (Geosciences Australia and the Australian Bureau of Agricultural and Resource Economics, 2010). Coal accounted for 15% of Australia's exports in 2011 (Reserve Bank of Australia, 2012). In 2010, coal exports were valued at $43 billion (Commonwealth Department of Foreign Affairs and Trade, 2011). Over 40,000 people are employed in coal mining in Australia.

It is accepted that the mining industry is the dominant contributor to the Australian economy. Whilst agriculture is also important, its contribution has not increased materially since the 1960s and is now a relatively smaller proportionate contributor than it has been in the past. Manufacturing has diminished in importance leaving agriculture and mining as the dominant earners of export income for Australia with mining increasing its dominance in recent times and in particular in the last ten years.

9.3.2 New South Wales

Coal mining is the largest contributing industry to the economy of New South Wales.

New South Wales receives $1.48 billion a year in mining royalties, expected to rise to a total of $8.9 billion in 2015 - 2016. Eighty one percent of the total value of mineral production in NSW is derived from thermal and coking coal the total value of which was $16.15 billion in 2010-2011 during which New South Wales produced a record 205 Mt of raw coal, yielding 157 Mt of saleable coal. In 2010-2011 total employment in the New South Wales coal industry was approximately 21,126 people (NSW Minerals Council Ltd, 2011).

9.3.3 Gunnedah Basin

The Gunnedah Basin was responsible for 5.7 Mt of coal production in 2009–2010 being 4% of the saleable coal produced in the State with the potential to increase to 52 Mtpa and approximately 33% of the State's current coal production following recent approvals in the Gunnedah Basin and considering applications for further approvals that are on the approvals path. In 2009–2010 there were 550 direct employees in coal mining in the region (DP&I, 2012). A further 2,767 people were employed in coal mining directly in Newcastle in 2011 (NSW Minerals Council Ltd, 2011). A total of approximately 5,000 jobs in coal mining would be available in total in the Gunnedah Basin if proposed projects were approved (DP&I, 2012).

Production from the Gunnedah Basin enters the Hunter Valley Coal Chain which is the largest coal export operation in the world consisting of approximately 40 coal mines owned by 14 coal producers with 27 load points from which there are 16,000 trips per year to load more than 1,200 coal vessels per year through the Port of Newcastle.

On average the coal mining industry contributes $60.8 M per year to the gross annual output of the Gunnedah Basin (Gillespie Economics, 2012). The total area of the Gunnedah Basin is approximately 1,500,000 ha (NSW Minerals Council Ltd, 2012). The ABS estimates that the area of land used for agriculture in the local region (Gunnedah, Liverpool Plains and Tamworth LGA) is 1,713 ha, or 85.8% of the local region's land (Appendix 7 of **Appendix Z**) as compared to the estimated area occupied by mining projects of 15,430 ha or 1.0% of the area of the Gunnedah Basin (Hansen Bailey, 2010; R. W. Corkery & Co. Pty. Limited, 2010; The Minister for Mineral Resources of the State of New South Wales, 2000, 2006, 2008a, 2008b, 2008c; Whitehaven Coal Mining Ltd, 2011e).

9.3.4 Economic Benefits of the Project

The Project will facilitate the recovery of a valuable, export quality thermal coal. Thermal coal remains a highly sought after energy source in Asian countries, including Japan, China and India. These countries continue to be the world's largest coal importers, and will largely account for an approximately 70% growth in total coal imports from 2009 to 2035 (United States Energy Information Administration, 2011).

This increasing demand supports the need for the Project and justifies further investment in the thermal coal mining industry.

To this end the Project will:

- Assist Australia to continue to meet the international demand for metallurgical and thermal coal, for at least the next 30 years, during which time it is expected that there will continue to be a strong world demand for coal for the purposes of steel production and generating electricity;
- Support Australia in maintaining its reputation as a consistent and reliable supplier of metallurgical and thermal coal to its existing and expanding markets; and
- Contribute materially to sustaining the Australian economy and maintaining the economic stability of NSW and the Gunnedah region.

The Project will deliver substantive socio-economic benefits to the Gunnedah, Liverpool Plains and Tamworth LGAs, but in doing so will create a need for supporting infrastructure and services. To this end, Shenhua Watermark is in the advanced stages of discussions with GSC, LPSC and TRC with the view of entering into a VPA pursuant to Section 93F of the EP&A Act.

The operational phase of the Project is expected to generate a total of approximately 908 jobs in the local Gunnedah, Liverpool Plains and Tamworth LGAs. On a regional basis (Gunnedah, Liverpool Plains, Tamworth, Narrabri and Upper Hunter LGAs) the Project is expected to generate a total of approximately 1,015 jobs.

These employment opportunities will provide significant benefits to the local region, which is characterised by a high rate of unemployment within the Gunnedah (6.7%), Liverpool Plains (6.6%) and Tamworth Regional (6.3%) LGAs when compared to other local regions, including the Upper Hunter LGA (1.7%), Narrabri LGA (5.2%) and the NSW average (5.2%) (DEEWR, 2012b).

An analysis of the current labour force in the Gunnedah, Liverpool Plains and Tamworth Regional LGAs shows that in 2012 there was predicted to be:

- Approximately 2,500 unemployed people living in Gunnedah, Liverpool Plains and Tamworth Regional LGAs;
- An available labour supply of 1,010 people in the Gunnedah LGA;
- An available labour supply of 734 people in the Liverpool Plains LGA; and
- An available labour supply of 4,674 people in the Tamworth Regional LGA.

As such, it appears that the Gunnedah, Liverpool Plains and Tamworth Regional LGAs will be able to effectively absorb a substantial proportion of the jobs created by the Project, thereby improving the social environment of these areas.

In addition to increasing employment opportunities, it is also expected that the Project will assist in improving the current high rates of youth and Indigenous unemployment in the study area. The Project could also assist in improving women's labour force participation rates.

Additionally, should the Project be approved, Shenhua Watermark will implement the following strategies which will result in tangible social benefits to the Gunnedah, Liverpool Plains and Tamworth Regional LGAs:

- The use of best endeavours to achieve the majority of its permanent workforce residing within the Gunnedah, Liverpool Plains and Tamworth Regional LGAs;
- A workforce recruitment strategy which addresses the needs of the semi-skilled and unskilled workforce which is available locally but will require on the job and more specific operator training;
- Provide apprenticeships, traineeships and graduate placement programs to local Gunnedah, Liverpool Plains and Tamworth residents;
- Provide part time and/or flexible employment opportunities to encourage a higher rate of labour force participation;
- Encourage skilled partners of the incoming mining workforce to also relocate to the local area to skilled jobs that are required outside the mining industry;
- Continue to be involved in TAFE New England Institute's consultation with the mining and resource sector to assist in determining the required level and scope of training needs for the campuses within the Region, including Gunnedah, Quirindi, Tamworth and Narrabri;
- Continue to be involved in discussions with The University of New England and other appropriate tertiary institutions to provide university training in the mining and mining support sectors in the Gunnedah Basin; and
- Develop a VPA with GSC, LPSC and TSC to provide contributions to address demands on local community infrastructure from the Project.

When the Project production costs (acquisition of affected land, opportunity cost of land, operating costs, environmental costs, decommissioning costs, etc.) are considered in the context of production benefits (revenues from production, residual values of land, etc.), the net financial benefits of the Project are approximately $3,047 M.

A minimum of $1,310 M of these will be net benefits accruing to Australia. There may also be some non-market benefits of employment provided by the Project which are estimated to be in the order of $324 M.

The Project will deliver significant socio-economic benefits to the region and the State of NSW through the provision of employment, taxes and fees.

The Project is estimated to make up to the following contribution to the local economy:

- $902 M in annual direct and indirect regional output or business turnover;
- $493 M in annual direct and indirect regional value added;
- $80 M in annual direct and indirect household income; and
- 908 direct and indirect jobs.

The Project is estimated to make the following contribution to the regional economy:

- $913 M in annual direct and indirect regional output or business turnover;
- $507 M in annual direct and indirect regional value added;
- $91 M in annual direct and indirect household income; and
- 1,015 direct and indirect jobs.

For the NSW economy, the operation of the Project is estimated to make up to the following contributions:

- $1,554 M in annual direct and indirect regional output or business turnover;
- $802 M in annual direct and indirect regional value added;
- $276 M in annual direct and indirect household income; and
- 3,260 direct and indirect jobs.

9.4 Alternatives Considered

The Project alternatives are discussed at Section 3.12. Eight different project alternatives were considered to identify if there was a Project which would address the following environmental planning imperatives:

- Protection of those environmental features that must be protected;
- Confirmation that it could be conducted with predictable and acceptable environmental planning effects;
- Best practice science applied to ensure all environmental effects have been determined with certainty;
- The application of all available feasible and reasonable management controls; and
- Assurance that any residual impacts would not have unacceptable environmental effects.

Due to the established need for the Project, the 'No Development, option was rejected when it was determined that there was a feasible and acceptable development as proposed by this assessment. The 'Underground Mining' alternative is not operationally or economically appropriate in the identified coal resource thereby leaving the Project as proposed, the preferred development.

9.5 Environmental Impacts

The environmental assessment of the Project has been conducted in accordance with the objects of the EP&A Act, including the principles of ESD and leading practice environmental and social standards.

This process has involved:

- A project risk assessment (Section 6);
- Consultation with stakeholders to identify any additional issues to be addressed in this EIS (Section 5);
- Technical assessment conducted in accordance with current 'best practice' and as required by the DGRs (Section 7);
- Quantification of any potential environmental impacts with certainty (Section 7); and
- The application (as part of the operation of the Project) best practice environmental management and mitigation measures (Section 7 and 8) to which Shenhua Watermark is committed.

Project impacts are outlined in Section 7 with the most significant environmental impacts summarised below.

9.5.1 Agriculture

The land within the Disturbance Boundary and the Biodiversity Offset Areas lost to agricultural production represents a gross value of $4.7 M per annum. This equates to 3.7% of the total agricultural production of the Gunnedah LGA, 2.0% of the Liverpool Plains region, 0.05% of NSW, and 0.01% of Australia. As such there will not be any material reduction in agricultural productivity of the Gunnedah or Liverpool Plains region or the State as a result of the Project (Appendix Z).

Strategic Regional Land Use Plan Gateway Criteria

The consideration of the gateway criteria within this EIS draws from the reports of various technical specialists. The "Site Verification" concludes that there are 96.1 ha of BSAL within the Disturbance Boundary and approximately 696 ha within the proposed Onsite Biodiversity Offset Areas. No BSAL is identified to likely occur within the Onsite Biodiversity Offset Areas.

The gateway criteria for BSAL require a consideration of the Project's impacts on Highly Productive Groundwater. The Gunnedah Formation is considered to satisfy the 'highly productive groundwater' criteria of the SRLUP and AIP. The Narrabri and Permian Formations are not considered to satisfy the 'highly productive groundwater' criteria.

As noted in Section 7.1.3, the groundwater model indicates that the Project will create a zone of depressurisation induced by mining in the Permian formations underlying the Upper Namoi Alluvium. Groundwater flow from the underlying Permian to the Upper Namoi alluvium will be reduced by a maximum rate of 0.3 ML/day.

Within 10 km of the Project Boundary, 35 privately owned bores are predicted to experience maximum groundwater level reductions of greater than or equal to 0.1 m. Of these, four bores adjacent to the Southern Mining Area have a maximum predicted drawdown greater than 1 m. All take of water will be accounted for by water access licences with appropriate volumetric allocations as described elsewhere in this EIS.

The largest predicted reduction in water levels of 1.4 m is limited to bore GW15505, which is the closest bore to the Southern Mining Area. When operations in the Southern Mining Area and Eastern Mining Area cease, the model predicts that groundwater levels in the depressurised zone recover relatively rapidly within approximately five years.

Therefore, the Project is not considered to reduce the agricultural productivity of BSAL within the Project Boundary and surrounds through impacts to highly productive groundwater.

Benefit Cost Analysis

The direct annual output of the Project is estimated at $744 M per annum. In contrast, the direct annual output of the continued use of the agricultural lands and water for agricultural purposes that will be utilised by the Project is estimated at $5 M per annum. The direct and indirect regional employment provided by the Project will be up to 908 full time equivalent jobs compared to up to 41 agricultural-related jobs that would be forgone as a result of the Project.

Gillespie Economics also undertook a BCA which included an estimation of the present value of production costs and benefits of the Project over a 30 year period (see Appendix AF). The present value of net production benefits of the Project to Australia are estimated at $1,310 M (7% discount rate). In contrast, the present value of the continued use of the agricultural lands and water for agricultural purposes that will be utilised by the Project is estimated at $40 M (7% discount rate). Based on these comparative values, the Project is considered to be a significantly more efficient land use than continued agricultural production.

9.5.2 Groundwater

The Gunnedah Formation does not exist within the Project Boundary, as shown on Figure 27. The closest occurrence being 900 m from the north-eastern corner of the Eastern Mining Area and 1.3 km in the south.

The Narrabri Formation is generally represented by the quaternary alluvium soil boundary of Banks (1995). Accordingly, the Eastern and Southern Mining Areas are set back by a minimum of 150 m from the Narrabri Formation.

The groundwater model predicts an average groundwater seepage rate into the mining areas of 180 ML/yr with a peak of up to 760 ML/yr. The groundwater seepage to the mining areas is largely sourced from the *Water Sharing Plan for the Murray-Darling Basin Porous Rock Groundwater Sources*. Groundwater seepage into the mining areas represents less than 0.1% of the extraction limits for this groundwater source.

The groundwater flow from the underlying Permian formations to the alluvium reduces by a maximum rate of 0.3 ML/day in Zone 7, with the maximum annual loss at 101.8 ML/year. The rate of transfer of water from the Permian to the alluvium reduces as the zone of depressurisation increases and reaches a peak when mining in the Southern Mining Area is most extensive in Year 24.

The average pumping rate from a single licensed agricultural bore in the Upper Namoi alluvium (within 10 km of the Project Boundary) is 142 ML/yr. The groundwater model predicts that the volume of water removed from the Zones 3, 7 and 8 is a very small quantity of water, peaking at 98.1 ML/year, which is equivalent to no more than the average usage from a single bore in the peak years for mining. All "take" of water will be accounted for with water access licences with appropriate volumetric entitlements.

Under post-mining conditions, the water levels in these areas recover and the surrounding Permian regains pressure. The emplacement of overburden in the mining areas and the associated enhanced recharge rapidly reverses the effects of groundwater depressurisation on the alluvial aquifer system. The model indicates that 15 years after mining ceases, upward flow to the alluvium will be returned to pre-mining rates. Beyond 15 years of recovery, the enhanced OEA recharge causes a net gain of 0.1 ML/day to the alluvial groundwater management areas, which means there is no long term deficit of water post mining

9.5.3 Surface Water

A site surface water management system is proposed to both provide suitable water for mine site use and to ensure that untreated mine water is not released from the site. As result, during wet years, it may be possible to obtain all water requirements for the mining operations from local runoff and groundwater inflows. However, during average and dry years it is predicted that annual volumes up to 600 ML will be required to supplement the mine water supplies to ensure a reliable source of water to the CHPP. Shenhua Watermark proposes to take water from nearby available water sources under appropriate water access licences or private commercial arrangements with holders of appropriate water access licences.

Based on the configuration and capacity of the proposed water management system, there will be no uncontrolled offsite spills from mine water storages or controlled discharges.

During and after the life of the Project, there is a potential for the reduction of catchment flows to surrounding waterways, including the Mooki River, Watermark Gully, Native Dog Gully and Lake Goran. A reduction in catchment area will decrease the volume of stormwater runoff. At the completion of mining, surface runoff from rehabilitated OEAs will be released offsite. An area of approximately 108 ha, which originally drained to Lake Goran, will continue to drain to the final void of the Western Mining Area.

Shenhua Watermark will implement the proposed water management system to minimise impacts on surface water and will also conduct monitoring of water quality. Further, Shenhua Watermark will prepare an Erosion & Sediment control plan to manage the design and maintenance of these structures.

9.5.4 Air Quality

Air quality modelling for the Project concludes that with the implementation of all reasonable and feasible mitigation and management measures, the construction phase will have a negligible impact on air quality.

Air quality modelling for the operational phase concludes that the Project considered alone and cumulatively with other sources is not predicted to cause exceedances of the annual average air quality criteria for PM_{10}, TSP, Dust Deposition or $PM_{2.5}$ at any privately owned receivers or properties.

Six private receivers (on five private properties) are predicted to experience exceedances of the 24-hour average PM_{10} assessment criterion (50 $\mu g/m^3$) between one and 36 days per year. These represent the worst case operation of the Project under adverse prevailing weather conditions. A further seven properties will experience maximum PM_{10} concentrations exceeding the 24 hour criteria of 50 $\mu g/m^3$ over an area greater than 25% of the property. Each of these receivers and properties affected by 24-hour average PM_{10} are also impacted by noise from the Project.

An assessment of fugitive fume and particulate matter emissions from blast activities indicated that the vast majority of predicted impacts are significantly below the impact assessment criteria. There are a maximum of 8 hours in a year (from a possible 2,920 available blasting hours) when the 1-hour average criterion is predicted to be exceeded.

Dispersion modelling of diesel fume and blasting emissions resulting from the Project has shown that the predicted impacts for PM_{10}, $PM_{2.5}$, NO_2 and SO_2 at all receptors will remain well below their respective assessment criteria / standard.

Shenhua Watermark will install a real-time dust monitoring and management system for the Project including a predictive meteorological forecasting system. Shenhua Watermark will also prepare an Air Quality Management Plan to minimise and manage air quality impacts associated with the Project.

9.5.5 Greenhouse Gas

Greenhouse and anthropogenic climate change is a global issue. Since the 2009 Copenhagen Climate Conference, it has become more apparent that the path to achieving a material reduction in the use of carbon based energy is challenging and will take time. There will continue to be actions to manage climate change which include different approaches in different jurisdictions. The objective of these actions will be to reduce reliance on carbon by making it more expensive and by developing alternate non-carbon based sources of energy such as wind, solar, geothermal and others.

However, an alternative source has not yet been, or not considered to be for some time to come, developed sufficiently to replace carbon based energy entirely as the source of energy for base load electricity supply (International Energy Agency, 2011). The demand for electricity is predicted to continue to increase with growing populations and the standards of living that are expected and required in the developing world.

While there will be development of non-carbon based energy, the socio-political and technological challenges and infrastructure development requirements (due to the inevitable increase in world demand for electricity) will result in a continued need for low sulphur, export quality coal, (as will be one of three coal products produced by the Project), to provide affordable and reliable electricity and energy security.

Shenhua Watermark will prepare an energy and greenhouse monitoring and management plan and will implement energy and greenhouse reduction initiatives at the design, operation and decommissioning phases of the Project.

9.5.6 Noise

Despite the incorporation of all reasonable and feasible noise management and mitigation measures into the Project six receivers will experience significant noise impact at their residences (14, 32, 60, 62, 103 and 125) and a further seven vacant properties will be subject to significant noise impacts over an area greater than 25% of the property (20, 26, 27, 28, 61, 65 and 116).

Seventeen receivers and nine vacant properties will also experience mild to moderate to noise levels (i.e. exceedance of intrusive criteria between 1 and 5 dBA).

Shenhua Watermark will install a real-time noise monitoring and management system for the Project including a predictive meteorological forecasting system. Shenhua Watermark will also prepare a Noise Management Plan to minimise and manage noise impacts associated with the Project.

9.5.7 Ecology & Offsets

A total of 19 vegetation communities were identified within the Project Boundary, of which nine are listed as CEEC or EEC under the EPBC Act and ten are listed as EEC under the TSC Act. One flora species listed as Vulnerable under the EPBC Act was identified in the Project Boundary.

One fauna species (the Koala), which is listed as Vulnerable under both the EPBC Act and TSC Act was recorded within the Project Boundary. An additional nine threatened fauna species listed under only the TSC Act, and one Migratory EPBC Act species, were also recorded within the Project Boundary during surveys, mostly birds and microbats. Although not recorded during field surveys, a suite of other fauna species listed as threatened or migratory under the TSC Act and/or the EPBC Act are considered to have potential to occur.

The Project will disturb the following:

- Approximately 789 ha of vegetation communities listed under the EPBC Act and / or the TSC Act;
- Approximately 148 ha of other woodland, providing known and potential habitat for the Koala and other threatened flora and fauna species; and
- Approximately 3,147 ha of low diversity grassland, planted and exotic pasture and areas disturbed for existing roads and agricultural infrastructure.

A Biodiversity Offset Strategy has been formulated to compensate for ecological impacts of the Project that will achieve a net gain in biodiversity in the bioregion in the long term. The Biodiversity Offset Strategy entails acquisition of offset properties for permanent conservation of flora and fauna, including species predicted to be impacted by the Project, rehabilitation of areas disturbed and the provision of indirect offsets. The Biodiversity Offset Strategy targets Box Gum Woodland and Derived Native Grassland and other habitats for all threatened fauna known to occur in the Project Boundary.

Based on preliminary mapping, the Onsite and Offsite Biodiversity Offset Areas will contribute 13,015 ha of woodland and grassland containing 6,366 ha of Box Gum Woodland and Derived Native Grassland. A further 8,412 ha is proposed for revegetation and rehabilitation. The Onsite Biodiversity Offset Areas will also provide extensive areas of habitat for the Koala.

The Biodiversity Offset Strategy will ultimately provide an offset ratio of 7.3:1 for Box Gum Woodland and Derived Native Grassland, 33.7:1 for other EECs and 31.9:1 for other woodland vegetation. In the medium to long term the Project will result in a net increase in woodland in and around the Project Boundary, and in the wider region.

9.5.8 Aboriginal Archaeology

A total of 55 new Aboriginal archaeological sites have been identified within the Project Boundary (see Figure 46) comprising 21 artefact scatters, 23 isolated finds, eight potential Aboriginal scarred trees and three grinding groove sites.

A total of 29 archaeological sites will be directly impacted, including 27 open artefact scatters and two grinding groove sites. All remaining 26 sites will be conserved. No scarred trees will be impacted by the Project.

Shenhua Watermark will develop an Aboriginal Cultural Heritage Management Plan (ACHMP) for the Project which will be guided by specific policies and procedures to manage sites within the Project Boundary. It will be periodically reviewed in consultation with Aboriginal stakeholders and relevant regulators. Shenhua Watermark will also establish the Watermark Gully Aboriginal Cultural Heritage Conservation Area and the Mooki River Aboriginal Cultural Heritage Conservation Area.

These areas offer both known and potential Aboriginal archaeological resources and cultural values on land owned by Shenhua Watermark within and adjacent to the Project Boundary.

9.5.9 Traffic & Transport

The Project is not predicted to cause any adverse impacts on the surrounding road network as a result of the increased traffic associated with construction and/or operational facilities. The modelling confirmed that the traffic generated by both the construction and operational phases of the Project would be efficiently absorbed into the existing traffic stream largely due to the substantial spare capacity available in the network.

As part of the Project, Shenhua Watermark will construct a new T intersection at the intersection of the Mine Access Road and the Kamilaroi Highway. The final design of the intersection will be developed in consultation with GSC and RMS. However, preliminary modelling indicates that a channelised T intersection with an indented right-turn lane for southbound traffic will be required.

The closure of The Dip Road will be required in Year 15 of the Project. This will require an alternative route via Cull Road, Werner Road and Clift Road. The general alignment of this route is presented in the EIS. The detailed design will be developed by Shenhua Watermark in consultation with GSC.

Shenhua Watermark will prepare a Traffic and Transport Management Plan to manage possible traffic impacts resulting from construction and operation of the Project.



9.6 Consistency with the Objects of the EP&A Act

Section 5, Part 1 of the EP&A Act contains its objects which are reproduced below followed by a consideration as to how the Project achieves these:

> *"To encourage the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment."*

The Project will facilitate the environmentally acceptable recovery of a 268 Mt of ROM coal reserves within the Black Jack group coal measures. At the same time, the Project will provide for the management of land owned by Shenhua Watermark and the establishment of a Biodiversity Offset Strategy to conserve forests and natural systems. The Project will not materially affect local surface water or groundwater regimes and through the additional employment generated will assist in sustaining the socio-economic viability of the nearby population, towns and the Liverpool Plains region. Mining developments are a major driver of development for towns and villages in regional areas.

> *"To encourage the promotion and co-ordination of the orderly and economic use and development of land."*

The Project will result in the recovery of a valuable coal resource from within NSW's identified coal reserves. The recovery of this coal resource has been designed to occur with identified, manageable and acceptable environmental and social impacts resulting in material social and economic benefit to NSW.

The mining land use will be the highest value land use available with the present value of net production benefits of the Project to NSW and Australia estimated at $1,310 M (7% discount rate) as compared to the present value of the continued use of the same land and water resources for agricultural purposes being $40 M (7% discount rate).

The Project will generally stimulate the economy with regional spending for production related costs and with wages for labour which will also contribute to the regional economy.

> *"To encourage the protection, provision and co-ordination of communication and utility services."*

The Project will expand utility services in the local area, improving the potential for increased connectivity by other users. The provision of services such as water, power and telecommunications to this location is currently low. Development of the Project will facilitate the provision of these and other services and as such, any subsequent access by other parties located in the vicinity of the Project will be improved.

"To encourage the provision of land for public purposes."

The Project will result in the establishment of a Biodiversity Offset Strategy which will include the conservation, restoration and rehabilitation of 6,366 ha of Box Gum Woodland and Derived Native Grassland, 1,759 ha of other EECs and 4,890 ha of other woodland vegetation. These areas will be set aside for scientific and conservation purposes in perpetuity.

"To encourage the protection, provision and co-ordination of community services and facilities."

The net economic benefit of the Project will encourage and support the provision and co-ordination of community services and facilities to the Gunnedah and Liverpool Plains region. In particular, the Project will also generate an estimated $565 M (present value) in royalties, which will be used by the State government to provide community services and facilities across NSW.

The Project will also implement three VPAs which are being developed in consultation with GSC, LPSC and TSC for the ongoing provision of community services, facilities and other local infrastructure.

"To encourage the protection of the environment, including the protection and conservation of native animals and plants, including the Threatened species, populations and ecological communities, and their habitats."

The Project will result in the loss of CEEC, EEC and the habitats of threatened species. In order to compensate for these impacts, Shenhua Watermark has developed a Biodiversity Offset Strategy for the Project which includes the conservation, restoration and rehabilitation of 6,366 ha of Box Gum Woodland and Derived Native Grassland, 1,759 ha of other EECs and 4,890 ha of other woodland vegetation.

"To encourage ecologically sustainable development."

The Project has been developed by a comprehensive planning, stakeholder engagement and environmental assessment process to ensure that the principles of ESD are addressed. The Project has been determined by a careful consideration of the alternatives. The impacts of the Project have been predicted with certainty in a detailed assessment process outlined in this EIS. Management measures to address the impacts that will occur have been incorporated into the Project as required, thus addressing the Precautionary Principle.

The environmentally optimised recovery of the in situ coal resource and the establishment of the Biodiversity Offset Strategy address the principles of Intergenerational Equity and Improved Valuation. The Biodiversity Offset Strategy proposed for the Project also addresses the principle of the Conservation of the Biological Diversity and Ecological Integrity.

The Project is consistent with the principles of ESD as discussed further in Section 9.7.

"To provide increased opportunity for public involvement and participation in environmental planning and assessment."

Section 5 describes the stakeholder engagement process relied upon during the preparation of this EIS. This process was extensive and hence fulfils this objective of the Act.

9.7 Consistency with the Principles of ESD

The objects of the EP&A Act adopt the principles of ESD in the application of the Act and which are also articulated in Section 6 (2) (a) of the *Protection of the Environment Administration Act* 1991 In this Act it is stated that *"ecologically sustainable development requires the effective integration of economic and environmental considerations in decision-making processes. Ecologically sustainable development can be achieved through the implementation of the following principles and programs:...".* These are identified below.

9.7.1 Precautionary Principle

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

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

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

(ii) an assessment of the risk-weighted consequences of various options,"

Adherence to the precautionary principle requires avoiding serious or irreversible environmental damage by properly assessing potential impacts and taking the necessary mitigation measures. This EIS identifies, with certainty, all environmental impacts from the development of the Project, which has been designed to avoid serious or irreversible environmental damage.

To ensure this, actions involving unquantifiable and unacceptable environmental consequences have been avoided. Environmental consequences have been assessed on a 'worst case scenario' basis, where if potential serious or irreversible damage was identified, an appropriate re-design of the Project was implemented to avoid those consequences. Additionally, this EIS adopted a risk-based approach to assessment whereby key aspects of the Project with a high risk profile have been peer reviewed by authoritative experts to ensure certainty over the predicted impacts of the Project.

9.7.2 Intergenerational Equity

This principle requires *"that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations"*.

The Project design, determined through the examination of the alternatives along with the commitments to environmental management systems and the management and mitigation measures, will operate to ensure that there is no significant effect on the environment as a result of the Project which would diminish the health, diversity or productivity of the environment for future generations. The cost of environmental effects will be borne through the Project life and will not be left to be borne by future generations.

This has been achieved by limiting the scale of the Project including excluding development from environmentally sensitive areas (e.g. black soil plains). Long term ecological conservation areas will be established for the Project as part of the Biodiversity Offset Strategy. Expert peer review of key scientific studies have confirmed with certainty that the Project will not measurably impact on the productivity of the region's groundwater resources.

9.7.3 Biodiversity Conservation

This principle requires the *"conservation of biological diversity and ecological integrity—namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration"* of any development proposal.

The design of the Project excludes, where possible, areas of native vegetation and endangered species. Along with the Biodiversity Offset Strategy committed to by Shenhua Watermark, this demonstrates adherence to this principle. These actions will ensure that the Project will not threaten the preservation of biodiversity and ecological integrity of the area and that the biodiversity and ecological value of the area is maintained and potentially improved in the long term.

9.7.4 Improved Valuation

This principle addresses *"improved valuation, pricing and incentive mechanisms—namely that environmental factors should be included in the valuation of assets and services, such as:*

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

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

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

Since Shenhua Watermark will be a producer of coal, only the 'polluter pays principle' is applicable through:

- Capital investment in the acquisition of offset lands and the establishment of rehabilitation programs to protect and enhance local and regional ecological biodiversity values;
- Establishment of the perpetual protection of the offset lands;
- Direct payments to the Commonwealth government in accordance with requirements of the Carbon Tax; and
- Shenhua Watermark will purchase land unacceptably affected by noise and mine related dust.

9.8 Matters for Consideration Under Section 79C of the EP&A Act

The Minister for Planning and Infrastructure (or delegate) is to take into consideration the following matters in Section 79C of the EP&A Act as are of relevance to the Project:

"(a) the provision of:

(i) any environmental planning instrument, and

(ii) any proposed instrument that is or has been the subject of public consultation under this Act and that has been notified to the consent authority (unless the Director-General has notified the consent authority that the making of the proposed instrument has been deferred indefinitely or has not been approved), and

(iii) any development control plan, and

(iiia) any planning agreement that has been entered into under section 93F, or any draft planning agreement that a developer has offered to enter into under section 93F, and

(iv) the regulations (to the extent that they prescribe matters for the purposes of this paragraph), and

(v) any coastal zone management plan (within the meaning of the Coastal Protection Act 1979),

that apply to the land to which the development application relates,

(b) the likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality,

(c) the suitability of the site for the development,

(d) any submissions made in accordance with this Act or the regulations,

(e) the public interest."

These sections below describe how this EIS has addressed each in relation to the Project.

9.8.1 Environmental Planning Instruments

The Project is wholly located within the Gunnedah LGA to which the Gunnedah LEP applies. The majority of the land within the Project Boundary is zoned as RU1 (Primary Production) with two small areas of land zoned as E3 (Environmental Management) which are located outside of the Disturbance Boundary. The land use table in the Gunnedah LEP states that open cut mining is permissible with Development Consent on land within Zone RU1.

The Mining SEPP applies to the whole of NSW and pursuant to clause 5(3) of the Mining SEPP it prevails over any other EPI to the extent of any inconsistency. The practical effect of clause 5(3) is that if there is any inconsistency between the provisions in the Mining SEPP and those contained in any other EPI, including relevantly the Gunnedah LEP, the provisions of the Mining SEPP will prevail. As discussed in Section 4.3.1 the application of the Mining SEPP results in the Project being permissible in Zone E3. However no development for the Project is proposed on land zoned E3. Accordingly the Project is permissible with Development Consent on the land on which the Project will be carried out.

9.8.2 Instruments Subject to Public Consultation

The relationship between the Project and the government's SRLUP has been discussed and considered as required by the DGRs.

9.8.3 Planning Agreement

Section 93F of the EP&A Act enables a VPA to be established which may replace the imposition of a condition under Section 94 or Section 94A. Shenhua Watermark has commenced discussions with GSC, LPSC and TSC in relation to entering into a VPA to meet the required contributions in relation to the Project under Division 6 of Part 4 of the EP&A Act.

9.8.4 Regulations

This EIS has been prepared in accordance with Part 2 of Schedule 2 of the EP&A Regulation. Detailed design as required under Schedule 1 of the EP&A Regulation is provided in Appendix B. DGRs were issued for the Project under Part 2 of Schedule 2 of the EP&A Regulation on 19 April 2012. Section 5.4.1 lists each DGR and indicates where each is addressed in this EIS.

No coastal zone management plan applies to the area within the Project Boundary.



9.8.5 Natural and Built Environment Impacts

This EIS provides a detailed assessment of identified potential impacts on the natural and built environments. Section 7 provides a summary of the predicted impacts associated with the Project. The Project design minimises the environmental impacts to the natural and built environment whilst maximising resource recovery.

9.8.6 Site Suitability

Abundant natural resources in the Gunnedah Coalfield have enabled a long history of coal mining in the area. In particular, coal mining occurred in the Project Boundary during the early 1900's.

The vast majority of the land within the Project Boundary is zoned as RU1 (Primary Production). All land within the Disturbance Boundary is zoned as RU1 (Primary Production) which states that open cut mining is permissible with Development Consent on land within Zone RU1.

The Project is not likely to have a significant impact regarding land use trends or be incompatible with any of those existing, approved or likely preferred uses of land surrounding the Infrastructure Boundary. A significant buffer of over 3 km exists between the proposed mining areas and private residences in Breeza. Further, the Project Boundary is generally surrounded by large, vacant agricultural properties associated with the black soil plains.

Major transport routes traverse the area to the east of the Project Boundary, including the Kamilaroi Highway and the Werris Creek – Moree Railway Line (which the Project's rail loop is proposed to connect too).

The proposed surface facilities for the Project are therefore in keeping with the surrounding land uses.

The Project is considered to be suited for the site.

9.8.7 Submissions

The Minister will consider any submissions made in accordance with the EP&A Act or the EP&A Regulation.

9.8.8 Public Interest

On the basis of this EIS which has quantified the Project's social and environmental impacts with scientific certainty, it available to conclude that the Project is consistent with the objects of the EP&A Act, addresses the principles of ESD and that the economic and social benefits of the Project outweigh its social and environmental costs. As such, it may be concluded that the Project is in the public interest.

9.9 Conclusion

The Project has been assessed in accordance with the EP&A Act, its 'objects', addresses the principles of ESD, and as required by the DGRs. This assessment has concluded that the Project can be approved under the EP&A Act.

There are environmental costs which have been identified with certainty and which are proposed to be being acceptably managed by operational controls, land acquisition and management plans that would be established and adopted as approved by the Director-General and appropriate other Government agencies and authorities. Ecological and long term costs have been minimised and will be offset by management strategies to maintain and over time improve vegetation and ecological values in the bioregion.

The Project mine plan appropriately represents a material reduction in scale and impact from the maximum resource extraction mine plan and justifiably sacrifices a material proportion of the remaining in-situ coal reserve. The Project as proposed meets environmental and social requirements and still results in a mine plan and development for which there is a demonstrated need and from which there are material economic, environmental and social benefits.

The Project will maximise the economic and social value from the remaining coal resource by a mine plan that will appropriately address the environmental and socio-economic constraints and the objects of the EP&A Act, including the principles of ESD.

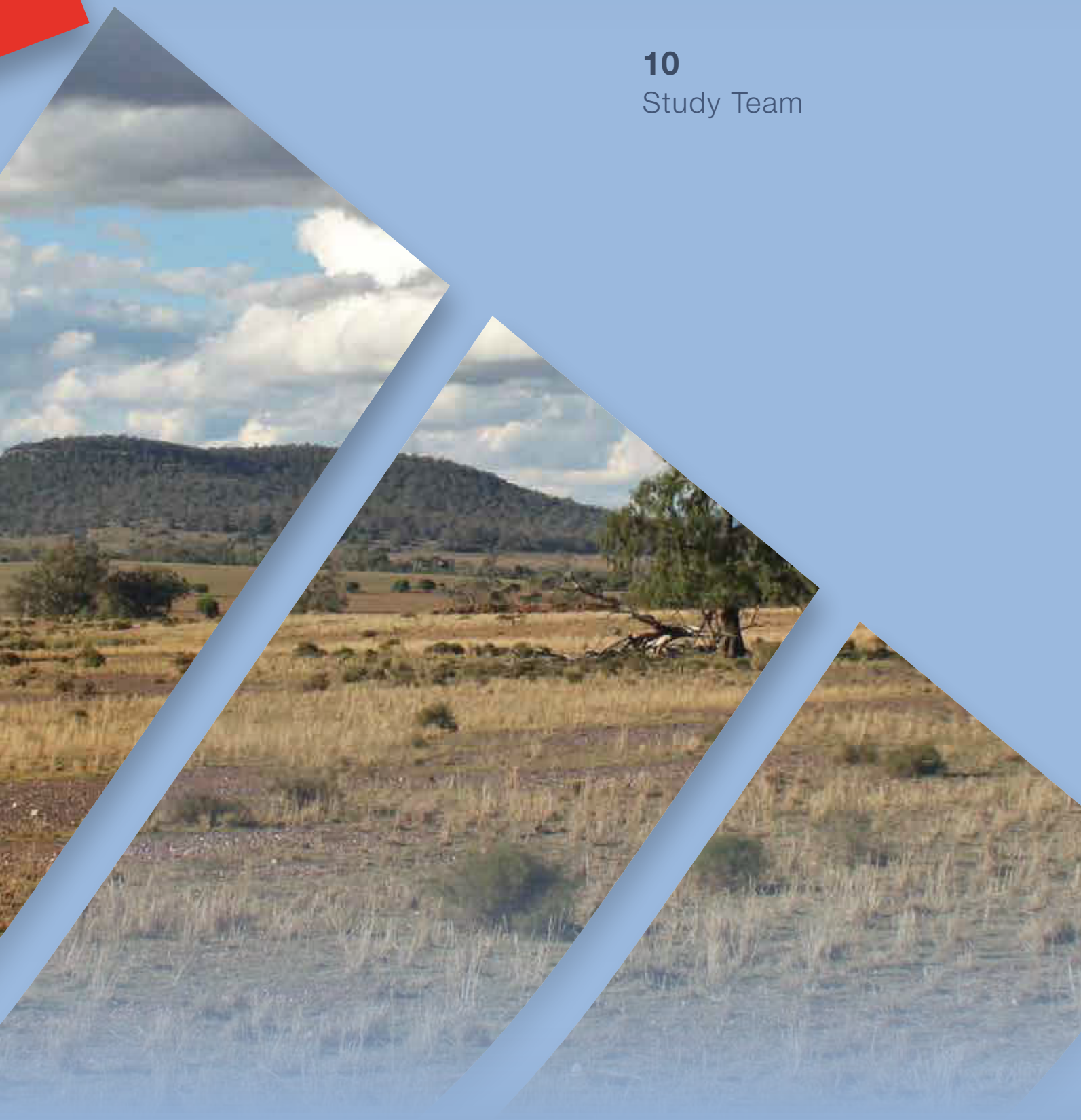
The Project will provide net production benefits to Australia of $1,310 M and will:

- Maximise the recovery of a high quality, thermal coal resource for which there is an increasing global demand;
- Create approximately 1,015 direct and indirect jobs on a regional basis (Gunnedah, Liverpool Plains, Tamworth, Narrabri and Upper Hunter LGAs), in areas with a relatively high unemployment rate;
- Create approximately 3,260 (direct and indirect) jobs in NSW;
- Continue and extend financial support to the region, NSW and Australia with taxation and royalty benefits of $1.31 billion over the Project life; and
- Achieve the most efficient economic use of the land.

It has been established that the Project will serve the essential purpose of providing metallurgical and thermal coal for current and future generations and will generate significant economic benefits in the process. Unacceptable and uncertain environmental effects have been avoided. The Project's social and environmental costs have been avoided or minimised as far as practicable by implementing all reasonable and feasible management and mitigation measures. As a consequence, the socio-economic benefits of the Project will far outweigh its social and environmental costs. Therefore, it can be considered that the Project is in the public interest.



WATERMARK
COAL PROJECT
ENVIRONMENTAL IMPACT STATEMENT
February 2013



10
Study Team



Study Team 10

Section	EIS Component / Role	Team Member and Company	
Project Management			
	Chief Executive Officer	Liu Xiang	Shenhua Watermark
	Deputy General Manager	Li Gang	
	Deputy General Manager	Chen Gang	
	Project Manager	Paul Jackson	
	Environment Manager	Mark Howes	
	Community Manager	Melanie Layton	
	Property Manager	Grayson Wolfgang	
EIS Management			
	Project Director	James Bailey	Hansen Bailey
	Project Manager	Melissa Walker	
	Project Coordinator	Michelle Cavanagh	
		Kyle Prowse	
		Chelsea Kavanagh	
Stakeholder Engagement			
	Project Manager	Paul Jackson	Shenhua Watermark
	Community Manager	Melanie Layton	
	Environment Manager	Mark Howes	
	Project Director	James Bailey	Hansen Bailey
	Project Manager	Melissa Walker	
	Project Coordinator	Michelle Cavanagh Kyle Prowse	
Technical Studies			
Appendix A	Schedule of Land to which this EIS Applies	Melissa Walker	Hansen Bailey
Appendix B	Detailed Design Drawings	Phillip Pigram	GHD
Appendix C	Mine Plan Justification Report	Melissa Walker Ian Reid	Hansen Bailey and GHD
Appendix D	Regulatory Correspondence	Melissa Walker	Hansen Bailey
Appendix E	Stakeholder Engagement	Melissa Walker	Hansen Bailey
Appendix F	Revised Environmental Risk Assessment	Melissa Walker	Hansen Bailey
Appendix G	Air Quality and Greenhouse Gas Impact Assessment	Judith Cox	PAEHolmes
Appendix H	Acoustics Impact Assessment	Mark Bridges	Bridges Acoustics

Section	EIS Component / Role	Team Member and Company	
Appendix I	Blasting Impacts on Landforms and Slopes	Luc Daigle	SCT
Appendix J	Visual Impact Assessment	John Van Pelt	JVP Visual Planning and Design
Appendix K	Ecological Impact Assessment	David Robertson	Cumberland Ecology
Appendix L	Koala Plan of Management	David Robertson	Cumberland Ecology
Appendix M	Report on Matters of National Environmental Significance	David Robertson	Cumberland Ecology
Appendix N	Aboriginal Cultural Heritage Synopsis Report	Melissa Walker	Hansen Bailey
Appendix O	Aboriginal Archaeology Impact Assessment	Andrew McLaren	AECOM
Appendix P	Aboriginal Cultural Heritage Values Assessment	Jane Delaney-John	Connect for Effect
Appendix Q	Geotechnical and Geomorphology Investigation of Grinding Groove Sites	Luc Daigle	SCT
Appendix R	Historic Heritage Impact Assessment	Susan Lampard	AECOM
Appendix S	Surface Water Impact Assessment	David Newton	WRM
Appendix T	Groundwater Impact Assessment	James Tomlin	AGE
		Jurgen Schaeffer	SKM
		Noel Merrick (Peer Review)	Heritage Computing
Appendix U	Stygofauna Impact Assessment	Peter Hancock	Eco Logical
Appendix V	Transient Electromagnetic Geophysical Survey	David Allen James Tomlin	Groundwater Imaging and AGE
Appendix W	Geochemical Assessment of Overburden/ Interburden and Coal Reject Materials	Alan Robertson	RGS
Appendix X	Geomorphology Impact Assessment	Guy Lampert	GHD
Appendix Y	Soil Survey and Land Capability Impact Assessment	Clayton Richards	GSSE
Appendix Z	Agricultural Impact Statement	Scott Barnett	Scott Barnett and Associates
Appendix AA	Rehabilitation and Mine Closure Strategy	Clayton Richards	GSSE
Appendix AB	Traffic and Transport Impact Assessment	Damien Chee	DC Traffic and Engineering
Appendix AC	Preliminary Hazardous Analysis	Melissa Walker	Hansen Bailey
Appendix AD	Preliminary Contamination Assessment	Melissa Walker	Hansen Bailey
Appendix AE	Social Impact Assessment	Jan Fallding	Hansen Bailey
Appendix AF	Economics Impact Assessment	Robert Gillespie	Gillespie Economics
Drafting and Graphics Design by Pegasus Survey and Drafting Pty Limited, Melissa Bahur Graphics Design and Publishing Services and Parsons Brinkerhoff			

WATERMARK
COAL PROJECT
ENVIRONMENTAL IMPACT STATEMENT
February 2013



11
Glossary and Abbreviations



Glossary and Abbreviations 11

Table 99 provides a glossary of terms and a list of abbreviations used in this EIS.

Table 99 Glossary and Abbreviations

Abbreviation	Description
ABS	Australian Bureau of Statistics
ACHMP	Aboriginal Cultural Heritage Management Plan
ADG Code	*Australian Code for the Transport of Dangerous Goods by Road and Rail* (National Transport Commission, 2007)
AECOM	AECOM Australia Pty Ltd
AGE	Australasian Groundwater and Environmental Consultants
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
AIP	Aquifer Interference Policy
AIS	Agricultural Impact Statement
ANZECC	Australian and New Zealand Environment Conservation Council
ANFO	Ammonium Nitrate and Fuel Oil
ARI	Average Recurrence Interval
ARS	Advisory Reporting Standard
ARTC	Australian Rail Track Corporation
AS	Australian Standard
AS 1940:2004	*Australian Standard 1940-2004 The Storage and Handling of Flammable and Combustible Liquids*
AS 2187.1:1998	*Australian Standard 2187.1-1998 Explosives - Storage, Transport and Use, Part 1: Storage*
AS 2187.2:2006	*Australian Standard 2187.2-2006 Explosives – Storage, Transport and Use, Part 2: Use of Explosives*
AWBM	Australian Water Balance Model
BCA	Benefit Cost Analysis
bcm	bank cubic metres
Blasting Guideline	*Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* (ANZECC, 1990)
BoM	Bureau of Meteorology
BSAL	Biophysical Strategic Agricultural Land
bt	Billion tonnes
CAP	Catchment Action Plan
CCC	Community Consultative Committee
CEEC	Critically Endangered Ecological Community
CH_4	Methane
CHPP	Coal Handling and Preparation Plant
CIC	Critical Industry Cluster
CMA	Catchment Management Authority
CMHS Act	*Coal Mines Health and Safety Act 2002*
CP Act	*Coastal Protection Act 1979*
CO_2	Carbon dioxide
CO_{2-e}	Carbon dioxide equivalent
Connect for Effect	Connect for Effect Pty Ltd

Abbreviation	Description
CSIRO	Commonwealth Scientific and Industrial Research Organisation
Cultural Heritage Guidelines	*Aboriginal cultural heritage consultation requirements for proponents* (DECCW, 2010)
Cumberland Ecology	Cumberland Ecology Pty Ltd
Dams Safety Act	*Dams Safety Act 1978*
dBA	decibels scaled on the *'A-weighted'* scale
dBL	Linear decibels
DCCEE	Commonwealth Department of Climate Change and Energy Efficiency
DEC	NSW Department of Environment and Conservation (now the Office of Environment and Heritage / the Environmental Protection Authority)
DECC	NSW Department of Environment and Climate Change (responsibilities have been transferred to OEH and EPA)
DECCW	NSW Department of Environment, Climate Change and Water (responsibilities have been transferred to OEH and EPA)
DEH	Commonwealth Department of Environment and Heritage (now Department of Sustainability, Environment, Water, Population and Communities)
DEWHA	Commonwealth Department of Environment, Water, Heritage and the Arts (now Department of Sustainability, Environment, Water, Population and Communities)
DGRs	Director General's Requirements
Disturbance Area	The total area of land to be disturbed by the Project (4,084 ha) within the Disturbance Boundary.
Disturbance Boundary	The delineated area on Figure 9 (blue line) within which mining, infrastructure and associated disturbance activities will occur (not exceeding the quantum of the Disturbance Area).
DMC	Dense Medium Cyclone
DP&I	NSW Department of Planning and Infrastructure (Incorporates former DIPNR, DoP, Planning NSW and DUAP)
DPI	NSW Department of Primary Industries (now DTIRIS)
DoP	NSW Department of Planning (now DP&I)
DoS	Degree of Saturation
Draft RING	*Draft Rail Infrastructure Noise Guideline* (OEH, 2012a)
DSC	NSW Dams Safety Committee
DSE	Dry Sheep Equivalent
DTIRIS	Department of Trade and Investment, Regional Infrastructure and Services
DTIRIS – DRE	Department of Trade and Investment, Regional Infrastructure and Services – Division of Resources and Energy
DTIRIS – PI	Department of Trade and Investment, Regional Infrastructure and Services – Division of Primary Industries
DUAP	NSW Department of Urban Affairs and Planning (now DP&I)
DUES	Department of Energy, Utilities and Sustainability (abolished in April 2007, responsibilities have since been transferred to NOW, EPA, and DTIRIS)
EC	Electrical conductivity
Eco Logical	Eco Logical Australia Pty Ltd
Economic EIA Guidelines	*Draft Guidelines for Economic Effects and Evaluation in Environmental Impact Assessment* (James and Gillespie, 2002)
EEC	Endangered Ecological Community
EIP	Extraction Industries Policy
EIS	Environmental Impact Statement
EL	Exploration Licence
EMP	Environmental Monitoring Program
EMS	Environmental Management System
ENM	RTA Technology's Environmental Noise Model
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Regulation	*Environmental Planning and Assessment Regulation 2000*
EPA	NSW Environment Protection Authority
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999* (Commonwealth)

Abbreviation	Description
EPI	Environmental Planning Instrument
EPL	Environmental Protection Licence
ESD	Ecologically Sustainable Development
Fisheries Act	*Fisheries Management Act 1994*
GDE	Groundwater Dependant Ecosystem
GHD	GHD Pty Ltd
Groundwater Imaging	Groundwater Imaging Pty Ltd
GSC	Gunnedah Shire Council
GSSE	GSS Environmental
Guidelines for Hazard Analysis	*Hazardous Industry Planning Advisory Paper No. 6 – Hazard Analysis* (DoP, 2011)
Gunnedah LEP	*Gunnedah Local Environmental Plan 2012*
ha	Hectare
HEC-RAS	Hydrologic Engineering Centres River Analysis System
Heritage Act	*Heritage Act 1977*
HPG	Highly Productive Groundwater
HVAS	High Volume Air Sampler
ICNG	*Interim Construction Noise Guideline* (DECC, 2009)
ICOMOS	International Council of Monuments and Sites
INP	*NSW Industrial Noise Policy* (EPA, 2000)
JORC	Australasian Joint Ore Reserves Committee
JVP	JVP Visual Planning and Design
km	Kilometres
km/hr	Kilometres per hour
kV	Kilovolt
kVA	Kilovolt amperes
LA_{10}	A noise level exceeded for 10% of the time
LA_{90}	Commonly referred to as the background noise, this is the level exceeded 90% of the time
LA_{eq}	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period
LALC	Local Aboriginal Land Council
LA_{min}	The minimum sound level recorded during a measurement period
LA_{max}	The maximum sound level recorded during a measurement period
LEP	Local Environment Plan
LGA	Local Government Area
LoS	Level of Service
LOX	Limit of Oxidisation
LPG	Liquid Petroleum Gas
LPSC	Liverpool Plains Shire Council
m	Metres
Mbcm	Million bank cubic metres
MIA	Mine Infrastructure Area
MIC	Maximum Instantaneous Charge
Mining Act	*Mining Act 1992*
Mining SEPP	*State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2011*
ML	Mega litre
MNES	Matter of National Environmental Significance

Abbreviation	Description
MOP	Mining Operations Plan
MSC Act	*Mine Subsidence Compensation Act 1961*
Mt	Million tonnes
Mtpa	Million tonnes per annum
MVKT	Million Vehicle Kilometres Travelled
N_2O	Nitrous oxide
Namoi 2030	*Namoi 2030 Regional Resource Strategy Final Report* (Parsons Brinckerhoff, 2010)
Namoi CAP	*Namoi Catchment Action Plan 2010 – 2020*
NEMP	National Environment Protection Measure
NGO	Non-Government Organisation
NOW	NSW Office of Water
NO_x	Nitrogen Oxide
NPW Act	*National Parks and Wildlife Act 1974*
NT Act	*Native Title Act 1993*
NTSCorp	Native Title Services Corporation Limited
NV Act	*Native Vegetation Act 2003*
OEA	Overburden Emplacement Area
OEH	Office of Environment and Heritage (formerly DECCW)
PAC	Planning Assessment Commission
PCI	Pulverised Coal Injection
PEL	Petroleum Exploration Licence
PFM	Planning Focus Meeting
Pipelines Act	*Pipelines Act 1967*
$PM_{2.5}$	Particulate matter less than 2.5 μm
PM_{10}	Particulate matter less than 10 μm
POEO Act	*Protection of the Environment Operations Act 1997*
Project Boundary	The Watermark Coal Project Application Boundary
RAP	Registered Aboriginal Party
RBL	Rating Background Level
RC	Resource Centre
RCLALC	Red Chief Local Aboriginal Land Council
RGS	RGS Environmental Pty Ltd
RL	Reduced Level
RMS	NSW Transport, Roads and Maritime Services (formerly RTA)
RNP	*NSW Road Noise Policy* (DECCW, 2011)
Roads Act	*Roads Act 1993*
ROM	Run of Mine
SAL	Strategic Agricultural Land
SAT	Spot Assessment Technique
SCT	SCT Operations Pty Ltd
SEPP	State Environmental Planning Policy
SEPP 33	*State Environmental Planning Policy 33 – Hazardous & Offensive Development*
SEPP 33 Guidelines	*SEPP 33 – Hazardous and Offensive Development Application Guidelines* (NSW Department of Urban Affairs and Planning, 1994)
SEPP 44	*State Environmental Planning Policy 44 – Habitat Koala Protection*
SEPP 55	*State Environmental Planning Policy 55 – Remediation of Land*
SEPP Mining	*State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007*

Abbreviation	Description
SEWPaC	Department of Sustainability, Environment, Water, Population and Communities (formerly Commonwealth Department of Environment, Water, Heritage and the Arts)
Shenhua Watermark	Shenhua Watermark Coal Pty Limited
SKM	Sinclair Knight Merz Pty Ltd
SRLUP	*Strategic Regional Land Use Plan – New England North West*
SRD	State and Regional Development
SRD SEPP	*State Environmental Planning Policy (State and Regional Development) 2011*
SSD	State Significant Development
Strategic Agricultural Land Assessment Policy	*Interim Strategic Agricultural Land Policy for State Significant and Transitional Part 3A Mining and Coal Seam Gas Proposals in the Upper Hunter and New England North West Regions*
t	Tonne
TARP	Trigger Action Response Plan
TDEM	Time Domain Electromagnetic
TDS	Total Dissolved Solids
tpa	Tonnes per annum
tph	Tonnes per hour
The Burra Charter	*The Burra Charter: the Australia ICOMOS Charter for the conservation of places of Cultural Significance* (ICOMOS, 1999)
The Project	The Watermark Coal Project
TRC	Tamworth Regional Council
TSC Act	*Threatened Species Conservation Act 1995*
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
TARP	Triggered Action Response Plan
VCU	Visual Character Units
Vibration Guideline	*Assessing Vibration – a Technical Guide* (DEC, 2006)
VPA	Voluntary Planning Agreement
WAL	Water Access Licence
Water Act	*Water Act 1912*
Whitehaven	Whitehaven Coal Mining Limited
WLALC	Walhallow Local Aboriginal Land Council
WM Act	*Water Management Act 2000*
WM Regulation	*Water Management (General) Regulation 2011*
WSP	Water Sharing Plan
WS1	Weather Station 1
WS2	Weather Station 2
WRM	WRM Water and Environment Pty Ltd



WATERMARK
COAL PROJECT
ENVIRONMENTAL IMPACT STATEMENT
February 2013



12
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References 12

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