

Executive Summary

INTRODUCTION

This *Environmental Impact Statement* (EIS) has been prepared by R.W. Corkery & Co. Pty Limited to accompany an application for development consent by Australian Zirconia Ltd (“the Applicant”) to construct and operate the Dubbo Zirconia Project (the “Proposal”).

The Proposal comprises a small scale open cut mine supplying ore containing rare metals (zirconium, niobium, hafnium and tantalum) and rare earth elements (REEs) to a processing plant near the village of Toongi, approximately 25km south of Dubbo (see **Figure A**). This area is referred to as the “DZP Site”.

The Proposal also provides for an upgrade to the Toongi-Dubbo section of the currently disused Dubbo-Molong Rail Line and the public road network, and the construction of separate pipelines to deliver natural gas and water to the DZP Site.

The Proposal is declared to be State Significant Development (SSD) in accordance with the *State Environmental Planning Policy (State and Regional Development) 2011* and consequently, the Minister for Planning and Infrastructure, or the Minister’s delegate, will be the determining authority.

As SSD, the Proposal would be assessed under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979*, for which an EIS is required.

This Executive Summary introduces the Applicant, provides relevant background information about the Proposal, presents an overview of design and operational safeguards, as well as a brief description of the local environment and predicted impacts on the surrounding physical, biological and socio-economic environment.

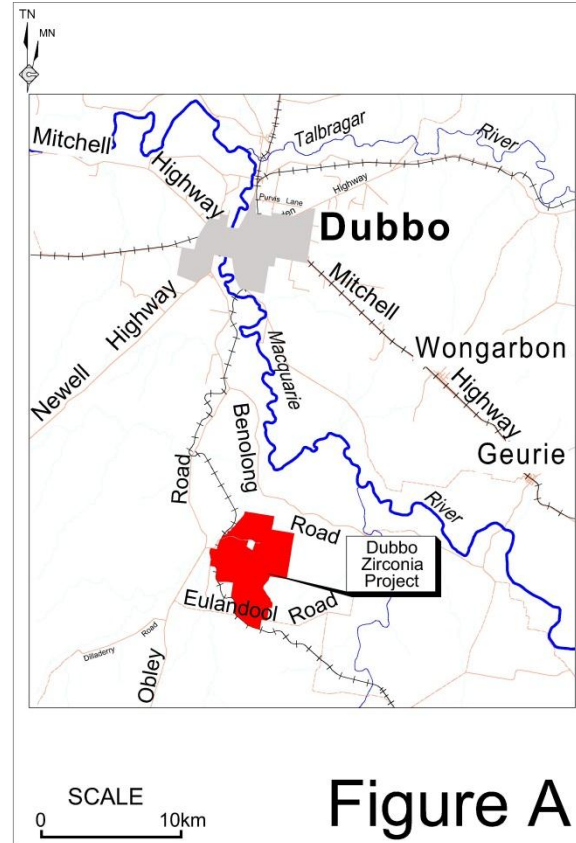


Figure A

THE APPLICANT

The Applicant, Australian Zirconia Ltd, was formed in July 2000 to hold all the assets of the Proposal and to facilitate the ultimate development of the Proposal. Australian Zirconia Ltd is a wholly owned subsidiary of Alkane Resources Ltd, a publicly listed Australian mining and exploration company which has been in existence since 1969.

Alkane has had a long term involvement and demonstrated ongoing commitment to the Central West of New South Wales and has substantial investment in the people and resources of the region. Alkane is currently developing the Tomingley Gold Mine approximately 50km southwest of Dubbo and previously operated the Peak Hill Gold Mine on the outskirts of Peak Hill from 1996 to 2005.

PROPOSAL OBJECTIVES

The Applicant's principal objectives of the Proposal are to:

- maximise the recovery of the rare metals and REEs contained within the Toongi ore body through efficient mining and processing operations;
- minimise the consumption of water, power, fuel and chemical reagents required by the processing operations;
- ensure that the waste by-products of the processing operations are managed to minimise the risk of pollution (short-term impact) or contamination (long-term impact), as well as minimise the impact footprint required to manage these;
- implement continual improvement such that the quality and quantity of waste generated by the processing operations are continually reviewed and modified to minimise consumption and waste generation;
- establish, re-establish and/or upgrade local/regional infrastructure for the purposes of the Proposal but which could also have beneficial uses for other industry/activities;
- undertake all activities in an environmentally responsible manner to ensure compliance with relevant criteria/goals or reasonable community expectations;
- provide a long term stimulus to the economy of the Dubbo Local Government Area and surrounds through employment opportunities and supply of services required for the development and operation of the Proposal;
- work cooperatively with the surrounding community to build socio-economic capacity within communities affected by the Proposal; and

- achieve the above objectives in a cost-effective manner to ensure security of employment, the continued economic viability of the Applicant and ultimately a return on investment for shareholders.

PLANNING CONTEXT

The components of the Proposal are located within the Dubbo City Local Government Area for which the *Dubbo Local Environmental Plan 2011* is the governing planning instrument. A summary of local zoning relevant to the Proposal is as follows.

- With the exception of the Dubbo – Molong Rail Line and a small area of land to the east of the rail line adjacent to the village of Toongi (zoned SP2 Infrastructure [Railway]), the land over which the DZP Site is located is zoned RU1 Primary Production.
- The proposed Macquarie River Water Pipeline would be located on land zoned RU1 Primary Production with the pumping infrastructure located within Zone W2 Recreational Waterways.
- The proposed Natural Gas Pipeline and the existing Dubbo-Molong Rail Line are located within the SP2 Infrastructure (Railway) easement of the Dubbo–Molong Rail Line.

The proposed development activities within the respective zones are permitted with consent.

The Proposal would also be developed and operated in accordance with a number of State planning instruments and regional strategic planning documents, namely:

- SEPP (State and Regional Development) 2011;
- SEPP (Mining, Petroleum Production and Extractive Industries) 2007;
- SEPP (Infrastructure) 2007;

- SEPP (Rural Lands) 2008;
- SEPP 33 (Hazardous and Offensive Development);
- SEPP 55 (Contaminated Lands);
- The NSW Strategic Regional Land Use Policy; and
- Central West Catchment Management Authority – *Catchment Action Plan 2006-2016*.

This EIS addresses each of the above documents together with *Dubbo Local Environmental Plan 2011*.

APPROVALS REQUIRED

In addition to development consent, the Applicant anticipates the following approvals, licences and leases would be required to allow the Proposal to proceed.

- An Environment Protection Licence under the Protection of the Environment Operations Act 1997.
- A Mining Lease under the *Mining Act 1992* encompassing the proposed activities / operation of the DZP Site.
- Water Supply Works and Use Approvals under the *Water Management Act 2000*.
- Water Access Licences (WALs) under the *Water Management Act 2000*.
- A Section 138 Permit, issued by the Dubbo City Council under the *Roads Act 1993*, for all works affecting classified roads, namely Obley and Toongi Roads.
- A licence agreement between John Holland Rail (JHR) and the Applicant to upgrade the Toongi to Dubbo section of the Dubbo–Molong Rail Line.
- A licence issued under the *Pipelines Act 1967* for the construction and operation of the proposed natural gas pipeline.

- An approval from the NSW Dams Safety Committee for the design and construction of the solid and liquid residue storage facilities.
- A licence issued by WorkCover Authority of New South Wales for the storage and use of explosives and other dangerous goods within the DZP Site.

Additionally, the Proposal will require approval from the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities in relation to impacts on matters protected by the *Environment Protection and Biodiversity Conservation Act 1999*.

BACKGROUND

The proposed open cut mine of the Proposal is centred on a trachyte formation which forms one of several alkaline volcanic and intrusive bodies of Jurassic age in the region. Initial geological mapping, sampling and drilling in the vicinity of the ore body indicated a substantial body of altered trachyte containing highly elevated levels of the metals zirconium, hafnium, niobium, tantalum and REEs. These rare metals and REEs are increasingly critical in the production of compounds used for a variety of green technology applications.

The Applicant subsequently undertook additional drilling (in 2000 and 2001) of the trachyte on a staggered 100m x 50m grid to an average vertical depth of 55m. The drilling demonstrated the remarkably uniform grade of the trachyte with dimensions of 900m by 500m to the drilled depth. Subsequent drilling has confirmed the trachyte extends to 115m below surface.

Following identification of the resource, the Applicant 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, the

Applicant commissioned a number of specialist environmental studies over the DZP Site and commenced consultation with the relevant government agencies as part of a planned development application in 2001.

Following the completion of an initial feasibility study in 2001, it was determined that further development work was required with key recommendations being to further refine the process flowchart through the construction of a demonstration pilot plant and provide product samples for market evaluation.

A Demonstration Pilot Plant (DPP) was subsequently designed and built at the Australian Nuclear Science and Technology Organisation (ANSTO) Minerals facility at Lucas Heights under the supervision of TZ Minerals International Pty Ltd (TZMI). The DPP has been operating since 2008, confirming the process flow sheet and providing market samples of sufficient quantity for customers to confirm that the different style of products would be suitable for their various end-use applications. In particular, the following advances have underpinned the feasibility of the Proposal.

- Several tonnes of a range of zirconia products have been prepared to customer-specific requirements.
- Niobium products (niobium pentoxide concentrate and ferro-niobium) have been developed.
- The recovery of a light REE product and heavy REE concentrates have been demonstrated.

The Definitive Feasibility Study completed in April 2013 confirmed existing markets for the products produced by the DPP. These final products include a range of zirconia products, several niobium products and other heavy and light rare earth products. There is considerable international market demand for zirconium chemicals, zirconia and niobium, that can be used in the ceramic, catalyst, electronics,

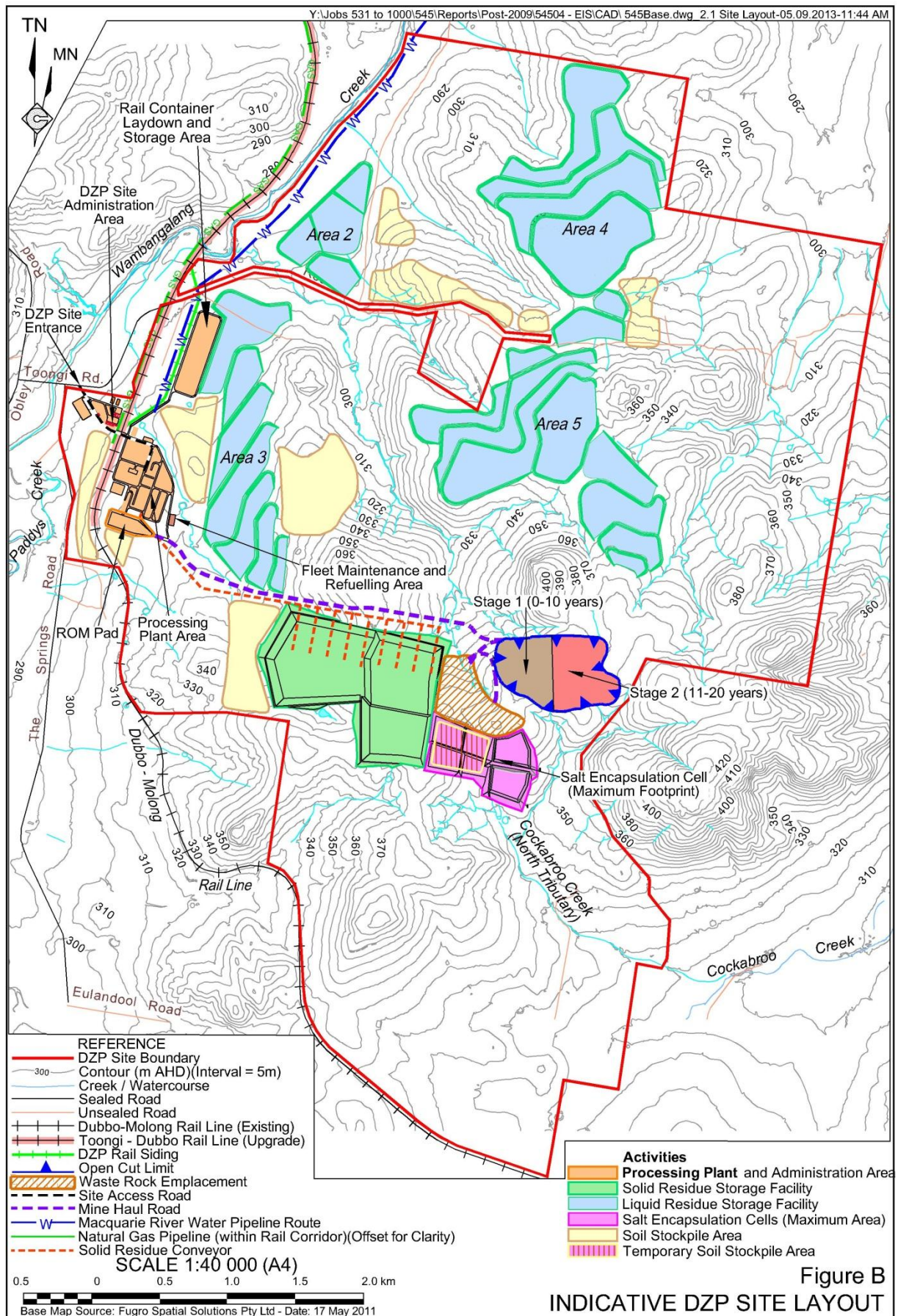
engineering ceramic, and specialty glasses and alloys industries. In many cases, there is no alternative to rare earths for manufacturing particular products. Furthermore, many of the end uses for these products have environmental benefits. Some will be used as substitutes for more traditionally used, but more harmful, products, while others will be used as components of modern technologies that deliver specific environmental benefits.

PROPOSAL DESCRIPTION

Overview

The following provides an overview of principal components and activities to be undertaken on the DZP Site (and illustrated on **Figure B**).

- Extraction of approximately 19.5Mt of ore at a maximum rate of 1Mt per year from a shallow open cut developed to a maximum depth of 32m (355m AHD) (remaining above the groundwater table).
- Extraction and placement of approximately 3.5Mt of waste rock (weathered material or rock containing insufficient rare metals or REEs for processing) within a small waste rock emplacement (WRE) to the southwest of the open cut.
- Haulage of ore to a Run-of-Mine (ROM) Pad for crushing and grinding.
- Processing of the crushed and ground ore using the following methodology.
 - Sulphation roast of ore and leaching to dissolve sulphated metals.
 - Solvent extraction, precipitation, thickening, washing and drying of the various rare metal and REE products.



- Construction and operation of a rail siding from the Toongi-Dubbo Rail Line and a Rail Container Laydown and Storage Area for the unloading and temporary storage of reagents and loading of products for despatch.
- Additional transportation by road via the public road network, with Obley Road and Toongi Road to be upgraded to accommodate the proposed increase in heavy vehicle traffic.
- Mixing and neutralising of solid residues produced by the processing of the ore with crushed limestone and transportation via conveyor to a Solid Residue Storage Facility (SRSF).
- Pumping of water used in the processing operations, which cannot be recycled, to a Liquid Residue Storage Facility (LRSF), comprising a series of terraced and lined crystallisation cells.
- Recovery and disposal of an estimated 6.7Mt of salt, which would accumulate within the LRSF, within a series of Salt Encapsulation Cells adjoining the WRE and SRSF.
- Other ancillary activities including equipment maintenance, clearing and stripping of the areas to be disturbed and rehabilitation activities.

Processing operations would require up to 4.05GL of make-up water annually which would be sourced from the Macquarie River and groundwater sources (under licence) and transferred to the DZP Site by water pipeline.

Figure C provides the proposed alignment of the Macquarie River Water Pipeline, the key features of which are as follows.

- A pumping station which incorporates a dual water inlet, wet well and vertically mounted axial flow pump configuration.

- A buried 400mm to 450mm diameter HDPE pipeline.

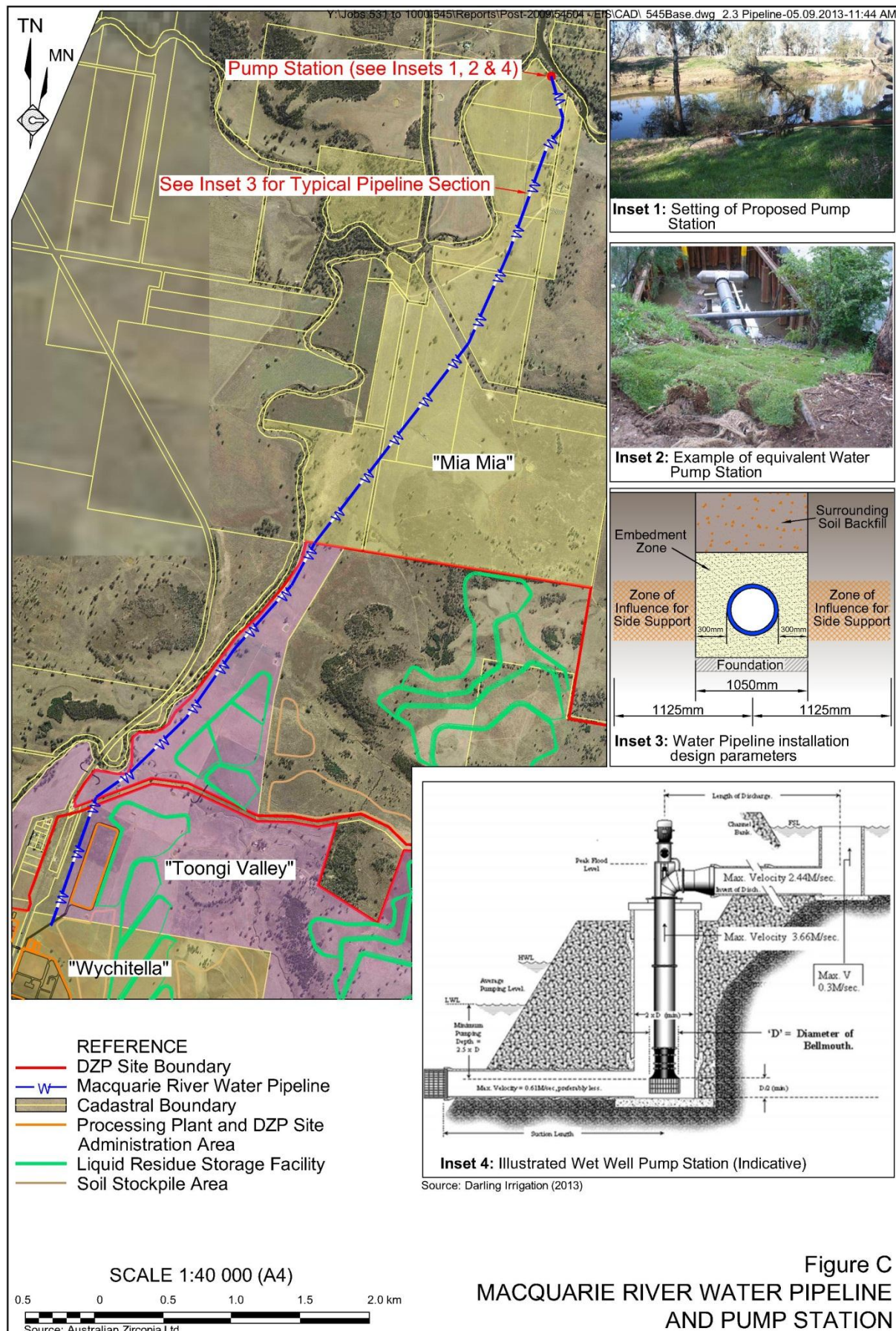
The easement to be created for the Macquarie River Water Pipeline Corridor would be approximately 15.2ha (20m x 7.6km), although the actual area of disturbance within this corridor would be much less. An area not exceeding 2 500m² would be disturbed on the river frontage of the “Mia Mia” property to allow for the construction of the pumping station.

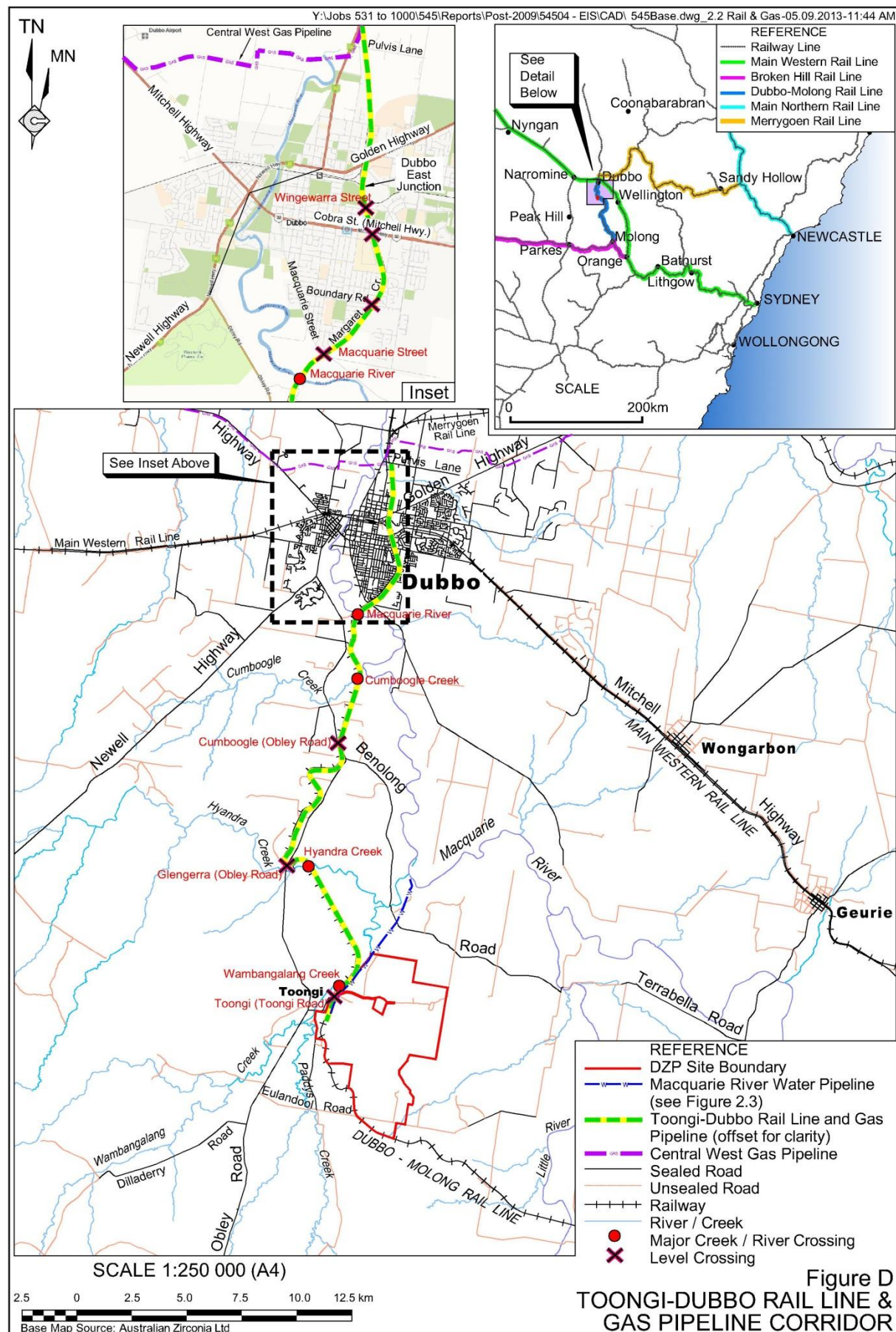
Figure D provides the proposed alignment of the Toongi-Dubbo Rail Line, the key features of which are as follows.

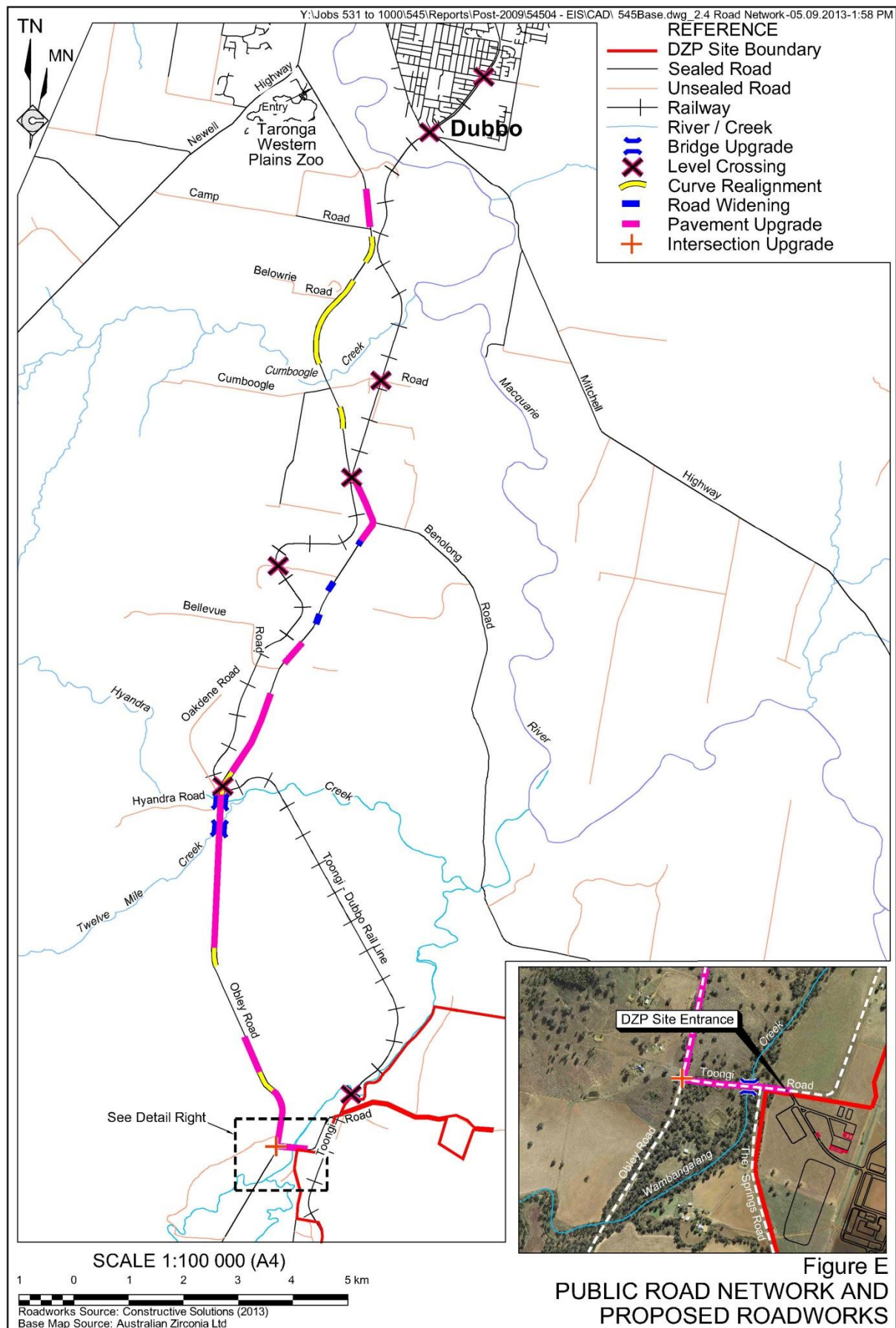
- Upgrade of the Toongi to Dubbo section of the Dubbo-Molong Rail Line to a Class 1 track.
- Replacement or upgrade of steel bridges, culvert structures, and timber bridges.
- Re-instatement, civil works and installation back to the required standard at each affected level crossing.

Figure D also identifies the proposed natural gas pipeline between the Central West Pipeline (of APA Group) at Purvis Lane, Dubbo, and the DZP Site which would deliver up to 970TJ/year of natural gas for the heating of various circuits within the processing plant.

To accommodate the proposed heavy vehicle traffic associated with the transport of processing reagents and other raw materials by road, the alignment and pavement depth of the Obley and Toongi Roads would be improved in several locations, with a number of creek crossings, rail level crossings and intersections to be upgraded. **Figure E** provides the locations of these works.







Site Establishment and Construction

In order for mining, processing and product transportation to be undertaken, the following infrastructure and other site features would first be established.

- The Macquarie River Water Pipeline (see **Figure C**).
- The natural gas pipeline within the Toongi-Dubbo Rail and Gas Pipeline Corridor (see **Figure D**).
- The Toongi-Dubbo Rail Line (see **Figure D**).
- Upgrades to the public road network including curve realignment, pavement upgrades and upgrades to creek crossings on Obley and Toongi Roads (see **Figure E**).
- Construction of an access road to the DZP Site and intersection with the public road network (see **Figure B**).
- Construction of a range of water management and retention structures within the DZP Site.

Site establishment would also include the construction of various infrastructure and facilities associated with processing operations, residue storage facilities and internal roads and hardstands.

The site establishment phase, i.e. from commencement to completion of all DZP Site infrastructure and facilities, is anticipated to take between 18 months and 2 years although it is noted that mining and processing would be undertaken concurrently for a period towards the end of the site establishment phase (as ore feedstock would be necessary for plant commissioning).

Site Preparation

During vegetation clearing operations, larger vegetation would be removed using a bulldozer with its blade positioned just

above the surface. Groundcover vegetation would then be removed with the topsoil to maximise the retention of the seed bank and nutrients within the soil, as well as to minimise opportunities for erosion and dust lift-off between removal of the larger vegetation and soil stripping.

All available topsoil material would be recovered from areas to be disturbed using bulldozers and/or scrapers. Enough subsoil would also be recovered to provide for rehabilitation of the progressively created final landform. The soil would either be transferred directly to other areas of the DZP Site for respreading, used in the construction of the upper 3m of the LRSF or placed in stockpiles of up to 3m in height (for subsoil) or 2m in height (for topsoil).

Prior to soil stripping over areas of potential Pink-tailed Worm-lizard¹ habitat, specific site preparation measures would be undertaken in accordance with a *Pink-tailed Worm-lizard Plan of Management* prepared for the Proposal.

Mining Operations

Figure B presents the boundaries of the proposed open cut and Waste Rock Emplacement (WRE).

Open Cut Mining

Drill and blast methods would be used to fragment all material that is to be excavated from the open cut. Blast holes would be drilled using one or more hydraulic drill rigs equipped with dust and noise suppression equipment. Fragmented material would then be loaded into trucks by hydraulic excavator and transported to the Run-of-Mine (ROM) Pad. All drill and blast operations would be supervised by a suitably qualified and experienced blasting engineer or shot-firer.

¹ A threatened lizard species listed under the NSW *Threatened Species Conservation Act 1975* and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Waste Rock Management

During mining operations, material that is excavated to enable access to the mineralised material, or contains insufficient grades of the targeted rare metals and REEs to justify processing or stockpiling for later processing, would be placed within the WRE by load and haul methods.

Processing Operations

Ore material would be processed within the on-site processing plant. The following provides an overview of the key features of the proposed processing operations.

- The mined ore would be loaded from the ROM Pad into a primary crusher where it would be reduced in size. From the crushing station, the crushed material would be transferred to a dry grinding circuit for further size reduction.
- Sulphuric acid, manufactured on the DZP Site, would be added to the ground ore feed and heated to convert the contained metals and REEs to sulphates ('sulphated ore').
- Following leaching in water of the sulphated ore, various solvent extraction, precipitation, thickening, washing, drying and smelting processes would be undertaken to produce the various rare metal products and REE concentrates.

Solid and liquid residues would be produced as a result of the processing operations, both of which would be neutralised by addition of a crushed and slurried limestone before being discharged to either the Solid or Liquid Residue Storage Facilities.

The volume of water required per tonne of ore processed would be minimised (4.05kL/t) by the construction and operation of two reverse osmosis plants.

Of this input, water would exit the process by three main methods:

1. 0.72kL/t would be lost as steam from the various processing plant cooling towers;
2. 0.84kL/t would be incorporated into the solid residue stream reporting to the SRSF; and
3. the bulk of the remaining (2.49kL/t) would be discharged as liquid residue.

A small proportion of the water would also leave the DZP Site within the REE solution product.

Process Residue Management

Solid Residue Management

The solid residue produced by the combination of the various precipitated and filtered waste and limestone slurry would be fine and have the physical appearance of a damp fine sand or clay. At maximum production (1Mtpa), approximately 2.0Mt of wet solid residue (at 35% moisture) would be generated each year reducing to 1.3Mt on drying.

The design of the SRSF is based on a cellular concept, where each cell can be filled, closed and rehabilitated independently of the other cells. In this way, the overall area of solid residue exposed at any one time would be limited, making the management of rainfall and runoff easier, and allowing for the SRSF to be rehabilitated progressively throughout the life of the Proposal.

The design of the SRSF includes the following features.

- Three separate cells, providing for a combined storage volume of 20Mm³, with a combined area of 103ha.

- External slopes of 18° 1:3 (V:H) and a final combined upper surface area of approximately 81ha.

The storage cells and upstream faces of the SRSF embankments would be double-lined with a leak detection system installed between the two liners. The upper liner would be HDPE (or material with an equivalent permeability) while the lower liner would be HDPE or compacted clay with a permeability of 1×10^{-9} m/s and thickness of 900mm (or equivalent combination of permeability and thickness).

Liquid Residue Management

Following treatment and neutralisation, the liquid residues would have a salinity of approximately 62 500ppm. This salinity would gradually increase within the LRSF with the loss of volume by evaporation. As the salinity increases, salts would crystallise and be deposited on the base of the LRSF cells.

The total volume of liquid residue to be evaporated is likely to be up to 2.5Mm³ (2.5GL) each year. This equates to 208ML/month.

The LRSF has been designed as a series of terraced salt crystallisation cells grouped into four distinct areas (LRSF – Areas 2 to 5) (see **Figure B**). The total surface area of the salt crystallisation cells of the LRSF on construction would be 425.4ha as follows.

LRSF Area	No of Cells	Total Area (ha)	Evaporative Surface Area (m²)
2	4	37.1	264 500
3	7	97.5	695 000
4	6	141.5	1 008 800
5	9	149.3	1 064 400
TOTAL	26	425.4	3 032 700

Cut and fill earthworks would be completed to create a flat surface area within each cell with a 6m embankment constructed between the individual cells. Each cell would provide for a water storage height of

5m with 1m freeboard. The embankments have been designed with a nominal crest width of 4m (with 34° 1:1.5 (V:H) side slopes). The lowest (outer) embankment slope(s) for each terraced LRSF Area would be constructed at 27° 1:2 (V:H). Following preparation of the cell foundations, each cell would be lined with a sheet of HDPE which would be subject to a thorough assessment protocol to ensure no breaches are present following installation.

Once each cell has been prepared, an accurate survey would be undertaken and the depth/volume and depth/area curves for each cell confirmed. The liquid residue would be pumped into the cells and between cells to allow for the brine to concentrate further, leading to the precipitation of salts for removal and placement within the Salt Encapsulation Cells.

Salt Management

The crystallised salt accumulated in the LRSF would be solid but retain a relatively high moisture content. It would be amenable to physical handling with earth-moving machinery. It is estimated that approximately 6.7Mt of salt would be deposited throughout the 20 year life of the Proposal.

The Salt Encapsulation Cells would be constructed as a series of up to six cells, similar to the SRSF (see **Figure B**). Each encapsulation cell would be fully lined with a double HDPE liner and leak detection layer in between the liners (the same as installed for the SRSF). The intra-liner drainage would be installed with both the upper and lower liner fully tested for leakage at the completion of construction.

Traffic and Transportation

The Applicant's preferred method of transporting reagents and other materials to, and products from the DZP Site, would involve a combination of road and rail

operations (see Option A below). However, while technically still 'in service', the long disused Dubbo-Molong Rail Line requires considerable engineering works before it can be re-opened. Considering the high capital cost associated with the required upgrades, as well as other logistical, operational and economic factors to be addressed prior to reopening, the Applicant considers it would be at least five years from the commencement of the Proposal (approximately 2020) before the incorporation of the rail option would be feasible. Two alternative (contingency) transport options have therefore been identified and assessed (Options B and C).

Option A – Rail (to Toongi)

This option includes three return train movements on the Toongi-Dubbo Rail Line per week for the delivery of bulk reagents and product despatch. The remaining reagents would either be transported to the DZP Site by road or by rail to Dubbo and road between Dubbo and the DZP Site.

Option B – Rail (to Dubbo) / Road

This option provides for the transportation of bulk reagents by rail to Dubbo where they would be transferred to trucks for delivery between Dubbo and Toongi. It is noted that B-doubles would not be able to be utilised for transport between Dubbo and Toongi and, as a result, the total number of truck movements for these reagents would be increased.

Option C – Road

This option assumes all reagents are transported to the DZP Site by road.

An estimate of the weekly truck movements (during operations) associated with each option is as follows.

Option	Loaded	Empty / Return	Total
Option A	44	44	88
Option B	79	79	158
Option C	69	69	138

Hours of Operation and Project Life

Processing operations would be undertaken on a continuous roster, seven days per week. Mining operations would be undertaken on a 10 to 10.5 hour day, 5 to 5.5 days per week for 48 weeks per year.

The Applicant anticipates that the life of the Proposal, based on the extent of the open cut design, would be 22 years (2 years construction and 20 years operation). It is noted that the resource continues at depth and as such there is likely to be opportunity to continuation of the DZP beyond the life of the current proposal.

Employment

The Applicant estimates that the Proposal would provide approximately 400 positions during site establishment phase and up to 250 full-time equivalent positions during the operational phase.

Rehabilitation and Final Landform

As far as practicable, the Applicant would adopt a progressive approach to the rehabilitation of disturbed areas within the DZP Site to ensure that as areas of mining, waste rock placement or solid residue storage are completed they are quickly shaped and vegetated to provide a stable landform. The nature of the Proposal dictates, however, that the largest area of disturbance on the DZP Site, namely the LRSF, remains active for the life of the Proposal. As a consequence the opportunity to undertake progressive rehabilitation on this structure would be restricted.

The final landform would include the following components.

- Removal of all processing plant, office and ancillary infrastructure, including concrete pads (unless required for a future land use) with the remaining landform profiled to approximate that which existed prior to the establishment of the infrastructure.

- A single, appropriately bunded, fenced and signed final void.
- A shaped and revegetated complex of the WRE, SRSF and Salt Encapsulation Cells comprising undulating upper surfaces and outer faces with maximum slopes of approximately 18° 1:3 (V:H).
- A return to the pre-disturbance landform over areas covered by the LRSF.
- Retention of various infrastructure that could be used for future activities on the DZP Site, for example surface water infrastructure, electricity transmission lines, the Macquarie River Water Pipeline, the Natural Gas Pipeline and rail line infrastructure.

The final land use of the DZP Site would incorporate sustainable agriculture with biodiversity conservation. Central to the final land use would be the establishment of a Biodiversity Offset Area of 1 021ha which would conserve, enhance and link the regionally significant remnant vegetation of Dowds Hill with remnant vegetation along Wambangalang Creek to the northwest and Benolong Road to the north.

CONSULTATION AND ISSUE IDENTIFICATION

In order to undertake a comprehensive environmental impact assessment of the Proposal, appropriate emphasis needs to be placed on those issues likely to be of greatest significance to the local environment, neighbouring landowners and the wider community. These issues (and potential impacts) were identified through a program of community and government consultation, preliminary environmental studies and literature reviews. This was followed by an analysis of the risk posed by each potential impact in order to prioritise the assessment of the identified environmental issues within the EIS.

Consultation

Consultation with the local community involved:

- individual discussions with the landowners / residents of Toongi and surrounding areas;
- several community meetings (in Toongi and Dubbo); and
- a regular newsletter distributed throughout the local community.

The Applicant and its consultants also regularly consulted with various government agencies and authorities throughout the planning phase of the Proposal.

Issue Prioritisation

Considering the environmental issues raised throughout the consultation process, an analysis of environmental risk for each potential environmental issue in the absence of any mitigation measures was then completed.

Through a review of the allocated risk ratings and the frequency with which each issue was identified, the following environmental issues were identified as requiring detailed assessment.

- | | |
|------------------------|---|
| 1. Noise and vibration | 8. Aboriginal and non-Aboriginal heritage |
| 2. Air quality | 9. Visual amenity |
| 3. Radiation | 10. Traffic |
| 4. Surface water | 11. Soil and land capability |
| 5. Groundwater | 12. Hazards |
| 6. Terrestrial ecology | 13. Socio-economic climate |
| 7. Aquatic ecology | |

ENVIRONMENTAL FEATURES, SAFEGUARDS AND IMPACTS

The components and features of the existing environment within and surrounding the DZP Site have been studied and the Proposal designed to avoid or minimise impacts on that environment. A brief overview of the main components of the surrounding environment, the proposed safeguards and the assessed level of impact for each environmental aspect is set out below.

Noise

The existing sources of noise in the vicinity of the DZP Site are typical of a rural environment, e.g. farming activities, insect noise, livestock, wind through vegetation and vehicles on local roads. Noise monitoring undertaken in 2001 and 2012 confirmed this with background noise levels (L_{A90}^2) of $<30\text{dB(A)}$. In accordance with the NSW *Industrial Noise Policy* (INP), a rating background noise level (RBL) of 30dB(A) applies for assessment of the Proposal.

The criteria for noise generated by the Proposal, based on the INP and other regulatory guidelines, are as follows.

- Site establishment and mine operations ($L_{Aeq(15\text{min})}$): $\text{RBL} + 5\text{dB(A)} = 35\text{dB(A)}$.
- Construction operations ($L_{Aeq(15\text{min})}$): $\text{RBL} + 10\text{dB(A)} = 40\text{dB(A)}$ (maximum of 75dB(A)).
- Sleep disturbance (L_{Amax}): $\text{RBL} + 15\text{dB(A)} = 45\text{dB(A)}$.
- Road traffic noise ($L_{Aeq(1\text{hr})}$): 60dB(A) (daytime) and 55dB(A) (night-time).
- Rail noise: $L_{eq(15\text{ hour})}$ of 65dB(A) for daytime and $L_{eq(9\text{ hour})}$ 60dB(A) for night time.

Following initial noise modelling, it was identified that noise levels received at a number of residences could exceed the nominated noise criteria. The primary sources of noise resulting in these exceedances relates to the operation of the crushing plant and other operations on the ROM Pad and within the Processing Plant Area.

The Applicant has subsequently committed to a range of additional noise attenuation measures. Further noise modelling incorporating these mitigation measures demonstrates that noise levels would comply with the intrusiveness criteria.

It is noted that should rail loading or unloading be undertaken at night, it is possible that maximum noises levels (L_{max}) received at non-Proposal related residences could be as high as 54dB(A) . The Applicant has, however, committed to avoiding night time loading and unloading unless critical to meet the allocated rail path. Furthermore, the Applicant has committed to enforcing operator behaviour to minimise and ultimately eliminate any sleep disturbing noise associated with careless movement / placement of containers. Considering these management controls, the frequency of L_{max} noise levels occurring would be low and notably below levels that are likely to wake sleeping occupants indoors (based on international research as published in the EPA's Road Noise Policy).

Noise associated with road and rail transportation was predicted to comply with the relevant noise criteria.

To ensure noise levels do not exceed the modelled predictions, the Applicant would implement a *Noise Management Plan* including noise monitoring at locations on and surrounding the DZP Site.

² The noise level which is exceeded for 90% of the time at a given location.

Blasting

Modelling of the likely airblast overpressure and ground vibration resultant from mine-related blasting was completed for the Proposal. The results of this modelling indicate that through the implementation of appropriate blast design and controls, compliance with the relevant criteria for both airblast overpressure and ground vibration would be achieved throughout the life of the Proposal.

Air Quality

Emission sources surrounding the DZP Site are typical of a rural environment, e.g. wind-generated dust from exposed and dry areas, agricultural activities, dust entrainment due to vehicle movements along unsealed roads and episodic emissions from vegetation fires and dust storms

A review of the proposed operations, meteorological data and the background air quality environment was completed and an assessment of potential air quality impacts undertaken.

Air quality modelling was undertaken for two operational scenarios examining particulate emissions, gaseous emissions (SO₂, NO_x, HCl), odour, radon and greenhouse gas emissions.

With the exception of cumulative 24-hour PM₁₀ emissions which combined the daily varying 24 hour emissions of both the Proposal and background, no exceedances of the relevant air quality criteria are predicted at any non-Proposal related residences or landholdings.

While the contribution of the Proposal to 24-hour PM₁₀ emissions would comply with the relevant criteria, when combined with the daily varying background data set, some residences would be subject to an exceedance of the cumulative PM₁₀ 24-hour criterion on 2 days. Notably, the background data set already contains two

exceedances of the criterion, and therefore the Proposal is not anticipated to contribute to any *additional* exceedances.

Average annual greenhouse gas emissions from the Proposal (0.26Mt CO₂-e) would represent approximately 0.04% of Australia's commitment for annual emissions under the *Kyoto Protocol* (591.5 Mt CO₂-e/annum). The Applicant contends that these emissions are not significant.

Radiation

The mineralised material contains between 80-160 parts per million (ppm) uranium and between 250-500 ppm thorium, and contains radionuclides from the U²³⁸, U²³⁵ and Th²³² decay chains. For reference, the world average for concentrations of these elements in soils is 3ppm for uranium and 6ppm for thorium.

The concentration of uranium and thorium in the ore is not excessive, however, it is at the level at which it is just defined as radioactive. These levels of uranium and thorium necessitate the consideration of radiological impacts on workers, the public and on the surrounding environment.

An assessment of radiological impact was completed for the Proposal and followed the recognised methods outlined by the International Commission on Radiological Protection and the Australian Radiation Protection and Nuclear Safety Agency. This involves estimating the potential exposure doses from each of the exposure pathways to give an indication of the potential overall radiation that workers or a member of the public may receive.

The Radiation Assessment considered both occupational exposure (via gamma radiation, inhalation of radionuclides in airborne dust, and inhalation of the decay products of radon) and public / environmental exposure to persons/biota located outside the boundary of the DZP Site (through airborne dispersion of dust containing radionuclides and radon).

The radiation assessment of the Proposal shows that the impacts would be well below recognised exposure limits. A summary of the radiological impacts of the Proposal, which all easily comply with international standard requirements, are as follows.

Dose Groups	Expected Dose / Impact (mSv/y)	Dose Limit / Standard (mSv/y)
Workers	2 to 9*	20
Member of Public	<0.1	1
Non-Human Biota	No impact	-
Note * depending on the work area		

Surface water

A surface water assessment was completed for the Proposal to consider the potential impacts of the proposed operations on the quality, quantity and hydrological flows of surface water that could discharge from the DZP Site. This assessment made the following conclusions.

- The Proposal would result in an annual reduction in runoff of 453ML per year from the DZP Site for the operational life. This represents only a minor proportion of the total volume within each affected catchment and is not expected to adversely impact downstream groundwater users.
- Based on the intended placement of all reagents on appropriately bunded surfaces, capture and retention of all runoff exposed to mineralised ore and waste rock containing trace radionuclide concentrations, and implementation of an *Erosion and Sediment Control Plan*, there would be no significant adverse surface water quality impacts as a result of the Proposal.
- The Proposal would not impact on flooding of the major creeks surrounding the DZP Site nor the tributaries to these creeks which traverse the DZP Site.

Groundwater

Two connected groundwater systems occur in the Toongi catchment, namely, a consolidated fractured rock system and an unconsolidated sedimentary system consisting mostly of alluvium (with minor colluvial and aeolian deposits). The alluvium overlies the fractured rock system, mostly filling past valleys and drainage lines beneath current day ephemeral creek lines.

Given the open cut would be developed above the groundwater table, no dewatering would be required and there would be no drawdown of groundwater levels associated with the Proposal. Impacts on local groundwater conditions could occur as a result of changes to recharge rates and flows resultant from the construction of various features of the DZP Site. The following outlines the potential impacts associated with the DZP Site.

Open Cut

On completion of the mining, enhanced recharge could be expected resulting in an increase in groundwater levels in the vicinity of the open cut. This impact is not predicted to extend to the alluvial sediments.

SRSF and Salt Encapsulation Cells (SEC)

The rate of recharge over the footprint of the SRSF and SECs would be reduced, leading to a possible moderate reduction in the level of the water table (in the order of 1m to 3m) beneath and in the vicinity of these structures. Based on the controls to be implemented, no adverse impacts on groundwater quality are expected.

LRSF

The rate of recharge over the footprint of the LRSF would be reduced during operations, leading to a reduction in the level of the water table beneath and in the vicinity of these structures. This impact would be limited to the life of the Proposal given the proposed rehabilitation of the LRSF back to agricultural use.

With the installation of an impermeable liner, and implementation of comprehensive and detailed protocols for design, construction, installation and testing of the cell foundations and synthetic liners, adverse impacts on groundwater quality are not expected.

With the use of a single liner, there remains potential for a breach of this liner to result in the leakage of saline material from the LRSF which could contaminate the aquifer below. A comprehensive monitoring system would be installed, using both monitoring bores and review of cell water balances, and a *Leak Detection Response Strategy* developed such that in the event of any leakage, this would be quickly identified, contained and remediated to limit the area of impact.

Groundwater users more than 100m to the west of Wambangalang Creek are assessed as unlikely to be affected by the DZP Site as they are outside the local flow system.

Assuming no leakage from the LRSF, or effective leak identification, response and remediation, no groundwater dependent ecosystems would be adversely affected.

Terrestrial Ecology

In the design of the Proposal, the Applicant attempted to locate component areas of disturbance away from remnants of native vegetation. As a result, of the 807.7ha of disturbance, less than 71ha (<8%) occurs on vegetation considered remnant of the original community type³. The vegetation communities to be impacted are as follows.

- 0.1ha of Fuzzy Box – Inland Grey Box on alluvial brown loam soils of the NSW South West Slopes Bioregion.
- 27.1ha of White Box – Tumbledown Gum woodland on fine-grained sediments on the Central West slopes.

- 43.7ha of White Box – White Cypress Pine – Inland Grey Box woodland on the western slopes of NSW (Quality Remnants).
- 1.1ha of Inland Grey Box tall grassy woodland on alluvial loam and clay soils in the South West Slopes and Riverina Bioregions (within Obley Road reserve).

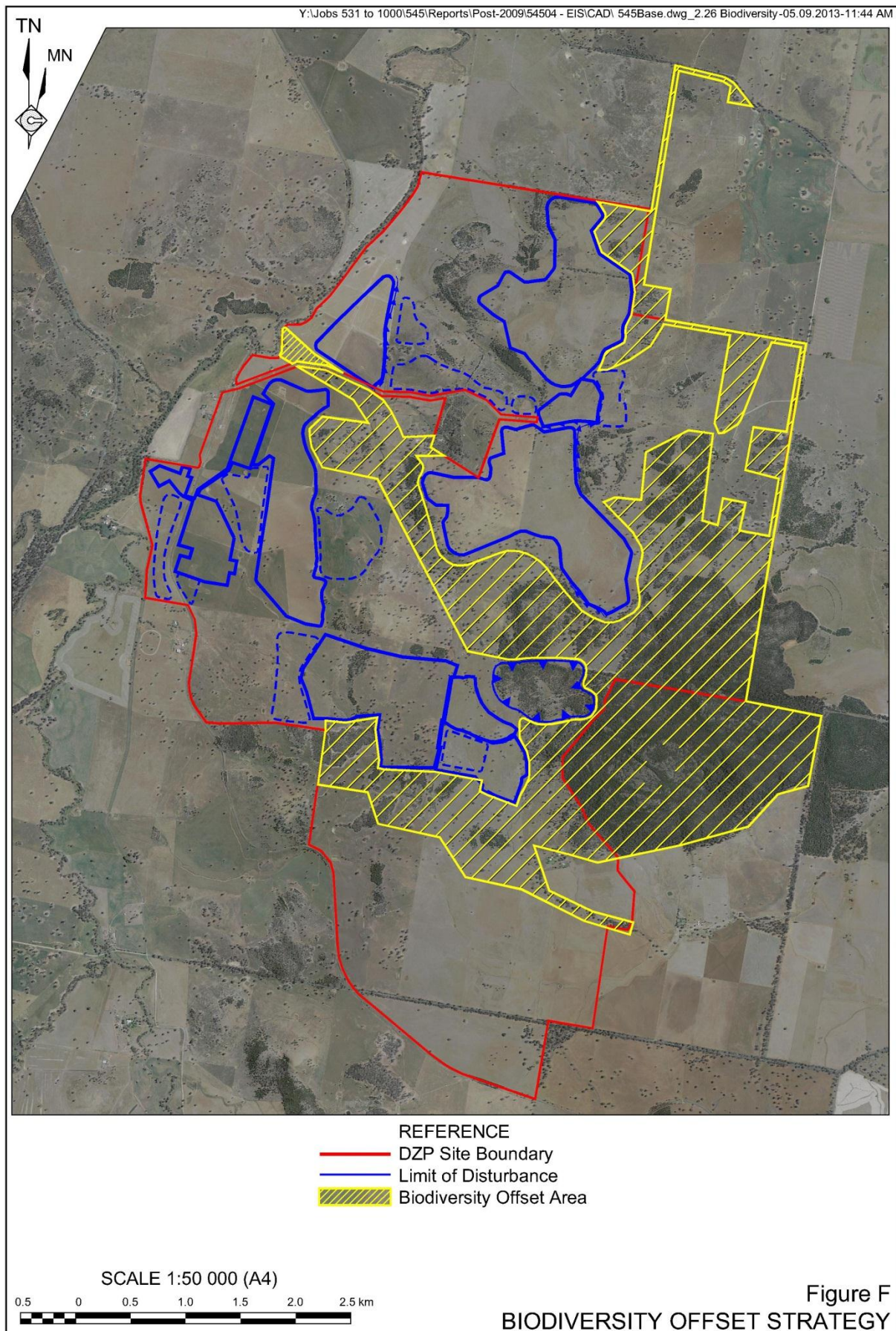
Vegetation communities CW138, CW213 and CW145 are considered Endangered Ecological Communities (EECs) under the TSC Act.

No threatened flora species were identified within the proposed impact footprint. A number of threatened fauna species were identified on or surrounding the DZP Site and other Proposal components, however, only the Pink-tailed Worm-lizard (*Aprasia parapulchella*) would be directly affected. A preliminary *Pink-tailed Worm-lizard Plan of Management* for this species has been prepared and the recommendations of this incorporated into the commitments made by the Applicant with respect to biodiversity management and the design of a Biodiversity Offset Area (BOA) for the Proposal.

An assessment of significance was completed for the EECs and threatened fauna identified, as well as other threatened species and communities considered as being potentially impacted by the Proposal. In each case, and after consideration of the many commitments made by the Applicant with respect to impact avoidance, minimisation and mitigation, the assessment determined that the Proposal would not have a significant impact such that viable local populations of these species and communities, or any other listed species or communities, are likely to be placed at risk of extinction.

A critical consideration in the assessments of significance completed was the proposed BOA, the proposed extent of which is presented on **Figure F**.

³ A further 414ha occurs on 'derived grasslands' which are >50% weedy and rotationally cropped by the landowners.



The principal elements of the proposed BOA are as follows.

- Protect and conserve an area of 1 021ha, comprising 653.1ha (64%) native vegetation communities, 306.8ha (30%) associated derived grassland communities and 61.1ha (6%) currently cleared land (without derived native grassland) or white cypress pine monoculture.
- The conservation of the remnant vegetation of Dowds Hill and linkage of this regionally significant remnant to other significant vegetation or habitat remnants including.
 - remnant vegetation of Wambangalang Creek which itself provides a corridor to the Macquarie River;
 - remnant vegetation within the road easement of Benolong Road to the north; and
 - isolated habitat for the NSW and Commonwealth listed threatened species, Pink-tailed Worm-lizard, to the west, northwest and north of Dowds Hill.

When considered using the BioBanking Assessment Methodology, the Biodiversity Offset Area variously achieves Tier 1, Tier 2 and Tier 3 (with application of Variation Rules) for each of the vegetation communities and threatened species impacted by the Proposal. The proposed BOA also satisfies each of OEH's nominated principles for biodiversity offsets and the offsetting requirements of the EPBC Offset Policy.

Aquatic Ecology

Streams, creeks and watercourses within the boundaries of the DZP Site and locality have been degraded through clearing,

agriculture and water abstraction over many years. These impacts have resulted in:

- changes in water quality from erosion and sedimentation, increased inputs of nutrients and increased salinisation;
- clearing of in-stream and overhanging vegetation and snags, and the establishment of weeds which have resulted in the simplification of habitat structure,; and
- changes to drainage patterns through the construction of farm dams, bridges and causeways, which has disrupted dispersal patterns.

Although the development of the Proposal would be undertaken across aquatic ecosystems that are stressed and degraded, these watercourses still provide habitat for aquatic biota. This includes habitat for threatened species, populations and endangered ecological communities such as the *Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River* and *Tandanus tandanus – Eel-tailed Catfish in the Murray/Darling Basin Endangered Population*. Through consideration of the proposed management and mitigation measures of the Applicant, it is assessed that impacts on these and other threatened communities, populations and species would be reduced to acceptable levels.

Aboriginal Heritage

The Proposal has the potential to impact on Aboriginal sites as a consequence of surface disturbing activities. Following consultation with registered Aboriginal community stakeholders, a field survey to identify the type and distribution of Aboriginal sites was undertaken.

In total, 52 sites have been identified within the DZP Site and other component disturbance areas of the Proposal. These sites include 19 sites previously recorded on the AHIMS database. Of the 52 sites:

- 26 occur away from the proposed disturbance and would not be impacted; and
- 12 are located in close proximity to the impact footprint but would remain undisturbed with the implementation of appropriate management.

Impact to 14 sites, including two Potential Archaeological Deposits (PADs), which occur within the impact footprint of the Macquarie River Water Pipeline and have been the subject of test excavations, would be unavoidable.

Specific management measures for each site to be affected have been proposed and presented to the registered Aboriginal parties (RAPs) for the DZP. These proposed management measures were discussed at an Aboriginal Focus Group Meeting held on 13 August 2013 with subsequent correspondence from the RAPs confirming satisfaction with the proposed management subject to the preparation and implementation of a Care Agreement between the Applicant and RAPs (to define the collection, transfer and management of artefacts salvaged).

Non-Aboriginal Heritage

A survey for historic (non-Aboriginal) sites and artefacts was undertaken concurrently with the Aboriginal heritage field survey. A total of six new historical heritage items were identified, of which four were described as historical sites (HS) and two were described as historical isolated finds (HIF).

Of these recorded sites, disturbance to four recorded sites, as well as the previously recorded Dundullimal Rail Bridge, would be unavoidable.

The Applicant has committed to taking archival records of the sites prior to disturbance and based on the low local significance of these sites, it has been assessed that there would be negligible residual impact on the local or regional historic context by the Proposal.

Soils and Land Capability

Ten soil landscapes have been identified within the DZP Site generally correlating with the underlying geology.

During construction and operations, soil material would be selectively stripped and stockpiled. A range of measures have been proposed to manage the soil during stripping, stockpiling and respreading. These measures aim to maximise the recreation of a soil profile that provides a topsoil layer for the entry and storage of water, air and nutrients for plant support and a subsoil layer for retention of water and deep root penetration.

On the basis of this approach, the volume of soil to be stripped would be minimised to that required for rehabilitation, and managed to maximise the potential re-use in the rehabilitation of the disturbed areas of the DZP Site, impacts on the soils of the DZP Site are assessed as likely to be effectively mitigated and limited to the life of the Proposal.

Land and soil capability classes were also determined for each of the soil landscapes within the DZP Site. The dominant classes are 3 (grazing and regular cultivation) and 4 (grazing and sufficient cultivation to establish improved pasture), which together account for 83% of the Soil Survey Area. However, it is noted that, due to the broad scale of the assessment, patches of lower capability land (higher land capability class number) would occur within the classified areas.

Following completion of rehabilitation there would be an overall reduction in the area of Class 3 land, however, as the

majority of this would be rehabilitated to Class 4 land, there would be only minor reduction in overall land capability.

Traffic and Transportation

The existing road and rail network has been reviewed and the potential impacts of the Proposal assessed.

Road Network

An analysis of two principal intersections, the Obley Road and Bootherba Road intersections with the Newell Highway, was undertaken using SIDRA intersection performance simulation software. The modelling indicates that the two intersections would still operate far below their capacity during peak traffic periods, even in Year 2036 with an applied traffic growth of 1.5% per annum. Additionally, the results clearly indicate that the introduction of traffic by the Proposal, which represents only a relatively minor percentage, does not significantly impact upon the performance of the intersections.

Despite the outcomes of the SIDRA intersection analysis, a range of road and intersection upgrades are proposed. The proposed upgrades would significantly improve road standards, road capacity and mitigate the effects of the Proposal on road capacity.

A range of other management measures are also proposed including:

- scheduling shift changes outside of peak traffic periods;
- implementation of a *Construction Traffic Management Plan*;
- implementation of a Driver's Code of Conduct; and
- a road maintenance contribution reflecting traffic generated and upgrade works completed.

Ultimately, the risk of a traffic incident cannot be completely removed, however, it is assessed that, with the implementation of the proposed management measures, these risks would not increase.

Rail Network

The re-opening of the Toongi-Dubbo Rail Line would require the re-opening of four level crossings within the Dubbo urban area and five level crossings between Dubbo and Toongi. The rail line also crosses numerous rural property driveways and farm tracks along its length.

Assuming an average train length of 500m and a travel speed of 10km/hr (in town) a maximum delay of 5 minutes and average delay of 2.5 minutes has been predicted. It is assessed that an average 2.5 minute delay six times per week is unlikely to have a significant impact on traffic movement within the Dubbo urban area provided:

- the number of movements during peak hour traffic are limited: and
- trains do not need to be held at the associated rail crossings waiting to obtain access to the main lines.

Delays at the associated rail crossings with Obley Road and Toongi Road would have a negligible impact as there is significantly less traffic than there is in the Dubbo urban area, and the delays are likely to be less than they are in town given that the train speeds would be greater than 10km/hr.

Visual Amenity

The existing visual amenity surrounding the DZP Site is typical of rural areas in the central west of NSW, with the outlook from most rural residences and other vantage points including remnant native vegetation, land used for agriculture, roads or other infrastructure.

The visual amenity in the vicinity of the DZP Site would be altered through the construction of a variety of structures not

associated with the local setting, with the most prominent being as follows.

- The Processing Plant and DZP Site Administration Area: due to its proximity to Obley Road and rural residential dwellings to the west and the overall size and nature of these facilities, e.g. various stacks, tanks and industrial buildings.
- The LRSF: due to its large size and the contrast that would be created between the embankments and surrounding grassy paddocks.
- The SRSF, WRE and Salt Encapsulation Cells: due to the large size and location of these features over relatively elevated sections of the DZP Site. It is noted that the nearest non-Proposal related residential vantage points to this complex would be at least 3km away, with the closest public vantage point (the very lightly trafficked The Springs Road) approximately 1.5km away.

However, the impacts of that change to the existing visual amenity (which would be limited to the life of the Proposal) would be minimised as far as practicable through the choice of materials for construction, construction of vegetation screens, rehabilitation of the DZP Site and development and implementation of a Biodiversity Offset Area. Furthermore, the Applicant would seek to address individual concerns in relation to impacts on visual amenity through discussions and negotiations with individual residents.

Hazards

The Applicant has identified and proposed management measures to reduce the associated risks to acceptable levels for the following hazards.

- Reagent transport, storage and use.
- Heavy vehicle transport.

- Land contamination.
- Bush fire.

Socio-economic

Based on a mining rate of 1Mtpa and annual production of 75 000tpa of products, the Proposal would generate a total revenue stream of over \$500 million/year. Earnings before Interest, Taxes, Depreciation, and Amortization (EBITDA) generated have been estimated at around \$5.4 billion over the life of the Proposal.

Importantly, the DZP would provide several economic benefits to the local and regional socio-economic setting, including the following.

- Direct employment for approximately 400 during the site establishment phase and up to 250 full-time equivalent positions during the operational phase.
- Priority sourcing of these employees from existing Dubbo residents (a target for the start-up workforce to comprise 85% drawn from Dubbo and surrounding towns).
- No fly in – fly out workforce is proposed.

Other direct and indirect (flow-on) benefits of the Proposal would include:

- stimulus for other local businesses;
- contribution of \$50 million per year to the local and regional economy through wages and purchases of local goods and services;
- the upgrade of Obley and Toongi Roads, at a cost likely to exceed \$15 million;
- a commitment to enter into an agreement with Dubbo City Council to compensate for any increased pressure placed on local infrastructure and services; and
- support of local community services and projects.

The operation of the DZP would also make significant contributions to the public sector via a range of payments made to the national, State, and local governments under existing legislative arrangements.

- Corporate tax payments (at an assumed rate of 30%) in the order of \$70 million annually.
- Royalties to the NSW State Government of approximately \$9.5 million annually.
- Annual payroll costs to the NSW State Government of around \$34 million.
- Relevant income tax payments generated by the higher wages paid by the mining sector.

The Proposal would also provide for the continued diversification of development / industry in the region and provide for one of the 10 key steps to Dubbo's economic success under the *Dubbo City Economic Development Strategy*, i.e. development of a mining and mining services sector.

It is acknowledged that while impacts on the biophysical environment have been assessed as complying with nominated criteria or meeting accepted environmental standards, the cumulative effect of these minor impacts may have some adverse effect on the socio-economic setting. This is often expressed as a reduction in the amenity of the local area.

An objective assessment of this impact on local amenity is difficult as what one person may consider as acceptable, may not be to another person (and vice versa). However, where all biophysical impacts are assessed as complying with nominated criteria or standards, it is considered unlikely for impacts on local amenity to be unacceptable to a reasonable person.

It is further noted that the Applicant remains accountable for managing the DZP in a manner that complies with the nominated environmental criteria and meets reasonable community expectations. A

comprehensive monitoring program would be established to demonstrate compliance with environmental criteria, and liaison with both official and unofficial community representation would continue to address community concerns as they arise.

PROJECT EVALUATION AND JUSTIFICATION

The Dubbo Zirconia Project has been evaluated and justified principally through consideration of its potential impacts on the environment and potential benefits to the local and wider community.

In evaluating the Proposal, it is concluded that, with the implementation of the proposed operational controls, safeguards and/or mitigation measures, the residual risk posed by each possible environmental incident or impact are reduced from original levels. With limited exceptions, the residual risk was classified as either moderate or low, and therefore considered acceptable. Further, the design of the Proposal has addressed each of the sustainable development principles, and on balance, it is concluded that the Proposal achieves a sustainable outcome for the local and wider environment.

The Proposal and associated activities have been assessed in terms of a wide range of biophysical, social and economic issues. Potential residual impacts can be justified in terms of the positive economic and social benefits to the local communities of the Dubbo and surrounding local government areas, NSW and Australia, the market opportunities for the export of the rare metal and rare earth products which are likely to be critical in the development of green technology, and the principles of ecologically sustainable development.

CONSEQUENCES OF NOT PROCEEDING WITH THE PROPOSAL

The consequences of not proceeding with the Proposal include the following.

- The recoverable rare metal and REE resource, globally important as critical to the ongoing development of 'green technology', would not be mined.
- The opportunity to create up to 400 construction and 250 operational full-time jobs would be foregone.
- The contribution of an anticipated \$50 million per year to the local and regional economy would be foregone.
- The contribution of at least \$114.5 million each year to the public sector would be foregone.
- The opportunity to provide for one of the 10 key steps of the *Dubbo City Economic Development Strategy* would be foregone.
- The opportunity for the training that would be provided, which would assist in the retention of school leavers and younger people who are often lost from regional communities, would be foregone.
- The minor impacts on the local biophysical environment would not eventuate.

It is considered that the benefits of proceeding with the Proposal therefore far outweigh the minor impacts on the environment that would result.

CONCLUSION

The Proposal has been, to the extent feasible, designed to address all issues raised by the local community and all levels of government, as well as the principles of ecologically sustainable development.

The Applicant has identified the need for the DZP Site to continue to contribute to the socio-economic setting of the local area and allows for a combination of biodiversity conservation, sustainable agriculture and possibly some other land use which could take advantage of the power and water supply to the site.

In light of the conclusions included throughout the EIS, it is assessed that the Proposal could be constructed and operated in a manner that would satisfy all relevant statutory goals and criteria, environmental objectives and reasonable community expectations.

The EIS is supported by the range of specialist consultant studies has established that if the Proposal proceeds, it would:

1. satisfy ecologically sustainable development principles;
2. operate with risks to the local environment minimised to the greatest extent practicable through Proposal design and implementation of a range of environmental controls and safeguards;
3. have a minimal and manageable adverse impact on the biophysical environment;
4. have a substantial positive impact on the local and wider regional and NSW socio-economic environment;
5. contribute to the continued economic activity of the local area; and
6. provide a site suitable for future agricultural activities incorporating areas for long term biodiversity conservation.

This page has intentionally been left blank