AUSTRALIAN ZIRCONIA LTD
(A SUBSIDIARY OF ALKANE RESOURCES LTD)

ABN: 51 091 489 511

Project Overview

And

Preliminary Environmental Assessment

for the

Dubbo Zirconia Project New South Wales

Prepared by:

R.W. CORKERY & CO. PTY. LIMITED

September 2012

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Dubbo Zirconia Project

Project Overview and Preliminary Environmental Assessment

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COMMONLY USED ACRONYMS IN THIS DOCUMENT

AZL	Australian Zirconia Ltd
ARTC	Australian Rail Track Corporation Ltd
CCC	Community Consultative Committee
DGRs	Director-General's Requirements
DP&I	Department of Planning & Infrastructure (NSW)
DRE	Division of Resources and Energy (NSW)
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (Commonwealth)
DTIRIS	Department of Trade and Investment, Regional Infrastructure and Services (NSW)
DZP	Dubbo Zirconia Project
EPA	Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979 (NSW)*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
EPL	Environment Protection Licence
LEP	Local Environmental Plan
LGA	Local Government Area
NOW	NSW Office of Water
OEH	Office of Environment and Heritage (NSW)
ROM	Run-of-Mine
SEPP	State Environmental Planning Policy
TSC Act	*Threatened Species Conservation Act 1995 (NSW)*

SUMMARY OF KEY FACTS AND STATISTICS

Applicant	• Australian Zirconia Ltd
Application Area / Site	• Mine Site (Investigation Area)[1] (~2 800ha) • Macquarie River Pipeline Corridor (10m x 8km =8ha) • Toongi – Dubbo Rail and Gas Corridor (~30km)
Area of Disturbance[2]	• Mine Area (open cut and waste rock emplacement) (61ha) • Processing Area (stockpile areas, crushing plant, processing plants, offices, laboratories and workshops) (60ha) • Residue Storage Area (to be determined) • Evaporation Ponds (to be determined) • Roads and other Infrastructure (10ha) • Macquarie River Pipeline Corridor (10m x 8km = 8ha) • Rail Load-out Facility (2ha)
Project Overview	• Zirconium, yttrium, niobium and rare earth element resources • Project Application sought for 20 years • Project Life = up to 80 years (with potential extension beyond) • Proved Ore Reserve (0-26m) of 8.07 million tonnes grading 1.91% ZrO_2(zirconium), 0.46% Nb_2O_5 (niobium), 0.03% Ta_2O_3 (tantalum), 0.14% Y_2O_3 (yttrium)), 0.04% HfO_2 (hafnium) and 0.75% REO (rare earth oxides) • Mining by drill and blast, load, haul and dump of 1Mtpa of ore. • Unique and purpose designed process to be implemented which incorporates grinding, sulphation (addition of sulphuric acid and roasting), water leaching, filtering and solvent extraction of zirconium, niobium and Rare Earth products, thickening, washing and drying • Waste residue from the process to be neutralised and stored within a lined residue storage facility • Waste water to be pumped into lined evaporation ponds • Rail Load-out Facility to be constructed on upgraded Toongi – Dubbo Rail Line for delivery of bulk chemical reagents and despatch of products • Access to the site via Obley Road (to be upgraded) • Estimated employment: 220 full-time • Hours of Operation – Mining: 7:00am to 6:00pm, Monday to Saturday – Processing: 24hrs/day, 7 days per week – Road transport: 24hrs/day, 7 days per week – Rail Loading/despatch: 24hrs/day, 7 days per week

[1] The final Mine Site will be defined following the completion of project planning.
[2] The areas quoted are preliminary and subject to modification following further project planning.

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1. INTRODUCTION

This section introduces the Dubbo Zirconia Project ("the DZP"), the Applicant and the Site. It also provides relevant background information and an overview of the consultation undertaken and proposed, and reviews the environmental studies commenced and the team assembled to undertake the assessment of the DZP.

1.1 SCOPE

Australian Zirconia Ltd ("the Applicant" or "AZL") proposes to develop and operate a small scale open cut mine supplying ore containing the metals: Zirconium; Niobium; and Yttrium, and Rare Earth Elements (REE's) including Hafnium, Tantalum to a unique and purpose developed processing plant near the village of Toongi, approximately 25km south of Dubbo (see **Figure 1-1**). Critical to the development and operation of the "Dubbo Zirconia Project" (DZP) would be the upgrade of the currently disused Toongi-Dubbo Rail Line, upgrade to Obley Road, construction of a water pipeline from the Macquarie River, construction of a gas pipeline (from Dubbo) and construction of a new 132kV transmission line (from Geurie to Toongi)[3]. The proposed mining and processing operations, and associated facilities for the storage and management of the various waste by-products of the mining and processing operations (referred to as the Mine Site), are located over parts of six farming properties. Negotiations have been successfully completed or are continuing with each land owner to purchase the entire property or that part of the property underlying the Mine Site. Access to those properties affected by the infrastructure external to the Mine Site will be negotiated.

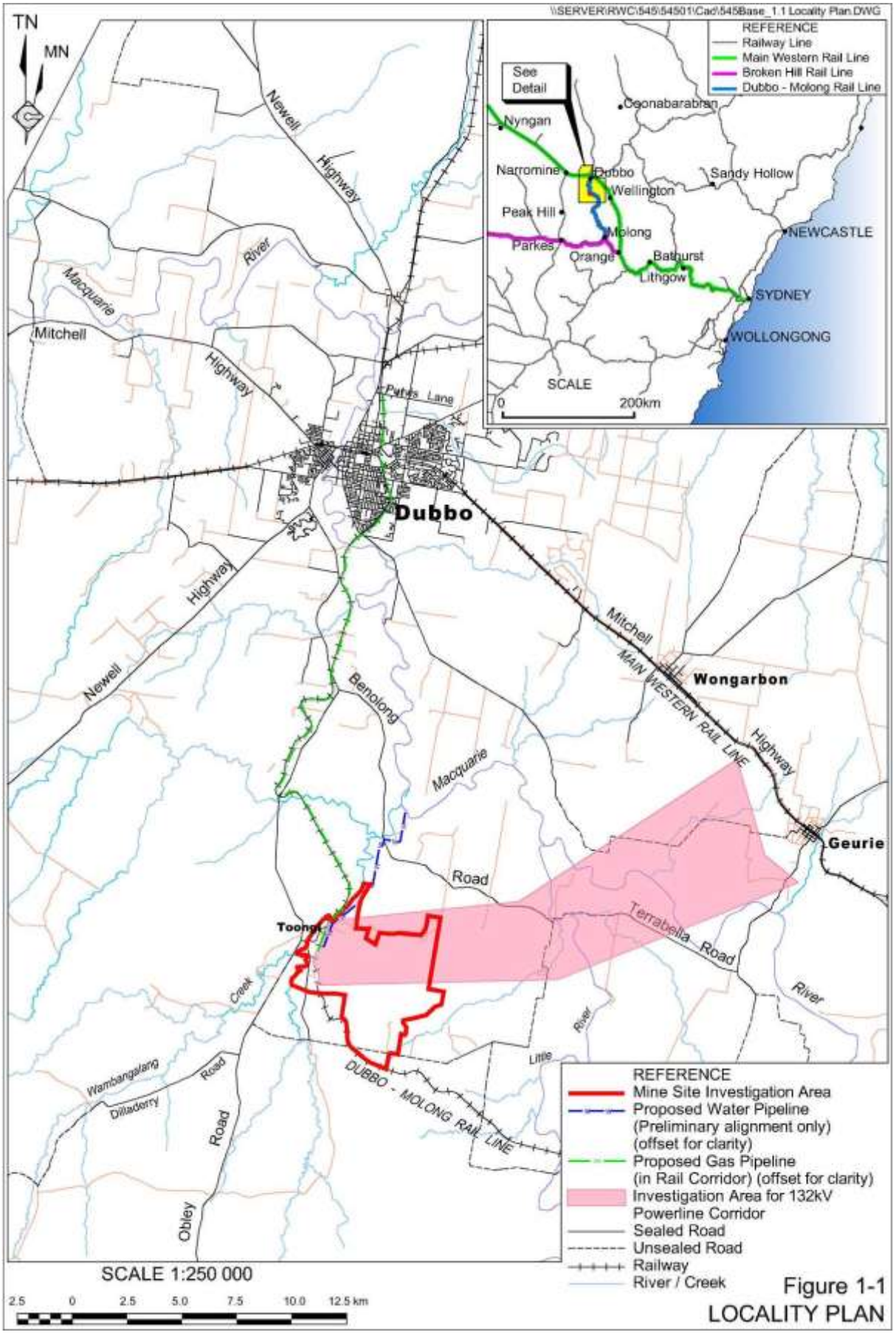
This document has been assembled by R.W. Corkery & Co. Pty Limited on behalf of the Applicant to provide the NSW Department of Planning & Infrastructure (DP&I) and other relevant government agencies with sufficient information to enable the Director-General's Requirements (DGRs) for an Environmental Impact Statement to be prepared for the DZP.

This document provides[4]:

- the local setting for the DZP (including land ownership, the location of nearby residences and the identification of critical infrastructure and environmental features):
- an overview of the proposed operations (identifying and describing each of the component activities of the DZP);
- a discussion on the strategic planning documents, environmental planning instruments and key development standards that applying to the DZP;
- details of the consultation undertaken by the Applicant to date;
- a preliminary risk assessment and discussion on the environmental parameters likely to be affected by the DZP; and
- justification for the development of the DZP.

[3] Approval for the construction and operation of the 132kV electricity transmission line and distribution network is being sought separately from Essential Energy under Part 5 of the EP&A Act.

[4] The Capital Investment Value (CIV) of the DZP is provided in the cover letter provided to the Department of Planning & Infrastructure.


\\SERVER\RWC\545\54501\Cad\545Base_1.1 Locality Plan.DWG
TN
MN
REFERENCE
Railway Line
Main Western Rail Line
Broken Hill Rail Line
Dubbo - Molong Rail Line
See Detail
Nyngan
Coonabarabran
Narromine
Dubbo
Wellington
Sandy Hollow
Peak Hill
Molong
Parkes
Orange
Bathurst
Lithgow
NEWCASTLE
SYDNEY
WOLLONGONG
SCALE
0
200km
Newell
Highway
Macquarie
River
Mitchell
Highway
Purvis Lane
Dubbo
Newell
Highway
Mitchell
MAIN WESTERN RAIL LINE
Wongarbon
Bentolong
Macquarie
Highway
Geurie
Road
Toongi
Terrabella
Road
Creek
River
Little
River
Wambangalang
Road
Dilladerry
Road
Obley
DUBBO - MOLONG RAIL LINE
REFERENCE
Mine Site Investigation Area
Proposed Water Pipeline
(Preliminary alignment only)
(offset for clarity)
Proposed Gas Pipeline
(in Rail Corridor) (offset for clarity)
Investigation Area for 132kV
Powerline Corridor
Sealed Road
Unsealed Road
Railway
River / Creek
SCALE 1:250 000
2.5 0 2.5 5.0 7.5 10.0 12.5 km
Figure 1-1
LOCALITY PLAN

It is noted that investigations potentially influencing the final location and design of various components of the DZP, e.g. ecological, archaeological and hydrological investigations, are ongoing. The layout of the DZP Site represents the most likely arrangement of activities, however, should modifications be required to accommodate environmental or operational constraints these will be identified in the *Environmental Impact Statement* for the DZP.

1.2 THE APPLICANT AND THE SITE

1.2.1 The Applicant

The Applicant, Australian Zirconia Limited, was formed in July 2000 to hold all the assets of the DZP and to facilitate the ultimate development of that project. AZL is a wholly owned subsidiary of Alkane Resources Ltd ("Alkane"), a publicly listed Australian mining and exploration company which has been in existence since 1969 and has approximately 6 100 shareholders.

Alkane has a long term involvement and ongoing commitment to the Central West of New South Wales and has substantial investment in the people and resources of the region. Alkane developed and operated the Peak Hill Gold Mine on the outskirts of Peak Hill from 1996 to 2005 and has an application before the DP&I to develop and operate a gold mine (open cut and underground) at Tomingley (50km southwest of Dubbo).

AZL is operated by a board and management team with numerous years of experience in open cut and underground mining projects. The key AZL personnel are as follows.

- Ian Chalmers (MSc) – Managing Director
- Mr Terry Ransted (BAppSc) - Chief Geologist; and
- Mr Mike Sutherland (BSc, GCComRel) - General Manager (Alkane) NSW.
- Mr Tony Wright – Commercial Manager.

1.2.2 The Site

The Site for the DZP corresponds to the application area for development consent and comprises four component areas (see **Figure 1-1**).

- The Mine Site: will incorporate all areas of proposed Project-related disturbance associated with mining, processing, waste management and related activities. The exact boundary of the Mine Site remains to be defined and will be dependent on the final size, location and shape of various project components (most notably the evaporation ponds). **Figure 1-2** provides the Mine Site investigation area, within Exploration Licence (EL) 5548, within which the final Mine Site will be located. The Proponent is negotiating options to purchase all land within the Mine Site investigation area.

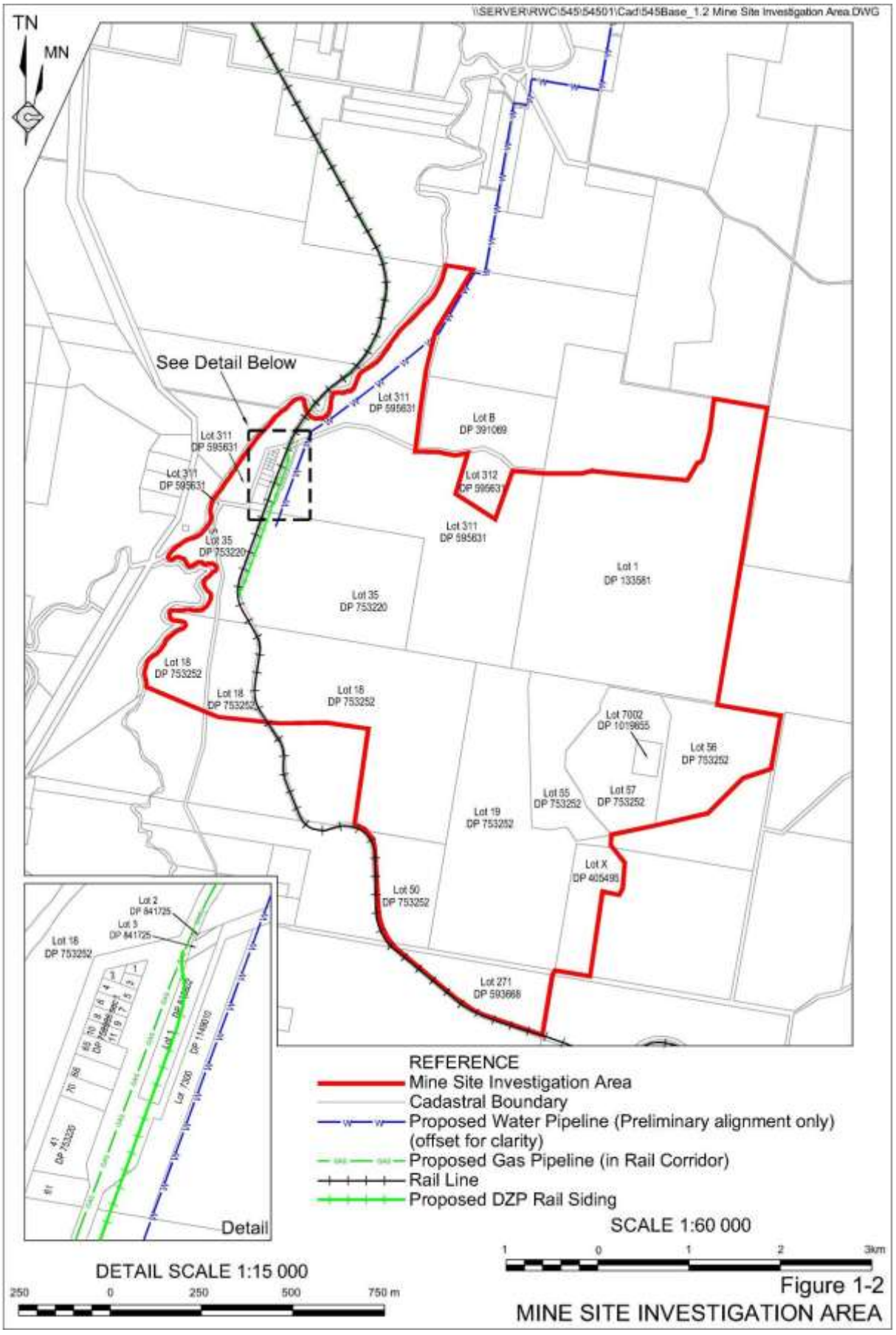


Figure 1-2
MINE SITE INVESTIGATION AREA

- Toongi – Dubbo Rail and Gas Corridor: comprising an upgrade to the Toongi – Dubbo section of the currently disused Dubbo-Molong Rail Line and the construction of a natural gas pipeline, developed as a spur line from the Central West Pipeline (operated by APA Group) between Purvis Lane, Dubbo and the Mine Site. The gas pipeline would be located within an approximately 30km long, 5m wide corridor within the rail easement.
- Macquarie River Water Pipeline: comprising a corridor approximately 8km long and 10m wide. **Figure 1-1** presents a preliminary alignment of the water pipeline constraining the pipeline primarily to unformed road reserves. However, it is likely that following consultation with the relevant owner(s) of land adjoining these road reserves that the alignment may become more direct between the Mine Site and Macquarie River.

Table 1-1 lists the associated land titles for each of the four component areas. It is noted that the perimeter or alignment of the component areas may be subject to modification following the completion of further project planning and design.

Table 1-1
Application Area Land Titles

Mine Site Investigation Area (see Figure 1.2)		**Macquarie River Water Pipeline (see Figure 1.2)**	**Toongi – Dubbo Rail and Gas Corridor**
Lot 311 DP595631	Lot 19 DP 753252	Lot 311 DP595631	Toongi – Dubbo Rail Reserve
Lot 35 DP753220	Lot X DP405495	Lot 27 DP753220*	
Lot 18 DP753252	Lot 55 DP753252	Lot 62 DP753220*	
Lot 50 DP756252	Lot 57 DP 753252	Lot 30 DP753220*	
Lot 271 DP593668	Part Lot 56 DP753252	Lot 1-4 DP753226*	
Lot 1 DP133581	Lot 211 DP595631	Various public road reserves	
Lot 7300 DP1149010	Lot 1 DP818802		
Lot 3 DP841725			
* By negotiation with land owner			

1.3 PROJECT BACKGROUND

The DZP is centred on the Toongi trachyte which forms one of several alkaline volcanic and intrusive bodies of Jurassic age in the region (see Section 3.2 for further detail on the local geology). Previous geological mapping, sampling and drilling (preceding EL 5548) indicated a substantial body of altered trachyte containing highly elevated levels of the metals zirconium, hafnium, niobium, tantalum, yttrium and rare earth elements.

AZL subsequently undertook additional drilling (in 2000 and 2001) of the trachyte on a staggered 100m x 50m grid to an average vertical depth of 55 metres. The drilling demonstrated the remarkably uniform grade of the trachyte with dimensions of 900m by 500m to the drilled depth.

Following identification of the resource, AZL undertook metallurgical scoping studies and assessment of potential markets and identified that it would be possible to produce high purity products for sale into expanding markets. At the same time, AZL commissioned a number of specialist environmental studies over the Mine Site and commenced consultation with the relevant government agencies as part of a planned development application in 2001.

A feasibility study completed by SNC Lavalin in 2001 established that while the project based on processing 200 000tpa provided a positive cash flow it did not generate a sufficiently attractive return on capital. Key recommendations were to further refine the process flowchart through the construction of demonstration pilot plant and provide product samples for market evaluation.

Work on demonstration pilot plant (DPP) was kick started with a Commercial Ready Grant from the Australian Federal Government in 2006. The DPP was built at ANSTO Minerals (Lucas Heights) under the supervision of TZMI. The DPP has been operating since 2008 confirming the process flowsheet and providing market samples of sufficient quantity to reassure consumers that the different style of products could be suitable for their various end-use applications. In particular, the following advances have underpinned the feasibility of the DZP.

- Several tonnes of a range of zirconia products have been prepared to customer special requirements.
- A niobium product (niobium pentoxide) has been developed and is suitable for use in the steel industry; and
- The recovery of a light REE product and a heavy Y/REE concentrates has been demonstrated.

On the basis of the progress made with the DPP, a revised Definitive Feasibility Study (DFS) was completed in August 2011 by TZMI illustrating the feasibility of the DZP. Marketing studies have also confirmed that adequate market opportunities exist for sale of the expected full production of zirconium, REE and niobium products.

1.4 CONSULTATION

1.4.1 Community Consultation

Since initial inception of the DZP proposal, AZL has been active in consulting with local landholders and other stakeholders. The following provides a summary of the consultation undertaken to date.

Stakeholder Identification

Since the potential for the development of a mining and processing operation at Toongi was conceived, AZL has actively sought to identify and engage local land holders and other potential stakeholders. Through a combination of face to face meetings, telephone conversations, emails and information sessions (see below), a database of local stakeholders has been developed.

AZL is committed to maintaining open lines of communication with these stakeholders through individual discussions, group meetings or community newsletters.

As a publicly listed company, Alkane provides regular updates to the Australian Stock Exchange and its 4,500 shareholders. The *Daily Liberal* (owned by Fairfax) newspaper usually runs a story as a follow up to any ASX release. There are very few people in Dubbo who would not have heard about the DZP over the past ten years.

Community Presentations

AZL has twice (in 2001 and November 2011) hosted information sessions to provide local land owners and stakeholders with relevant details on the nature of the proposal, potential impacts on the local environment, process by which the DZP is to be assessed and determined, and methods by which the local community can contribute to the assessment.

The 2011 information session was held on 28 November at Toongi Hall, with a flyer prepared and distributed to local land owners and other known stakeholders inviting attendance. Between 80 and 100 people attended the information session during which AZL's managing director, Mr Ian Chalmers, presented information on the proposed operations, outlined the environmental studies to be commissioned to assess impact and explained the opportunities a project of this magnitude and longevity would have. Mr Chalmers and other AZL representatives then answered questions raised by those attending. A variety of questions were raised, however, the following provides a summary of the main issues raised by the attending stakeholders.

- The nature of the radioactivity of the ore, products and waste.
- Noise associated with the proposal, in particular that generated by 24 hour operations and rail noise.
- Potential impacts on surrounding agricultural activities and concerns over sterilisation of agricultural land through implementation of a 'buffer zone'.
- Management of waste materials.
- Volume of water required and likely source of this water.
- Employment opportunities and other potential benefits for the local and wider community.

Community Newsletters

- Community Newsletters have been prepared and distributed to the local community at various stages during the development of the DZP. These newsletters have been used by AZL as a method of keeping the wider community informed of the status of DZP planning and development, as well as providing the contact details of critical AZL personnel who can be contacted to discuss any issues relevant to the proposal.
- The most recent newsletter was issued in January 2012, and provided an update on the work that has been completed on the development of the DZP, principally in the development and review of a pilot plant at the Australian Nuclear Science

and Technology Organisation (ANSTO) facility at Lucas Heights, since the previous newsletter of August 2002. The commissioning of a number of specialist environmental assessments to assist in the preparation of and Environmental Impact Statement (EIS) was noted along with information on studies related to the upgrade of the Toongi-Dubbo Rail Line.

- The convening of a Planning Focus Meeting (PFM) on 28 March 2012, where AZL would formerly introduce the project to a variety of NSW government agencies responsible for assessing and ultimately regulating the project and obtain feedback from these agencies and authorities as to specific environmental issues requiring coverage in the EIS, was identified as a key milestone to be achieved in the immediate term.

Engagement of Landholders Potentially Affected by the Rail Line Upgrade

AZL recognises that reinstating (noting that the rail line has never officially been decommissioned) rail operations on the Toongi-Dubbo Rail Line could potentially impact on landholders and residents neighbouring the rail line, both within and beyond the Dubbo city limits. AZL has commenced identifying land owners and residents adjoining the rail line such that formal consultation with these parties can be undertaken. Some correspondence has already been received from potentially affected residents, and it is noted that there has been coverage of the issue in the editorial / letters to editor section of the Daily Liberal (Dubbo Newspaper). To assist in informing local stakeholders as to the proposed incorporation of the rail line into DZP operations, CRrail (an engineering consultancy engaged by AZL to assess the existing conditions and prepare plans for the upgrade of the rail line) advertised5 an invitation for walking and driving inspections of the rail line.

AZL recognises the potential for the recommencement of rail operations on the Toongi-Dubbo Rail Line to impact on those land owners and residents adjoining the rail line and as noted above has committed to continuing consultation with these stakeholders.

Individual Consultation

AZL personnel regularly visit the site and discuss progress of planning and assessment with the affected landholders and current Toongi residents. Invariably, these discussions are not formerly noted, however, issues raised are addressed as relevant or commitments made to do so as part of the environmental assessment process. It is further noted that all community newsletters and other AZL documentation and correspondence provide the contact details of local personnel and invitation to discuss issues of concern as they are identified.

On the basis of the above consultation undertaken by AZL, undertaken in 2001 and recommencing during 2011, AZL has established and maintained excellent lines of communication with the local community and other stakeholders. AZL is confident that in establishing these lines of communication, all issues relevant to the local community and potentially affected stakeholders will be identified and comprehensively addressed in the *Environmental Impact Statement* and/or the appropriate specialist environmental assessments.

[5] 16 January 2012 in the Daily Liberal

1.4.2 Government Agency Consultation

Since AZL recommenced planning for the submission of a development application for the DZP, discussions have been held with the following government agencies and authorities.

- Department of Planning & Infrastructure (DP&I).

  A letter informing the DP&I of the intention of AZL to submit an application for DGR's and host a Planning Focus Meeting (PFM) was sent on 20 February 2012. The DP&I informed the AZL that it was unlikely that a representative would be able to attend the PFM, however, a future site visit to review and discuss the project was suggested.

- Dubbo City Council.

  AZL has undertaken limited discussion with the Council, preferring to wait until project plans are well advanced. Since invitation to a PFM was sent to the Council on 20 February 2012, several informal discussions regarding the type, scale and longevity of the DZP have been held between RWC and Council's Planning Services Supervisor.

- Department of Trade & Investment, Regional Infrastructure & Services – Division of Resources & Energy (DRE).

  On 30 November 2011, AZL presented the Conceptual Project Development Plan (CPDP) to the DRE at the Department's Orange office. The CPDP outlined the background to the development of the DZP, local geology and exploration completed, identified resources, proposed mining, processing and waste management activities and environmental management. Following review of the CPDP, the DRE referred the project to the DP&I (on 8 December 2011), noting no technical impediments to the mining and processing operations proceeding.

- NSW Office of Water (NOW).

  Informal discussions have been held between AZL and NOW personnel.

- NSW Office of Environment and Heritage (OEH) / Environment Protection Authority (EPA).

  While there has been no formal consultation by AZL with either the OEH or EPA since planning for the DZP recommenced, various personnel within these government agencies have been kept informed over specific issues relevant to the DZP. For example, personnel from OEH's threatened species unit in Dubbo have been kept informed as to developments related to classification and further survey for a species of Aprasia (worm lizard) originally identified on the Mine Site in 2001.

- Department of Primary Industries (DPI).

  While there has been no direct consultation by AZL with the DPI in relation to the DZP, the NSW Agriculture and NSW Fisheries divisions of DPI have been informed as to progress of the DZP proposal.

Sustainable Soils Management, a consultancy commissioned by AZL to assist in soil and land management of the Mine Site (during and post-mining operations), has consulted Regional Services & Land Use section of the DPI in relation to sampling requirements for the preparation of an Agricultural Land Capability Assessment (and Agricultural Impact Statement)..

NSW Fisheries has been consulted in relation to expediting a licence for sampling of fish and other aquatic fauna as part of an aquatic ecological assessment in preparation.

Discussions have also been held with the NSW Transport Country Rail Infrastructure Authority (CRIA) and Essential Energy regarding the suitability of the existing rail and power infrastructure to support the DZP.

Between 20 February and 19 March 2012, invitations to attend a PFM for the DZP on 28 March 2012 were sent to the following government agencies and public authorities considered as having an interest in the assessment and ultimately operation of the DZP.

- NSW Department of Planning & Infrastructure (Major Project Assessments).
- NSW Department of Planning & Infrastructure (local Dubbo office).
- NSW Department of Premier & Cabinet.*
- NSW Office of Environment & Heritage.*
- NSW Office of Water.*
- NSW Department of Trade & Investment, Regional Infrastructure & Services (Mineral Resources).*
- NSW Roads & Maritime Services.*
- NSW Department of Primary Industries (Catchments & Lands).*
- NSW Department of Primary Industries (NSW Agriculture).*
- NSW Department of Primary Industries (NSW Fisheries).*
- Dubbo City Council.*
- Central West Catchment Management Authority.*
- Commonwealth Department of Sustainability, Environment, Water, Populations & Communities.
- Essential Energy.*
- NSW Transport Country Rail Infrastructure Authority.*
- Australian Rail Tack Corporation.*
- John Holland Rail.*

Those noted with an * indicated an intention to attend a PFM.

It is expected that the specific requirements of all relevant government agencies will be sought by DP&I following the circulation of this document and attendance at the PFM.

1.5 MANAGEMENT OF INVESTIGATIONS

This document has been prepared by Mr Alex Irwin, B.Sc (Hons), and Ms Christy Hill, B.Env.Man.(SusDev), both Senior Environmental Consultants of R.W. Corkery & Co Pty. Limited (RWC).

Details of the DZP have been provided by Messrs Mike Sutherland, Terry Ranstead and Ian Chalmers of the Applicant. Input into the proposed processing operations of the DZP has been provided by Mr Gavin Diener of TZ Minerals International Pty Ltd (TZMI).

A range of environmental investigations have been initiated to identify the environmental constraints that need to be taken into account by the Applicant during the design of the DZP. These studies are being undertaken by a team of specialist consultants managed by RWC including the following key individuals and companies

- Mr Phillip Cameron of OzArk Environmental Heritage & Management Pty Limited (OzArk): Biodiversity Impact Assessment.

  OzArk's assessment will build upon earlier survey and assessment completed by Geoff Cunningham of Geoff Cunningham Natural Resource Consultants Pty Ltd (GCNRC) (flora) and Dr David Goldney (fauna) in 2001 and 2002. OzArk will also rely upon specialist study and advice provide by Dr Arthur White of Biosphere Environmental Consultants Pty Ltd in relation to herpetological issues.

- Dr Alison Hunt of Alison Hunt & Associates: Aquatic Ecology Assessment.

  Dr Hunt's brief also includes the consideration of potential impacts on local stygofauna.

- Dr Jodie Benton of OzArk: Cultural Heritage Assessment.

  OzArk's assessment will build upon earlier survey and assessment completed by Lloyd Nolan of Guarra Aboriginal Site Surveys in 2000 and 2002.

- Mr Damon Roddis of PAEHolmes: Air Quality Impact Assessment.

- Mr Oliver Muller of EMGA Mitchell McLennan (EMM): Noise and Vibration Impact Assessment.

  The Noise and Vibration Impact Assessment of EMM will build upon noise monitoring completed by Richard Heggie Associates Pty Ltd in December 2001.

  Both the Noise and Vibration Assessment and Air Quality Impact Assessment will incorporate meteorological data collected at the Toongi Meteorological Station (operated by Alkane Resources Ltd) and collated by Mr Pvel Zib (of Zib & Associates Pty Ltd).

- Mr Mark Passfield of SEEC has been commissioned to complete a Surface Water Impact Assessment.

  SEEC's assessment will build upon survey and assessment completed by Golder Associates Pty Ltd in 2002.

- Mr Blake Dickson and Mr Stuart Brisbane of Environmental Earth Sciences (EES): Groundwater Assessment.

  The hydrogeological investigations and assessment to be completed by EES will build upon detailed groundwater testing, modelling and assessment completed by Golder Associates Pty Ltd in 2002.

- Mr David Duncan of Sustainable Soils Management: Soils Land Capability and Agricultural Impact Assessment.

  SSM's assessment will build upon earlier survey and assessment completed by GCNRC in 2001 and 2002.

- Mr Ben Rossiter of Constructive Solutions Pty Ltd: Traffic Impact Assessment.

  The brief of Constructive Solutions also includes provision of conceptual engineering plans for new and upgraded road intersections and assessment of the proposed level crossings to be reinstated as a result of the Toongi – Dubbo Rail Line.

- Mr James Hondros of JRHC Enterprises Pty Ltd: Radiation Impact Assessment.

  The brief of JRHC Enterprises Pty Ltd includes assessment of residual radiation impacts of the mined ore, products, processing wastes and fugitive emissions.

- Ms Melissa Chin, Mr Giles Peach and Mr Stuart Chia of Sherpa Consulting Pty Ltd: Preliminary Hazard Analysis.

  The brief of Sherpa Consulting Pty Ltd includes initial risk screening in accordance with SEPP 33 and preliminary hazard analysis for the dangerous goods transported to, stored and used as part of the Project.

- Ms Diana Gibbs of Diana Gibbs and Partners: Socio-Economic Assessment.

These and additional specialist consultancies will complete relevant assessments of the key issues and the identification of the design and operational safeguards for the DZP for inclusion in the *Environmental Impact Statement*. As noted in Section 1.1, the DZP design and/or layout could be modified as a consequence of constraints identified by any of the assessments noted above. Any such modification will be identified in the *Environmental Impact Statement* (EIS).

2. APPROVALS REQUIRED, PLANNING ISSUES AND THE APPROVALS PROCESS AND PRELIMINARY RISK ASSESSMENT

This section introduces the approvals the Applicant understands will be required for the Dubbo Zirconia Project to proceed. The State and local planning issues are canvassed and the overall approvals process outlined.

2.1 APPROVALS REQUIRED

Based upon the current design and understanding of relevant environmental issues, the Dubbo Zirconia Project would require the following approvals to proceed.

1. Development consent under the *Environmental Planning and Assessment Act 1979* (EP&A Act). As the DZP represents mining which has a capital investment value of more than $30 million, it is recognised as State Significant Development under *State Environmental Planning Policy (State and Regional Development) 2011* for which approval is required (in accordance with Division 4.1 of the EP&A Act) from the Minister for Planning and Infrastructure or as delegated by the Minister to the Planning Assessment Commission, the Director-General or to another public authority.
2. Mining Lease under the *Mining Act 1992* for the area nominated as the Mine Site. The issuing authority would be the Minister for Resources and Energy. A mining lease application (MLA183) covering 916.95ha within the nominated Mine Site area was lodged with the Department of Mineral Resources on 14 August 2001. Given modifications to the Mine Site impact footprint since 2001, it is anticipated that this MLA will be replaced by a new title application.
3. An Environment Protection Licence under the *Protection of the Environment Operations Act 1997*. The issuing authority would be the Office of Environment and Heritage (Environment Protection Authority) (OEH (EPA)).
4. A *Water Access Licence* (WAL) and Water Use Approval issued by NOW under Part 5 of the *Water Act 1912* would be required to permit extraction of water from the Macquarie River.
5. One or more licences issued by NOW under Part 5 of the *Water Act 1912* would be required for each of the three existing and any additional proposed groundwater monitoring bores. The Proponent already holds licences for Monitoring Bores 2, 5 and 6.
6. A permit under the *Roads Act 1993* to undertake road and intersection works on Obley Road, together with modifications to rail crossings of the Dubbo-Molong Rail Line. Dubbo City Council or the NSW Roads and Maritime Services (RMS) would be the issuing authority for the required permits. A Works Authorisation Deed would be entered between the Proponent and RMS and is the agreement by which all works (as per the definition provided for in Section 138 of the Roads Act 1993) would be administered by the RTA.

7. A licence agreement between John Holland Rail / Australian Rail Track Corporation Ltd (ARTC) and the Proponent to upgrade the Dubbo-Molong Rail Line.
8. An approval from the NSW Dams Safety Committee for the design and construction of a residue storage facility.
9. A Licence issued by Workcover Authority of New South Wales for the storage and use of explosives, cyanide and other reagents within the Mine Site. This licence is typically only granted after the Department of Trade & Investment, Regional Infrastructure and Services – Division of Resources & Energy (DRE) approves a Security Plan for the storage and handling of explosives (including explosive precursors).
10. A high voltage Connection Agreement with Essential Energy which holds an electricity distributor's licence under the *Electricity Supply Act 1995*.
11. Approval from Essential Energy to relocate a distribution asset.

The Applicant also proposes to refer the DZP to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) to establish whether the Proposal is a controlled action under the *Environment Protection and Biodiversity Conservation* (EPBC) *Act 1999*. Should the DZP be determined to be a controlled action under the EPBC Act, an approval would be sought from the Commonwealth Minister for DSEWPaC.

2.2 PLANNING ISSUES

2.2.1 Commonwealth Planning Issues

Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places. These are collectively referred to as Matters of National Environmental Significance (NES).

Under the EPBC Act, if a proposal has the potential to have a significant impact on a Matter of NES, it is required to be referred to the Department of Sustainability, Environment, Water, Populations and Communities (DSEWPaC) for assessment as to whether it represents a 'controlled action' and therefore requires approval from the Minister for the Environment.

It is considered likely that the DZP would impact on at least one endangered ecological community (EEC) listed under the EPBC Act (see Section 5.7.2), a Matter of NES, and therefore referral to the Minister for the Environment is likely.

2.2.2 State Planning Issues

The following six State Environmental Planning Policies (SEPPs) have been identified which do or could potentially apply to the Proposal.

- SEPP (State and Regional Development) 2011
- SEPP (Rural Lands) 2008
- SEPP (Mining, Petroleum Production and Extractive Industries) 2007
- SEPP (Infrastructure) 2007
- SEPP 33 – Hazardous and Offensive Development
- SEPP 55 – Remediation of Land

State Environmental Planning Policy (State and Regional Development) 2011

As mining development, the DZP is identified as State Significant Development under Schedule 1(5) by virtue of a CIV exceeding $30M.

State Environmental Planning Policy (Rural Lands) 2008

The aims of this SEPP, which applies to the local government area of Dubbo City, as considered relevant to the Project, are to:

(a) facilitate the orderly and economic use and development of rural lands for rural and related purposes; ……..

(c) implement measures designed to reduce land use conflicts;

(d) identify State significant agricultural land for the purpose of ensuring the ongoing viability of agriculture on that land, having regard to social, economic and environmental considerations; ……..

Specifically, and as described in Clause 12, the objectives of this SEPP are to provide for the protection of agricultural land:

i) that is of State or regional agricultural significance, and

ii) that may be subject to demand for uses that are not compatible with agriculture, and

iii) if the protection will result in a public benefit.

An assessment of the impact of the DZP on agricultural land will be considered against these objectives will be provided within the *Environmental Impact Statement*.

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

The Rural Lands SEPP was gazetted on 17 February 2007 in recognition of the importance to New South Wales of mining, petroleum production and extractive industries.

The SEPP specifies matters requiring consideration in the assessment of any mining, petroleum production and extractive industry development. A summary of the matters that the consent authority needs to consider when assessing the DZP is as follows.

- **Clause 12**: Compatibility of proposed mine with other land uses.
- **Clause 13**: Compatibility of proposed development with mining.
- **Clause 14:** Natural resource management and environmental management.
- **Clause 15:** Resource recovery.
- **Clause 16:** Transportation.
- **Clause 17:** Rehabilitation.

An assessment of how each of these clauses is addressed with respect to the DZP will be provided within the *Environmental Impact Statement*.

State Environmental Planning Policy (Infrastructure) 2007

The Infrastructure SEPP identifies, amongst other things, the matters to be considered in the assessment of development adjacent to particular types of infrastructure, including:

- Electricity Infrastructure (Clause 45).
- Pipeline Infrastructure (Clause 55).
- Road Infrastructure (Clause 101).
- Telecommunication Infrastructure (Clause 115).
- Railway Infrastructure (Clause 86).

An assessment of how each of these clauses is addressed with respect to the DZP will be provided within the *Environmental Impact Statement*.

State Environmental Planning Policy No. 33 – Hazardous and Offensive Development (SEPP 33)

Hazardous and offensive industries, and potentially hazardous and offensive industries, relate to industries that, without the implementation of appropriate impact minimisation measures, would, or potentially would, pose a significant risk in relation to the locality, to human health, life or property, or to the biophysical environment. The Proponent notes that diesel fuel and other hydrocarbons, compressed natural gas and a number of the reagents to be used or stored within the Mine Site have dangerous goods classifications. To assess the risk posed by the transport, storage and use of these materials, a risk screening for the DZP would be undertaken in accordance with the document entitled *Applying SEPP 33 Consultation Draft July 2008* (DoP, 2008).

If the risk screening indicates that the DZP may be potentially hazardous based on the use, storage and transportation of any of the potentially hazardous materials, a preliminary hazard analysis (PHA) would be undertaken to identify appropriate management of these materials to reduce the risk associated with the transport, storage, use or disposal of these materials to an acceptable (tolerable) level.

State Environmental Planning Policy No. 55 – Remediation of Land

SEPP 55 aims to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human health or any other aspect of the environment. In particular, this policy requires consideration of whether a development requires a consent for remediation works or not and, where warranted, requires that remediation works meet certain standards and notification requirements.

As the areas proposed for disturbance within the Mine Site have previously been used only for agriculture, it is highly unlikely any contamination is present that requires remediation work prior to undertaking the proposed mining operation. It is noted that the Toongi ore body contains radioactive elements, uranium and thorium, and emits low level natural emissions. These Naturally Occurring Radioactive Materials (NORM) are very low and do not pose a risk within the local environment.

2.2.3 Local Planning Issues

The Site is located within the Dubbo City Local Government Area for which the *Dubbo Local Environmental Plan* (LEP) *2011* is relevant. **Figure 2-1** displays the section of the Dubbo LEP 2011 relevant to the Application Area and its surrounds.

- With the exception of the Dubbo – Molong Rail Line and a small portion of land to the east of the rail line adjacent to the village of Toongi which is zoned SP2 Infrastructure (Railway), the land over which the Mine Site is located is zoned RU1 Primary Production.
- The Macquarie Water Pipeline is located entirely on land zoned RU1 Primary Production (the Macquarie River is zoned W2 Recreational Waterways).
- Natural Gas Pipeline and Dubbo-Molong Rail Line are located within the SP2 Infrastructure (Railway) easement of the Dubbo – Molong Rail Line.

The planning objectives of the RU1 Primary Production and SP2 Infrastructure (Railway) Zones are as follows.

Zone RU1 – Primary Production

The six objectives of the RU1 Zone are to:

- 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 enable uses of an appropriate scale to facilitate the economic sustainability of primary production.
- To enable function centres, restaurants and appropriate forms of tourist and visitor accommodation to be developed in conjunction with agricultural uses.

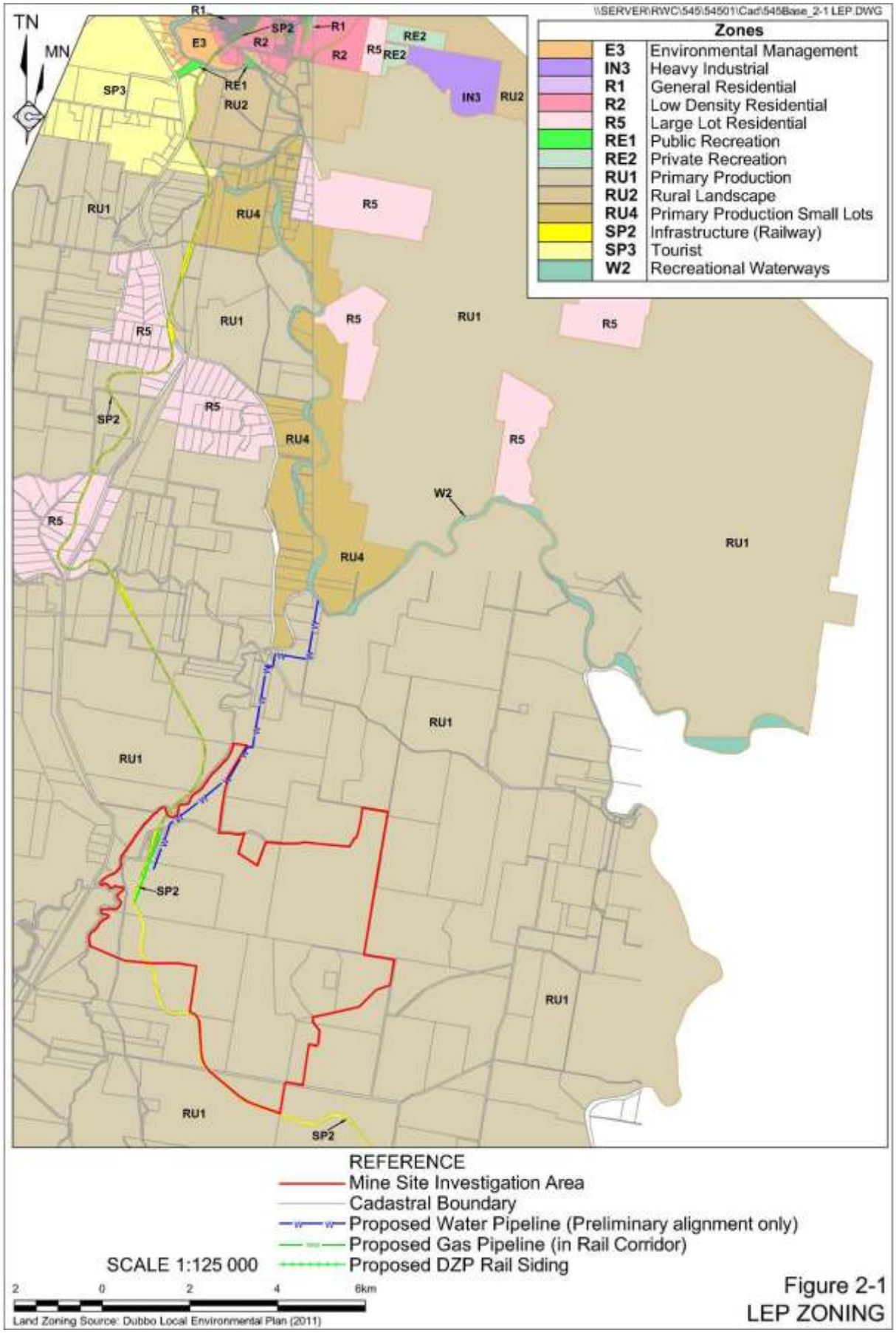


Figure 2-1
LEP ZONING

Open cut mining is permissible within this zone with consent.

Zone SP2 – Infrastructure (Railway)

The two objectives of the E3 Zone are to:

- To provide for infrastructure and related uses.
- To prevent development that is not compatible with or that may detract from the provision of infrastructure.

Development within this zone for the purpose nominated on the LEP map (Railway) is permitted with consent.

2.3 THE APPROVALS PROCESS

Table 2-1 presents the component stages of the approvals process under the EP&A Act and for some of the other approvals referred to in Section 2.1 and provides an indicative timetable currently being followed by the Applicant. It is noted that the timing for a number of the component stages, namely those stages that are managed by the DP&I have been given an indicative timing based principally upon previous approvals issued for mining projects under Part 3A of the EP&A Act. However, based upon the submission of an adequate *Environmental Impact Statement* to be placed on public exhibition in September 2012 and the subsequent granting of development consent, assuming it is granted, the Applicant proposes to commence development of the mine during the first quarter of 2013 and despatch the first product in the first quarter of 2015.

2.4 PRELIMINARY RISK ASSESSMENT

2.4.1 Introduction

Risk is the chance of something happening that will have an impact upon the objectives of a task, which in this case is the development and operation of the DZP in an environmental responsible manner. Risk is measured in terms of consequence (severity) and likelihood (probability) of the event happening.

On 11 January 2012, a preliminary risk assessment workshop was held by the Applicant to identify and quantify the risks associated with the DZP to the environment. Attending the preliminary risk assessment workshop were the following.

- Mr Michael Sutherland, Alkane General Manager, NSW.
- Mr Tony Wright, Alkane Commercial Manager.
- Mr Paul Broadbent, TZMI Engineering Manager.
- Mr Gavin Diener, TZMI Managing Consultant.
- Mr Dereck Becker, TZMI Consulting Engineer.
- Mr Alex Irwin, RWC Senior Environmental Consultant.

Table 2-1
Approvals Process for the Proposal and the Applicant's Indicative Timing

Indicative Timing*	Activity
Ongoing	Extensive project planning as well as local and wider community consultation
23 March 2012	Submit Request for Director-General's Requirements and supporting documentation to the Department of Planning and Infrastructure
28 March 2012	Planning Focus Meeting held for the DZP
April 2012	Department of Planning and Infrastructure issues Director-General's Requirements for the Environmental Impact Statement
April 2012	Lodge new mining lease application(s) with Division of Resources and Energy
April 2012	Refer the project to the Commonwealth Government in accordance with the requirements of the EPBC Act 1999
May 2012	Commonwealth Government determines if the Proposal is a controlled action under the EPBC Act 1999
August 2012	Lodge Development Application and Environmental Impact Statement with Department of Planning and Infrastructure for acceptance by the Department
September 2012	Department of Planning and Infrastructure places Development Application and Environmental Impact Statement on public exhibition
October 2012	Public exhibition of the Environmental Impact Statement
November 2012	Provide responses and clarification of issues arising from the exhibition of the Environmental Impact Statement to the Department of Planning and Infrastructure so that it can prepare its Assessment Report
December 2012	Lodge applications for an Environment Protection Licence as well as lodge applications for other approvals required under various other Acts.
January 2013	Department of Planning and Infrastructure completes the assessment report
* Based on best estimates of the Applicant and RW Corkery & Co Pty Ltd.	

2.4.2 Preliminary Analysis of Environmental Risk

As part of the preliminary risk assessment workshop, and in accordance with Australian Standards HB 203:2006 and AS/NZS 4360:2004, environmental parameters that could be affected by the DZP were identified. Risk sources, potentially affected receptors or environments and potential consequences were then discussed and determined. For each risk source, receptor and potential consequence, a specific potential impact was identified.

On identification of each potential environmental impact associated with the DZP, a review of the Project design, the local environment and other factors was undertaken to identify the likely consequence and likelihood.

The allocation of a consequence rating was based on the definitions contained in **Table 2-2**. It is noted that the assigned consequence rating represents the highest level applicable, i.e. if a potential impact is assigned a level of 4 - Major based on impact to the environment and 2 - Minor based on area of impact, the consequence level assigned would be 4 - Major.

Table 2-2
Qualitative Consequence Rating

Level	Descriptor	Description
5	Catastrophic	• Massive and permanent detrimental impacts on the environment. • Very large area of impact. • Massive remediation costs. • Reportable to government agencies. • Large fines and prosecution resulting in potential closure of operation. • Severe injuries or death.
4	Major	• Extensive and/or permanent detrimental impacts on the environment. • Large area of impact. • Very large remediation costs. • Reportable to government agencies. • Possible prosecution and fine. • Serious injuries requiring medical treatment.
3	Moderate	• Substantial temporary or minor long term adverse impact to the environment. • Moderately large area of impact. • Moderate remediation costs. • Reportable to government agencies. • Further action may be requested by government agency. • Injuries requiring medical treatment.
2	Minor	• Minor detrimental impact on the environment. • Affects a small area. • Minimal remediation costs. • Reportable to internal management only. • No operational constraints posed. • Minor injuries which would require basic first aid treatment.
1	Insignificant	• Negligible and temporary detrimental impact on the environment. • Affects an isolated area. • No remediation costs. • Reportable to internal management only. • No operational constraints posed. • No injuries or health impacts.
Source: modified after HB 203:2006 (Standards Australia, 2006) - Table 4(B)		

The likelihood or probability of each impact occurring was then rated according to the definitions contained in **Table 2-3**.

Table 2-3
Qualitative Likelihood Rating

Level	Descriptor	Description
A	Almost Certain	Is expected to occur in most circumstances.
B	Likely	Will probably occur in most circumstances.
C	Possible	Could occur.
D	Unlikely	Could occur but not expected.
E	Rare	Occurs only in exceptional circumstances.
Source: HB 203:2006 (Standards Australia, 2006) - Table 4(A)		

The risk associated with each environmental impact was assessed without the inclusion of any operational controls or safeguards in place and is based on the qualitative assessment of consequence and likelihood, a risk ranking of either; low, medium, high or extreme was assigned to each potential impact based on the matrix presented in **Table 2-4**.

Table 2-4

Risk Rating Matrix

Likelihood	Consequences				
	Insignificant 1	**Minor 2**	**Moderate 3**	**Major 4**	**Catastrophic 5**
A (Almost Certain)	H	H	E	E	E
B (Likely)	M	H	H	E	E
C (Possible)	L	M	H	E	E
D (Unlikely)	L	L	M	H	E
E (Rare)	L	L	M	H	H

Note: Rating modified after HB 203:2006 (Standards Australia, 2006) - Table 4(C)

The four risk rankings are defined as follows.

Low (L): requiring a basic assessment of proposed controls and residual impacts. Any residual impacts are unlikely to have any major impact on the local environment or stakeholders.

Moderate (M): requiring a medium level assessment of proposed controls and residual impacts. It is unlikely to preclude the development of the Project but may result in impacts deemed unacceptable to some local or government stakeholders.

High (H): requiring in-depth assessment and high level documentation of the proposed controls and mitigation measures. Ultimately, this level of risk may preclude the development of the Project.

Extreme (E): requiring in-depth assessment and high level documentation of the proposed controls and mitigation measures and possible preparation of a specialised management plan. Unless considered to be adequately managed by the controls and/or management plan, this level of risk is likely to preclude the development of the Project

Table 2-5 identifies each of the risk sources, receptors, potential consequences and potential impacts for each environmental parameter. **Table 2-5** then provides the assessment of the unmitigated risk, namely the risk level in the absence of management and mitigation measures, identified for each potential environmental impact during the preliminary environmental risk analysis workshop.

Table 2-5
Preliminary Risk Analysis

Environmental Issue	Risk Source (s)	Receptor/Surrounding Environment	Potential Consequences	Potential Environmental Impacts	Likelihood (A to E)	Consequence (1 to 5)	Risk Rating
Radiation	Low level radiation emitted by ore	Mining workforce	Exposure to radiation during mining.	Adverse health outcomes for workforce	A	1	H
		Processing plant workforce	Exposure to radiation during processing.	Adverse health outcomes for workforce	A	2	H
	Low level radiation emitted by process residues and by-products	Surrounding land owners and residents	Exposure to radiation in tailings during the life of the mine.	Adverse health outcomes for surrounding land owners / residents during the period of mine operation	D	1	L
			Exposure to radiation in tailings beyond the life of the mine.	Long-term adverse health outcomes for surrounding land owners / residents following the completion of the project	D	2	L
		Local flora and fauna	Exposure to radiation in tailings during the life of the mine.	Degradation of local vegetation and/or reduced survival rates of local fauna during the life of the project	E	1	L
			Exposure to radiation in tailings beyond the life of the mine.	Long-term degradation of local vegetation and/or reduced survival rates of local fauna following the completion of the project	E	1	L
	Low level radiation emitted by product	Vessels and equipment / Destination of used equipment and scrap	Exposure to radiation from equipment / scrap.	Adverse health outcomes for those exposed to the equipment or scrap	C	1	L
		Product / Destination of the product	Exposure to radiation in product.	Adverse health outcomes for the customer or end user	C	1	L
Groundwater	Leachate from the RSF	Local aquifer(s)	Elevated concentration of metalliferous or other contaminants in the groundwater.	Reduction in groundwater quality	C	2	M
		Surrounding landholders utilising bores or pumps	Elevated concentration of metalliferous or other contaminants in the groundwater accessed by surrounding landholders.	Reduction in the beneficial uses of the water and therefore availability to existing groundwater users.	C	3	H
		Dubbo City Council bores downstream of project	Elevated concentration of metalliferous or other contaminants in the groundwater accessed for Dubbo City water supply.	Contamination of Dubbo City water supply	D	3	M
				Health related impacts (people) due to consumption of contaminated water	E	3	M
				Health related impacts (stock) due to consumption of contaminated water	C	3	H
		Groundwater dependent ecosystems	Contamination of accessible water.	Degradation of groundwater dependent ecosystems	E	2	L
	Leachate from evaporation ponds	Local aquifer(s)	Elevated concentration of metalliferous or other contaminants in the groundwater.	Reduction in groundwater quality	C	3	H
		Surrounding landholders utilising bores or pumps	Elevated salinity of the groundwater accessed by surrounding landholders.	Reduction in the beneficial uses of the water and therefore availability to existing groundwater users	C	3	H
		Dubbo City Council bores downstream of project	Elevated salinity of the groundwater accessed for Dubbo City water supply.	Contamination of Dubbo City water supply	D	3	M
		Groundwater dependent ecosystems	Contamination of accessible water.	Degradation of groundwater dependent ecosystems	E	2	L

Table 2-5 (Cont'd)
Preliminary Risk Analysis

Environmental Issue	Risk Source (s)	Receptor/Surrounding Environment	Potential Consequences	Potential Environmental Impacts	Likelihood (A to E)	Consequence (1 to 5)	Risk Rating
Groundwater (Cont'd)	Hydrocarbon spills	Local aquifer(s)	Elevated concentration of hydrocarbon contaminants in the groundwater.	Reduction in groundwater quality	B	1	M
		Surrounding landholders utilising bores or pumps	Elevated concentration of hydrocarbon contaminants in the groundwater accessed by surrounding landholders.	Reduction in the beneficial uses of the water and therefore availability to existing groundwater users	B	1	M
		Dubbo City Council bores downstream of project	Elevated concentration of hydrocarbon contaminants in the groundwater accessed for Dubbo City water supply.	Contamination of Dubbo City water supply	D	3	M
				Health related impacts (people) due to consumption of contaminated water	E	3	M
				Health related impacts (stock) due to consumption of contaminated water	E	3	M
	Process chemical / reagent spills	Local aquifer(s)	Elevated concentration of chemical contaminants in the groundwater.	Reduction in groundwater quality	D	3	M
		Surrounding landholders utilising bores or pumps	Elevated concentration of chemical contaminants in the groundwater accessed by surrounding landholders.	Health related impacts (people) due to consumption of contaminated water	E	3	M
				Health related impacts (stock) due to consumption of contaminated water	C	3	H
		Dubbo City Council bores downstream of project	Elevated concentration of chemical contaminants in the groundwater accessed for Dubbo City water supply.	Contamination of Dubbo City water supply	D	3	M
				Health related impacts (people) due to consumption of contaminated water	E	3	M
				Health related impacts (stock) due to consumption of contaminated water	E	3	M
		Groundwater dependent ecosystems.	Contamination of accessible water.	Degradation of groundwater dependent ecosystems	E	2	L
	Groundwater drawdown	Local aquifer(s)	Reduced groundwater level.	Reduction in the volume of water contained within the affected groundwater aquifer	E	1	L
		Surrounding landholders utilising bores or pumps	Decrease in availability of groundwater to adjoining land owners.	Reduced yields of local groundwater bores	E	3	M
		Groundwater dependent ecosystems	Reduced availability of water.	Degradation of groundwater dependent ecosystems	E	2	L
	Reduction in contribution to surface water flows	Local streams, and springs	Changes to local hydrological regime and surface flows.	Reduced surface flows to Wambangalang and other creek catchments of the Macquarie River	E	2	L
				Degradation of riparian or aquatic vegetation / ecosystems	E	2	L
		Groundwater dependent ecosystems	Reduced availability of water.	Degradation of groundwater dependent ecosystems	D	2	L
Surface Water / Flooding / Erosion and Sediment Control	Reduction in environmental flows through on-site capture of water	Local streams, creeks and tributaries	Reduced natural surface water flows.	Reduced flows to Wambangalang Creek and other tributaries of the Macquarie River	B	2	H
		Downstream water users	Reduced natural surface water flows.	Reduced availability of water to downstream users	B	1	M
		Local flora, terrestrial and aquatic fauna	Reduced volume of water available to local flora and fauna.	Stress and possible reduction in viability of native vegetation	D	1	L
				Degradation of aquatic habitats	D	1	L

Table 2-5 (Cont'd)
Preliminary Risk Analysis

Environmental Issue	Risk Source (s)	Receptor/Surrounding Environment	Potential Consequences	Potential Environmental Impacts	Likelihood (A to E)	Consequence (1 to 5)	Risk Rating
Surface Water / Flooding / Erosion and Sediment Control (Cont'd)	Discharge of dirty, saline or contaminated water	Local creeks and tributaries	Decreased water quality.	Pollution of downstream waters	D	2	L
				Pollution of local waterways resulting in detrimental affects to flora and fauna	D	2	L
		Mine Site soils and vegetation.	Contamination of soil resources.	Contamination of soil resources and indirect impacts on future land use	D	3	M
		Local and regional catchment ecosystem	Introduction of a toxic compound to the environment.	Health related impacts (people) due to consumption of contaminated water	E	3	M
			Contamination of soil and water resources.	Health related impacts (stock) due to consumption of contaminated water	C	3	H
	Wall failure or overtopping of evaporation ponds	Surrounding land and surface water	Uncontrolled flows of contaminated water.	Contamination of local surface water	D	4	H
				Contamination of local soil resources	D	4	H
				Contamination of drinking water supply	D	3	M
	Changes to hydrology of creeks and drainage lines	Local creeks and drainage lines	Reduced flows.	Reduced surface flows within the affected waterway and the Macquarie River catchment more generally	B	2	H
			Changed alignment of hydrological flow.	Increased erosion potential resultant from changed alignment of flow	D	2	L
		Local flora, terrestrial and aquatic fauna	Reduced volume of water available to local flora and fauna.	Reduction in the quality of aquatic habitat	D	2	L
	Changes to the flood regimes of Wambangalang and Paddy's Creek	Wambangalang and Paddy's Creek and associated communities and ecosystems.	Changes to frequency or intensity of local flooding.	Increased erosion potential within Wambangalang and Paddy's Creek catchments	D	2	L
				Detrimental impacts on surrounding properties as a result of changes to flooding regime	E	2	L
				Changes to vegetation community structure and habitat values	E	2	L
	Erosive actions of water	Project Site soils	Loss of topsoil.	Soil erosion and loss of agriculturally productive capacity	C	2	M
				Decreased availability of soil for rehabilitation	C	3	H
	Sedimentation of water on and discharged from the Project Site	Local creeks and drainage features	Increased sedimentation within downstream creeks.	Increased sediment load in drains and/or waterways	C	2	M
				Increased siltation	C	2	M
	Increase in dryland salinity	Project Site Lands	Rise of groundwater table due to removal of vegetation.	Occurrence of dryland salinity on the Project Site	C	3	H
Biodiversity (Flora and Fauna)	Removal of native vegetation due to clearing activities	Vegetation and habitat within the impact footprint	Reduced biodiversity.	Loss of biodiversity and alteration to existing habitat	A	3	E
		Threatened species, populations and endangered ecological communities	Removal of threatened species, populations and endangered ecological communities from the Project Site.	Direct adverse impact on threatened species, populations and communities.	B	3	H
				Local or regional reduction in distribution of threatened species, populations and endangered ecological communities	A	3	E
	Detrimental affects of indirect project impacts, e.g. noise, dust, lighting	Locally occurring species, populations and communities	Dispersal of locally occurring species, populations and communities from the site.	Reduced biodiversity value of the site.	B	2	H
			Reduced potential for use of the site by threatened species, populations and endangered ecological communities.	Reduced local distribution of threatened species, populations and endangered ecological communities	D	3	M
	Pooling of contaminated (including hypersaline) water on the RSF and evaporation ponds	Local fauna	Ingestion of water by local fauna.	Detrimental health impacts on native fauna	A	2	H
		Local fauna	Hit by vehicle.	Injury or death of fauna	A	2	H

Table 2-5 (Cont'd)
Preliminary Risk Analysis

Environmental Issue	Risk Source (s)	Receptor/Surrounding Environment	Potential Consequences	Potential Environmental Impacts	Likelihood (A to E)	Consequence (1 to 5)	Risk Rating
Aboriginal Heritage	Removal or destruction of known Aboriginal sites and/or artefacts	Local archaeological setting	Damage or destruction of Aboriginal artefacts or site.	Destruction of identified site	E	4	H
				Cumulative reduction of the in-situ archaeological record	E	4	H
	Removal or destruction of currently unidentified Aboriginal sites and/or artefacts	Local archaeological setting	Damage or destruction of Aboriginal artefacts or site.	Destruction of identified site	C	4	E
				Cumulative reduction of the in-situ archaeological record	C	4	E
European Heritage	Removal or destruction of sites of heritage significance due to project activities	Local archaeological setting	Loss or damage to heritage sites.	Loss or destruction of items of heritage significance	D	3	H
Noise	Increased noise resultant from construction on the Project Site (18 month to 24 months)	Surrounding residents and land owners	Increased noise levels.	Noise levels associated with the Project causing annoyance and/or distractions	A	3	E
			Impacts on the health and well-being of local residents.	Noise levels associated with the Project causing adverse affects on physical or mental health.	E	3	M
		Native fauna	Detrimental effects on local fauna.	Adverse effects on the local fauna assemblage	D	1	L
	Increased noise levels resulting from mining and haulage	Surrounding residents and land owners.	Increased noise levels.	Noise levels associated with the Project causing annoyance and/or distractions.	A	3	E
			Impacts on the health and well-being of local residents.	Noise levels associated with the Project causing adverse affects on physical or mental health.	C	4	E
		Native fauna	Detrimental effects on local fauna	Adverse effects on the local fauna assemblage.	D	1	L
	Increased noise levels from process plant	Surrounding residents and land owners	Increased average noise levels.	Noise levels associated with the Project causing annoyance and/or distractions	A	3	E
			Occurrence of occasional very loud noises.	Sleep disturbance as a result of maximum noise levels	E	3	M
			Impacts on the health and well-being of local residents.	Noise levels associated with the Project causing adverse affects on physical or mental health	C	4	E
		Native fauna	Detrimental effects on local fauna.	Adverse effects on the local fauna assemblage	D	1	L
	Noise associated with the construction of the rail line	Residences adjacent to rail line	Increased average noise levels.	Noise levels associated with the Project causing annoyance and/or distractions	A	2	H
	Increased noise levels from rail loading	Surrounding residents and land owners	Increased average noise levels.	Noise levels associated with the Project causing annoyance and/or distractions	A	3	E
			Occurrence of occasional very loud noises.	Sleep disturbance as a result of maximum noise levels	B	3	H
			Impacts on the health and well-being of local residents.	Noise levels associated with the Project causing adverse affects on physical or mental health	C	4	E
		Native fauna	Detrimental effects on local fauna.	Adverse effects on the local fauna assemblage.	E	1	L
	Increased rail traffic noise levels	Residences adjacent to rail line	Increased average noise levels.	Noise levels associated with the Project causing annoyance and/or distractions	A	2	H
			Occurrence of occasional very loud noises.	Sleep disturbance as a result of maximum noise levels	C	3	H
	Noise associated with road upgrades			Increased noise levels associated with DZP activities causing annoyance, distractions, i.e.. amenity impacts	A	2	H
	Increased road traffic noise levels	Residences adjacent to Obley Road	Increased average noise levels.	Noise levels associated with the Project causing annoyance and/or distractions	A	2	H
			Occurrence of occasional very loud noises.	Sleep disturbance as a result of maximum noise levels	C	3	H

Table 2-5 (Cont'd)
Preliminary Risk Analysis

Environmental Issue	Risk Source (s)	Receptor/Surrounding Environment	Potential Consequences	Potential Environmental Impacts	Likelihood (A to E)	Consequence (1 to 5)	Risk Rating
Vibration	Vibration from mine blasting	Surrounding residences, buildings and other structures	Structural damage to buildings and structures.	Structural damage to buildings and structures	E	2	L
			Nuisance/amenity impacts on surrounding landowners / residents.	Reduced local amenity	D	2	L
		Native fauna	Dispersal of locally occurring species, populations and communities from the site.	Reduced biodiversity value of the site.	D	2	L
		Local livestock	Reduced production from livestock.	Reduced productivity	C	2	M
	Vibration from rail traffic	Surrounding residences, buildings and other structures to the rail line (including within Dubbo)	Nuisance/amenity impacts on surrounding landowners / residents.	Reduced local amenity	C	2	M
Air Pollution – Dust, Odour, other	Dust generation resulting from blasting, vehicle movements on unsealed haul roads	Surrounding residents and buildings	Increased deposited dust and suspended particulates.	Nuisance/amenity impacts from dust deposited on window sills, cars, surfaces etc.	C	2	M
			Health-related complaints.	Adverse health impacts (if PM_{10} levels are excessive)	C	3	H
		Surrounding pastures	Reduced palatability of pastures	Decreased productivity of pastures	D	2	L
	Wind action on disturbed areas, waste rock emplacements, RSF and other stockpiles	Surrounding residents and buildings.	Health-related complaints.	Nuisance/amenity impacts from dust deposited on window sills, cars, surfaces etc.	D	2	L
				Adverse health impacts (if PM_{10} levels are excessive)	D	3	M
	Blasting fugitive emissions	Local airshed	Increase in greenhouse gas and other emissions	Increase in the greenhouse gas effect	A	1	H
	Crushing and grinding emissions	Surrounding residents and buildings	Health-related complaints.	Nuisance/amenity impacts from dust deposited on window sills, cars, surfaces etc.	D	2	L
				Adverse health impacts (if PM_{10} levels are excessive)	D	3	M
		Surrounding grazing land	Ingestion of radionuclides.	Health related impacts (stock) due to consumption of contaminated pasture	C	3	H
	Material handling (train unloading bulk products limestone and sulphur)	Workforce	Health-related complaints.	Adverse health impacts (if PM_{10} levels are excessive)	C	3	H
	Process plant stack emissions	Local airshed	SO2, CO2, water vapour (H2O) emissions.	Increase in the greenhouse gas effect	A	1	H
	Emissions resultant from plant malfunction	Local airshed	Elevated levels of process chemical emissions, e.g. SOx, Ammonia (NH3), HCl etc., VOC's.	Temporary reduction in local amenity due to odour and visible plume	D	3	M
		Surrounding land and community		Acute health impacts associated NH3, SO2, SO3 emissions	E	5	H
	Vehicle emissions	Local and global air-shed	Increased greenhouse and other gas emissions.	Increased contribution to greenhouse effect.	A	1	H
Traffic and Transport	Obley Road and Toongi Road upgrade and site access road construction	Local landforms, vegetation and neighbouring land holdings	Impacts associated with road construction (noise, dust, vegetation clearing, ground disturbance, etc.).	See "*air pollution*", "*flora and fauna protection*" and "*noise*" and "*Aboriginal heritage*" above.			
		Local road network					
		Existing road users	Temporary closure of Toongi Road to upgrade Wambangalang Creek crossing.	Temporary inconvenience to commuters if stopped for road works	A	2	H
			Vehicle traffic disruptions – temporary delays during road works.				
			Increased traffic hazards during construction.	Increased risks of accident	C	4	E
	Re-establishment of railway Dubbo-Toongi	Local landforms, vegetation and neighbouring land holdings	Impacts associated with road construction (noise, dust, vegetation clearing, ground disturbance, etc.).	See "*air pollution*", "*flora and fauna protection*" and "*noise*" and "*Aboriginal heritage*" above.			
		Road traffic	Vehicle traffic disruptions – temporary delays during road works.	Temporary inconvenience to commuters if stopped for road works	A	2	H
		Surrounding residents	Impacts associated with rail traffic (noise, etc.).	See "*air pollution*", "*noise*" and "*vibration*" above.			
	Train derailment causing chemical spill	Local groundwater	Chemical seepage to groundwater.	Broad dispersion of chemicals	D	3	M
		Local streams and drainage features	Chemical runoff into local streams.	Hydrocarbon or other pollutant contamination of surface water	D	3	M

Table 2-5 (Cont'd)
Preliminary Risk Analysis

Environmental Issue	Risk Source (s)	Receptor/Surrounding Environment	Potential Consequences	Potential Environmental Impacts	Likelihood (A to E)	Consequence (1 to 5)	Risk Rating
Traffic and Transport (Cont'd)	Road accident causing chemical spill	Local groundwater	Chemical seepage to groundwater.	Broad dispersion of chemicals	C	4	E
		Local streams and drainage features	Chemical runoff into local streams.	Hydrocarbon or other pollutant contamination of surface water	C	3	H
		Local air shed	Dispersion of ammonia / HCl vapour.	See "*air pollution*" above			
		Local landforms and vegetation	Initiation and spread of fire.	See "*Bushfire*" below			
	Railway crossings	Traffic and Transport (Cont'd)	Vehicle traffic disruption (delays at lights).	Temporary inconvenience to commuters and loss of productivity	A	1	H
		Obley Road (2 crossings)	Vehicle - train collision.	Loss of life/property damage through collision with train	C	5	E
		Transport network	Altered transport patterns.	Use of an existing easement/asset	Positive impact (no risk rating)		
				Lessen road freight task (increased transport safety)	Positive impact (no risk rating)		
	Workforce commuter traffic	Local road network.	Increased vehicle movements (especially heavy vehicles) on Obley Road.	Increased traffic creating pressure on existing road and infrastructure function	A	2	H
				Accelerated road pavement deterioration	A	3	E
		Existing road users.	Vehicle accident/roll over.	Elevated risk of accident/incident on local roads	C	4	E
	Heavy vehicle movements for reagent delivery	Local road network.	Increased vehicle movements (especially heavy vehicles) on Obley Road.	Increased traffic creating pressure on existing road and infrastructure function	A	2	H
				Accelerated road pavement deterioration	A	4	E
		Local streams & drainages	Hydrocarbon spill following vehicle malfunction or accident.	Hydrocarbon or other pollutant contamination of surface water	D	3	M
			Chemical reagent spill following vehicle malfunction or accident.	Contamination of local water resources by leaking or spilt chemical reagent	D	4	H
Visual Amenity	Changes in visual characteristics of the site from agriculture to industrial	Surrounding residents and passing traffic on Obley Road.	Clearing of native vegetation and increased visibility of the mine processing activities.	Decreased visual amenity	A	3	E
	Night lighting	Surrounding farms	Increased 'glow' from site.	Reduced amenity of night sky	C	2	M
Rehabilitation and Final Landform	Modifications to the landform of the site	Local landforms and surrounding land owners and/or residents.	Altered local landforms and influence on activities/lifestyle of adjoining land owners.	Reduced amenity of the final landform resultant from altered topography	A	2	H
				Final landform and land use that is different from current activities/lifestyle of local community	A	3	E
Soil Resources	Local soils	Soils of the site	Structural damage to soils through poor soil management practices.	Rehabilitation outcomes not meeting objectives	C	3	H
			Reduced biological activity of soils.	Reduced productivity on final landform	B	3	H
			Increased soil erodibility.	Increased erosion on the final landform	C	3	*H*
Waste Management	Management of process waste	Site land and water resources	Leak or spill from RSF, evaporation ponds or waste rock emplacements over downstream lands and into local drainage lines and creeks.	See "*surface water / flooding / erosion and sediment control*" above.			
		Local landforms	Changes to local landforms for stockpiling / disposal of process waste.	Reduced visual amenity	B	2	H
	Management of waste rock from mining	Site land and water resources	Acid Mine Drainage.	Generation of acid from waste rock	No potential for AMD		
		Downstream land and water resources	Erosion and sedimentation from stockpiles.	Reduced water quality of downstream catchment	D	2	L
		Local and regional groundwater	Leaching of contaminants to groundwater.	Reduction in groundwater quality	C	2	M
				Reduction in the beneficial uses of the water and therefore availability to existing groundwater users	C	3	H
				Health related impacts (people) due to consumption of contaminated water	E	3	M
				Health related impacts (stock) due to consumption of contaminated water	C	3	H

Table 2-5 (Cont'd)
Preliminary Risk Analysis

Environmental Issue	Risk Source (s)	Receptor/Surrounding Environment	Potential Consequences	Potential Environmental Impacts	Likelihood (A to E)	Consequence (1 to 5)	Risk Rating
Waste Management (cont'd)	Low level radionuclides contained in RSF and evaporation ponds	See "*surface water / flooding / erosion and sediment control*" above.					
	Management of Effluent	Site treatment plant and groundwater resources	Spill or leaching of effluent to groundwater.	Organic and nitrate contamination of groundwater	D	3	M
	Disposal of Reagent packaging waste	Site and disposal location	Contaminated packaging waste sent to local landfill.	Contaminate off-site landfill	C	3	H
	Disposal of waste process consumables, e.g. filter cloths	Site and disposal location	Contaminated packaging waste sent to local landfill.	Contaminate off-site landfill	C	3	H
	Disposal of non-processing waste, e.g. engineering scrap, office waste, domestic waste	Site and disposal location	Increased volume of waste sent to landfill.	Reduced life of landfill	A	1	H
Bushfire	Initiation of fire in the processing plant	Project personnel, equipment and adjoining properties	Endangerment of Project workforce.	Health and safety impacts to project personnel	E	5	H
			Damage to site infrastructure.	Damage to Project Site equipment	E	5	H
				Property damage and impacts on process	E	3	M
		Adjoining land vegetation, property and landforms	Damage to adjoining property infrastructure and land.	Damage to adjoining properties and/or native vegetation	E	5	H
	Bushfire in pasture, cropping and offset woodlands	See above					
	Ignition of sulphur stockpile	Site and surrounds	Generation of SO_2 / SO_3 gas.	Acute health impact from ingestion of SO_2	E	5	H
				Death of vegetation	E	3	M
	Fire within Solvent Extraction Plant (large volumes of kerosene)	Site and surrounds and local air shed	Toxic products of incomplete combustion emissions.	Air contamination	E	3	M
Socio-Economic Impacts	Alteration of social activities or employment	Local community and businesses.	Transfer of workers from other industry to the Project.	Strain/drain on local skilled workforce	B	3	H
				Reduced unemployment and increased local spending	Positive impact (no risk rating)		
				Additional population for schools and community services	Positive impact (no risk rating)		
		Local government (mainly DCC)	Influx of additional workforce to Dubbo and surrounds.	Strain on local (Dubbo) housing and other community infrastructure and services	C	3	H
	Perceived or real impacts on local amenity of neighbouring properties	Surrounding property owners	Reduced desirability of properties.	Reduced property values	D	3	M
				Reduced amenity value of landholdings.	D	3	M
	Resuming railway land	Current lessees of railway land	Removal of stock from corridor.	Loss of associated income	A	2	H
			Removal of amenity tree plantings.	Loss of biodiversity	A	2	H

Source: Modified after HB203:2006 (Standards Australia, 2006) - Table 3

3. ENVIRONMENTAL SETTING

This section provides a brief overview of the regional and local setting of the Site. The attributes of the environmental setting described relate to topography, drainage, geology, surrounding land ownership and residences and climate. Each of these attributes is referred to when discussing other environmental features of the local area and in the presentation of the preliminary environmental impact assessment in Section 5.

3.1 LOCAL SETTING

Figures 3-1 and **3-2** which identify the Mine Site, Macquarie Water Pipeline, Dubbo-Molong Rail Corridor and Dubbo – proposed Natural Gas Pipeline on an aerial photograph, illustrate the three dominant features of the local setting.

- The city of Dubbo: a major regional centre with a population of over 41 000[6].
- The Macquarie River: which flows in a generally northerly direction (through Dubbo). Major tributaries of the Macquarie River identifiable and include, Little River (which receives flow from a minor first order stream known as Cockabroo Creek) and Wambangalang Creek (which receives flow from Paddy's Creek and Meadows Creek within the affected catchment).
- Agricultural activities: identified by the extensive clearing of woodland vegetation, identifiable paddocks and irrigation features. Irrigation agriculture, dryland cropping and grazing of cattle and sheep are all established features of the local setting.

3.2 TOPOGRAPHY AND DRAINAGE

The Mine Site is located within three main catchments (see **Figure 3-3**), namely:

- the Wambangalang Creek catchment, which flows into the Macquarie River;
- the Cockabroo Creek catchment, which flows into the Little River immediately upstream of the confluence of the Little and Macquarie Rivers; and
- an undefined catchment of the Macquarie River.

Wambangalang Creek Catchment

- The Wambangalang Creek catchment drains north-northeast before joining the Macquarie River approximately 7km north of the Mine Site. The catchment drains an area of approximately 23 800ha[7] (which represents approximately 1.9% of the Macquarie River catchment) and the Mine Site is located in the lower 10% of the catchment (near the confluence point with the Macquarie River).

[6] Population obtained from Dubbo City Council website: http://www.dubbo.nsw.gov.au/AboutDubbo/aboutdubbo.html (27 February 2012)

[7] It is noted that Hyandra and Twelve Mile Creek also drain into Wambanglang Creek, however, the confluence point is almost at the Macquarie River and so for the purposes of assessing local setting these have been excluded.

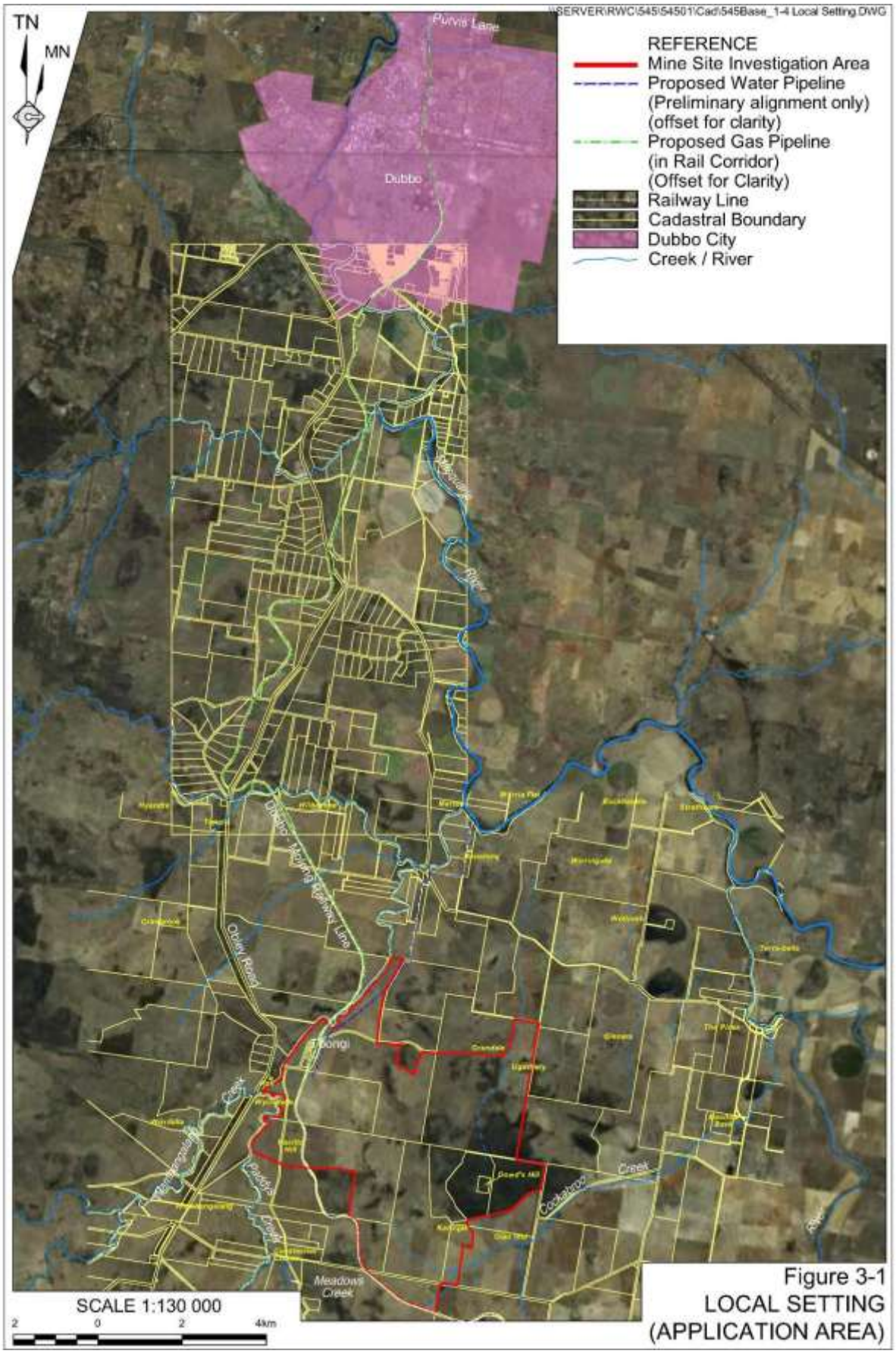


Figure 3-1
LOCAL SETTING
(APPLICATION AREA)

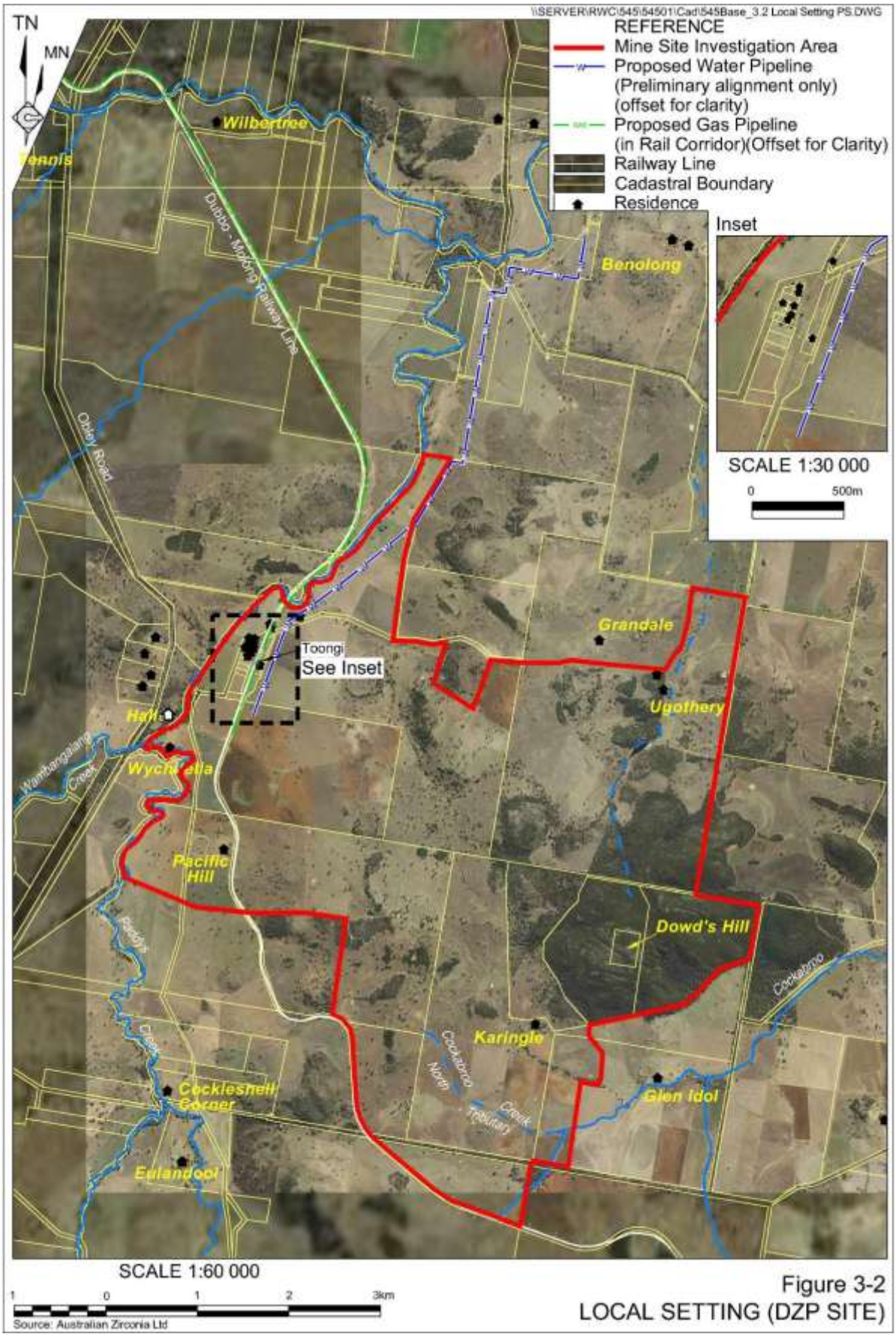


Figure 3-2
LOCAL SETTING (DZP SITE)

Major Creeks draining into Wambangalang Creek (also identified on **Figure 3-2**) include the Belowrie, Glennie and Tanners Creeks from the upper western side of the catchment. The Emmagool and Meadows Creeks drain the upper central section of the catchment, and Paddy's and Springs Creeks drain the upper southeastern area of the catchment. All flows are ephemeral but may have some degree of subsurface flow through unconsolidated alluvium.

Topography in the head of the catchment is steep to undulating with granite tors, pavements and rocky outcrops occurring especially near the rim of the catchment. lgneous intrusions such as Turtle Hill form high hills and knolls which can have steep slopes and rocky outcrops. These rise significantly above the surrounding land. In the lower catchment (where the Mine Site is located) slopes are undulating to more gentle, although elevations of approximately 400m AHD occur over the western section of the Mine Site along the catchment boundary with Cockabroo Creek. Elevations within the catchment range from 620m lo 275m AHD, a fall of 345m.

The Toongi ore body (see Section 3.3.2 for further detail) is located within the Wambangalang Creek catchment and forms a low irregular topographic rise with a common semi-continuous rock pavements on the south and east side of the body and steeper outcrops of boulder on the north and west side of the body.

The proposed Macquarie Water Pipeline would be located for the majority of its length within this catchment. The final alignment likely to be chosen considering local topography with gentle undulations preferred to more steeply rising and falling terrain.

Cockabroo Creek Catchment

The Cockabroo Creek catchment drains to east before joining the Little River approximately 4km east of the Mine Site. This small catchment of 4 240ha drains surface flows off a local high point, Dowd’s Hill, and other rockier and subsequently more densely vegetated areas of the local setting.

On the Mine Site, the elevation of the catchment falls from approximately 440m on Dowd’s Hill to approximately 300m AHD within Cockabroo Creek. The Cockabroo Creek catchment provides both the most elevated and steepest terrain on the Mine Site.

Macquarie River (Undefined) Catchment

A small section of the Mine Site, predominantly on the “Ugothery” property, flows via several ephemeral channels directly into the Macquarie River (approximately 7km to the north). While the catchment is bound by several isolated hills up to 385m AHD, the elevation is generally below 320m AHD.

A small portion of the Macquarie Water Pipeline, were it accesses the river, is likely to be located in this catchment.

Further consideration of surface water resources within and surrounding the Mine Site and other DZP components are presented in Section 5.4.

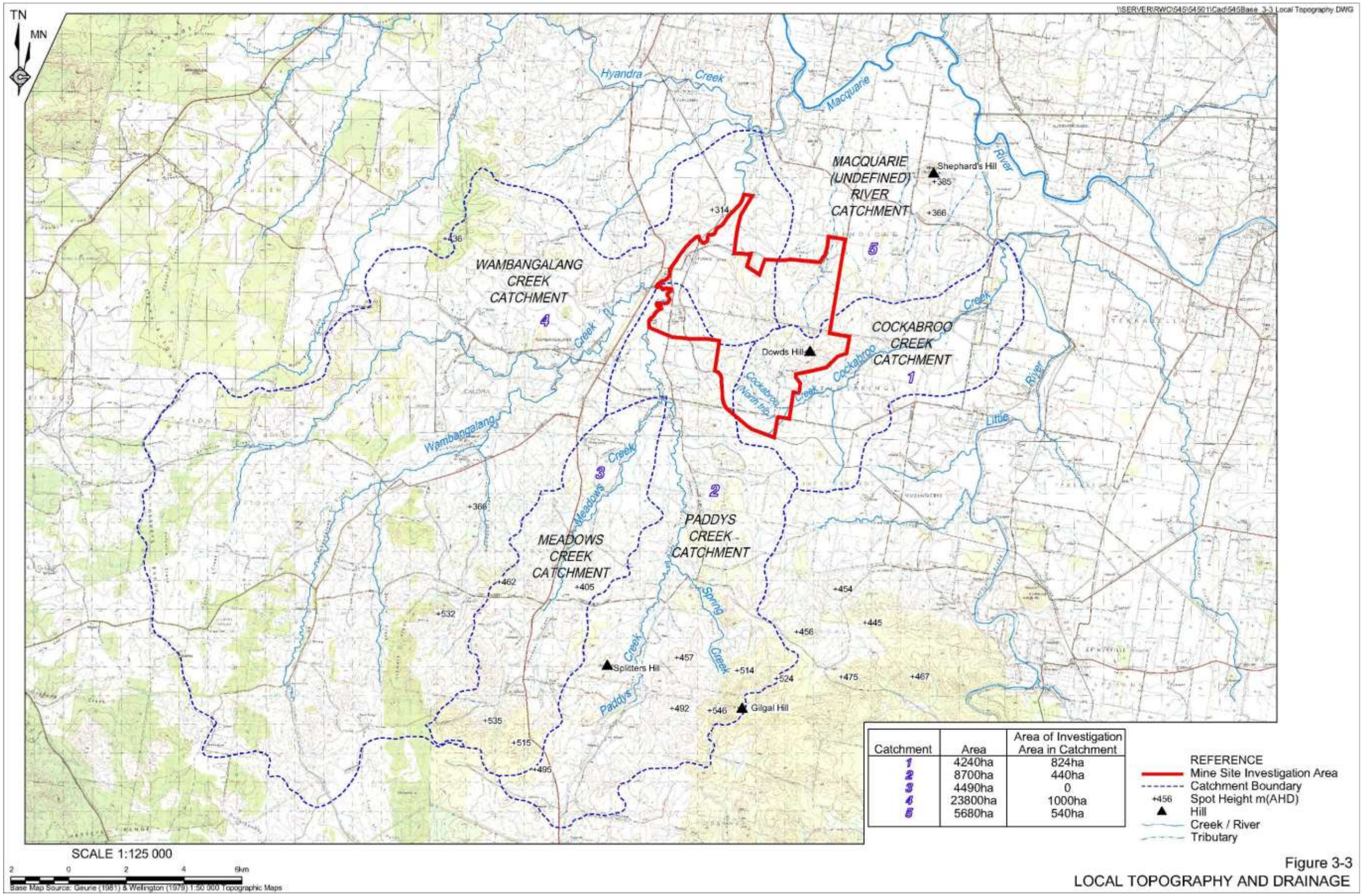


Figure 3-3
LOCAL TOPOGRAPHY AND DRAINAGE

3.3 GEOLOGICAL SETTING

3.3.1 Regional Setting

The DZP is located at the northern end of the Palaeozoic Lachlan Fold Belt where the volcanic-sedimentary-intrusive sequences are covered by onlapping Mesozoic sediment of the Gunnedah Basin. The oldest rocks present in the locality are the Silurio-Devonian age Toongi Group comprising a sequence of fine and medium grained sedimentary and volcanic rocks.

The Mine Site is centred on an alkaline suite of intrusive and extrusive rocks that intrude and partly onlap relative flat lying sediments.. This sequence occupies the southern edge of the Great Australian Basin forming a broad embayment of 10km in diameter and overlays a tightly folded Siluro-Devonian Vocano-sedimentary terrain.

The alkaline igneous rocks are of Jurassic age (180 to 200 million years) and are considered part of a relatively extensive alkaline igneous complex in the region south of Dubbo (in turn part of the major eastern Australian volcanic event). Geological mapping has identified a number of trachytes in the region however geochemical sampling by AZL, and others, has identified anomalous levels of niobium, yttrium and zirconium of potential economic significance within two of these. One is the Toongi deposit, a relatively small, apparently, intrusive stock of hydrothermally altered trachyte.

Table 3-1 provides the stratigraphy of the regional geology below the Mine Site.

Table 3-1

Regional Stratigraphy

System	Group	Formation	Reference (1:250 000 mapsheet)	Description
Quaternary			Qa	Alluvium
Tertiary			Tb	Olivine basalt as flows, dykes and plugs
Jurassic			Jt	Trachyte, quartz trachyte, minor phonlite, rhyolite as flows, tuffs, plugs and necks
Triassic	Gunnedah Basin	Napperby	Rp	Siltstone, lithic quartz-sandstone, minor conglomerate
Devonian			Dmd	Dolerite dykes, diorite, gabbro sills and stocks
	Gregra	Cuga Burga Volcanics	Dge	Latitic crystal-lithic sandstone, breccia, siltstone, tuff, minor andesite, basalt, limestone
Siluro-Devonian	Toongi		S-Do	Sandstone, shale, siltstone, latitic sandstone, volcanoclastic sandstone
Silurian	Cudal	Hanover	Sce	Micaceous shale, siltstone, fine-grained sandstone, rhyolite-tuff, tuff-sandstone, latitic sandstone, breccia
Source: Dubbo 1:250,000 Geology Map (AGSO/DMR 1999) – Table 7				

3.3.2 Mine Site Geology

The Toongi intrusive is a Jurassic aged trachyte plug intruded into a flat lying sequence of interbedded Triassic sandstone and siltstone. The trachyte is one of a number of alkaline igneous bodies which form part of a relatively extensive alkaline igneous complex in the Dubbo region, which in turn forms part of the major Eastern Australian alkaline volcanic event.

The Toongi intrusive is a roughly elliptical stock with outcrop dimension of 600m x 400m. Exploration completed by AZL has identified the trachyte body as extending below a thin veneer of soil and recent sediments to be approximately 900m (east-west) x 500m (north south) (surface area of 360 000m^2) (see **Figure 3-4**). The Toongi intrusive appears to be a near vertical body of indeterminate depth.

Mineralogical studies indicate that the minerals contained within the deposit are extremely fine grained being less than 100µm in size (and generally less than 10µm, and of rare composition. The intrusive exhibits uniformly elevated grades for zirconium (Zr), hafnium (Ha), niobium (Nb), tantalum (Ta), yttrium (Y) and rare earth elements (REE's). The ore body also contains uranium and thorium and is classified as a weakly radioactive ore, however, neither gets concentrated in the process and after initial sulphation roast and leaching, remains in solution and are neutralised by limestone in the waste streams. The average uranium and thorium content in the residue storage facility is less than that in the ore.

3.4 SURROUNDING LAND OWNERSHIP AND RESIDENCES

3.4.1 Mine Site

AZL is currently negotiating an option to purchase the land on the Mine Site. This includes the agricultural properties to the east and south of Toongi village, as well as the properties within the village. The properties outside of Toongi village are predominantly agricultural properties varying in size from approximately 290ha to 605ha. A block of crown land is located on Dowd's Hill towards the southeastern section of the Mine Site. A second block of Crown land is located adjacent to the disused rail spur at Toongi.

Properties within Toongi village are located on Toongi Road and currently eight people reside in the four houses in Toongi. The Toongi Quilt Shop is a business run from home in village. A community hall, solid waste transfer station and tennis courts are located west of Wambangalang Creek and serve as a focal point for the community and district.

Figure 3-5 displays the land ownership status and the location of residences within and surrounding the Site.

3.4.2 Macquarie Water Pipeline

AZL is negotiating with a single land owner of a property extending between the northern edge of the Mine Site and the Macquarie River (see **Figure 3-5**). It would be possible to align the pipeline between the Mine Site and the Macquarie River on road reserves, however, by traversing Lots 1, 2, 27, 30 and 62 of DP 753220, the length of the pipeline would be reduced and the requirement for severe direction changes avoided.

The only notable road to be crossed would be Benolong Road, approximately 2km from the Macquarie River.

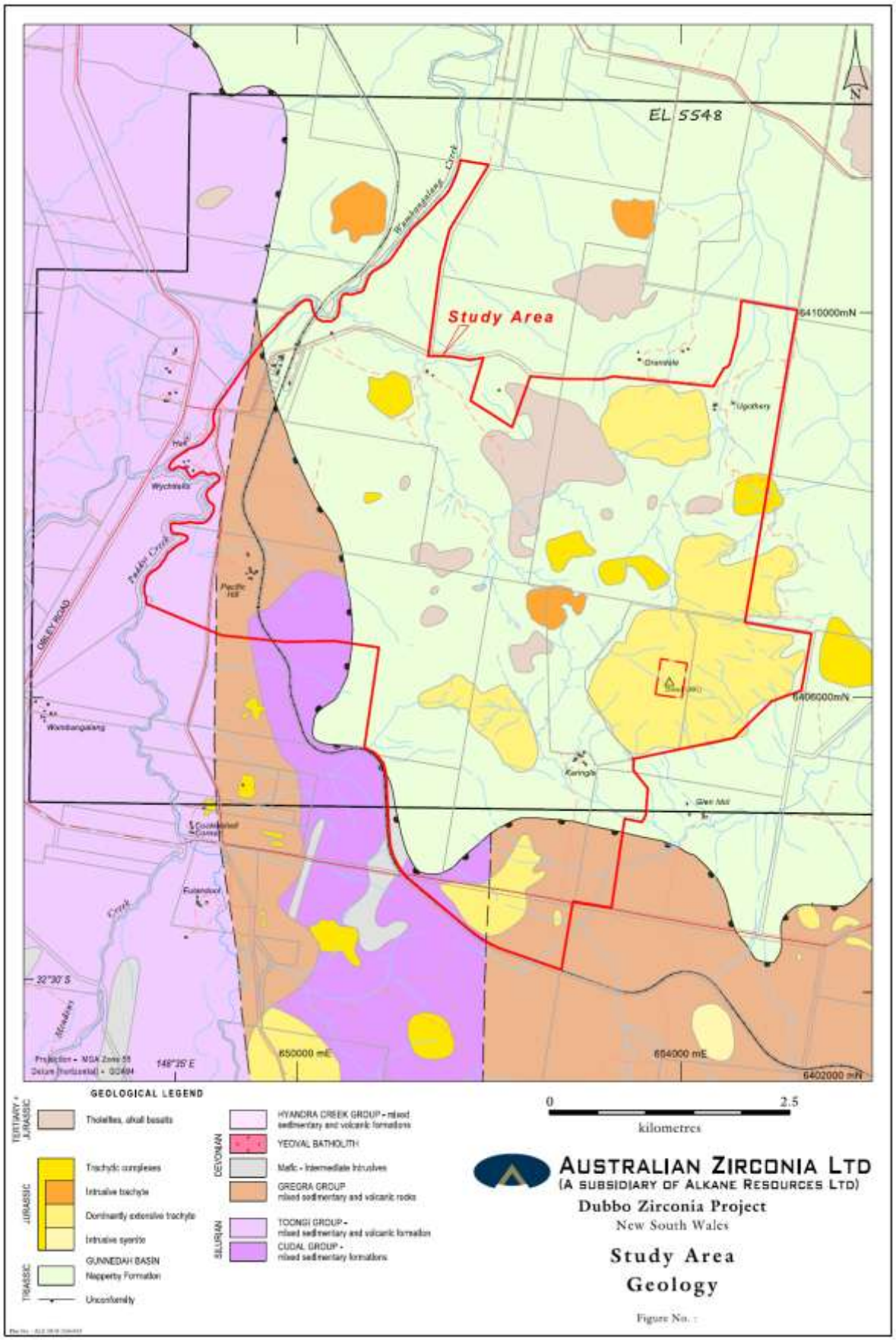


Figure 3-4 MINE SITE INVESTIGATION AREA GEOLOGY

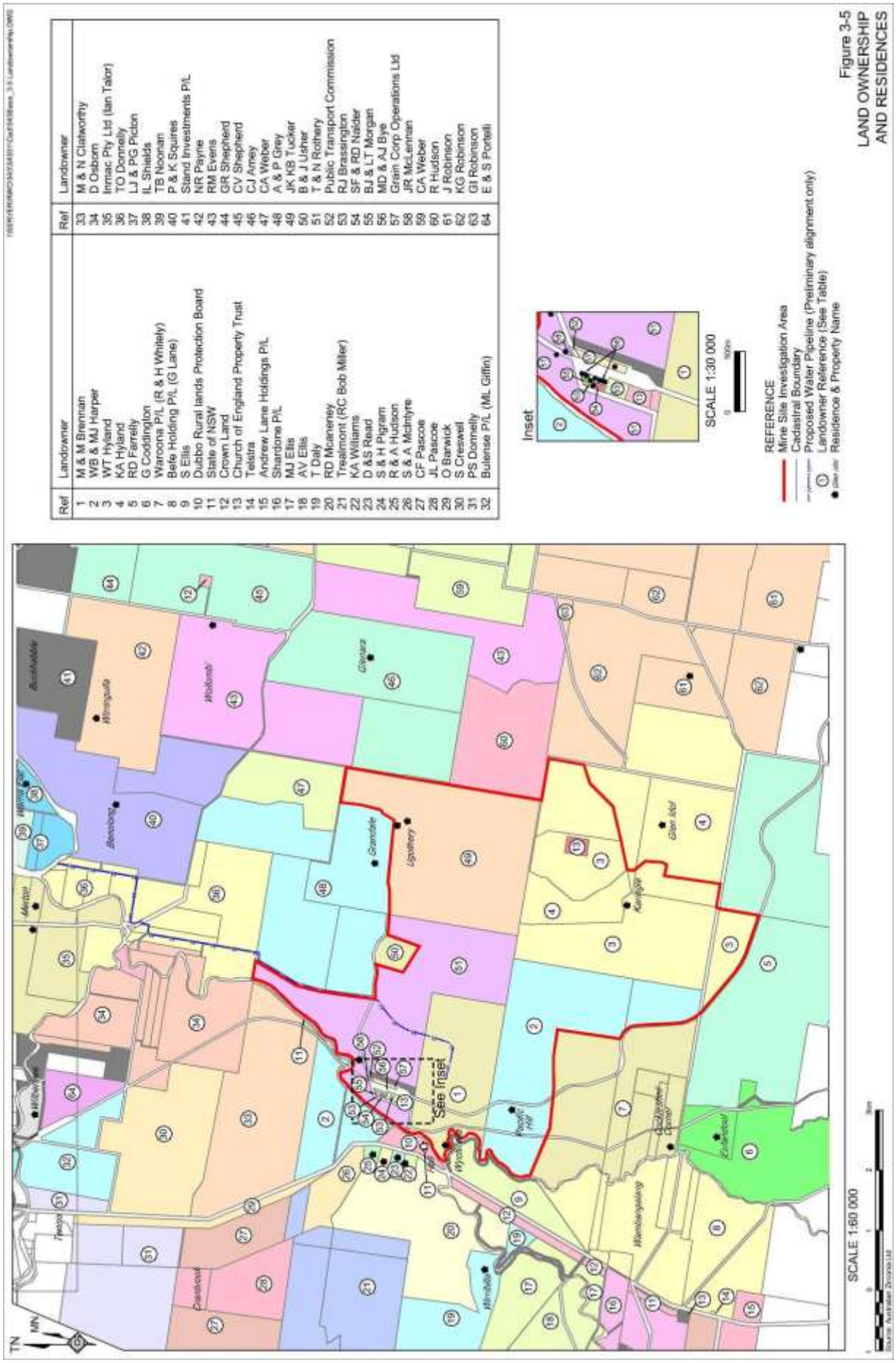


Figure 3-5
LAND OWNERSHIP AND RESIDENCES
Ref Landowner
1 M & M Brennan
2 WB & MJ Harper
3 WT Hyland
4 KA Hyland
5 RD Farrelly
6 G Coddington
7 Warrooma P/L (R & H Whitely)
8 Bafe Holding P/L (G Lane)
9 S Ellis
10 Dubbo Rural lands Protection Board
11 State of NSW
12 Crown Land
13 Church of England Property Trust
14 Telstra
15 Andrew Lane Holdings P/L
16 Shardone P/L
17 MJ Ellis
18 AV Ellis
19 T Daly
20 RD Mcaneney
21 Trealmont (RC Bob Miller)
22 KA Williams
23 D &S Read
24 S & H Pigram
25 R & A Hudson
26 S & A McIntyre
27 CF Pascoe
28 JL Pascoe
29 O Barwick
30 S Creswell
31 PS Donnelly
32 Bulense P/L (ML Giffin)
33 M & N Clatworthy
34 D Osborn
35 Inmac Pty Ltd (Ian Talor)
36 TO Donnelly
37 LJ & PG Picton
38 IL Shields
39 TB Noonan
40 P & K Squires
41 Stand Investments P/L
42 NR Payne
43 RM Evens
44 GR Shepherd
45 CV Shepherd
46 CJ Arney
47 CA Weber
48 A & P Grey
49 JK KB Tucker
50 B & J Usher
51 T & N Rothery
52 Public Transport Commission
53 RJ Brassington
54 SF & RD Nalder
55 BJ & LT Morgan
56 MD & AJ Bye
57 Grain Corp Operations Ltd
58 JR McLennan
59 CA Weber
60 R Hudson
61 J Robinson
62 KG Robinson
63 GI Robinson
64 E & S Portelli
Inset
SCALE 1:30 000
REFERENCE
Mine Site Investigation Area
Cadastral Boundary
Proposed Water Pipeline (Preliminary alignment only)
Landowner Reference (See Table)
Residence & Property Name
See Inset
SCALE 1:60 000
TN
MN

3.4.3 Toongi – Dubbo Rail Line

AZL is in the process of identifier all adjoining land owners and residents so as to brief each on the DZP and identify issues of critical concern.

3.5 CLIMATE

3.5.1 Introduction

Table 3-2 presents Meteorological data sourced from the Dubbo Airport Bureau of Meteorology (BOM) station (station number 065070, year 1946 to present). The Dubbo Airport meteorological station is located approximately 23km to the north of the site.

Table 3-2
Dubbo Airport Monthly Meteorological Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature (°C)													
Mean maximum temperature	33.2	31.8	28.7	24.6	19.9	16.2	15.4	17.4	21	24.5	28.2	30.8	24.3
Mean minimum temperature	18.1	17.7	14.4	10.1	6.5	4.3	3.1	3.4	6.2	9.3	13.5	15.7	10.2
Rainfall (mm)													
Mean monthly rainfall	52.4	45.2	48.9	35.6	41.1	43.2	41	39.4	42.3	49.2	70.5	62	572
Highest monthly rainfall	191	218.2	173.8	105.8	102.2	122	138	151.6	111.6	112	181.8	188.8	851
Lowest monthly rainfall	3.8	7	10	0.2	0.6	4	4	0.4	0.6	1.2	0	5.6	228.6
Highest daily rainfall	74	77	80	72	45	43	44	53	61	60	51	67.6	80
Relative Humidity (%)													
Mean 9am relative humidity	56	62	64	64	76	86	86	76	67	56	56	52	67
Mean 3pm relative humidity	32	36	36	37	47	57	55	47	43	36	35	30	41

Source: BOM, Dubbo Airport, Station Number 065070, downloaded 9 February 2012. Temperature data collected from 1993, Rainfall data collected from 1994

It is noted that meteorological data has been collected from a weather station established on the Mine Site, adjacent to the "Wychitella" homestead, in 2001. Rainfall data collected in this period is presented as **Table 3-2** with other data collected, e.g. temperature, wind direction and wind speed, is currently being compiled and will be collated, included and used in the EIS and specialist environmental assessments to be prepared.

Table 3-3
Mine Site Meteorological Station ("Wychitella Homestead) Rainfall - March 2001 to June 2011

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average monthly	38.5	58.7	35.9	29.4	26.9	48.6	39.0	29.1	38.1	41.3	66.9	77.6	497
Max monthly	86.6	133.6	96.6	62.0	72.6	96.2	88.2	102.2	102.6	86.8	162.4	157.8	919.4
Min monthly	9.6	19.0	8.4	0.6	0.6	6.4	7.4	3.8	1.0	0.6	11.4	23.8	179.6

3.5.2 Temperature and Relative Humidity

January is typically the hottest month of the year with a mean maximum temperature of 33.2°C and mean minimum temperature of 18.1°C being the highest throughout the year. The coldest month of the year is July with the lowest mean maximum temperature of 15.4°C and coldest mean minimum temperature of 3.1°C.

In both the 9:00am and 3:00pm relative humidity data sets, the highest humidity was recorded in June with 86% and 57% respectively. Again for both 9am and 3 pm, the lowest humidity was recorded in December with 52% and 30% respectively.

3.5.3 Rainfall and Evaporation

Rainfall collected at the Dubbo Airport indicates November has on average the highest rainfall per month within 70.5mm which equates to approximately 12.3% of the total rain falling through the year. April has the least amount of rainfall in the year with only 35.6mm which equates to approximately 6.2% of the total rail falling throughout the year.

The rainfall data collected at the Mine Site meteorological station has been influenced by the predominantly drought conditions during this period of measurement. However, the data does compare to that collected at the BOM Station 065070 in that the highest and lowest rainfall months are similar (November/December and April/May).

3.5.4 Wind Speed and Direction

Figure 3-6 provides the BOM wind rose for the Dubbo Airport, data included from 16 January 1993 to 30 September 2010. The wind rose indicates that the airport has a predominant wind direction (approximately 19% of the time) from the west with most winds between 10 and 30km/hr.

Site specific wind data is being generated through analysis of the data collected at the Mine Site meteorological station and will be used in the air quality and noise modelling for the EIS.

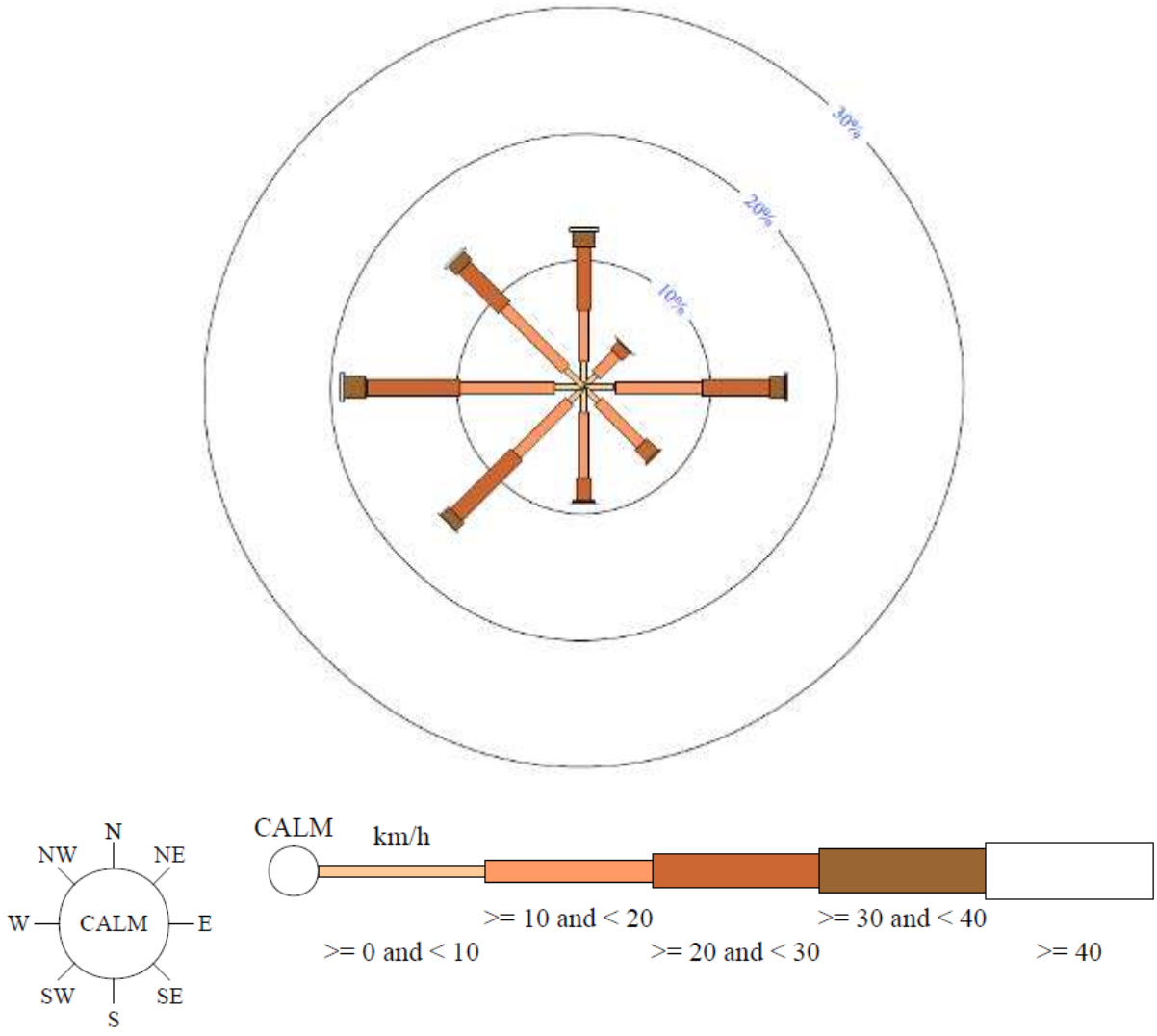


FIGURE 3-6 WIND ROSE FOR THE DUBBO AIRPORT (BOM, 2012)

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4. DESCRIPTION OF THE PROPOSAL

This section provides an overview of the Dubbo Zirconia Project in sufficient detail to enable the reader to understand the type and scale of activities proposed. A more detailed description of the DZP would be included in the Environmental Impact Statement.

4.1 OBJECTIVES

The principal objectives of the Dubbo Zirconia Project are to:

- maximise the recovery of the metals and REE's contained within the Toongi trachyte through efficient of mining and processing operations;
- establish a processing facility that can process the currently identified and any additional mineral resources that may be identified within or in the vicinity of the Mine Site;
- establish or re-establish infrastructure for the purposes of the DZP but which could also have beneficial uses for other industry / activities during or following the completion of the DZP;
- operate the DZP in a manner that minimises surface disturbance and generation of waste by-products;
- undertake all activities in an environmentally responsible manner to ensure compliance with relevant criteria/goals or reasonable community expectations; and
- provide a stimulus to the economy Dubbo and other towns and localities through employment opportunities and supply of services required for the development and operation of the DZP;
- work cooperatively with the surrounding community to build socio-economic capacity within communities affected by the DZP; and
- achieve the above objectives in a cost-effective manner to ensure security of employment, the continued economic viability of the Proponent and ultimately a return on investment for shareholders.

4.2 NEED FOR THE PROPOSAL

While not well known, the metals and rare earth elements to be mined and produced by the DZP have important and wide ranging applications. **Plates 4-1**, **4-2** and **4-3** provide illustrations of the applications of Zirconium, Niobium and REE's.

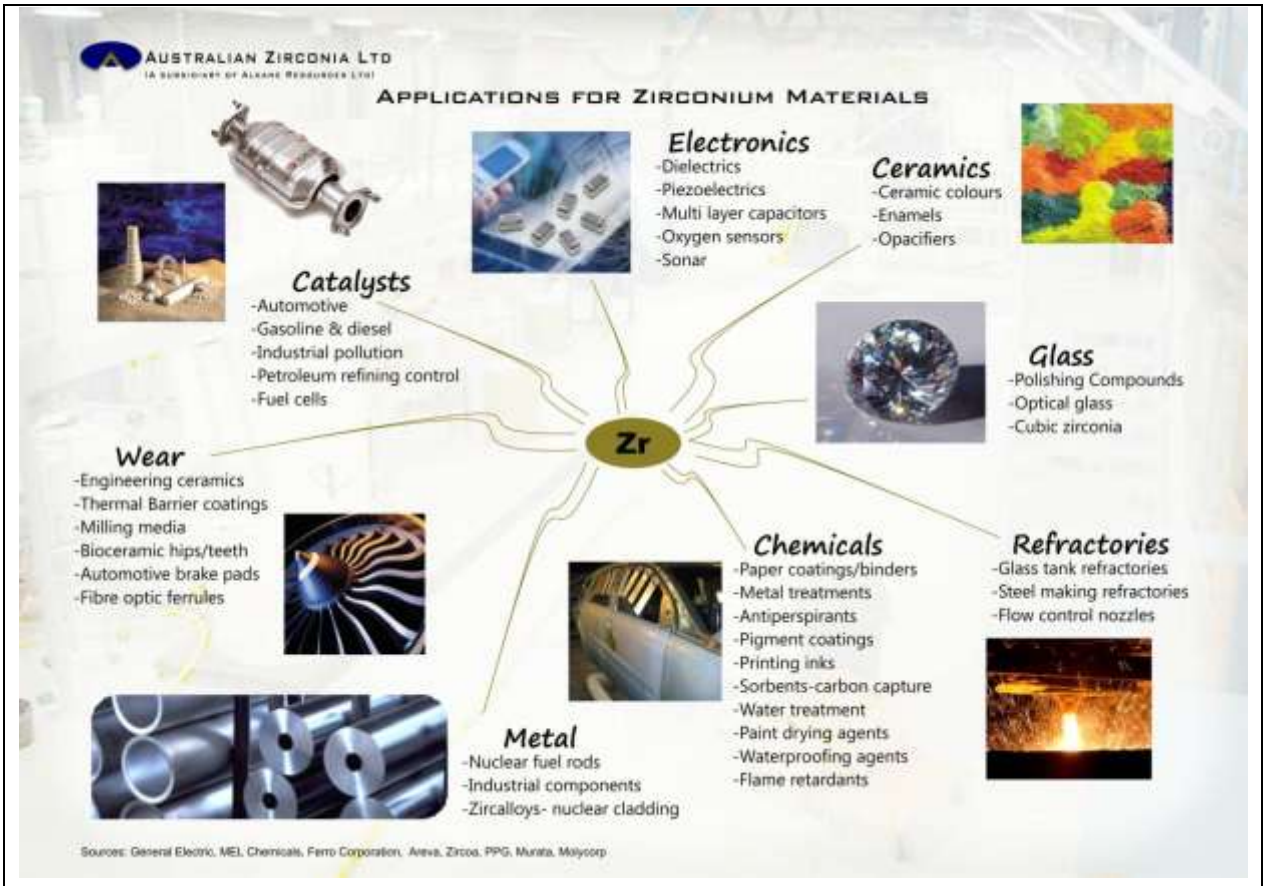

Plate 4-1 Applications for Zirconium Materials

Plate 4-2 Applications for Niobium Materials

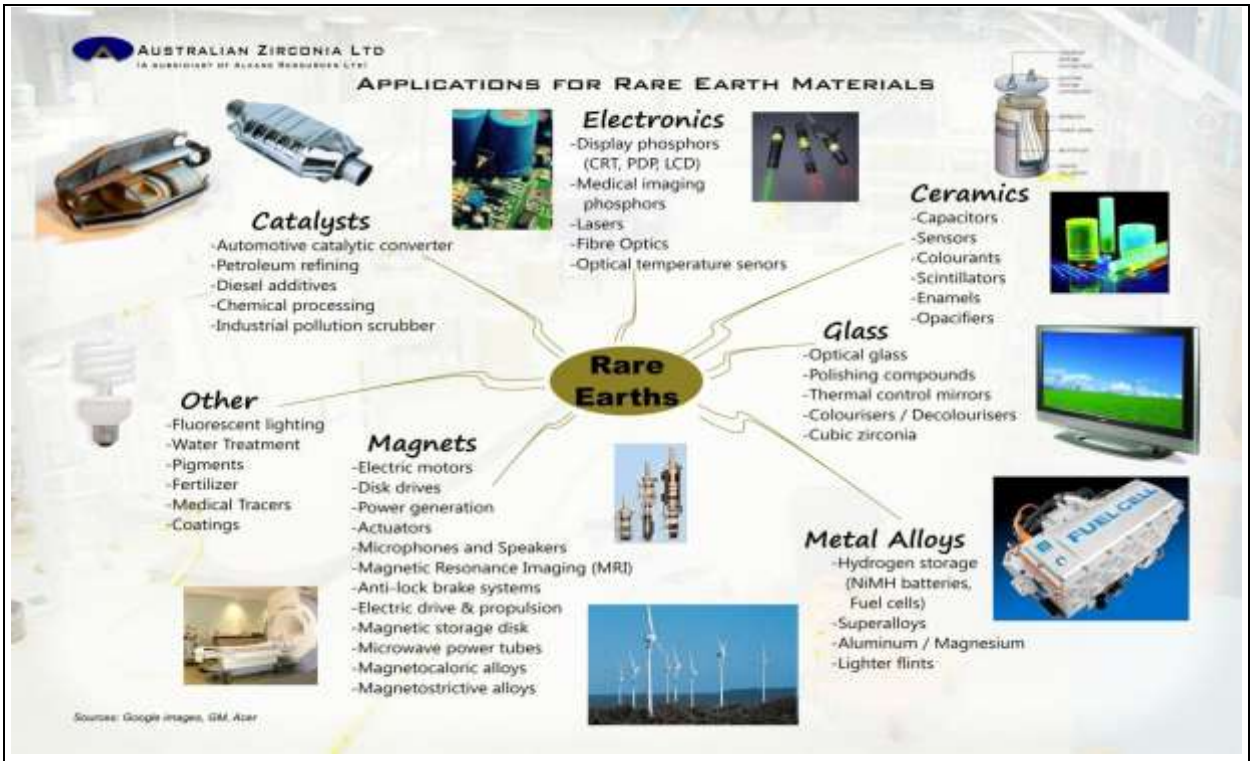

Plate 4-3 Applications for Rare Earth Materials

Currently the vast majority of these metals and REE's are mined and produced in China and global markets for the products identified in **Plates 4-1**, **4-2** and **4-3** have expressed interest in expanding the available supply. The Toongi deposit is one of the more advanced projects for the production of the various metals and REE's and therefore there is an opportunity for a world class and globally significant resource and industry to be developed in regional NSW.

4.3 DZP OVERVIEW

The Dubbo Zirconia Project comprises the following principle components.

- A shallow Open Cut Mine of up to 40m in depth from which the ore would be mined by standard drill and blast, load and haul methods. Waste rock from the margins of the body will be transferred to a small Waste Rock Emplacement Area to the southwest of the open cut.
- The ore would be trucked to a Processing Plant located close to the Toongi siding where the ore would be crushed and ground before the various rare metals and REE's are separated from the ore by sulphation leach, solvent extraction and precipitation processes.
- The waste residue (ground rock) produced by the processing of the ore would be mixed with lime (to neutralise the residue) and transported on a conveyor to a Residue Storage Facility (RSF) adjacent to the Processing Plant.
- Water which cannot be recycled through the Processing Plant would be pumped to a number of Evaporation Ponds located within cleared areas of the Mine Site.

- The Processing Plant requires significant volumes of water which would be sourced from the Macquarie River (under licence) and transferred to the Mine Site by water pipeline (from the Macquarie River).
- The Processing Plant requires significant volumes of chemical reagents and other processing materials which would be delivered to the Mine Site either by road (via Obley Road which is to be upgraded) or the reopened Toongi – Dubbo Rail Line. A Rail Loading Facility on the upgraded and reopened Toongi – Dubbo Rail Line would be constructed to accept these reagents and processing materials, as well as despatch the DZP products.
- The DZP would be powered by mains power with a 132kV spur line from the Geurie – Dubbo 132kV powerline to be constructed.
- Natural gas (for heating) would be imported to the Mine Site, via a Natural Gas Pipeline spur developed from the Central West Pipeline (of APA Group) at Purvis Lane, Dubbo.
- Additional Mine Site infrastructure such as haul and other roads, hardstand areas, workshops and offices would also be established within the Mine Site.

Figure 4-1 provides the conceptual layout of these principle components.

4.4 SITE ESTABLISHMENT AND CONSTRUCTION

Following the receipt of development consent and all necessary approvals, the Applicant would undertake a program to establish the off-site infrastructure and prepare the Mine Site for mining, processing, reagent transport and product despatch and. The key site establishment and construction activities are as follows.

- Upgrade and reopening of the Toongi – Dubbo Rail Line.
- Construction of a Rail Loading Facility (hardstand area) near Toongi on the Mine Site.
- Construction of a water pipeline between the Macquarie River and the Processing Plant on the Mine Site.
- Construction of a natural gas pipeline between Dubbo and the Mine Site.
- Upgrade of Obley Road to carry B-Double trucks, including the construction of a new intersection with a site access road, for the carriage of heavy vehicles and various rail level crossings.
- Construction of a site access road from Obley Road to the site office (including a bridge over Wambangalang Creek) and amenities.
- Construction of the key site water management structures.
- Installation/construction of required offices and amenities.

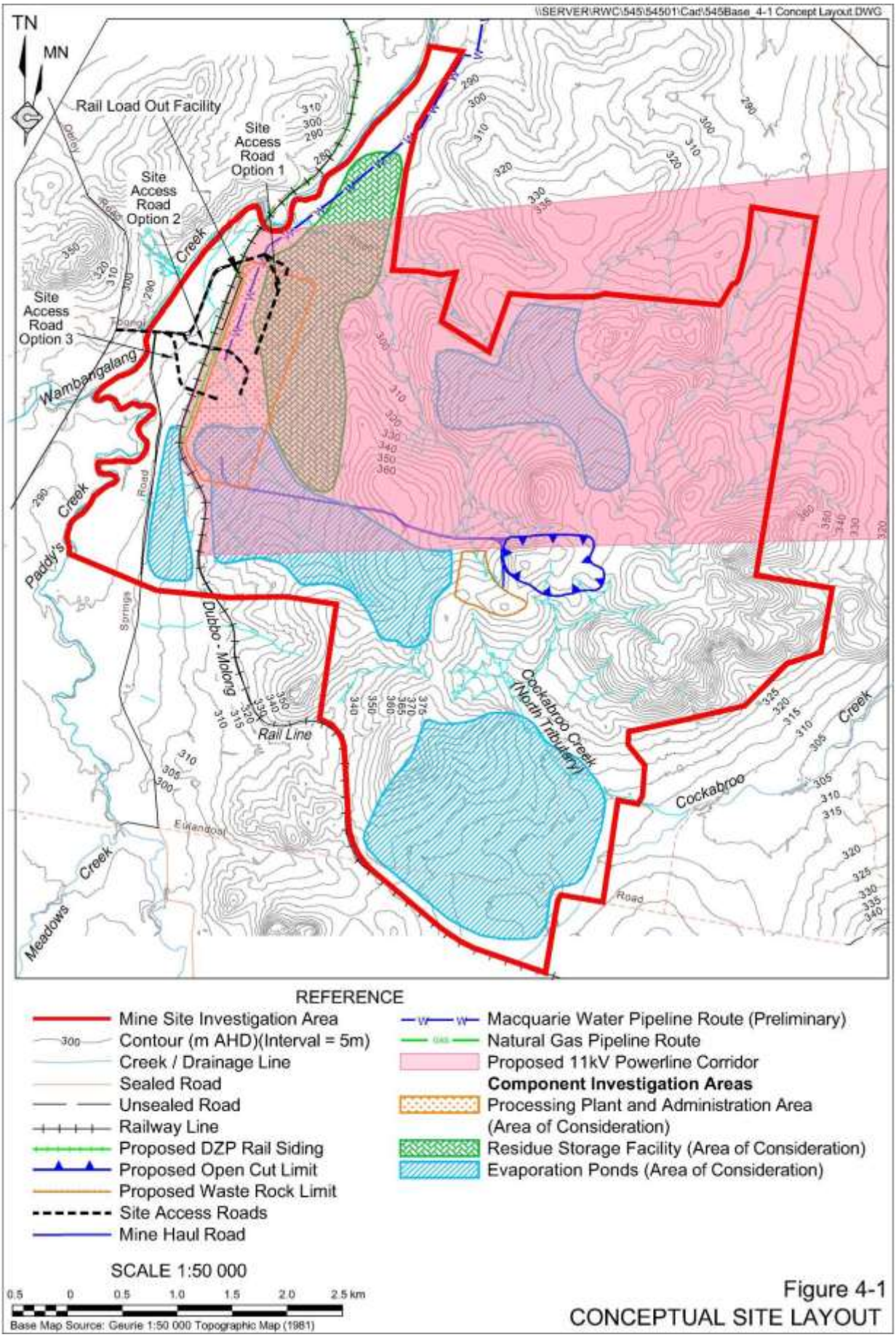

Figure 4-1
CONCEPTUAL SITE LAYOUT

- Construction of a Sulphuric Acid Plant for onsite manufacture of acid from imported sulphur.
- Construction of the Processing Plant and associated hardstands, stockpile areas and workshops.
- Construction of a Residue Storage Facility and evaporation pond(s) for the management of process residues and waste water.
- Installation of power supply and control infrastructure.

The Proponent anticipates that 24 months will be required to complete the site establishment and construction phase of the DZP.

4.5 MINING OPERATIONS

4.5.1 Resources

Exploration over the Toongi deposit has included 120 reverse circulation and two diamond drill holes completed on a staggered 100m x 50m grid (see **Figure 4-2**). **Figure 4-3** provides a cross-sectional interpretation of the Toongi deposit. Interpretation and modelling of the drill hole data have resulted in a Measured Resource to approximately 55m vertical depth of 37.5Mt grading 1.95% ZrO_2 (zirconium), 0.46% Nb_2O_5 (niobium), 0.03 Ta_2O_3 (tantalum), 0.04% HfO_2 (hafnium), 0.14% Y_2O_3 (yttrium) and 0.75% REO (rare earth oxides).

Several deeper drill holes confirm the continuity of ore grades to approximately 100m depth and an additional Inferred Resource of 37.5Mt at similar grades has been estimated.

Based on the estimated costs and revenues from the feasibility study completed in September 2011 a Proven Ore Reserve of 8.07Mt grading 1.92% ZrO_2 (zirconium), 0.04% HfO_2 (hafnium), 0.46% Nb_2O_5 (niobium), 0.03% Ta_2O_5 (tantalum), 0.14% Y_2O_3 (yttrium) and 0.75% REO (rare earth oxides) has been estimated to approximately 25 metres depth.

Using the same costs and revenues an additional 27.86Mt grading 1.93% ZrO_2 (zirconium), 0.04% HfO_2 (hafnium), 0.46% Nb_2O_5 (niobium), 0.03% Ta_2O_5 (tantalum), 0.14% Y_2O_3 (yttrium) and 0.74% REO (rare earth oxides) has been estimated as a Probable Ore Reserve below the Proven Ore Reserve.

4.5.2 Conceptual Mining Operations

Mining operations would involve the sequential activities of vegetation clearing, soil stripping, and mining of waste rock and ore.

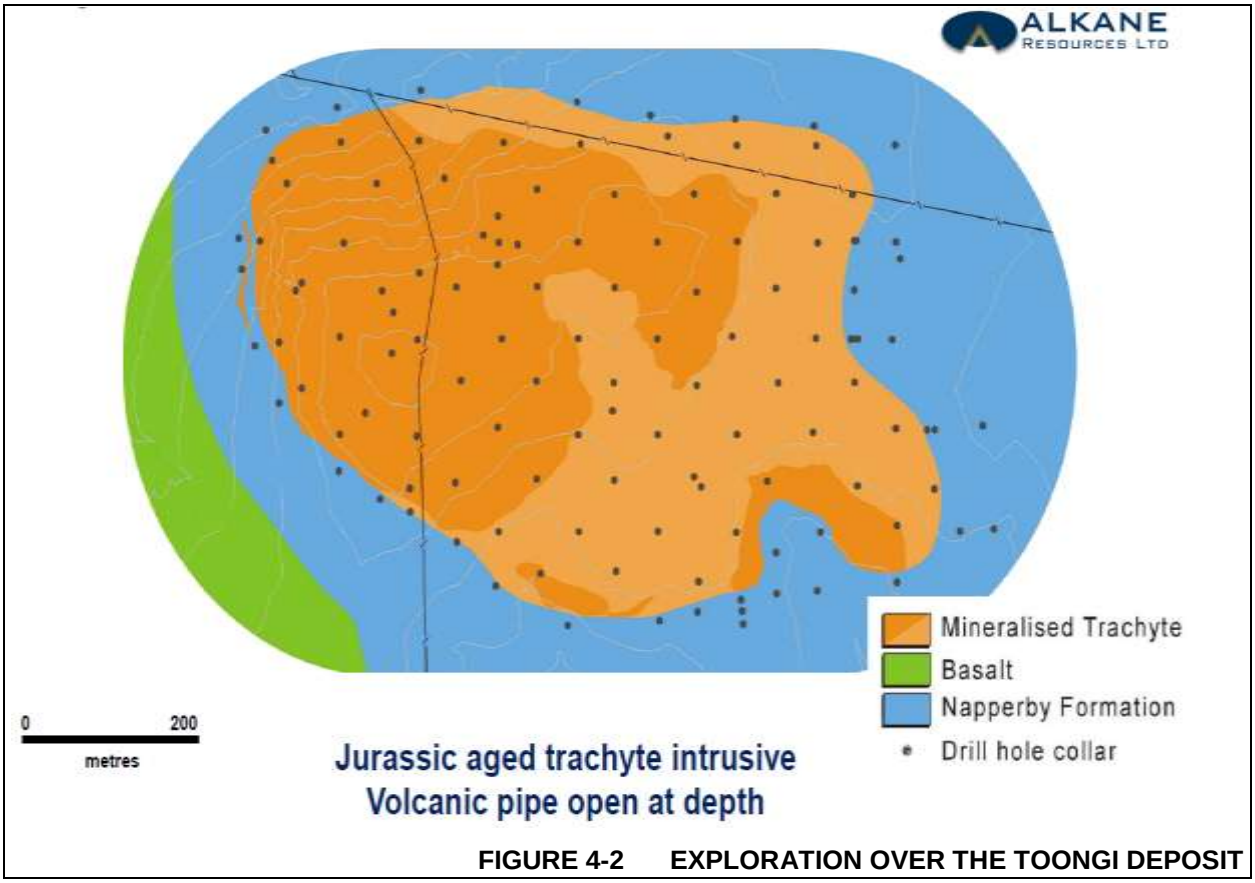

FIGURE 4-2 EXPLORATION OVER THE TOONGI DEPOSIT

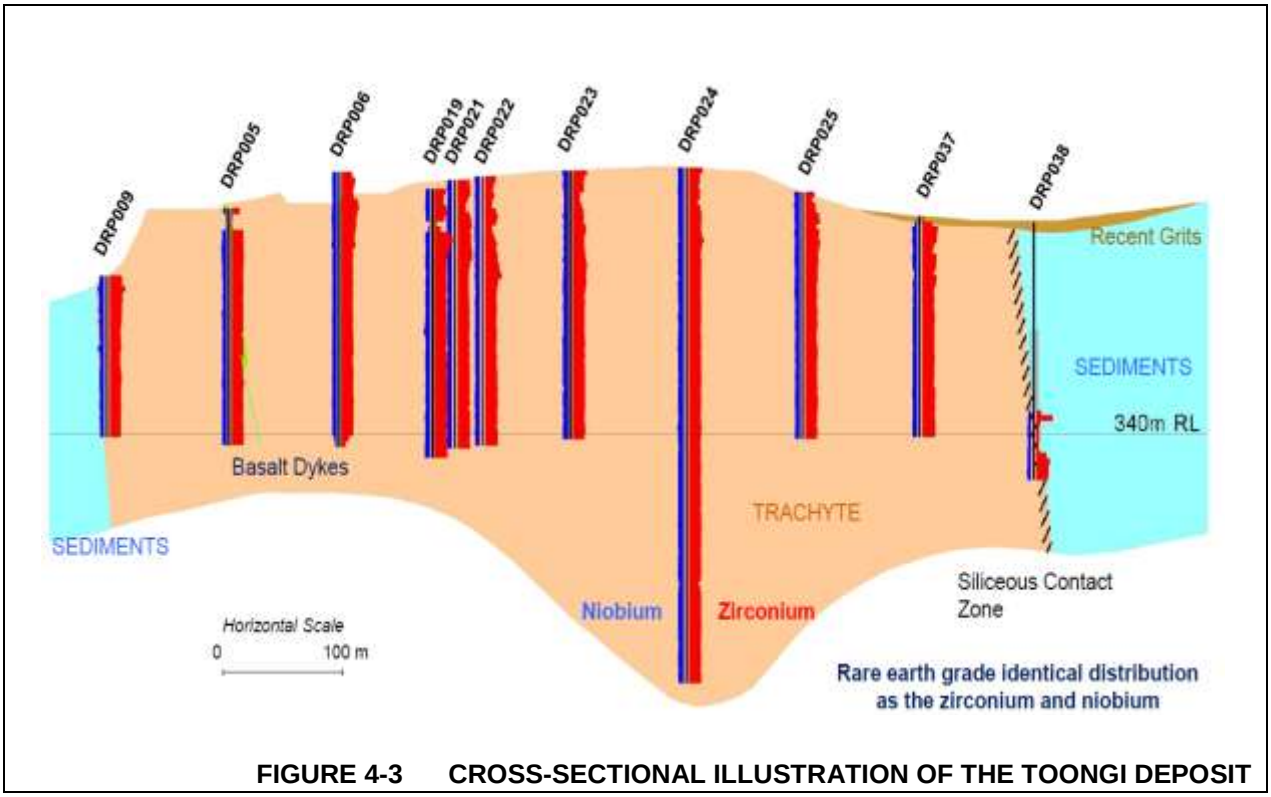

FIGURE 4-3 CROSS-SECTIONAL ILLUSTRATION OF THE TOONGI DEPOSIT

Vegetation Clearing

The vegetation of the Mine Site varies between agricultural land with isolated trees which would not require any substantial native vegetation clearing[8], regrowth woodland and remnant stands of woodland vegetation. Section 5.7.1 provides further description of the existing vegetation of the Mine Site.

Any trees to be removed would be progressively felled by chainsaw and/or bulldozer during mining as the mining benches reach natural ground surface. All vegetation removed will stockpiled for placement on selected areas of the final landform to be assigned a nature conservation land use post mining, mulched and incorporated within the topsoil or, where practicable, placed within biodiversity offset areas.

In the event that habitat features important to locally occurring fauna are identified, these would be managed in accordance with a vegetation clearing protocol to be developed following the recommendations of consultant ecologists and/or OEH.

Soil Stripping

Topsoil and subsoil, although minimal over the deposit, would be separately stripped in accordance with recommendations of Sustainable Soils Management Pty Ltd, soil and land management consultants to AZL. As with the vegetation removal this would be progressive throughout mining as mining benches reach natural ground surface. Topsoil and subsoil will be stockpiled in key strategic areas within the Mine Site. The stockpiled soil resources will be progressively respread over the final landform, with direct replacement of topsoil and subsoil undertaken whenever possible.

Mining

Mining would be by conventional drill and blast, and load, haul, dump of ore to the ROM pad at the processing site and waste rock to the waste rock emplacement (WRE). Grade control would be based on assay/leach ability test results from drill cuttings from the blast drill holes.

It is proposed that drill and blast operations be conducted by a specialised local or regional contractor. These activities could be undertaken on a campaign basis and remain well ahead of mining.

Blasting would be completed using dry blasting (ANFO) on a 3.0m x 2.6m pattern on a 5m bench.

It is also proposed that mining operations be conducted by a specialised local or regional contractor and given the low waste to ore ratio and the minimal requirement for selective mining it is proposed that mining will by front end loader rather than an excavator.

Ore and waste haulage will be by 38 tonne articulated haul trucks.

Mining is based on working a single 10 hour shift during a 5 to 5.5 day week for 48 weeks of the year. Such a mining roster will necessitate minimal stockpiling at the plant and provides flexibility to add a second shift if required during times when additional waste movement is required.

[8] The presence of native grasses is to be confirmed by flora survey to be undertaken in 2012.

The open cut has been designed to provide ore for 20 years at a rate of 1 000 000tpa. Very simple design parameters were required as the maximum depth of the open cut is 40m below current ground surface and the highest pit wall is approximately 32m below ground surface. The parameters used in the design were a batter slope of 55° with an 8m berm at the 370mRL (approximately 20 metre below surface). The open cut has a total surface area of approximately 40.3ha and daylights at current ground surface along the north-western edge.

The current mining schedule has waste material being removed progressively to the perimeter of the 20 year pit outline. Waste mining volumes will vary from year to year (approximately 16 000 bank cubic metres [bcm] in year 18 to about 275 000bcm in year 4).

It is estimated that a total of 1.36M bcm of waste will be removed during the 20 year mine life.

The waste will be transported to a Waste Rock Emplacement (WRE) situated immediately south west of the open cut. The WRE is located on a gently sloping ground surface and will cover a total area of 20.3ha. The design is for a stockpile with maximum height of 40m in the north and 15m in the south. The WRE will be developed with 10m batters at 1 in 3 slope separated by a 5m berms.

4.5.3 Mobile Equipment

Table 4-1 presents an indicative list of the proposed mobile equipment the Applicant intends to use on the Mine Site.

Table 4-1
Indicative Mobile Equipment List

Equipment	Unit numbers
Cat 980G front end loader	1
Cat 740–38 tonne articulated dump truck	5
Cat D8R bulldozer	1
Cat 14G grader	1
14 kl water cart	1
Drill rig	1
Light vehicles and service trucks	As required
Source: AZL	

The equipment list will be reviewed and may be modified following modelling of noise emissions and dust dispersion and consideration against the nominated criteria.

4.6 PROCESSING OPERATIONS, STOCKPILES AND PRODUCTS

4.6.1 Processing Operation

The final layout for the processing operations and associated facilities, e.g. laboratories, offices, workshops, amenities, car parks, will be determined following confirmation of the final process flow sheet. A "Processing Plant and Administration Area" would, however, likely comprise the following principal components.

- ROM Pad.
- Primary ore hopper and crushing stations (primary, secondary, tertiary and quarternary).
- Dry ball mill (ore).
- Feed conveyors for transfer between the crushing, milling and processing cycles.
- Sulphur stockpiles and Sulphuric Acid Plant.
- Reagent and chemical storage areas.
- Roasting kilns.
- Leaching and Filtration Circuit
- Solvent Extraction Circuits.
- Refining and metal / REE recovery circuits.
- Crushed limestone stockpile.
- Crushed limestone feed hopper.
- Wet ball mill (limestone).
- Milled limestone slurry tank.
- Storage receptacles for solid tailings (filter cake) and pipelines for delivery of liquid tailings (slurry).
- Various water storages.
- Storage receptacles for metal and REE products.
- Administration complex including offices, amenities and car parking.
- Various workshops

The final location of the Processing Plant and Administration Area remains to be determined (and will consider such factors as local soils, groundwater, flooding). **Figure 4-1** provides the general area of consideration within which the Processing Plant and Administration Area will be located. This location provides direct access to the Toongi-Dubbo Rail Line, which will be reinstated and upgraded, for the delivery of bulk reagents and despatch of products, and Obley Road, via Toongi Road.

The process flow sheet has been developed over a number of years at AZL's pilot plant at the ANSTO Lucas Heights Facility. The specific details of these processing operations are not available for public review due to the commercial sensitivity of this information, however, an overview of the processing operations is as follows.

- ROM ore would be loaded from the ROM Pad into a primary crusher where the ore would be reduced in size. From the primary crusher, the ore would be transferred to secondary, tertiary and quarternary crushing stations to reduce the size of the ore.
- From the crushing station, the material would be transferred to a dry grinding circuit to further reduce the feed size.

- Acid, produced on-site by a sulphuric acid plant, would then be added to the ore feed and heated to 230ºC to convert metals and REE's to sulphates which are then dissolved into solution by leaching. (The Sulphuric Acid Plant produces Sulphuric Acid (H_2SO_4) by burning sulphur to produce sulphur dioxide gas [S + $O_2(g) \rightarrow SO2(g)$]. The sulphur dioxide is then oxidised using oxygen with vanadium (V) oxide as a catalyst [$2SO_2 + O_2 \rightarrow 2SO_3$]. The sulphur trioxide is then hydrated into sulphuric acid [$SO_3 + H_2O \rightarrow H_2SO_4(g)$] and the gas then condensed to liquid.)
- The leached solution is then filtered with solids removed as tailings. The solid residue removed at this point would be transferred to a stabilisation area, neutralised and then transferred to a Residue Storage Facility for disposal (see Section 4.7.3).
- The filtered solution is transferred to a series of solvent extraction (SX) and precipitation cycles for the recovery of the targeted metals and REE's. The tailings generated will be removed to the Residue Storage Facility for disposal (see Section 4.7.3) and remaining solution will be pumped to a series of lined evaporation ponds on the Mine Site (see **Figure 4-1**) for disposal as liquid tailings.

It is intended that the details of the proposed processing operations will be made available to relevant regulatory authorities at the time of public exhibition.

4.6.2 Reagent Management

The raw material and reagent inputs to the processing plants will be stored within the Processing Plant and Administration Area in accordance with relevant Australian and International Standards, guidelines and recommendations issued following the completion of a PHA (if required).

Suitable precautions for fire prevention will be taken and fire fighting equipment provided for the entire site, but in particular for the following combustible materials: Sulphur, NH_3, SX Organics, Flocculent and Coagulants.

Suitable precautions for spill prevention and containment will be taken and spill emergency response procedures developed for all site materials. Bulk reagents will be transported to site by rail with the other reagents transported either directly to site by road or in containers by rail to Dubbo and then transferred to site by road.

As noted for the processing operations, the Applicant intends on providing the specific details of reagent transport, storage and use to relevant regulatory authorities at the time of public exhibition.

4.6.3 Stockpiles

The raw material and reagents to be stockpiled within the Processing Plant and Administration Area include ROM ore, sulphur (for use in the on-site manufacture of sulphuric acid) and limestone ($CaCO_3$) (for neutralising tailings prior to disposal to the Residue Storage Facility). ROM Ore and Limestone will be stored in open stockpiles with compacted earth floor, while Sulphur will be an open stockpile on an impermeable and bunded surface.

All other raw materials, reagents and products will be stored in appropriate containers, vessels or purpose built warehouses.

4.7 PROCESSING WASTE MANAGEMENT

4.7.1 Introduction

The process produces waste streams of solids from the residual rock mined and precipitates from the process plant. Liquid waste streams are produced in the process plant from the water used to perform the hydrometallurgical extraction and separation processes. Gaseous emissions occur from the combustion of fuel to supply heat to the process; the production and use of sulphuric acid; and the use of limestone for neutralisation.

4.7.2 Air Emissions

Table 4-2 presents a summary of the emissions that would be generated by the processing plant. The state and anticipated quantity are also supplied.

Table 4-2
Raw Material and Reagent Stockpiles

Stacks	Physical State	Approximate Quantity	
		t/h (component)	Nm^3/hr (Total)
Primary Emissions			
Sulphuric Acid Plant stack (SO_x)	Gas	0.2	100 000
HR Boiler stack (CO_2)	Gas	5	30 000
Roaster Scrubber stack (SO_x)	Gas	0	180 000
Fe Precipitation vent (CO_2)	Gas	7	10 000
Secondary Emissions			
Standby Gas Boiler stack (CO_2)	Gas	1	10 000
Ammonia scrubber vent (NH_3)	Gas	0	100
Zr Dryer vent (H_2O)	Gas	5	7 000
Nb Dryer vent (H_2O)	Gas	2	2 000
Source: TZMI Pty Ltd			

The Sulphuric Acid Plant stack will be fitted with continuous emission monitoring equipment for SO_2.

4.7.3 Residue Management

As identified in the discussion of the processing circuit, there would be two process residue (tailings) streams generated by the processing and refining of the metals and REE's.

- Solid residue (tailings) with a 34% moisture content will be generated by the leaching and filtration circuits.
- The solid residue will be combined with lime (to neutralise any residual acidic residue) and temporarily stockpiled on lined storage pads. Runoff from these pads will be contained, collected and either returned to the leach circuit or directed to the liquid residue tailings stream.
- The stabilised residue would then be transferred to a Residue Storage Facility (RSF) for disposal.
- Liquid residue is generated by the processing plant in the form of high salinity liquor.
- The liquid residue would be pumped to lined evaporation ponds on the Mine Site (the exact size and placement of which is the subject of ongoing assessment but which are likely to occur within the areas nominated on **Figure 4-1**). The Uranium and Thorium containing residues removed during the refining of the Zirconium, Hafnium, Niobium and Tantalum products would be added to the liquid tailings stream. These ponds would be constructed to isolate them from surface runoff, and lined to prevent leaching of liquids to the soils and sub-surface flows below.
- Promising test work is underway to reduce the quantity of liquid residue produced. A reduction in fresh water use as well as further recycling opportunities have been identified in laboratory tests and will now be evaluated on the pilot plant scale. In addition, investigations are under way to evaluate membrane and evaporator options for the recovery of water from the liquid residue.
- At the completion of the project, the precipitated solids would be excavated and disposed of, through encapsulation, either within the completed open cut (above the groundwater table), the waste rock emplacement or a specifically constructed structure for this purpose.

4.8 TRANSPORTATION

4.8.1 Introduction

Transportation of construction materials, processing reagents, products and personnel would be by a combination of road and rail. The following sub-sections provide an overview of the likely transport requirements and currently proposed arrangement.

4.8.2 Construction Materials Transport

AZL is currently finalising requirements for the construction phase of the DZP which will influence the method of transport, type of vehicles used and number of vehicle movements during this 18 to 24 month period. At this time, it is likely that the majority of materials transported to the Mine Site would be by road (as construction will be ongoing on the rail line upgrade).

Further detail will be included in the EIS currently in preparation.

4.8.3 Reagent Transport

The DZP requires a relatively complex freight logistics task with a clear goal to get as much freight off road networks and onto rail. AZL will seek to assign the rail freight task to an established service provider. A dedicated train will be required to run between Newcastle and Toongi with close to full utilisation (operating 48 weeks per year).

A train consist would likely include a rake of twenty five x 60' wagons at 92 tonnes gross weight. One hundred top lift containers (5.9 x 2.35(w) x 2.33(h) – volume 32.8m^3) would be purpose built for the project.

AZL estimates that approximately 500 000t of reagents will require transport to the Mine Site each year and approximately 100 000 tonnes would be exported from site.

Of this total reagent transport, initial transport planning indicates that up to 350 000t of bulk reagents would be transported to the Mine Site.

AZL anticipates 1 train (of 25 to 30 wagons) would travel between Dubbo East and Toongi each day. The train would enter a rail siding on the Mine Site (see **Figure 4-1**) where it would be unloaded by forklift which will transfer the containers to the relevant stockpile or reagent management area for emptying or storage (the isotainers would be stored within a specific reagent management area whereas the containers containing sulphur, salt and limestone would be side tipping to allow immediate emptying to stockpile).

The train would take on average 2 hours to unload, with containers carrying DZP products placed on the empty wagons (see Section 4.8.4).

The remaining 150 000t of reagents and other materials required for the DZP would be transported to the Mine Site via the State highway network and Obley Road, predominantly in B-Double trucks. AZL has committed to ensuring that Obley Road is appropriately upgraded to accommodate the use of this road by B-Double trucks.

4.8.4 Export Product Transport

Export product is proposed to travel back to the Port of Newcastle in 20' standard export containers in the middle position on the 60' wagons. It is yet to be determined which port the containerised export product will depart from (Newcastle, Sydney or Wollongong).

Export containers may travel by road from Newcastle to Port Botany. Some export zirconium product may travel to Western Australia by road and rail.

DZP product marketing and logistics continue to be defined.

4.8.5 Workforce Transport

The workforce would access the Mine Site via Obley Road and Toongi Road. It is expected that most employees would travel between the Mine Site and Dubbo though it is likely some of the workforce would be sourced from local farms and towns and villages (Yeoval, Geurie and Obley).

4.9 MINE INFRASTRUCTURE AND SERVICES

4.9.1 Mine Site Access

The location of the DZP Mine Site Entrance and Access Road remains to be confirmed and will be dependent on the preferred location of the Processing Plant and Administration Area. Two entrance points off Toongi Road are under consideration which would provide access to the Mine Site either to the north or south of Toongi (see **Figure 4-1**). The intersection of the Mine Site Access Road and Toongi Road will be appropriately designed to provide suitable intersection performance for the volume and type of traffic to utilise this intersection. Similarly, the intersection of Obley Road and Toongi Road will be upgraded to provide for safe and efficient operation.

The section of Toongi Road to be used would be upgraded to provide a sealed road with 3.5m wide lanes and sealed shoulder. The Mine Site Access Road would be similarly constructed between Toongi Road and the Processing Plant and Administration Area. Constructive Solutions have been commissioned to identify the principal road improvements required for the DZP such as intersection upgrades, pavement widening and the installation of improved infrastructure.

4.9.2 Site Infrastructure

Internal Road Network

The Applicant would maintain a network of internal roads to enable haul trucks to transfer waste rock from the open cut to the designated areas of emplacement. An internal haul road would also be constructed and maintained between the open cut and the Processing Plant. The Proponent would also maintain a series of internal roads to enable access to the RSF and various evaporation ponds.

The internal open cut haul road would be designed and constructed to a maximum gradient of 10%.

Site Offices, Workshop and Facilities

AZL is currently finalising plans for site offices, workshops and amenities. Further detail is to be supplied in the EIS currently under preparation.

4.9.3 Services

4.9.3.1 Power

Power requirements for the DZP will be large, currently anticipated to be approximately 25MVA load.

The current delivery of electricity to Toongi is via 11kV lines which will not be capable of supplying the required power requirements. Given the possible 25MVA load of the DZP, AZL proposes to construct a new 132kV powerline, most likely from the 94J feeder to Dubbo which is closest to the DZP on the western side of Geurie (**Figure 1-1** provides an indicative alignment of the proposed 132kV powerline). A new substation on the Mine Site would also be required to distribute the electricity from the proposed 132kV powerline. The construction of this power infrastructure will be assessed separately to the DZP by Essential Energy under Part 5 of the EP&A Act.

Alternative power supply options are also under consideration, including the construction and operation of a natural gas fired power station on the Mine Site (natural gas is already required for heating and other activities on the Mine Site) and generation of electricity using the waste heat generated by the Sulphuric Acid Plant.

4.9.3.2 Natural Gas

Natural gas would be required for heating the kilns, burning sulphur in the Sulphuric Acid Plant, precipitating the Zirconium and other metals in the refining circuits and product drying. AZL proposes to obtain the estimated 2.4J/day (792TJ per year) from a purpose built pipeline between the main trunk line (of the Central West Pipeline) at Purvis Lane, Dubbo and the Mine Site. Discussions have commenced with the APA Group (the operator of the Central West Pipeline and Australia's largest natural gas distributors).

Currently, AZL proposes to utilise the Toongi-Dubbo Rail Line easement for the placement of the pipeline, however, this is the subject of ongoing discussion with John Holland Rail and local landholders.

4.9.3.3 Water

AZL proposes to obtain water via a pipeline to be constructed between the Macquarie River and the Mine Site. The alignment of the pipeline is currently shown to follow road reserves, however, AZL is negotiating with local land owners to create a more direct route between the Mine Sit and the river.

AZL understands that licence entitlement to extract and use the equivalent to the volume of water to be drawn from the river must be acquired and negotiations are advanced with a number of licence holders to purchase or lease part or all of existing entitlements.

4.9.3.4 Fuel

Approximately 585 000L of diesel is expected to be consumed by the mining fleet and generators across the Mine Site each year.

4.10 EMPLOYMENT

During the construction phase of the DZP, likely to continue for 18 to 24 months, the workforce would vary depending on the critical construction activities being undertaken. Including all contracted workers, it is estimated that between 150 and 300 jobs would be created during the construction phase. On commencement of operations, AZL estimates that in excess of 220 people would be employed directly by the DZP.

The construction and operational workforce would be preferentially sourced from the Dubbo region (90%). AZL has committed to training local people where required in preference to importing already trained operators from other mining regions across NSW and Australia. However, it is likely that some specialist or technical positions would be sourced from outside Dubbo and move to the local area. From time to time, AZL may be required to contract specific projects to mining or engineering contractors. These may be drawn from outside the Dubbo area also and would be housed in short-term accommodation within the Dubbo region, e.g. hotels, motels, caravan parks or rental accommodation, for the duration of their activities. There is no intention to establish camp accommodation for the workforce.

4.11 HOURS OF OPERATION AND LIFE OF THE PROPOSAL

4.11.1 Hours of Operation

Mine Construction

Mine construction activities would generally be undertaken between 7:00am and 10:00pm Monday to Saturday with selected activities undertaken between 8:00am and 6:00pm on Sundays, public holidays excluded. Activities which would be unlikely to generate noticeable noise such as electrical installation work within the Processing Plant and Administration Area, may be undertaken outside these hours while other activities, e.g. soil stripping, would be undertaken only during daylight hours.

Mining Operations

As a general rule, mining activities would be undertaken over a single 12 hour shift, 5 days per week, public holidays excluded. The mining schedule is likely to be relatively flexible, i.e. additional shifts or longer campaigns may be required to ensure a consistent supply of ore to the processing operations.

Processing Operations

The operation of the processing plant will be 24 hours a day, 7 days a week (public holidays inclusive). The only time when the processing plant will not operate would be during planned shutdown events or in response to unforeseen incidents.

Reagent Deliveries / Product Despatch

The hours of operation for reagent deliveries (by rail) and product despatch could be dictated by the timetable nominated by CRIA regarding the available train paths. However, as the Toongi-Dubbo Rail Line would be dedicated to the DZP, AZL is reviewing whether movements on this line can be managed based on operations at the Mine Site. Should this be the case, all efforts would be made to restrict reagent delivery and product despatch to between 6:00am and 10:00pm.

Road deliveries of reagents would be preferentially scheduled to arrive after 7:00am and before 10:00pm, however, occasional deliveries outside these hours may occur.

4.11.2 Life of the Proposal

The Dubbo Zirconia Project is based upon a 73M tonne resource and while this development application is limited to 20 years it is highly likely that the project will continue for generations to come. Only 18M tonnes of the ore body will be mined over the 20 year life of this application.

4.12 REHABILITATION

4.12.1 Rehabilitation Objectives

The Applicant's objectives for rehabilitation are centred upon the progressive restoration of areas of disturbance through the creation of a final landform, soil substrate and vegetative cover suitable for a level of agricultural productivity similar to existing levels, and/or passive nature conservation. The specific objectives for the long term rehabilitation program are to:

- blend the created landforms and vegetation established on the post-mining landform with that of the surrounding topography;
- provide a low maintenance, geotechnically stable and safe landform with minimal erosion; and
- re-instate the pre-disturbance land capability and agricultural suitability.

The Applicant would also implement a program of interim rehabilitation of disturbed/constructed areas in order to:

- reduce the visibility of mining and tailings disposal activities from surrounding properties and the local road network;
- minimise the areas of exposed surfaces which would otherwise be potential sources of windblown dust; and
- ensure the interim slopes are stable.

4.12.2 Final Land Use and Landform

4.12.2.1 Mine Site

The Proponent proposes to re-instate the landform within the Mine Site to allow its use for a combination of agricultural operations and/or passive nature conservation purposes, i.e. land uses consistent with those currently applying to the site.

An important focus of the rehabilitation program would be to return as much of the land disturbed as is practicable to a land capability and agricultural suitability comparable to the existing land.

All final slopes would be created principally through bulldozers pushing the overburden into the required form, after which subsoil and topsoil would be placed with emphasis placed upon progressive landform creation and stabilisation.

4.12.2.2 Macquarie Water Pipeline

The potential for any pipeline infrastructure to be retained for future use on the rehabilitation Mine Site (or other properties) will be assessed over the life of the DZP. If required, AZL would excavate and dispose of pipeline infrastructure and sow vegetation over the backfilled pipeline trench.

4.12.2.3 Rail Infrastructure

The Applicant intends to retain the Rail Load-out Facility and DZP Rail Siding until such time as it is no longer required for product despatch or for any other similar purpose. At this time, the structures would either be demolished and removed from the site, or on-sold to a future user of the land.

4.12.3 Potential Biodiversity Offsets

The DZP would involve the removal of yet to be defined types and areas of native vegetation. The Proponent intends to offset the removal of this vegetation by defining an offset area on the undisturbed areas of the Mine Site and surrounds. The area of land and its ongoing management would be addressed in the *Environmental Impact Statement*.

4.13 ALTERNATIVES CONSIDERED

During the design of the Dubbo Zirconia Project, the Applicant examined a range of alternatives before deciding upon the Proposal as presented within this document. The following sub-sections outline the alternatives considered and the reasons for proceeding with the preferred option.

Building the Project in the Dubbo LGA

The Applicant has spent the past twelve years developing a process flowsheet and a suite of high value metal products using novel technology. Mining and exporting unprocessed ore would add little value to the local and national economy. Have a regional city close by, existing infrastructure and proximity to water and power supply all support the case for value adding on site.

Mining Methods

Given the nature and location of the resource near surface, open cut methods were determined to be the only feasible means of extracting the identified resource.

Limits of Mining

The Toongi deposit continues at depth with the current application restricted to mining 8Mt of the 73Mt that has been identified. Extending the limits on mining as part of this application was considered, however, it was determined that restricting the current application to mining above the groundwater table would reduce the complexity of the mining operations and assessment.

Experience gained over the initial 20 year mine life will ultimately guide future applications for recovering more of the identified resource at depth.

Waste Rock Disposal

The near vertical intrusive nature of the trachyte deposit makes progressive backfilling of the open cut unfeasible (as it would sterilise the resource below).

Placement of waste rock to the immediate north and east of the open cut was considered, however, this would require clearing of additional remnant vegetation. Placement of the waste rock at lower elevations to the south, west and north was considered, however, this would increase the cost of haulage. These areas of lower elevation have also been considered more suited to the construction of the RSF and evaporation ponds.

Processing Options

Various process pathways have been trialled over the last 10 years. These alternative processes have considered such factors as reagent type and process efficiency, water consumption, processing rates, residues generated and cost of plant manufacture and operation. The process to be implemented represents the most efficient and environmentally sound process considered. It is noted AZL will continually review operations with the objective of improving processing operations and environmental outcomes.

Processing Plant Location

The optimum are for the placement of the processing plant is still being considered. While it must be located adjacent to the Toongi-Dubbo Rail Line, the exact placement is the subject of ongoing assessments and investigations of soils, groundwater, noise and air quality issues.

Transport Options

Transporting all reagents and products by road was considered, however, this alternative would vastly increase the impact of the DZP on local traffic, as well as traffic on regional distribution routes. This alternative would also ignore the presence of existing (if currently unusable) rail infrastructure.

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5. ENVIRONMENTAL FEATURES AND PRELIMINARY ASSESSMENT

This section reviews the range of features of the environment within and surrounding the Site that would or could be impacted during and/or beyond the life of the DZP. A brief description is provided of the existing environment, together with discussions of the investigations already undertaken, underway or planned. Where relevant, information on safeguards and management measures to be adopted by the Proponent are identified. This section also introduces how impacts of the Proposal will be assessed.

5.1 AIR QUALITY

PAEHolmes have been commissioned to undertake a comprehensive air quality impact assessment of the DZP. The following provides a compilation of air quality monitoring data collected on the Mine Site by AZL, consideration of the potential impacts on air quality that could be associated with the DZP and an outline of the proposed method of assessment to be applied.

5.1.1 Existing Environment

5.1.1.1 Introduction

Air quality guidelines and goals refer to levels of "pollutants" in the air which include both existing and operational sources. In order to fully assess impacts against all the relevant air quality guidelines and goals, it is therefore necessary to compile information or estimates on existing dust deposition levels and the existing concentrations of airborne particulates.

An appreciation of the existing air quality in the vicinity of the Mine Site has been obtained from two principal sources, namely:

- dust deposition monitoring undertaken between March 2001 and April 2002 at nine locations on, and surrounding the Mine Site; and
- suspended particulates (TSP) monitoring undertaken at one site, "Wychitella" homestead (the site of the Mine Site meteorological station).
- **Figure 5-1** presents the location of the air quality monitoring locations.

5.1.1.2 Deposited Dust

Table 5-1 presents the results of the dust deposition monitoring program of 2001 - 2002. The annual average dust deposition levels across all sampling locations was 1.1g/m^2/month. These results are indicative of a very low emissions environment.

There is no reason to suggest that the dust deposition levels recorded in 2001 – 2002 would have changed significantly since that time given there has been no major change to activities in the local area.

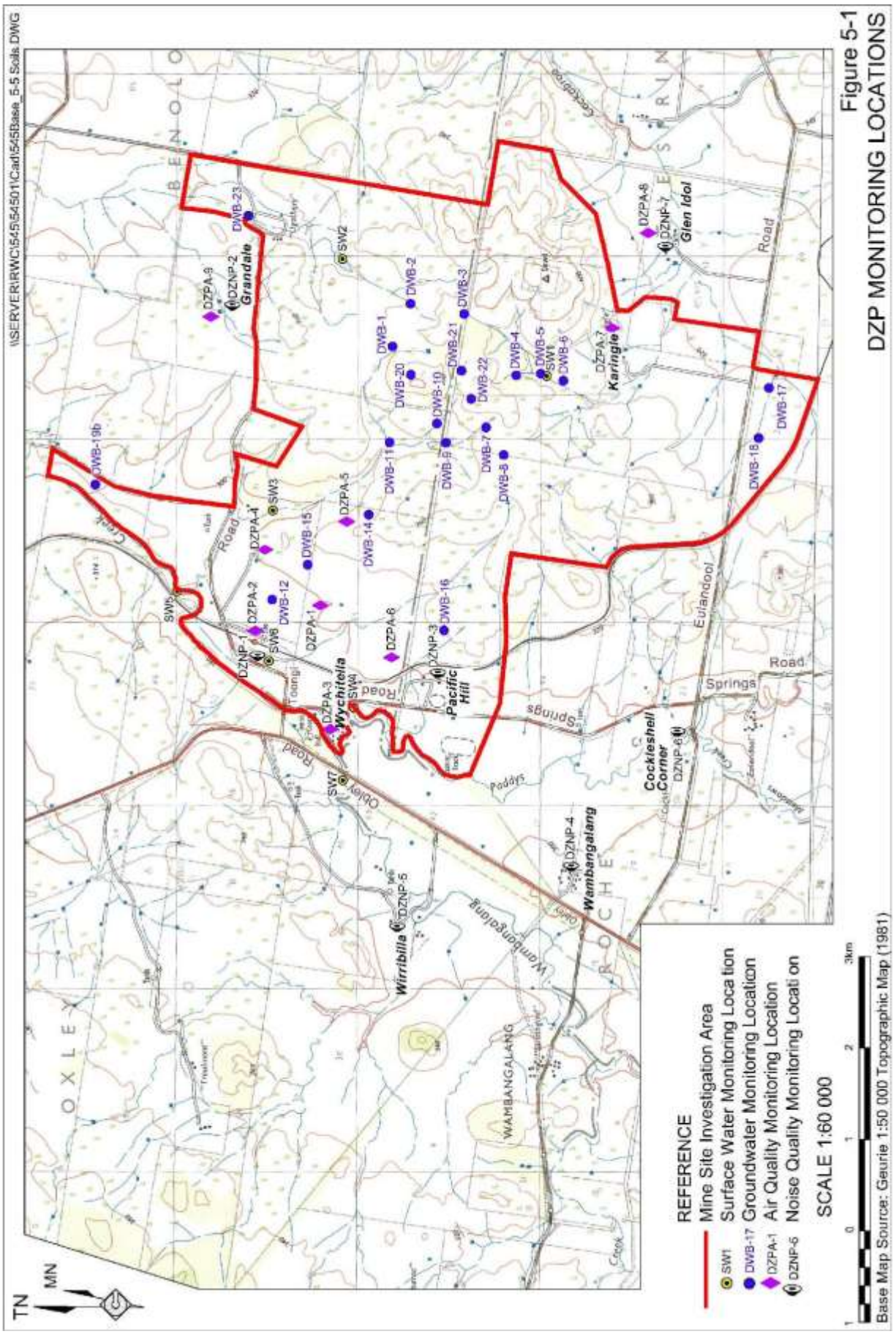

\\SERVER\RIWC\545\545501\Cad\545Base_5-5 Scale.DWG
Figure 5-1
DZP MONITORING LOCATIONS
REFERENCE
Mine Site Investigation Area
SW1 Surface Water Monitoring Location
DWB-17 Groundwater Monitoring Location
DZPA-1 Air Quality Monitoring Location
DZNP-6 Noise Quality Monitoring Location
SCALE 1:60 000
Base Map Source: Geurie 1:50 000 Topographic Map (1981)
TN
MN
Grandale
Wychitella
Pacific Hill
Wirribilla
Wambangalang
Cockieshell Corner
Glen Idol
Karingle
Springs
Road
Creek
OXLEY
BENOLO
WAMBANGALANG

Table 5-1
Dust Deposition Monitoring Results (g/m^2/month)

Date	Monitoring Location[1]									
	DZPA-1	DZPA-2	DZPA-3	DZPA-4	DZPA-5	DZPA-6	DZPA-7	DZPA-8	DZPA-9	Average
Mar 2001	0.8	0.6	0.3	0.4	0.2	0.4	-	-	-	**0.45**
Apr 2001	1.5	3.1	0.5	0.9	0.8	0.9	-	-	-	**1.28**
May 2001	0.2	1.4	0.2	0.3	0.2	0.4	-	-	-	**0.45**
Jun 2001	0.2	1.0	0.2	0.1	0.1	3.4	-	-	-	**0.83**
Jul 2001	0.1	0.5	0.2	0.6	9.4	0.8	-	-	-	**1.93**
Aug 2001	1.0	1.2	1.1	1.2	1.9	1.8	-	-	-	**1.37**
Sep 2001	0.2	0.4	0.3	0.6	0.4	0.3	-	-	-	**0.37**
Oct 2001	0.8	1.6	0.9	0.6	2.6	0.5	-	-	-	**1.17**
Nov 2001	0.5	0.7	0.5	0.8	0.7	0.8	1.4	0.9	1.4	**0.86**
Dec 2001	3.0	2.7	1.4	1.4	1.0	1.3	1.6	2.3	1.8	**1.83**
Jan 2002	0.9	3.2	1.3	0.9	0.2	1.1	2.5	1.3	0.9	**1.37**
Feb 2002	0.8	1.2	1.0	2.0	0.4	1.2	0.5	0.8	1.3	**1.02**
Mar 2002	0.8	1.0	1.4	0.7	0.4	0.9	0.7	3.8	0.9	**1.18**
Average	**0.83**	**1.43**	**0.72**	**0.81**	**1.41**	**1.06**	**1.34**	**1.82**	**1.26**	
Note 1: see **Figure 5-1**										
Source: Alkane Resources Ltd										

5.1.1.3 Total Suspended Particulates

Measurements of TSP concentrations are available from a high volume sampler operated adjacent to the "Wychitella" homestead between March 2001 and April 2002 (see **Figure 5-1**). Sampled every 6 days, the average TSP over the period was 20.3µg/m^3 with a maximum daily concentration of 66.9µg/m^3[9] and minimum of 2.4µg/m^3.

5.1.1.4 PM_{10}

There has been no monitoring of PM_{10} concentration on the Mine Site. The air quality impact assessment will therefore rely on regional data collected by the EPA and comparison to the TSP data collected on the Mine Site.

5.1.1.5 Greenhouse Gases and Other Emissions

Small concentrations of NO_2 and SO_2 would be emitted by vehicles travelling on local roads, however, these levels are considered to be minimal given the minor concentrations of NO_2 and SO_2 emitted by vehicles.

[9] 129.9µg/m^3 was recorded on one occasion, however, this was measured over 2 days.

Existing background concentrations of carbon dioxide and methane are recognised to be negligible and typical of a rural area.

5.1.2 Potential Sources of Air Contaminants

5.1.2.1 Particulate Matter (Dust)

Dust generation would be one of the principal air quality issues relevant to the DZP. Depending upon the size and concentration of particles in the air and their composition, airborne dust has the potential to affect human health as well as contribute to the general degradation of the environment. The term *"particulate matter"* refers to a category of airborne particles typically less than 50µm in aerodynamic diameter. The human respiratory system has a built-in defensive system that prevents particles greater than 10µm in diameter from reaching sensitive areas of the respiratory system. As a result particles with a diameter of less than 10µm (referred to a PM_{10}) and 2.5µm (referred to as $PM_{2.5}$), if in high enough concentration, may adversely affect human health.

As particles larger than 10µm can also contribute to environmental degradation, the air quality assessment also considers the total mass of particles suspended in the air, namely total suspended particulate matter (TSP). Particles that have an aerodynamic diameter sufficiently large so as not to be suspended in air (typically >35µm) are referred to as deposited dust and may result in environmental impacts, principally visual and amenity impacts.

The principal sources of dust emissions that would be generated by the DZP would include:

- vegetation clearing and soil stripping (largely during construction);
- excavation of soil, waste rock and ore material and loading of that material into trucks;
- blasting;
- crushing of ore;
- major earthworks and construction activities (largely during construction);
- wind erosion from disturbed areas and stockpiles;
- movement on hard stand areas loading and unloading trains;
- stockpiles of sulphur and limestone in the plant area; and
- general movement of vehicles on unsealed roads within the Mine Site.

5.1.2.2 Greenhouse Gas Emissions

Greenhouse gases would be produced as a consequence of the DZP, the primary source of which being through the combustion of diesel and natural gas by hydrocarbon-powered plant, mobile equipment and vehicles. Greenhouse gas emissions would also be generated through on-site electricity consumption, initiation of explosives (for blasting) and the movement of the vehicles to and from the Mine Site. Although carbon dioxide (CO_2) would be the principal gas produced, greenhouse gases emitted as a result of the Project would also include carbon monoxide (CO), methane (CH_4), oxides of nitrogen (NO_X), SO_2 and non-methane volatile organic compounds (NMVOCs). For the purposes of the air quality assessment, all greenhouse gas levels are expressed in CO_2 equivalent units (CO_2-e).

5.1.2.3 Other Stack Emissions

The processes of burning sulphur to produce sulphuric acid, and roasting the ground ore (following addition of acid) would generate stack emissions of gases such as ammonia (NH_3), oxides of sulphur (SO_x) and oxides of nitrogen (NO_x). While the SO_x produced by the burning of sulphur is captured to produce sulphuric acid (see Section 4.6.1), any of these gases, if emitted in high enough concentration, have the potential to impact on local vegetation, as well as the health of people, livestock or other fauna exposed to it.

5.1.3 Key Air Quality-related Issues and Preliminary Assessment

5.1.3.1 Key Air Quality-related Issues

Based on the risk assessment undertaken for the Project (see Section 2.4), the specific air quality-related impacts that may result as a consequence of the Project (without the implementation of the safeguards, controls and mitigation measures presented in this section) and therefore require assessment include the following.

- Dust generation resulting from vehicle movements on unsealed roads, hardstand surfaces, fixed plant, including crushing operations, blasting operations and wind action on disturbed areas, overburden emplacements and stockpiles resulting in:
  - nuisance/amenity impacts from dust deposited on window sills, cars, surfaces;
  - adverse health impacts (if PM_{10} levels are excessive);
  - impacts associated with exposure to radiation; and/or
  - stress of native vegetation, and indirect impacts on fauna habitat.
- Increased contribution to greenhouse effect.
- Stack emissions resulting in adverse impacts on health and safety and/or local amenity (due to unsightly or odorous emissions).

The following sub-section reviews the proposed management and preliminary assessment relevant to the above sources of risk.

5.1.3.2 Preliminary Assessment

5.1.3.2.1 Dust Deposition

The methods to manage dust in the mining industry are well known and would be adopted by AZL. The methods relate principally to minimising dust generated through:

- limiting the disturbance areas exposed at any one time, both in terms of new areas disturbed and areas being rehabilitated;
- suppression of dust on internal roads, activity areas and stockpiles through the application of water or dust suppressants; and
- control of dust at its source through collection and/or suppression.

The air quality assessment will incorporate further details of the design and operational safeguards that AZL would implement so that compliance with the site specific criteria would be achieved.

The air quality assessment for the DZP will involve consideration of several representative operational scenarios. The scenarios selected would involve the proposed mining, processing, waste and residue management, rehabilitation and related activities with the nominated static equipment positioned at their nominated locations and elevations and the mobile equipment considered along their movement paths.

The dust levels attributable to each of the proposed activities on site, i.e. after the adoption of the design and operational safeguards, would be entered into a dispersion model and predictions made to each of the non project-related residences surrounding the proposed activities. The meteorological inputs to the model would be drawn from the on-site meteorological station and any available relevant longer term data.

The air quality modelling would predict future air quality surrounding the Mine Site through the use of the following descriptors relating to both the amenity and health effects of dust.

- Deposited Dust (annual average).
- PM_{10} (annual average and 24 hour average).
- $PM_{2.5}$ (annual average and 24 hour average).

The predicted air quality based upon the above descriptors will be assessed against the relevant criteria. It is noted that part of the waste residue stream will contain traces of Uranium, which will have low levels of radioactivity. The air quality assessment will also consider the concentration of dispersed radioactivity and possible impact on people and the environment.

The inputs to the air quality model would include the dust generated by the Applicant's operations together with that from other existing and proposed developments to ensure the combined or cumulative dust levels comply with the nominated criteria.

The assessment of potential air quality impacts for inclusion in the *Environmental Impact Statement* will also incorporate details of the proposed air quality monitoring program.

Whilst it is likely that the AZL would increase dust levels in the surrounding community to some degree, the controls and safeguards to be adopted would be designed to ensure that the levels of dust produced would satisfy all relevant amenity and health criteria.

5.1.3.2.2 Greenhouse Gas Emissions

Emissions of carbon dioxide (CO_2) would be the most significant greenhouse gases (GHGs) emitted from the DZP. Detailed inventories of greenhouse gas emissions will be presented in the *Environmental Impact Statement* for the three 'scopes' of emissions (Scope 1, Scope 2 and Scope 3). Sources that will be considered for the DZP include:

- fuel consumption (diesel and gas) during mining operations – Scope 1;
- Natural gas consumption;
- indirect emissions resulting from the consumption of purchased electricity – Scope 2;
- indirect emissions associated with the production and transport of fuels – Scope 3;
- indirect emissions associated with transmission and distribution losses from electricity supply – Scope 3; and
- emissions from transportation – Scope 3.

GHG emissions will be presented in the *Environmental Impact Statement* in the context of Australian baseline and NSW total emissions and global climate change. A qualitative assessment of the potential impacts of these emissions on the environment will be presented in the *Environmental Impact Statement*, including consideration of all reasonable and feasible measures to minimise emissions.

The DZP would result in an increase in GHG emissions as both Scope 1 and Scope 2 emissions are anticipated to be significant. In assessing the impact of the DZP on NSW and Australia GHG emissions, the air quality assessment will consider and recommend methods by which emissions may be reduced.

5.1.3.2.3 Other Stack Emissions

In order to assess stack emissions, the air quality assessment will complete an emissions inventory based on the composition of the ore, type and volume of reagents to be used and the chemical reactions to be initiated to either produce sulphuric acid or remove the various metals and REE's from the ore. Dispersion modelling from a point (stack) source will then be implemented to identify the likely dispersion of these emissions and potential impacts on surrounding receivers.

As identified in the preliminary risk assessment, the main risk associated with the stack emissions revolves around a malfunction resulting in uncontrolled releases of various gases. Given the detailed design process being followed and the implementation of a comprehensive quality control and maintenance program, however, the likelihood of such a malfunction is considered exceptionally small. The likely concentration of sulphur dioxide and other stack emissions is likely to be relatively low and quickly dispersed and therefore unlikely to have an adverse impact on the surrounding environment.

5.2 NOISE AND VIBRATION

EMM Mitchell McClennan has been commissioned to complete a Noise and Vibration Impact Assessment of the DZP. The following provides a compilation of noise monitoring data collected in the local area previously by AZL, consideration of the potential impacts on the local setting attributable to noise and vibration generated by the DZP and an outline of the proposed method of assessment to be applied.

5.2.1 Existing Noise Climate

5.2.1.1 Existing Noise Sources

Existing noise levels in the vicinity of the Mine Site are influenced by a range of sources including:

- traffic on Obley Road and other local roads;
- domestic noises such as lawn mowers;
- rural noises such as tractors, stock and birds;
- wind in the trees;
- livestock/vehicles on properties; and
- insect and bird noise.

5.2.1.2 Existing Noise Levels

Monitoring of background noise levels was conducted at several locations on and surrounding the Mine Site in December 2001. **Figure 5-1** identifies the noise monitoring locations which were subject to both attended and unattended surveys.

Unattended Noise Monitoring

During the survey period, 7 to 17 December 2001, environmental noise loggers were used to continuously record noise levels at each location during the survey period. **Table 5-2** presents the results of the unattended noise monitoring, as rating background level (L_{90}), i.e. the noise level exceeded for 90% of the time.

Table 5-2
Unattended Ambient Noise Environment (Rating Background Level)

Monitoring Location[1]	Reference	Rating Background Level (L_{A90}) All Noise Sources[1]		
		Day	Evening	Night
DZPN-1	Bye	30	30	27
DZPN-2	Grandale	28	29	28
DZPN-3	Pacific Hill	28	30	30
DZPN-4	Wambangalang	33	31	28
DZPN-5	Wirribilla	30	33	30
Note 1: see Figure 5-1 Note 2: Units = dB(A) re 20µPa				
Source: Richard Heggie Associates (2002) - unpublished				

Attended Noise Monitoring

In order to supplement the unattended noise logger measurements and to assist in identifying the character and duration of the ambient noise sources, operator-attended night-time noise surveys were conducted at selected residences on 29 and 30 April 2009. **Table 5-3** presents the results of the attended noise monitoring program.

The monitoring confirms that the local setting is typical of a quiet agricultural setting with no dominant noise source. While the monitoring was undertaken in 2001, there is no reason to suggest that this environment would have change since as there has been no major change to local activities. EMM will confirm this through the completion of further noise monitoring in 2012.

5.2.2 Key Noise-related Management Issues and Preliminary Assessment

5.2.2.1 Key Noise-related Management Issues

Based on the risk assessment undertaken for the DZP (see Section 2.4), specific noise-related impacts that may result as a consequence of the DZP (without the implementation of the safeguards, controls and mitigation measures presented in this section) include the following.

- Increased noise levels associated with Mine Site activities (construction and operation) (≤5dBA above noise criteria) causing annoyance, distractions, i.e. amenity impacts.
- Increased noise levels associated with Mine Site activities (construction and operation) (>5dBA above noise criteria) causing more significant amenity impacts.
- Increased noise levels associated with transport operations causing annoyance, distractions, i.e. amenity impacts.
- Sleep disturbance as a result of maximum noise levels.
- Increased noise levels associated with the Project leading to impacts on local fauna assemblage.

Table 5-3
Operator-attended Ambient Noise Survey Results

Res	Date - Time	Primary Noise Descriptor (dB(A) re 20µPa)					Description of Noise Emissions (and Typical Maximum Levels – dB(A) (L_{Amax}))
		L_{A1}	L_{A10}	L_{Aeq}	L_{A50}	L_{A90}	
Daytime							
DZPN-5	7/12/02 – 1.30pm	44	36	37	32	29	Birds: 30 to 35 Insects: 28 to 29 Vehicles: 35 to 38
DZPN-1	7/12/02 – 2.15pm	51	45	43	39	33	Birds: 35 to 48 Dog Barking: 60 to 68 Vehicles: 43 to 48 Plane: 30 to 35
DZPN-2	7/12/02 – 3.55pm	48	46	42	37	33	Birds and Insects: 46 to 48 Vehicle: 44
DZPN-4	7/12/02 – 5.00pm	49	43	41	38	34	Birds: 40 to 45 Sheep: audible Vehicles: 38 to 43
DZPN-6	7/12/02 – 5.30pm	58	48	47	37	32	Birds: 60 to 64 Insects: 30 Dog: 50 Vehicle: 35 Pump: 40
DZPN-3	7/12/02 – 6.10pm	56	43	44	36	31	Birds: 40 to 65 Insects: audible Vehicles: 30 to 430
DZPN-7	17/12/02 – 1.45pm	53	44	41	40	37	Birds: 40 to 50
DZPN-7	17/12/02 – 2.05pm	52	44	40	37	32	Birds: 33 to 51 Vehicles: 30 to 35
DZPN-2	17/12/02 – 3.15pm	47	42	41	35	29	Birds: 30 to 35 Cow: 40 to 45
Night Time							
DZPN-5	8/12/02 – 12.30am	58	40	44	38	37	Insects: 35 to 40 Dog: 55 to 65 Vehicles: 25 to 54
DZPN-4	8/12/02 – 12.55am	36	32	31	31	28	Insects: 25 to 40 Vehicles: 30
DZPN-6	8/12/02 – 1.25am	39	32	32	31	30	Insects: 25 to 32 Pump:41
DZPN-3	8/12/02 – 1.40am	39	37	36	35	34	Insects: 28 to 34 Vehicles: 35 to 38
DZPN-1	8/12/02 – 2.00am	42	41	37	35	31	Insects: 28 to 42
Source: Richard Heggie Associates (2002) - unpublished							

The quiet nature of the area within and around the Mine Site dictates that noise management will be an important issue for coverage in the *Environmental Impact Statement*. The Applicant recognises that the construction of the Processing Plant and Administration Area, operation of the processing plant, the use of a wide range of mobile earthmoving equipment and machinery, and transport operations would all cause noise levels within the local area to increase.

5.2.2.2 Preliminary Assessment

The noise assessment of the DZP would involve the consideration of a number of representative operational scenarios, similar to those used for the air quality assessment. The scenarios selected would involve the proposed construction, mining, processing, transportation, rehabilitation and related activities with the nominated mobile and static equipment positioned at typical locations and elevations. The noise levels of the various items of equipment and their locations/elevations will be entered into the approved noise model and predictions made to each of the non project-related residences surrounding the Mine Site.

The noise modelling will predict future noise levels under both neutral (calm) and adverse weather conditions, e.g. temperature inversion/gentle breeze towards residences. The existing meteorological conditions will be reviewed over an entire year and prevailing conditions determined in accordance with the Industrial Noise Policy for consideration as adverse conditions. Based upon the background noise measurements outlined in **Table 5-2**, the rating background levels at most assessed residences will be 30dB(A) ± 2dB(A) and the associated intrusiveness criterion in the order of $L_{Aeq\ 15mins}$ 35dB(A) ± 2dB(A).

In addition to modelling the noise generated by construction and operational activities on the Mine Site, the noise and vibration assessment will consider the following.

- The noise generated by both road and rail transport to and from the Mine Site. This is considered especially relevant when considering rail noise impacts on residences within Dubbo, which have been constructed since the last regular operation of the Dubbo-Molong Rail Line.
- The noise and vibration assessment will include an assessment of the proposed blasting activities throughout the life of the DZP. The assessment would focus on identifying the blast parameters necessary to achieve compliance with both ground vibration and airblast overpressure levels. It is likely that some blasts could be noticed by surrounding landholders, however, the noise and ground vibration levels would be designed to be within all relevant blasting criteria.

The noise modelling and assessment will assist AZL in identifying practical and effective noise mitigation measures to attenuate the noise generated by the mobile and static equipment, blasting operations and transportation so as to achieve compliance with the relevant criteria under both calm and adverse weather conditions.

Given predicted noise levels are required to be compliant at non project-related residences during adverse weather conditions and such conditions only occur periodically, operational noise levels at most other times would be lower and therefore acceptable throughout the community for the life of the DZP.

5.3 TRANSPORTATION

Constructive Solutions Pty Limited has been commissioned to complete a Traffic Impact Assessment of the DZP. The following provides a compilation of noise monitoring data collected in the local area previously by AZL, consideration of the potential impacts on the local setting attributable to noise and vibration generated by the DZP and an outline of the proposed method of assessment to be applied.

5.3.1 Existing Road Network

Access to the Mine Site is currently provided via Obley Road, which forms a T-intersection with the Newell Highway on the western outskirts of Dubbo. Obley Road is most notable as an alternate route between Dubbo and Molong, via Cudal, Cumnock and Yeoval, and as the access road to the Taronga Western Plains Zoo.

From Obley Road, access to the Mine Site could be gained either via Toongi Road which forms a T-intersection with Obley Road, or via a new access road and intersection to be constructed.

AZL has commissioned three periods of traffic counts on Obley Road.

- November 2011. To obtain information on traffic levels capturing the annual harvest.
- February 2012. To obtain information on traffic levels during a more representative period of the year.
- June – July 2012. To obtain information on how traffic levels on Obley Road vary either side of the Taronga Western Plains Zoo entrance.

Traffic data was also obtained from a traffic count completed by Dubbo City Council in March – April 2012 near Dundillimal homestead on Obley Road.

The results of these traffic counts has yet to be compiled and analysed, however, will be informative in considering the impacts associated with the DZP transportation operations and the design of the required road improvements discussed in Section 5.3.2.

5.3.2 Key Road Management Issues and Preliminary Assessment

5.3.2.1 Key Road Management Issues

Based on the risk assessment undertaken for the DZP (see Section 2.4), the specific traffic-related impacts that may result as a consequence of the DZP (without the implementation of the safeguards, controls and mitigation measures presented in this section) and therefore require assessment are as follows.

- Road construction activities, e.g. entrance to the Mine Site and Obley Road upgrade resulting in:
  - Temporary inconvenience to commuters (if delayed for road works); and/or
  - Increased potential for road accident.

- Increased traffic levels due to movement of workforce and contractors resulting in:
  - increased traffic congestion and or traffic delays; and/or
  - elevated risk of accident/incident on local roads.

- Increased heavy vehicle movements or transportation of oversize of overweight loads resulting in road pavement deterioration.
- Transportation of dangerous or hazardous goods resulting in contamination as a result of a spill of dangerous or hazardous goods.

5.3.2.2 Preliminary Assessment

In order to accommodate the traffic to be generated by the DZP, including over size/weight vehicles, upgrading of Obley Road would be required. AZL recognises that a range of management procedures would also need to be adopted to ensure that its and any sub-contractors' vehicles operate in a manner that do not cause unacceptable impacts. Subject to the outcomes of investigations being undertaken by Constructive Solutions, these upgrading works and procedures may include, but not necessarily be limited to, the following.

- Upgrading/widening the road formations of Obley Road between the Mine Site and Newell Highway.
- Construction of a new intersection between Obley Road and an access road to the Mine Site.
- Construction of a crossing over Wambangalang Creek and possibly an upgrade of the Hyandra and another un-named floodway on the Obley Road.
- Constructing or upgrading rail level crossings on various roads including:
  - Toongi Road, Bellevue Road and Cumboogle Road between the Mine Site and Dubbo:
  - Wingewarra Street, Cobra Street, Boundary Street and Macquarie Street within the Dubbo city limits.
- A requirement for all drivers of heavy vehicles to adhere to a "code of conduct" or similar.
- Installation of appropriate signage.

The use of the rail network to transport reagent deliveries to the Mine Site and despatch products from the Mine Site would significantly reduce the volume of heavy vehicles potentially associated with the DZP and therefore minimise the potential impacts on the road network. Following the site establishment/construction period and the delivery of the mining equipment to the site, the principal vehicle movements associated with the DZP would comprise light vehicles driven by mine employees and contractors, and heavy vehicles supplying consumables to and servicing the mine.

The impact of the increased volumes of traffic on the existing road network and users will be considered in greater detail as part of the *Environmental Impact Statement* for the DZP. This assessment will be undertaken in accordance with the *Guide to Traffic Generating Development, Road Design Guide* (Roads & Traffic Authority), relevant Austroad standards and other relevant guidelines.

The DZP would result in increased levels of traffic on local roads, however, with road improvements, the likely impacts upon the road pavements, traffic congestion and road safety would be acceptable.

5.3.3 Existing Rail Network

The railway line which runs past the Mine Site, whilst not officially decommissioned, has not been operated for many years[10] but previously carried rail traffic between Dubbo and Molong. It connects between the Main Western and Broken Hill Rail Line which provide access from Sydney and western NSW (see **Figure 5-2**).

5.3.4 Key Rail Management Issues and Preliminary Assessment

5.3.4.1 Key Rail Management Issues

The principal rail management issues will include the following.

- Preparing engineering plans for the Dubbo-Toongi Rail Line upgrade, including a number of wooden bridges. AZL has commissioned CRrail to review the status of the existing rail line and associated infrastructure and prepare detailed designs.
- CRrail have conducted inspections of all bridges between the Mine Site and Dubbo and indicate that upgrading these to meet the required standards is feasible.
- Providing safe access from Toongi on the Dubbo-Molong Branch Line to the Sandy Hollow Rail Line. AZL would also utilise the Dubbo East interchange on the Main Western Rail Line to access a proposed siding new Geurie (to collect crushed limestone) and does not anticipate that this will constrain the use of the rail network.
- Ensure the minimisation of noise and dust impacts associated with rail movements arising from the DZP. Train scheduling into Newcastle will have an influence on the scheduling of train movements through Dubbo. The length of the train will also be considered for potential to disrupt traffic flow across more than one level crossing at once in Dubbo. Air quality and noise impact assessment will consider the potential increase in noise and particulate emissions and recommend mitigation measures as necessary to ensure compliance with assessment criteria.
- Minimise real or perceived amenity related impacts to residents adjoining the rail line in Dubbo. AZL has identified this as a potential issue and has committed to identifying the potentially affected stakeholders and discussing the actual as opposed to perceived impacts.

[10] The last train between Molong and Yeoval was 1992. Last train between Yeoval and Dubbo East interchange – 1988 (http://www.nswrail.net/lines/show.php?name=NSW:Molong_Dubbo)

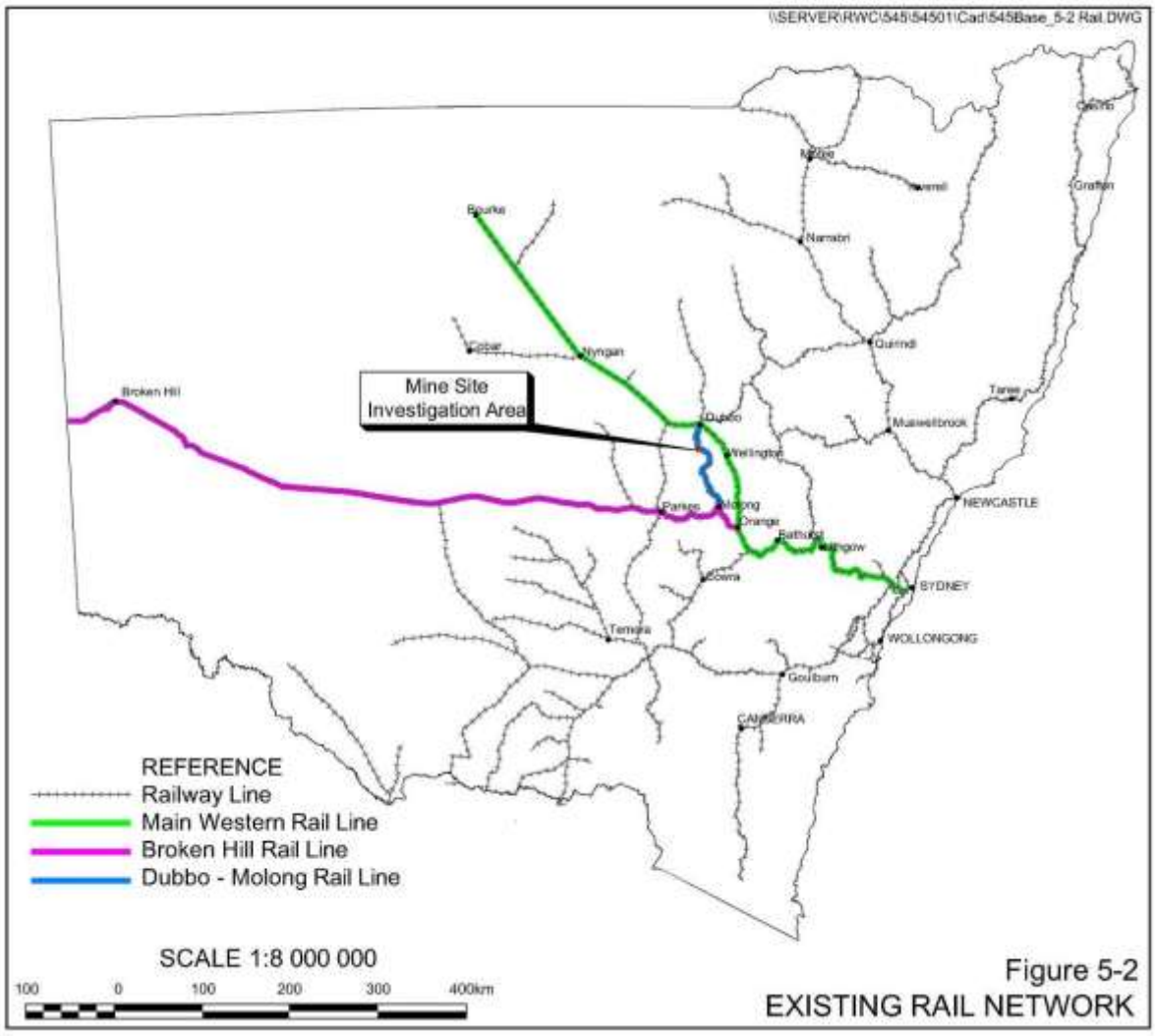


Figure 5-2
EXISTING RAIL NETWORK

5.3.4.2 Preliminary Assessment

The Applicant's initial discussions with the NSW Transport Country Rail Infrastructure Authority (CRIA) have established that the adoption of industry best practice safeguards and operating procedures for the DZP would assist to achieve acceptable outcomes for the despatch of the product from the Mine Site.

5.4 SURFACE WATER

Strategic Environmental and Engineering Consultants (SEEC) has been commissioned to complete a Surface Water Impact Assessment of the DZP. The following provides a compilation of surface water monitoring data collected in the local area, consideration of the potential impacts on the local setting attributable to the DZP and an outline of the proposed method of assessment to be applied.

5.4.1 Existing Environment

5.4.1.1 Surface Water Catchments

The Mine Site is located across three catchments within the Macquarie River catchment, with the majority of mine related disturbance to occur within the Wambangalang Creek catchment (see Section 3.2). **Figure 3-3** identifies the relative areas of the Mine Site incorporated into these three catchments. The following consideration of the existing environment considers the creek systems most likely to be affected by the DZP.

5.4.1.2 Wambangalang Creek

This is an ephemeral creek which flows relatively regularly in response to local rainfall. Surface Water monitoring within Wambangalang Creek, and Paddys Creek which flows into Wambangalang Creek at Toongi (see **Figure 3-3**), was completed in 2001-2002 and again in January 2012. The locations of the monitoring are identified on **Figure 5-1** and **Table 5-4** presents the results.

The results indicate elevated salinity levels at a number of the monitoring locations, both in 2001 and 2012. These sites, SW3, SW4, SW5 & SW7, are located within the streams of Wambangalang and Paddys Creeks and suggest dryland salinity within the catchment upstream of the Mine Site is influencing water quality. Indicators of sedimentation within the surface water of the catchment, turbidity, indicate levels exceeding ANZECC drinking water criteria, however, measurements of total suspended sediment in 2001 are indicative of relatively low sedimentation levels. This could suggest a degradation of catchment and channel quality over the drought period between sampling, or be indicative of the natural variability in conditions within the catchment.

Measurements of metals and radiometrics levels were generally found to meet the ANZECC (2000) aquatic ecosystems and livestock drinking water guideline levels respectively. However, the 2012 monitoring identifies nutrient levels (Total Phosphorous and Total Nitrogen) exceeding ANZECC (2000) criteria, which is somewhat indicative of the local agricultural setting and may reflect a flushing of the catchment of accumulated nutrient levels (nutrient concentrations in 2001 were compliant with ANZECC, 2000, guidelines).

5.4.1.3 Cockabroo Creek

Cockabroo Creek is an ephemeral creek with a much smaller catchment to Wambangalang Creek (see **Figure 3-3**) and accordingly flows far less frequently and generally only following periods of heavier or prolonged rainfall. Surface water monitoring in 2001 and 2012 also included a site within this catchment (SW1 / SW1b[11]) (see **Figure 5-1**) and the results of this monitoring are included on **Table 5-4**.

Water within the Cockabroo Creek catchment appears to be fresh, however relatively turbid. Concentrations of metals, radiometrics and nutrients all meet ANZECC (2000) guideline levels.

[11] No flow was current during the 2012 sampling and a sample was taken from a dam adjacent to the 2001 sampling location.

Table 5-4
Surface Water Monitoring

Parameter	ANZECC (2000) Trigger Values Units	SW1 (SW1b)		SW2		SW3		SW4		SW5		SW7	
		2001	2012	2001	2012	2001	2012	2001	2012	2001	2012	2001	2012
Indicators and Indices													
pH	<6.5 or >8	6.82	7.86	7.76		8.66	8.38	8.47	7.74	8.38	7.94		7.3
Acidity as $CaCO_3$			5		15		< 5		15		15		30
Ammonia(N)	0.013		3.6		0.29		0.22		0.22		0.2		0.2
Conductivity (µS/cm)	350	95	330	182	200	1970	2300	2220	2500	1830	2800		3800
Oil & Grease (HEM)			< 5		< 5		< 5		8		< 5		<5
Turbidity (NTU)	<2 or >25	100	26	19	11	2.6	11	4.6	30	5.9	26		18
Alkali Metals													
Calcium			13		3.3		23		65		53		56
Magnesium	600	2	5.3	69	3	125	73	82	47	67	63		58
Potassium		5	13	12	5.3	6	3.2	7	3.8	7	3.9		3.7
Sodium		10	4.5	20	8.7	165	120	266	150	227	190		260
Hardness Set													
Hardness mg equivalent $CaCO_3/L$			54.2		20.5		360		360		390		380
Major Anions													
Bicarbonate Alkalinity-mg $CaCO_3/L$			150		54		190		380		540		420
Carbonate Alkalinity-mg $CaCO_3/L$			< 5		< 5		88		<5		< 5		<5
Chloride		21	< 1	25	< 1	425	19	492	19	371	80		120
Sulphate (S)		2	< 2	<1	< 2	36	19	44	19	56	80		120
Metals M8 filtered													
Arsenic (filtered)	0.013	<0.01	0.002	<0.01	< 0.001	<0.01	0.004	<0.01	0.002	<0.01	0.003		0.001
Cadmium (filtered)	0.0002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		< 0.001
Chromium (filtered)	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		< 0.001
Copper (filtered)	0.0014	0.003	0.002	0.001	< 0.001	0.002	< 0.001	0.001	< 0.001	0.001	< 0.001		< 0.001
Lead (filtered)	0.0034	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		< 0.001
Mercury (filtered)	0.00006	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001		< 0.0001
Nickel (filtered)	0.011	0.003	0.008	0.002	0.002	0.003	0.003	<0.001	0.002	<0.001	0.001		<0.001
Zinc (filtered)	0.008	0.012	< 0.005	0.007	< 0.005	0.007	< 0.005	0.005	< 0.005	0.004	< 0.005		< 0.005
Nutrient Levels													
Uranium	0.2	<0.001				<0.001							
Thorium		<0.001				0.013							
Nutrient Levels													
Nitrate & Nitrite (N)	0.015	0.02	0.07	0.02	<0.01	0.24	< 0.01	0.02	< 0.01	0.02	< 0.01		< 0.01
Total Kjeldahl Nitrogen (N)	0.25	0.5	4.1	3.6	1.1	0.5	0.9	0.2	0.7	0.4	0.5		0.3
Total Nitrogen (N)	0.25	0.5	4.2	3.6	1.1	0.7	0.9	0.2	0.7	0.4	0.5		0.3
Phosphate ortho (P)			< 0.005		0.006		< 0.005		<0.005		0.02		<0.005
Total Phosphorous	0.02	<0.01	0.06	<0.01	0.03	<0.01	0.06	<0.01	0.04	<0.01	0.08		<0.01
Field Measurements													
Conductivity (µ/cm)	350		360		437		2078		2258		2516		3031
Temp			19.3		20.1		21.8		18		20.7		19.1
Oxidation reduction Potential (mV)			135		120		188		157		166		152

Blue = ANZECC (2000) Drinking Water Criteria Red = Livestock Watering Criteria

Bold = Exceeding Criteria

5.4.1.4 Flooding

Mapping completed by Dubbo City Council does not identify the Mine Site as being located within flood prone land, however, the surface water impact assessment will consider whether periodic or occasional inundation of water from Wambangalang (or other) Creeks could occur.

5.4.2 Key Surface Water Management Issues and Preliminary Assessment

5.4.2.1 Key Surface Water Management Issues

Based on the risk assessment undertaken for the Project (see Section 2.4), the specific surface water-related impacts that may result as a consequence of the Project (without the implementation of the safeguards, controls and mitigation measures presented in this section) and therefore require assessment are as follows.

- Reduction in environmental flows as a result of on-site capture of water resulting in:
  - reduced availability of water to downstream users;
  - reduced environmental flows;
  - stress to, and possible reduction in viability of native vegetation; and
  - degradation of aquatic habitats.
- Discharge of dirty, saline or contaminated water resulting in pollution of downstream waters, adverse impacts on flora and/or fauna (high risk) and/or reduced soil quality. Potential sources of pollution on the Mine Site could include:
  - sediment from disturbed areas;
  - hydrocarbons as a result of spills or leaks;
  - chemical reagents as a result of spills or leaks from the processing plant; and
  - overtopping or leaching from the TSF or evaporation ponds.
- Changes to hydrology of creeks and drainage lines resulting in:
  - reduced environmental flows within the Wambangalang Creek, Cockabroo Creek and Macquarie River catchments;
  - increased erosion potential resultant from changed alignment of flow; and/or
  - reduction in the quality of aquatic habitat.
- Changes to the flood regimes of Wambangalang Creek. resulting in:
- Erosive actions of water in undisturbed sections of the Mine Site.

5.4.2.2 Preliminary Assessment

A comprehensive suite of surface water and erosion control structures would be required on the Mine Site to ensure as much water as possible can be diverted around areas of disturbance and sediment-laden water is collected and contained on site. All structures would be designed in accordance with the latest version of the Managing Urban Stormwater: Soils and Construction Handbook (DECCW, 2008). The final landform would be designed to generally re-create the existing drainage catchments as closely as possible.

Appropriate controls and contingency measures would be designed and adopted to minimise the potential for fuel or chemical spills which could contaminate local surface water. The RSF and evaporation ponds would be appropriately designed and regularly inspected to ensure that no overtopping or leaching occurs.

The surface water to be captured and used on site would be undertaken with recognition of the Maximum Harvestable Rights Dam Capacity (MHRDC) for the Applicant's aggregated landholding. Water licences would be obtained for the surface water collected and used in excess of the MHRDC entitlement.

It is assessed that such controls can be designed and implemented such that the overall impact on the surface water resources would be acceptable. To further review the adequacy of surface water management and assess residual impacts on the local environment Strategic Environmental and Engineering Consulting ("SEEC") have been commissioned and will complete a Surface Water Impact Assessment for the DZP.

5.5 GROUNDWATER

Environmental Earth Sciences (EES) has been commissioned to complete a Groundwater Impact Assessment of the DZP. This assessment will build upon a hydrogeological and hydrological assessment completed over the Mine Site by Golder Associates in 2002. The following provides a review of the known groundwater environment, consideration of the potential impacts on the local setting attributable to the DZP and an outline of the proposed method of assessment to be applied.

5.5.1 Existing Environment

5.5.1.1 Aquifer Systems

Based on the results of field investigations and geological interpretation, Golder (2002) identified that groundwater occurs within two aquifer types in the vicinity of the Mine Site (although these essentially constitute a single groundwater flow system). Groundwater occurs within:

- generally shallow alluvium and colluvium; and
- underlying weathered and fractured basement rock.

Golder (2002) report that both units display low permeability, however, both contain localised areas of moderate to high permeability (occurring as sand / gravel layers within the predominantly clay alluvium and fracture zones of the basement rock). The Toongi deposit is located in an area interpreted to be a recharge area for both the shallow alluvium and deeper basement aquifers.

5.5.1.2 Groundwater Levels, Flows and Hydraulic Conductivity

Groundwater levels and flows over the Mine Site are generally sympathetic with surface topography, i.e. the highest groundwater levels generally reflect the more elevated sections of the Mine Site and vice versa. Groundwater flows also reflect surface topography with groundwater generally flowing away from the Toongi deposit (representing a local high point), i.e. the Toongi deposit represents a recharge area for groundwater on the Mine Site.

The average hydraulic gradient between the Toongi deposit and Wambangalang Creek is 0.022 (1 in 45).

Hydrogeological testing of 13 (of 21) groundwater bores over the Mine Site in 2001/2002 determined that the average hydraulic conductivity of the groundwater to be 1 x 10^{-8}m/s. Based on an anticipated average porosity of 0.1, the average velocity of groundwater flows from the Toongi deposit towards Wambangalang Creek would be approximately 1x10^{-7}m/s. It is noted that flow rates could be higher if zones of higher permeability not identified by groundwater testing occur, however, these would be unlikely to represent increases of more than an order of magnitude, still a relatively low flow velocity.

5.5.1.3 Groundwater Quality

Sampling of water from 21 groundwater monitoring bores over the Mine Site identifies variable salinity levels (an electrical conductivity of between 470µS/cm in the upper catchments and 6 700µS/cm in the lower catchment).

The concentration of metals in the groundwater are generally low and fall within the recommended guideline concentration of ANZECC (2000) for livestock watering. Low concentrations of Uranium and Thorium, which include radioactive isotopes producing α and β radiation, were recorded. However, that 4 of 5 analysed samples analysed produced radiation levels exceeding livestock watering guideline levels of ANZECC (2000).

It is also noted that nutrient levels were also analysed and the results for phosphorous and nitrogen exceeded ANZECC (2000) guideline levels.

5.5.1.4 Groundwater – Surface Water Interaction

As noted in Section 5.5.1.1 and 5.5.1.2, recharge to the deeper basement aquifer occurs in the elevated areas higher in the surface water catchments of the Mine Site where there are exposures of fractured but relatively fresh unweathered basement rocks with limited cover of clays and other weathered rock. The rainfall infiltrates the ground surface and percolates down to the groundwater table at which point it flows laterally down-gradient towards discharge areas associated with the local creeks and rivers. Discharge from the bedrock aquifer occurs to present day creeks and rivers, as well as low lying wetland areas bordering the Macquarie and Little Rivers, either directly or more commonly indirectly via the alluvial aquifer system.

Recharge to the alluvial aquifer system is likely to occur locally, through infiltration of incident rainfall through the surface soils and into the alluvial water table (albeit slowly due to the predominance of clays). Water may also infiltrate from stream beds and channels through more permeable sands and gravels. An additional source of recharge to the alluvial aquifer would be the lateral flow within the basement aquifer. Discharge occurs from the alluvial aquifers into the existing creeks, rivers and low lying wetland areas, however, an interchange between recharge and discharge is likely to take place seasonally, i.e. groundwater discharges into the streams when surface flows are reduced and recharged again when stream flows increase.

5.5.1.5 Dryland Salinity

A salinity risk assessment completed by Smithson (2001) in association with the former Department of Land and Water Conservation (DLWC) identifies the Wambangalang Creek catchment as having a high salinity hazard rating. Evidence of this salinity issues was highlighted by the surface water monitoring results (see Section 5.4.1 – **Table 5-4**).

Dryland salinity is a form of land degradation resulting from rising water tables in areas of relatively shallow groundwater and is a likely cause of the observed elevated salinity levels. Dryland salinity occurs when salts within the groundwater are precipitated as the water level rises and accumulate within the soil. Dryland salinity problems are generally caused by factors that either increase the groundwater recharge rate, e.g. through a change in the infiltration characteristics of the surface, or reduction in natural discharge, e.g. though land clearing that reduces rates of evapotranspiration losses. Dryland salinity is a natural phenomenon, however, is also caused or accelerated by anthropogenic sources, in particular land clearing for agricultural purposes.

Areas at greatest risk are those where the groundwater table is less than 5m below natural surface and these areas have been mapped by Smithson (2001). Notably, none of the mapped areas occur on the Mine Site, however, groundwater levels 5m to 10m below surface do occur in the vicinity of Wambangalang Creek (Golder, 2002) and could become at risk in the future (Smithson, 2001, noted rising groundwater levels of 0.2m a year within the Wambangalang Creek Catchment)..

5.5.1.6 Registered Bores

A search of the NSW Natural Resource Atlas indicates that there are more than 130 registered groundwater bores within 10km of the Mine Site. The majority of these bores are identified as for domestic supply and there are no large scale licences (either groundwater or surface water) for irrigation or industrial purposes within the 10km zone.

It is noted that due to the salinity of much of the local groundwater, the water is generally only suitable for stock watering.

5.5.2 Key Groundwater Management Issues and Preliminary Assessment

5.5.2.1 Key Groundwater Management Issues

Based on the preliminary environmental risk assessment undertaken for the DZP (see Section 2.4), the specific groundwater-related impacts that may result as a consequence of the Project (without the implementation of the safeguards, controls and mitigation measures presented in this section) include the following.

- Pollution of groundwater due to leaching of contaminants from the RSF or evaporation ponds resulting in a reduction in beneficial uses of the water and therefore availability to existing groundwater users.
- Pollution of groundwater due to hydrocarbon or chemical reagent spills.

- Reduction of groundwater levels due to mining intercepting aquifers resulting in:
  - Reduction in the volume of water contained within the affected groundwater aquifer (drawdown of water table);
  - Reduced yields of local groundwater bores (moderate risk); and/or
  - Reduced viability of groundwater dependent ecosystems.
- Reduction in contribution to surface water flows resulting in:
  - Reduced flows to Wambangalang and other creek catchments of the Macquarie River; and/or
  - Reduced viability of groundwater dependent ecosystems (low risk).
- Increase in dryland salinity as a result of land clearing leading to local elevation in the groundwater table

5.5.2.2 Preliminary Assessment

Groundwater modelling (steady state) and assessment completed by Golder in 2002 (Golder, 2002), considered the potential impacts nominated above for mining completed to 20m below surface). The results of Golder (2002) concluded the following.

- On development of the open cut below current groundwater level (~325m AHD), water would require pumping from the open cut (to remove inflow of approximately 100m^3/day). It is noted that the proposed depth of mining would remain above this elevation and hence the noted impact, which would result in a reduction in recharge to the local basement and alluvial aquifer systems, should not occur.
- A reduction in recharge wold likely have a net positive impact on dryland salinity issues by counteracting any water table rises resultant from clearing (pre-dating the DZP).
- A limited cone of depression would be created around the open cut once mining presses below the water table, with the groundwater flow within a radius of approximately 600m around the open cut reversed to flow towards the open cut. The zone of reduced groundwater levels, which will be largely restricted to the land included within the Mine Site, is unlikely to impact on any existing groundwater users.

- Following the cessation of mining, groundwater levels would return to pre-mining elevations of approximately 325m AHD. Over time, water accumulating in the completed open cut would increase in salinity as salts are concentrated by evaporation. However, as a positive hydraulic gradient into the open cut void would be maintained due to evaporative rates exceeding in-flow rates, there would be no movement of concentrated saline water back into the aquifer.
- Assuming the use of appropriate liners for the RSF and evaporation ponds, leachate of pollutants to groundwater is highly unlikely to occur. However, in the unlikely event of such leachate escaping, a monitoring network would be established around each structure to enable early detection and implementation of contingency measures.

Environmental Earth Sciences (EES) has been commissioned to review and build upon the Golder (2002) modelling and assessment. This will include the development of a detailed hydrogeological model that will enable each of the above impacts to be established. It is noted that there would be no groundwater intersected or any groundwater impacts associated with the proposed water pipeline or other component activities of the DZP. As a result, the groundwater assessment focuses only on the groundwater impacts within and surrounding the Mine Site.

5.6 VISIBILITY

5.6.1 Existing Environment

The existing visual amenity surrounding the Mine Site is typical of rural areas in the central west of NSW, with the outlook from most rural residences and other vantage points including land used for agriculture, transportation or other infrastructure, as well as remnant native vegetation. Outlooks from residences within the village of Toongi include views of surrounding buildings, established trees and smaller vegetation and Obley Road.

The Mine Site is typically visible from the following locations.

- Residences of Toongi.
- Rural residences to the east, north and south of the Mine Site.
- Obley Road.
- The rural landscape of the Mine Site and surrounds is typically undulating with creek flats proximal to Wambangalang Creek. Dowd's Hill is the dominant landscape feature in the vicinity of the Study area and rises to an elevation of approximately 440m AHD. Much of the local arable land has been cleared of trees, however, remnant native woodland vegetation remains on Dowd's Hill, as well as other hills of the Mine Site and surrounding land. Native vegetation also occurs along the alignment of local creeks and drainage features, as well as road easements. In cleared areas, visual amenity changes with the seasons from red-brown fallowed paddocks to green growing crops and straw collared harvest residues (stubbles). Livestock are also a common feature in depending on availability of feed.

The alignment of the Macquarie Water Pipeline route is unlikely to be visible from any residences. Construction work required during installation is likely to be visible from surrounding properties and roads.

The principal night-time activity in the vicinity of the Mine Site is transportation on Obley Road. As a result, lighting-related impacts on the existing night-time visual amenity in areas away from the highway and other local roads is likely to be limited.

5.6.2 Key Visual Issues and Preliminary Assessment

5.6.2.1 Key Visual Issues

Based on the risk assessment undertaken for the DZP (see Section 2.4), the specific visual amenity-related impacts that may result as a consequence of the DZP (without the implementation of the safeguards, controls and mitigation measures presented in this section) and therefore require assessment include the following.

- Changes in visual characteristics of the Mine Site resulting in changes to local visual amenity or an unsightly landform at the completion of the Project.
- Increased lighting from the Mine Site reducing the visibility of stars and the overall amenity of the night sky.
- Overall, emphasis would also be placed upon minimising the views of operational areas during the life of the DZP and the creation of a final landform that is compatible with and aesthetically acceptable in the long term visual landscape.

5.6.2.2 Preliminary Assessment

The most prominent features of the Mine Site would be the processing plant, to be located adjacent to Toongi village and Obley Road, and the RSF and evaporation ponds which are likely to represent the largest area of impact. The open cut mine and waste rock emplacement would also represent significant modifications to the landform, however, these are relatively small in area (comparatively) and distant from most vantage points.

To minimise the visual impact of the processing plant from vantage points such as Toongi and Obley Road, appropriate materials and colour schemes would be used in construction and native trees either retained or planted to screen buildings and fixed plant. Progressive rehabilitation of the RSF and evaporation ponds would be implemented to reduce the overall visual impact on these structures from neighbouring land holdings and local roads. AZL would also ensure that areas of disturbance would be minimised ahead of development and the Mine Site be maintained in a clean and tidy state at all times. Furthermore, dust suppression activities would be implemented to reduce the occurrence of visible dust emissions from the Mine Site.

- It is noted at the outset that the value placed upon visual amenity and the impacts upon surrounding visual amenity would vary from person to person and from location to location. As a result, a visual amenity assessment is, by its nature, somewhat subjective. As a result, during the visual amenity assessment emphasis will be placed on providing a description of the existing visual amenity surrounding the Mine Site and the measures that would be undertaken by AZL to

minimise potential visual amenity-related impacts on surrounding residents and others. The subjective nature of visual impact assessment notwithstanding, it is concluded that the DZP is likely to achieve a satisfactory level of compatibility with the existing visual landscape and be undertaken in a manner which minimises visual impact.

5.7 ECOLOGY

OzArk Environmental & Heritage Management Pty Limited has been commissioned to complete a Biodiversity Assessment of the DZP. The assessment of OzArk will build upon data collected by Dr David Goldney and Mr Geoff Cunningham (of Geoff Cunningham Natural Resource Consultants) in 2001 / 2002. OzArk will also be assisted by Dr Arthur White of Biosphere Environmental Consulting in relation to herpetological issues associated with the DZP. Dr Alison Hunt of Alison Hunt & Associates will prepare a separate Aquatic Ecology Assessment. The following provides a summary of the ecological setting, based on survey data completed to date, consideration of the potential impacts on the local setting attributable to the DZP and an outline of the proposed method of assessment to be applied.

5.7.1 Existing Environment

5.7.1.1 Flora

Figure 5-3 displays the distribution of the eight vegetation communities identified on and immediately surrounding the Mine Site by GCNRC in 2002.

- Community 1: Cleared cultivation and grazing country with scattered trees and tree clumps.
- Community 2. Black cypress pine – tumbledown gum – white cypress pine community.
- Community 3. White box – grey box – white cypress pine community.
- Community 4. Black cypress pine – red stringybark community.
- Community 5. Open rocky heath community.
- Community 6. Fuzzy box – yellow box – red river gum community.
- Community 7. Bulloak community.
- Community 8. White box – grey box – fuzzy box – yellow box – white cypress pine community.

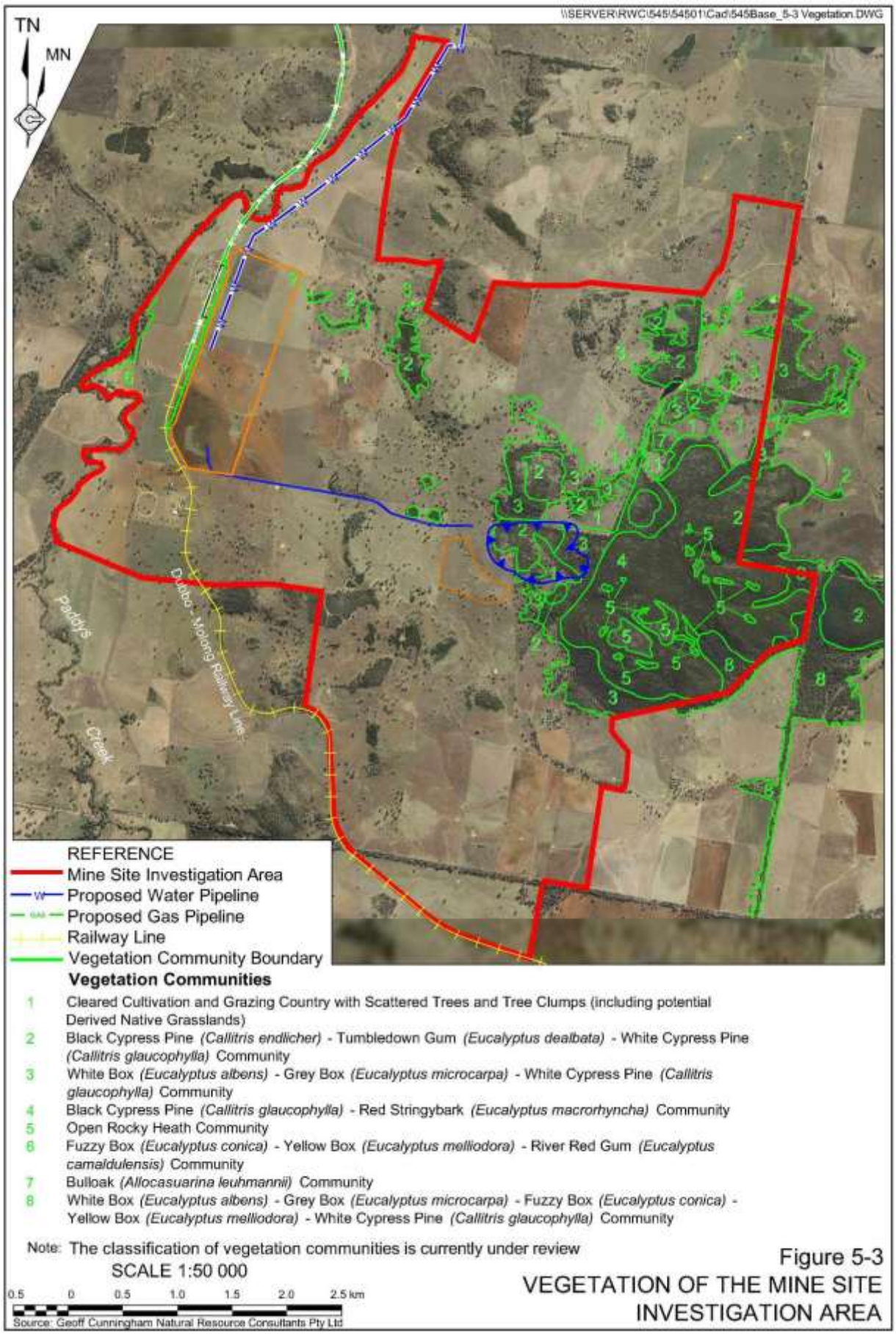


Figure 5-3
VEGETATION OF THE MINE SITE INVESTIGATION AREA

The dominant vegetation community over the Mine Site is Community 1 which includes a mixed ground layer of native and introduced pasture grasses and herbaceous weeds. This community accounts for in excess of 85% of the vegetation across the Mine Site. It is noted, however, the description of Community 1 is to be reviewed considering the potential occurrence of Derived Native Grasslands. A review of this community could result in a re-categorisation of part or all of this community.

Communities 2, 3 and 4, representing remnant native woodland vegetation, are the next most common communities in the local setting. AZL has designed the Mine Site layout to avoid the majority of these areas for mining related disturbance.

Further details on threatened flora species or communities either identified or considered as likely to occur are provided in Section 5.7.2.

5.7.1.2 Fauna

Various vertebrate fauna have been identified on the Mine Site during surveys conducted in 2001 and 2002. AZL has commissioned OzArk EHM has commenced additional field survey and is likely to complete this in mid-2012. Further details on threatened fauna species either identified or considered as likely to occur are provided in Section 5.7.2.

5.7.1.3 Aquatic Ecology

The DZP could potentially impact on local creeks and even the Macquarie River (although unlikely). Field survey of aquatic habitat on and surrounding the Mine Site is to be completed by Alison Hunt & Associates during the first half of 2012. The results of this field survey will determine the type and status of aquatic habitat and whether threatened aquatic fauna occurs within, or has the potential to utilise these habitats. The results of the field survey and subsequent assessment of impacts associated with the DZP will be included in the ESI for the DZP.

5.7.2 Issues of Conservation Significance

5.7.2.1 Flora

Following the field survey and vegetation mapping completed by GCNRC (2002), Communities 3 and 8 were identified as probable variations of the White Box Yellow Box Blakely's Red Gum Woodland Community, a NSW (TSC Act) listed Endangered Ecological Community. The composition of these two vegetation communities could also classify these communities as the Grassy White Box Woodland EEC under the Commonwealth EPBC Act. The classification of all communities on and surrounding the Mine Site will be reviewed and updated as part of the preparation of the EIS.

One threatened species of flora, *Philotheca ericifolia*, has been found on the Mine Site. It is noted that the location of this species, on Dowd's Hill is well removed from the proposed areas of disturbance.

5.7.2.2 Fauna

Records of the fauna identified on the Mine Site have not been reviewed in detailed, however, it is noted that the Mine Site and surrounds would provide suitable habitat for a range of threatened fauna species. One such species is the Pink-tailed work lizard, identified during field survey in 2001[12]. Further survey undertaken in ideal conditions in January and February 2012 has failed to identify another individual of this species.

Further field survey is to be completed over February and March 2012 to determine whether any other threatened fauna species occur, or are likely to occur on the Mine Site. The results of this field survey will be included in the EIS to be prepared for the DZP.

5.7.3 Key Ecological Issues and Preliminary Assessment

5.7.3.1 Key Ecological Issues

Based on the risk assessment undertaken for the DZP (see Section 2.4), the specific biodiversity impacts that may result as a consequence of the DZP (without the implementation of the safeguards, controls and mitigation measures presented in this section) and therefore require assessment would include the following.

- Direct impacts on native flora and fauna, i.e. clearing of vegetation and habitat resulting in:
  - loss of, or alteration to, existing habitats;
  - removal or mortality of individual species;
  - local or regional reduction in distribution of threatened species, populations and endangered ecological communities; and/or
  - possible local extinction of threatened species, populations and endangered ecological communities.
- Direct impacts on native flora and fauna through interaction with project-related vehicles.
- Direct impacts on native fauna through drinking or bathing in pooling water on the RSF resulting in mortality of individual species and/or local or regional reduction in distribution of threatened species, populations and endangered ecological communities.
- Indirect impacts on flora, fauna and fauna habitat, e.g. noise, dust etc.

5.7.3.2 Preliminary Assessment

AZL has designed the proposed mining and associated activities on the Mine Site to avoid as far as practicable areas of remnant native vegetation. However, clearing of areas of Communities 2 and 3 will be unavoidable due to occurrence over the open cut.

[12] After initial analysis, the species was originally identified as the Flinder's Ranges worm lizard, however, it was later established that this was incorrect.

A biodiversity Offset would be provided for the native vegetation cleared or modified and are available in the forested areas on the steeper land associated with Dowd's Hill and surrounds. Notably, this area contains the identified population of *Philotheca ericifolia*, as well as habitat suitable for the Pink-tailed work lizard. The development of the offset will be undertaken in accordance with the BioBanking Assessment Methodology with the objective of achieving either a Tier 1 ("maintain or improve") or Tier 2 ("no net loss") outcome.

Eliminating roadkill would be practically impossible, however, AZL would attempt to reduce the number of vehicle – fauna interactions by educating the workforce regarding the presence of native fauna within the road reserves and encourage personnel to reduce vehicle speeds at dawn, dusk and night time.

Habitats adjacent to the area of proposed mining and associated operations may also be subject to disturbance attributed to noise, dust and movement of machinery and people, and may become unsuitable for sensitive fauna species during the life of the operations. The areas likely to be affected are not likely to be so large as to impact on the local survivability of threatened fauna species.

An assessment of the residual impact of the DZP on local biodiversity is to be completed by of OzArk Environmental and Heritage Management Pty Ltd ("OzArk"). It is anticipated, however, that the DZP could be managed with minimal and mitigated impacts on local biodiversity principally because:

- of the planned avoidance of direct impacts on remnant native vegetation and fauna habitat on the Mine Site;
- use of solid residue placement, thereby minimising the potential for potentially contaminated water to pool within the RSF; and
- an offset in perpetuity would be established.

5.8 SOIL RESOURCES AND LAND CAPABILITY/AGRICULTURAL SUITABILITY/AGRICULTURAL PRODUCTIVITY

Sustainable Soils Management Pty Limited (SSM) has been commissioned to complete a Soils, Land Capability and Agricultural Impact Assessment of the DZP. The assessment of SSM will build upon data collected by Mr Geoff Cunningham (of Geoff Cunningham Natural Resource Consultants) in 2001 / 2002. The following provides a summary of the local setting, based on survey data completed to date, consideration of the potential impacts on the local setting attributable to the DZP and an outline of the proposed method of assessment to be applied.

5.8.1 Existing Environment

A preliminary soil and land capability assessment was completed on the Mine Site in 2002 by GCNRC. Based on 38 pits dug to a depth of 2.5m or bucket refusal across an area of 170ha (corresponding to the proposed areas of disturbance defined in 2001), GCNRC identified 3 soil mapping units (SMUs) over the Mine Site (see **Figure 5-4**).

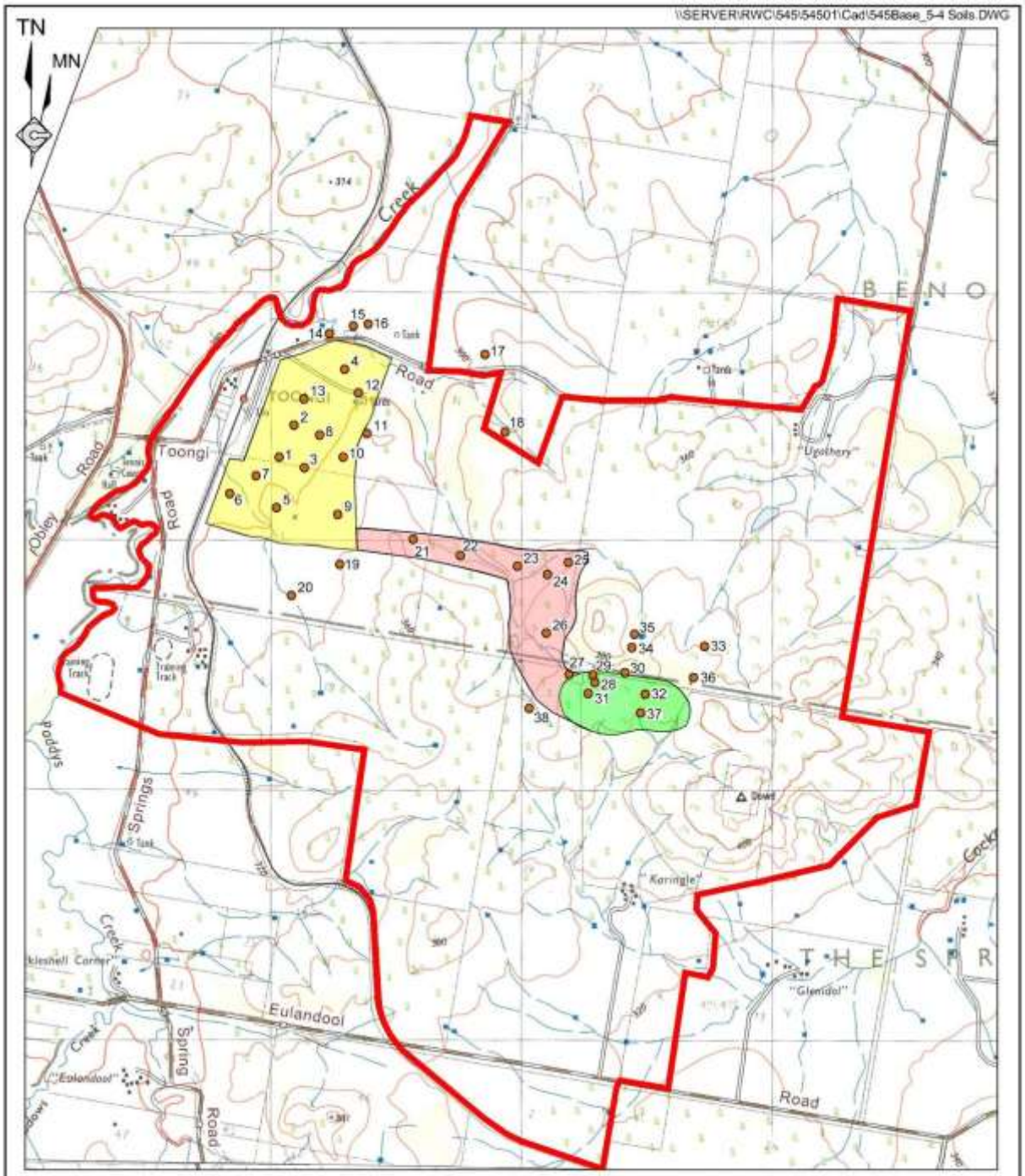


Figure 5-4
SOIL MAPPING UNITS OF THE MINE SITE INVESTIGATION AREA

The SMU's correspond to their location in the landscape, namely:

- SMU 1: Lower Slopes (gradients of 0 to 5%). Red and Brown Chromosols. Sandy loam to clay loam generally very deep soils (with deep topsoil layer of 10 to 23cm) that are hard setting with a surface crust. Surface stone is generally absent although angular flat stone is encountered at some locations. There is usually strong variation between the surface and B horizons with the B horizon occasional outcropping as self-mulching clay.
- SMU 2: Upper Slopes (gradients of 5% to 10%). Red and Brown Chromosols. Loamy topsoil over clay and clay and clay loam. Shallower soils than SMU 1, these soils are also hard setting. Surface stone is usually present and gravel occurs in most horizons. There is usually an abrupt increase in texture between the A and B horizons at varying depths in the profile.
- SMU 3: Ridge Crests (gradients of 0 to 15%). Red and Brown Chromosols. Loamy sand topsoil over sandy loam. Shallower soils than SMU 1 and 2, these soils are also hard setting. Rock outcrop is present on some site and Surface stone is usually present. Gravel and stones occur in most horizons and larger stones can be found near the surface. There is usually a substantial increase in texture (over about 5cm) between the A and B horizons at varying depths in the profile.

All three SMU's have slight dispersion percentage suggesting low dispersibility (although high clay content is likely to increase the dispersibility of the soils in situ). GCNRC suggests that the erosion potential of all three SMU's is moderate, particularly for any exposed subsoil. The pH levels of the upper horizons was between 4.5 and 7.5, an acceptable range for reuse in rehabilitation.

GCNRC also reviewed the likely land capability of the soils on the Mine Site. This assessment concluded that:

- SMU 1 represents a land capability of Class 3, i.e. grazing lands or lands well suited to pasture improvement and may be cultivated or cropped in rotation with pasture.
- SMU 2 represents a transition between land capability Class 3 (see above and Class 4, i.e. lands suitable for grazing using native pasture or possibly some pasture improvement with minimum tillage but not for cultivation.
- SMU 3 represents land capability Class 4.

Notably, the soil and land capability mapping of GCNRC only covers a portion of the Mine Site. Sustainable Soils Management have been commissioned to undertake a review of the 2001 field survey and classification and extend the areas of survey and mapping over the entire Mine Site.

5.8.2 Key Soil and Land Capability Issues and Preliminary Assessment

5.8.2.1 Key Soil and Land Capability Issues

Based on the risk assessment undertaken for the DZP (see Section 2.4), the specific soil and associated land use related impacts that may result as a consequence of the DZP (without the implementation of the safeguards, controls and mitigation measures presented in this section) and therefore require assessment include the following.

- Reduction in soil quality through poor soil stripping, stockpiling or spreading practices resulting in:
  - Insufficient soil quantities for rehabilitation.
  - Reduced soil viability resulting in poor rehabilitation or inability to achieve nominated final land capability.
  - Increased erosion or erosion potential compared with original landform.
- Reduction in the capability and suitability of the land for future agricultural production.

5.8.2.2 Preliminary Assessment

The proposed mining operations would involve the removal and transfer/storage of all topsoil and selected subsoil in operational areas. Progressive and final rehabilitation would also be undertaken using the previously stripped topsoil and subsoil. As the majority of the Mine Site is currently used for agriculture, further studies have commenced to quantify the impact the DZP would have on the agricultural suitability and productivity of the areas to be disturbed. These studies will also provide recommendations on soil stripping, stockpiling, erosion control and rehabilitation methods.

5.9 HERITAGE

OzArk Environmental & Heritage Management Pty Limited has been commissioned to complete a Cultural Heritage Assessment of the DZP. The assessment of OzArk will build upon data collected by Mr Lloyd Nolan Guarra Aboriginal Site Surveys in 2000 and 2002. The following provides a summary of the archaeological setting, based on survey data completed to date, consideration of the potential impacts on the local setting attributable to the DZP and an outline of the proposed method of assessment to be applied.

5.9.1 Stakeholder Consultation

Stakeholder consultation has and will continue to be conducted in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Applicants 2010 (DECCW 2010).*

5.9.2 Existing Environment

5.9.2.1 Aboriginal Heritage

Desk-based and field investigations relating to Aboriginal heritage on the Mine Site commenced in 2001, with field survey and impact assessment over the then impact footprint completed (as a draft) by Guarra Aboriginal Site Surveys (Guarra) in January 2002.

- 22 Aboriginal sites were identified (see **Figure 5-5**) including:
  - 11 scarred trees;
  - 6 open scatters;
  - 2 isolated artefacts; and
  - 3 grinding grooves.

All sites were assessed as having high cultural significance.

- Reference to the AHIMS database identified a further 19 Aboriginal sites in the vicinity of the Mine Site.

Figures 5-5 and **5-6** identify the locations of the identified Aboriginal sites. OzArk have been commissioned to recommence consultation with local Aboriginal stakeholders and undertake additional field survey over the Mine Site and other component areas of the DZP. The results of this survey and an assessment of the likely impacts of the DZP on Aboriginal cultural heritage will be provided in the EIS for the DZP.

5.9.2.2 Historic (European) Heritage

OzArk are currently reviewing all literature and database sources to establish as to whether there are any sites of historic heritage located on the Mine Site. Consideration of historic heritage will extend to the Toongi – Dubbo Rail Line, as well as the alignment of the Macquarie Water Pipeline.

The field survey of the Mine Site by Guarra Aboriginal Site Surveys (Guarra, 2002) identified a single site of potential historic heritage, a telephone cable runner on a pine sapling (see **Figure 5-5**). OzArk will extend the historic heritage assessment over the remainder of the Mine Site and associated component areas of the DZP. The results of these surveys and assessments will be reported in the EIS for the DZP.

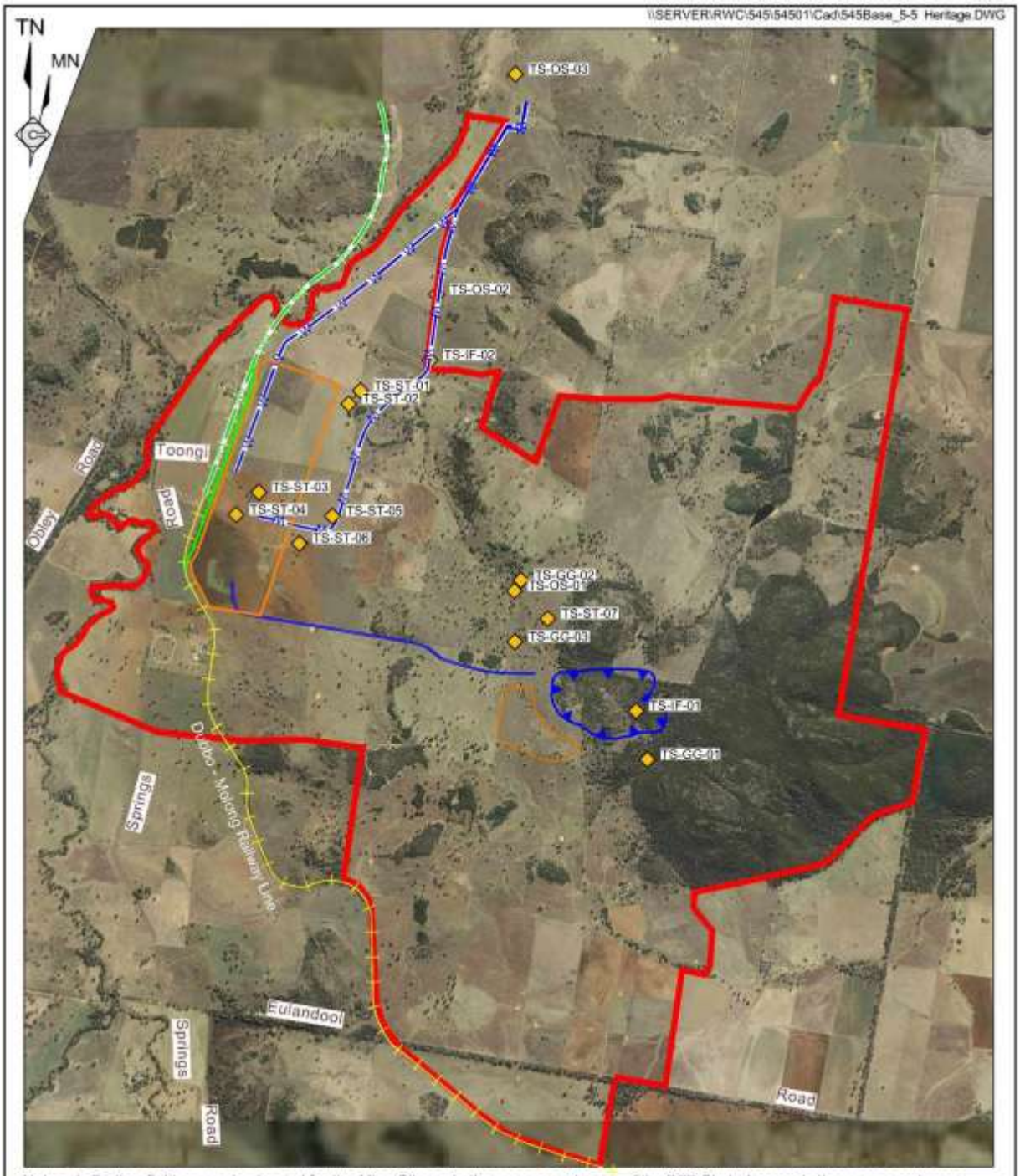
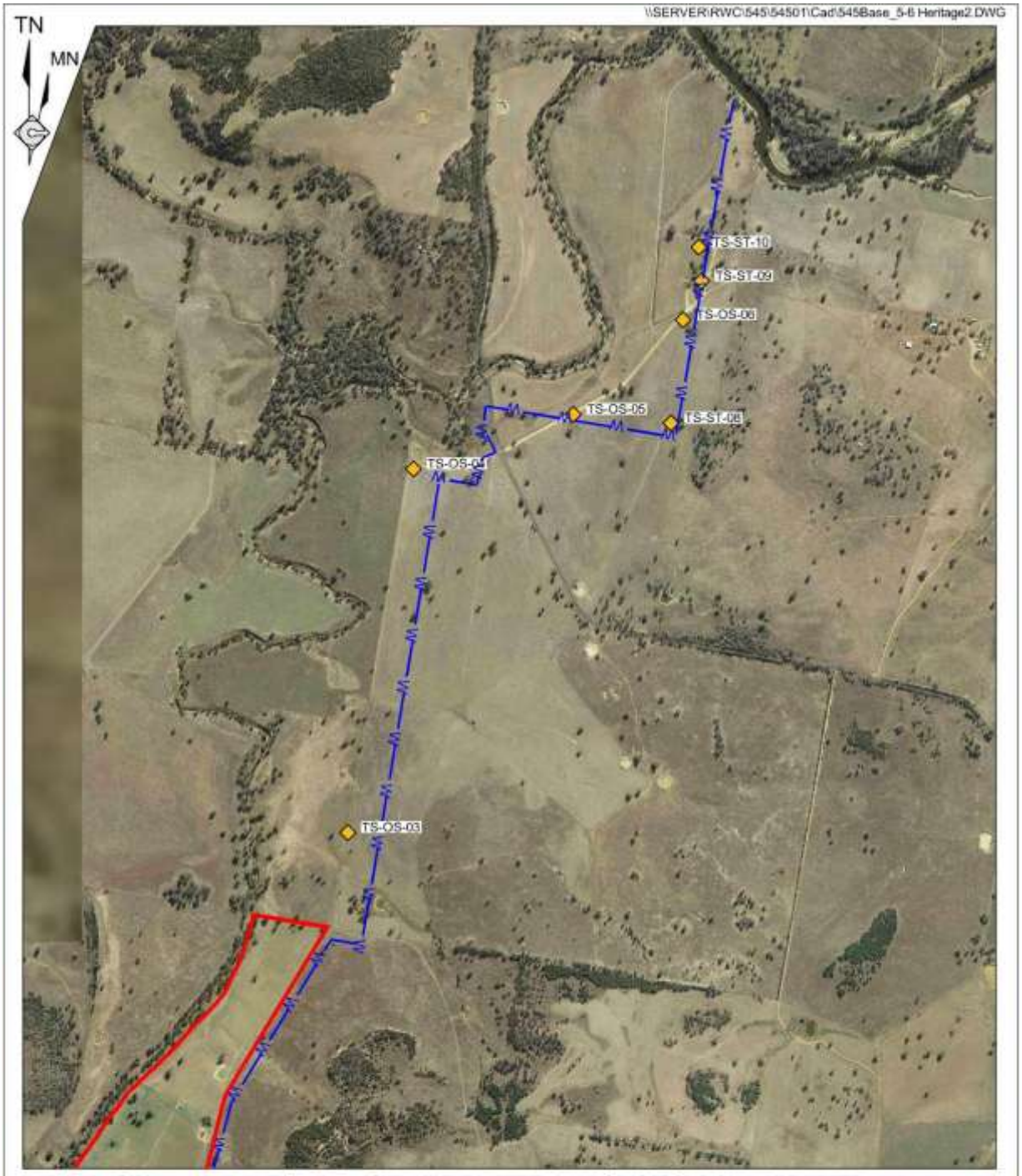


Figure 5-5
IDENTIFIED ABORIGINAL SITES OF THE MINE SITE



Note: Further field survey is planned for the Mine Site and other component areas of the DZP Study Area and other component areas.

REFERENCE
- Mine Site Investigation Area
- Proposed Water Pipeline
- Proposed Gas Pipeline
- Railway Line
- TS-ST-01 Identified Aboriginal Heritage Site

SCALE 1:25 000

250 0 250 500 750 1000 1250 m

Source: Guarra Aboriginal Site Surveys

Figure 5-6
IDENTIFIED ABORIGINAL SITES ALONG THE MACQUARIE WATER PIPELINE

5.9.3 Key Heritage Issues and Preliminary Assessment

5.9.3.1 Key Heritage Issues

Based on the risk assessment undertaken for the DZP (see Section 2.4), the specific heritage-related impacts that may result as a consequence of the DZP (without the implementation of the safeguards, controls and mitigation measures presented in this section) and therefore require assessment include the following.

- Removal or destruction of known Aboriginal sites and/or artefacts within the Mine Site, Macquarie Water Pipeline or other component area impact footprints.
- Removal or destruction of currently unidentified Aboriginal sites and/or artefacts due to disturbance associated with the DZP.
- Removal or destruction of sites of historic (European) heritage significance due to disturbance associated with the DZP.

5.9.3.2 Preliminary Assessment

The survey results to date suggest that the Mine Site and surrounding areas were occupied by Aboriginal people and there could be further sites or artefacts identified. The management of the identified sites and artefacts would be undertaken in accordance with the wishes of the local Aboriginal stakeholders and documented in a Cultural Heritage Management Plan prior to the commencement of any disturbance.

On the basis of the site survey and assessment already completed (Guarra, 2002) and the likelihood of identifying additional sites, it is considered that there may be a requirement to negotiate the removal and management of one or more artefacts. There is no reason to suggest at this stage that appropriate site management cannot be negotiated with the traditional owners and local Aboriginal stakeholders to achieve this.

There may be some local historic significance associated with the rail infrastructure remaining within the Toongi – Dubbo rail line easement. However, it considered unlikely that AZL cannot design upgrades of the existing rail infrastructure that is sympathetic to and promotes this heritage value (which is currently falling into disrepair).

5.10 SOCIO-ECONOMIC SETTING

Diana Gibbs & Partners has been commissioned to complete a Cultural Heritage Socio-economic Impact Assessment of the DZP. The following provides a summary of the socio-economic setting, consideration of the potential impacts on the local setting attributable to the DZP and an outline of the proposed method of assessment to be applied.

5.10.1 Existing Environment

The Mine Site and other component activities are all located in the Dubbo City local government area. Centred on the major regional centre of Dubbo, the Dubbo City LGA also includes surrounding villages and localities (see **Figure 5-7**), including (amongst others):

- Angle Park;
- Brocklehurst;
- Dilladerry;
- Eulomogo;
- Rawsonville;
- Toongi; and
- Yarandale

A summary of key demographic statistics of the Dubbo LGA, obtained from the Dubbo City Council website and 2006 Census data collected by the Australian Bureau of Statistics is presented as follows.

Population

Dubbo City Council quotes the Dubbo LGA population as 41 790 (as of June 2010) which represents a population growth of 1.4% on the previous year. Census data (2001 and 2006) identifies a trend towards an aging of the population with the percentage of children and young people trending down.

Employment, Labour Force and Industry Employment Profile

Unemployment figures decreased between 2001 and 2006 from 6.7% to 5.3%. Overall, 94.7% of the labour force was employed (58.8% of the population aged over 15), and 5.3% unemployed (3.3% of the population aged over 15), compared with 93.0% and 7.0% respectively for Regional NSW.

An analysis of the jobs held by the resident population in the LGA (in 2006) shows the three most popular industry sectors were:

- Retail Trade (2,332 persons or 13.7%)
- Health Care and Social Assistance (2,242 persons or 13.2%)
- Education and Training (1,494 persons or 8.8%)

It is notable that currently only 62 persons (0.4%) are employed in the mining industry.

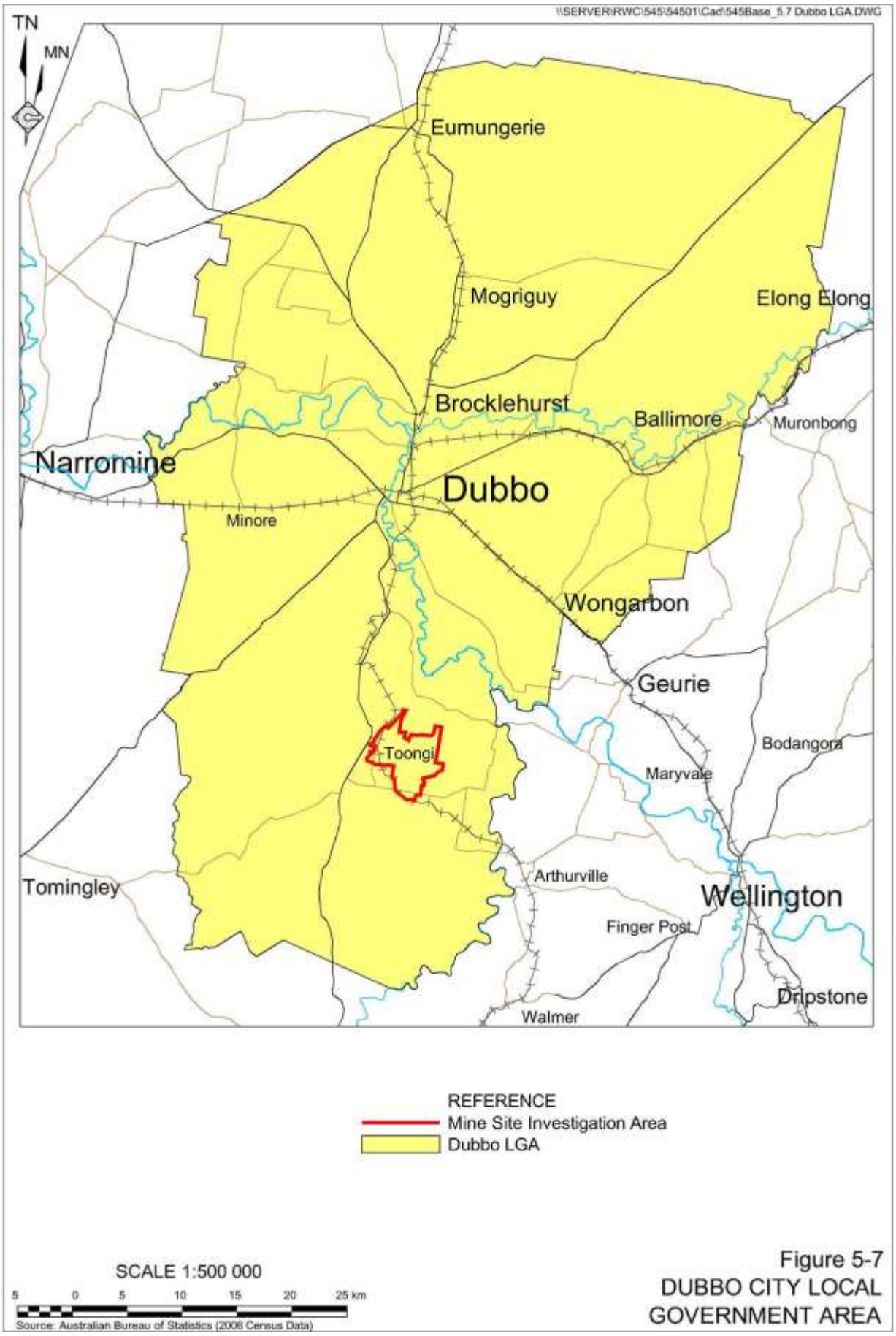


Figure 5-7
DUBBO CITY LOCAL GOVERNMENT AREA

Income

Analysis of household income levels in the Dubbo City LGA in 2006 compared to the regional NSW shows a similar proportion of persons earning a high income (those earning $1,000 per week or more) but a smaller proportion of low income persons (those earning less than $400 per week).

Overall, 14.7% of the population earned a high income, and 40.1% earned a low income, compared with 13.7% and 47.4% respectively for regional NSW.

Housing

The total number of households at the time of the 2006 census was 11,746. Of these households, 30.5% of the population owned their dwelling; 32.6% were purchasing, and 28.0% were renting, compared with 38.3%, 28.7% and 26.2% respectively for Regional NSW.

The largest changes in housing tenure categories for the households in Dubbo City between 2001 and 2006 were:

- Being purchased (+843 households);
- Owned (-536 households);
- Other tenure type (-236 households), and;
- Renting (-179 households).

Analysis of the types of dwellings of the households in Dubbo City LGA in 2006 compared to Regional NSW shows that 78.0% occupied a separate house; 13.1% occupied a medium density dwelling; while 0.1% occupied high density dwellings, compared with 72.1%, 11.4%, and 1.6% respectively in Regional NSW.

5.10.2 Approach to the Socio-economic Assessment

The approach to the socio-economic assessment will involve an analysis of the available socio-economic data together with the results of qualitative research undertaken with local people to capture the full range of potential issues and opportunities within the community. The assessment will include the following.

1. A review of all available socio-economic related studies/data for the local and regional communities surrounding the Site.
2. Use of Australian Bureau of Statistics and Council data to profile the local and regional communities including information relating to education, housing, industry and employment, community services and facilities.
3. Identification of all land uses and community infrastructure/services surrounding the Site and identification of the potential social contribution/impact on those land uses and community infrastructure/services.

4. Consultation with various stakeholders to scope socio-economic issues and refine the research methodology. Consultation will likely include:
   - structured interviews with near neighbours; and
   - structured interviews with key community organisations including local peak groups for business, training organisations, real estate agencies/housing bodies, health organisations, farming organisations, environment groups and local tourism groups.
5. An assessment of the potential impact on the local and regional communities including the following.
   - Social impact with respect to potential noise, air quality, visibility and transport impacts.
   - Impacts upon services and social infrastructure.
   - Social impact associated with the proposed preferred final land use(s).
   - Economic impacts on the local community (e.g. employment market, tourism and land values) and broader area of influence (i.e. contribution to the regional and NSW economies).
   - Community perceptions.
   - Cumulative impacts and mitigation strategies.
   - Ongoing consultation mechanisms for the life of the mine (e.g. CCC, company website, 1800 number, community newsletter, etc.).
6. Consideration of community contributions appropriate for the types and scale of development proposed.

5.10.3 Preliminary Scoping of Socio-economic Impacts

Whilst in the preliminary stage of community and stakeholder consultation, AZL understands that a project of the type and scale proposed is likely to cause some concern to some members of the local and regional communities. As illustrated by the proposed approach documented in Section 5.10.2, AZL intends on undertaking a comprehensive review of the existing socio-economic setting in order to ensure that the impacts associated with the DZP do not compromise community well-being, regional development and strategic plans for the region. AZL recognises that many of the issues likely to be raised through the community and stakeholder consultation process may relate to both the perceived specific impacts associated with the DZP and the broader community polarisation in relation to mining generally.

The following discussion does not pre-suppose the issues that may be raised through the consultation process, however, does provide an overview of the socio-economic impacts associated with the DZP to be further explored through the community engagement process are as follows.

Contribution to the wider Regional and State Economy

Through its market research, AZL has identified a growing market for the rare metals and REE's to be produced. As a consequence of global markets seeking alternate sources of these products, which to date have been dominated by Chinese suppliers, the DZP would contribute to Australian mineral exports and deliver a return to the State Government and regional economy.

Employment Impacts and Population Growth

The DZP would deliver an estimated peak of 220 FTE[13] positions on commencement of mining and processing operations. During the 18 to 24 month construction period, the number of FTE positions generated would fluctuate, however, between 150 and 300 FTE positions are likely to be created during this period. The current predicted life of the DZP is 20 years with the potential to extend well beyond this (subject to future development application and approval). Once construction and mining multipliers are applied, the Proposal represents a significant increase in local employment opportunities. Once operational, the DZP would significantly increase the proportion of people directly employed in the mining industry within the region, which is likely to assist in protecting the regional economy during periods when other industries, e.g. agriculture may be experiencing down turn.

AZL has committed to training and employing local people, however, it acknowledges that specialist positions and a temporary contract workforce during construction will also be required. Importantly, the creation of new employment opportunities for existing residents of the Dubbo City LGA and influx of people to Dubbo (on either a permanent or temporary basis) will contribute to the local community and economy. It is recognised that employment in the mining sector can be a challenge to other areas, particularly agriculture where competition for workers based on level of pay is not viable.

The injection of employment activity arising directly or indirectly as a consequence of the DZP would stimulate local investment in the rental market, as well as apply pressure to local vacancy rates. However, given the long-term nature of the DZP, in the longer term it is likely to stimulate housing construction and possibly increase the average price of local housing stock.

Key strategies to be developed through the process of community and stakeholder engagement and ongoing planning by AZL will include ways of maximising local employment, encouraging relocation to the area, encouraging the provision of training for vulnerable groups in the employment market (such as young people) and establishing company policies that support employee engagement and contribution to the local community.

Environmental Impacts

There is a social dimension to environmental impacts and community and stakeholder consultation will explore the priorities of the community and provide information on environmental issues of likely concerns such as:

- vegetation clearing (loss of local habitat and rehabilitation plans);
- impacts on agricultural land (direct and indirect);
- processing and dust emissions (and perceived health impacts);

[13] FTE – Full Time Equivalent

- water management and impacts;
- visual (amenity) impact during operational phase;
- traffic impacts;
- noise and blasting impacts; and
- final landform.

6. CUMULATIVE IMPACTS

The development and operation of the Dubbo Zirconia Project is proposed within the Dubbo City LGA which has not traditionally been the subject of mining and processing projects of the scale proposed by the DZP. Located in an area devoid of other industry, it is not expected that the DZP will have direct cumulative impacts with other industry or development.

Acknowledging that there may be future development proposed in the area which could result in cumulative impacts, AZL will continue to review this situation and provide for an assessment of cumulative impacts should the need arise.

Coal Seam Gas Exploration and Development

It is noted that prior to the NSW government recently placing a moratorium on coal seam gas exploration in NSW, AZL is aware that areas within the Dubbo City and surrounding LGA's had been identified for exploration and development.

At this stage, it is not considered at this stage that there would be any direct cumulative impact with future coal seam gas exploration or development, as specific locations for such operations are not known. However, should the coal seam gas industry commence in the region, there may be some indirect cumulative impact associated with competition for employment and potentially impacts on local services and infrastructure. This possibility will be considered further in the EIS to be prepared for the DZP.

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7. CONCLUSION

Based upon the previous investigations undertaken in 2001 and 2002, and preliminary work associated with a recommencement of these studies in 2012, and the information assembled for this document, it is assessed that the Dubbo Zirconia Project is practical and feasible and can be designed and operated in a manner which reflects the environmental and other constraints. At the same time, the DZP would optimise the recovery and production of a globally significant resource with benefits to be felt by the State, region and local area. As such, it is concluded that the information currently available and presented in this document is sufficient for the Department of Planning and Infrastructure and both State and local government agencies to issue their requirements for an *Environmental Impact Statement* for the Proposal. Likewise, it is also concluded that it would be possible for an appropriately designed Project to be assembled for determination.

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