Regional Mining and Infrastructure Planning project - Far North

Contractor’s Report – November 2013

Prepared for the South Australian Department of Planning, Transport and Infrastructure and the Commonwealth Department of Infrastructure and Regional Development
This final contractor report is one of three prepared for the Regional Mining and Infrastructure Planning project. As each report is intended to be a 'stand-alone' document there is some duplication between the three reports, particularly in chapters 1, 2, 9, 10 and 11.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ag</td>
<td>Silver</td>
</tr>
<tr>
<td>ARTC</td>
<td>Australian Rail Track Corporation</td>
</tr>
<tr>
<td>Au</td>
<td>Gold</td>
</tr>
<tr>
<td>Axle load</td>
<td>Weight felt by road or rail surface for all wheels connected to a given axle</td>
</tr>
<tr>
<td>Beneficiation</td>
<td>Processing of raw ore to increase mineral concentration prior to export</td>
</tr>
<tr>
<td>Bulk commodities</td>
<td>Commodities shipped unpackaged in large volumes</td>
</tr>
<tr>
<td>Concentrate</td>
<td>Processed ore with increased mineral concentration</td>
</tr>
<tr>
<td>Cu</td>
<td>Copper</td>
</tr>
<tr>
<td>DIRN</td>
<td>Defined Interstate Rail Network</td>
</tr>
<tr>
<td>DSO</td>
<td>Direct Shipping Ore</td>
</tr>
<tr>
<td>Easement</td>
<td>Right to use land for a specified purpose</td>
</tr>
<tr>
<td>EIS</td>
<td>Environmental impact statement</td>
</tr>
<tr>
<td>Fe</td>
<td>Iron</td>
</tr>
<tr>
<td>GL</td>
<td>Gigalitre</td>
</tr>
<tr>
<td>GWh</td>
<td>Gigawatt Hours</td>
</tr>
<tr>
<td>HM</td>
<td>Heavy mineral</td>
</tr>
<tr>
<td>HML</td>
<td>High Mass Load</td>
</tr>
<tr>
<td>IDS</td>
<td>Infrastructure Demand Study</td>
</tr>
<tr>
<td>ISR</td>
<td>In situ recovery process (for extracting uranium)</td>
</tr>
<tr>
<td>JORC</td>
<td>Joint Ore Reserves Committee</td>
</tr>
<tr>
<td>kV</td>
<td>Kilovolt</td>
</tr>
<tr>
<td>MAPS</td>
<td>Moomba to Adelaide pipeline system</td>
</tr>
<tr>
<td>MCA</td>
<td>Multi-Criteria Analysis</td>
</tr>
<tr>
<td>Mtpa</td>
<td>Million Tonnes per annum</td>
</tr>
<tr>
<td>MW</td>
<td>Megawatt</td>
</tr>
<tr>
<td>Ni</td>
<td>Nickel</td>
</tr>
<tr>
<td>Ore</td>
<td>A metal bearing mineral or rock</td>
</tr>
<tr>
<td>PACE</td>
<td>Plan for accelerating exploration</td>
</tr>
<tr>
<td>Pb</td>
<td>Lead</td>
</tr>
<tr>
<td>PIP</td>
<td>Planning Improvement Process</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>--------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Potable</td>
<td>Water of quality to be safe for human consumption</td>
</tr>
<tr>
<td>Remnant vegetation</td>
<td>Areas of native trees, shrubs and grasses which have not been altered</td>
</tr>
<tr>
<td>RESIC</td>
<td>Resources and Energy Sector Infrastructure Council</td>
</tr>
<tr>
<td>REE</td>
<td>Rare Earth Elements</td>
</tr>
<tr>
<td>RMIP</td>
<td>Regional Mining and Infrastructure Planning</td>
</tr>
<tr>
<td>TJ</td>
<td>Terajoules</td>
</tr>
<tr>
<td>Transmission network</td>
<td>Network of high voltage electricity lines and transformer assets</td>
</tr>
<tr>
<td>U</td>
<td>Uranium</td>
</tr>
<tr>
<td>Zn</td>
<td>Zinc</td>
</tr>
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Foreword

The South Australian Government has invested heavily to promote mining exploration and development over the past ten years. This investment is paying dividends in the form of an increase in minerals exploration and the number of mines in production.

The expansion in the mining industry presents a tremendous opportunity to further economic and social objectives in South Australia, particularly in regional centres.

The South Australian Government, miners and regional communities are becoming increasingly concerned about the ability of existing infrastructure to service the future needs of the mining industry.

The South Australian Government commissioned the Regional Mining and Infrastructure Planning (RMIP) project to consider the infrastructure which is best able to facilitate the development of the mining sector and articulate the means of delivering this infrastructure. Three reports have been developed for the regions in which existing and potential mining operations are concentrated – Eyre and Western, Far North and Yorke and Mid-North/Braemar. Each of the reports are intended be standalone documents, but will recognise the interdependencies between the regions.

Funding for the RMIP project has been provided by the Commonwealth Government through the Regional Infrastructure Fund.

This final report presents the findings of the RMIP project, including the feedback received on the interim report during public consultation. The report consolidates the analysis provided in the interim reports to identify the projects that have been assessed against a prioritisation framework as having the best ability to facilitate the development of the mining sector. This analysis is extended to include consideration of the impediments to these infrastructure projects and how they might be resolved, along with the economic and social impacts which can be expected to result.
1. Purpose and intent

Purpose and intent of the Regional Mining and Infrastructure Planning project

The Regional Mining and Infrastructure Planning (RMIP) project has been tasked with articulating a plan for the delivery of infrastructure to support the development of mining in South Australia.

The objective of the RMIP project is to identify infrastructure solutions that maximise the net benefits to South Australia by improving connectivity from existing mines and reducing infrastructure related risks for new mines.

The RMIP project delivers a roadmap, including the respective role of governments and the private sector in facilitating the delivery of long-term infrastructure solutions which are sensitive to the diverse economic, social and environmental requirements of all stakeholders in each of the regions.

This final report identifies the infrastructure requirements to support further development of existing mines and new mines located within the Far North region. This infrastructure is generally located in the Far North region or it may be located in one of the adjacent regions, where there is better connectivity to support mine development. For this reason, RMIP project documents were developed concurrently for the Eyre & Western and Yorke and Mid-North/Braemar regions to provide an integrated approach to planning of mining developments across the State.

Previous work undertaken

The Resources and Energy Sector Infrastructure Council (RESIC) commissioned the 2011 Infrastructure Demand Study (IDS) which surveyed resource and energy project proponents in South Australia to develop a dataset of mine proponents’ expectations for future infrastructure requirements for their projects.

The RESIC commissioned study collated proponents’ infrastructure requirements in the event projects proceeded. The study assigned weights based on the likelihood projects would proceed, however this was not based on forecast economic conditions. The RESIC study identified a project weighted outbound resource task of 120 million tonnes per annum from 2017 and beyond.

Building upon the findings of the RESIC study, further information gathering from prospective miners and infrastructure proponents, industry experts and economic forecasts, the RMIP project has assessed the future infrastructure requirements of mining in South Australia. The assessment in this project considers the drivers and impediments to mining project development to develop realistic mining infrastructure demand scenarios, underpinned by key macroeconomic drivers.

The South Australian Government’s response to the RESIC IDS noted two actions which are to be included in the RMIP project:

- Consider the infrastructure requirements of the sector, including progressing the corridor and utility hub concepts. This will help planners and the private sector to determine their location, purpose and function
- Investigate the need for and location of Capesize port capability.
Purpose and intent of the final report

The purpose and intent of the final report is to consolidate the analysis in the interim report by incorporating the feedback received during consultations to form a list of prioritised infrastructure projects that will best facilitate the development of the mining sector. In doing so, the impediments to - and social and economic outcomes of - the infrastructure are identified and analysed.

The final report presents our findings with respect to:

- The current state of mining and resultant infrastructure demand
- The forecast future state of mining and resultant infrastructure demand
- The state of current and committed infrastructure
- The gap between forecast infrastructure demand and provision
- The prioritised infrastructure projects and the rationale supporting the prioritisation process
- The impediments to prioritised infrastructure and the means by which these impediments can be overcome
- The social and economic outcomes resulting from the prioritised infrastructure
2. Approach

Introduction
The approach adopted in the development of the RMIP project has been designed to ensure the comprehensive assessment of current and future infrastructure needs of mining and related industries across South Australia.

The RMIP project considers the requirements of three interrelated regions; as such, the report has been prepared with consideration to each region to avoid duplication of infrastructure solutions. The approach adopted assessed the various infrastructure solutions and considered the feasibility, cost and delivery requirements of the infrastructure required.

Mining considered in this plan
There is a significant range of mining activity in South Australia including iron ore, copper, uranium, heavy mineral sands, silver, gold and zinc.

For the purposes of this project, the mining industry is taken to include the exploration and extraction of minerals with a significant or potentially significant demand for freight, water, power and/or gas infrastructure.

It is recognised that iron ore is the most infrastructure-intensive commodity, in terms of power, water, freight and other infrastructure and is therefore the primary focus of this project.

Energy projects, including coal, coal to liquids, geothermal, conventional and gas projects, have not been addressed in this study, however may be referenced from time to time where opportunities or impacts in relation to mineral projects are identified.

Infrastructure considered in this plan
Infrastructure is a broad term, which refers to the basic physical and organisational structures required for business and community functions to operate. This includes the network of roads, highways, railways and ports that underpins the transportation into, out of and within a region, the water and sewage systems that ensure an adequate supply of clean water as well as the disposal of waste, the power and gas grids that fuel enterprise, the networks that support communication and commercial exchange between parties and the structures and institutions that underpin the delivery of social services such as health, education and justice.
The infrastructure requirements of miners are considered in two dimensions; the extraction of the resources and the transportation of the resources. Subsequently, the infrastructure considered in this report includes:

- Transport and logistics infrastructure, comprising:
  - Port facilities for import of goods required by the mine and export of product produced by the mine. This includes landside port facilities as well as marine facilities
  - Freight route infrastructure between the mine site and the port. This comprises road, rail, conveyor systems and slurry pipelines or a combination of these
- Water infrastructure to collect, treat as necessary and transport water to mine sites
- Energy infrastructure to produce and/or supply gas and/or electricity to support mine sites processes as well as processes for transport and water infrastructure above.

Project governance

A Steering Committee comprising government agencies has been established due to the relevance of the RMIP project to a range of government functions. The Steering Committee is led by the Department of Planning, Transport and Infrastructure and includes representatives from:

- Department of Manufacturing, Innovation, Trade, Resources and Energy
- Department of Primary Industries and Regions South Australia
- Department of the Premier and Cabinet
- Department of Treasury and Finance
- Regional Development Australia
- Commonwealth Department of Infrastructure and Regional Development.

The primary role of the Steering Committee is to ensure that the Government’s objectives on behalf of the South Australian community are considered in the RMIP project.

Those who have contributed to the development of the final report

The South Australian Government has established a team of deeply experienced contractors to support the RMIP project. This team brings a broad range of skills and expertise including:

- Minerals extraction and processing
- Freight and logistics
- Integrated infrastructure planning
- Public policy analysis
- Regional development
- Electricity generation and transmission
- Gas transmission
Approach

- Land transport
- Water supply and transmission
- Ports and shipping
- Cost estimation
- Community planning
- Economic impact assessment
- Environmental assessment.

The contractor team, government, industry and peak bodies have all been involved in planning workshops, one-on-one consultations and have reviewed detailed analysis of the market forecasts, possible solutions and feedback from public consultation, all of which inform this final report.

Methodology

The methodology which was applied in the development of the RMIP report for the Far North region is discussed in Appendix A.
Mining has the ability to generate benefits for regional centres through its ability to create employment opportunities and support towns which underpin vibrant communities. The ability of regional communities to benefit from mining activity will in part be driven by the socio-demographic profile of the people in the region and in part the ability of the region to attract and support skilled labour.

For context, this chapter provides an overview of the economic activity and demographic characteristics of the Far North region. The data contained in this chapter will underpin social and economic modelling undertaken as part of the prioritisation process.

**The Far North region**

The Far North covers a region of 799,850 square kilometres and accounts for approximately 80 per cent of the State’s land mass.

**Figure 3.1: Map of South Australian regions**
The Far North region has a population of over 32,000; major towns include Port Augusta (13,658 residents), Roxby Downs (4,717 residents) and Coober Pedy (1,695 residents). This region is home to around one-fifth of the State’s Indigenous community, with the Anangu Pitjantjatjara Yankunytjatjara (APY) Lands located in the north west (2,400 residents). The region is characterised by the strong presence of mining and the resultant fly-in-fly-out population, notably around Olympic Dam.

Table 3.1: Socio-demographic data for the Far North region and South Australia

<table>
<thead>
<tr>
<th></th>
<th>Units</th>
<th>South Australia</th>
<th>Far North</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>no.</td>
<td>1,596,572</td>
<td>32,765</td>
</tr>
<tr>
<td>Population (0-15 years)</td>
<td>% of population</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>Population (15-64 years)</td>
<td>% of population</td>
<td>66</td>
<td>69</td>
</tr>
<tr>
<td>Population (65 years+)</td>
<td>% of population</td>
<td>16</td>
<td>11</td>
</tr>
<tr>
<td>Population growth (2001-2011)</td>
<td>%</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Average wage/salary income*</td>
<td>$</td>
<td>41,896</td>
<td>50,137</td>
</tr>
<tr>
<td>Indigenous population</td>
<td>% of population</td>
<td>2</td>
<td>19</td>
</tr>
</tbody>
</table>

Education and employment

<table>
<thead>
<tr>
<th></th>
<th>Units</th>
<th>South Australia</th>
<th>Far North</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of primary and secondary schools†</td>
<td>no.</td>
<td>785</td>
<td>63</td>
</tr>
<tr>
<td>School enrolment</td>
<td>no.</td>
<td>258,991</td>
<td>n/a</td>
</tr>
<tr>
<td>Population with non-school qualification</td>
<td>% of working age population</td>
<td>42</td>
<td>34</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>% labour force</td>
<td>5.7</td>
<td>5.0</td>
</tr>
<tr>
<td>Labour force participation rate</td>
<td>% working age population</td>
<td>59.9</td>
<td>59.8</td>
</tr>
</tbody>
</table>

Major industries

|                          | Manufacturing (15%), Construction (12%), Retail trade (9%) | Mining (28%), Health care and social assistance (9%), Construction (8%) |

*RDA regional data. Regions approximately correspond to the study regions as discussed earlier in this report.
†This variable describes the level of education of the highest completed non-school qualification (e.g. bachelor degree, diploma)
http://www.sahealth.sa.gov.au/wps/wcm/connect/8b527f004ce0d7ba8d2e9da496684d9f/ED+Care+Aust+Health+Stats.pdf?MOD=AJPERES&CACHEID=8b527f004ce0d7ba8d2e9da496684d9f

† Population for Coober Pedy is taken from the 2011 Census data for the Coober Pedy Statistical Local Area which encompasses the Coober Pedy Indigenous Location.
Profile of the Far North

The concentration of the population of the Far North region in townships is summarised in Figure 3.1.

Figure 3.1: Top towns by population, Far North, 2011

Source: ABS Census 2011

Regional Demographics

The age distribution of the population of the Far North region clearly shows a high proportion of people aged between 25 and 54 years. The higher representation of males in these working-age brackets is particularly notable, likely reflecting the relative proportion of men in mining professions in this region.

Figure 3.2: Far North population profile, 2011

Source: ABS Census 2011

Population projections

Table 3.2 presents forecasts of the population for the Far North RDA region, compared to South Australia. These forecasts refer to the RDA Far North region which is a larger approximation of the region considered in this study. The Far North RDA is expected to experience 16.4 per cent growth over the coming decade, slightly higher than the forecast population growth rate for South Australia (16.1 per cent).
**Table 3.2: RDA population projections**

<table>
<thead>
<tr>
<th>RDA region*</th>
<th>2016</th>
<th>2021</th>
<th>2026</th>
<th>% change 2011-2026</th>
</tr>
</thead>
<tbody>
<tr>
<td>Far North</td>
<td>31,778</td>
<td>33,395</td>
<td>34,910</td>
<td>16.4%</td>
</tr>
<tr>
<td>South Australia</td>
<td>1,770,644</td>
<td>1,856,435</td>
<td>1,935,161</td>
<td>16.1%</td>
</tr>
</tbody>
</table>

*NB these regions approximately correspond to the study regions as discussed earlier in this report.
Source: Department of Planning and Local Government, cited in SA Centre for Economic Studies 2012

**Economy**

The largest industry of employment in the Far North region is mining, representing 28 per cent of employed persons. The concentration of employment in mining is a reflection of the presence of a number of major mines, including Olympic Dam, Prominent Hill and Challenger. Employment in the Far North region is significantly more concentrated in mining than South Australia as a whole, where only two per cent of employment is in the mining sector.

Health care and social assistance is the second largest industry by employment in the Far North region, accounting for nine per cent of employment, followed by construction (eight per cent) accommodation and food services (eight per cent).

**Figure 3.3: Top industries of employment, Far North, 2011**

![Pie chart showing employment distribution]

Source: ABS Census 2011

The Far North region has a relatively high percentage of the labour force in full time work (65 per cent), above South Australia as a whole (57 per cent) and Australia (60 per cent).

Figure 3.4 shows the relatively flat income profile of the region, compared to the income profile of South Australia as a whole. Interestingly, there is a large disparity between low and high income earners compared to the income distribution for South Australia as a whole.
The disparity of incomes in the Far North region is significantly greater than the rest of South Australia. This income disparity in the Far North is likely a reflection of the number of welfare recipients on one hand and high mining incomes on the other. Overall, the Far North region has a significantly higher average annual income ($50,137) than the South Australian average ($41,896).

**Figure 3.4: Total personal weekly income, Far North, 2011**

Source: ABS Census 2011

Income support for residents in the Far North RDA region included 9.5 per cent of the population being recipients of unemployment benefits and 27.7 per cent of the region being Centrelink card holders. This reflects both the highest proportion of unemployment benefit recipients and the lowest total proportion of card holders of the three regions in this study. This further highlights the relative disparity in the Far North region.

**Education**

The Far North region has a significantly lower proportion of its working age population with non-school qualifications (34 per cent) when compared to the South Australian average (42 per cent) or to Australia as a whole (44.9 per cent).  

The biggest gap in non-school qualifications is at the bachelor degree level, with 6.3 per cent of the working age population in the Far North region holding a qualification at this level, compared to 11.6 per cent of the working age population of South Australia and 13.5 per cent nationally.

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2 This variable describes the level of education of the highest completed non-school qualification (e.g. bachelor degree, diploma).
Figure 3.5: Non-school qualifications in the Far North region compared to working age population

The proportion of adults who were full-time students in the Far North region (4.4 per cent) is significantly lower than the proportion for South Australia as a whole (19.3 per cent). There is also a greater percentage of adults in the Far North region not attending any type of educational institution (80.6 per cent) compared to South Australia as a whole (71.3 per cent).

Social infrastructure

Healthcare in the Far North is provided by nine health services, governed by five health advisory councils. Six hospitals operate in the Far North region. The Royal Flying Doctor Service is particularly significant due to the remoteness of many communities in the Far North region. The RFDS services provided include 24 hour telephone and radio medical consultation. Expansion of remote health delivery via videoconferencing and other tele-health solutions is expected with the roll out of the National Broadband Network.

The majority of the population (75 per cent) in the Far North region is located within the urban centres of Port Augusta, Roxby Downs, Coober Pedy and Quorn, with the majority of community arts and sporting facilities centred around these towns.

Land use and the environment

Land use in the Far North region is dominated by pastoral uses. Other significant land uses in the region include conservation (such as the Flinders and Gammon Ranges National Parks and the Arakarooa Protection Area, as well as those managed by non-government organisations such as the Australian Wildlife Conservancy, Bush Heritage Australia and Arakarooa Sanctuary), defence (the Woomera Prohibited Area) and indigenous areas (such as the Anangu Pitjantjatjara Yankunytjatjara (APY) Lands). Remnant vegetation
in the Far North is relatively widespread, although its condition varies dependent on the extent of degradation due to clearing, stocking and the impact of feral animals and weeds. This region also includes a significant number of arid land wetlands (such as the Coongie Lakes and numerous mound springs associated with the Great Artesian Basin), and salt lakes (such as Lakes Eyre, Torrens and Frome).

A list of key environmental assets in the Far North region is provided in Appendix B and the figure overleaf shows the location of key environmental assets across South Australia. It is important to note this figure (and Appendix B) is intended to provide a high-level overview rather than a detailed assessment, as would be required as part of the environmental impact assessment required for any major project.
Figure 3.6: Key South Australian environmental assets
Implications of mining growth

Mining sector expansion is expected to have a significant impact on development and community dynamics of the Far North region. Along with the increased investment and commercial activity that would be expected, the increased mining activity will also result in an influx of temporary and permanent residents to the region.

The distance from established townships of almost all mines in the Far North means these operations will rely heavily on labour sourced from outside the area. It is likely the remoteness of the new operations will promote the development of company-built and operated towns to house the growing workforces and provide basic social services such as health and education, social infrastructure such as housing, water and sewerage and broader community and recreational services such as pools, gymnasiums, cafes and retail facilities.

The requirement to accommodate workers from outside the region may necessitate the investigation of new or expanded airports to service these clusters.

The need for additional or upgraded social infrastructure is considered in Chapter 9.
4. Regional mining profile

Mining in South Australia

Mining has played a key part in the development of South Australia from its foundation, providing not only an economic mainstay but encouraging waves of immigration and exploration. Australia’s first metal mine was established at Glen Osmond in 1841, and before 1850, virtually all of Australia’s metal mines were located in South Australia which, for a period, produced about 10 per cent of global copper supply. Many South Australian firms supplied mining machinery to other Australian colonies, and the economic benefits derived from mining made finance available for further mining developments around Australia.

The copper and gold rushes of the 1850s and 1860s, and the subsequent development of South Australia’s mining industry through the early 20th century fostered the development of infrastructure across the State, facilitating the exploration and settlement of the more remote areas of the State. Numerous towns were founded along or near the infrastructure corridors established to service the State’s burgeoning minerals exports. Through the 20th century, the impact of mining on the state economy was overtaken by agricultural exports but, with the development of the Olympic Dam mine in the 1980s and a steady increase in minerals exploration through the 1990s, the importance of the minerals sector in South Australia began to rise once more.

The PACE (Plan for Accelerating Exploration) funding initiative was established by the South Australian Government in 2004 to promote minerals exploration in the state. PACE seeks to provide a robust, transparent and timely process to streamline the mining assessment and approval processes that are critical in determining the overall economic, environmental and social impact of a project.\(^3\)

Initially a five year program, PACE is now funded through to 2014 with total funds in excess of $40 million. Due to the increased exploration over the last decade facilitated by the PACE program, and encouraged by increasing commodity prices, hundreds of new deposits have been identified and several new mines are now operating. From four operating mines in 2000, South Australia currently has 20 approved mines, and over 130 developing projects and prospects. In the 2012 financial year, South Australia’s minerals exports exceeded $4 billion per year, more than one third of total State exports.

With this existing and potential activity evident from the number of significant mining projects currently in advanced development, the expansion of South Australia’s mining sector over the coming decades will place additional demand on existing infrastructure networks, support services and systems. Development of the State’s power, water and transport infrastructure is critical in order to capitalise on the State’s mineral prospects. The expansion of this infrastructure will drive the growth of mineral production and exports, while also delivering broad infrastructure benefits to regional communities that would otherwise be difficult to provide.

\(^3\) DMITRE website http://www.pir.sa.gov.au/minerals/initiatives/pace2020/pacemining
Mining in the Far North region

The Far North region is the largest and least populated area of South Australia, but has experienced a long and diverse history of mining operations, such as the Tarcoola goldfield, copper mines throughout the Flinders Ranges, opals at Coober Pedy and Andamooka, and coal at Leigh Creek.

Most of South Australia’s major mines are located in the Far North, including Olympic Dam and Prominent Hill (copper, gold, silver, uranium), Beverly (uranium), Cairn Hill and Peculiar Knob (iron), Leigh Creek (coal), Beltana (zinc) and Challenger (gold). This mining activity is a key component of the economy of the Far North region, with 28 per cent of employment directly related to the sector.

Of the 21 major mines operating in South Australia, seven are located in the Far North. A summary of the mining pipeline for the region is presented overleaf.
In total, there are 26 mining sites recognised by the Department for Manufacturing, Innovation, Trade, Resources and Energy (DMITRE) across the Far North region that have been considered as part of the RMIP project.

The analysis undertaken in the RMIP project has been limited to the mines recognised by DMITRE, however the prioritised projects identified as part of this project are likely to be able to support the development of other projects as they commence. The rationale for the selection of mining projects to be assessed as part of this project is presented in Appendix C.

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4 Note that while Wilcherry Hill is classified as a major mine it is not yet operational.
5 Although the Gawler Iron Project is located in the boundaries of the Eyre and Western region, it is included in considerations for the Far North due to its proximity to the Tarcoola cluster and likely similar infrastructure needs.
The Far North exhibits considerable diversity in its minerals prospects, with exploration and development projects targeting iron, copper, uranium, gold and silver. Areas around existing or historical mining areas, such as Olympic Dam, Tarcoola and Coober Pedy, have undergone considerable exploration in the past decade, and have resulted in the identification of some significant deposits. In addition, the emerging provinces of the Musgrave Ranges and the Woomera Prohibited Area, which has been recently opened up to additional exploration, have added to the geographic spread and diversity of exploration targets in this region.

Current production levels from the major mines in the region are modest, varying between 1,000 tonnes per annum of uranium oxide at Beverly through to 3.6 million tonnes per annum of iron ore from Peculiar Knob. Excluding Olympic Dam, the major mines in the region have a remaining expected resource life of between five and ten years. It should be noted the economic contribution of mining is a function of production volumes and price paid for the commodity (i.e. uranium is produced in relatively low volumes, but has a relatively high price per tonne).

The RMIP project has not included assessment of the numerous prospects currently under development in the far north west of the South Australia, or interstate projects in associated geological provinces (such as the proposed Wingellina nickel mine in Western Australia) that would envisage using South Australian transport networks. Due to the preliminary nature of most of these prospects, any data pertaining to future infrastructure demands is not sufficiently accurate to provide any additional benefit to the estimates developed for this report. In addition, it appears at this stage that the associated target commodities (e.g. uranium, silver, nickel, copper and platinum group metals) would not provide sufficient additional demand to significantly affect any of the estimates.

As exploration continues in this region and information becomes more accurate and readily available, additional assessments of the infrastructure required to service this region may be able to be undertaken. It should be noted that many of these projects are located within Indigenous Protected Areas or areas under the administration of Aboriginal Lands Trusts. Access and activities within these areas are strictly regulated and require specific access approvals, and future mining operations would require consideration of and cooperation with the requirements of the residents and management bodies in these areas.
### Table 4.2: Indicative annual production values for the major operating mines in the region (2012-13)

<table>
<thead>
<tr>
<th>Mine</th>
<th>Proponent</th>
<th>Mineral</th>
<th>Annual Production volume</th>
<th>Mine/ resource life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southern Iron (Peculiar Knob)</td>
<td>Arrium</td>
<td>Iron DSO</td>
<td>3.6 mtpa</td>
<td>8</td>
</tr>
<tr>
<td>Cairn Hill</td>
<td>IMX Resources</td>
<td>Iron-Copper</td>
<td>1.8 mtpa</td>
<td>3</td>
</tr>
<tr>
<td>Olympic Dam</td>
<td>BHP Billiton</td>
<td>Refined copper</td>
<td>0.20 mtpa, 80,000 ounces</td>
<td>50+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gold</td>
<td>80,000 ounces</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Silver</td>
<td>800,000 ounces</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Uranium</td>
<td>4,500 tonnes</td>
<td></td>
</tr>
<tr>
<td>Prominent Hill (Malu and Ankata)</td>
<td>OZ Minerals</td>
<td>Copper concentrate</td>
<td>0.10 mtpa, 160,000 ounces</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gold concentrate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Challenger</td>
<td>Kingsgate</td>
<td>Gold</td>
<td>90,000 ounces</td>
<td>5</td>
</tr>
<tr>
<td>Beverly (including Beverly North)</td>
<td>Heathgate Resources</td>
<td>Uranium oxide (ISL)</td>
<td>1,000 tonnes</td>
<td>5+</td>
</tr>
</tbody>
</table>

1 - 3.3 mtpa from Peculiar Knob with the balance from blending low grade Middleback ore
2 – includes output from phase 2

### Iron Projects

The defining characteristic of iron ore mining is whether the target ore body is haematite or magnetite; these two types of iron oxide deposits have vastly different mineral characteristics which in turn have considerable impacts on the commercial considerations of mining.

#### Haematite

Haematite comprises the majority of Australia’s iron ore projects, including those in the Pilbara region of Western Australia. Haematite deposits are usually found with other iron minerals such as goethite and limonite, and contain high levels of iron (usually around 60 per cent).

The higher proportion of iron in haematite deposits means mine production can be shipped to steelworks with little or no processing at the mine site. This practice of shipping ore in the state in which it is extracted is referred to as a direct shipping ore (DSO) operation.

The lack of processing required for DSO haematite operations means there is a significantly lower need for processing equipment at the mine site than for magnetite mines. Less capital equipment results in a lower capital cost of developing mines and lower operating cost as there is not as large a draw on power.

The relatively low capital and operating cost of haematite mines means they can be commercially viable at significantly lower production levels (as low as 1-2 mtpa) than magnetite mines.

#### Magnetite

Magnetite is a magnetic iron oxide, often found in association with haematite deposits. Magnetite deposits have a lower iron content when mined (usually 25 per cent to 40 per cent) when compared to haematite, which means these deposits have lower overall yields.

The lower iron content found in magnetite deposits means the extracted ore needs to undergo more complex processing at the mine site to produce a magnetite concentrate. This beneficiation requires capital intensive
processing equipment such as grinding mills, crushing plants and magnetic separators, which significantly increases the capital and operating cost of magnetite mines. The greater fixed and operating cost of magnetite means they must ship ore in larger volumes (around 5 mtpa) to be commercially viable.

However, magnetite mines typically ship concentrate at 68 per cent to 70 per cent iron content. This higher quality product attracts a premium price from steel making customers, which can potentially offset the greater costs associated with processing.

**Iron deposits in the Far North region**

The geographic distribution of iron ore deposits in the Far North region is presented in the figure below.

**Figure 4.2: Map of the iron ore mining activity in the Far North region**

There are currently three operating iron ore operations in the Far North region: Southern Iron (Peculiar Knob), the Middleback Ranges and Cairn Hill. Southern Iron (Peculiar Knob) is a DSO haematite operation producing approximately 3.6 mtpa. The Middleback Ranges DSO operation has a nominal production rate of 9.2 mtpa from the Iron Chieftain, Iron Duke and Iron Duchess deposits; as Arrium Mining currently ships product from these mines via Whyalla, the Middleback Ranges project has been included in the Eyre and Western region for the purposes of its infrastructure needs. Cairn Hill is a magnetite operation shipping approximately 1.7 mtpa of mixed magnetite/copper ore. Cairn Hill is commercially viable as a magnetite operation at these relatively low levels of production because the copper content of the concentrate commands a higher price than typical magnetite concentrates.
In addition to the three operating mines in the Far North region, there are a further seven prospective iron ore mines at varying stages of development that have been assessed as part of the RMIP project, as shown in the table overleaf.

**Table 4.3: Iron ore activity in the Far North region**

<table>
<thead>
<tr>
<th>Mine</th>
<th>Operator</th>
<th>DMITRE status</th>
<th>Mine Stage</th>
<th>Target Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southern Iron (Peculiar Knob)</td>
<td>Arrium Mining</td>
<td>Major mine</td>
<td>Operating</td>
<td>Iron</td>
</tr>
<tr>
<td>Cairn Hill (includes phase 2)</td>
<td>IMX Resources</td>
<td>Major mine</td>
<td>Operating</td>
<td>Iron, Cu</td>
</tr>
<tr>
<td>Wilcherry Hill</td>
<td>IronClad Mining</td>
<td>Major mine</td>
<td>PEPR* Dec 2012, Construction 2013</td>
<td>Iron</td>
</tr>
<tr>
<td>Southern Iron (Hawks Nest)</td>
<td>Arrium Mining</td>
<td>Developing project</td>
<td>Exploration</td>
<td>Iron</td>
</tr>
<tr>
<td>Giffen Well</td>
<td>WGP Resources</td>
<td>Developing project</td>
<td>Pre FS 2012</td>
<td>Iron</td>
</tr>
<tr>
<td>Mt Woods (Snaefell)</td>
<td>IMX Resources</td>
<td>Developing project</td>
<td>Scoping study 2013</td>
<td>Iron</td>
</tr>
<tr>
<td>Commonwealth Hill (Sequoia)</td>
<td>Apollo Minerals</td>
<td>Prospect</td>
<td>Scoping study 2012</td>
<td>Iron</td>
</tr>
<tr>
<td>Tarcoola Iron (includes Hicks Hill and Coolybring)</td>
<td>Stellar Resources</td>
<td>Prospect</td>
<td>Exploration</td>
<td>Iron</td>
</tr>
<tr>
<td>Hercules</td>
<td>IronClad Mining</td>
<td>Prospect</td>
<td>PEPR* Dec 2012, Construction 2013</td>
<td>Iron</td>
</tr>
<tr>
<td>Gawler Iron Project</td>
<td>Iron Road</td>
<td>Prospect</td>
<td>Exploration</td>
<td>Iron</td>
</tr>
</tbody>
</table>

* PEPR – Program for environment protection and rehabilitation

Within close proximity to the Sequoia, Giffen Well and Coolybring sites in the north east of the Eyre and Western region is the Gawler Iron Project (including the Mt Christie and Boomer deposits). Due to this proximity, consideration will be given to how regional path to market solutions can also accommodate the infrastructure demands for these prospects.

**Copper Projects**

Many of the known South Australian copper deposits occur near the margins of the Gawler Craton, including several significant copper prospects within the Far North region.

The copper produced in South Australia is shipped either as a concentrate or as refined copper metal. The processing of copper has a significant power and water requirement per tonne, particularly the production of refined copper.

Copper deposits are often found in association with commercial reserves of iron ore, gold and uranium. Often the more valuable metals are obtained as by-products of iron ore processing.
Copper deposits in the Far North region

The geographic distribution of copper deposits in the Far North region is presented in the figure below.

Figure 4.3: Map of the copper mining activity in the Far North region

There are currently three mines producing copper in the Far North region: Olympic Dam, Prominent Hill and Cairn Hill.

Olympic Dam is a unique ore body, both in size and quality. Copper extracted at Olympic Dam is processed and smelted to produce refined copper metal for shipping. Olympic Dam ships approximately 200 ktpa of refined copper annually.

Prominent Hill produces approximately 100 ktpa of copper concentrate from the Malu (open pit) and Ankata (underground) operations. The Cairn Hill magnetite deposit has a relatively high proportion of copper in the iron ore shipped, and produces 1.8mtpa of copper and magnetite DSO product.

In addition to the three operating mines, there is one copper prospect in the Far North region that has been assessed as part of the RMIP project. Details of the Far North copper deposits assessed are provided below.
Table 4.4: Copper activity in the Far North region

<table>
<thead>
<tr>
<th>Mine</th>
<th>Operator</th>
<th>DMITRE status</th>
<th>Mine Stage</th>
<th>Target Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cairn Hill (includes phase 2)</td>
<td>IMX Resources</td>
<td>Major mine</td>
<td>Operational</td>
<td>Iron, Cu</td>
</tr>
<tr>
<td>Carrapateena</td>
<td>OZ Minerals</td>
<td>Developing project</td>
<td>Pre-feasibility study completed</td>
<td>Cu, Au, Ag, U</td>
</tr>
<tr>
<td>Olympic Dam</td>
<td>BHP Billiton</td>
<td>Major mine</td>
<td>Operational</td>
<td>Cu, U, Au</td>
</tr>
<tr>
<td>Prominent Hill (Malu open cut + Ankata underground)</td>
<td>OZ Minerals</td>
<td>Major mine</td>
<td>Operational</td>
<td>Cu, Au, U</td>
</tr>
<tr>
<td>Vulcan</td>
<td>Tasman Resources</td>
<td>Prospect</td>
<td>Prospect</td>
<td>U, Cu, Au, Mo, REE</td>
</tr>
</tbody>
</table>

Uranium Projects

Uranium mines typically undertake a significant amount of beneficiation at the mine site to produce uranium oxide concentrate that is suitable for shipping. Although the volumes of concentrate produced are generally not large in comparison to bulk minerals such as iron ore, the processing requirements mean uranium mines have a relatively high power and water requirement per tonne of final product shipped.

Uranium deposits in South Australia are generally either hosted in breccia or sandstone geology.

Breccia hosted uranium

Breccia hosted uranium mines require the breccia in which the uranium is contained to be extracted by either open cut or underground mining for processing. The hardness of breccia means it is technically challenging to extract the material as well as costly to crush sufficiently to enable further processing. Breccia hosted uranium deposits must normally be close to the surface if they are to be commercially viable.

Breccia hosted uranium is processed to derive uranium oxide above ground, with significant water and power requirements. In addition, considerable safety measures are required due to its radioactivity.

Sandstone hosted uranium

Due to the porous nature of the surrounding rock, sandstone hosted uranium can be extracted using the-in-situ recovery (ISR) process. This process involves circulating local groundwater and chemical solutions through a network of wells through the host rock, which dissolves the uranium. The solution is then pumped to the surface and processed to produce uranium oxide concentrate suitable for shipping.

Because the ISR process is largely undertaken underground, this removes the need for much of the capital expenditure associated with traditional open cut or underground mining operations, such as crushing plants and smelters. Therefore, sandstone hosted uranium deposits require less power and water for extraction and processing than breccia hosted uranium, and produce fewer tailings.
Uranium deposits in the Far North region

The geographic distribution of uranium deposits in the Far North region is presented in the figure below.

Figure 4.4: Map of uranium mining activity in the Far North region

There are currently two operating uranium mines in the Far North region: Olympic Dam and Beverley.

Although primarily a copper mine, Olympic Dam also produces approximately 4,500 tonnes of uranium oxide concentrate annually from breccia hosted deposits.

Beverly produces approximately 1,000 tonnes per annum of uranium oxide using an ISR processes.

Along with these existing operations, the RMIP project has assessed a further eight uranium deposits in the Far North region, as summarised in the table overleaf.
Table 4.5: Uranium activity in the Far North region

<table>
<thead>
<tr>
<th>Mine</th>
<th>Operator</th>
<th>DMITRE status</th>
<th>Mine Stage</th>
<th>Target Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acropolis</td>
<td>BHP Billiton Ltd</td>
<td>Prospect</td>
<td>Exploration</td>
<td>U</td>
</tr>
<tr>
<td>Aphrodite</td>
<td>BHP Billiton Ltd</td>
<td>Prospect</td>
<td>Exploration</td>
<td>U</td>
</tr>
<tr>
<td>Beverly</td>
<td>Heathgate Resources</td>
<td>Major mine</td>
<td>Operational</td>
<td>U</td>
</tr>
<tr>
<td>Big Lake 20 &amp; 28</td>
<td>Focus Minerals Ltd</td>
<td>Prospect</td>
<td>Exploration</td>
<td>U</td>
</tr>
<tr>
<td>Blanchewater</td>
<td>Cauldron Energy Ltd</td>
<td>Prospect</td>
<td>Exploration</td>
<td>U</td>
</tr>
<tr>
<td>Carrapateena</td>
<td>OZ Minerals</td>
<td>Developing project</td>
<td>Pre-feasibility study completed</td>
<td>Cu, Au, Ag, U</td>
</tr>
<tr>
<td>Mount Distance</td>
<td>Regalpoint Resources</td>
<td>Prospect</td>
<td>Exploration</td>
<td>U</td>
</tr>
<tr>
<td>Olympic Dam</td>
<td>BHP Billiton</td>
<td>Major mine</td>
<td>Operational</td>
<td>Cu, U, Au</td>
</tr>
<tr>
<td>Victory (Edward Creek)</td>
<td>Reedy Lagoon Corp Ltd</td>
<td>Prospect</td>
<td>Exploration</td>
<td>U, REE</td>
</tr>
<tr>
<td>Vulcan</td>
<td>Tasman Resources</td>
<td>Prospect</td>
<td>Exploration</td>
<td>U, Cu, Au</td>
</tr>
</tbody>
</table>

Other projects (gold, silver, lead, zinc, molybdenum and rare earths)

In addition to the minerals discussed above, the Far North region includes several operating mines and prospects that target other commodities, including gold, silver and other metals.

Gold

As discussed above, gold is often found in association with copper and also with uranium and iron ore. There are two operating mines producing gold in the Far North; Challenger, which produces 90,000 ounces of gold per year and Olympic Dam, which produces 80,000 ounces annually. The major gold prospect assessed is the Tunkillia prospect.

Silver and Zinc

Silver, zinc and lead are often found in association in the same orebody. The Olympic Dam mine produces around 800,000 ounces of silver each year.

Major silver prospects assessed as part of this project include the Paris deposit in the Gawler Ranges and the Tunkillia deposit south of Tarcoola. The Beltana prospect (also known as Flinders-Reliance) located south of the Leigh Creek coal mine is targeting additional zinc and lead deposits associated with the existing Beltana zinc mine.

Rare earths

Rare Earth Elements (REEs) are usually found in association with uranium or heavy mineral sands deposits. REEs including lanthanum, scandium and cerium, are found in the Olympic Dam deposit, but are not present in commercial quantities so are not recovered.

The Victory prospect in the Far North targets REEs in addition to the major commodities of uranium and copper.
A summary of the gold, silver, zinc and rare earth minerals in the Far North region is provided in the table below.

**Table 4.6: Other mineral activity in the Far North region**

<table>
<thead>
<tr>
<th>Mine</th>
<th>Operator</th>
<th>DMITRE status</th>
<th>Mine Stage</th>
<th>Target Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Olympic Dam</td>
<td>BHP Billiton</td>
<td>Major mine</td>
<td>Operational</td>
<td>Cu, U, Au</td>
</tr>
<tr>
<td>Prominent Hill (Malu open cut + Ankata UG)</td>
<td>OZ Minerals</td>
<td>Major mine</td>
<td>Operational</td>
<td>Cu, Au, U</td>
</tr>
<tr>
<td>Challenger</td>
<td>Kingsgate</td>
<td>Major mine</td>
<td>Operational</td>
<td>Au</td>
</tr>
<tr>
<td>Carrapateena</td>
<td>OZ Minerals</td>
<td>Developing project</td>
<td>Pre-feasibility study completed</td>
<td>Cu, Au, Ag, U</td>
</tr>
<tr>
<td>Paris</td>
<td>Investigator</td>
<td>Developing project</td>
<td>Exploration</td>
<td>Ag</td>
</tr>
<tr>
<td>Tunkillia</td>
<td>Mungana</td>
<td>Developing project</td>
<td>Scoping study</td>
<td>Au, Ag</td>
</tr>
<tr>
<td>Beltana (exploration of Reliance and other satellite deposits)</td>
<td>Perilya</td>
<td>Prospect</td>
<td>Exploration</td>
<td>Zn</td>
</tr>
<tr>
<td>Victory (Edward Creek)</td>
<td>Reedy Lagoon Corp</td>
<td>Prospect</td>
<td>Exploration</td>
<td>U, REE</td>
</tr>
<tr>
<td>Vulcan</td>
<td>Tasman</td>
<td>Prospect</td>
<td>Exploration</td>
<td>Cu, Au, U</td>
</tr>
</tbody>
</table>
**Mining clusters**

To aid in the identification of concentrations of mining activity in South Australia and the associated requirement for supporting infrastructure, mineral deposits have been grouped into clusters of mines.

The intention of the development of clusters is to identify those operating and prospective mines which are likely to have similar infrastructure needs. Therefore, three factors determined whether or not mines would be clustered together:

- Common mineral being extracted (likely to reflect common freight need)
- Common extraction technique (likely to reflect common water and power needs)
- Geographic proximity (to reflect the location in which the infrastructure must be provided).

A key advantage of the development of clusters is the ability it provides to analyse infrastructure demand and facilitate solutions on an aggregated basis, as opposed to mine-by-mine solutions. Further, the consideration of clusters rather than individual mines means identified infrastructure demand, and thus the viability of solutions, is not reliant on circumstances impacting individual operations.

The mining clusters referred to for the remainder of this interim report are presented in the figure overleaf.
Figure 4.6: Mining clusters in the Far North region
5. Existing infrastructure profile

The number of mines operating in the Far North region has increased significantly over the last decade. Mineral exports from the region have largely been achieved utilising pre-existing infrastructure networks. This chapter reviews the nature and extent of infrastructure currently in place to support mining activity in the Far North region; specifically, its condition, capacity and capability to meet current infrastructure needs and any current infrastructure deficiencies that need to be addressed.

This chapter is divided into three sections:

- The first is a summary of the infrastructure solutions utilised by existing mines
- The second is an examination of the technical characteristics of infrastructure in the Far North region across the categories necessary to support current and future mining activity
- The third summarises the extent to which current infrastructure is supporting mining activity in the Far North region.

The information in this chapter is presented to give context and a point of comparison to the discussion of the expected future infrastructure needs of mining in the Far North region presented in chapter 6.
Current infrastructure approach of major miners in the region

A summary of the major mines’ current output and infrastructure tasks is provided in the table below.

Table 5.1: Major mine infrastructure needs

<table>
<thead>
<tr>
<th>Mine</th>
<th>Annual Production volume</th>
<th>Transport to market</th>
<th>Utilities</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southern Iron (Peculiar Knob)</td>
<td>3.6 mtpa</td>
<td>Road to Wirrida siding then rail to Whyalla</td>
<td>Mains power and desalinated ground water, no gas</td>
<td>n/a</td>
</tr>
<tr>
<td>Cairn Hill</td>
<td>1.8 mtpa</td>
<td>Road to Rankin Dam siding then rail to Port Adelaide</td>
<td>Mains power and desalinated ground water, no gas</td>
<td>n/a</td>
</tr>
<tr>
<td>Olympic Dam</td>
<td>0.20 mtpa</td>
<td>Road to Port Adelaide</td>
<td>Mains power and desalinated ground water, no gas</td>
<td>n/a</td>
</tr>
<tr>
<td>Prominent Hill (Malu and Ankata)</td>
<td>0.10 mtpa 160,000 ounces</td>
<td>Road to Wirrida siding then rail to Port Adelaide</td>
<td>Mains power and desalinated ground water, no gas</td>
<td>n/a</td>
</tr>
<tr>
<td>Challenger</td>
<td>90,000 ounces</td>
<td>Road to Port Adelaide</td>
<td>Onsite diesel power station, desalinated groundwater</td>
<td>n/a</td>
</tr>
<tr>
<td>Beverly (including Beverly North)</td>
<td>1,000 tonnes</td>
<td>Road to Port Adelaide</td>
<td>Power generated locally from mains gas, desalinated groundwater</td>
<td>Import of approx 5,000 tpa of consumables primary freight task</td>
</tr>
</tbody>
</table>

Source: SMEC

Existing infrastructure profile

Ports

The Far North has no established ports in the region to support mining activities. The closest facilities with the potential to support mining output from the region can be found at Whyalla, Port Bonython and Port Pirie.

While at present the majority of operators export their product to market via Port Adelaide, the majority of volume (dominated by Peculiar Knob) is shipped through Whyalla. Additionally, Darwin has been used from time to time by mines with access to the northern rail link. Table 5.1 overleaf provides an overview of the current bulk freight tasks for the major mines in the region.

Rail

The rail network in the Far North region is predominantly comprised of standard gauge line, with a short narrow gauge segment servicing the port at Whyalla from the west. As shown in the map overleaf, the Far North network is comprised of four parts:

1. A narrow gauge rail link between Iron Knob, Iron Duke (via Iron Baron) and Whyalla
2. A standard gauge rail link between Port Augusta and Whyalla and Port Augusta and Tarcoola
3. A standard gauge rail link between Tarcoola and the Northern Territory
4. A standard gauge rail link between Leigh Creek and Port Augusta
Further details for these lines are provided below.

2. Narrow gauge rail link between Iron Knob, Iron Duke (via Iron Baron) and Whyalla

The narrow gauge links between Iron Knob, Iron Baron and Whyalla are owned by Arrium and operated and maintained by Genesee Wyoming Australia (GWA).

A review of the link demonstrates no identified deficiencies with the condition of these lines, which are capable of operating at a 23 tonne axle load (currently being upgraded to 25 tonnes). The lines currently carry approximately 6mtpa, although the capacity is intended to increase to approximately 9.4mtpa in 2013. Arrium are currently building a balloon loop at Whyalla that will support both standard and narrow gauge rail traffic.

GWA advise that there is no available capacity for additional freight movements on these lines. Third party access to this track would have to be negotiated with Arrium.

3. Standard gauge rail link between Port Augusta and Whyalla and between Port Augusta and Tarcoola

The standard gauge rail links between Port Augusta and Whyalla and between Port Augusta and Tarcoola link to form part of the Defined Interstate Rail Freight Network (DIRN) and are owned and operated by the Australian Rail Track Corporation (ARTC). Tarcoola is located at the junction of the Tarcoola – Darwin railway and the Adelaide – Perth rail line.

The Port Augusta to Whyalla line is capable of carrying 1800m trains with 25 tonne axle loads at an operating speed of 80km/h. The Port Augusta to Tarcoola line is capable of carrying 1800m trains with 23 tonne axle loads at an operating speed of 80km/h. Train control is via a verbal train order system although ARTC is
proposing to roll-out a new ‘in-cab’ train control system in the next decade which will improve safety and operational efficiency on the line.

ARTC has advised there is currently no spare capacity on these sections of line. Work is planned by ARTC to add two additional passing loops between Port Augusta and Tarcoola to accommodate short term requirements, with a new signalling system to be installed along this section as well (both of which will improve capacity on the line).

4. Standard gauge rail link between Tarcoola and Northern Territory

The standard gauge rail link between Tarcoola and Northern Territory is part of the DIRN and is owned by the Australasia Railway Corporation and operated by GWA. This line operates at 23 tonne axle load at 80km/h, and there are no significant speed restrictions operating.

GWA advise that this section of line currently operates ‘near full capacity’.

5. Standard gauge rail link between Leigh Creek and Port Augusta

The standard gauge rail link between Leigh Creek and Port Augusta is owned by the South Australian Government and operated by Alinta Energy. The line carries 23 tonne axle loads at 70km/h and currently moves approximately 2.5mtpa of coal. This line does have additional freight carrying capacity although some upgrade/modifications may be required depending on the level of additional traffic proposed.

Road

Roads through this region that support mining activity are a combination of National Highway (Eyre Highway and Stuart Highway), State arterial roads and local roads. Typical existing traffic volumes (V) and the percentage of freight vehicles (F) on these roads are shown on the diagram overleaf.
Figure 5.2: Overview of the existing road network in the Far North region

The Stuart Highway is in fair condition and has recently benefited from shoulder sealing works between Port Augusta and Pimba to provide 3.5m lanes and 1.5m shoulders. North of Pimba, shoulder widths are reduced to 0.5m.

The only sealed arterial roads in the region are the Stuart Highway to Roxby Downs road, the Roxby Downs to Andamooka road and the Port Augusta to Leigh Creek roads. All are in fair condition, however would benefit from shoulder widening and sealing if significant additional loads were to be accommodated.

There are approximately 10,000km of unsealed road in the Far North (from the far west of the State into Eyre and Western region) that are situated in unincorporated areas. Almost all unsealed roads in the Far North would require pavement upgrade, shoulder widening and sealing if significant additional loads were to be accommodated. It should be noted, however, that sealing may not be the most cost effective option for moderate load increases, as the maintenance costs of sealed roads may be higher than unsealed roads, particularly in areas prone to flooding. The approach for each road would need to be considered on a case by case basis. Two roads identified by some community and industry groups for potential upgrade are Yorkey’s Crossing and the Strzelecki Track, however neither of these roads support mining projects in the scope of the RMIP.6

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6 It is noted both these roads support elements of the energy and resources sector outside the scope of the RMIP project
A number of roads, as detailed in the DPTI online RAVNet system, are currently gazetted for a range of Restricted Access Vehicles including:

- 53.5m road trains
- 32m and 36.5m road trains
- B-doubles
- Higher Mass Limit (HML) vehicles.

In addition, a number of roads are used for over-dimension and over-mass loads.

At present, the roads in the Far North region are considered to have adequate capacity to accommodate expected freight growth along these corridors; however, impacts on road safety and condition as a result of this increased activity will need to be considered on a case by case basis. Route assessments will need to be undertaken on roads expecting a material change in volumes or the type(s) of larger transport vehicles likely to be used, including consideration of impacts no:

- Pavement capacity
- Road geometry (including intersection layouts)
- Safety, including interfaces with other users (e.g. rail) and crash history
- Impact on structures (culverts, bridges)
- Community impact (e.g. if a road passes through a town)
- Service level impacts (e.g. opportunities to overtake)
- Road upgrade costs and responsibility
- Road maintenance costs and responsibility.

It is likely that as the volume of traffic increases on these roads, the inclusion of overtaking lanes over the short to medium term will provide both operational capacity and safety benefits, and likely negate the need for road duplication over this time period.

It should be noted ownership and responsibility for maintenance of national highways is with the Commonwealth Government, state roads with the South Australian Government, local roads with local councils and private parties in maintaining private roads.

**Electricity**

Electricity for the Far North region is provided from the South Australian electricity grid via transmission infrastructure provided by ElectraNet and BHP (to the Torrens West cluster).

The South Australian electricity grid receives power generated from coal fired power stations at Port Augusta (approximately 16 per cent), nine gas fired power stations (approximately 65 per cent) and a number of wind (17 per cent) and diesel (2 per cent) generation sites. In addition, the South Australian grid is connected to the National Electricity Market via two interconnector systems.
The peak demand for South Australia is at approximately 3,400MW, which occurs for approximately 80 to 100 hours per year. For over 90 per cent of the year, South Australia uses between 1,000 and 2,000 MW - a level which is well below the State’s peak demand.

The generation capability for South Australia, without reliance on the interconnectors, is approximately consistent with the current peak demand requirements.

For the Far North region of the State, transmission of electricity occurs via a 275kV network to Davenport and then via 132kV ElectraNet radial supplies to Woomera and Leigh Creek. A separate single circuit 275kV line between Davenport and Olympic Dam is owned by BHP, and a separate 132kV line between Pimba and Olympic Dam is also owned by BHP. A further 132kV line is owned by Oz Minerals and connects the Prominent Hill mine to Olympic Dam. A summary of the electricity network in the region is presented in the figure below.

Figure 5.3: Overview of the existing electricity network in the Far North region

ElectraNet have advised that their transmission network has some available capacity to Woomera (in the order of 30-40MW) but minimal available capacity to Leigh Creek. It is estimated that the BHP system is likely to have some available capacity, however there are some network security constraints (i.e. balancing of loads) which limit the ability to use this section of the transmission network to its full capability. The line to Prominent Hill has a total capacity of approximately 65MW and is typically used at about 35MW.

The existing transmission network has some capability (in the order of 30-50MW per line to the Woomera line and 10MW to the Leigh Creek line) to accept generation from the Far North region.
**Water**

South Australia uses just over 200GL of water per annum. This water comes from four key sources:

- Surface water - 46.6%
- River Murray - 45.6%
- Ground water - 6.0%
- Sea water - 1.8%

With the exception of the River Murray water main owned by the Department of Defence for Woomera, there is essentially no mains water network north of Port Augusta.

Water supply for towns such as Roxby Downs, Coober Pedy, Marla and Maree rely on desalinated groundwater or UV treated water.

**Gas**

South Australia’s gas is supplied from two sources;

1. The Moomba to Adelaide pipeline system (MAPS), which links to the South West Queensland Pipeline System. This system is owned by Epic Energy (which is owned by QIC Global Infrastructure) and has a transmission capacity of 253 Terra Joules (TJ) per day.

2. The South East Australia (SEAGAS) pipeline system which links to the Victorian gas fields. This system is owned by SEAGAS (which is 50 per cent owned by APA Group) and has a transmission capacity of 303TJ per day.

The MAPS pipeline is shown in the figure overleaf.\(^7\)

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\(^7\) The SEAGAS pipeline is not as it is not located within the study region.
Gas supply to South Australia is dependent on overall demands from the eastern states. At current demand rates it is forecast that the existing supply basins have capacity for a further 50 years.

The current usage of the MAPS and SEAGAS transmission systems is generally well below the systems peak capacity levels (although usage approaches capacity at times of peak demand), indicating that there is likely to be capacity for additional gas supply if required; this conclusion is consistent with feedback received during consultations suggesting that commitment to supply is much higher than ‘actual use’.

Gas supply to the Far North region is limited to a small number of direct connections to the Moomba-Adelaide pipeline for individual supplies (e.g. Beverley uranium mine). There is only limited capability to supply gas to most areas of the Far North region without requiring significant capital expenditure.

Assessment of existing infrastructure

Existing Far North freight, power and water infrastructure were assessed to ascertain their condition, capacity and capability to meet current mining demand. Current infrastructure demand refers to the aggregate requirements of the major mines. The scoring scale used for this assessment is outlined in the table overleaf.
Table 5.1: Infrastructure assessment scale

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
</table>
| ![Good Symbol](image) | Good | • Infrastructure presents a low risk to mining operations/performance  
• Infrastructure considered adequate to meet current requirements  
• No immediate action required |
| ![Moderate Symbol](image) | Moderate | • Infrastructure presents a moderate risk to mining operations/performance  
• Moderate risk that emerging issues will impact the ability of infrastructure to meet current requirements  
• Short to medium term action likely |
| ![Poor Symbol](image) | Poor | • Infrastructure presents a high risk to operations, threatening overall performance  
• Significant risk that infrastructure will be unable to meet current demand requirements  
• Immediate action required |
| ![Not Applicable Symbol](image) | Not Applicable | • No infrastructure required, alternative infrastructure solution(s) are sufficient at this time  
• No current mining demand in area requiring infrastructure  
• No immediate action required |

The results of this assessment are summarised in the table below. This assessment was guided by the infrastructure benchmarks attached at Appendix D that outline the expected capacity, condition and capability standard of the alternate infrastructure.

Existing Far North freight, power and water infrastructure were assessed to ascertain their condition, capacity and capability to meet current mining demand. These results are summarised in the table below.

Table 5.2: Assessment of existing infrastructure to meet current demand

<table>
<thead>
<tr>
<th>Mine Cluster</th>
<th>Ports</th>
<th>Rail</th>
<th>Roads</th>
<th>Power</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Condition</td>
<td>Capacity</td>
<td>Capability</td>
<td>Condition</td>
<td>Capacity</td>
</tr>
<tr>
<td>Frome North</td>
<td><img src="image" alt="Condition Symbol" /></td>
<td><img src="image" alt="Capacity Symbol" /></td>
<td><img src="image" alt="Capability Symbol" /></td>
<td><img src="image" alt="Condition Symbol" /></td>
<td><img src="image" alt="Capacity Symbol" /></td>
</tr>
<tr>
<td>Mount Christie</td>
<td><img src="image" alt="Condition Symbol" /></td>
<td><img src="image" alt="Capacity Symbol" /></td>
<td><img src="image" alt="Capability Symbol" /></td>
<td><img src="image" alt="Condition Symbol" /></td>
<td><img src="image" alt="Capacity Symbol" /></td>
</tr>
<tr>
<td>Mount Woods</td>
<td><img src="image" alt="Condition Symbol" /></td>
<td><img src="image" alt="Capacity Symbol" /></td>
<td><img src="image" alt="Capability Symbol" /></td>
<td><img src="image" alt="Condition Symbol" /></td>
<td><img src="image" alt="Capacity Symbol" /></td>
</tr>
<tr>
<td>South Gawler</td>
<td><img src="image" alt="Condition Symbol" /></td>
<td><img src="image" alt="Capacity Symbol" /></td>
<td><img src="image" alt="Capability Symbol" /></td>
<td><img src="image" alt="Condition Symbol" /></td>
<td><img src="image" alt="Capacity Symbol" /></td>
</tr>
<tr>
<td>Tarcoola</td>
<td><img src="image" alt="Condition Symbol" /></td>
<td><img src="image" alt="Capacity Symbol" /></td>
<td><img src="image" alt="Capability Symbol" /></td>
<td><img src="image" alt="Condition Symbol" /></td>
<td><img src="image" alt="Capacity Symbol" /></td>
</tr>
<tr>
<td>Torrens East</td>
<td><img src="image" alt="Condition Symbol" /></td>
<td><img src="image" alt="Capacity Symbol" /></td>
<td><img src="image" alt="Capability Symbol" /></td>
<td><img src="image" alt="Condition Symbol" /></td>
<td><img src="image" alt="Capacity Symbol" /></td>
</tr>
<tr>
<td>Torrens West</td>
<td><img src="image" alt="Condition Symbol" /></td>
<td><img src="image" alt="Capacity Symbol" /></td>
<td><img src="image" alt="Capability Symbol" /></td>
<td><img src="image" alt="Condition Symbol" /></td>
<td><img src="image" alt="Capacity Symbol" /></td>
</tr>
</tbody>
</table>

The assessment demonstrated that while some of the freight links were at or approaching capacity, the transport alternatives available coupled with the low output profile for the region placed the infrastructure in a good position to meet current mining demand.
The primary emerging freight issue for the region relates to roads. While the roads network in the Far North that services the mining sector is considered to have adequate capacity to meet the current freight task, the condition and capability of significant parts of the network are expected to require upgrades. This is firstly related to the age of the roads in the region and secondly their fitness for purpose. While the Stuart and Eyre highways have been developed to handle larger axle loads, most of the roads to the mine gates are not. Significant proportions of these roads are unsealed, have access constraints (both physical and regulatory) and will deteriorate at a much faster rate due to the current mine to market transport solutions that have been adopted.

The small production volumes (and the predominance of iron ore activities) in the region mines mean that current water and energy requirements are being adequately met by the existing infrastructure. Electricity to the region is provided from the South Australian electricity grid via transmission infrastructure provided by ElectraNet and BHP. At present, the network has available capacity to accommodate short term growth demands. Only two of the mines generate on-site power, with the remaining mines accessing this mains power. All the major mines in the region utilise treated ground water from various sources including the Great Artesian Basin, the Arckaringa Basin, the Eromanga Basin and local saline aquifers.
6. Future mining demand

Analysis presented in Chapter 5 demonstrates infrastructure in the Far North region is sufficient to support existing mining operations. This chapter presents forecasts of future mining activity, and resultant infrastructure demand, under high, medium and low global economic growth scenarios.

Chapter 7 presents our analysis of the extent to which the existing infrastructure examined in Chapter 5 is able to accommodate the future demands discussed in this chapter. Investigating ways to address the gap between the state of current infrastructure and demands of future mining is at the core of the RMIP project.

Future infrastructure needs will be driven by the mining production activity and freight and logistics task expected to take place in the region. Separate from the availability of infrastructure, the progression of mines from prospects to developments and developments to major mines will be based on the underlying profitability of each mine. Establishing an objective, transparent and robust forecast for this future mining activity is central to understanding what are and will be the pressing and emerging infrastructure needs for the region. This chapter presents the results of this mining demand forecast.

Demand modelling

A four step approach was undertaken to model the future mining demand for the Far North region. An overview of this approach is presented below. Data was collected on the nature and level of mining activity in the region during the preliminary stages of the project. Sources for this data included mining company annual reports, public statements by mining companies in relation to future mining plans, government databases and outputs from the previous RESIC survey. This material was augmented by private consultations with the leading mining companies, who assisted in validating and refining the information that had been collected.
This process underpinned the development of a mining project database which included the following detail:

**Table 6.1: Project mine data collected**

<table>
<thead>
<tr>
<th>Project</th>
<th>Resources</th>
<th>Demand estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Target metals</td>
<td>Base production rate</td>
</tr>
<tr>
<td>Phase</td>
<td>Total resource deposits</td>
<td>Export freight</td>
</tr>
<tr>
<td>DMITRE status</td>
<td>Grade of deposits</td>
<td>Import freight</td>
</tr>
<tr>
<td>Region</td>
<td>Beneficiation process</td>
<td>Peak power</td>
</tr>
<tr>
<td>Mine life</td>
<td>Main product</td>
<td>Electricity consumption</td>
</tr>
<tr>
<td>Estimated lead time</td>
<td>Ore mining Rate</td>
<td>Water consumption</td>
</tr>
<tr>
<td>Logistics path(s)</td>
<td>Concentrate grade</td>
<td>Potential gas use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Potable water requirement</td>
</tr>
</tbody>
</table>

This data was then further reviewed and refined through consultations with the Department of Manufacturing, Innovation, Trade, Resources and Energy and specialist mining consultants (AMEC).

In parallel to this exercise commodity price data was collected for iron ore, copper, uranium and gold along with cost data for the respective mine operations and freight and logistics tasks.

Commodity price forecasts were drawn from Consensus Economics’ quarterly energy and metals forecasts, published December 2012. Consensus Economics develops forecasts using predictions submitted by more than 30 commodity forecasters (of which Deloitte Access Economics is one), including private sector consultancies and leading investment and commercial banks. The median of these forecasts is taken to be the most likely international economic scenario and the highest and lowest forecast is the high and low growth scenarios respectively.\(^8\)

Using this data cost and revenue per tonne estimates have been calculated and the profitability of respective mines determined for high, medium and low global economic growth scenarios. Based on the mines profitability, a total resource output was determined and associated freight, power and water demand requirements forecast for the relevant mining clusters and region. The results of this analysis are presented in the tables overleaf.\(^9\)\(^10\)

Following consultations and a more detailed assessment of the potential infrastructure projects, operating costs for supporting infrastructure relevant to clusters of prospective mining projects have been refined. The impact on individual mine viability has been assessed and regional infrastructure demand cases restated through an iterative process to assess ideal regional common user infrastructure outcomes.

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\(^8\) Refer to Appendix E for further details on these commodity price forecasts.

\(^9\) Mine to gate and gate to port operating costs are still to be finalised for each project. For the purposes of this interim report conservative estimates have been used. The analysis presented will be refined as this updated cost data is available and reported in the final draft of the plan.

\(^10\) In assessing the path to market solutions for each region, we have included mining clusters from neighbouring regions where for some clusters appear multiple times (i.e. in more than one plan) and subsequently caution should be taken if aggregating the demand totals from the three plans.
Low case scenario

Demand and prices indicated under the low global growth scenario are unlikely to support significant investment in new mining projects in the Far North region. Production from existing lower cost iron ore developments would be expected to continue over the effective life of existing projects, but investment in new production would be unlikely due to prices and high operating costs reducing commercial viability of projects.

With uranium prices expected to remain relatively stagnant, new uranium production is expected to be limited to lower cost operations and extensions of existing developments. Copper prices are expected to see significant falls under the low global growth scenario. This would be expected to lead to reductions in production from existing operations and no new investment in production.

Reflecting the countercyclical nature of gold prices, the low global growth scenario is likely to provide continued upward price movement supporting existing production and new developments in the Far North.

Table 6.2: Low case forecast infrastructure demand

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Annual Mineral/Concentrate Production (Mt p.a.)</th>
<th>Bulk Freight Task (Mt p.a.)</th>
<th>Peak Power Demand (MW)</th>
<th>Energy Consumption (GWh p.a.)</th>
<th>Water Consumption (ML p.a.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frome North</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Mount Christie</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Mount Woods</td>
<td>5.44</td>
<td>3.26</td>
<td>0.07</td>
<td>1.60</td>
<td>3.59</td>
</tr>
<tr>
<td>South Gawler</td>
<td>6.00</td>
<td>6.00</td>
<td>6.00</td>
<td>6.60</td>
<td>6.60</td>
</tr>
<tr>
<td>Tarcoola</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Torrens East</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Torrens West</td>
<td>0.20</td>
<td>0.20</td>
<td>0.20</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Other</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Total</td>
<td>11.64</td>
<td>9.46</td>
<td>6.28</td>
<td>13.59</td>
<td>11.20</td>
</tr>
</tbody>
</table>

*Includes Challenger, Big Lake 20 and Big Lake 28*

**Production in Mount Woods considered commercially unviable due to prices and high path to market operating costs**

**South Gawler low scenario demand driven by Arrium existing Middlback Ranges operation**

**Low growth scenario expects uranium production through in-situ recovery**

**Relative high water and power needs due to Olympic Dam’s processing and value adding activities, including on-site smelting.**

**Water demand driven by magnetite and haematite production**
Medium case scenario

Demand and prices indicated under the medium global growth scenario are expected to result in moderate to low investment in new mining projects in the Far North region over the medium term. Growth is particularly dampened by the high mine to port freight costs faced by miners in the region; which erodes the viability of a number of projects progressing.

Iron ore prices are expected to moderate as additional global supply comes on-line and growth in demand eases. Production from existing iron ore developments would be expected to continue over the effective life of existing projects along with projects to extend mine life and investment in new lower cost operations.

Moderate growth in uranium prices are expected to support new uranium production in lower cost operations and extensions of existing developments. Copper prices are expected to fall in the longer term under the medium global scenario. Forecast prices are expected to support ongoing production from existing operations however investment is expected to be limited to extensions of existing operations. Moderating gold prices are expected to be sufficient to support existing production and some new developments in the Far North.

It is important to note that while production increases modestly under the medium growth scenario from the low growth scenario (in the order of 50 per cent in each time period), this is not representative of the significant proven deposits that exist throughout the Far North region. These deposits represent a significant demand for infrastructure which could rapidly be activated if higher prices were to occur and/or more efficient production techniques and mine to port freight solutions lead to these projects becoming commercially viable.

Table 6.3: Medium case forecast infrastructure demand

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Frome North</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.01</td>
<td>0.01</td>
<td>8.8</td>
</tr>
<tr>
<td>Mount Christie</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.5</td>
</tr>
<tr>
<td>Mount Woods</td>
<td>5.64</td>
<td>3.30</td>
<td>0.07</td>
<td>6.38</td>
<td>3.67</td>
<td>0.08</td>
</tr>
<tr>
<td>South Gawler</td>
<td>6.00</td>
<td>9.00</td>
<td>11.00</td>
<td>6.60</td>
<td>9.90</td>
<td>12.10</td>
</tr>
<tr>
<td>Tarcoola</td>
<td>0.00</td>
<td>0.32</td>
<td>0.22</td>
<td>0.00</td>
<td>0.35</td>
<td>0.40</td>
</tr>
<tr>
<td>Torrens East</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Torrens West</td>
<td>0.20</td>
<td>0.32</td>
<td>0.35</td>
<td>1.00</td>
<td>1.24</td>
<td>1.30</td>
</tr>
<tr>
<td>Other</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Total</td>
<td>11.84</td>
<td>12.94</td>
<td>11.64</td>
<td>13.99</td>
<td>15.17</td>
<td>13.90</td>
</tr>
</tbody>
</table>

Additional iron ore production drives some increased freight volumes compared to low growth scenario

Future mining demand

Tarcoola production expected to be driven by relative small-scale magnetite mining

South Gawler production expected to grow in this scenario as additional iron ore mines are viable

Water and power needs expected to peak in first period in this scenario due to declining gold production

This is the driver of water need, in accordance with increased production
High case scenario

Demand and prices indicated under the high global growth scenario are expected to result in significant investment in new mining projects in the Far North region in the medium and longer term.

Iron ore prices are expected to return to historic highs supporting significant developments in new haematite and magnetite operations in the Far North. Growth in uranium prices is expected to support new uranium production and extensions of existing developments. Copper prices are expected to return to historic highs supporting the expected development of new mining operations in the Torrens East and Torrens West clusters. Moderating gold prices are expected to be sufficient to support existing production and some new developments in the Far North.

Table 6.4: High case forecast infrastructure demand

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Annual Mineral/ Concentrate Production (Mt p.a.)</th>
<th>Bulk Freight Task (Mt p.a.)</th>
<th>Peak Power Demand (MW)</th>
<th>Energy Consumption (GWh p.a.)</th>
<th>Water Consumption (ML p.a.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frome North</td>
<td>0.00 0.00 0.00 0.01 0.01 0.02 6.0 8.8 11.4 167 243 316 150 219 285</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mount Christie</td>
<td>0.00 0.00 0.00 0.00 0.00 0.00 0.0 0.5 1.2 0 13 33 0 12 30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mount Woods</td>
<td>8.02 12.22 9.35 9.00 13.48 10.29 326.5 478.5 464.4 380 475 434 9,704 12,404 11,149</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Gawler</td>
<td>8.34 10.65 11.00 9.17 11.80 12.20 66.4 76.0 59.8 89 224 301 5,181 8,416 9,927</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tarcoola</td>
<td>0.00 0.32 0.22 0.00 0.00 0.35 0.40 0.0 2.8 1.9 0 17 11 0 384 262</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Torrens East</td>
<td>0.01 0.04 0.04 0.02 0.08 0.08 6.0 30.0 30.0 48 238 238 241 1,204 1,204</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Torrens West</td>
<td>0.20 0.32 2.88 1.00 127.24 291.30 129.5 351.5 551.8 898 2,885 5,279 10,363 43,471 75,498</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>0.00 0.00 0.00 0.00 0.00 0.00 3.2 0.5 1.2 20 13 33 308 12 30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>16.57 23.55 23.50 19.20 152.97 314.29 537.6 948.5 1,121.7 1,601 4,109 6,646 25,947 66,122 98,385</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It is assumed the expansion of BHP Billiton’s Olympic Dam operation, as detailed in the environmental impact statement released in 2009, is viable in this scenario and commences in the second time period.
The table below presents a consolidated regional demand profile for bulk freight, power and water across the high, medium and low global growth scenarios.

Figure 6.2: Consolidated regional demand profile
Growth in mining activity which creates demand for infrastructure in the Far North region is focused at particular points in time. In the low growth scenario, mining activity remains relatively constant with existing haematite DSO and some magnetite operations continuing, without any significant additional investment to spur growth in production. In the medium and high growth scenarios, mining activity peaks in 2021. In all scenarios mining activity and resultant infrastructure demand declines to a plateau after it has reached the assumed peak. Critically important to the development of strategic infrastructure plans for the Far North as a region is that infrastructure projects are commenced with sufficient lead time to meet the peak of mining demand. Following the peak in mining infrastructure demand, the need for new investment in infrastructure is moderated and the concern turns to operating and maintaining the infrastructure which has already been put in place.
This chapter consolidates the analysis presented in chapters 5 and 6 to present an understanding of the extent to which existing infrastructure in the Far North region is able to meet the forecast needs of the mining industry. The difference between current infrastructure and future needs is the gap to be examined by the RMIP project.

**Adequacy of existing infrastructure in meeting future demands**

Infrastructure demand for this analysis is based on the medium global growth scenario, and is undertaken to identify the critical infrastructure deficiencies that are likely to hinder the development of South Australia’s mining sector in the region.

Analysis of the adequacy of current infrastructure in meeting forecast demand from mining is summarised in the tables overleaf, and is presented using the system of traffic lights and symbols depicted in the table below. Colours are used to indicate the rating of the ability of the infrastructure to meet the forecast demand over 0-5, 6-10 and 11-20 year time periods from 2013, while the symbols indicate how this adequacy changes between the periods.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
</table>
| 🟢     | Good   | • Infrastructure presents a low risk to mining operations/performance  
|        |        | • Infrastructure considered adequate to meet current requirements  
|        |        | • No immediate action required |
| 🟠     | Moderate | • Infrastructure presents a moderate risk to mining operations/performance  
|        |        | • Moderate risk that emerging issues will impact the ability of infrastructure to meet current requirements  
|        |        | • Short to medium term action likely |
| ⚫     | Poor   | • Infrastructure presents a high risk to operations, threatening overall performance  
|        |        | • Significant risk that infrastructure will be unable to meet current demand requirements  
|        |        | • Immediate action required |
| 🟪     | Not Applicable | • No infrastructure required, alternative infrastructure solution(s) are sufficient at this time  
|        |        | • No current mining demand in area requiring infrastructure  
|        |        | • No immediate action required |
| ↑      |        | • Adequacy of infrastructure to meet identified need improved compared to previous period |
The following tables summarise the assessment of the ability of existing infrastructure in meeting the forecast infrastructure demand from the mining industry. These assessments are presented for the 0-5, 6-10 and 11-20 year timeframes, beginning in 2013.

### Table 7.1: Assessment of existing infrastructure to meet 0-5 year demand

<table>
<thead>
<tr>
<th>Mine Cluster</th>
<th>Ports</th>
<th>Rail</th>
<th>Roads</th>
<th>Energy</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Condition</td>
<td>Capacity</td>
<td>Capability</td>
<td>Condition</td>
<td>Capacity</td>
</tr>
<tr>
<td>Frome North</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mount Christie</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mount Woods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Gawler</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tarcoola</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Torrens East</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Torrens West</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 7.2: Assessment of existing infrastructure to meet 6-10 year demand

<table>
<thead>
<tr>
<th>Mine Cluster</th>
<th>Ports</th>
<th>Rail</th>
<th>Roads</th>
<th>Energy</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Condition</td>
<td>Capacity</td>
<td>Capability</td>
<td>Condition</td>
<td>Capacity</td>
</tr>
<tr>
<td>Frome North</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mount Christie</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Mount Woods</td>
<td></td>
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<td></td>
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<tr>
<td>South Gawler</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Tarcoola</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Torrens East</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Torrens West</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Table 7.3: Assessment of existing infrastructure to meet 10 - 20 year demand**

<table>
<thead>
<tr>
<th>Mine Cluster</th>
<th>Ports</th>
<th>Rail</th>
<th>Roads</th>
<th>Energy</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Condition</td>
<td>Capacity</td>
<td>Capability</td>
<td>Condition</td>
<td>Capacity</td>
</tr>
<tr>
<td>Frome North</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Mount Christie</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Mount Woods</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>South Gawler</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tarcoola</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Torrens East</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Torrens West</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Future infrastructure demands**
Emerging infrastructure issues

The second half of this chapter distils identified infrastructure deficiencies to critical infrastructure issues which must be addressed to facilitate the development of the mining sector. Again, these issues are presented with reference to the time periods in which they manifest.

These key deficiencies in the current infrastructure which form impediments to the development of the mining sector are identified below.

**Issue A**

Lack of bulk commodity export port accessible by South Gawler and Mount Woods mines

The volumes of ore assumed to be produced by mines in the South Gawler and Mount Woods clusters will require transportation to markets by large bulk vessels to be commercially viable. This requires bulk commodities export facilities at which these vessels can be loaded.

It must be noted the critical export port needs for Mount Woods cluster mines is not expected to manifest until production increases considerably in the second time horizon of this study (2018-2022).

There are multiple bulk commodity export ports (noting Port Bonython exports gas only) on the eastern side of the Eyre Peninsula, however limitations in relation to the size of vessels which can be loaded at these ports limit their capability to service future mining demand.

Currently operating South Gawler and Mount Woods mines export via transhipment operations at Whyalla and specialised rail containers at Port Adelaide. These are higher operating cost export solutions than loading through a bulk commodities export port.

Existing approaches and infrastructure for bulk commodity export are unlikely to be suitable to meet the demands of future projects in the South Gawler and Mount Woods clusters.

**Issue B**

Inadequate mine to port bulk transport links connecting Mount Woods mines

The ability of miners to safely and efficiently transport bulk commodities to ports for export is critical to miners’ ability to reach their markets.

The existing standard gauge rail network in South Australia is well located to form the majority of a transport link to port for Mount Woods cluster mines. Augmentation of this rail network may be needed to connect to suitable bulk commodity export facilities. Capacity constraints on this network limit its ability to meet the potential future freight demand of Mount Woods cluster mines.

Road freight is unlikely to provide a commercially viable bulk commodity freight transport solution given the distance between the Mount Woods cluster and likely port options.
Issue C
No existing electricity transmission links to South Gawler mines

Mining activity requires considerable electricity for extraction and processing activities. Much of the infrastructure which may be necessary to support mining activities, such as ports and desalination plants, also have significant electricity demands.

Existing electricity transmission infrastructure on the Eyre Peninsula is near capacity under existing loads and is close to the end of its economically useful life. Upgrades to the existing electricity infrastructure have been identified which would extend its economically useful life and provide some additional capacity, however this would not meet the significant demands of mining and associated infrastructure.

Many of the major mining projects in this cluster involve the mining and processing of magnetite ores, which is particularly electricity intensive. Provision of suitable access to electricity will be critical to the development of these large scale mining projects.

Issue D
No identified suitable source of water for South Gawler mines

Mining projects have a range of water needs including dust suppression, processing, slurry operation and potable supplies.

Parts of the Eyre Peninsula are connected to the SA Water supply network via the Mannum-Whyalla pipeline. The capacity of the existing pipeline is expected to be insufficient to meet the needs of existing users of the reticulated supply networks on the Eyre Peninsula in the medium-term. Desalination has been proposed to supplement existing SA Water potable supply; however, the scale of proposed infrastructure would be insufficient to meet mining demand.

There is also groundwater extraction in the region for human and agricultural use. There is insufficient information in relation to the groundwater resources in the top section of the Eyre Peninsula to accurately assess the adequacy of these sources in meeting mining demand and the impact this would have on the environment and existing extractors.

Issue E
Lack of adequate electricity transmission to north western Far North mines (Tarcoola and Mount Woods)

The electricity needs of mining are discussed in Issue C.

Existing electricity supply in the Far North region is limited to localised generation and BHP Billiton’s privately owned transmission lines that service Olympic Dam and some surrounding mining operations.
OZ Minerals’ Prominent Hill operation sources power through the privately owned transmission line. However, this does not have sufficient capacity to meet the expected future demands of surrounding magnetite projects. As noted above, suitable access to electricity is critical to the development of magnetite projects.

**Issue F**

**Lack of adequate water supply to the Far North region under significant additional demand**

The water needs for mining are discussed in issue D.

At present, existing mining operations have been able to develop individual solutions to meet their demand for water using a range of on-site processes. Importantly, these all draw on sources of groundwater within the region. Given demand from existing mining operations and communities, it is likely existing identified groundwater sources are being used at or near their sustainable yields.

Under the medium growth scenario, demand is expected to increase from 24,425ML p.a. in the 2013-2017 period to 32,154ML in the 2023-2032 period; this is unlikely to represent a significant constraint on the estimated mining demand. If, however, the high growth scenario eventuates, demand for water is estimated to reach 75,762 in the 2018-2022 period, and 110,536ML in the 2023-2032 period.

If this demand is to be accommodated, significant additional supply will need to be secured for the Far North region.

**Alignment of emerging infrastructure issues**

The five emerging infrastructure issues identified here constitute the five issues to be addressed by the prioritised projects identified by the RMIP project; they are at the core of the discussions of the potential and prioritised infrastructure projects in chapters 8 and 10.

The table overleaf summarises these key emerging issues as impediments to the development of the mining industry in the Far North region.
### Table 7.4: Key emerging mining infrastructure issues for the Far North region (2013 – 2032)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Lack of bulk commodity export port accessible by South Gawler cluster mines</td>
<td>Lack of bulk commodity export port accessible by South Gawler and Mount Woods cluster mines</td>
<td>Lack of bulk commodity export port accessible by South Gawler and Mount Woods cluster mines</td>
</tr>
<tr>
<td>B</td>
<td>Inadequate mine to port bulk transport links connecting Mount Woods cluster</td>
<td>Inadequate mine to port bulk transport links connecting Mount Woods cluster</td>
<td>Inadequate mine to port bulk transport links connecting Mount Woods cluster</td>
</tr>
<tr>
<td>C</td>
<td>No existing electricity transmission links to South Gawler mines</td>
<td>No existing electricity transmission links to South Gawler mines</td>
<td>No existing electricity transmission links to South Gawler mines</td>
</tr>
<tr>
<td>D</td>
<td>No identified suitable source of water for South Gawler mines</td>
<td>No identified suitable source of water for South Gawler mines</td>
<td>No identified suitable source of water for South Gawler mines</td>
</tr>
<tr>
<td>E</td>
<td>Lack of adequate electricity transmission to north western Far North mines (Tarcoola and Mount Woods)</td>
<td>Lack of adequate electricity transmission to north western Far North mines (Tarcoola and Mount Woods)</td>
<td>Lack of adequate electricity transmission to north western Far North mines (Tarcoola and Mount Woods)</td>
</tr>
<tr>
<td>F</td>
<td>Lack of adequate water supply under significant additional demand</td>
<td>Lack of adequate water supply under significant additional demand</td>
<td>Lack of adequate water supply under significant additional demand</td>
</tr>
</tbody>
</table>

Each of the identified issues are represented geographically in the map of the Far North region provided overleaf.
Figure 7.1: Map of key emerging infrastructure issues for the Far North region
8. Potential infrastructure solutions

This chapter presents the infrastructure projects and their associated groupings which have been identified as having the potential to address the issues detailed in Chapter 7. A summary of each of the projects is presented to provide an understanding of their underlying technical attributes.

Projects identified

Projects with the potential to address the issues discussed in Chapter 7 have been identified through consultation with infrastructure proponents, mining proponents and peak bodies.

The table below summarises all the projects which were identified and considered. Through the course of our investigations, it was established some of the identified projects would not be likely to meaningfully address issues identified in Chapter 7.

<table>
<thead>
<tr>
<th>Project</th>
<th>Issue addressed</th>
<th>Considered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Path to market</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yorkey’s Crossing</td>
<td>No – does not address identified mining issues</td>
<td></td>
</tr>
<tr>
<td>Strzelecki Track</td>
<td>No – does not address identified mining issues</td>
<td></td>
</tr>
<tr>
<td>Whyalla Port expansion</td>
<td>No – current expansion to 12mtpa is significant and effective use of this transhipment option for significant volumes beyond this is considered unlikely.</td>
<td></td>
</tr>
<tr>
<td>Lucky Bay</td>
<td>No – does not address regional mining issues; would be a low volume solution only.</td>
<td></td>
</tr>
<tr>
<td>Outer Harbour Port expansion</td>
<td>No – current mining export is approximately 1.8mtpa, with limited opportunity to increase this with existing infrastructure. Sufficient expansion to meet mining demand is not likely given port and ‘access to port’ constraints combined with competing priorities for port use.</td>
<td></td>
</tr>
<tr>
<td>Expanded use of Higher Mass Limit vehicles such as triple road trains</td>
<td>No – while this will assist some mining operations, including inbound freight, the magnitude of the benefits will not address the broader identified mining issues. Each potential change in road use needs individual assessment to determine the overall suitability of the proposal including associated road upgrade and/or maintenance requirements.</td>
<td></td>
</tr>
<tr>
<td>Specific road intersection upgrades</td>
<td>No – as above</td>
<td></td>
</tr>
<tr>
<td>Port Bonython</td>
<td>A and B</td>
<td>Yes – a “northern Eyre peninsula port”</td>
</tr>
<tr>
<td>Port Nonowie</td>
<td>A and B</td>
<td>Yes – a “northern Eyre peninsula port”</td>
</tr>
<tr>
<td>Rail connection via Whyalla to northern Eyre Peninsula port</td>
<td>A and B</td>
<td>Yes</td>
</tr>
<tr>
<td>Partial duplication and upgrade of rail from Wirrida to northern Eyre Peninsula port</td>
<td>A and B</td>
<td>Yes</td>
</tr>
<tr>
<td>Potential infrastructure solutions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Road upgrades from South Gawler to northern Eyre Peninsula port</strong></td>
<td>A and B</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Export through Port of Darwin</strong></td>
<td>A and B</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Rail upgrades, Tarcoola and Mount Woods clusters to Darwin</strong></td>
<td>A and B</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Energy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gas line to on-site generation at more than one site</strong></td>
<td>E</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Gas line to on-site generation from Whyalla branch line</strong></td>
<td>C</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>On-site diesel generation</strong></td>
<td>C and E</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Transmission link from Cultana</strong></td>
<td>C</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Transmission link from Davenport</strong></td>
<td>E</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>On-site LPG power generation to service individual sites</strong></td>
<td>C and E</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Renewable generation to support mining loads</strong></td>
<td>C and E</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Water</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Arckaringa coal mine</strong></td>
<td>No – mine in early feasibility stage. It is recognised however that this may present a future water supply option.</td>
<td></td>
</tr>
<tr>
<td><strong>Groundwater assessment of Far North region</strong></td>
<td>No – does not address identified issue</td>
<td></td>
</tr>
<tr>
<td><strong>On-site desalination groundwater for Torrens West</strong></td>
<td>No – does not address identified issue</td>
<td></td>
</tr>
<tr>
<td><strong>On-Coast desalination plant and transmission main to Mount Woods and Torrens West</strong></td>
<td>No – does not address identified issue</td>
<td></td>
</tr>
<tr>
<td><strong>On-site desalination plants with seawater transmission</strong></td>
<td>No – does not address identified issue</td>
<td></td>
</tr>
<tr>
<td><strong>Groundwater investigations</strong></td>
<td>D and F</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>On-site groundwater extraction and desalination plant(s)</strong></td>
<td>D and F</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>On-coast desalination plant and transmission main</strong></td>
<td>D and (potentially) F</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>On-site desalination plants with seawater transmission</strong></td>
<td>D and (potentially) F</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Reuse of water from dewatering operations</strong></td>
<td>D and (potentially) F</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Regional solutions

The figure below is provided to give an understanding of the geographic alignment of the identified infrastructure projects relative to sensitive environmental areas. More detailed summaries of the environmental assets and potential impacts in this region are provided in Appendix B and Chapter 9 respectively.
Path to market

Identified freight projects have been grouped into paths to market which integrate potential ports with land transport infrastructure able to deliver product to the port. It is necessary to group freight projects based around the port for export because of the dependency between the port and landside infrastructure.

The two paths to market which have been derived in response to issues identified in the Far North region are:

- PTM1: Northern Eyre Peninsula port with land transport links:
  - rail connection via Whyalla
  - partial duplication and upgrade of rail to Wirrida/Rankin Dam
  - road upgrades from South Gawler to port

- PTM2: Port of Darwin
  - upgrade rail capacity from Tarcoola and Mount Woods clusters to Darwin

PTM1: Northern Eyre port with transport links

*Project description:* A range of initiatives including rail connection to Whyalla, partial duplication and upgrade of rail to Wirrida/Rankin Dam, and road upgrades from the port to South Gawler.

*Issue addressed:*
A. Lack of bulk commodity export port accessible by South Gawler and Mount Woods cluster mines
B. Inadequate mine to port bulk transport links connecting Mount Woods cluster

*Capital cost:* Port; $750m - $1b

Potential infrastructure solutions
Potential infrastructure solutions

**Rail;** $500m  
**Road;** $120m

**Capacity:** 20 mtpa

**Scalability of capacity and planned upgrades:** Port and rail connection to existing freight corridor initially established for 20mtpa and expandable for in excess of 50mtpa. Rail upgrades of existing corridors can be done in stages as demand requires. Road upgrades can be done in stages as demand requires.

**Lead time to operation:** 4 years

**Clusters and industries serviced:**
- **Clusters:** Mount Woods, Tarcoola, Mount Christie, Braemar, South Gawler, Central Eyre
- **Supported industries:** Fuel, mining consumables, grain

Two port locations in this region have previously been identified by others;
- Port Bonython (adjacent to the existing Port Bonython jetty) has been identified due to its access to deep water and close proximity to road, rail and utility services. The Spencer Gulf Ports Link Consortium has undertaken feasibility assessments and is currently conducting an Environmental Impact Study for the site.
- Port Nonowie, south of Whyalla, has been identified by the Alternative Ports Working Party as an alternate option to Port Bonython. To the best of our knowledge the site does not currently have a commercial proponent willing to back a project at the site. Detailed feasibility assessments are still to be completed for the site, introducing an element of commercial and technical uncertainty to its consideration.

**Key technical and operational considerations for either site:**
- Proximity to deep water. This will impact capital cost
- How sheltered the deep water is, from both weather and tidal impacts. This will impact capital and operating costs
- Shipping channel depths and capacity. The shipping channel to a northern Eyre Peninsula port has high levels of available capacity. It is noted that there are limited sections where the channel depth is less than the desirable 20m, however this is not expected to be a significant constraint
- Proximity to road, rail and utility services – impacts capital cost
- Community impacts – during construction and operation
- Environmental impacts
- Geographic, hydrology and flooding – unknown levels
- Geotechnical conditions – existing terrain not investigated
- Rail corridor signalling system upgrade likely to be required to safely manage additional rail traffic volumes
- Much of the corridor has sufficient width for duplication but some land acquisition would be required where there is insufficient width or where corridor realignment is required
- Port Augusta triangle required (to enable trains to bypass Port Augusta going to/from Whyalla)
- Additional and busier level crossings (there are currently three excluding Port Augusta)

**General comments (irrespective of where a northern Eyre Peninsula port is located):**

**Advantages**
- Being centrally located, the port could support the Far North, Eyre and Western and Braemar regions of the State
- Good opportunity to connect to the main standard gauge freight rail network – maximises use of rail for freight
- Well positioned for road access from South Gawler cluster
- Well positioned for power and water connections to the port
- Rail upgrades may benefit broader rail users
- May be an efficient alternative port for grain export
- Port is well positioned for the import of mining consumables

**Disadvantages**
- A number of issues associated with increased rail use, particularly in relation to road crossings
- May not be the ‘most efficient’ option for Eyre and Western and Braemar regions.
- Large central port may require additional land transport
- High capital cost
PTM2: Darwin

Project description: Upgrade rail capacity to Darwin and Darwin port capacity

Issue addressed:
A. Lack of bulk commodity export port accessible by South Gawler and Mount Woods cluster mines
B. Inadequate mine to port bulk transport links connecting Mount Woods cluster

Capital cost: $100 - $700 million

Capacity: 2 - 10 mtpa

Scaleability of capacity and planned upgrades: Rail and port upgrades can be done in stages as demand requires. It is understood that the Port of Darwin current exports approx. 3.2mtpa. The port could accommodate approximately an extra 2.0mtpa without significant investment, however road and/or rail routes to port would require additional infrastructure. Beyond a total of approximately 5.0mtpa from Darwin, both port and transport route capacity upgrades would be required. Beyond a total of approximately 10.0mtpa, major infrastructure upgrades would be required, including a second dedicated berth at the Port, re-alignment of stockpile facilities and significant rail augmentation.

Lead time to operation: 2 – 4 years

Clusters and industries serviced:
Clusters - Mount Woods
Supported industries – general freight

Key technical construction and operational risks:
- Rail to Darwin is operating at close to full capacity now, with the section between Katherine and Darwin particularly constrained
- Corridor width and land acquisition
- Terrain and wet season impacts
- Storm events
- Impacts on road level crossings
- Impacts on existing signalling system
General comments:

Advantages
- Existing rail corridor simplifies achievement of additional capacity
- Minerals facility is separated from main built-up area

Disadvantages
- Long distance to Darwin results in high operating cost
- Limitations on Darwin Port capacity; limited storage capacity, multi user facility and high capital cost for any material increase in volumes
- Some structural concerns at wharf area may impact cost of expansion works
- Storm and terrain impacts
Energy

The seven energy projects have been derived in response to issues identified in the Far North are:

E1: Gas line to on-site generation at more than one site
E2: Gas line to on-site generation from Whyalla branch line
E3: On-site diesel generation
E4 Transmission link form Cultana
E5: Transmission link from Davenport
E6: On-site LPG power generation to service individual sites
E7: Renewable generation to support mining loads

E1: Gas line to on-site generation at more than one site

Project description: New gas line from Moomba / Adelaide pipeline to on-site generation and local transmission

Issue addressed:
E. Lack of adequate electricity transmission to north western Far North mines (Tarcoola and Mount Woods)

Capital cost: $300 million (gas line); $420 million for distributed power generation

Capacity: 36 TJ per day (for generation of 200 MW(e))

Scalability of capacity and planned upgrades: Power stations can be a staged development to increase capacity in line with demand growth. Modular gas engines (eg 5MW) can be used; this approach reduces design and maintenance costs. Capital cost of gas pipeline connection could be relatively high under a low demand scenario, compared to freighted fuel options. Availability of gas supply may be an issue under high demand scenario and may to require some augmentation of existing transmission network.

Lead time to operation: 2 years

Clusters and industries serviced:
Clusters - Mount Woods, Tarcoola, Torrens West, Torrens East

Supported industries - Potential for other community gas/power supply

Key technical construction and operational risks:
- Unknown topography/geology – may encounter rock etc.
- Path for easement/construction – land ownership, environmental aspects
- Actual pipeline route and site elevations will affect the design but conservative design assumed.

General comments:

Advantages:
- Flexibility and mobility of generation
- Miners build own and operate their own (modular generation plan)
- Reduced cost and impact of above ground power transmission
- Lower cost of generation for larger demands compared to diesel fuel or LPG
- Does not impact overall State generation requirements

Disadvantages:
- Capital cost
E2: Gas line to on-site generation from Whyalla branch line

Project description: Install new gas supply line connected to existing Moomba-Adelaide branch line to Whyalla to South Gawler region and establish local gas generation plant

Issues addressed:

C. No existing electricity transmission links to South Gawler mines

Capital cost: $30 million (gas line), $84 million for onsite power generation

Capacity: 8 TJ per day (for generation of 40MW)

Scalability of capacity and planned upgrades: Generation capacity can be increased in a modular way in line with demand, providing initial gas supply pipe is sized to enable this.

Lead time to operation: 2 years

Clusters and industries serviced:

Clusters - South Gawler

Supported industries – Potential for other community gas/power supply

Key technical construction and operational risks:

- Unknown topography/geology – may encounter rock etc.
- Availability of gas from the Whyalla branch line would need to be checked. 8TJ represents approximately 30 per cent of this line’s capacity
- Requires establishment of an easement – land owner interfaces, environmental considerations, construction disruption
- For power at more than one site a localised distribution system will be required, or additional generation facilities at additional cost

General comments:

Advantages

- Lower cost electricity for significant volumes on a long-term basis, than on-site diesel generation
- Underground pipeline has minimal ongoing community impact

Potential infrastructure solutions
Potential infrastructure solutions

Disadvantages

- Improved electricity and gas security to area
- Risk of gas supply availability and/or need to augment Whyalla branch line capacity
- Higher cost option than transmission connection to Cultana
- Temporary disruption during construction
E3: On-site diesel generation

Project description: Provision of on-site diesel storage to fuel on-site power generation at localised site/s

Issues addressed:

C. No existing electricity transmission links to South Gawler mines
E. Lack of adequate electricity transmission to north western Far North mines (Tarcoola and Mount Woods)

Capital cost: $1.0 million per MW

Capacity: 2 – 300 MW

Scalability of capacity and planned upgrades: High flexibility - Capacity can be added or removed in line with demand.

Lead time to operation: < 1 year

Clusters and industries serviced:
Clusters - All
Supported industries – Nil

Key technical construction and operational risks:
- High operating cost for large demand

General comments:

Advantages
- Solution already adopted at a number of existing mine sites – generally with relatively low power demand
- High flexibility to ramp up or down with demand
- Short lead time to operation
- Low capital cost for low demands

Disadvantages
- Cost of transporting diesel
- Impact on road network from additional heavy vehicles
- Impact of road closures due to wet weather
- Environmental impacts from diesel emissions
- Reliability of supply – backup generation may be appropriate in some circumstances
- High operating costs for larger demands
E4: Transmission link from Cultana

Project description: Installation of 275 / 132kV substation at Cultana and single circuit 132kV transmission line to South Gawler cluster

Issues addressed:
C. No existing electricity transmission links to South Gawler mines
E. Lack of adequate electricity transmission to north western Far North mines (Tarcoola and Mount Woods)

Capital cost: $50 million (transmission line); $15 million (substation)

Capacity: 200MW

Scalability of capacity and planned upgrades: The project does not lend itself to being staged as the 132kV line is required in the first stage of the project. Cannot be scaled up without effectively replacing the system.

Lead time to operation: 2 years (from the time a transmission agreement is signed)

Clusters and industries serviced:
Clusters - South Gawler

Supported industries – potential for other community power supply, may support renewable generation

Key technical construction and operational risks:
- Unknown topography/geology
- Requires establishment of easement
- Limited 275/132kV transformer capacity at Cultana may require additional substation works
- Limited 275KV capacity between Cultana and Davenport may necessitate a level of upstream augmentation

General comments:
Advantages
- Common approach to provision of electricity supply
- Potential for use by others in the region – strengthens electricity supply security
- Potential to support renewable generation in the region

Potential infrastructure solutions
Disadvantages

- Limited scalability options, therefore may be a high capital cost for initially low demand in order to protect higher use options later
E5: Transmission link from Davenport

Project description: Construction of a dual circuit 275kV line from Davenport to Mount Woods cluster

Issue addressed:
E. Lack of adequate electricity transmission to north western Far North mines (Tarcoola and Mount Woods)

Capital cost: $1.1b

Capacity: 1000MW

Scalability of capacity and planned upgrades: A single 275kV circuit could be provided initially at a lower capital cost but with reduced reliability. It is unlikely a 132kV option would be suitable.

Lead time to operation: 3 years (from the time a transmission agreement is signed)

Clusters and industries serviced:
Clusters - Mount Woods, Torrens West
Supported industries – Regional electricity security, renewable generation

Key technical construction and operational risks:
- Establishing easement corridor
- Capability of the broader upstream transmission network to support the project, particularly in the context of possible works for the Eyre and Western and Braemar regions. In conjunction with possible upgrades in other areas, there may be a need to strengthen the transmission network back to the main grid
- Capability of the ‘base load’ generation in the State. Again, in conjunction with possible upgrades in other areas there may be a need for additional base load generation to support the network as a whole. The location(s) of additional generation are also an important consideration
- Need to manage the maximum load the network can handle in a single ‘electrical trip’. This may limit supply capacity initially or may result in constraints on the networks export load through interconnectors

General comments:
Advantages
- High level of reliability – link to grid gives access to interconnector generation if required
- Link to grid enables renewable generation options
- Broader regional community benefits

*Disadvantages*
- High capital cost
- May require a level of augmentation of upstream transmission network
- May require additional network generation capability
- Long lead time to construct
E6: On-site LPG power station to service individual sites

Project description: Provision of on-site LPG storage to fuel on-site power generation at localised site/s

Issues addressed:
C. No existing electricity transmission links to South Gawler mines
E. Lack of adequate electricity transmission to north western Far North mines (Tarcoola and Mount Woods)

Capital cost: $2.1 million per MW
Capacity: 2 – 300 MW

Scalability of capacity and planned upgrades: Capacity can be added or removed in line with demand.

Lead time to operation: 1 year

Clusters and industries serviced:
Clusters - All
Supported industries - Nil

Key technical construction and operational risks:
- Freight task for LPG
- High operating cost for larger demands

General comments:
Advantages
- Short lead time to operation
- High flexibility

Disadvantages
- High operating cost for larger/longer term demands
- Reliability of supply may warrant backup system
E7: Renewable generation to support mining loads

Project description: Renewable generation plant/s as required to provide electrical supply to mining loads. For the Far North region generation is likely to be via solar, geothermal or hybrid solutions.

Issues addressed:

C. No existing electricity transmission links to South Gawler mines
E. Lack of adequate electricity transmission to north western Far North mines (Tarcoola and Mount Woods)

Capital cost: Solar; $3m - $4m/MW
Geothermal; $7 - $11m/MW

Capacity: As required

Scalability of capacity and planned upgrades: Plants can be established in a ‘modular’ approach as demand requires.

Lead time to operation: 1-3 years (for commercial technologies)

Clusters and industries serviced:
Clusters - All

Supported industries – Community if connected to transmission network grid, renewable energy sector

Key technical construction and operational risks:

- May be higher capital cost but lower operating cost (there is forecast downwards movement on renewable capital costs)
- Solar is an intermittent source and will require ‘backup’ supply. Backup supply could be via alternative on-site generation (such as diesel or gas generation), or via hybrid solutions (such as diesel/solar/batteries) or via connection to the grid transmission network
- Geothermal is a potential ‘base load’ supply
- New or establishing technology in some areas. Flat panel photo-voltaic is an established commercial technology. Geothermal is a developing technology
- Proximity of suitable generation location may still require transmission to power demand point/s

General comments:

Potential infrastructure solutions
### Advantages
- Aligns with South Australian Renewable Energy plan and South Australian Strategic Plan
- Does not necessarily rely on, or defers need for, network transmission upgrade
- Possible entitlement to ‘green energy funds’

### Disadvantages
- May be a higher up-front cost solution overall (depending on available options for funding support), particularly if two generation sources are required (i.e. backup supply) – although may be cost effective over a longer period of time due to low operating costs
- Proximity of available generation to demand – particularly for geothermal
- Land use planning approval requirements
- Possible requirements for land purchase if facilities not able to be located on mine site
- Limited broader community benefits unless integrated with the electricity grid
**Water**

The five water projects have been derived in response to issues identified in the Far North are:

W1: Groundwater investigations
W2: On-site groundwater extraction and desalination plant(s)
W3: On-coast desalination plant and transmission main
W4: On-site desalination plants with seawater transmission
W5: Reuse of water from dewatering operations

**W1: Groundwater investigation**

*Project description:* Undertake a high level overview analysis, building on existing knowledge bases, of the potential for further groundwater use in the Far North. Include consolidation of existing available data for easy and consistent access.

**Issue addressed:**

D. No identified suitable source of water for South Gawler mines

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**Diagram**

- **Legend:**
  - Iron
  - Uranium
  - Other
  - Copper
  - Gold
  - Silver
  - Zinc
  - Tin
  - Lead

- **Legend:**
  - GROUNDWATER ASSESSMENT

- **Mining Projects by Community:**
  - Copper
  - Iron

- **Clusters and industries serviced:**
  - Clusters - Mount Woods, Tarcoola, Torrens West, Torrens East
  - Supported industries – Agriculture, tourism, oil and gas, community

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**Capital cost:** $2 - $5 million

**Capacity:** N/A

**Scalability of capacity and planned upgrades:** N/A

**Lead time to operation:** N/A

**Clusters and industries serviced:**

**Supported industries** – Agriculture, tourism, oil and gas, community

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**Potential infrastructure solutions**
W1: Groundwater investigation

- Undertake in partnership with DEWNR and NRM to ensure appropriate processes are followed and outcomes are maximised.

General comments:

Advantages

- Improved early understanding of groundwater conditions will assist in early identification of environmentally sustainable solutions for planning and development
- May improve overall levels of confidence of the understanding of environmental impacts of proposals
- Consolidated database may assist mining, farming and other community water supply planning by minimising the extent of investigation works required to establish confidence (or otherwise) in the feasibility of a water supply option
- May assist Government approval processes where water supply proposals can be demonstrated to be consistent with improved knowledge of groundwater availability and conditions

Disadvantages

- Capital cost
W2: On-site groundwater extraction and desalination plant(s)

*Project description:* Separate on-site desalination at each project site.

**Issue addressed:**

D. No identified suitable source of water for South Gawler mines

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**Capital cost:** $25 million/GL

**Capacity:** Dependant on individual mine requirements

**Scalability of capacity and planned upgrades:** Desalination units can be modular and therefore are highly scalable.

**Lead time to operation:** 1 year

**Clusters and industries serviced:**

Clusters – All (subject to sustainable groundwater availability)

Supported industries - Nil

**Key technical construction and operational risks:**

- Extraction and desalination requirements will depend on groundwater quality and yield
- On-site power requirements – desalination is relatively energy intensive
- Environmental method of reusing/disposal of desalination process waste brine at mine sites
- Environmental compliance requirements – studies, approvals and well licensing

**General comments:**

- This approach is currently used for a number of existing Far North water supplies

**Advantages**

- Scalable modular plant tailored to each mine’s quality requirements over time
- Product water quality can be tailored to each specific mine’s needs

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Potential infrastructure solutions
### W2: On-site groundwater extraction and desalination plant(s)

**Advantages**
- Low start-up cost and timeframes
- Lower transmission pumping costs compared with long distance water supply options

**Disadvantages**
- Limited opportunities for broader community benefits
- Power demands at individual sites
Potential infrastructure solutions

W3: On-coast desalination plant and transmission main

**Project description:** Desalination plant at coast and transmission pipeline to provide water to potable quality.

**Issue addressed:**

D. No identified suitable source of water for South Gawler mines

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**Capital cost:** $1b

**Capacity:** 10GL/a

**Scalability of capacity and planned upgrades:** Limited scalability - initial intake/outlet sizing and transmission main should be sized for maximum forecast demand. Modular booster pumping can be incorporated.

**Lead time to operation:** 3 years

**Clusters and industries serviced:**

Clusters - Mount Woods, Torrens West

Supported industries – Agriculture, oil and gas, tourism, community

**Key technical construction and operational risks:**

- Environmental method of reusing/disposal of desalination process waste brine
- Transmission main route will require easement/construction disruption
- Power requirement for desalination plant and pumping (approximately 3-4 MW)
- May be able to be considered in conjunction with some expansion of SA Water mains supply for potable water

**General comments:**

- The desalination plant can be designed to desalinate seawater to different salinities to suit different end-uses. This option assumes desalination to the salinity level required for potable water but a re-mineralisation process is required to bring the mineral content of the desalination water to normal levels
- If desalination is undertaken to a lesser extent (e.g. suitable for mine processing, dust suppressant etc.), the ability to use this
W3: On-coast desalination plant and transmission main

- Water for other sectors and the broader community is reduced without further subsequent desalination

- The location of the desalination plant would require detailed assessment and would be based on assessment of economic factors, proximity to power and environmental considerations. There may be opportunities to include the pipeline in a shared infrastructure corridor. Options on the western side of Eyre Peninsula could be considered

Advantages

- Opportunities to supply other potential users from the transmission pipeline and increase water security for these users. Outlet points could be provided at minimal additional cost. Outlet points could also be used for firefighting

- Primary power demand is well positioned near available supply

Disadvantages

- A centralised desalination point cannot produce water of varying quality for different users

- High capital cost
Potential infrastructure solutions

W4: On-site desalination plants with seawater transmission

**Project description:** Seawater transported from the coast and desalinated as required at each site.

**Issue addressed:**

D. No identified suitable source of water for South Gawler mines

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**Capital cost:** $1.2b (allows for six individual desalination units)

**Capacity:** 13GL/a

**Scalability of capacity and planned upgrades:** Limited scalability for raw seawater pump and transmission main - initial intake/outlet sizing and transmission main should be sized for maximum forecast demand. Modular booster pumping arrangements can be incorporated. Individual desalination plants can be applied or removed as demand dictates.

**Lead time to operation:** 3 years

**Clusters and industries serviced:**

- Clusters - Mount Woods, Torrens West
- Supported industries - Agriculture, oil and gas, tourism, community

**Key technical construction and operational risks:**

- Management of pipeline durability from saline water
- Management of risks of brine spills or leaks during operation. May require detection system, ‘sleeving’ or regular detention ponds
- Treatment/reuse/disposal of waste brine at individual desalination sites
- Transmission main route will require easement/construction disruption
- Power requirement for desalination at individual sites
- May be able to be considered in conjunction with some expansion of SA Water mains supply for potable water

**General comments:**

Advantages
• Product water quality can be tailored to suit each individual user’s requirements. An individual user can use raw seawater or desalinated water for different purposes.
• Good flexibility for other users to use the pump and transmission pipeline system and apply their own desalination.

Disadvantages
• Management of the risk of seawater leaks
• Management/reuse/disposal of waste brine at individual sites
• Provision of power at remote sites for desalination
W5: Re-use of water from dewatering operations

Project description: Re-use of surplus water from sites where significant de-watering is undertaken as a part of mining or oil and gas extraction processes. Examples may be Moomba or Arckaringa.

Issue addressed:

D. No identified suitable source of water for South Gawler mines

Capital cost: $350,000/km for 6GL

Capacity: Varies

Scalability of capacity and planned upgrades: N/A

Lead time to operation: 2-3 years

Clusters and industries serviced:

Clusters - Mount Woods, Tarcoola, Torrens West, Torrens East

Supported industries – Oil and gas, community

Key technical construction and operational risks:

- Approach needs to be environmentally sustainable
- Need to provide certainty of supply to miners

General comments:

Advantages

- Makes efficient use of an otherwise unproductive source of extracted water
- Provision of water to multiple users could provide Capital cost saving to establish trunk line

Disadvantages

- Capital cost – pipelines (150+ km Arckaringa – Mt Woods cluster; 400+ km Moomba – Torrens clusters)
- Ensuring sufficient recharge or sufficiently minimising drawdown to achieve a sustainable outcome for groundwater dependent
W5: Re-use of water from dewatering operations

- Water quality may vary and may require treatment
- Consolidating a number of supply points at the water source may add to capital cost
- Issues associated with establishing easement/corridor
9. Regional sustainable development

In order to achieve the primary objective of the RMIP project – that is, to identify infrastructure solutions that maximise the net benefits to South Australia by improving connectivity from existing mines and reducing infrastructure-related risks for new mines – it is essential that the prioritised projects facilitate regional sustainable development. To achieve this regional sustainable development, prioritised infrastructure projects must be developed with consideration to the unique social and environmental features of the Far North region described in Chapter 3 and Appendix B respectively.

To ensure that the prioritised projects are capable of doing this, the RMIP project team has adopted a triple-bottom line approach in assessing the environmental, social and broader economic impacts of the infrastructure projects identified in Chapter 8. This has ensured that infrastructure projects have been prioritised (or not) on the basis of the full range of impacts that can be expected to result.

The specific methodology used to consider each type of impact has been adapted to suit the specific nature of that impact; however, all have been informed by the feedback received during public consultations on the interim reports.

Environmental impacts

In order to inform the prioritisation process described in Chapter 10, a high level review of the environmental impacts of the infrastructure projects has been undertaken. Rather than undertaking the detailed environmental impact assessment that would be required for the development of each infrastructure project, this review sought to outline the key potential environmental impacts posed by the infrastructure projects.

This high level review involved consultation with a range of conservation and environmental groups and working with technical experts to ensure potential environmental impacts were properly identified and considered. In undertaking this review, a range of factors were considered, with these summarised in the following sections. It should be noted that construction of all forms of infrastructure would be expected to have some degree of environmental impact. This review has not specifically identified particular environmental impacts arising from each individual proposed infrastructure projects at this point in time.

Assumptions

In undertaking this high level review, the following assumptions were made:

- All infrastructure projects would comply with existing legislation and obtain all relevant approvals under existing local, State and Commonwealth frameworks. In broad terms, these frameworks (at a Commonwealth and State level) include those established under the following pieces of legislation:
  - **Commonwealth**
    - Aboriginal and Torres Strait Islander Heritage Protection Act 1984
    - Australian Radiation Protection and Nuclear Safety Act 1998
    - Civil Aviation Act 1988
    - Customs Act 1901
Defence Act 1903 (for operations within the Woomera Prohibited Area and the Cultana Training Facility)

Environment Protection (Sea Dumping) Act 1981

Environmental Protections and Biodiversity Conservation Act 1999 (EPBC Act)

National Greenhouse and Energy Reporting Act 2007

Native Title Act 1993

Navigation Act 1912

Nuclear non-Proliferation Safeguards Act 1997

Work Health and Safety Act 2011

State

Aboriginal Heritage Act 1988 and Aboriginal Heritage Act 1979

Climate Change and Greenhouse Emissions Reduction Act 2007

Crown Lands Act 1929

Dangerous Substances Act 1979

Development Act 1993

Electricity Act 1996

Environment Protection Act 1993

Explosives Act 1936

Gas Act 1997

Harbors and Navigation Act 1993

Heritage Places Act 1993

Highways Act 1926

Local Government Act 1999

Marine Parks Act 2007

Mines and Works Inspection Act 1920

Mining Act 1971

Petroleum Act 2000

Petroleum Products Regulation Act 1995

Protection of Marine Waters (Prevention of Pollution from Ships) Act 1987

Public and Environmental Health Act 1987

Rail Safety Act 2007

Railways Act 1997

Road Traffic Act 1961

Roads Opening and Closing Act 1991

Work Health and Safety Act 2012

Vegetation clearance would be minimised wherever possible. This would include the clearance of roadside vegetation, which often comprises significant populations of remnant vegetation, as well as threatened species and ecological communities in some areas of South Australia where widespread clearing has taken place.

Detailed identification and assessment of Matters of National Environmental Significance (as defined by the EPBC Act) would be undertaken on a project-by-project basis.

Interruptions to existing land uses and existing access arrangements would be minimised wherever possible.

Any extraction and/or reinjection of groundwater would comply with the requirements of the existing system of water licensing and Water Allocation Plans for Prescribed Wells Areas (e.g. the Far North PWA) and, where relevant, the Murray-Darling Basin Plan.
**Principles**

In implementing the prioritisation framework to assess the infrastructure projects, a series of guiding principles have been used to inform the scoring of the projects against a number of strategic and deliverability criteria. These guiding principles were developed for each type of infrastructure project considered in the project, and summarised the potential impacts which may need to be considered by the infrastructure proponents in further approval processes.

These guiding principles are summarised below.

**Ports**

Numerous ports proposals are able to meet the needs of the growing mining and minerals processing industries in South Australia, including the construction of new ports and the expansion of existing facilities. The types of ports likely to be considered in the project include:

- **Direct loading ports:**
  - Product (e.g. ore or concentrate) is transported along a jetty to a bulk carrier moored in deep water at the end of the jetty
  - Containerised product is transported to a port where it is loaded directly onto bulk carriers at berth
- **Transhipment:**
  - Product is loaded into barges in shallow water ports and transported to an offshore transfer facility where the product is loaded onto a bulk carrier anchored in deep water
  - Product is slurried to an offshore vessel anchored in deep water, dewatered and transferred into a bulk carrier moored alongside.

Potential impacts associated with mineral export ports (and associated facilities) can include:

- Increased shipping traffic, dust generation from stockpiles (terrestrial impact) and ship loading (marine impact)
- Increased turbidity and sediment disturbance from dredging and propeller wash
- Impacts to existing land uses from establishment of stockpiles and associated landside facilities
- Soil erosion and subsequent sedimentation in coastal environments from construction of landside facilities
- Interruption to or restriction of existing land uses
- Impacts on visual amenity from the wharf, stockpiles, conveyors and other landside facilities
- Impacts on large marine fauna such as whales, dolphins and seals
- Impacts on coastal/shallow water species such as cuttlefish, fish and crustacean larvae that form important nursery and food populations for significant fisheries, and sedentary organisms such as coral, sponges and some shellfish
- Impacts on coastal vegetation such as mangroves, saltmarshes, estuaries and seagrass beds
- Disturbance of coastal acid sulphate soils during construction
- Impact on coastal processes such as interruption of longshore drift through construction of groynes, harbours and other structures
- Introduction of exotic marine species via discharge of ballast water or hulls of vessels
- Potential product loss (although the likelihood of this is generally perceived to be low).
Potential environmental benefits of establishing a high-volume port capable of servicing Capesize bulk carriers include:

- Consolidation of all environmental impacts to one location (including reduced emissions)
- Ability to service multiple industry sectors (e.g. agriculture) through the provision of a multi-commodity port could provide further consolidation of port infrastructure and associated environmental impacts
- Reduction of overall shipping traffic and transport emissions due to larger vessels with ability to ship greater volumes.

The establishment of ports and associated landside coastal developments will also need to consider the potential impacts of sea level rise.

**Rail**

Rail is often preferred over road transport for minerals export as rail can transport greater volumes with lower operating expense. The construction of new rail lines or upgrading of existing lines can pose potential environmental impacts such as:

- Vegetation clearance
- Impacts on terrestrial fauna from construction and operation of rail line
- Interruption of surface water drainage pathways which may affect the viability of remnant vegetation and fauna dependent on intermittent lakes and waterways
- Noise impacts to communities along the rail corridor
- Interruption to or restriction of existing land use or access arrangements
- Dust impacts along rail corridors.

Potential environmental benefits of providing additional rail infrastructure include:

- Transport by rail reduces the need for road traffic (providing road safety benefits and reduction in maintenance and upgrade requirements for existing roads)
- Lower transport emissions per tonne when compared to road transport
- Reduction of overall freight traffic due to higher volume parcels.

**Road**

The construction of new roads or upgrade of existing roads for the transport of mineral products is generally countenanced when production volumes are relatively low, short distances are involved or the capital expenditure required for the construction of new rail is seen to be prohibitive when considered in relation to factors such as production volumes, commodity value and anticipated mine life. Potential environmental impacts associated with road construction (new or upgraded) include:

- Vegetation clearance, including impacts on roadside vegetation during upgrades or widening of existing roadways
- Noise impacts to communities along the road corridor
- Interruption or restriction of existing land use or access arrangements
- Soil erosion during construction
• Traffic restrictions during construction
• Increased traffic volumes (particularly heavy vehicle movements) during operation.

### Slurry Pipelines

The construction of slurry pipelines can pose a number of potential environmental impacts, including:

- Vegetation clearance
- Interruption to or restriction of existing land use or access arrangements
- Impacts to terrestrial fauna from construction of trenches
- Impacts to marine or terrestrial environments if water is discharged after dewatering slurried product/slurry is released due to pipeline rupture
- Soil erosion during construction
- Power use (and emissions generation) required for pump stations along pipeline route.

Environmental benefits of slurry pipelines relative to other infrastructure solutions include:

- Impacts to visual amenity, land use and access can be minimised – due to undergrounding of pipelines, existing aesthetics can be maintained, and existing land uses and access would undergo temporary interruption during construction, with minimal permanent restrictions
- Vegetation clearance can be minimised as the pipelines would be able to avoid significant stands of remnant vegetation (including those in road reserves)
- Traffic impacts reduced in comparison to road and rail solutions, freeing up capacity on existing freight networks for other commodities/sectors
- Use of fossil fuels and associated emissions can be reduced in comparison to road and rail solutions – although pumping would entail further emissions through electricity use, the opportunity exists for this to be provided through renewable or energy sources with lower emissions than diesel fuel.

### Groundwater Extraction

The majority of mines in South Australia extract groundwater, either as part of a dewatering program, as a supply for mine processes and/or dust suppression, as part of their recovery process (e.g. ISR uranium mines), or for use as a potable supply. Potential impacts associated with the extraction of groundwater include:

- Impacts on groundwater dependent ecosystems, e.g. mound springs
- Questions around potential yield in various regions and sustainability of yield
- Slow recharge rate for many aquifers
- Aquifers may become more saline as water is extracted
- If desalination required (or saline water used in processing) there will be a need to dispose of high chloride waste (tailings/brine).

The relative benefits of using groundwater at mine sites include:

- Groundwater being drawn relatively close to mine sites and would require shorter pipelines (with lower associated vegetation clearance) and less energy for pump stations
- The demand on potable (mains) supplies or water from the River Murray is significantly reduced.
Coastal Desalination Plants

Desalination by reverse osmosis (RO) is generally viewed as the most efficient method of desalination in Australia (in terms of energy use, capital and operating cost, and water recovery) and, in general, RO desalination plants pose the same potential impacts to the environment, including:

- Pipelines will be required to transport the water from the coast to mine sites, which may require vegetation clearance and interruption or restriction of existing land uses or access arrangements.
- Considerable electricity usage (for both the RO process and pump stations) and associated emissions.
- Impacts from trenching of intake and outfall pipelines.
- Risk of seawater intake entraining biota such as planktonic larvae or other small, slow-swimming organisms.
- Ecological impacts from disposal of brine and pre-treatment chemicals (although, in some cases, brine can be pumped to mine site for disposal in tailings), including:
  - Increased local salinity.
  - Increased turbidity.
  - Ecotoxicological effects on local flora, including seagrasses and macroalgae.
  - Ecotoxicological effects on local fauna species (particularly sessile or sedentary organisms, or those with limited ranges or specific, localised habitats).

Relative benefits of coastal desalination plants include:

- Certainty of supply and water quality for mining operations.
- No demand on groundwater.
- No demand on existing potable supplies (reticulated mains water).
- No demand on water from the River Murray.
- Desalination plants also have the potential to contribute to local potable (town) water supplies, reducing reliance on groundwater systems and/or reticulated mains water.

Power Generation, Transmission and Distribution

On-site power generation (diesel or gas)

- On-site diesel generation results in higher greenhouse gas emissions (per kWh of electricity generated and per tonne of product) than central power generation, and also requires significant energy use in transporting fuel to site.
- Co-generation can utilise waste heat from processing operations (such as acid plants) to generate electricity in a co-generation power plant; and
- No need for long-distance electricity transmission lines and associated impacts, such as vegetation clearance and interruption or restriction of existing land uses or access arrangements.

Transmission of power from central generation

- Potential for vegetation clearance along transmission alignment and associated maintenance access track.
- Visual impact of transmission pylons.
- Opportunity to provide power to multiple users and excellent economies of scale.
- Requirement for significant cooling water supply.
- Production of waste products at generation site (e.g., ash, wastewater, sludge, residues); and
• Greater overall greenhouse emissions (depending on fuel source) but lower emissions per kWh of electricity generated than on-site generation, as emissions are centralised.

Renewable energy generation

• Potential for co-location with mines, other mining related infrastructure and/or other renewable generation facilities (e.g., wind/ solar/ geothermal);
• May not be in close proximity to existing transmission network;
• Generally not considered able to provide baseload power; however, it has been suggested that more renewables in the network means non-mining demand can potentially be diverted from traditional generation sources.

Considerations for individual projects

In addition to these general assumptions and principles applied in considering each infrastructure project considered as part of the RMIP process, a number of proposed projects have been identified as requiring particular attention; this has been the case where acute or frequent community concerns have been raised or where the project has been identified in consultations with a peak body as requiring specific attention.

The following is a summary of the considerations specifically relevant to proposed infrastructure projects in the Far North region.

Eyre Peninsula Ports

Port Bonython

The Port Bonython development proposed by Spencer Gulf port Link includes the construction of a common-user bulk iron ore storage and handling facility, a 17.5km rail spur connecting the site to the existing Whyalla to Port Augusta rail line, and a 3km long jetty12.

In addition to the summarised environmental impacts associated with ports listed previously, potential impacts specific to Port Bonython include:

• Vegetation clearance for rail corridor from main line to port site
• Impacts to visual amenity of isolated coastal environment
• Impacts to coastal homeowners (noise, dust, light from construction and operation of port, associated railway and landside facilities)
• Impacts to nursery (larval and juvenile) populations of marine species, including several significant fisheries species such as prawns and snapper
• Impacts to breeding aggregations of the Australian Giant Cuttlefish
• Impacts to commercial aquaculture developments in Fitzgerald Bay.

The Port Bonython project site is located within the Upper Spencer Gulf Marine Park. However, it should be noted that Marine Parks do not preclude industrial activities per se (except in specific areas such as Sanctuary Zones), but guide their development and operation. The proposed Port Bonython site is zoned Special Purpose Area (Harbour activities) within the Upper Spencer Gulf Marine Park. However, it is located

adjacent to the Cuttlefish Coast and Fairway Banks Sanctuary Zones of the Park which, respectively, provide
breeding habitat for the Australian Giant Cuttlefish, and significant offshore seagrass habitat.

Concerns have been raised regarding sediment disturbance and resultant increased turbidity caused by
dredging and limited keel clearance and propeller wash from loaded Capesize vessels being manoeuvred by
tugs at Port Bonython.

It is noted that an Environmental Impact Statement (EIS) is currently being prepared for this site; the
guidelines for this EIS specifically include requirements for consideration of impacts of dredging, blasting and
piling (if required), impacts on Australian Giant Cuttlefish, fishery species and migratory species, and
cumulative impacts of such developments as existing and approved petroleum facilities, the Whyalla port and
the approved BHP Billiton desalination plant at Point Lowly.  

Potential advantages of the Port Bonython site include:

- Land around the proposed port is zoned for industrial use, and is not in proximity to major population
centres;
- The project site is situated immediately adjacent to an existing industrial facility and existing port
(Santos petroleum facility) which could provide consolidation of environmental impacts;
- Opportunity to provide an export solution for a number of Eyre Peninsula and Far North mines.

Port Nonowie

The proposed Port Nonowie site is located south of the boundary of the Upper Spencer Gulf Marine Park,
near the Cowleds Landing Sanctuary Zone of the Park, which provides significant habitat for internationally
important migratory seabirds and feeding grounds for blue crabs. The proposed site for Port Nonowie is also
located north of the Munyaroo Conservation Park. Development of a port facility, links to existing power, rail
and road networks would need to consider potential impacts to these conservation assets.

Port Pirie and MyPonie Point ports

In assessing the various permutations of port options for servicing the Far North, the RMIP project has also
considered the use of a Port Pirie transhipment operation and a greenfield port in the northern Yorke
Peninsula south of Tickera (with MyPonie Point used as an example). While no direct environmental concerns
have been raised to date with regard to these two projects, detailed environmental impact assessments
would need to be undertaken for these projects in order to develop a fulsome understanding of the environmental
impacts of the development of either these port options. As with the Port Nonowie project, such detailed
assessments have not yet been undertaken.

Far North Transmission Upgrade

Options for the upgrade of electricity supply infrastructure to the Far North region could include:

- A new electricity transmission line from Davenport (Port Augusta) to Coober Pedy (approximately
500km) and surrounding mines via Olympic Dam and Prominent Hill
- An extension of the existing transmission line from Prominent Hill to Coober Pedy (approximately 120
km) and surrounding mines.

Environmental impacts and benefits associated with this project are considered to be generally similar to
those detailed previously for electricity transmission.

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13 DAC 2012, op cit.
Provision of Far North water supplies from mine dewatering or petroleum production water

The use of water from the dewatering of the proposed Arckaringa open cut coal project (Altona Energy) or from production water from oil and gas production in the Cooper and Eromanga Basins (e.g., Santos, Beach Petroleum, Senex Energy and other operators) has been proposed as a potential solution for the water needs of mining.

The Arckaringa project could yield up to 300 ML/d from the ongoing dewatering operations. Impacts and issues that have been identified include:

- Uncertainty regarding ongoing sustainability of yield in terms of quality and quantity
- Uncertainty regarding the likelihood of gaining approval for proposed groundwater management plan, including
  - extraction rates
  - impacts to local and regional aquifer pressure
  - possible managed aquifer recharge
  - disposal of water to surface watercourses if necessary
- Impacts from construction of pipeline/s (e.g., the distance between Arckaringa and Coober Pedy is approximately 85 km; additional pipelines would be required to deliver water to mines beyond Coober Pedy), requiring some vegetation clearance and land use and access impacts, as well as energy use and emissions for pump stations.

The use by miners of production water from the petroleum industry has associated issues and impacts including:

- Uncertainty about consistency of supply, as most producers are not required to monitor the amounts of water they yield from each production well
- Uncertainty with regard to water quality; given the wells are hydrocarbon production wells, the water would likely be contaminated and would likely require some level of treatment prior to use
- Impacts from construction of pipeline/s (for example, the distance between Moomba and Roxby Downs is approximately 450-500 km; additional pipelines would be required to deliver water to mines beyond Roxby Downs), requiring some vegetation clearance, land use and access impacts, as well as energy use and emissions for pump stations.

Social impacts

As briefly discussed in Chapter 2, infrastructure is a broad term which encapsulates more than just the physical infrastructure identified in the previous chapters; it also refers to the basic organisational structures required for business and community functions to operate. Ignoring the needs of workers, their families and existing communities will decrease the benefits that mining will deliver for South Australia, and also increase the risk that mining projects will not succeed. As raised by a range of stakeholders throughout the consultation process, the need to plan for social infrastructure is an important aspect of the RMIP project.

The figure below summarises the key types of social infrastructure that will need to be considered in order to provide for both the existing community as well as new people moving to the region.
There are a range of stakeholders beyond those currently living in the Far North region (or predicted to move into the region) that will need to be involved in the planning and provision of social infrastructure.

These stakeholders are outlined in the figure overleaf.

**Figure 9.2: Key social infrastructure stakeholders**

- Mining operators
- State Government and agencies
- Local Government
- Commercial and NFP operators
- Community

The social infrastructure needs of communities in the Far North region will depend heavily on the location of the mines in relation to existing population centres, the number of employees required at the mine and the employment model adopted at each individual mine (whether that be integrated housing in existing communities, fly-in-fly-out or new communities).

The proximity of a number the Far North projects relative to townships are depicted in the figure below.

**Mine locations compared to population centres**

**Figure 9.3: Locations of Far North mines in relation to population centres**
The Far North region is a huge geographical area with disparate population centres. The largest population centre in the region is Port Augusta which serves as a gateway to many of the outback communities across the north of South Australia.

For the North and East Outback ABS region there is a population of 28,222 spread over the wide area. The main population centres are in Port Augusta, Coober Pedy, Roxby Downs and Quorn – representing over 75 per cent of the population in the region.

The DPTI planning report ‘Far North Region Plan’ outlines the focuses of the significant population centres in the region:

- Coober Pedy, Leigh Creek, Port Augusta and Roxby Downs dominate the region in terms of population and commercial activities. These centres, together with Port Pirie, Broken Hill and Alice Springs, will continue to be the region's major service centres.
- Andamooka, Marla, Oodnadatta, Glendambo, Marree, Yunta and Innamincka are important towns, also providing accommodation, fuel and services to local communities and travellers.
- Local/small-scale commercial and retail activities will continue to be located in other towns to support local communities and tourists.

Source: Far North Region Plan, DPTI July 2010

The section below discusses the impact of mining activity on the social infrastructure of these alternate communities.

**Housing**

**Model of housing**

The impact of a mine upon the social infrastructure of a region is heavily influenced by the employment model that is used by the mining operation. Over the past 30 years, mines in Australia have increasingly utilised ‘Fly in Fly out’ (FIFO) or ‘Drive in drive out’ (DIDO) workforces. The reasons for the increase in the adoption of these models includes the remote locations of mines, the need to attract a workforce that would prefer to live in large cities, advances in technology and transport and differing costs of respective operating models.

In February 2013 the House of Representatives Standing Committee on Regional Australia tabled a report ‘Cancer of the bush or salvation for our cities? Fly in, fly out and drive-in, drive-out workforce practices in Regional Australia’. The report identified that many regional communities affected by FIFO or DIDO workforces have developed significant concerns regarding a lack of engagement between the workforce and the existing community and related concerns including economic impact, safety, drain on social services and the cost of housing.

The extent to which FIFO or DIDO is used as the model for the workforce in this region will have a significant impact on the planning for the social infrastructure.

For almost all of the proposed mines in this region, FIFO workforces are likely to be heavily relied upon due to the lack of a large local population base. While Roxby Downs, Coober Pedy, Port Augusta and Ceduna all are potential base population centres, it is likely a large proportion of the workforce will still be employed on a FIFO basis.
Housing supply

There are currently over 9,000 dwellings occupied in the region, with an additional 2,700 currently unoccupied. The large majority of dwellings are in the city of Port Augusta, as well as in the towns of Roxby Downs, Coober Pedy and Quorn.

Table 9.1: Dwellings in the Outback - North and East Statistical Area

<table>
<thead>
<tr>
<th>Dwellings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total occupied private dwellings</td>
</tr>
<tr>
<td>Unoccupied private dwellings</td>
</tr>
<tr>
<td>Source: ABS 2011 Census</td>
</tr>
</tbody>
</table>

Despite the number of unoccupied (presumably available) dwellings, the State Government has noted that the increased mining investment is leading to increased residential development in Port Augusta, Roxby Downs, Coober Pedy, Quorn and Andamooka. The Government has therefore recommended that new housing is developed in a planned way (such as structure planning in Port Augusta), that new areas are extensions and fit the character of the existing town and ensure strong linkages across the town and supports passenger movements. Developments outside of the existing population centres are discouraged except where they are self-sufficient in critical infrastructure needs (namely energy, water and wastewater). Importantly the State Government states that such infrastructure should be provided for and maintained by the developer.

Therefore, collaboration between State government, local government, mining proponents and property developers will be critical to identify the best locations for developments, land releases and associated infrastructure that will be essential to plan for housing across the region.

Community

Transport

As well as the bulk freight needs of mining operations discussed earlier in this report, there also needs to be planning for the transport needs of FIFO, DIDO and locally based workers, as well as community members affected by new mining operations.

Roads

For DIDO workers, transport will likely involve the same roads that will need to be upgraded or constructed to build and service the mine. Routes will be important to the regional centres of Port Augusta, Roxby Downs and Coober Pedy. Consideration will need to be given to road safety measures including road grading and overtaking lanes where regional population increases demand on local roads and highways.

15 Source: Far North Region Plan, DPTI April 2012
Airports

Figure 9.4: Airports in the Far North and Outback

Source: atlas.sa.gov.au

The location of airports will be particularly important for FIFO workers, as well as for growing regional communities, to be serviced from Adelaide and other cities. There are many airstrips across the Far North of South Australia, however the vast bulk of these would need upgrading in order to handle regular charter or commercial flights. There are airports with regular commercial flights at Port Augusta (Sharp), Coober Pedy (Rex), and Olympic Dam (Qantaslink). Alliance also operates flights to Coober Pedy, Prominent Hill and Olympic Dam. Other airports exist for particular mining operations such as at Prominent Hill and Moomba. There is also a significant airport at the Woomera RAAF base which is for military purposes. Mines at the northern end of the Eyre Peninsula are accessible such as Whyalla Airport which offers regular flights to Adelaide by Rex.

Given that most mines in the area will require FIFO workers to service them, the development of additional air strips to facilitate charter flights for FIFO workers will be essential.

Commerce

Commercial services are part of the mix of social infrastructure that needs to be in place to support existing and new communities. These services include retail, hospitality, professional services and entertainment. While commercial operators will, in many instances, be attracted to grow and establish services to meet the needs of a growing population, there are limiting factors and potential market failures that should be considered by mining operators and communities during planning stages:

- In a limited market with a large increase in demand fuelled by a highly paid workforce, there is the risk of increases in prices of goods and services that can cause problems for the existing population. This has affected some mining developments in other states. As such, it is important to ensure a sufficient supply of commercial services are available so that prices are not driven up (beyond those which can be accommodated by the local community) as a result of an influx of highly paid mining sector workers
• In very remote sites there will be a difficulty in attracting commercial services that will necessitate mining proponents to support the provision of essential goods and services. Without financial and/or logistical support to set up at remote mining facilities it would be uneconomic to do so in many cases.

Recreation

Figure 9.5: Recreation facility at Prominent Hill

Providing recreation services for new workers and larger regional communities is a critical part of attracting a highly skilled workforce and increasing social cohesion and security. In particular, sport is a critical part of the social fabric of regional communities. There are significant recreational and sporting facilities available in sections of the Far North, although there are no such facilities available to cater for a large population increase in remote mining centres. In centres such as Port Augusta and other towns, it will be important to ensure there is sufficient capacity to ensure that they can be properly utilised by the existing community harmoniously with the new employees. If planned properly these facilities should provide spaces where the existing and new residents are able to develop a community bond.

In addition there may be additional demand upon other recreation facilities such as libraries and community centres that will need to be part of planning between the local government and mining developer.

Where mines are built in particularly remote locations – as is likely to be the case for the majority of this region - it will be necessary for the mining proponent to provide sufficient sporting and recreation facilities for their employees. This will also be an important part of the attraction and retention of skilled employees at the mine. This is already the case with FIFO communities such as the Prominent Hill community or Roxby Downs servicing Olympic Dam.

Broadband

The National Broadband Network will be a key enabler of services for employees and communities in the region – helping to deliver services via the internet and videoconferencing, as well as allowing sophisticated communications for those employees who have travelled to work at mines.

Currently there is a mixture of internet utilisation across the region with two thirds of residents having an internet connection (the vast majority of which utilise a broadband connection).

For the very remote mining sites across the Far North, it will not be possible for the NBN to deliver fibre or fixed wireless connections. In these instances broadband will be accessible via the new satellite services that the NBN will deliver.
### Table 9.2: Dwellings in the Far North Statistical Area

<table>
<thead>
<tr>
<th></th>
<th>Dwellings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet connection</td>
<td>6,038 (64%)</td>
</tr>
<tr>
<td>- Subset of broadband connection</td>
<td>5,353 (57%)</td>
</tr>
<tr>
<td>No internet connection</td>
<td>2,950 (31%)</td>
</tr>
<tr>
<td>Internet connection not stated</td>
<td>411 (4%)</td>
</tr>
<tr>
<td>Total</td>
<td>9,399</td>
</tr>
</tbody>
</table>

#### Power, water, waste

While this report has considered the need for electricity and water supplies for mines, the same will also be true for regional communities as they grow. In most cases these communities will benefit from the provision of supplies to the mines themselves. The greatest risk to those supplies is if the infrastructure for the mine is not in place at the right time and then places pressure on the infrastructure supporting existing regional communities.

The disposal of community waste will need to be properly planned for as communities grow or new communities are developed. This includes the collection, landfill and recycling needs of residential and commercial properties. This will be a key responsibility of local governments but must be considered in conjunction with mining proponents in remote locations that are far away from existing infrastructure networks.
Health

Figure 9.6: Country hospitals in the Far North region

Existing health facilities

The largest hospital in the region is the Port Augusta hospital which offers a wide range of health services. It is also designated by Country Health SA as a Centre of Excellence in Aboriginal Health. The hospital designated as a General Hospital is at Whyalla which has recently received a significant upgrade.

Smaller hospitals operate in Coober Pedy, Roxby Downs, Woomera, Quorn, Hawker and Leigh Creek, with a number of other local health services and aboriginal health services operating across the region.

General Practitioners operating in this area are eligible for a range of Commonwealth Government incentives based on the SGC classification of the area in which they operate (as depicted in Figure 9.7). These incentives include relocation allowances, grants based on the length of time operating in the region, and HECS repayment assistance.

This region is also able to utilise Medicare payments for telehealth consultations with specialists.
SA Health planning

SA Health has developed a ‘Strategy for Planning Country Health Services in SA’ as an overall document to guide the approach to health planning in regional South Australia. One of the key principles of this document is planning for changing needs, including growth in communities associated with developments including mining.

The plan provides for growth of Country General Hospitals, including the Whyalla hospital, to accommodate the majority of health care needs, so that only patients with highly specialised or complex care need to travel to Adelaide. The plan for these hospitals includes staffing by salaried medical officers, capital upgrades which are underway, returning surgery that was once conducted in Adelaide to these country locations.

Hospitals and medical centres will need to consider the specific needs of mining workers as the industry starts to expand. This includes the need to manage industrial accidents. Mining companies will be responsible for providing occupational health and safety and preventative health for their workforce, particularly when dealing with industrial accidents and preventative health. This will be particularly important at very remote mining localities that will not be in easy reach of a medical centre or hospital.
Education

Schools

Table 9.3: Schools in the DECD Far North region

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aboriginal/Anangu Schools</td>
<td>11</td>
</tr>
<tr>
<td>Child Care Centres</td>
<td>5</td>
</tr>
<tr>
<td>Learning Together @ Home</td>
<td>1</td>
</tr>
<tr>
<td>Family Day Care Schemes</td>
<td>1</td>
</tr>
<tr>
<td>Integrated Centres</td>
<td>1</td>
</tr>
<tr>
<td>Occasional Care</td>
<td>3</td>
</tr>
<tr>
<td>Out of School Hours Care</td>
<td>4</td>
</tr>
<tr>
<td>Preschools</td>
<td>26</td>
</tr>
<tr>
<td>Primary Education</td>
<td>7</td>
</tr>
<tr>
<td>Primary/Secondary Combined</td>
<td>8</td>
</tr>
<tr>
<td>Rural Care Program</td>
<td>1</td>
</tr>
<tr>
<td>Secondary Education</td>
<td>1</td>
</tr>
<tr>
<td>Special Education</td>
<td>1</td>
</tr>
<tr>
<td>Support Services</td>
<td>4</td>
</tr>
</tbody>
</table>

Source: Department for Education and Child Development

There are a variety of public schools across the region – ranging from major regional centre schools in Port Augusta, to small area schools in remote areas. Some of these schools will have capacity to increase enrolments if there was sufficient demand, and if teaching resources were available. The demand for education services will come from those employees with families that are based in the region, rather than FIFO or DIDO employees. Demand will also come from those with families who move into the region to take up employment in industries supporting the mining industry. Given the remoteness of many of the mines in this region, it is unlikely that a significant migration of families will occur; however, this should be monitored to ensure adequate education services are available.

Child care

In addition to school education, families in the area will also need to utilise child care services. There are a range of child care types that are necessary – these include before/after school care, vacation care, occasional care and long day care. As a snapshot of current services there are two child care centres in Port Augusta, two in Roxby Downs and one in Coober Pedy. Funding for child care services is predominantly provided by the Commonwealth Government, while child care services providers are a mix of private and not-for-profit community providers. Where communities grow it will be necessary to ensure that the child care capacity keeps pace with demand.

Training

Table 9.4: Tertiary education institutions in the Far North region

<table>
<thead>
<tr>
<th>Location</th>
<th>Courses</th>
<th>Mining courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coober Pedy TAFE</td>
<td>7 courses</td>
<td>No</td>
</tr>
<tr>
<td>Port Augusta TAFE</td>
<td>73 courses</td>
<td>Yes</td>
</tr>
<tr>
<td>Roxby Downs TAFE</td>
<td>22 courses</td>
<td>Yes</td>
</tr>
<tr>
<td>Whyalla UniSA*</td>
<td>8 degrees</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Source: TAFE SA and UniSA (* = outside the Far North region)

According to the 2011 Census, there are 509 students in the region enrolled in full-time or part-time training at a technical or further educational institution and 304 students enrolled in a university or other tertiary
institution. The three main centres of further education in the region are at the Port Augusta TAFE and Roxby Downs TAFE. Both of these sites conduct training for skills necessary in the mining industry. As skills training would need to increase as mining operations expand, TAFE (in conjunction with the Department of Further Education, Employment, Science and Technology) could consider increasing the range and/or number of mining related courses at Port Augusta or Roxby Downs, including potentially remotely carrying out some focused training from the small satellite TAFE centres. The region is also serviced by the UniSA campus at Whyalla which provides training for the mining industry amongst its courses.

Safety

Police

There is a number of police stations across the region, with a main base at Port Augusta and stations in regional centres such as Roxby Downs, Leigh Creek, Coober Pedy and Marla. There are also smaller stations in other towns and the APY lands to the north west of the State. There is a Far North Local Service Area that covers the same area as this report.

To cater for an increase in population in the region, it will be necessary to plan for adequate resources across the region. As the population increases the level of policing should continue to be reviewed to ensure adequate resources are available as a key part of community safety for new or growing population centres.

Emergency services

Emergency services in the region include the Country Fire Service (CFS), State Emergency Service (SES) and Metropolitan Fire Service (MFS). The CFS and SES are volunteer organisations that operate throughout the region. The MFS has permanent paid staff at stations in Port Pirie, Peterborough, Wallaroo, Kadina and Kapunda. The Department of Environment, Water and Natural Resources also provides paid fire fighters in national parks and reserves.

As mining increases in the region, there should be effective communication between mine operators and emergency service providers regarding the risks of emergencies at mines and whether additional infrastructure or resources might be needed to mitigate the risks. However, as part of careful planning for each project, the mining proponent should allocate adequate funding to provide emergency services and infrastructure for its own needs to prevent the need to draw on resources which should be allocated to communities across the State.

Courts

At the centre of the justice system is the State and Federal courts system. There is a major country courts centre at Port Augusta that provides the ability for the Supreme Court, District Court, Magistrates Court, Youth Court and Federal Court to sit there. There is also a circuit court of the Magistrates Court that sits when required at Coober Pedy. The resourcing of all of these courts will need to be considered as the population grows and demand increases – and depending upon population increases in remote areas it may be necessary to consider further circuit courts over time.

Planning approach

As outlined in this section the social infrastructure needs across of the Far North region will differ significantly based on the location of the mine, employment to be generated, model of employment and housing, and existing infrastructure in the immediate area. Planning for the social infrastructure will ensure that the benefits to the community are maximised, the likelihood of the projects progressing and improve the attractiveness of the region for the highly skilled workforce required.
As has been evident from the House of Representatives Committee report, a lack of early, consultative planning can lead to community concerns and gaps in social infrastructure. Therefore as each project is planned across this region, it would be beneficial for all involved to have an inclusive process of information sharing, planning and consultation. This will need to happen region-by-region, and mine-by-mine, but with all levels of government to consider the overall demand and supply in the areas to deliver effective regional service planning.

To prepare for the process of consultations as mining developments progress, the South Australian Government might consider establishing a small, focused planning group involving key social infrastructure agencies. This group should then offer to meet privately with mining proponents to discuss their social infrastructure needs – initially in a non-committal information sharing dialogue. This will allow miners to describe their current planning and considerations without necessarily making pronouncements to the market – as well as feeding into those plans the best information available on what social infrastructure will be required. It will also allow the state government to have more notice of the potential pipeline of social infrastructure needs.

Once a project progresses with further confidence about the ability for a mine to succeed then it is recommended there should be a public process including the state government, local government and the miner to engage with the community about the mine and the associated social infrastructure. This could be aligned to the process of conducting an environmental impact statement. An important part of this stage of planning would be the assessment of the state of community assets, the potential benefit for local commerce, the housing model and its integration to the community. Undertaking this process will allow opportunities of mutual benefit to be identified for the miner, community and government.

**Figure 9.8: Recommended social infrastructure planning approach**

Concurrently to this recommended localised approach, State and local government can now use the mining projections, employment projections and infrastructure recommendations in this project to inform their state and regional plans.

**Economic impact**

Growth in the mining industry in the Far North region provides a multitude of economic opportunities for both the region and the State. In considering this range of opportunities, it is important to consider how the development of these mining projects and associated infrastructure projects will affect the overall economic
conditions of the region, including directly within the mining industry and indirectly within industries affected by or supplying to the mining industry.

These direct and indirect impacts will include changes to levels of employment and aggregate demand, as well as changes to particular industries as a result of increases in the level of output and, potentially, competition of workers and resources.

To gain an understanding of what these impacts mean, it is important to remember the context of the mining industry at present in terms of its economic impact on the State. In 2012, the gross value added by the mining industry (including indirect economic contributions through demand created by the mining industry) was approximately $8.5 billion in South Australia, with the value of minerals production worth over $4.2 billion.\(^{16,17}\)

**Economic modelling of the impact of mining in the Far North region**

The economy-wide impacts of these new mining and minerals developments have been modelled using the Deloitte Access Economics General Equilibrium Model (DAE-RGEM). The model projects macroeconomic aggregates such as gross regional product (GRP), employment, wages and exports. Modelling of the impact of this increase in mining activity was undertaken for the period 2013/14 to 2032/33. This time period captures the construction and operation of mines active in the medium and high economic growth scenario, including initial ramp ups and the stabilisation of production. The timeframe reflects the long term economic life of many existing and forthcoming minerals projects.

One of the realities of an extended analytical horizon is that it is coated with a layer of uncertainty. In particular, it is very difficult to forecast economic growth, advances in technology, external political dimensions and other dynamic factors which will impact commodity prices and the investment climate into the future. This analysis has therefore adopted a range of scenarios which represent current perspectives on plausible investment and price outcomes.

To gauge the economic impacts of varying levels of mining development, each scenario is compared against a baseline, or counterfactual. The baseline case sets out a story of how the regional economy would have evolved over time in the absence of new mining developments. In this respect, each scenario symbolises the potential incremental gains to the economy above and beyond what would have occurred without further capital and infrastructure investments.

**Interpreting the results of the economic modelling**

In modelling the economic impact of forecast mining activity in the Far North region over the period considered in the RMIP project, forecasts of the economic impact of this activity have been developed for the medium growth and high growth scenarios. The results contained in the tables below, along with the accompanying commentary, are provided in the context of these scenarios occurring as opposed to the counterfactual base line scenario in which the regional economy (of the Far North region) develops without new mining developments.

\(^{16}\) Australian Bureau of Statistics (2012), *Cat. no. 5220.0 – Australian National Accounts: State Accounts, 2011-12*, accessed

\(^{17}\) Department for Manufacturing, Innovation, Trade, Resources and Energy (2013), *South Australian mineral resource production statistic for the six months ended 30th June 2012*, accessed
The results presented in Table 9.5 and Table 9.6 are the deviations from this base line counterfactual, i.e. the increase (or decrease) in employment and gross regional product (GRP) which occurs as a result of the new mining activity forecast in the respective scenarios at this point in time.

In terms of how the figures for regions might compare, it is important to remember that the DAE-RGEM framework captures flows between sectors in a dynamic setting; as such, regions with greater connectivity are likely to witness greater deviations.

A detailed explanation of the DAE-RGEM model is provided at Appendix F.

**Medium growth scenario**

The forecast economic impact of the growth in the mining industry in Far North region under the medium growth scenario is summarised in Table 9.5 below.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative GRP deviation (NPV - $AU 2011-12 million)</td>
<td>948.2</td>
<td>1,994.6</td>
<td>3,276.4</td>
</tr>
<tr>
<td>Average GRP deviation (%)</td>
<td>8.0</td>
<td>17.9</td>
<td>16.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average deviation (FTE)</td>
<td>964.7</td>
<td>1,753.3</td>
<td>1,317.5</td>
</tr>
<tr>
<td>Average deviation (%)</td>
<td>4.6</td>
<td>7.8</td>
<td>5.2</td>
</tr>
</tbody>
</table>

Under the medium growth scenario, the net present value of the deviation in GRP starts at $948.2 million for the first period from 2013/14 – 2017/18 before steadily increasing to $1.99 billion for the period 2018/19-2022/23 and $3.28 billion in the final 2023/24 – 2032/33 period. In an area with relatively few economic opportunities outside of the energy and resources and pastoral sectors represents an important driver of economic growth.

This is mirrored in the forecast increase in employment for the Far North region, with the peak deviation in employment modelled in 2019/20 equating to an additional 1,837 FTE positions in the region. This period of peak employment is relatively early when compared with the other two regions, can be explained by the fact most of mines forecast to be operating under the medium growth scenario are in fact already operating.

This relatively early window of peak employment created by growth in the mining industry in the Far North region is illustrated in the figure overleaf.
It is important to remember these results are modelled on the basis of the forecast growth of mining in the Far North region under the medium growth scenario and that the results of the modelling undertaken for the other two study regions (along with the balance of South Australia) would be required to obtain an understanding of the state-wide economic impacts of growth in mining.

**High growth scenario**

Table 9.6 below summarises the forecast economic impact of growth in the mining industry in the Far North region under the high growth scenario.

**Table 9.6: Forecast economic impact under the high case scenario**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gross Regional Product (GRP)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cumulative GRP deviation (NPV - $AU 2011-12 million)</td>
<td>1,686.9</td>
<td>4,031.8</td>
<td>6,727.7</td>
</tr>
<tr>
<td>Average deviation (%)</td>
<td>14.2</td>
<td>36.2</td>
<td>33.5</td>
</tr>
<tr>
<td><strong>Employment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average deviation (FTE)</td>
<td>1,694.5</td>
<td>3,671.6</td>
<td>2,761.5</td>
</tr>
<tr>
<td>Average deviation (%)</td>
<td>8.0</td>
<td>16.2</td>
<td>11.0</td>
</tr>
</tbody>
</table>

The employment and GRP impacts modelled in the high growth scenario illustrate a similar trend as in the medium growth scenario in the sense that deviations are expected to peak in the second period between
2018/19 – 2022/23, however the level of forecast economic activity is significantly higher in the former, reflecting the greater number of mines expected to be operating under this scenario.

The NPV of the deviation in GRP increases from $1.69 billion for the first 2013/14 – 2017/18 period before reaching $6.73 billion in 2023/24 – 2032/33 period. Employment would similarly increase, increasing from an additional eight per cent on average in the 2013/14 – 2017/18 period to reach a peak of 16.2 per cent in the 2018/19 – 2022/23 period, before tailing off to an average of 11 per cent in the final period. This decrease in the employment deviation between the second and third period can be explained by the conclusion of the construction phases of most of the mines during the second period, and is illustrated in the figure below.

**Figure 9.10: Deviations in GRP and employment under the high growth scenario**

As in the medium growth scenario, these results should be considered in the context of the economic impact of forecast mining growth in the Far North region under the high growth scenario. Modelling for the other two study regions and the balance of South Australia is required for state-wide impacts.
10. Infrastructure prioritisation

The need to prioritise projects

The development and future prosperity of the mining sector and regional communities are interlinked. Efficiently developed, operated and coordinated infrastructure is vital to enabling and maximising the returns available from mining investment. Large capital requirements, constrained funding access and competing private and public sector needs means that each project cannot be considered in isolation from the other. Securing the infrastructure and network connectivity (i.e. freight, water and power) required to enable the efficient growth of the sector (and the communities they operate in) requires a coordinated and systematic prioritisation of the projects that will best address the gaps and issues curtailing current investment and development activity. Unless infrastructure is targeted where needed, infrastructure investment will achieve little except add to the level of private and public debt and drive up the underlying costs of operation.

Principles of prioritisation

The objective of the prioritisation process is to identify those infrastructure projects which have the greatest ability to facilitate growth in South Australia’s mining industry. In prioritising the projects the below principles were used to ensure that projects were considered in the context of the broader environment in which they will be delivered.

- Timing is the core driver of prioritisation and issues in the first time period should be addressed first
  - There is a need to review projects to ensure they meet the test of being a long-term desirable solution
- Freight, electricity and water infrastructure is critical to the facilitation of mining and therefore all infrastructure issues must be addressed
- Following the selection of infrastructure projects there must be a review to assess whether infrastructure issues persist in other clusters and future time periods
- The project assessments guide which projects are selected to address issues, the highest assessed project to address a given issues is chosen

The prioritisation process

To establish the full list of priority projects (and actions for reform) for the region, a three step prioritisation process was followed:

1. Assess projects strategic fit and delivery risk
2. Identify which projects best meet the regions key emerging mining infrastructure issues
3. Identify the supporting infrastructure required to deliver effective paths to market

To begin each project included in the solutions outlined in Chapter 8, along with alternate delivery permutations, were assessed using a multi-criteria analysis that gauged each projects strategic fit and ability to be delivered.
- **The strategic objective** is a reflection of the extent to which the project aligns to the strategic objectives of government.

- **The deliverability objective** is a reflection of the extent to which the project exhibits or lacks barriers to implementation.

The assessment framework is a systematic and objectives-driven approach to prioritise potential infrastructure projects. Projects are assessed on a standalone basis, against the below criteria, to demonstrate the comparative merits of each project to address the identified issues.

**Strategic objective criteria:**
- Efficiency of delivery (strategic importance to multiple mines)
- Facilitation of growth in the mining and minerals processing industries
- Contribution to economic prosperity
- Regional and community impact
- Environmental benefit/costs

**Deliverability objective criteria:**
- Financial viability (affordability to the entity developing the project)
- Legislative and political risks
- Non-legislative and political risk (market and community)
- Planning gaps (does an effective planning regime exist for the project?)
- Constructability
- Commercial feasibility (can a bankable delivery model be developed)
- Sustainability (ongoing commercial viability)
- Ability to leverage partner funding for government and the private sector

Projects that demonstrated the strongest strategic alignment and capacity to be delivered, while also addressing the key emerging mining infrastructure issues were prioritised accordingly. Following this, linking or supporting infrastructure projects required to activate path to market connectivity for clusters were also prioritised. Once the projects have been assessed and prioritised, each is classified for its priority of action (i.e. importance and timing).

**Project prioritisation**

The priority projects for the region are identified and discussed below, and are grouped by their ability to address the key emerging mining infrastructure issues presented earlier in Chapter 7.
### Issue A

Lack of bulk commodity export port accessible by South Gawler and Mount Woods cluster mines

Seven port locations (of permutations thereof) have been identified which have the ability to meet the needs of mining in the South Gawler and Mount Woods clusters:

<table>
<thead>
<tr>
<th>Project</th>
<th>Note on scoring</th>
<th>Strategic score</th>
<th>Deliverability score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Northern Eyre Port</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Port Bonython - development of a 20mtpa facility with staged expansion of land side storage. Capacity to expand capacity to greater than 50mtpa.</td>
<td>1</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Port Nonowie - development of a 20mtpa facility with staged expansion of land side storage. Capacity to expand capacity to greater than 50mtpa.</td>
<td>2</td>
<td>Moderate</td>
<td>Weak</td>
</tr>
<tr>
<td>Port Bonython - development of a 20mtpa facility with staged expansion of land side storage. Ability to expand capacity to 50mtpa, utilising Port Pirie to build (and service) demand for development and expansion.</td>
<td>3</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Port Nonowie - development of a 20mtpa facility with staged expansion of land side storage. Ability to expand capacity to 50mtpa, utilising Port Pirie to build (and service) demand for development and expansion.</td>
<td>4</td>
<td>Moderate</td>
<td>Weak</td>
</tr>
<tr>
<td>Myponie Point – development of a 20mtpa facility with staged expansion of landside storage. Capacity to expand capacity to 50mtpa</td>
<td>5</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Port Pirie – upgrades to develop a 20mtpa transhipment operation via the island adjacent to the existing wharf precinct</td>
<td>6</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Darwin – expansion of Port of Darwin to cater for export from Mt Woods and Tarcoola clusters, with an additional 10mtpa requiring substantial capex for port and rail upgrades</td>
<td>7</td>
<td>Weak</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
Notes

1. Well positioned to support the Far North region, but not the Eyre and Western or Braemar regions. Has existing zoning and surrounding land use suitable for industrial development, however would involve high capital costs, and as such is not the most efficient option for the Far North mines under the medium growth scenario (or the Braemar cluster and Eyre and Western regions at all), but could be financially viable under the high growth scenario for the Far North. To this effect, the project has attracted some interest from port proponents. Has also attracted some community and environmental concerns.

2. Well positioned to support the Far North region, but not the Eyre and Western or Braemar cluster. Involves high capital costs (higher than Port Bonython), and as such is not the most efficient option for the Far North mines under the medium growth scenario (or the Braemar cluster and Eyre and Western regions at all). Unlike the Port Bonython option, this solution has not been associated with community concerns, however has not been the subject of a detailed environmental impact or feasibility assessment and has not been backed as a commercially viable project by any port proponent or miner.

3. Comments as per Note 1. Provides a lower capital cost start-up approach, but with higher operating costs; an option to link to the Braemar port solution may be more efficient. Would also involve substantial interaction with the community in the movement of bulk product through Port Pirie.

4. Comments as per Note 2. Provides a lower capital cost start-up approach, but with higher operating costs; an option to link to the Braemar port solution may be more efficient. Would also involve substantial interaction with the community in the movement of bulk product through Port Pirie.

5. May be the most efficient option to support the Far North mines under the medium growth scenario, and is likely to be the most efficient approach for the Braemar cluster as it is well positioned to support the Braemar cluster, while also making efficient use of the existing DIRN (specifically the section between Port Augusta and Snowtown with available capacity). Is not associated with any community or environmental issues.

6. Makes efficient use of the existing DIRN (specifically the section between Port Augusta and Snowtown with available capacity), but would also involve substantial interaction with the community in moving bulk product through Port Pirie. May be an efficient option for the Far North region under the medium growth scenario, however is unlikely to be an efficient solution under the high growth scenario.

7. May be a viable solution for low volumes where capital investment can be avoided (or is limited), however is unlikely to be an efficient, sustainable solution for the region due to high operating costs.

The major drivers of port demand for the Far North region come from the South Gawler cluster with 6 mtpa currently increasing to 9 mtpa, and the Mt Woods cluster at 9 mtpa increasing to 13 mtpa. This demand is driven primarily by the expansion of mines that are already operating in these clusters. The established operations in these clusters already have path to market solutions out of Whyalla and Port Adelaide.

New demand without an existing path to market solution from the Far North region, excluding South Gawler, is forecast at less than 7 mtpa under the medium growth scenario, with some of this demand associated with relatively short current mine life forecasts. This is not considered sufficient to support the establishment of a new Northern Eyre Peninsula port. Additional demand from the South Gawler cluster (excluding Arrium’s operations) are expected to be equally well served by a central Eyre Peninsula port, particularly if rail use is contemplated for larger volumes in the future, and this is therefore not considered to be a significant support for a northern Eyre Peninsula port.
It is recognised that mines using the existing path to market solutions at Whyalla and Port Adelaide may choose to transfer operations to a potentially lower operating cost northern Eyre Peninsula deep water port if available and this would push the potential volumes for this port close to a level which may support its viability. While this is considered a likely outcome for existing Port Adelaide freight, it is considered to be a significant risk at this point in time for the existing Whyalla use, particularly in light of the substantial upgrade works undertaken this year at the Whyalla port. It is not assumed that the operational cost benefits to Arrium that may come with a bulk deep water facility will offset the necessary contribution to the capital expenditure in this instance. Even with the transfer of Port Adelaide export volumes to a new northern Eyre port, the forecast demand remains at less than 10mtpa.

Notwithstanding the view that a new northern Eyre Peninsula port cannot be supported as a high priority project at this point in time, it is recognised that there remains significant potential for additional demand from the Far North region and this is the strategically best placed location for a new deep water port to support this demand. Therefore, it must be stressed that if the economic proposition for developing these mines were to improve (either through commodity price increases or bulk transport efficiencies) and/or additional demand was released through access being granted to large deposits in the Woomera Prohibited Area, then the case for an additional port would emerge strongly and quickly. Therefore, while the port is not currently assessed as a high priority over the next one to two decades, planning for its future development is still required to enable a timely and low risk response from the market when it is required, and subsequently the port should be considered a low long term priority.

In making this observation of the current commercial viability of a northern Eyre port, it should be noted that the development of either Port Bonython or Port Nonowie is more desirable than sending ore for export through the port of Darwin. The relatively high mine to port operating cost of transporting ore to Darwin would mean the mines considered in this study would not be developed. Furthermore, the use of the Port of Darwin would mean that jobs associated with the operation of an export terminal for these mines would occur in Darwin rather than in South Australia.

Given they are both direct loading deep-water ports in close geographic proximity, the service which would be provided to mines by ports at either Bonython or Nonowie would be fundamentally the same. Port Nonowie is expected to generate fewer community concerns than Port Bonython (however has not been the subject of a detailed environmental impact or feasibility assessment), and will have a higher capital cost by virtue of a longer rail extension requirement, longer wharf requirement to deep water and more challenging landside ground conditions.

It should be noted Spencer Gulf Port Link have undertaken considerable studies in the planning of the development of an iron ore lading facility at Port Bonython. Spencer Gulf Port Link’s investigations are part of the reason why it is known there are social and environmental concerns in relation to the further development of Port Bonython. Port Nonowie, on the other hand, has not been the subject of any such study as it has not been backed by a commercial proponent; as such, it is unknown whether similar investigations undertaken for the proposed Port Nonowie site would identify social and environmental concerns akin to those identified for Port Bonython.

In the absence of a northern Eyre deep water port, at least in the short to medium term, alternative path to market solutions for the Far North mines have been considered. The most appropriate solution is to use the interstate rail network to link to the port solution for the Braemar region, which is likely to be located on the northern Yorke Peninsula. The rail corridor is considered likely to have suitable available capacity south of Port Augusta (in the order of 8mtpa). Providing the Braemar solution is built with this capacity in mind, it is considered this will give the best value-for-money option for new freight demands from the Far North. It is noted however, that in exchange for a lower up-front capital cost to link with the Braemar solution, operating costs will be higher than if a northern Eyre Port was in place. On balance, the lower amortised capital costs
with the higher operating costs are expected to be in favour of the Far North mines under the medium demand forecast. The positive-trade off for these lower amortised capital cost (as a result of the capital being recovered over a significantly larger resource profile than what would be achievable for a northern Eyre port in the short to medium term) is the reason for the stronger deliverability score for a MyPonie Point port option.

It is also recognised that the existing Whyalla port may be able to accommodate some additional volume over and above Arrium’s requirements and this option could be pursued by others.

**Issue B**

**Inadequate mine to port bulk transport links connecting Mount Woods cluster**

The only project identified as being capable of transporting ore from the Mount Woods cluster to a port solution in a cost effective manner is upgrades to the existing rail corridors between Port Augusta and Tarcoola and between Tarcoola and Wirrida.

<table>
<thead>
<tr>
<th>Project</th>
<th>Notes on scoring</th>
<th>Strategic score</th>
<th>Deliverability score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail upgrade between Port Augusta and Wirrida</td>
<td>1</td>
<td>Good</td>
<td>Strong</td>
</tr>
</tbody>
</table>

**Notes:**

1. Expected to be required under virtually every path to market solution for the Mt Woods, Tarcoola and Mt Christie clusters. Will support broader uses of the DIRN, and can be staged as demand requires.

The section of rail corridor between Wirrida (selected as a nominal starting point; this is likely to change subject to mine specifics) and Port Augusta operates at close to its full capacity at this point in time. This rail corridor is currently used by a number of miners and is the clear logical link between the mines in the Mt Woods region and port solutions.

Irrespective of the port solution for this region, increased capacity on these lines will support the path to market capability for the cluster. The corridors generally have sufficient width and limited constraints to the installation of passing loops and such works can be planned and installed incrementally as demand dictates.

In making use of the existing Adelaide-Tarcoola rail line, miners in the Mount Woods cluster can minimise capital expenditure while also minimising any additional impacts on the environment in terms of remanent vegetation. The development of additional capacity along this existing line will also allow for the staging of the development.

It is important to note that if Nonowie is chosen as the preferred northern Eyre port option, a rail link would need to be developed to allow ore carrying trains to be diverted around the township of Whyalla. The interaction between additional ore trains along the existing rail corridor and roads would need to be considered in the design of the rail alignment and crossings.
## Issue C

No existing electricity transmission links to South Gawler mines

Five electricity projects were identified as being able to meet the electricity needs of mining in the South Gawler cluster. The assessment of these projects is summarised in the table below.

<table>
<thead>
<tr>
<th>Project</th>
<th>Notes on scoring</th>
<th>Strategic score</th>
<th>Deliverability score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas line to on-site generation from Whyalla branch line</td>
<td>1</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>On-site diesel generation</td>
<td>2</td>
<td>Weak</td>
<td>Moderate</td>
</tr>
<tr>
<td>Transmission link from Cultana</td>
<td>3</td>
<td>Moderate</td>
<td>Strong</td>
</tr>
<tr>
<td>On-site LPG power station to service individual sites</td>
<td>4</td>
<td>Weak</td>
<td>Weak</td>
</tr>
<tr>
<td>Renewable generation to support mining loads</td>
<td>5</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

**Notes:**

1. Supports demand from the South Gawler cluster while also adding additional generation to support state-wide generation capabilities, however is unlikely to be the most efficient option for the cluster and is subject to a high risk of inadequate gas supply from existing branch line; may require higher-cost augmentation back the MAPS pipeline to address this issue.

2. May be suitable as a start-up option for individual, low-demand sites, but would only support individual sites and involves operating costs that are too high for this to be considered a viable long-term solution under the medium growth scenario. Additional demand and transport of fuel will also produce environmental impacts.

3. Likely to be the most efficient option in supporting demand from the South Gawler cluster in the medium growth scenario, while also being able to support the high growth scenario. Potentially also provides opportunities to integrate with the upgrade to the existing transmission network on the Eyre Peninsula. Is likely to involve some community impacts with regards to land/easement requirements.

4. May be suitable as a start-up option for individual, low-demand sites, but would only support individual sites and involves operating costs that are too high (higher than diesel) for this to be considered viable even in this instance.

5. Supports the South Australian Renewable Energy Plan in providing additional generation capacity to the network, however is not considered to be suitable for ‘base load’ generation, and would hence require an alternative base load generation capability (making the capital costs higher than other options).

Of the projects listed above the development of a new transmission line from Cultana received the highest assessment score. It is noted however that this is based on a medium growth demand for the higher energy demand magnetite operations. In the meantime, it is considered likely that the lower capital cost option of using on-site generation will be adequate to support haematite operations.
The provision of a gas line from Whyalla to a local gas fired generation plant has been assessed as likely to be more expensive than a transmission line from Cultana, and is associated with a risk that there is insufficient capacity in the existing gas pipeline to Whyalla and therefore even greater costs could be associated with upgrading the capacity back to the Moomba – Adelaide pipeline.

A highly prioritised project in the assessment of energy options for the Eyre and Western region was the upgrade to transmission network on the Eyre Peninsula. There may be opportunities to link this project with a transmission line into the South Gawler and such opportunities should be considered in the planning of both projects.

**Issue D**

No identified suitable source of water for South Gawler mines

Four projects were identified which have the ability to meet the water needs of mining in the South Gawler cluster

<table>
<thead>
<tr>
<th>Project</th>
<th>Notes on scoring</th>
<th>Strategic score</th>
<th>Deliverability score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundwater investigation</td>
<td>1</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>On-coast desalination and transmission network</td>
<td>2</td>
<td>Moderate</td>
<td>Good</td>
</tr>
<tr>
<td>Seawater pipeline with on-site desalination as required</td>
<td>3</td>
<td>Moderate</td>
<td>Good</td>
</tr>
<tr>
<td>Morgan-Whyalla pipeline with storage points</td>
<td>4</td>
<td>Weak</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

**Notes:**

1. Could provide benefits to both mining proponents and communities by providing a better understanding of the availability, quality and sustainability of groundwater, however is not expected to identify sufficient sustainable volumes to support mining sector development in the South Gawler region. Process to undertake further groundwater exploration works and to ensure consolidation of available data would be low-cost.

2. Will support demand from a number of mines while also providing an opportunity to leverage community water benefit, however will require management of environmental issues associated with disposal or re-use of brine. This option is likely to become more efficient if a larger percentage of water required for use needs to be desalinated. Desalination (involving either on-coast or on-site desalination) is likely to be the most efficient option for the Far North region.

3. Comments as per Note 2, but will also require management of the environmental risk of seawater leaks along the transmission line.

4. May supply some mines with low-cost water of a potable standard, but will be insufficient to supply mining demand under the medium growth scenario within a system with limited available capacity.

Use of seawater, either directly with on-site desalination as required, or via an on-coast desalination plant, is assessed as the most likely solution to this issue. However, similar to electricity for this region above, the water demand on which this is based is generated by the requirements of magnetite operations.
meantime, it is recognised that there may be a lower capital cost, lower demand option to explore opportunities for groundwater use.

As there are a number of significant information gaps with regards to the availability of groundwater in the Far North region, there are a number of issues in assessing the viability of these projects addressing the lack of an identified water source for the region. Although further information is needed before these projects can be precluded, similar to other regions, it is likely existing resources are already largely committed to.

In considering alternatives to groundwater projects, the assessment of desalination projects did not identify a material difference in the suitability of either option for the purposes of supporting the development of mining in the South Gawler cluster. Having made this observation, it must be noted there are considerable environmental concerns in relation to managing the impacts of desalination plants; these concerns would need to be managed.

Given there is no material difference between these options in terms of their ability to meet the needs of mining, there is no reason for the government to prioritise one at the expense of the other; instead, if both options are open miners can decide which best meets their needs. Allowing the decision to be made in response to the commercial considerations of infrastructure proponents and miners will create the opportunity for innovative delivery solutions to be pursued. For example, consultations have identified opportunities for desalination to support SA Water by providing an additional water source and relieving demand pressures on the Eyre Peninsula network which is operating near capacity. However, because of the mining industry’s requirements for water quality are generally not consistent with potable standards, it is likely the water produced for the mines will need to be treated further to form part of potable supply.

<table>
<thead>
<tr>
<th>Project</th>
<th>Notes on scoring</th>
<th>Strategic score</th>
<th>Deliverability score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas line to on-site generation at more than one site</td>
<td>1</td>
<td>Good</td>
<td>Moderate</td>
</tr>
<tr>
<td>On-site diesel generation</td>
<td>2</td>
<td>Weak</td>
<td>Moderate</td>
</tr>
<tr>
<td>Transmission link from Davenport</td>
<td>3</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>On-site LPG power station to service individual sites</td>
<td>4</td>
<td>Weak</td>
<td>Weak</td>
</tr>
<tr>
<td>Renewable generation to support mining loads</td>
<td>5</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

Notes:

1. While involving a high capital cost, this may provide an efficient solution overall for the Far North region, particularly if state-wide generation and backbone transmission networks would otherwise require augmentation. Can support a broad range of clusters in the Far North region while also providing opportunities to leverage community electricity supply benefits.
2. May be suitable as a start-up option for individual, low-demand sites, but would only support individual sites and involves operating costs that are too high for this to be considered a viable long-term solution under the medium growth scenario. Additional demand and transport of fuel will also produce environmental impacts.

3. Can support high demand clusters in Mt Woods and Torrens West, but may require additional generation capabilities and/or strengthening of the transmission backbone of the main grid if this project is implemented in conjunction with other transmission demands on the network. Is likely to be the most commercially feasible approach to support the medium growth scenario, while also supporting further renewable energy generation in the Far North region.

4. May be suitable as a start-up option for individual, low-demand sites, but would only support individual sites and involves operating costs that are too high (higher than diesel) for this to be considered viable even in this instance.

5. Supports the South Australian Renewable Energy Plan in providing additional generation capacity to the network, however is not considered to be suitable for 'base load' generation, and would hence require an alternative base load generation capability (making the capital costs higher than other options).

The medium growth forecast demand in the Far North exists principally in the Mount Woods and Torrens West clusters. The combined demand in these clusters reaches approximately 700MW in the medium growth case and it is worth noting that it reaches in excess of 1,000MW in the high growth case, which includes expansion of Olympic Dam.

While there is some available capacity within the existing electricity infrastructure to these regions, this is inadequate to cope with the medium growth demand and augmentation will be required.

The assessment concludes that an additional transmission supply from Davenport is likely to achieve the best outcomes from a strategic and deliverability perspective. It is recommended that the transmission link be at 275kV and given the potential demand for the region it is recommended that the link be either established as double circuit (depending on timing of committed demand) or be constructed so that it can efficiently be upgraded to double circuit at a later date.

Given such a project is not required in order for ElectraNet to deliver on its network requirements, it is expected this would be an un-regulated project requiring full commitment from users in advance. The project can be delivered in a competitive environment. Many miners are unable to commit to a level of demand for power as they are still developing the feasibility of their mines (with this feasibility being contingent on having access to adequate power supply). This is likely to be an impediment to the progression of this project.

Given there is a timing lag for demand for this project relative to similar projects for the Eyre and Braemar regions, it is recommended that the policies and frameworks developed for these regions be developed in the context of applying the same principles to the Far North. In the meantime it is considered likely that electricity demand will be met from the existing transmission network, supplemented by on-site generation as required.

The use of on-site diesel and LPG generation provides a highly scalable option for providing electricity to individual sites, but requires relatively high operating expenditure as a result of diesel and LPG requirements; this also adds to the bulk freight task for the region, with the initial price of the fuel being exacerbated by the freight costs in travelling to such remote sections of South Australia. Diesel generation also produces more greenhouse gas emissions per unit of electricity generated than centralised generation projects, adding to the negative environmental and visual amenity impacts produced.

It is considered that the project described above fits with the potential for higher than medium growth for the region. It is noted however, that further augmentation may be required in this instance and gas fired
generation options linked to the Moomba-Adelaide pipeline might compliment the transmission link to the main grid and support the overall ‘base load’ generation capability for the state.

It is also noted, that an upgrade and demand of this magnitude in the Far North does need to be planned and managed in a way which considers the overall management of other potentially significant demands across the regions and the State. This broader picture may identify a need for additional ‘base load’ generation, network security management approaches and/ or upgrades to backbone elements of the transmission network over and above the individual requirements in the Far North region.

### Issue F

Lack of adequate water supply in the Far North under significant additional demand

Four projects have been identified as having the ability to address the lack of adequate water supply in the Far North region under significant additional demand. The assessment of these projects is summarised in the table below.

<table>
<thead>
<tr>
<th>Project</th>
<th>Notes on scoring</th>
<th>Strategic score</th>
<th>Deliverability score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundwater investigation</td>
<td>1</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>On-coast desalination and transmission network</td>
<td>2</td>
<td>Moderate</td>
<td>Good</td>
</tr>
<tr>
<td>Seawater pipeline with on-site desalination as required</td>
<td>3</td>
<td>Moderate</td>
<td>Good</td>
</tr>
<tr>
<td>Re-use of water from dewatering processes</td>
<td>4</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

**Notes:**

1. Could provide benefits to both mining proponents and communities by providing a better understanding of the availability, quality and sustainability of groundwater. It is considered that groundwater has potential to be a key ongoing element of the water supply solution to the Far North region. It will important that sufficient information is available to ensure a sustainable approach is adopted. Process to undertake further groundwater exploration works and to ensure consolidation of available data would be low-cost.

2. Will support demand from a number of mines while also providing an opportunity to leverage community water benefit, however will require management of environmental issues associated with disposal or re-use of brine. This option is likely to become more efficient if a larger percentage of water required for use needs to be desalinated. Desalination (involving either on-coast or on-site desalination) is likely to be the most efficient option for the Far North region.

3. Comments as per Note 2, but will also require management of the environmental risk of seawater leaks along the transmission line.

4. May provide an efficient and sustainable use of water that might otherwise be a ‘waste’ product from other operations. Commercial viability will depend on location, volumes and quantities available.
While the medium growth case would not identify this as a key issue for the region, it is considered that the size of the potential demand under the high growth case warrants identification of this as a key potential issue for the region.

The above scores show potentially significant benefit in continuing to build a strong understanding of the groundwater system in the Far North. This will assist mining proponents with planning water supply solutions and will assist government bodies with the assessment and regulation of proposals. De-watering processes associated with a number of projects in the Far North have the potential to generate significant amounts of surplus water which may be able to be productively used by other mining projects.

In considering alternatives to groundwater projects, the assessment of desalination projects (both on-coast and on-site desalination plants) did not identify a material difference in the suitability of either option for the purposes of supporting the development of mining in the Eyre and Western region. Having made this observation, it must be noted there are environmental aspects in relation to either option which would need to be assessed on a detailed level. The preferred option will also be impacted by mining water quality needs which may vary from site to site.
11. Findings

The prioritisation process discussed in Chapter 10 of this report describes infrastructure required to support preferred solutions addressing critical and identifiable infrastructure needs for the Far North region. Importantly, this prioritisation process addresses issues separately identified within the three clearly defined time periods (i.e. 0-5 years, 6-10 years and 11-20 years).

For the preferred solutions to be progressed, recognition of the roles that both the public sector and private sector can play needs to be made.

Role for government

The priority actions of the South Australian Government regarding the resources industry are documented with the South Australian Economic Statement 2013. Amongst a number of actions, a commitment is made to the following:

- Assisting the co-ordination and planning of regional infrastructure development
- Maintaining regulatory certainty and reducing red tape for the project proponents
- Pursuing growth for the mining services sector

The South Australian Government clearly recognises the wider geographical dispersion of the State’s various resource deposits makes unlocking value within the resources sector more complex.

Co-ordinated, economically and socially efficient and effective infrastructure is necessary to generate broader regional sustainability driven through mining demand.

From a regional perspective, processes based on individual treatment of projects can result in sup-optimal outcomes. In such circumstances, the private sector (in seeking security in its path to market) can become ‘incentivised’ to find their own infrastructure solutions which ultimately can result in the absence of wider, more consistent and economically efficient infrastructure outcomes more likely to reflect the broader interests of the State.

Consequently, there is a clear role for the South Australian Government to deliver policy and planning processes which move beyond the single need and toward understanding the broader social, economic and environmental impacts for regional South Australia. These processes need to support longer term strategies aimed at addressing the future needs of the resources sector as well as other regional based industries and communities. These outcomes can only be achieved through consistent and co-ordinated regional planning and supportable economic modelling.

Decision making by the private sector

In conjunction with the role of government, the progression of preferred infrastructure solutions will more likely occur where the primary needs of the project proponents and wider private sector can be better understood.
The likelihood the private sector would be willing to contribute towards financing and supporting delivery of the infrastructure projects considered in this plan is at its core a function of:

- The perceived risk of a project
- The expected return on the capital

The greater the perceived risk of an infrastructure project, the greater the level of return which will be sought by the private sector in return for providing financing. This logic holds in the absence of legal or other impediments which would prohibit the development of a project (e.g. where environmental legislation prevents the development of a port at a specified location under any circumstances).

Where there are acceptable rates of return for the perceived level of risk, it is more likely project proponents will raise sufficient funding from capital markets required to contribute towards financing an infrastructure project. The perceived level of risk will be determined from numerous risk categories, including but not limited to the following:

- Design, construction and commissioning risk
- Financial risk
- Operating risk
- Market risk
- Interface risk
- Site risk (including environmental and approvals risk)
- Legislative and government policy risk
- Asset ownership risk

These risk categories comprise factors within the control of project proponents, factors within the control of the public sector and factors beyond the control of any group of entities.

**How government can support the private sector**

The risk categories that encompass factors beyond the control of any group of entities have been particularly prolific over the past seven years. In relatively quick succession, the sub-prime mortgage crisis, the Global Financial Crisis, the European Debt Crisis and the simultaneous liquidity crises and commodity price cycles have resulted in a cumulatively massive impact on financial markets. These impacts are no less apparent in project finance markets than in other financial markets.

As a result of tighter funding markets, the manner in which investment decisions are made in accordance with the risk categories identified above has changed substantially as a result. While projects are able to deliver the same or similar levels of return as seven years ago, financiers and investors now require lower levels of risk for the same returns. This conclusion holds for both debt and equity funded projects alike.

As such, it is apparent that there is a need for government to increase its support in projects – or, as specific to this context, those which support growth in the mining industry - to address the reluctance of private project finance to fund these projects. For some projects, government may be able to facilitate decreases in the level of risk through mechanisms such as those that would provide greater certainty for demand. The intent would be to allow the private sector to make their investment decisions based on lower levels of risk.
Discussion of some of the impediments to the issues previously identified is continued in this chapter.

**Issue A**

Lack of bulk commodity export port accessible by South Gawler and Mount Woods cluster mines

*Northern Eyre Peninsula port*

Although the demand for a northern Eyre Peninsula is not considered immediate given demand forecasts, the development of a northern Eyre Peninsula port when required will be dependent on an entity being willing to accept demand risk. The risk of developing the port would be reduced if miners were able to agree to guarantee a throughput to underpin commercial viability. However, it is difficult for miners to make these guarantees in the absence of a port and when faced with high transport costs, as the viability of a port and its transport links is necessary for the miners to develop a bankable feasibility study.

The development of the northern Eyre Peninsula port is in part about being able to break the self-reinforcing cycle between the port not being viable in the absence of mining and mines not being viable in the absence of a port and the impact of bulk freight transport costs on mining project viability. This cycle is exacerbated by the fact that any proponent (unless they are a third party provider) can – and in fact has an incentive – to develop a port sufficient for their own needs but not for the needs of others. This can result in a scenario where larger, more efficient ports are not viable as demand leakage can flow to the smaller capital-expenditure, less efficient ports developed by individual proponents.

**Issue B**

Inadequate mine to port bulk transport links connecting Mount Woods cluster

*Rail upgrade for the Wirrida – Port Augusta rail lines*

No significant impediments have been identified for the progression of this project. Necessary capacity upgrades can be undertaken in a staged manner as demand dictates and there is generally sufficient corridor capacity to install passing loops.

The existing commercial framework is expected to see ARTC and GWA respond to committed demands as required.
**Issue C**
No existing electricity transmission links to South Gawler mines

*Transmission link from Cultana*

Given the new demand in the South Gawler region is predominantly for one proponent, Iron Clad Mining, with no regulated aspect, a transmission link into this region will only be required if it forms a part of the overall business case from Iron Clad. This is ‘normal’ business and no impediments to this process are identified.

It is noted however that assistance in establishing easements for such projects is likely to be beneficial and this project should be supported in a manner consistent with other recommendations for the establishment of corridors throughout the Regional Mining and Infrastructure Plan.

Similar to other electricity projects, it is also considered important that possible future demand in this region continue to be monitored so that any infrastructure works undertaken appropriately considers efficient expansion if required.

Equally, it is important this project is planned in the clear context of the overall state-wide planning to ensure any opportunities to integrate with the Eyre Peninsula network upgrade are identified and to ensure the system wide aspects of generation and network backbone capacity are appropriately considered.

**Issue D**
No identified suitable source of water for South Gawler mines

*Groundwater investigation*

The majority of mines in South Australia extract groundwater, either as part of a dewatering program, as a supply for mine processes, for dust suppression, or for use as a potable supply. Much of this groundwater is highly saline, and often requires treatment at the mine site (desalination) prior to use. The feasibility of mining operations is often predicated on the availability of sufficient sustainable volumes of water within reasonable proximity of the mine site. Quality considerations with regard to processing requirements are also significant, depending on the commodity mined.

Given the majority of mining exploration is in the sparsely populated (and often infrequently visited) regional and remote areas of South Australia, there is a paucity of available data on groundwater resources in the key mining areas of the State, including the Braemar region through to Broken Hill in New South Wales. Therefore, given the lack of information available to inform the assessment of the sustainability and potential impacts (both environmental and social) of groundwater use by mining operations, the acquisition of additional groundwater data is considered imperative to provide greater certainty both to mining proponents and the communities in which they operate.

A number of programs have or are currently being implemented to provide this additional data for other areas of the State, including the Finding Long-term Outback Water Sources (FLOWS) program and non-prescribed
groundwater assessments (undertaken by DEWNR). However, these studies do no currently extend to the Braemar region.

**Issue E**

Lack of adequate electricity transmission to north western Far North mines (Tarcoola and Mount Woods)

**Transmission Link from Davenport**

The regulatory framework within which ElectraNet operates requires the firm commitment from any party connecting a new load to the transmission network before ElectraNet can effect that connection. A new transmission link into the Far North region is expected to be an un-regulated project and as such can be built by any transmission provider in a competitive environment. Notwithstanding this, it is reasonable that any provider will require payment certainty in order to proceed with such a project.

Many miners are currently unable to commit to a level of demand for power as they are still developing the feasibility of their mines (with this feasibility being contingent on having access to adequate power supply). Additionally, a commitment from a single mine generates a risk that the mine pays a high cost for initial infrastructure (as it is based on percentage of supply). It also generates a risk that a lower capacity solution is implemented which only meets the committed demand and does not protect likely future demand.

It is also recognised that the process of reaching a transmission agreement and then implementing major works of this nature takes a considerable amount of time, and may result in delays to the timelines miners would otherwise seek to pursue.

As such, there is a potential self-reinforcing cycle with mines not being viable in the absence of a transmission line and the proposed transmission line not being viable without the mines.

It is noted that the timeframes for the demand in this region are likely to lag, similar to the situations on the Eyre Peninsula and in the Braemar region and therefore policies, principles and lessons learnt from these regions will be able to inform the progression of works in the Far North.

In addition to the above, it is recognised that the state-wide impacts of this potential demand, when coupled with further potential demand increases in the Eyre and Western and Mid North and Braemar regions is likely to have deeper network implications. This may include a need for additional ‘base load’ generation or augmentation of other elements of the existing transmission network.

**Issue F**

Lack of adequate water supply to the Far North region under significant additional demand

**Groundwater investigation**

The majority of mines in South Australia extract groundwater, either as part of a dewatering program, as a supply for mine processes, for dust suppression, or for use as a potable supply. Much of this groundwater is highly saline, and often requires treatment at the mine site (desalination) prior to use. The feasibility of mining operations is often predicated on the availability of sufficient sustainable volumes of water within reasonable
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**General findings**

The recommendations below are capable of supporting the development of all infrastructure projects.

**Early engagement in the planning process**

A core function of the planning process is to facilitate the implementation of Government policy by providing clarity in relation to the intended future use of land. Early consideration of infrastructure projects in the Government’s land use planning will provide guidance and clarity to miners and infrastructure proponents.

Until approval to build a project is granted, the planning process is not able to provide perfect certainty to infrastructure proponents. However, as successively more detailed information in relation to a project becomes available, the planning process is able to provide progressively greater certainty.

Greater clarity reduces the risks associated with infrastructure development for proponents by clearly signalling the Government’s intentions.

It should be noted that the planning process in South Australia has the ability to restrict the future use of land, but not prevent the continuation of land being used for its existing purpose.

**Review of planning procedures**

The development of infrastructure, particularly in association with mining, and particularly in remote and often undisturbed areas, is a perpetual struggle between various stakeholders pursuing potentially competing interests. The South Australian planning system as it pertains to the approval of mining related infrastructure developments is widely perceived as fair, consistent and efficiently administered. However, it is generally conceded that there is some room for improvement; it is viewed by some, both within and outside the mining industry, as cumbersome, time-consuming, opaque and inflexible.

The most common complaints from miners and explorers relate to the timeliness of receiving approvals. As mining exploration activity and, consequently, the number of mining proposals, have increased over the last decade, the pressures on the approvals processes provided for in the Mining Act and Development Act have also increased. Concerns have been expressed about the alignment of the types of mining-related infrastructure projects with categories of developments approval processes available; this has led to a perceived need to “shoe-horn” developments into either a Miscellaneous Purpose License or a Section 46 or Section 49 status under the Development Act 1993. This creates the perception that these processes may not be appropriate for the development concerned.
Although it is generally conceded that government personnel in the relevant departments, such as DPTI and DMITRE, do their best to facilitate the assessment of proposals in a timely manner, the complexity of some statutory requirements is seen as the major reason for delays, with concerns that project approval timelines are extending several years from initial application to final approval. A particular issue that has been raised on several occasions is the complex nature of establishing a corridor for linear infrastructure (e.g., for a pipeline or electricity transmission line) that traverses numerous individual tenures, and a desire to see the process streamlined to provide greater certainty for proponents, landholders, government and other parties. Another issue is the complexity around the approval of proposals for the development of infrastructure (including linear infrastructure requiring the establishment of a corridor) by a party which is not itself seeking approval to develop the mine that the infrastructure will service.

Conversely, concerns expressed by those external to the mining sector commonly contend that the assessment process is not rigorous, detailed or transparent enough, particularly with regard to land access, use and tenure issues, environmental impacts, and the extent of community consultation required or undertaken, in particular with regard to Section 49 developments and projects located in or adjacent to sensitive areas (such as towns, heritage sites or areas of conservation significance).

A recent issues paper produced by the Productivity Commission identified further non-financial barriers to mineral and energy resource exploration in Australia, including a lack of regulatory certainty due to incremental legislative amendment rather than reviewing how processes interact as a whole and increasing complexity with regard to overlapping layers of State and Commonwealth jurisdiction.

The State Government last undertook a review of the Mining Act in 2009. This review and the subsequent public consultation process resulted in a number of amendments to the Act being passed in late 2010; these amendments included provisions regarding land access and exemption of land from mining activity, management and approval of exploration licences, conditions of approval and compliance requirements.

The government has recently announced (February 2013) that it has commissioned a review of the Development Act 1993, known as the “Planning Improvement Project” (PIP). The PIP is the first comprehensive review of the State’s planning legislation since the review that resulted in the drafting and subsequent enactment of the Development Act in 1993. An expert panel has been established to undertake the PIP, and has been asked to review statutory and non-statutory governance and administrative arrangements relating to the planning system, and to propose a new statutory framework, governance and administrative arrangements. The panel is required to report to Government and to Parliament by December 2014 and, particularly relevant to the mining sector, the PIP’s terms of reference state that the “panel’s recommendations must be directed to realising the vision of … thriving, sustainable regional communities”.

### The Regional Mining and Infrastructure Plan

The findings identified in this Contractor Report for the Far North region, along with the findings from the other two regional Contractor’s Reports, form the basis of the SA Government’s Regional Mining and Infrastructure Plan. In doing so, the Plan considers the aggregated demand for each mining cluster to then identify the preferred solution from a regional or cross-regional perspective. This approach enables a more holistic consideration of environmental issues in the development of infrastructure solutions, along with those of the community, and desirable social and economic outcomes.

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The Plan should be read in conjunction with the three regional Contractor’s Reports for the Regional Mining and Infrastructure Planning project, in order to fully appreciate the level of detail and complexity of analysis undertaken to develop the priority actions.
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Various Development Approvals
Various publicly available data for mines
Appendix A - Approach

Stage 1 – Review of existing infrastructure

Stage 1 is focused on understanding the state of the infrastructure currently servicing regional mining activity along with the expected future demand profile for freight, water and power that will be required to support growth in the sector.

Task 1.1 – identify existing regional infrastructure

A detailed understanding of the mining sector in South Australia was gained through information gathering from the following sources:

- Mining company annual reports
- Public statements by mining companies in relation to future mining plans
- Private consultations with mining companies
- Review of State Government databases
- Outputs from RESIC’s IDS
- Consultation and validation with the Department of Manufacturing, Innovation, Trade, Resources and Energy
- Published feasibility reports and environmental impact statements for mining projects
- Technical mining and infrastructure assessment by a specialist mining consultancy.

To develop a holistic understanding of the existing infrastructure environment, additional insights were gained through face to face consultations and workshops with industry bodies, government agencies, RDAs, infrastructure operators and other interested parties.

Information was gathered on a mine by mine basis in relation to each mine’s respective infrastructure requirements over the 20 year life of the plans. This included any planned or proposed infrastructure solutions identified by the mine proponents.

Task 1.2 – assess existing regional infrastructure

The focus of this task was to establish a comprehensive understanding of existing infrastructure capabilities. This assessment determines the condition, capacity and capability of existing infrastructure to meet current and emerging mining infrastructure demands and highlights the likely infrastructure deficiencies across the region.

The consultations discussed above included exploration of the extent to which existing infrastructure is likely to be suitable to support the development of the South Australian mining industry. Information gathering was tailored to reflect the unique nature of each type of infrastructure and is detailed in Appendix C.
Task 1.3 – forecast future mining infrastructure demand

Using the data collected and refined in tasks 1.1 and 1.2, mining infrastructure demand was forecast over the period to 2037.

Mining industry data led to the development of clusters which grouped mines likely to have common infrastructure needs. The clusters were developed by grouping mines in close proximity to each other with relatively homogeneous mineral production profiles.

The likelihood of individual mines proceeding to production was modelled with reference to

- Forecasts of commodity prices
- Estimates of likely mine operating cost
- Estimated mine and direct procured (by mine proponent) infrastructure capital cost
- Estimated cost of feasible mine to port transport solutions
- Allowance for minimum market benchmark return on invested capital.

Commodity price forecasts (i.e. for iron ore, copper, uranium and gold), were drawn from leading international forecasters Consensus Economics. Consensus Economics develops forecasts using predictions submitted by more than 30 commodity forecasters, including private sector consultancies and leading investment and commercial banks. The forecasts of each contributor are aggregated using a proprietary Consensus Economics’ moderation technique to develop a weighted forecast for each commodity.

Prospective mines whose fully burdened cost (including return on capital) are lower than the relevant long-run forecast commodity price were included in the forecast mining activity for the cluster (and region). Demand forecasts based on high, medium and low world economic growth scenarios were produced.

Using this forecast mining output, demand for freight, water and power infrastructure supply was established for each individual mine, with results consolidated for reporting at the cluster level. In collecting the data to enable this analysis, commercially sensitive information (not publicly available) was disclosed to the project team by established and developing miners. As a result, key mine level data and operating assumptions have not been disclosed in the regional mining infrastructure plans and forecasts have been presented at a mine cluster level.

Stage 2 – Identify supply chain solutions

The objective of the second stage was the development of a list of infrastructure projects able to contribute to meeting the needs of the South Australian mining industry. Both tasks 2.1 and 2.2 involved a preliminary identification and a workshop refinement process.

Task 2.1 – identify potential infrastructure gaps and issues

Based on the assessment of existing infrastructure in task 1.2 and the future cluster demand profiles established in task 1.3, the gaps and issues faced by existing infrastructure to service growing mining infrastructure requirements were identified. The analysis drew on findings contained in previous studies (including the 2011 Infrastructure Demand Study commissioned by RESIC), along with commentary from mining proponents and interest groups to establish a base list of mining project inhibitors or challenges. This list was then refined through targeted stakeholder workshops focused on freight and logistics, water and power (electricity and gas).
Task 2.2 – identify potential infrastructure solutions

Following detailed technical research, industry consultation with key mining proponents and industry stakeholders, the project team was able to articulate for each of the regions:

- The current state of relevant infrastructure
- The likely future infrastructure gaps
- Key issues impeding existing infrastructure meeting future demand (i.e. prohibitive commercial or access arrangements, reliability concerns, environmental or social issues)
- Solutions which have been proposed by miners or infrastructure proponents.

This information was presented to targeted stakeholder workshops for consideration. Structured group discussions among workshop participants were used to first test the issues identified and subsequently augment the list of infrastructure solutions which could be capable of addressing the identified infrastructure needs and issues. The ideas of the individual groups were consolidated to produce a complete list of potential infrastructure projects (Refer to Chapter 8 for a complete list of these projects).

Following this workshop the list was refined and any approved or funded projects were removed from further consideration by this project. Further projects determined to be unlikely to meaningful contribute to the strategic delivery of infrastructure for mining in South Australia were removed from the list. This included projects that addressed the requirements for a single mine only and projects so closely aligned it was not meaningful to investigate the projects separately.

Stage 3 – Technical consideration

The objective of the third stage was to gather technical information for each of the identified infrastructure projects, to identify potential path to market solutions (i.e. from mine clusters to port) that address the identified infrastructure deficiencies. This involved grouping dependent and interconnected infrastructure projects into solutions for the alternate mining clusters across the regions.

Task 3.1 – review technical merits of identified projects

This task involved gathering data to establish a deep understanding of the technical merits of each project. To develop this understanding a comprehensive information gathering exercise was undertaken, including the collection and review of the following key metrics:

- Capital cost
- Operating cost
- Capacity
- Mining clusters which would be serviced
- Potential for scalability
- Estimated life
- Supporting infrastructure required
- Key technical and operational risks
- High level pro’s and con’s
- General social, environmental and commercial commentary.
Workshop attendees were consulted where the key metrics identified in task 3.1 could not be sourced from within our project team. This also gave the opportunity for issues to be discussed which could not be raised in the workshops due to time constraints or commercial concerns of workshop participants.

**Task 3.2 – identify alternate infrastructure solutions**

Using the technical information gathered in task 3.1, the project list was consolidated into alternate path to market solutions. The paths are designed to address the needs of regional clusters while reducing unnecessary infrastructure duplication and enabling public benefits. The paths group interrelated, dependent and optional infrastructure projects that would be involved in activating these paths over the twenty year life of the plans. Specifically the freight and logistics projects are grouped by the exit port solution they potentially service. Potential solutions were grouped into packages capable of servicing one or more of the mining clusters.

While energy and water are central to the operation of mines and their associated freight solutions, their demands can be equally addressed (from a technical perspective) by distributed or onsite solutions. Consequently the alternate water and energy solutions that have been identified are decoupled from the path to market solutions and presented separately as standalone solution options.

**Stage 4 - Undertake public consultations**

Before the infrastructure projects are prioritised, an interim report outlining the key regional gaps and issues and the list of infrastructure projects and potential path to market solutions has been released for public consultation. This process enabled the key drivers of the RMIP project to be discussed and validated with a broad range of community and industry stakeholders to ensure a robust foundation for determining the priority activities for driving development and growth of regional mining activity and growth and development.

**Task 4.1 – release interim reports**

All relevant information gathered over the course of the project were compiled in interim reports for the consideration of interested stakeholders.

The interim reports were not a detailed inventory of the full range of investigations undertaken and information gathered over the course of the project to date. The interim reports presented a consolidated summary of the factual and material findings of the project to date which are able to inform submissions of interested stakeholders.

The analysis of the forecast mining infrastructure gaps and the infrastructure projects which may potentially address these gaps were contained with the interim report released for public comment.

The interim report provided interested parties an understanding of:

- The nature and level of mining activity in the region
- Forecast nature and level of mining activity in the region
- Key risks to the forecast level of mining activity being achieved
- Forecast infrastructure gap
- Our initial assessment of the proposed projects.

The insight of stakeholders, particularly in relation to the questions posed in Chapter 1, were gathered to enhance the understanding of the relative merits of each of the infrastructure proposals under consideration.
Task 4.2 – stakeholder consultations

A range of consultation activities have been undertaken to give the greatest possible opportunity for interested parties to provide comment on the interim reports. These consultation activities included:

- Roving interviews
- Drop in information sessions
- Invitee workshops
- Request for hard copy or electronic submissions.

Respondents to the consultation process were asked to provide their thoughts on the interim reports with respect to five specific questions:

- Are the future infrastructure gaps and/or issues adequately identified?
- Have all feasible potential infrastructure solutions been identified?
- When assessing potential solutions, what are the key issues which should be considered?
- Are barriers to the development of priority infrastructure solutions government may seek to address adequately identified?
- Are there any other issues in relation to the RMIP project you wish to raise?

The information gathered in the project (including the consultation processes) was collated for each of the potential infrastructure solutions. This information provided the basis of a detailed process of prioritisation of which the ultimate intention is identifying viable path to market, energy and water infrastructure solutions. Consideration of the timing of the delivery of infrastructure capacity will be critical to the development of clusters.

Projects were prioritised based on their alignment to the criteria below:

- Efficiency of delivery (strategic importance to multiple mines)
- Facilitation of growth in the mining and minerals processing industries
- Contribution to economic prosperity
- Regional and community impact
- Environmental.

Further details of the prioritisation process developed are provided in Chapter 10.

Task 4.3 – refine solution list

Feedback from consultations furthered the project team’s understanding of the implications of each of the project clusters under consideration.

The feedback provided by interested stakeholders was used by the project team to further refine the list of potential solutions and their clustering. Shortlisting of the projects based on the outcomes of consultation focused the deliberations of the project team.

Stage 5 - Infrastructure assessment

The objective of the fifth stage is to identify the priority paths to market solutions and infrastructure projects for each region. The assessment applies a multi-criteria approach that considers a range of economic, financial,
strategic, environmental, and social and government criterion. The assessment considers the priority of projects over the twenty year life of the plans based on the evolving demand from the regions.

**Task 5.1 – assess strategic alignment**

The prioritisation process identified projects with the greatest strategic alignment to the intended outcomes of this project. The prioritisation process identified which projects are the most important to the development of the South Australia mining industry and the time period in which the project needs to be delivered.

**Task 5.2 – assess deliverability**

In addition to assessing the strategic alignment, the deliverability of the identified solutions has assessed. The deliverability assessment analysed the extent to which the identified solutions are able to be implemented in South Australia.

**Task 5.3 – prioritise infrastructure solutions**

At the completion of the prioritisation process a priority ranking will be given to each of the infrastructure projects. The priority ranking will also outline the expected relative timing for each of the projects.

Strategically important areas are those in which infrastructure delivery is able to support the development of multiple mines and/or provide demonstrable community benefits.

**Stage 6 - Identify actions required**

The objective of the sixth stage is to identify the key actions that would facilitate the development of priority infrastructure. This particularly focused on how the State Government can assist in reducing the risk of projects through policy and regulation reform, process improvement, capital investment, coordination and strategic planning and commercial collaboration or facilitation\(^{21}\).

**Task 6.1 - identify scope for government and private sector involvement in projects**

Having identified the priority infrastructure projects, consideration was given to the potential role for government\(^{22}\) and the private sector in facilitating investment in the preferred infrastructure. The core principle driving the identification of the role for government involved focusing on removing impediments to the private sector delivering the necessary infrastructure.

Consideration of the potential role for government focused on projects which are:

- Likely to alleviate ‘blockages’ preventing further private sector investment
- Market failures in which agents pursuing individual interests are not motivated to pursue outcomes which are optimal from a state wide perspective.

Examples of the identified role for government in facilitating the preferred infrastructure solution may include, policy change, partnering and direct financing, among many others.

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\(^{22}\) This will involve the roles that all tiers of government (i.e. local, State and Commonwealth) can contribute to facilitating the delivery of priority projects.
Task 6.2 - identify means and timing of government involvement

Having identified the role for government in facilitating the delivery of the prioritised infrastructure to support the development of the mining sector in South Australia, consideration will be given to the most effective means of intervention.

Consideration has been given to the most effective and efficient means of government intervention to address the gaps identified in Subsection 6.1. The recommended role for government will be that which is most likely to deliver the desired infrastructure with the fewest expected negative consequences.

Stage 7- Finalisation of plans

Task 7.1 – finalise regional mining infrastructure plans

The final task of the project will be the preparation and finalisation of the regional mining infrastructure plan. The final plan will build on the technical assessments and demand modelling presented in this final report and include a summary of feedback (and refinements) from the community and stakeholder consultations, the assessment of infrastructure priorities and discussion of the key activities required to facilitate development of critical mining freight, water and power related infrastructure. This will also include the role of government and identification of likely regional social infrastructure requirements.

Task 7.2 – policy and project proposals

The finalised plan will identify the priority mining infrastructure projects and supporting activities required to enable the growth of the mining sector. These plans will be used over this period to guide the development of policy and project proposals in support of the State Government’s involvement in facilitating these priorities. As required, the policy and project proposals will present, to a preliminary or feasibility level of detail, the case for project action, the required involvement of government (and the private sector), options for the projects and governments involvement and affordability and delivery considerations. This proposal will be used to seek endorsement from Cabinet for policy, regulatory and/or procedural changes to be pursued or alternatively for a detailed business case to be developed seeking funding or commercial engagement (i.e. for joint ventures) approval.
Appendix B - Far North environmental assets

Matters of National Environmental Significance protected under the *Environment Protection and Biodiversity Conservation Act 1999* for the Far North include:

- One wetland of international importance (Coongie Lakes)
- Nine wetlands of national importance
- Two listed threatened communities:
  - The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin (Endangered Community) occurs within area
  - Peppermint Box (Eucalyptus odorata) Grassy Woodland of South Australia (Critically Endangered Community) likely to occur within area
- Other significant ecological communities
  - Coolibah and River Red Gum woodland on regularly inundated floodplains
  - Old-man Saltbush on floodplains
  - Queensland Bluebush shrubland on cracking clay depressions subject to periodic waterlogging
  - Broughton Willow and Coolibah woodland along drainage lines and on floodplains
  - Mulga low woodland on sand plains
  - Bullock bush tall shrubland
  - Needle wattle woodland on sandplains
  - Eucalyptus flindersii mallee
  - Eucalyptus intertexta woodland
  - Allocauarina verticellata woodland
  - Triodia spp. grassland
- Threatened Species
  - 58 listed threatened species
  - 13 listed migratory species
  - 14 listed marine species
- Examples of threatened species and habitats
  - Club Spear Grass (*Austrostipa nulnulla*) in drainage areas
- Plains Rat (Pseudomys australis), Thick-billed Grasswren (eastern) (Amytornis textilis modestus) and Sea Heath (Frankenia plicata) on cracking clay pans and stony plains with gilgais
- Thick-billed Grasswren (eastern) (Amytornis textilis modestus) and Slender-billed Thornbill (western) (Acanthiza iridalei iridalei) in chenopod shrublands
- Mallee fowl (Leipoa ocellata) and Yellow Swainson-pea (Swainsona pyrophila) in mallee habitats
- Johnston’s Slipper-plant (Embabium johnstoni) and Haegi’s Stemodia (Stemodia haegii) on gypseous clays
- Salt Pipewort (Eriocaulon carsonii) associated with Great Artesian Basin spring complexes
- Kowari (Dasycercus byrnei), Fawn Hopping-mouse (Notomys cervinus) and Pickard’s Wattle (Acacia pickardii) on stony plains
- Yellow-footed Rock-wallaby (Petrogale xanthopus xanthopus), Corunna Daisy (Brachyscome muelleri), Desert Greenhood (Pterostylis xerophila) and Ooldea Guinea-flower (Hibbertia crispula) on ranges and hills.
- Marsupial Mole (Notoryctes typhlops) in the Simpson Desert and Finke regions
- Dusky Hopping-mouse (Notomys fuscus) in the Strzelecki Desert
- Bronze-back Legless Lizard (Ophidiocephalus taeniatus), Slender-billed Thornbill (Acanthiza iridalei iridalei – western ssp.) on Northern Myall low woodland and breakaways
Appendix C – Alignment of mines to DMITRE Pipeline

General points on the mines we have excluded:

Our list has been based primarily on the Department of Manufacturing, Innovation, Trade, Resources and Energy (DMITRE) triangle and available information (e.g. information from the RESIC Infrastructure Demand Study, Invest in SA commodity data, information from miners); anything not on the DMITRE triangle was only included in our assessment if it would have a significant infrastructure demand (e.g. Haw sons project in NSW - Braemar).

We have not included the north west corner of South Australia (Musgraves, Far North region) because:

- The timelines for development of resources in the region are uncertain
- Most of the projects in this region (except Metals X’s Wingellina project in Western Australia) are not advanced
- The commodities in this area are produced in low volumes (nickel, zinc, uranium).

Points on the mines we have included

Our assessment focuses on iron ore projects as it is an infrastructure intense commodity – it is a bulk product with significantly greater freight, power and water demands than any other commodity due to the volumes involved (i.e. mtpa vs. ktpa) – we have included almost every iron ore project on the DMITRE triangle except for five (all of which are not very advanced).

Copper and uranium commodities are also assessed because:

- Copper and uranium are SA’s biggest mineral export earners
- There is information available on the development of these commodities (e.g. Invest in SA).

We have also concentrated on the operations for which we have the most comprehensive and accurate data; the less advanced a project is, the more uncertainty there is as to its potential infrastructure requirements. Therefore, if we included all prospects in their initial exploration phases the resultant demand estimates would have included a lot of variability which would have skewed the curves and provided little value to the planning process.

Summary of included and excluded projects

Some projects included in the DMITRE triangle were excluded from our assessment for the reasons below:

- **Associated with other projects** White Dam North, Olympic Dam Expansion, Beverley South, Four Mile
- Coal projects (not included in this project as they energy related, infrastructure supporting Leigh Creek included in considerations of projects), Leigh Creek, Clinton, Arckaringa, Lock
- Out of the region, Kingston
- Focus on commodities outside scope this project, Beltana
- **Sufficient information is not available to robustly assess the infrastructure needs to develop these deposits.** Jungle Dam, Parkinson Dam, Baggy Green, Barns, Black Hills, Golf Bore, Mainwood, Monsoon, Tomahawk/Tunkillia area 191, Mongolata, Sheoak, Skye, Ultima Dam, Yanyarrie, Mount Christie Siding, Willy Willy, Glenrae, Mount Woods, Stuart, Mount Cora, Mount Brady, Jamieson Tank, Pollinga, Claude Hills, Mount Davies, Pindari, Kenmore II, Mount Caroline, Telephone Dam, Menninnie Dam, Weednanna, Alvey, Kangaroo Dam, Taurus, Prospect Hill, Samphire, Armchair, Yadglin, Yarramba, Radium Hill, Aristotle, Oakdale, Malache, Arona 2, Blinman, Emmie Bluff, Emmie North, Moorilyanna, Bagot Well, Burra, Miranda, Moonta, Netherleigh Park, Princess Royal, Punt Hill, Titan, Toondulya, Torrens South JV, Wirrda, Eurinilla Dome, Melton, North Kalkaroo, North Portia, Shylock, Willamulka, Blue Rose, Mount Gunson, Mutooroo, Netley Hill, Zeus, Winjabbie East, Flinders Island, Eurelia, Barton West, Dromedary, Gullivers, Mojave, Notrab
- Mining largely complete, White Dam
- Outside the regions in the plans, Bird-in-Hand, Deloraine, Lady Jane, Kanmantoo, Mount Torrens, Springfield, Mindarie, Angas, Wheal Ellen
Appendix D – Infrastructure assessment benchmarks

The assessment of the adequacy of infrastructure to meet the current and future infrastructure needs of the mining industry were undertaken with reference to the data sets below.

Roads
The heavy vehicle routes in each of the regions were assessed with reference to:
- the current condition of roads
- the capability of the roads to cater for heavy vehicles
- the location and proximity of routes to possible mine sites
- the traffic volumes on routes to determine if capacity exists
- the proximity of routes to other freight (particularly rail) to determine if intermodal opportunities exist
- current use patterns by mining and non-mining traffic.

Rail
Reference material was reviewed and infrastructure proponents interviewed to assess rail infrastructure in relation to:
- the location and proximity of routes to possible mine sites
- the traffic volumes on routes to determine if capacity exists
- the proximity of routes to other freight (particularly roads) to determine if intermodal opportunities exist
- rail gauge
- ability to accommodate different commodities
- current use patterns by mining and non-mining traffic
- the current condition and compatibility with national rail network
- ownership structure and access regime
- capability of lines (i.e. to handle axle loads)

Ports
The review of ports infrastructure included the following key areas for assessment:
- shipping channel and swing basin specifications and dimensions, including maximum vessel sizes
- prevailing subsea geology, tide and current conditions and related maintenance dredging
- towage and pilotage service capacity (equipment and labour force)
- aids to navigation inventory
- berth size and wharf conditions (including all mooring and fendering)
- cargo handling equipment – both ship and stevedoring and terminal related
- cargo storage capacity and operating constraints
- other considerations such as covered loading requirements
• encroachment of incompatible land uses
• community or local government expectations and concerns
• ownership structure and access arrangements
• environmental implications such as proximity to marine parks and recreational facilities
• land transport access (road and rail).

Energy
Gas and electricity providers were identified in each of the regions and information gathered in relation to existing infrastructure affecting the region included:

• location and extent of network
• capacity
• capability (pressure, interruptible etc.)
• upgradability
• current condition and remaining economic life
• constraints and opportunities to optimise use of existing infrastructure
• current and expected demand for commercial and industrial use
• opportunities and challenges of connecting to renewable energy supply
• regulatory and commercial environment
• ownership of assets
• security of supply.

Water
Key information in relation to water assets and potential constraints on supply was reviewed in each of the regions, including:

• population growth forecasts
• climate change and demand impacts
• water allocation (River Murray, prescribed wells, Great Artesian Basin)
• demand projections
• yield capacity and water quality potential water sources, including:
  • prescribed and non-prescribed groundwater resources
  • surface water catchments
  • stormwater reuse
  • wastewater and effluent reuse
• reservoir capacities
• transfer pipeline capacities
• water treatment plant capacities and water quality
• desalination plant capacities and water quality
• existing operating rules.
Appendix E – Commodity price scenarios

Deloitte Access Economics (DAE) has developed three forecast scenarios for commodity prices over the next 10 years. DAE’s forecasts for commodity prices reflect three different set of assumptions in relation to international macroeconomic conditions; a base case, high growth and low growth scenario.

The commodity price forecasts are drawn from Consensus Economics’ quarterly energy and metals forecasts. Consensus Economics develops forecasts using predictions submitted by more than 30 commodity forecasters (of which DAE is one), including private sector consultancies and leading investment and commercial banks. The forecasts of each contributor are aggregated using Consensus Economics’ moderation process to develop a weighted forecast for each commodity. Drawing forecasts from a range of parties supports the consideration of the forward outlook from a broad range of international perspectives.

The weighted forecast for iron ore, copper, gold and uranium published in Consensus Economics’ December 2012 energy and metals forecast is the base case which has been adopted by DAE.

The outlook for Australian macroeconomic conditions is not considered in detail because forces impacting commodity prices are determined by international markets and minimally impacted by Australian economic conditions.

The following commentary for each scenario provides a background to the likely international economic conditions that would be expected to underpin each commodity price scenario. Charts of the forecast price paths are provided following the commentary.

**Base case**

This is the forecast most likely scenario for international economic conditions.

**Scenario overview**

Significant risk remains present in the global environment as a result of continuing sovereign debt problems in the Eurozone and uncertainty in China. However, these risks are lower than observed in recent years and global growth prospects are greater than they have been in recent times. Economic growth in the United States in the short-term in this scenario is supported by a turnaround in the housing market and cheap energy.

Suppressed by potential downside risks from the Eurozone, United States debt issues, declining Chinese investment and possible disruptions to oil supplies, global economic growth in the short-term is lower than the long-term average. Developing nations, while not returning the rates of growth seen pre-GFC, would be expected to continue to outperform the developed nations and will be key to global growth over the next decade in this scenario.

Commodity prices continue on a relatively volatile path, particularly over the short-term as a result of the uncertainty detailed above. Base commodity prices trend downward over the next decade. Investment from developing countries cools, while new supply enters the market as investment in new export capacity gradually leads to increased levels of production.

**Country expectations**

This scenario is predicated upon improving conditions in the housing market, the addition of cheap energy and the willingness of the US Federal Reserve to persist with aggressive monetary policy easing being enough for the United States to start to deliver some much needed momentum to the global economy. Confidence in the business sector would be expected to improve and economic growth would be expected to provide a stronger employment outlook which would lead to the unemployment rate trending down. This
scenario assumes the United States’ fiscal issues are negotiated without incident in 2013, but the need to consolidate debt over the long term ensures average economic growth over the next decade is lower than in the previous decade. After a period of adjustment the United States economy would be expected to make a solid recovery with economic growth, unemployment and consumer spending all returning to more normal levels by the decade end.

This scenario assumes **China’s** willingness to support steel-intensive, investment driven activity will remain the key driver of China’s economic growth over 2013 and will keep global commodity prices elevated (albeit at lower peaks than seen in 2012). Credit growth in China has also been strong, however this may soon begin to drag on economic growth as interest repayments make up a greater share of spending. This scenario envisions the Chinese economy still being heavily reliant on manufacturing and export growth. The share of output from industry is expected to shrink at the same time as the services sector expands as incomes continue to rise over the long-term (a higher income population places additional demand on services). China’s export share of gross domestic product (GDP) is expected to shrink while imports increase as the share of output from industry decreases. These changes would be slow to manifest. Overall, this scenario assumes income growth in China is solid throughout the next decade and consumption slowly accounts for a greater share of the economy over time.

**Europe** is the major risk to the global economic outlook over the next decade -- its banks are undercapitalised, making it hard for them to finance new growth and political divisions threaten the recovery process. In this scenario recession in Europe’s periphery creeps towards its core and economies on Europe’s southern fringe remain on the back foot for some years until wage costs are restrained (relative to those in Germany and France). Unemployment within the Eurozone is expected to remain at record rates for a few more years and with austerity measures on top it is unlikely Europe’s economy will return to positive economic growth in the short-term. The Eurozone is expected to drag on global economic growth for some years in this scenario with a long period of adjustment and austerity over the next decade.

**Japan** faces a unique mix of economic and demographic challenges to be addressed over the next decade. Government debt in Japan is a larger multiple of national income than in Greece and economic growth has been almost stagnant for the past decade. Japan’s population is shrinking and ageing rapidly. In this scenario Japan is expected to undergo a period of structural adjustment and debt consolidation over the next decade resulting in only modest rates of real economic growth.

**India, Brazil** and **Turkey** all slowed in 2012, meaning the outperformance of emerging economies over the past decade suffered some headwinds, while **Asia’s Tigers** (**Korea, Taiwan, Hong Kong, Singapore, Thailand, Malaysia, Indonesia** and the **Philippines**) are also seeing more modest growth prospects. This scenario assumes growth in these economies will trend above global averages, but be lower than has been recorded over the past decade.

**Commodity price outlook**

**Iron ore** prices bounced back from their lows in September 2012. Strong investment led growth in China is expected to ensure excess supplies accumulated over the latter half of 2012 are quickly used up and prices remain high over 2013. The massive surge in investment in iron ore projects across many countries earlier in the decade will result in a gradual ramping up of supply in this scenario. The increase in supply is expected to cause prices ease a little after 2014, but continuing strong growth from emerging economies would be expected to support prices for most of the next decade. As China moves from an investment-driven to a consumption-driven economy, global demand for iron ore is expected to ease somewhat and cause prices to cool toward the latter half of the next decade.

The high rates of investment expected to keep the iron ore price strong in 2013 are expected to do the same for **copper**. More positive business sentiment and stronger residential housing construction in developed countries over the short-term would be expected to help support the copper price at current highs in this scenario. After that, prices are expected to cool as new supply becomes available and Chinese economic growth slows over the next decade.

After good gains over 2012, a better global economic outlook for 2013 would drive the price of **gold** downward over the short-term as investors seek higher returns in riskier assets. The record prices seen at the end of 2011 do not return in this scenario and the end of monetary easing policies from many of the world’s major central banks would be expected to place further downward pressure on the gold price into the middle of the next decade. The gold price would be expected to settle as threats to the global economy subside over the latter half of the next decade and the world enters a phase of sustained growth.

**Uranium** demand would be expected to return to growth over time in this scenario as the memory of the Fukushima disaster in Japan fades. Additional energy demands from developing countries with rapidly urbanising populations and growing incomes make nuclear a more attractive energy source – this is particularly pronounced in response to the growing air pollution issues in many of Asia’s major cities. This
scenario assumes uranium exporting countries invest heavily in new mine capacity to keep pace with demand over the next decade. Uranium prices rise, but remain below the levels seen in recent years.

**High economic growth scenario**

Below is a scenario for international macroeconomic conditions which is at the higher end of expectations.

**Overview**

This scenario assumes the global economy hits its straps in 2013 after stumbling throughout 2012. Sovereign debt issues in the Eurozone subside as unconventional monetary policy from the European Central Bank (ECB) has the desired effect, while government investment in infrastructure in China drives strong economic growth in the short-term. United States growth surprises in the short-term, as a resurgence in housing construction and consumer spending drives a sustained turnaround in economic activity.

This scenario assumes the global economy moves into full recovery mode, the major economies track well and global uncertainty retreats over 2013. Developing countries, led by China, will continue to make a substantial contribution to global economic growth and outpace the economic growth of developed countries. Developing country growth in this scenario continues to be driven primarily by engineering construction investment, supporting commodity prices over the short-term. This scenario is reliant upon political unrest in a number of oil exporting nations being negotiated without any disruption to oil supplies and the world economy being positioned to make a sustained recovery.

Base commodity prices continue to be buoyed by robust demand from developing nations in this scenario. Indeed, demand for base commodities would outpace supply even in light of the massive amount of new mine capacity which would push the global output of raw materials to record levels. Uranium prices would rise in this scenario as the world demand for energy drives upward. A better global economic outlook would cause the price of gold to fall sharply in the short-term as investors chase higher returns in riskier assets.

**Country expectation**

In the scenario the United States performs strongly over 2013. Low interest rates and continued monetary easing would drive a better than expected recovery in housing construction and prices. Banks would be provided greater liquidity facilitating increased access to capital for the private sector. Exports of gas would increase significantly to underpin this scenario. The unemployment rate would fall sharply over the short-term as a resurgent United States business sector provides a platform for robust jobs growth, while better business and consumer confidence drives a turnaround in retail spending. This scenario assumes United States Government debt issues will be resolved with Congress negotiating the approaching debt ceiling without issue, while also reaching its target of 2.5 per cent debt consolidation in 2013. Indeed, United States economic growth is strong enough over the next decade in this scenario to ensure the United States can consolidate its debts while not impeding economic growth.

In this scenario strong short-term growth in China is driven by engineering construction as the new government renews steel-intensive, investment driven growth. The immediate excess supplies of raw materials are expected to be quickly used up and base commodity prices rise as a result of the lift in demand. In the next five years the consumption share of output in China rises as a result of stronger income growth, particularly in China’s major cities. The rate of consumption growth overtakes growth in investment within a few years, but investment remains the most significant contributor to economic growth in the interim. As a result of increasing consumption growth, base commodity prices begin to fall after 2015 in this scenario. Over the longer-term, China’s economic development follows the same pattern of the other developed nations in the region – such as Japan and Korea – with higher household income associated with a relative decline in the industrial sector and an expansion in the services sector.

Even under this scenario the outlook for the Eurozone is modest at best. The ECB’s commitment to aggressive and unconventional monetary easing ensures liquidity in the financial system. Banks begin to issue more loans resulting in some small gains in business investment and housing construction. Fiscal consolidation reduces government debt and provides some confidence in financial markets, but limits economic growth as the government sector contracts. The recessionary conditions in the periphery countries ease, though growth is slow.

Japan remains a key risk to global economic stability in this scenario, with few prospects for growth over the next decade. The Asian Tigers perform well, with economic growth riding high on an engineering construction boom which lasts well into the next decade. India negotiates its fiscal and monetary issues in this scenario – keeping inflation under control and beginning the process of reducing its fiscal deficit.
Commodity price outlook

Strong investment led growth in China in this scenario pushes iron ore prices higher over 2013. The massive surge in investment in iron ore projects across many countries earlier in the decade increases supply post 2013. Continuing strong growth from emerging economies ensures demand outpaces supply for at least the first half of the next decade – pushing prices up until around 2015. As China’s demand for iron ore eases toward the latter half of the next decade, prices retreat in this scenario.

Strong investment-led growth in China would also be good news for the copper price, ensuring it remains high over the short-term. New supply is expected to be significantly less than for other base metals and demand is expected to continue to increase until at least 2015 as the global demand is driven up by rapidly urbanising populations in a number of developing countries in this scenario. Hence, demand for copper may outstrip supply over the medium-term. The copper price is therefore projected to rise – coming close to the historic highs seen in 2011 – but then cool in line with falling engineering construction in developing countries over the latter half of the next decade.

Strong growth in the global economy in 2013 in this scenario drives the price of gold downward over the short-term, as investors seek higher returns in riskier assets. Monetary policy easings from many of the world’s major central banks are stopped short in this scenario, placing further downward pressure on gold prices over 2013. Indeed, above average global economic growth over the next few years would ensure the gold price remains on a downward path until around 2015.

Additional energy demands from developing countries in this scenario will ensure the uranium price grows strongly over the short-term. As the memory of Fukushima disaster in Japan fades, and amid rapid growth in population and income in developing countries, nuclear energy is expected to become a more attractive energy source. Prices for other energy commodities would also be expected to increase; ensuring the uranium price remains well above historical averages over the next decade.

Low economic growth scenario

Below is a scenario for international macroeconomic conditions which is at the lower end of expectations.

Scenario overview

In this scenario the global economy continues to stumble for a number of years. Global economic growth is plagued by a series of small financial crises as high government debts, particularly in the Eurozone and the United States destabilises financial markets. Chinese growth shudders as falling demand from the Eurozone and the United States (China’s two largest export partners) cause export volumes to fall dramatically. The global output of base commodities increases significantly in this scenario over the next few years as investment in new mine capacity from years past pushes supply to record levels. Demand for these commodities does not keep pace and prices fall as a result.

Some years after the end of the GFC, the world economy may remain in a state of flux, with low growth and high debt in high-income countries a major concern. Global growth over the short-term grinds to a halt as downside risks from the Eurozone, United States debt issues and declining Chinese investment damage global growth prospects in this scenario.

Base commodity prices suffer as demand from developing nations, particularly from China, begins to moderate. Global demand for base commodities struggles to keep up with supply as a lift in new mine capacity pushes the global output of raw materials to record levels in this scenario. Uranium prices would remain stagnant, in line with global energy demand. The price of gold would be expected to make some strong gains as investors seek to secure their wealth from volatile movements in other asset prices, including equities.

Country expectation

The United States underperforms over the short-term in this scenario. The United States housing market is expected to remain flat, with little in the way of price growth or new construction, in spite of low interest rates and continued monetary easing. Unemployment in the United States remains above 7.5 per cent leading into middle of the next decade, while business and consumer confidence is plagued by uncertainty in the financial sector and insipid retail spending remains a drag on economic performance. This scenario assumes Congress manages to negotiate the approaching debt ceiling, but without a turnaround in economic performance, the United States is unable to consolidate any of its debts over 2013. The United States does not make any significant contribution to global economic growth over the next decade in this scenario.
In this scenario China’s economy feels the pinch of a slower global economy and financial market uncertainty. Investment spending is expected to begin to cool and domestic consumption remains subdued after the most recent government stimulus package has run its course. All efforts by China’s new government to encourage growth in consumption spending in the short-term fail. Household income growth would be expected to slow and ensure China’s reliance on export growth and investment to drive economic growth continues over the medium-term. However, China’s export volumes would be expected to fall significantly, particularly in the short-term, as instability in the Eurozone and the United States cause demand for Chinese manufactures to fall. China’s economic growth is projected to slow significantly over the next decade in this scenario and contribute to the general fall in commodity prices.

Monetary easing by the ECB in this scenario is not enough to pull the countries on the periphery of the Eurozone out of recession. The economic instability felt on the fringes of the Eurozone moves towards the core. Political divisions and the varying degree of competitiveness between member countries stifle the Eurozone’s recovery. Unemployment within the Eurozone would be expected to remains at record levels over the medium-term as a result of uncertainty and austerity measures.

Political uncertainty and a lack of policies to reduce excessive government debt damages growth in Japan in the short-term and a need to consolidate debts and a rapidly ageing population damages prospects for economic growth in the long-term in this scenario. The Asian tigers would be expected to slow as a result of weaker growth in China, Europe and the United States. India is expected to continue to struggle with high inflation on the one hand and low growth on the other. The Indian Central Bank and the government in this scenario would be limited in their ability to encourage economic growth through monetary and fiscal policy. A period of low growth relative to years past would be expected to set in for the next decade.

**Commodity price outlook**

In this scenario the iron ore price would be expected to begin to fall over the first half of 2013 as China does not utilise excess supplies accumulated over the latter half of 2012. The surge in supply resulting from recent investment combined with slower growth from emerging economies would mean demand struggles to keep pace with supply for at least the first half of the next decade in this scenario. The iron ore price would be expected to fall significantly in the lead-up to 2015. After that, prices settle well below current levels towards the end of the next decade.

Copper prices fall sharply in the lead-up to 2015 primarily as a result of softening Chinese investment in this scenario. This would be expected to be compounded by falling global energy demand reducing copper demand from new electricity infrastructure. The addition of new supply would be expected to place further downward pressure on copper prices. In this scenario the price of copper is expected to level off over the long-term as stability returns to global markets, but at significantly lower prices as a result of a structural shift in supply.

Weak growth in the global economy drives the price of gold upward over the short term in this scenario, as investors seek to secure their wealth. Monetary easing policies by many of the world’s major central banks extend well into the middle of the next decade and would be expected to depress currency values and place further upward pressure on gold prices. Softer global economic growth in this scenario ensures gold prices remain on an upward path over the long-term.

Governments across the globe remain wary around the use of uranium for nuclear power as the memory of the Fukushima disaster in Japan remains vivid in this scenario. Some governments may seek to reduce their use of nuclear energy and others look to increase it in pursuit of a less carbon-intensive base load energy. Uranium production would be expected to keep pace with demand over the next decade. However, a weaker global economy reduces overall global energy demand and ensures uranium prices remain relatively flat over the next decade.
Appendix E – Commodity price scenarios
Appendix F – The DAE-RGEM model

The Deloitte Access Economics – Regional General Equilibrium Model (DAE-RGEM) is a large scale, dynamic, multi-region, multi-commodity computable general equilibrium model of the world economy. The model allows policy analysis in a single, robust, integrated economic framework. This model projects changes in macroeconomic aggregates such as GDP, employment, export volumes, investment and private consumption. At the sectoral level, detailed results such as output, exports, imports and employment are also produced.

The model is based upon a set of key underlying relationships between the various components of the model, each which represent a different group of agents in the economy, with these relationships are solved simultaneously.

Figure A.1 shows the key components of the model for an individual region. The components include a representative household, producers, investors and international (or linkages with the other regions in the model, including other Australian States and foreign regions). Below is a description of each component of the model and key linkages between components. Some additional, somewhat technical, detail is also provided.

Figure A.1: Key components of DAE-RGEM

DAE-RGEM is based on a substantial body of accepted microeconomic theory. Key assumptions underpinning the model are:

The model contains a 'regional consumer' that receives all income from factor payments (labour, capital, land and natural resources), taxes and net foreign income from borrowing (lending).

Income is allocated across household consumption, Government consumption and savings so as to maximise a Cobb-Douglas (C-D) utility function.

Household consumption for composite goods is determined by minimising expenditure via a CDE (Constant Differences of Elasticities) expenditure function. For most regions, households can source consumption goods only from domestic and imported sources. In the Australian regions, households can also source goods from interstate. In all cases, the choice of commodities by source is determined by a CRESH (Constant Ratios of Elasticities Substitution, Homothetic) utility function.

Government consumption for composite goods, and goods from different sources (domestic, imported and interstate), is determined by maximising utility via a C-D utility function.
All savings generated in each region are used to purchase bonds whose price movements reflect movements in the price of creating capital.

Producers supply goods by combining aggregate intermediate inputs and primary factors in fixed proportions (the Leontief assumption). Composite intermediate inputs are also combined in fixed proportions, whereas individual primary factors are combined using a CES production function.

Producers are cost minimisers, and in doing so, choose between domestic, imported and interstate intermediate inputs via a CRESH production function.

The model contains a more detailed treatment of the electricity sector that is based on the ‘technology bundle’ approach for general equilibrium modelling developed by ABARE (1996).

The supply of labour is positively influenced by movements in the real wage rate governed by an elasticity of supply.

Investment takes place in a global market and allows for different regions to have different rates of return that reflect different risk profiles and policy impediments to investment. A global investor ranks countries as investment destinations based on two factors: global investment and rates of return in a given region compared with global rates of return. Once the aggregate investment has been determined for Australia, aggregate investment in each Australian sub-region is determined by an Australian investor based on: Australian investment and rates of return in a given sub-region compared with the national rate of return.

Once aggregate investment is determined in each region, the regional investor constructs capital goods by combining composite investment goods in fixed proportions, and minimises costs by choosing between domestic, imported and interstate sources for these goods via a CRESH production function.

Prices are determined via market-clearing conditions that require sectoral output (supply) to equal the amount sold (demand) to final users (households and Government), intermediate users (firms and investors), foreigners (international exports), and other Australian regions (interstate exports).

For internationally-traded goods (imports and exports), the Armington assumption is applied whereby the same goods produced in different countries are treated as imperfect substitutes. But, in relative terms, imported goods from different regions are treated as closer substitutes than domestically produced goods and imported composites. Goods traded interstate within the Australian regions are assumed to be closer substitutes again.

The model accounts for greenhouse gas emissions from fossil fuel combustion. Taxes can be applied to emissions, which are converted to good-specific sales taxes that impact on demand. Emission quotas can be set by region and these can be traded, at a value equal to the carbon tax avoided, where a region’s emissions fall below or exceed their quota.

The representative household

Each region in the model has a so-called representative household that receives and spends all income. The representative household allocates income across three different expenditure areas: private household consumption; Government consumption; and savings.

Going clockwise around Figure B, the representative household interacts with producers in two ways. First, in allocating expenditure across household and Government consumption, this sustains demand for production. Second, the representative household owns and receives all income from factor payments (labour, capital, land and natural resources) as well as net taxes. Factors of production are used by producers as inputs into production along with intermediate inputs. The level of production, as well as supply of factors, determines the amount of income generated in each region.

The representative household’s relationship with investors is through the supply of investable funds – savings. The relationship between the representative household and the international sector is twofold. First, importers compete with domestic producers in consumption markets. Second, other regions in the model can lend (borrow) money from each other.

Some detail

The representative household allocates income across three different expenditure areas – private household consumption; Government consumption; and savings – to maximise a Cobb-Douglas utility function.

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Private household consumption on composite goods is determined by minimising a CDE (Constant Differences of Elasticities) expenditure function. Private household consumption on composite goods from different sources is determined by a CRESH (Constant Ratios of Elasticities Substitution, Homothetic) utility function.

Government consumption on composite goods, and composite goods from different sources, is determined by maximising a Cobb-Douglas utility function.

All savings generated in each region is used to purchase bonds whose price movements reflect movements in the price of generating capital.

Producers

Apart from selling goods and services to households and Government, producers sell products to each other (intermediate usage) and to investors. Intermediate usage is where one producer supplies inputs to another’s production. For example, coal producers supply inputs to the electricity sector. Capital is an input into production. Investors react to the conditions facing producers in a region to determine the amount of investment. Generally, increases in production are accompanied by increased investment. In addition, the production of machinery, construction of buildings and the like that forms the basis of a region’s capital stock, is undertaken by producers. In other words, investment demand adds to household and Government expenditure from the representative household, to determine the demand for goods and services in a region.

Producers interact with international markets in two main ways. First, they compete with producers in overseas regions for export markets, as well as in their own region. Second, they use inputs from overseas in their production.

Some detail

Sectoral output equals the amount demanded by consumers (households and Government) and intermediate users (firms and investors) as well as exports.

Intermediate inputs are assumed to be combined in fixed proportions at the composite level. As mentioned above, the exception to this is the electricity sector that is able to substitute different technologies (brown coal, black coal, oil, gas, hydropower and other renewables) using the ‘technology bundle’ approach developed by ABARE (1996).

To minimise costs, producers substitute between domestic and imported intermediate inputs is governed by the Armington assumption as well as between primary factors of production (through a CES aggregator). Substitution between skilled and unskilled labour is also allowed (again via a CES function).

The supply of labour is positively influenced by movements in the wage rate governed by an elasticity of supply is (assumed to be 0.2). This implies that changes influencing the demand for labour, positively or negatively, will impact both the level of employment and the wage rate. This is a typical labour market specification for a dynamic model such as DAE-RGEM. There are other labour market ‘settings’ that can be used. First, the labour market could take on long-run characteristics with aggregate employment being fixed and any changes to labour demand changes being absorbed through movements in the wage rate. Second, the labour market could take on short-run characteristics with fixed wages and flexible employment levels.

Investors

Investment takes place in a global market and allows for different regions to have different rates of return that reflect different risk profiles and policy impediments to investment. The global investor ranks countries as investment destination based on two factors: current economic growth and rates of return in a given region compared with global rates of return.

Some detail

Once aggregate investment is determined in each region, the regional investor constructs capital goods by combining composite investment goods in fixed proportions, and minimises costs by choosing between domestic, imported and interstate sources for these goods via a CRESH production function.
International

Each of the components outlined above operate, simultaneously, in each region of the model. That is, for any simulation the model forecasts changes to trade and investment flows within, and between, regions subject to optimising behaviour by producers, consumers and investors. Of course, this implies some global conditions must be met such as global exports and global imports are the same and that global debt repayments equals global debt receipts each year.