



Monday, 19 June 2017

Mr Simon Williamson
Cameco Australia

Re: Night Parrot habitat in proximity to the Yeelirrie orebody

Dear Simon

Thank you for your enquiry as to the occurrence of likely habitat for the Night Parrot within close proximity to the Yeelirrie orebody area. You mentioned to me that the Department of Environment and Energy (DEE) has an interest in the potential occurrence of the Night Parrot (*Pezoporus occidentalis*) species within 40 km of the Yeelirrie tenements.

The habitats favourable to the Night Parrot are not well understood. In discussions with both Mike Bamford (Bamford Consulting) and Roy Teale (Biota Environmental Sciences), they have described probable suitable habitat for the Night Parrot as co-occurrences of (i) old, long unburnt Spinifex with or without Mulga (assumed nesting habitat) and (ii) Samphire shrublands on salt lake beds (assumed feeding habitat). In the region surrounding Yeelirrie Station, these habitats relate to extensive sandplains supporting Spinifex hummocked grasslands (the Bullimore Land System); and those supporting halophytic shrublands: (the Carnegie, Cosmo, Cunyu, Darlot, Gransal, Melaleuca and Mileura Land Systems). Only four of these seven Land Systems supporting halophytic Shrublands are present within the Yeelirrie SAA Area with the Darlot, Carnegie and Gransal Land Systems occurring in the region but outside the Yeelirrie State Agreement Act (SAA) Area.

As these Land Systems have been mapped on a regional scale in the north-eastern Goldfields (Pringle *et. al.* 1994) and are sufficiently well described to determine that they represent the vegetation of the described preferred habitat of the Night Parrot, Land Systems can be used for analysis of likely habitat for Night Parrot on a regional scale.

A detailed analysis of the fire history of the region has not yet been undertaken, though can be conducted of necessary for this exercise. A quotation for this data has been requested from CAD Resources.

You mentioned to me that the DEE regards that 40 km is a reasonable range for Night Parrots to travel in the landscape. For the purposes of this assessment, I have used a 50 km radius from the outer boundary of the Yeelirrie SAA Area which is

inclusive of the proposed mining tenements on Yeelirrie Station and the proposed upgraded Access Road from the Goldfields Highway to Yeelirrie Station.

The absolute and relative areas of each of the Land Systems are listed in Table 1. These are assessed in three categories: (i) the area within the Yeelirrie SAA Area, (ii) the area within a 50 km radius of the outer boundary of the Yeelirrie SAA Area, and (iii) the area on a state-wide basis (inclusive of the two subsets above).

The sandplains supporting Spinifex hummock grasslands of the Bullimore Land System are very extensive in the Murchison biogeographic region. The Land Systems supporting minor to major components of Samphire Shrublands are found within and adjacent to the numerous but disjunct paleochannels and associated salt lakes in the region.

While the consolidated Yeelirrie Study Area incorporates large areas of the Bullimore Land System (31,380 ha), the 50 km buffer outside this also includes a correspondingly large area (805,594.23 ha), while the Sir Samuel map sheet shows the regional distribution of the Land Systems, Figures 1, 2 and 3.

There are no Samphire Shrublands within the Yeelirrie SAA area, however, there are patchy areas of Samphire shrublands in the eastern part of Yeelirrie Station, associated with the paleochannel and the Carnegie Land System. These are around 32 to 40 km east of the Yeelirrie orebody area but lie in closer proximity to the south of the existing road from the Goldfields Hwy to Yeelirrie Station (about 1.7 km at it's closest point). There are extensive areas of Samphire shrublands within Lake Way and Lake Mason, each some 43 to 60 km distant from the Yeelirrie orebody area, as well as parts of Lake Miranda some 70 km south-east of here. Extensive areas of sandplain with Spinifex hummock shrublands in various states of post-fire regeneration interpose and link these salt lakes.

Given the distribution of the Samphire shrublands in the region and the preferred habitat being adjacent occurrences of Samphire Shrublands to old, unburnt Spinifex hummock grassland on sandplains, I do not believe that Night Parrots would, on current habitat preferences, be likely to frequent the Yeelirrie orebody area. However, it is more likely, if they are present in the region, that they could utilise the Samphire shrublands in the eastern part of Yeelirrie Station, some 32 to 40 km away from the orebody areas, but in closer proximity, some 1.7 to 2 km distant, from the existing public road which will need to be upgraded to service the Yeelirrie project.

Yours faithfully

Geoff Cockerton

Table 1. Land System Statistics

Land System Name	Land System Description	Yeelirrie State Agreement Act Area (ha)	% of Total SAA Area	Outside Yeelirrie SAA Area but Within 50 km buffer (ha)	% of Total outside SAA Area but within 50 km radius	State-Wide area (ha) within Western Australia	% within Local Area (SAA and 50 km radius buffer) vs. area within Western Australia
Bullimore Land System	Extensive sandplains supporting Spinifex hummocked grasslands	31,380.73	3.75%	805,594.23	96.25%	4,785,066.76	17.49%
Carnegie	Salt lakes with fringing saline alluvial plains, kopi dunes and sandy banks, supporting halophytic shrublands and <i>Acacia</i> tall shrublands.	-	0.00%	60,384.18	0.00%	2,596,312.34	2.33%
Cosmo	Calcreted drainage tracts through sandplain with Spinifex hummock grasslands and occasional Black Oak or Mulga open woodlands.	1,772.55	65.92%	916.40	34.08%	19,151.13	14.04%
Cunyu	Calcrete platforms and intervening alluvial floors and minor areas of alluvial plains with <i>Acacia</i> shrublands and minor halophytic shrublands	2,432.40	14.47%	14,381.01	85.53%	318,952.64	5.27%
Darlot	Salt lakes, fringing saline alluvial plains, regularly arranged sandy banks and numerous claypans and swamps, supporting halophytic shrublands and spinifex and wanderrie grasslands.	-	0.00%	2,209.85	100.00%	160,006.96	1.38%

Land System Name	Land System Description	Yeelirrie State Agreement Act Area (ha)	% of Total SAA Area	Outside Yeelirrie SAA Area but Within 50 km buffer (ha)	% of Total outside SAA Area but within 50 km radius	State-Wide area (ha) within Western Australia	% within Local Area (SAA and 50 km radius buffer) vs. area within Western Australia
Gransal	Stony plains and low rises based on granite supporting mainly halophytic low shrublands.	-	0.00%	8,591.55	100.00%	360,931.94	2.38%
Melaleuca	Sandy-surfaced plains and calcareous plains supporting Spinifex or mulga shrublands with wanderrie grasses.	263.97	2.73%	9418.56	97.27%	39610.42	24.44%
Mileura	Calcrete platforms and saline alluvial plains, supporting halophytic shrublands	2,559.24	23.40%	8,377.40	76.60%	261,554.10	4.18%

Figure 1. Land Systems of the Sir Samuel map sheet, north-eastern Goldfields



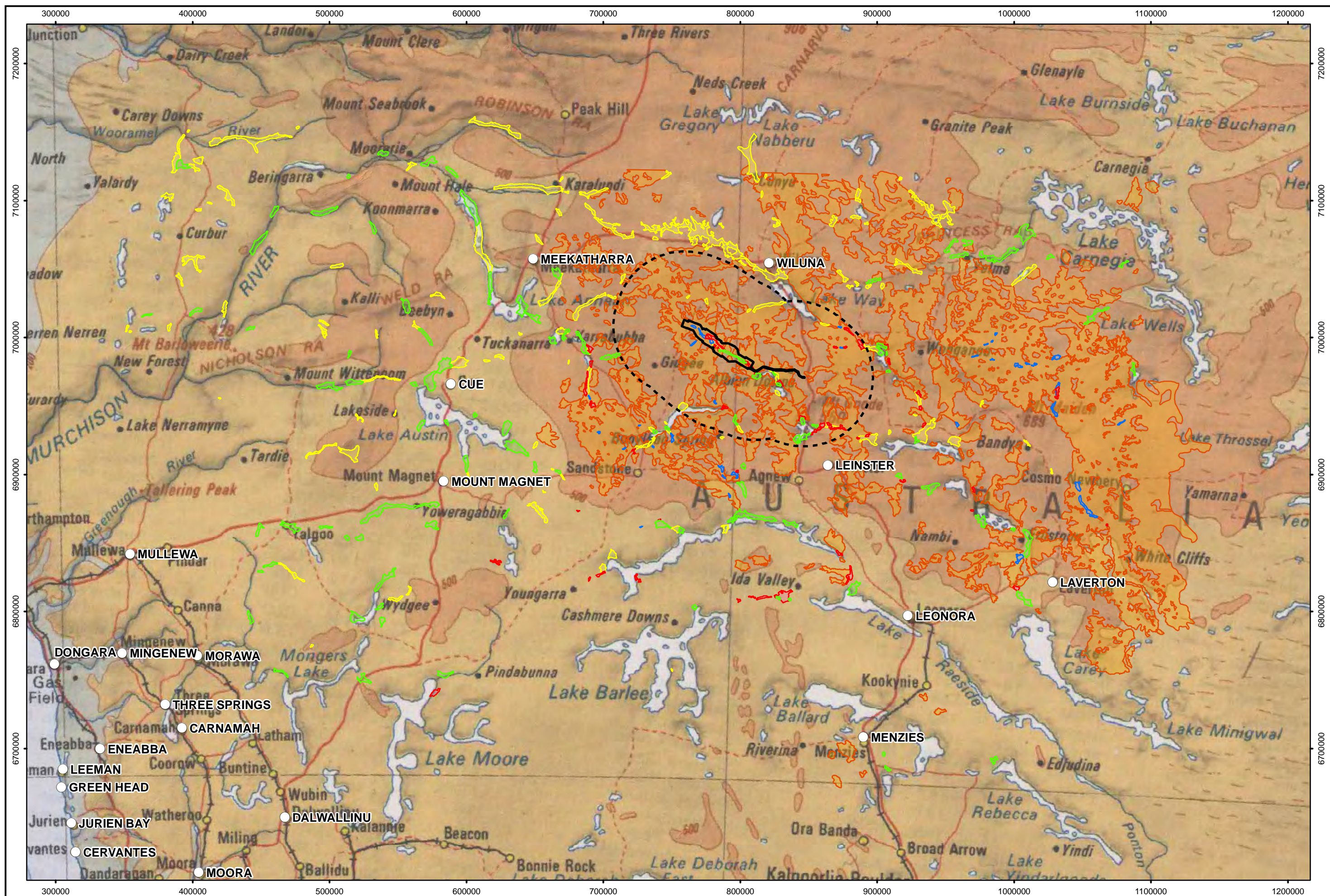


Figure 2. Land Systems of the Yeelirrie SAA Area and a 50 km buffer around the SAA Area



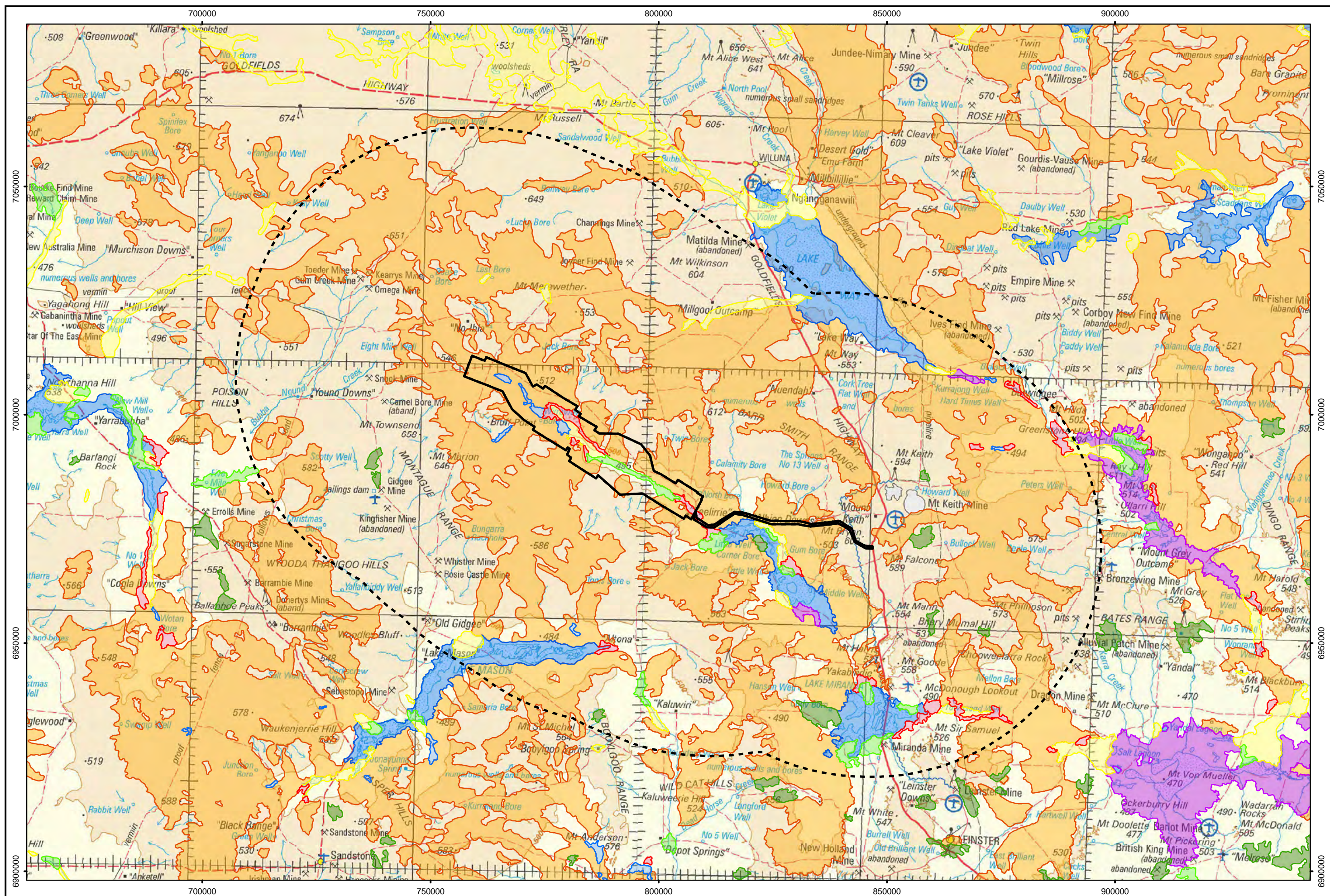
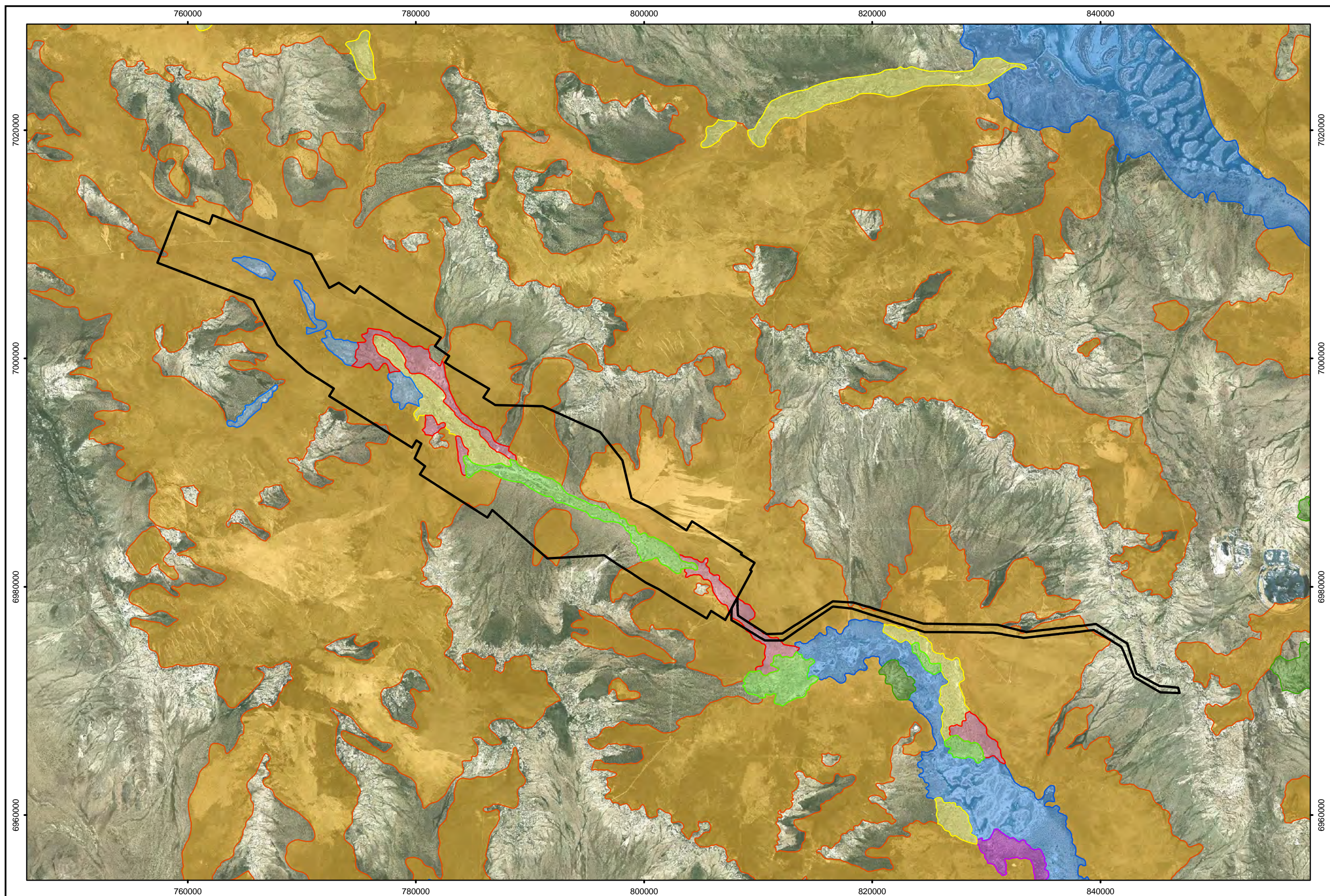


Figure 3. Land Systems of the Yeelirrie SAA Area







Social and Economic Benefits of Uranium Mining at Yeelirrie



Report prepared for:

Cameco Australia

November 2016

This Publication

This report has been prepared for Cameco to describe the economic impacts a new uranium mine will have on the North-Eastern Goldfields and Western Australian economies.

The project is at the development stage and hence there is restricted financial information. This report thus describes the parameters of a potential project in this location using low and high investment scenarios. Cameco has provided information to assist with the preparation of this report and their support is gratefully acknowledged.

The financial estimates contained in this report reflect Economics Consulting Services considerable experience with the costs of mining projects in Western Australia. However, the numbers should be regarded as broadly indicative only. No investments should be based on this project without independently verifying the information.

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Abbreviations

km – kilometres Mt – million tonnes Mtpa – million tonnes per annum

EXECUTIVE SUMMARY

Cameco proposes to establish a mine and processing plant based on the Yeelirrie uranium deposit in Western Australia. Cameco is a Canadian company created in 1988 from two government owned corporations. It is the largest publicly traded uranium company in the world and operates mines and processing plants in three countries.

Yeelirrie is in a remote area of Western Australia. The area is arid with low rainfall and extreme temperatures. The land is largely used for animal grazing on native grasses/bushes. Salt lakes are common and are dry most of the time. The calcrete deposit at Yeelirrie was discovered 44 years ago but has not been developed due to low prices and government restrictions on uranium mining. It is the largest uranium deposit known in Australia that is not in production.

The project is located at the intersection of three large Local Government Areas – the Shires of Wiluna, Sandstone and Leonora. The deposit is on a pastoral station 70km from Wiluna, 120km from Leinster and 200km from Leonora.

Cameco commenced an environmental approval process for the project in 2015. The scoping documents envisage average annual production of 3,850 tonnes of uranium oxide concentrate.

Given the very small population in the region and the limited mine life, Cameco will operate the mine primarily as a fly in-fly out operation with a temporary mine village. The company will provide a bus service to Wiluna if there is sufficient demand and there will be car parking at the village for workers driving to the mine.

An accommodation village will be built on Yeelirrie Station with a peak capacity of 650 beds. This will be reduced to around 300 for the operations phase. The workforce will be transported to the site by bus from a mining company airstrip at Mt Keith 50km east of the site.

The mine and processing plant will operate for 15 years using water from dewatering of the pit and a borefield and energy from an 18MW gas fired power plant.

Development of the mine will be considered when uranium prices improve **considerably from today's historic lows**. The project is still in the prefeasibility stage and hence the financial and manpower data used in this study are broad estimates at +/-30% accuracy. This large range has been accommodated by using low and high case scenarios.

The project will use existing regional and national infrastructure, including:

- Road and rail network between Perth, Esperance, Kalgoorlie-Boulder and Geraldton for the import of materials
- Port facilities at Adelaide for the export of concentrate
- Airport facilities at the BHP Billiton Nickel West Pty Ltd Mount Keith operation, coupled to a bus service between Mount Keith and Yeelirrie for the movement of the workforce.

An estimated 67,600 tonnes of construction items, cement and steel will be transported to the site during construction. When the project is operating, inward freight will include diesel, chemicals, mechanical and catering supplies. Workforce bus movements between the project and Mt. Keith airport are estimated at 1.4 bus return trips a day and will not be a large road user. The transport of the uranium concentrate is expected to require two road trains a week.

To assess the economic impacts, this study defines four areas:

1. *Local* – the mine site and camp and the Albion Downs to Yeelirrie road.
2. *District* – the three Shires of Wiluna, Leonora and Sandstone.
3. *Region* – with strong resource sector service economies in Kalgoorlie and Geraldton, this study defines a region to include the Kalgoorlie – Esperance and Mid-West Development Commission areas.
4. *State* – Western Australia.

Local Area

The population of the local area is extremely small and limited to those working on pastoral properties. Cameco owns the Yeelirrie pastoral station and hence the impact on the local community and economy is minor. The study focus is thus at a broader scale.

District

The Wiluna, Leonora and Sandstone Shires are very lightly populated with an estimated resident population in 2015 of 3,737 people representing a tiny 0.14% of the State population.

Wiluna, Leonora and Sandstone townships contain most of the resident population followed by some Aboriginal settlements and a small number of people living on pastoral stations. Several large mining camps and one closed company mining town (Leinster) provide a significant boost to the local population but they are not **“resident” and are not available as local employees for a new project. Nor is there** business capacity in these camps and town to service other projects.

The towns in the district owe their existence to the discovery of gold in the 1890’s. While tourism is a growth industry, mining has been the dominant economic sector and the pastoral industry the dominant land use for over 100 years. An estimated 60% of the jobs appear to be mining or mineral processing.

There appears to be about 120 businesses in the local area within 200km of the Yeelirrie project with an estimated 15 of these having more than 5 employees. The limited local capacity will initially restrict the contracts that can be awarded to suppliers in the district.

Wiluna and Sandstone Shires have a high level of social disadvantage with a low workforce participation rate and relatively low income levels. Leonora is more prosperous with a high proportion of the workforce in mining.

Region

The region population estimated at 118,500 is about 30 times larger than the defined district. Close to 27% of the 53,000 jobs in the region in 2011 were mining based.

There are 7,300 businesses registered in the region with an estimated 237 having more than 20 employees. Many businesses operate in the resources sector including construction, transport and logistics, mining, accommodation and camp services and mineral exploration drilling.

This is clearly a mining dominant region. The high employment level in mining and related sectors and the substantial business capacity mean that the region can provide substantial manpower and goods and services to the project.

Construction phase impacts

The establishment and construction of the project is estimated to cost between \$580 million and \$1,077 million. An estimated 4% can be sourced from the district and 26% from the broader region bringing the total spend in the region to 30% (\$175m to \$325m). Expenditure in the rest of the State is estimated at 45% taking total State expenditure to 75% with 18% in the rest of Australia. Only a small proportion of the expenditure is overseas –7%.

Manpower estimates range from an average of 310 to 560 over the two-year establishment and construction phase. Around 10% will be sourced from the district and 30% from other parts of the region taking the total region share to 40%.

The economic output of the State is expected to grow by between \$939m and \$1,783m during construction representing an average of \$375m to \$713m a year.

The project will provide employment opportunities for workers and businesses in the region. The impact in the Goldfields-Esperance and Mid-West region is estimated at between \$331m and \$614m. This represents around 35% of the total State impact.

Notwithstanding the limited duration of the impact, the construction phase will boost the district economy. Of the increase in total output for the State, the district will gain between \$33m and \$60m.

The total employment generated during the construction phase across Western Australia is estimated to average 739– 1,338 full time equivalent (FTE) jobs over the 2.5-year construction period. These jobs originate from direct employment on the project, indirect employment generated from money spent on goods and services within Western Australia by the project and flow-on multiplier impacts on employment in the State. Of those jobs, 59 – 108 FTE are in the district and 290 to 522 in the region.

Operations phase impacts

The project will employ between 230 and 410 people for the fifteen-years of mining and processing of which the major share (80%) will come from within the State. This study assumes a conservative 10% locally sourced workforce. Cameco has a strong tradition of engagement with the Traditional Owners of the regions where it mines and has achieved high levels of workforce participation in Canada. The company has established sound working relations with the Martu people in the eastern Pilbara and is confident it can work in a similar way with the Aboriginal people in Wiluna and Leonora. The company will strive for a 15% Indigenous employment target.

Operating expenditure is estimated to be between \$187 million and \$347 million a year plus \$28 million payable to the Western Australian government in royalty payments. This study takes a conservative approach in assuming the purchase of diesel fuel and chemicals from overseas and interstate. This means that the project will spend around \$120m per annum on imports that **won't contribute directly to** the Australian economy. If these purchases can be made in Western Australia, the economic impacts would be greater than estimated in this study.

The project will have a strong multiplier impact in the region and Western Australia generating between \$77m and \$145m a year of economic activity in the region and between \$226m and \$424m in the State. The share of this going to the district is estimated to be 18% of the region. This is a significant injection for a small economy.

The multiplier effect means the creation of 55 to 95 new jobs in the district representing a 2.5% to 4.4% increase above the 2,150 workforce recorded in 2011. The increase in the region is from 200 to 360 jobs.

The project will have an estimated uranium sale value of around \$500m a year for 15 years based on a long-term average price of \$A60 a pound. This output represents close to a 25% addition to the estimated current value of regional production.

General equilibrium modelling

During the construction phase, the dynamic general equilibrium model predicts a peak increase of 450 full-time equivalent (FTE) jobs above the base case forecast for Western Australia. The region sees a peak increase of 180 jobs in construction year three while nationally, the increase peaks at 2,200 jobs.

Real wages in 2019 are 0.03% higher in the State in the peak year but adjustment in the economy nationally means the increase is less than 0.01%.

The operating phase commences with real wages in the region 0.6% above forecast from the stimulus of the construction phase. Aggregate consumption continues to rise relative to base over the operating phase and the spending effect further strengthens the local labour market.

Labour supply in the region eventually meets employment (labour demand) in 2027 at which time real wages cease to rise relative to the base. Real wage rises peak at 0.9% in the region. The region job increase peaks at 320 FTE above forecast in the first year, and then gradually slips back to the base forecast because of the higher wages. State wide jobs show a similar trend peaking at 350 FTE before slipping slowly back to the base forecast.

At the national level, real wage increases are less than at the region or State level but still result in a peak followed by a reduction back to the base forecast. In the first year of operations, national jobs are 220 FTE higher.

The rehabilitation phase of the project provides jobs after mining and processing cease but again the pressure on wages means an offsetting weakening in the labour market in other areas. This is the balancing mechanism inherent in an equilibrium model which assumes no net inward migration of workers into Australia.

The net Australian welfare gain is \$123 million annualised.

1. Introduction

1.1 Project overview

Yeelirrie is the largest uranium deposit known in Australia that is not in production and the largest resource in Western Australia. The project is in a remote area of Western Australia near Wiluna (Figure 1).

Figure 1: Yeelirrie region location



Environmental studies were undertaken and a Draft Environmental Impact Statement (EIS) and an ERMP were submitted to the WA EPA and Australian Government in 1978. The project was approved by both the Australian and Western Australian governments in 1979 – 37 years ago.

Test mining and metallurgical extraction trials were undertaken between 1980 and 1982 but the mine was placed on care and maintenance in 1984 following the introduction of a Federal government three mine policy and ban on new uranium mining and opposition to development by the Western Australian government.

The project was acquired by BHP Billiton with the takeover of Western Mining Corporation in 2005. BHP Billiton commenced the environmental approval process in 2009 and followed up with extensive mine and processing studies. The company did not proceed with the project.

The bans on uranium mining were lifted in 2007 and 2008 by the Federal and State governments, respectively.

Cameco purchased the project in 2012 including the Yeelirrie pastoral lease.

The deposit is the largest calcrete hosted uranium orebody in the world. It covers an extensive area around 9km long by 1km wide. The orebody is shallow and generally less than 6 metres from the surface and up to 7 metres thick. The mineral resource has been estimated at 57,740 tonnes (t) of uranium oxide concentrate (as U₃O₈ equivalent).

Cameco commenced the environmental approval process in 2015 and the Western Australian Government is due to decide whether the Project can proceed by around the end of 2016. The project is in the prefeasibility stage and Cameco is completing social and economic impact assessments as part of the evaluation. Development of the mine would only be considered once market conditions improve and there is a significant improvement in uranium prices.

The environmental scoping document released in September 2015 envisages production peaking in year two and then declining as the grade of ore falls over the 15-year mining life. The average yearly production level proposed is 3,850 tonnes of concentrate (as UO₄) with peak production in year two at approximately 7,500 tonnes (as UO₄).

A treatment plant will be constructed for the leaching, concentration, precipitation and product packaging processes. The concentrate will be transported from the mine by road from Yeelirrie to the Port of Adelaide in South Australia via the Goldfields and Eyre Highways for export.

An accommodation village will be built near Yeelirrie homestead with a peak construction phase capacity of 650 beds. This will be reduced to around 300 for the operations phase. The workforce will be transported to the site by bus from the airstrip at Mt Keith 50 kilometres east of the site.

1.2 The company

Cameco has its head office in Canada **and is one of the world's largest uranium** producers with projects on three continents. It was created in 1988 from two government owned Canadian corporations. These corporations have now sold all their shares and Cameco is the largest publicly traded uranium company in the world.

Cameco employs more than 3,300 people worldwide in uranium mining, refining and conversion, and its uranium products are used to generate clean electricity in nuclear power plants around the world. The company operates two uranium mines in Canada, two in the United States, and one in Kazakhstan and is also a significant supplier of conversion services and one of two CANDU fuel manufacturers in Canada.

1.3 Uranium outlook

Australia has the world's largest reserves of uranium (31%), and has been the third largest exporter after Kazakhstan and Canada. Uranium deposits are also found in Niger, Russia, Namibia, Uzbekistan and the United States.

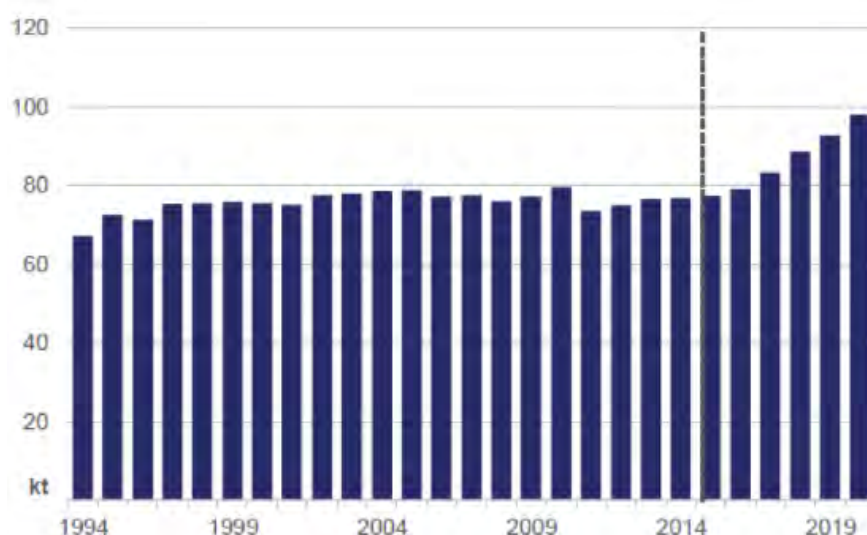
The major consumers are those with the most nuclear power plants being the United States, France, Japan, Russia and Germany. These countries account for about two thirds of nuclear electricity generation.

The 2015 World Energy Outlook prepared by the International Energy Agency (IEA) forecasts world electricity demand to grow by more than 70% by 2040, with a concerted effort to reduce the environmental consequences of power generation. China and India provide most of the expansion.

Nuclear power plants account for **11% of the world's electricity supply and 13** nations are dependent on such energy for at least 30% of their requirements.

The demand for nuclear electricity is forecast to grow by 80% between 2015 and 2040. This will significantly increase uranium demand. In the short term, growth will accelerate with the IEA forecasting a jump in consumption of oxide concentrate to nearly 100,000 tonnes in 2019 (Figure 2).

Figure 2: Uranium oxide concentrate consumption (thousand tonnes)



Source: IEA

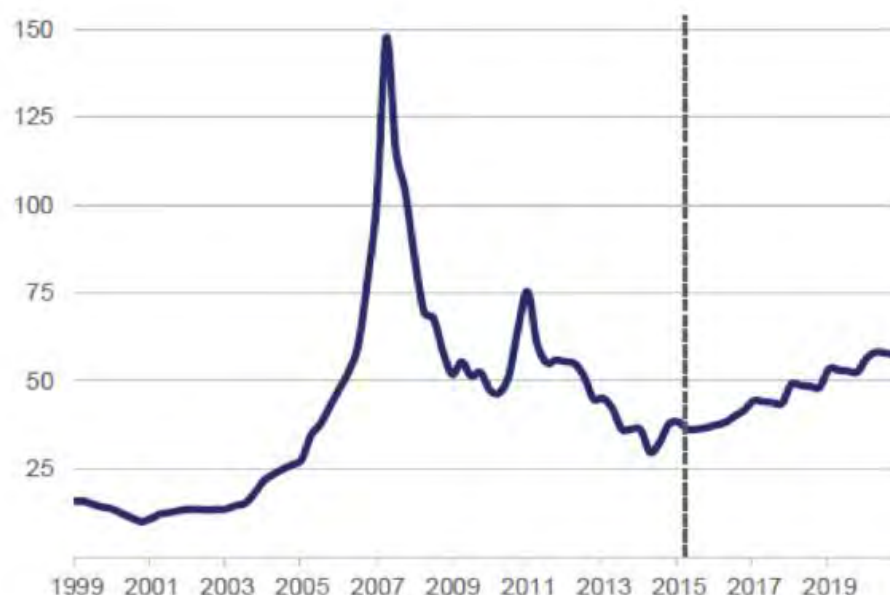
Uranium prices have been low in recent years due to soft world economic conditions, low prices for competing fuels (oil, gas and coal) and a global oversupply of uranium. Greater energy efficiency and a growth in renewable

sources with government subsidies have also had a significant impact. However, the outlook is positive.

Analysts surveyed by Focus Economics' **expect the prices to gradually rise due** to an increase in demand from India, Russia and China.

This study assumes a conservative long term average price of \$A60 a pound.

Figure 3: Uranium oxide concentrate prices (\$US/pound)



Source: Cameco, OCE

1.4 Western Australian context

Uranium has not been mined commercially in Western Australia although the State has a substantial number of known deposits. Uranium is mined at three projects in Australia with projects in the Northern Territory and South Australia.

In 2014-15, Australia produced around 6,200 tonnes of uranium oxide representing around 10% of world production in that year. Production came from four projects – Olympic Dam, Four Mile, Ranger and Beverley.

At an average production rate of 3,850 tonnes a year, Yeelirrie will contribute an extra 6% to the international production and over 60% to Australian production.

2. The region

2.1 Project location

The proposed project is in a relatively remote region of Western Australia 660 kilometres (km) north east of Perth and 420km (or 500km by road) north of Kalgoorlie-Boulder (Figure 4). The region is arid with low rainfall and extreme temperatures. The mean rainfall is 250mm a year, although high rainfall is possible at any given time. Daily temperatures can vary from highs of well over 40 degrees in the summer months to nightly lows in the winter months below zero. Most land used for animal grazing on native grasses/bushes. Salt lakes are common in the region and are dry most of the time.

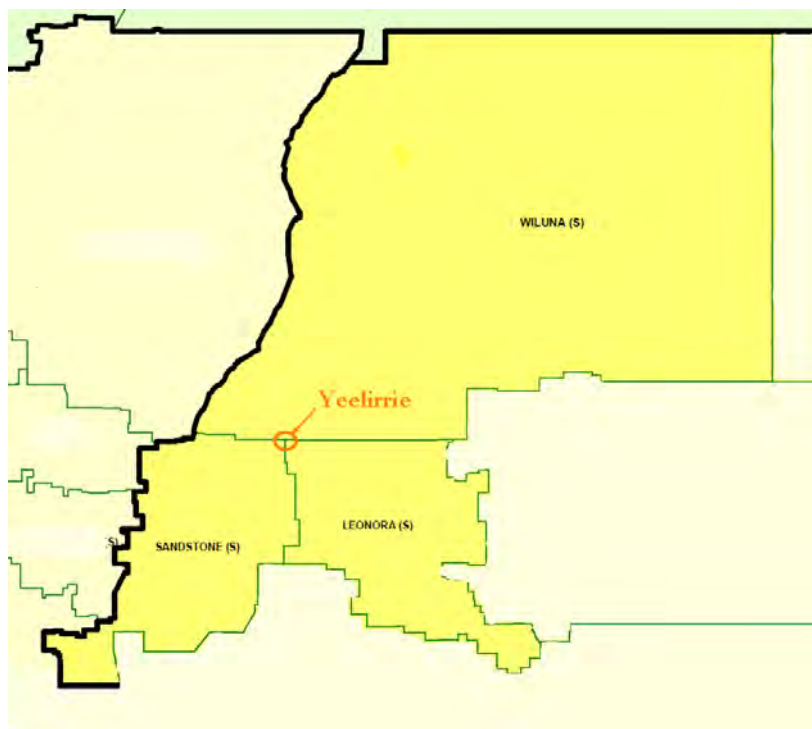
The nearest town Wiluna is 70km north east of the project area with Leinster around 120km south-east. The site is serviced by an unsealed road and the nearest sealed road is around 50km to the east.

Figure 4: Project location – region



The project is situated at the intersection of three large Local Government Areas – the Shires of Wiluna, Sandstone and Leonora (Figure 5).

Figure 5: Project location – local government



2.2 Project impact

The economic impact of a project such as a mine depends on the scale of the project and the size of the economy in which it operates. The impact is assessed by examining the consequences of adding the new project to the existing economy. This includes new construction investment, additional workers and an increased flow of purchases and sales associated with the mining activities. It is common to examine the impacts at local, regional and State levels. For reasons that will be explained more fully in subsequent sections, this study has examined the impacts at four levels – local, district, region and State. There are no strict definitions of these geographical terms with delineation based on the demographic and business environment in which the project will operate.

Given the very small population in the region and the limited mine life, Cameco will operate the mine primarily as a fly in-fly out operation with a temporary mine village and workers operating on extended rosters. The company will provide a bus service to Wiluna if there is sufficient demand and there will be car parking at the village for workers driving to the mine.

In remote areas, mining companies generally discourage daily commuting given the combination of long shift hours and the safety implications of travel on poor standard roads. The small local labour force means it is unlikely that there will be many local employees although the company has aggressive local employment policies to encourage this.

The main access to the site will be along the Albion Downs to Yeelirrie road to the accommodation village near the Yeelirrie homestead and then along the Yeelirrie to Meekatharra road to the mine site. These roads will be upgraded to handle heavy transport vehicles.

An estimated 67,600 tonnes of construction items, cement and steel will be transported to the site. When the project is operating, the inward freight carriage will include diesel, chemicals, mechanical and catering supplies. Workforce bus movements between the project and Mt. Keith airport are estimated at 520 return trips a year. This is an average of 1.4 bus return trips a day and will not be a large road user. Uranium concentrate will be trucked from the mine to Adelaide and truck movements will be approximately two road trains a week over the life of the mine.

The local impact will be limited to the remote mine site and camp and the Albion Downs to Yeelirrie road. Hence, for the purposes of this report the local area is defined to include the project area and the road to Mt Keith which will handle most of the transport needs. The current population in this area is extremely small and limited to those working on pastoral properties. Hence for this study, the local area economic impact is minor and the focus is at a broader scale.

The district is defined more broadly as the three Shires of Wiluna, Leonora and Sandstone given the location of this project close to each Shire (Figure 5).

Main roads will be the key determinant of the passage of goods and services. The company anticipates that most services will come from Kalgoorlie, Geraldton or Perth. With strong resource sector service economies in Kalgoorlie and Geraldton, this study defines the region to include the Kalgoorlie – Esperance and Mid-West Development Commission areas (Figure 6).

Figure 6: Kalgoorlie-Esperance and Mid-West Development Commissions



The study thus uses four geographic areas for the economic impact assessment (Table 1).

Table 1: Study areas

Local Area	District	Region	State
Yeelirrie Station	Wiluna Shire	Mid-West Development Commission	All Local Government Areas
	Leonora Shire	Goldfields-Esperance Development Commission	
	Sandstone Shire		

2.3 History

2.3.1 Wiluna

The Town of Wiluna was established in 1896 after the discovery of gold. With the demise of the gold sector, the town evolved to focus on services to the pastoral industry and local Aboriginal population.

An estimated 25% of the population were Aboriginal at the 2011 census and it is likely that this number was under-recorded. The traditional owners of the area are predominately Martu and Ngaanyatjarra people, who are part of the 'Western Desert bloc' population. This Aboriginal group is highly mobile and often leave their places of usual residence to fulfil cultural obligations elsewhere. Wiluna is a significant cultural law centres where traditional rituals and ceremonies are conducted. It is believed that the population can more than double at times of cultural ritual or ceremony.¹

The gold mines in the Shire employ relatively well paid, educated and skilled employees. Virtually all are employed on long distance fly in-fly out rosters.

The living conditions of Wiluna's Aboriginal population are regarded as poor with low educational outcomes, very low income levels, high welfare dependence and poor housing with large numbers of people living in improvised housing, chronic homelessness, poor health and wellbeing, alcoholism, violence and poverty.²

Wiluna was ranked 139 in the ABS Index of Social Relative Advantage/Disadvantage in 2013. This was seventh last in the list of Local Government Areas in the State reflecting a high level of disadvantage.

2.3.2 Leonora

Leonora was also established in 1896 following the discovery of gold. It is now characterised by mining and pastoral activity and there are many historical buildings and museums related to the 19th Century gold rush. Gold discoveries led to the establishment of the twin Towns of Leonora and Gwalia. Gwalia closed in 1963.

¹ Christina Lange. Local Governance in Remote Regions – Models and Issues: Governance and Service Delivery in Wiluna WA. ANU Centre for Aboriginal Economic Research. October 2005

² Department of Indigenous Affairs, WA. Services to Indigenous People in the Shire of Wiluna: Mapping and Gap Analysis, Final Report, 2004.

The median weekly income of Leonora workers was well above that of the State. However, as with Wiluna, the few large mining operations distort the socio-demographics and mask the actual socio-economic disadvantages.

Around 9% of the Shire's population are Indigenous. However, as Leonora is situated on established travel pathways from the northern Ngaanyatjarra Lands and interior Central Desert lands, its Aboriginal population can change dramatically during cultural ceremonies and events.

2.3.3 Sandstone

The Shire of Sandstone includes the townships of Sandstone, Nunngarra and Youanmi. Between 1907 and 1913, Sandstone was a small city of some 6,000 to 8,000 people but only 200 people remained by 1919. Sandstone survived as a centre for the pastoral industry. Gold-mining has re-emerged as a principal industry but the population remains tiny.

2.4 Demography

2.4.1 District

The Wiluna, Leonora and Sandstone Shires are a lightly populated part of Western Australia. The towns owe their existence to the discovery of gold. While tourism is a growth industry, mining has been the dominant economic sector and the pastoral industry the dominant land use. A few towns contain most of the resident population followed by some Aboriginal settlements with a small number of people living on pastoral stations. Several mining camps provide a significant workforce but as will be explained in more detail, they are generally not counted as "resident" and are not available as local employees for the new project.

The district had an estimated resident population in 2015 of 3,737 people representing a very small 0.14% of the State population (Table 2). Most were living in Leonora Shire (66%) followed by Wiluna Shire (31%) and a small proportion in Sandstone Shire (3%). Effectively, for this study, the human and business environment is focused on Leonora and Wiluna Shires.

There was significant growth over the decade from 2005 to 2015 exceeding 4% a year in Wiluna and Leonora Shires while the population of Sandstone declined to a very small number.

Table 2: Estimated resident population

Indicator	2005	2010	2015	Change (%)
Wiluna	768	1,095	1,156	4%
Leonora	1,599	2,452	2,476	4.50%
Sandstone	126	110	105	-1.50%
District	2,493	3,657	3,737	4.30%
WA	2,011,207	2,290,845	2,590,259	2.55%

Source: ABS census 2006 Catalogue

The estimated resident population does not generally include those working in mine camps as most of the workforce are employed on fly in-fly out rosters and generally record their home base as their usual place of residence.

An estimate of this “transient” population can be gained from the census “place of enumeration” count which records the location of people on census night along with their “normal” place of residence. In 2011, there were 2,861 visitors to the Shires recorded on census night representing 76% of the number of residents (Table 3). While some of these will have been visitors to families in the area, some tourists and some business people, the large number suggests many workers in mine camps.

Table 3: Estimated resident population and visitor numbers (2011)

Measure	Resident	Visitors	Visitor %
Wiluna	1,159	877	76%
Leonora	2,513	1,914	76%
Sandstone	105	70	67%
Region	3,777	2,861	76%

There were 528 Indigenous persons recorded at the census representing 14% of the population, well above the Western Australian average of 3% (Table 4). There were very few Indigenous people recorded in the Sandstone Shire with virtually all in Wiluna and Leonora.

Table 4: Population characteristics

Measure	Wiluna	Leonora	Sandstone	District	State
Population (2011)	1,158	2,513	169	3,840	2,590,260
Indigenous (2011)	290	234	4	528	69,890
Indigenous share (%)	25%	9%	2%	14%	3%
Under 20 years (June 2015)	13%	20%	12%	18%	25%
20-64 years (June 2015)	84%	77%	73%	80%	61%
65+ years (June 2015)	3%	3%	15%	2%	13%
Median age (2011)	34	32	48	38	36

The average age in the district of 38 years was slightly above the State average of 36. Leonora had the youngest average age at 32 years with 20% of the population under 20 while Sandstone had 15% over 65 and hence a much older average age of 48 years.

There were an estimated 2,084 people employed in 2011 and 66 looking for work (Table 5). This provided a workforce participation rate of 66% in the district ranging from a low of 51% in Sandstone to a high of 73% in Wiluna.

Table 5: Population workforce participation

Measure	Wiluna	Leonora	Sandstone	District	State
Employed persons (2011)	722	1,318	44	2,084	606,142
Unemployed and looking (2011)	36	27	3	66	28,765
Aged 15+	1,038	2,105	93	3,236	910,791
Participation rate (working or looking over 15yrs+)	73%	64%	51%	66%	70%

Workforce participation rates are also reflected in the household income with the median family income significantly higher in Leonora than Wiluna and way above Sandstone (Table 6). Leonora was above the average for the State while Wiluna was 12% lower and Sandstone 35% lower.

Table 6: Median household weekly income

Area	2001	2006	2011
Wiluna	\$522	\$1,042	\$1,242
Leonora	\$1,061	\$1,292	\$1,726
Sandstone	\$559	\$1,031	\$919
WA	\$781	\$1,071	\$1,405

2.4.2 Region and State

The Goldfields-Esperance and Mid-West Development Commission areas had an estimated population in 2015 of 118,500 people with the two regions quite similar in population (Table 7). The region population was around 30 times larger than that in the defined district.

Table 7: Population characteristics

Measure	Goldfields-Esperance	Mid-West	Region	District	State
Population (2015)	60,532	57,974	118,500	3,840	2,590,260
Indigenous share (%)	9%	10%	10%	14%	3%
Under 20 years (2015)	29%	30%	30%	18%	25%
20-60 years (2015)	59%	53%	56%	75%	61%
60+ years (2015)	12%	17%	14%	7%	13%

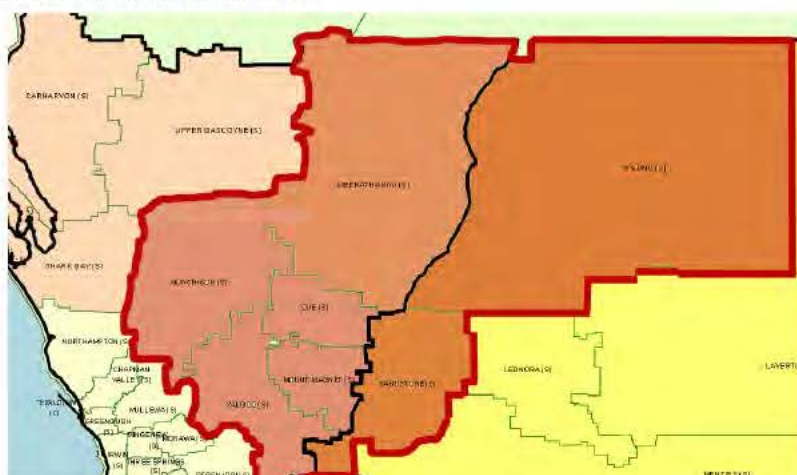
The region has a relatively high Aboriginal population share compared to the State but significantly lower than the district in which the mine is located.

The region has a far higher share of the resident population in the younger and older age brackets than the district where the population is focused in the working years of 20 to 60 years.

2.5 Business activity

Data is available on business numbers in Leinster-Leonora and an area defined as Meekatharra which includes five Shires – Wiluna, Sandstone, Meekatharra, Murchison, Cue, Mount Magnet and Yalgoo (Figure 7). The Meekatharra region will clearly overstate business numbers.

Figure 7: Meekatharra Statistical Area 2



There were an estimated 305 businesses in the area in June 2015 with the highest number engaged in agriculture (26%) followed by construction (17%). Around 100 businesses were in Leinster-Leonora and 200 in the Meekatharra designated area (Table 8). There were six business recorded with employees engaged in mining and none in manufacturing.

Table 8: Business numbers and employment (ABS catalogue 8615, 2015)

Industry	No employees	1-4	5-19	20+	Total
Agriculture	51	24	5		80
Mining	22	6			28
Manufacturing	6				6
Utility Services			3		3
Construction	28	14	9		51
Wholesale Trade	3			3	6
Retail Trade	9	8	6		23
Hospitality Services	9	7	7		23
Transport/Postal/Warehousing	6	7	6		19
Financial and Insurance Services	7				7
Rental/Hiring/Real Estate Services	11	3			14
Professional/Scientific/Technical Services	3	3			6
Administrative and Support Services	6	5			11
Education and Training		3			3
Other	14	11			25
Total	175	91	36	3	305
Total share (%)	57%	30%	12%	1%	

Nearly 60% of the businesses did not have any employees most appearing to be pastoral stations or tradespeople in the construction sector. Only three businesses in the region had more than 20 employees.

The ABS Regional Profile records 33 businesses in Wiluna of which only 15 employ staff. Leonora had 87 businesses. The disparity between the Regional Profile record of businesses and the Business Count reflects definition differences for a business and a small difference in timing.

The 305 businesses in the Leinster-Leonora and Meekatharra areas had a wide range of annual turnover (Table 9). Just on 40% had a turnover of less than \$100,000 with 18 (6%) having a turnover of more than \$2 million.

Table 9: Business numbers and turnover (ABS catalogue 8615, 2015)

Industry	Zero to \$50k	\$50k to \$100k	\$100k to \$200K	\$200k to \$500k	\$500k to \$2m	\$2m +	Total
Leonora	39	30	36	48	35	12	200
Meekatharra	33	19	9	19	18	6	104
Total	72	49	45	67	53	18	304
Share (%)	24%	16%	15%	22%	17%	6%	

The Shire of Wiluna Business Directory reflects the limited service capacity available in the town. It lists two retail businesses, two accommodation providers, two transport organisations and several service organisations including the school, police station, and post office. The town power station is run by the government and service businesses include electrical, carpenter, and auto mechanic.

This profile suggests that there are about 120 businesses in the area within about 200km of the Yeelirrie project and on a pro-rata basis, based on the 2015 survey, around 12% or 15 of these will have more than 5 employees. Given the demands of large mining companies for contractors to have high standards of competency, health and safety systems and environmental policies, Cameco will need to focus on the larger businesses as potential suppliers. The limited local capacity will initially restrict the contracts that can be awarded to local suppliers.

Business numbers in the **region** are far higher at over 7,300 compared to the estimated 120 in the area around the project (Table 10). The scale of businesses is similar with over half being sole traders (no employees) and 3% with more than 20 employees. However, the 3% represents 237 businesses.

Table 10: Business numbers and employment (ABS catalogue 8615, 2015)

Area	No employees	1-4	5-19	20+	Total
Goldfields-Esperance	2,390	1,288	557	137	4,372
Mid-West	1,715	753	383	100	2,951
Region	4,105	2,041	940	237	7,323
Region share	56%	28%	13%	3%	100%
District share	57%	30%	12%	1%	100%

Business scale is also reflected in the turnover estimates. In the region, there were 732 businesses (10%) with a turnover more than \$2 million a year.

Table 11: Business numbers and turnover (ABS catalogue 8615, 2015)

Industry	Zero to \$50k	\$50k to \$100k	\$100k to \$200K	\$200k to \$500k	\$500k to \$2m	\$2m +	Total
District area	72	49	45	67	53	18	304
District share (%)	24%	16%	15%	22%	17%	6%	100%
Region	1,513	983	1,173	1,479	1,451	732	7,331
Region share (%)	21%	13%	16%	20%	20%	10%	100%

2.6 Employment

Mining provided the largest number of jobs in the district in 2011 with 44% employed in that sector followed by manufacturing (15%) (Table 12).

Table 12: Area employment by industry

Industry	Wiluna	Leonora	Sandstone	District	District Share (%)	WA Share (%)
Agriculture	11	8	3	22	1%	2%
Mining	258	652	8	918	44%	6%
Manufacturing	180	129		309	15%	8%
Construction	68	95	7	170	8%	11%
Wholesale Trade		17		17	1%	4%
Retail Trade	4	21		25	1%	10%
Hospitality	29	86		115	6%	6%
Transport, Postal and Warehousing	9	39	4	52	3%	5%
Information services						1%
Professional/Scientific/Technical Services	17	23		40	2%	7%
Administrative and Support Services	32	23		55	3%	3%
Public administration and safety	44	56	13	113	5%	6%
Education and Training	17	58	6	81	4%	8%
Health and social assistance	27	33		60	3%	11%
Other	24	61	3	95	4%	8%
Total	720	1,308	44	2,072	100%	100%

Industry sectors almost entirely missing from the region (less than 5 companies) include water and energy services, and information services.

The employment data at the census needs clarification. The business register recorded only 6 businesses in the manufacturing sector in June 2015 and none with any employees while the census recorded 309 people employed in manufacturing. It is highly likely that 180 employees in Wiluna Shire were

engaged in the Magellan lead project or the Mt Keith nickel project. Those in Leonora were probably working on the Leinster nickel projects. While the description of manufacturing may be statistically correct, they are best regarded as mining sector employees for this study being reliant on local mining operations. Combining these sectors means that very close to 60% of the jobs at the 2011 census were in the mining industry.

Further clarification of the role of mining in the region can be gained from the census details that record individual's location on census night (enumeration rather than residence).

Most jobs are in machinery operations (29%) followed by technicians and trades (25%) (Table 13).

Table 13: Employment role

Industry	Wiluna	Leonora	Sandstone	District	District Share (%)	WA Share (%)
Managers	39	94	10	143	7%	12%
Professionals	108	160	4	272	13%	20%
Technicians, trades workers	196	312	6	514	25%	17%
Community, personal service workers	41	59	3	103	5%	9%
Clerical, administrative workers	37	101	4	142	7%	14%
Sales workers	3	24		27	1%	9%
Machinery operators and drivers	198	395	9	602	29%	8%
Labourers	91	159	6	256	12%	10%
Other	10	13	3	26	1%	1%
Total	723	1,317	45	2,085	100%	100%

Given the number of mine camps in the area, census statistics recorded by place of enumeration rather than residence provide another picture of employment in the region. The head count in 2011 was 6,529 with the resident population put at 3,777 (Table 14). While some of the extra people would have been tourists, family visitors and business people, the large number (extra 73%) suggests many were in mining camps. The number of people employed was similarly greater while the potential labour force (over 15 years) was close to 6,000 - nearly double the 3,236 residents employed. Nearly 2,000 people were recorded as working in the mining sector compared with only 918 residents.

Table 14: Workforce by enumeration (2011)

Measure	Wiluna	Leonora	Sandstone	District
Population enumerated	2,016	4,344	169	6,529
Employed	1,360	2,493	54	3,907
Workforce	1,408	2,533	57	3,998
Potential labour force	1,871	3,922	149	5,942
Mining	505	1,408	13	1,926
Mining	37%	56%	24%	49%

The resident workforce in the region was estimated at 53,000 in 2011, more than 13 times that in the district. Clearly, the region has far greater capacity to provide workers than the small district population and workforce.

The pattern of employment in the geographic areas used is very different. Mining provides 44% of the jobs in the district falling to 21% in the region and 8% in the State (Table 15). There is a low proportion of the workforce engaged in wholesale and retail trade in the district (2%) compared to 12% in the region and 14% in Western Australia. These businesses are missing from the district as are businesses involved in education and training and health services. Combining mining and manufacturing means that virtually 60% of the jobs in the district are mining based compared with 27% in the region and 14% in the State. This is clearly a mining dominant region.

Table 15: Employment by industry

Industry	Region Share (%)	District Share (%)	WA Share (%)
Agriculture	6%	1%	2%
Mining	21%	44%	6%
Manufacturing	6%	15%	8%
Construction	8%	8%	11%
Wholesale Trade	3%	1%	4%
Retail Trade	9%	1%	10%
Hospitality	6%	6%	6%
Transport, Postal and Warehousing	5%	3%	5%
Information services	1%	1%	1%
Professional/Scientific/Technical Services	3%	2%	7%
Administrative and Support Services	2%	3%	3%
Public administration and safety	6%	5%	6%
Education and Training	8%	4%	8%
Health and social assistance	8%	3%	11%
Other	9%	4%	8%
Total	100%	100%	100%

2.7 Economic output

Statistics on the value of economic output for the Shires are not available. An estimate can be made for this study using different sources. The Department of Mines and Petroleum estimated mineral production in 2015-16 for Leonora and Wiluna and Three Springs at \$1,965 million. Removing the talc and gypsum (primarily produced in Three Springs) gives an estimate for Wiluna and Leonora of \$1,953 million. The Sandstone contribution is considered negligible.

Business turnover can be estimated from ABS business numbers and the distribution of turnover reported in June 2015. The turnover mid-point for the \$2 million plus category is put at \$4 million on the basis that larger businesses are likely to have been included in the minerals estimate. Using all 305 businesses in the Meekatharra and Leonora areas is an over-estimate but suitable for the broad purposes of this study. The total is \$200 million.

There will be some individual income that is earned by people resident in the area but working in other areas and income from those in receipt of various government pensions and benefits. These are likely to be relatively small in the context of this study.

The total value of output in the region for this study is thus put at \$2,150 million. The mining sector contributes over 90% of this value.

Output in the region also reflects the importance of the mining sector but other sectors are substantial and the output more diverse (Table 16). The total value of output is estimated at \$28,390 million, more than 13 times the district level.

Mining and manufacturing provide a combined 56% of the output in the region compared with about 90% in the district.

Figure 16: Region output by industry (top five sectors)

	Mid-West (\$m)	Goldfields-Esperance (\$m)	Region (\$m)	Region Share (%)
Mining	3,380	8,448	11,828	42%
Manufacturing	1,330	2,652	3,982	14%
Construction	1,244	1,275	2,519	9%
Rental, hiring,	816	981	1,797	6%
Agriculture	556	345	901	3%
Transport etc.	501	605	1,106	4%
Other				22%
Total	10,829	17,565	28,394	100%

2.8 Precip of project setting

The proposed Yeelirrie uranium mine is in a remote region of Western Australia. The area is arid with most land used for animal grazing on native grasses/bushes.

There are two small towns near the project area - Wiluna (70km) and Leinster (120km). Leinster is a closed company town and unlikely to provide goods and services to Cameco. The next closest town with services after Wiluna is Leonora which is close to 200km.

There are some small Aboriginal settlements in the area that can provide employees but they do not have any substantial business enterprises.

Towns in the area owe their existence to the discovery of gold. Mining has been the dominant economic sector and the pastoral industry the dominant land use for over a century.

The mine and camp will be on the Yeelirrie Pastoral Station which is owned by Cameco. There will be negligible economic impact at this local level.

The district for this study is defined as the three Local Government Areas situated around Yeelirrie Station – Wiluna, Leonora and Sandstone.

The three Shires had an estimated resident population of 3,737 in 2015 representing a very small 0.14% of the State population. Sandstone Shire has a tiny and declining population.

The Aboriginal share of the population is high particularly in Wiluna.

The total workforce resident in the district is very small at just over 2,000 in 2011. There is a substantial additional number of workers living in mine camps and commuting from other areas on fly in-fly out rosters. While they add more than 60% to the local workforce, they are not available for **recruitment to the Yeelirrie project as “local” workers.**

Mining provided an estimated half of the jobs in the region and more than 90% of the estimated value of economic output.

Wiluna and Sandstone have a high level of social disadvantage. Leonora Shire is more prosperous with a high proportion of the workforce in mining.

Business capacity in the area is very limited. The ABS Regional Profile records 33 businesses in Wiluna of which only 15 employ staff. Leonora is reported as having 87 businesses many of which are pastoral stations.

The limited local business capacity will restrict the contracts that can be awarded to local suppliers. Most goods and services are thus likely to be provided by larger business centres - Kalgoorlie, Geraldton and Perth.

The broader region encompassing the Goldfields-Esperance and Mid-West has a substantial population and workforce and a business capacity that is an order of magnitude more than the defined district. This region also has a strong mining sector and many mine services businesses and has the capacity to provide much of the goods and services the project requires.

3. The Project

3.1 The production process

Mining is expected to be undertaken from several relatively shallow pits averaging about 10 metres in depth. The ore will be trucked to a crushing, wet milling and screening plant. The processing plant will use an alkali tank leaching process, followed by direct precipitation.

The uranium oxide concentrate commonly known as yellowcake will be packaged into drums and sealed shipping containers and transported to Adelaide for export.

The residual tailings material will be retained by replacing them back into engineered tailings storage facilities located within the mined out open pits.

The low radioactivity grade of the original ore at Yeelirrie means that the tailings are also relatively low in radioactivity. Most the radioactivity associated with the mined ore remains in the tailings and is disposed of in the tailings storage facility.

At the end of the mine's operational life the tailings storage facility will be stabilised and capped to ensure that there is no dust from the tailings and that radon gas emanation is minimised.

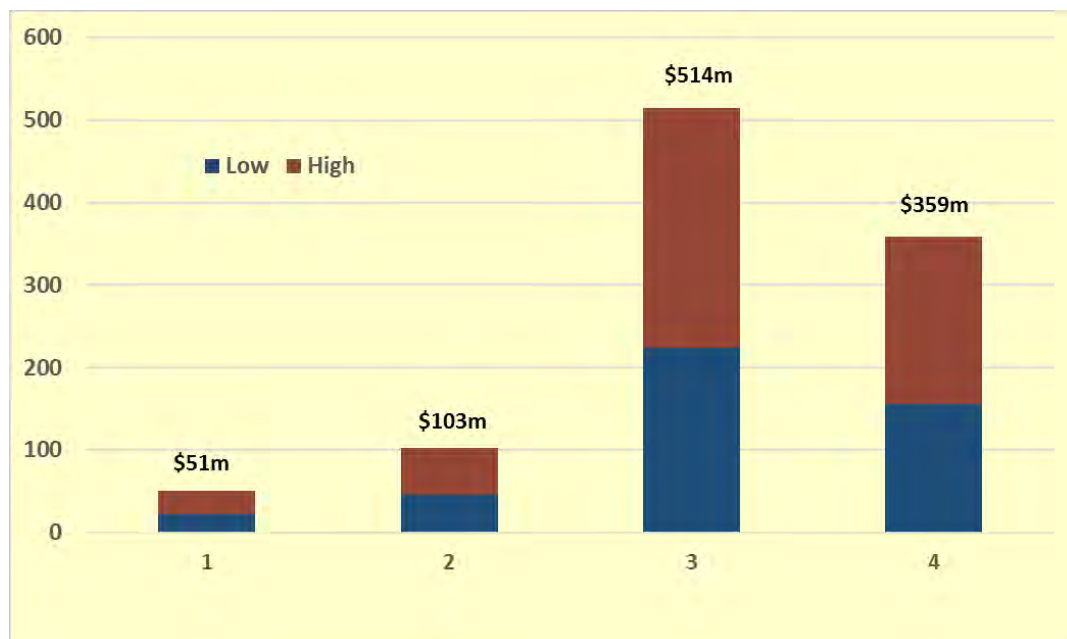
The uranium concentrate produced at Yeelirrie is only mildly radioactive and can be shipped in normal shipping containers to overseas destinations in compliance with State, National and International regulations.

Water will be used in the process plant and will be sourced from groundwater near the project. Water will be recycled and any wastewater treated to ensure minimal environmental impact.

3.2 Timeline

Development of the Yeelirrie mine will be considered when uranium prices improve **considerably from today's historic lows**. The project is still in the prefeasibility stage and hence accurate financial data is not available. Preliminary studies to a prefeasibility level of engineering definition have provided a range of costs with the variation dependant on the accuracy of the capital and operating cost estimates for the mining and engineering studies (nominally +/-30% cost estimation accuracy). The establishment cost range at this stage is from an estimated \$580 million to \$1,077 million (m).

Figure 8: Capital Expenditure – high and low estimates by year



3.3 Development costs

The proposed development will involve the construction and operation of infrastructure to support mining and processing:

- Quarry to provide raw construction materials
- Dewatering system consisting of trenches, sump drains and pumps to lower the groundwater in the pit and provide process water
- Water supply borefield to supplement the water obtained from pit dewatering
- Drainage system to exclude water from the mining area, the tailings and the stockpiled ore
- Electricity supply network powered by natural gas fired generators
- Buildings, including workshops, offices and warehouses
- Accommodation village catering for a peak on-site construction and mine pre-production workforce of up to 650
- Associated infrastructure including potable water and sewage treatment plants

The project will use existing regional and national infrastructure, including:

- Road and rail network between Perth, Esperance, and Kalgoorlie-Boulder for the import of materials
- Port facilities at Adelaide for the export of concentrate
- Airport facilities at the BHP Billiton Nickel West Pty Ltd Mount Keith operation, coupled to a bus service between Mount Keith and Yeelirrie for the movement of the (FIFO) workforce

3.4 Workforce

The workforce will operate on a fly in- fly out basis using the Mt Keith airport as a base then travelling to the mine by bus. A drive in-drive out service may also operate from either Leonora and/or Wiluna for workers residing in the area depending on recruitment numbers. Private vehicles may access the accommodation village.

Cameco has a strong tradition of engagement with the Traditional Owners of the regions where it mines and has achieved high levels of workforce participation in Canada.³ The Company has established sound working relations with the Martu people in the eastern Pilbara and is confident it can work in a similar way with the Aboriginal people in Wiluna and Leonora. The company will strive for a 15% Indigenous employment target.

This study adopts a 10% local employment level on the basis that a conservative approach is important to ensure the local benefits of the project are not over-stated. The region also has a significant mining presence and most people who want to work in this industry will have had access to employment in the past.

Manpower estimates are still preliminary and range from an average of 310 to 560 over the two-year establishment and construction phase (Table 12).

Table 17: Labour in construction phase (FTE)

Scenario	Total	District	Other Region	Other WA	Other Aust.
High case	560	55	168	280	57
Low case	310	30	93	155	32
Share (%)		10%	30%	50%	10%

During construction, 10% of the workforce is assumed to be recruited in the region, 80% from Western Australia and 10% from other States.

3.5 Construction phase

Development, or construction, costs have been broken down into the nature of the expense (Table 18). Materials are the major cost item representing more than 55% of the total in each case.

³ In northern Saskatchewan, where Cameco has been operating of 30 years, the Companies preference is to hire locally In 2015 the numbers of local employees made up over 49% of total employees (www.cameco.com/sustainable_development/2016/gri-index/#EC6)

Table 18: Development costs by nature of expenditure (\$'million)

Cost Item	Low case	High case
Site labour	73	126
Offsite labour	3	3
Materials	461	869
Professional Services	43	79
Total	580	1,077

Development costs can also be categorised by the location of the spend (Table 19). Labour is allocated based on where the workers are expected to be permanently resident.

Table 19: Development costs by region of expenditure (\$'million rounded)

Region	Low case	High case	Share (%)
District	25	45	4%
Rest of Region	150	280	26%
Rest of WA	250	482	45%
Rest of Australia	105	195	18%
Overseas	40	75	7%
Total	580	1,077	100%

While around 10% of construction labour is sourced from the district the capacity to contribute materials and large construction services for large projects is limited to an estimated 4% of the cost. An estimated 26% can be sourced from the broader region bringing the total spend in the region to 30% or \$175m in the low-cost scenario and \$325m in the higher cost scenario. Expenditure in the rest of the State is estimated at 45% taking total State expenditure to 75 with 18% in the rest of Australia. Only a small proportion of the expenditure goes overseas –7%.

3.6 Operating costs

Mining of the pit will use standard surface mining equipment, such as excavators and front-end loaders in conjunction with haul trucks and scrapers, to remove the ore and overburden. Minimal drilling and blasting is required as the ore is generally friable.

The mining fleet will consist of 3 to 6 excavators, or similar surface mining equipment and about 12 haul trucks. Standard surface mining support fleet would include water trucks, graders, drill rigs (for grade control) and bulldozers.

The processing plant will handle about 2.4 Mtpa of ore and produce up to 7,500tpa of uranium oxide concentrate (UO₄) in peak years averaging 3,850tpa over the 15-year project life. The extraction involves a heated alkali leaching process with direct precipitation of sodium diuranate (SDU) using sodium hydroxide (caustic) and refining the SDU to produce a uranium oxide concentrate with flexibility to produce UO₄, UO₃ or U₃O₈.

The mine and plant will operate continuously for the 15 years. Water will come from dewatering of the pit and a borefield while an 18MW gas fired power plant will supply energy.

Workforce estimates are still preliminary and range from 230 to 410 for the fifteen-year operating phase (Table 20).

Table 20: Labour in the operations phase (FTE rounded)

Scenario	Total	District	Other Region	Other WA	Other Aust.	Overseas
High case	410	40	82	205	62	21
Low case	230	23	45	115	35	12
Share (%)		10%	20%	50%	15%	5%

Like construction, 10% of the workforce is assumed to be recruited in the district, 20% from the remainder of the region, a total of 70% from Western Australia and 20% commuting from other States or overseas.

The operating costs for the mine have been estimated for an average year over the life of the mine. Most costs such as labour, energy and chemicals will not vary much from year to year. Operating costs are for the mine, processing plant and concentrate transport to port. They also include investment in plant and equipment to maintain the project. While this is treated as a capital expenditure for company reporting and taxation purposes, it is annual expenditure that benefits the economy. The nature of sustaining capital is like operating expenses and is included in this study as an operating cost.

The most significant cost for the mine is chemicals for the processing plant followed by sustaining capital, labour and energy (gas and diesel fuel). These four cost categories represent around 68% of the total (Table 21).

Table 21: Operating costs by nature of expenditure (\$'million)

Cost Item	Low case	High case	Share (%)
Sustaining capital	19	35	10%
Labour	28	50	15%
Energy	20	37	11%
Chemicals	62	116	33%
Other materials	13	25	7%
Services	1	2	1%
Other	40	80	22%
Transport	4	4	1%
Total	187	347	100%

Operating costs are primarily incurred overseas (chemicals) and within the State (labour) with regional and interstate expenditures relatively small in comparison (Table 22).

Table 22: Operating costs by region of expenditure (\$'million rounded)

Region	Low case	High case	Share (%)
District	9	17	5%
Rest of Region	37	70	20%
Rest of State	56	104	30%
Rest of Australia	21	38	11%
Overseas	64	118	34%
Total	187	347	100%

A relatively small proportion of operating inputs (5%) are sourced in the district due to the isolation of the mine from nearby towns and mining service centres. However, the business capacity in the region means that a further 20% can be sourced from this area bringing total region expenditure to an estimated 25% which is from \$46m to \$87m a year.

The relatively high proportion of expenditure that goes overseas is a result of two major cost items - diesel and sodium hydroxide. Another important cost item, sodium carbonate is sourced interstate.

4. Economic Impacts - Multiplier Analysis

4.1 Evaluating the economic impact of projects

The impact that a new project has on a region and the broader economy is determined by the amount of investment and the size of the economy.

A large project or group of smaller projects will create substantial flow-on effects for other industries and wage and salary earners. Purchases from suppliers will create employment and investment opportunities in supply businesses while wages and salaries allow employees to acquire accommodation, hospitality, recreation and cultural services. However, workers will be attracted from other industries putting pressure on wages and salaries and the export earnings may place upward pressure on Australian dollar exchange rates. Hence, the project will produce both positive and negative impacts on other businesses in the economy.

Several methods can be used to estimate a project impact. In this report, a multiplier approach is used to examine the positive flow-on effects at a district, region and a State level. A computerized general equilibrium model is also used to assess the region and State level impacts with a greater emphasis on long term adjustments in these economies (Chapter 5). Both approaches provide useful insights into economic impacts.

4.2 Multiplier analysis

Multiplier analysis is a standard tool used to assess the flow-on effects on income, investment and employment. The multiplier effect operates because the operating or investment expenditure requires the purchase of labour, goods and other services and these purchases generate further flow-on expenditure. At each round of investment and expenditure the effect diminishes until a final total increase in the economy can be calculated. It is the ratio of the size of the initial expenditure to the resultant final increase across the economy that is termed the multiplier.

Multiplier ratios are derived from tables of the transactions in an economy which show the linkages between industries and the flows of goods and services used in producing their output. The size of the multiplier ratio depends on several factors including the ability of the economy to supply the goods needed. If a large proportion of goods are imported, the multiplier will

be smaller. Consequently, the multiplier effect in a small regional economy will be less than for a larger regional or national economy, as there will be considerable imports from outside the area. A project will thus have relatively small multipliers for a local economy and larger multipliers for the State.

Input-output tables are a representation of the economic interactions within a region - they demonstrate the trade relationships between industries and consumers. Input-output tables are presented in either transactions or coefficient form. The transactions tables show flows between industries in dollar amounts while the coefficients tables show the proportion of each **industry's inputs derived from the other industries.** Through the manipulation of the coefficient table, various types of input-output multipliers can be derived. The type selected for analysis depends upon the requirements of the application.

The multipliers used in this report demonstrate the economic impacts in terms of the incomes generated, changes in economic output and changes in employment. The output multipliers represent the increase in goods and services produced by the economy, the income multipliers show the increase in wages and salaries, and, finally, the employment multipliers show employment growth. A total multiplier has been used (Type 2A) which gives the direct and indirect impact; that is, the total multipliers include both the direct and flow-on effects.

If for example, a new project increases the value of production from an industry by \$100 million, this will produce an increase in the output of those industries supplying it such as fuel, transport, chemicals, equipment etc. This in turn increases the demand from those industries that supply their inputs. The initial effect is termed the first-round effect or production-induced impact while the second-round effect is termed the industrial support impact. The increase in job numbers will mean more wages and salaries paid because of the increased production. This generates the third-round effects, or consumption induced impacts. To illustrate, total output of \$100 million with a multiplier of 2.08 could thus produce:

- A first round or production impact of \$38 million;
- A second and subsequent supplier impact of \$28 million; and
- A consumption induced impact of \$42 million.

The total impact of \$208 million is a multiple of 2.08 times the initial increase in output (\$100 million). This report does not separate out the second and third round effect; with indirect impacts including both.

The output generated by a change in expenditure is measured in dollars, while employment impacts are in full time equivalent jobs.

The multipliers used in this study are based on input-output tables produced by the ABS. Careful judgement has been used to ensure that the multipliers are defensible and hence they consider a range of other studies including models of the State, Pilbara and Kimberley and tables developed by the Gascoyne and the Goldfields Esperance **Development Commissions (Table 23).**

Table 23: Multipliers

Output	District	Region	WA.
Capital costs	1.33	1.89	2.21
Operating costs	1.60	1.67	2.22
Jobs			
Capital costs	1.97	2.33	2.66
Operating costs	2.37	2.95	3.30

4.3 Construction phase

The direct and total impacts of the development phase for the project are significant for the region and for the State (Table 24). Expenditure on Interstate and overseas purchases are excluded on the conservative basis that they will no impact on the State economy.

Table 24: Construction phase – economic output impact of construction

	Impact of Construction Phase			
	Direct Effect		Multiplied Impact	
Area	Low Estimate (\$million)	High Estimate (\$million)	Low Estimate (\$million)	High Estimate (\$million)
District	25	45	33	60
Region	175	325	331	614
State	425	807	939	1,783

Source: ECS

The economic output of the **State** is expected to grow between \$939m and \$1,783m because of the investment in this project. This injection into the state economy occurs over the relatively short period of around 30 months, amounting to an average of \$375m to \$713m a year during construction.

The project will provide opportunities for workers and businesses in the region. The district and region have expertise in mining and construction and will be able to provide employees and services. Transport operations will also provide opportunities. The impact in the Goldfields-Esperance and Mid-West region is estimated at between \$331m and \$614m. This represents around 35% of the total State impact.

Notwithstanding the limited duration of the impact, the construction phase for the expansion will result in a boost to the district economy. Of the increase in total output for the State, the district will gain between an estimated \$33m and \$60m.

Employment generated during the construction phase across Western Australia is estimated to average 739 to 338 full time equivalent (FTE) jobs over the 2.5-years (Table 25). These jobs originate from direct employment on the project, indirect employment generated from money spent on goods and services within Western Australia by the project and flow-on multiplier impacts on employment in the State. Of those jobs, 59 – 108 FTE are sourced from the district and a total of 290 to 522 from the region. Cameco aims to achieve an Indigenous employment of between 30 and 55 people (10% of workforce) and is hopeful a higher level can be achieved.

Table 25: Construction phase – increase in employment during construction

	Direct project employment		Multiplied impact	
Region	Low Estimate (FTE)	High Estimate (FTE)	Low Estimate (FTE)	High Estimate (FTE)
District	30	55	59	108
Region	123	223	290	522
WA	278	503	739	1,338

Source: ECS

4.4 Impacts of Operations Phase

While its annual impact will be less than for the construction phase, the operations phase will have a more enduring impact over the expected mine life of 15 years.

The annual impact is estimated assuming a constant output 3,850 tonnes of Uranium Oxide a year. Operating expenditure is estimated to be between \$187 million and \$347 million per annum, not including \$28 million per annum payable to the Western Australian government in royalty payments which are regarded as a transfer payment that does not multiply through the economy. The purchase of diesel fuel and chemicals overseas means that the project will spend around \$120m per annum on imports that won't contribute directly to the Australian economy and are excluded. If the diesel or fuel was purchased in Australia, the impacts would be greater than estimated here.

The project will have a strong multiplier impact in the region and Western Australia during the operating phase generating between \$77m and \$145m a year of economic activity in the region and between \$226m and \$424m in the State (Table 26). The share of this going to the district is estimated to be 18% of the gain in the region. This is a significant injection for the small district economy.

Table 26: Economic impact of annual operating expenditure

	Direct Effect		Multiplied Impact	
Region	Low Estimate (\$'million)	High Estimate (\$'million)	Low Estimate (\$'million)	High Estimate (\$'million)
District	9	17	14	27
Region	46	87	77	145
State	102	191	226	424

The project is estimated to employ between 230 and 410 persons, of which the major share (about 80%) will come from within the State. A multiplier effect comes about in two steps. In the first step, goods and services purchased for the project include a labour component. For example, in the low scenario, in addition to the direct employment of 23 local jobs, the expenditure of \$13m in the region includes another 8 jobs bringing the region labour impact to 30 jobs.

These employees will in turn purchase goods and services to meet their living needs creating a second round of flow on impacts that bring total jobs in the region to 55 (Table 27).

The addition of 55 to 95 jobs represents around a 1% increase in the number of jobs in the region.

The company objective is to create jobs for locals, particularly indigenous persons, and hence the share of regional jobs which are filled by residents is expected to be at least 10% and the company looks on this as a floor level.

Table 27: Operating phase – increase in employment (FTE)

Region	Direct project employment		Multiplied impact	
	Low Estimate (FTE)	High Estimate (FTE)	Low Estimate (FTE)	High Estimate (FTE)
District	23	40	55	95
Region	67	122	200	360
State	182	327	604	1,080

New projects lead to an expansion in State mining output and this increased output calls for inputs from, and an expansion in production from, the manufacturing, utilities, transport, and property sectors. Since mining operations cause a large net increase in Western Australian consumption levels, sectors that sell primarily to domestic consumption also do well because of this sort of project being established in the State. These sectors include dwellings, personal and other services, cultural and recreational services, communications, accommodation, cafes and restaurants. At the local level, one of the most obvious impacts will be on road transport and transport logistics.

The project will have an estimated uranium sale value of around \$500m a year for 15 years based on a long-term average price of \$A60 a pound. This output represents close to a 25% addition to the estimated current value of regional production.

5. Economic Impacts – GE Model

5.1 Introduction

This chapter examines the economic impacts using a computable general equilibrium model (CGE). The model differs from an input-output analysis in that it solves for both prices and quantities together. The dynamic model used is based on linkages between investment and capital across time, and the balance of trade and net foreign liabilities. Investment and balance of trade outcomes are flows that can be modelled using a static model while capital and net foreign liabilities are stocks that require a dynamic model.

Construction projects rely on borrowings or foreign funding. Once a project is operational, foreigners are re-paid part of the earnings, either through interest payments on loans or through earnings on new their capital. In calculating income available to Australians, the outflows in the form of interest payments or foreign earnings are deducted from GDP. The project impact on national welfare can then be estimated after allowance for the outflows.

A project may result in a national welfare loss if eventual returns to investment are low through, for example, output prices falling below expectations.

The model used in this study (TERM) was originally developed by Mark Horridge at the Centre of Policy Studies at Monash University. Professor Glyn Wittwer has developed a dynamic version which includes an underlying macro-economic forecast based on the forecasts of other agencies. This underlying forecast provides a “business as usual” scenario in which year 1 is 2017. While the project does not have a start date, it is necessary to “anchor” the project to a forecast and the results are considered sufficiently robust that similar outcomes will result for a later start time.

Each region in the model has its own production functions, household demands, input-output database and inter-regional trade matrices thus enabling the analysis of relatively local issues.

The results reported in this study are regional real GDP, employment and aggregate consumption as well as the impacts on other industry sectors.

The model is based on 182 industry sectors which is more than the ABS transactions tables as the database splits agriculture, mining, electricity, health and education sectors into sub-sectors. There are 205 regions in the full Australian model representing ABS statistical sub-divisions.

The region defined for this study includes six statistical sub-divisions (SSDs) - Kalgoorlie, Lefroy, Johnston, Geraldton, Carnegie and Greenough River (Figure 9). This aggregation reflects the expectation that labour and other goods and services will be drawn almost entirely from outside the statistical division in which the project is located.

Figure 9: Study regions (add Esperance)

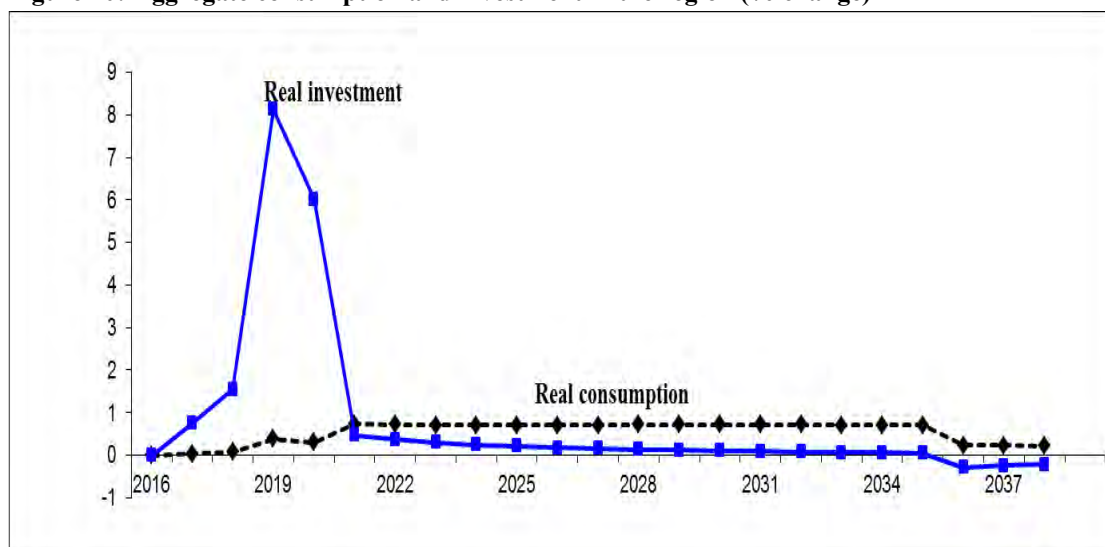


5.2 The construction phase impacts on the labour market

The construction phase entails expenditure of \$828 million over a four-year period.

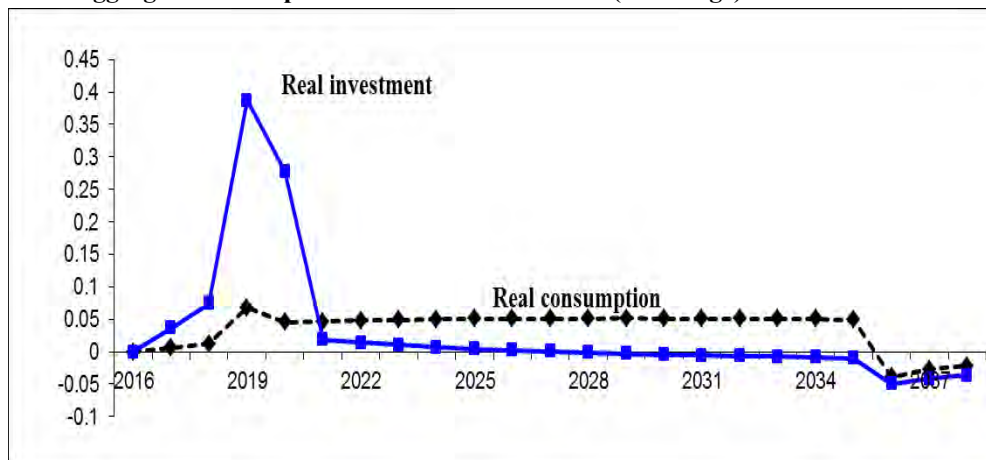
Total investment in the region rises above the base case by 1% in 2017, 2% in 2018, 8% in 2019 and around 6% in 2020 (Figure 10). The impact on aggregate consumption in the region is relatively minor.

Figure 10: Aggregate consumption and investment in the region (% change)



The impact at the State level is understandably smaller with an increase of 0.4% forecast in the peak year of 2019 (Figure 11). Aggregate consumption rises over time to around 0.5% above the base forecast.

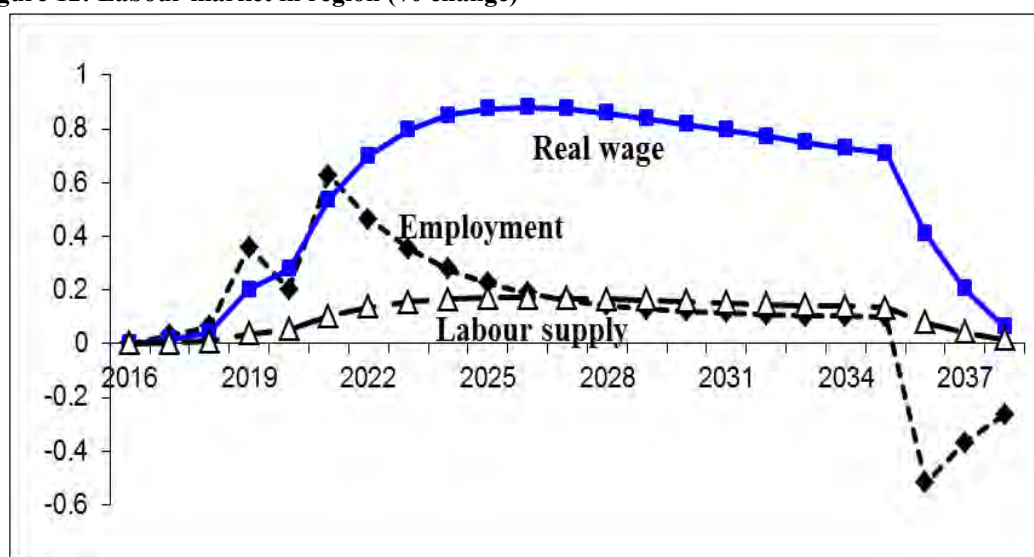
Figure 11: Aggregate consumption and investment in WA (% change)



The construction phase leads to a strengthening of the labour market with the impact dependent on the assumptions used to model changes in wages with rising labour demand. A sticky wages assumption has been used meaning that in the early years of the project, real wages move slowly upwards. This means that choking of additional employment through higher wages occurs in later years rather than the early years. The assumption that real wages adjust at the regional level is more appropriate than assuming such adjustment occurs at the national level with perfectly elastic (i.e., real wages adjust equally across all regions) labour mobility. The mining boom in WA over the past decade has demonstrated that very high wages are needed to attract workers to remote regions.

The impact of the construction phase on the region is relatively minor, reflecting both the size of the project and the reliance on inputs from outside the region (Figure 12).

Figure 12: Labour market in region (% change)



The increase in jobs in the region relative to the business as usual scenario is estimated at 15 full-time equivalent (FTE) in 2017 rising to 180 in 2019 (Table 28).

Table 28: Construction phase – increase in jobs (FTE)

Year	Region	State	National
2017	15	50	190
2018	30	100	360
2019	180	570	2,200
2020	100	270	890

Over the State there is an increase of 570 jobs in the peak construction year.

Besides reflecting the stimulus outside the region of the mine, the interstate job increase implied by these numbers reflects a smaller proportional choking of jobs by higher wages at the national level. For example, real wages in 2019 are 0.03% higher in WA (Figure 13), but less than 0.01% the national level (Figure 14).

Figure 13: Labour market in WA (% change)

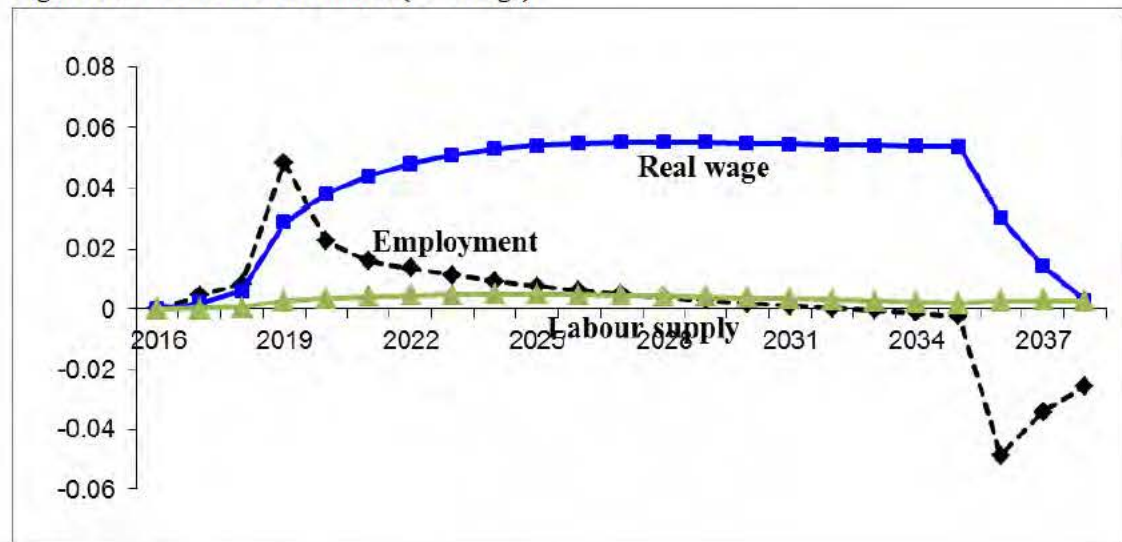
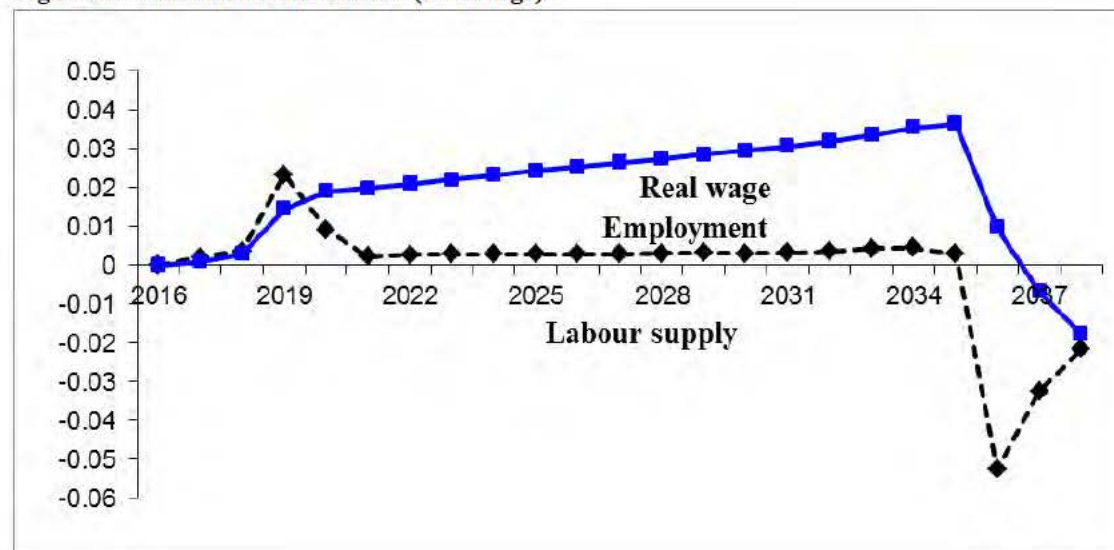


Figure 14: National labour market (% change)



5.3 The operational phase impacts

The dynamic nature of the model and the adjustments that occur in the economy mean that after the construction phase, aggregate investment returns to a little above base in both the region and the State as whole.

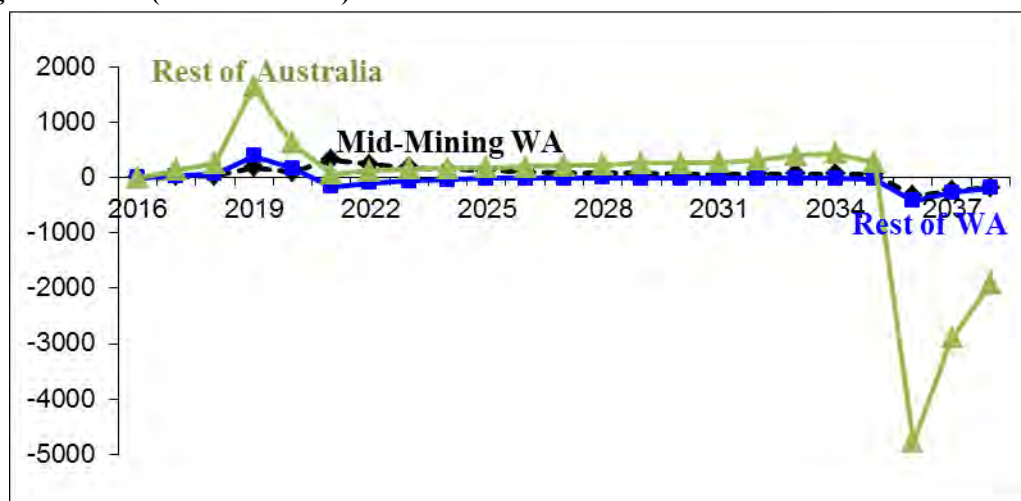
The operating phase commences with real wages in the region already around 0.6% above forecast from the stimulus of the construction phase. In this case, higher real wages do not translate into jobs falling relative to forecast, because the mine operations raise the marginal product of labour sufficiently to cover higher wages. Since aggregate consumption continues to rise relative to base over the duration of the operating phase, there is a spending effect which further strengthens the local labour market over time (Figure 11).

During the operations phase, labour supply in the region eventually meets employment (labour demand) in 2027 (Figure 13). At this point in time, real wages cease to rise relative to base in the region.

Region jobs peak at 320 FTE above forecast in the first year (referred to as Mid-Mining in the graph), and then gradually move back towards base over the operational phase through the impact of higher than base real wages (Figure 15). National jobs are higher by 220 FTE in the first year of operations with 70 FTE in the Rest of Australia.

In Western Australia, wages cease to rise once labour supply meets demand for employment. Thereafter, the higher wages lower employment back towards forecast (Figure 15). A similar trend occurs at the national level even though there was a smaller increase in real wages (Figure 15).

Figure 15: Jobs (FTE above base)



In the rehabilitation phase, region employment falls below labour supply, thereby exerting downward pressure on regional real wages (Figure 12). This impact is reflected at the state-wide level (Figure 13). Nationally, the weakened labour market combined with persistent above-base real wages is sufficient to bring employment below base (Figure 15). National employment will not return to base until real wages have adjusted sufficiently downwards.

The region sees a peak of 320 jobs while the rest of Western Australia also sees a peak increase over the base forecast of 350 jobs (Table 29). The model formulation means that wages adjust nationally and a restructuring of jobs means that in the long-term, there is no gain in Australian jobs but real wages have increased.

Table 29: Operations phase – increase in jobs (FTE)

Year	Region	Rest of State	Rest of Australia
Peak	320	350	2,200

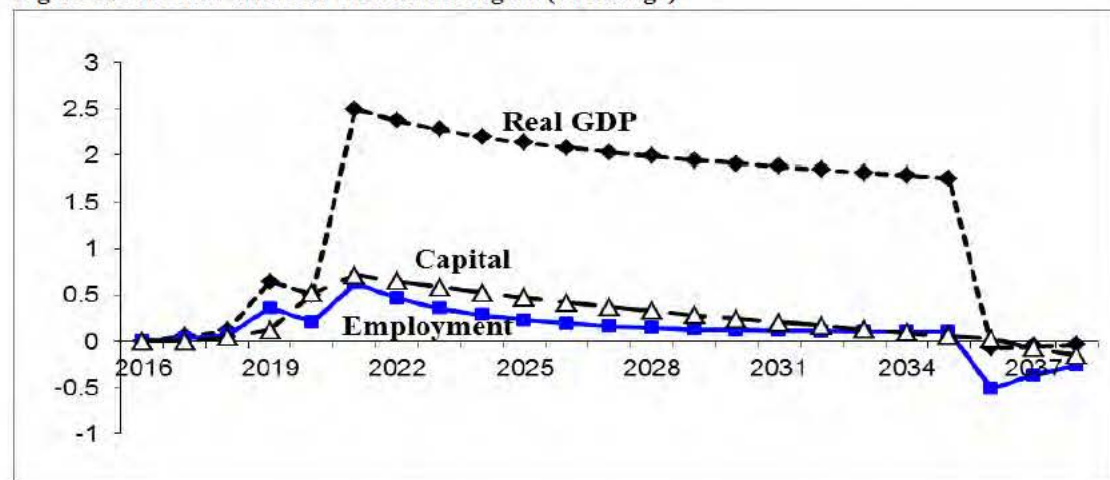
5.4 Impacts on Gross Domestic Product

GDP is a function of labour (L), capital (K, including land) and technology (A):

$$GDP = f(L, K, 1/A)$$

During the operational phase, real GDP in the region is greater than the share-weighted sum of capital and labour (Figure 16). This reflects the technological gain (i.e., increase in output per unit of inputs, implied by ore extraction) that occurs during the operational phase of the project.

Figure 16: Income-side real GDP in the region (% change)



State and national GDP peaks in 2020 and then slowly falls to the end of the operations period (Figure 17, 18).

Figure 17: Income-side real GDP in WA (% change)

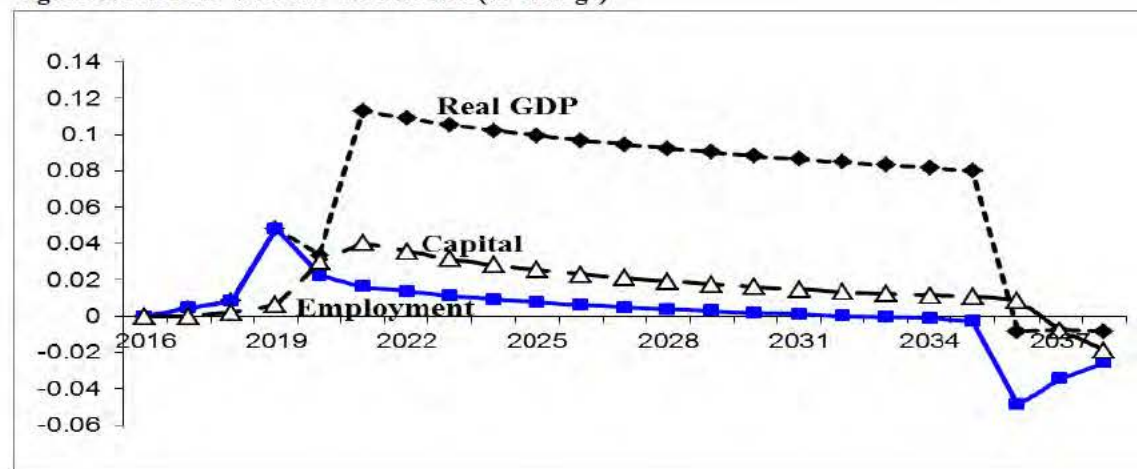
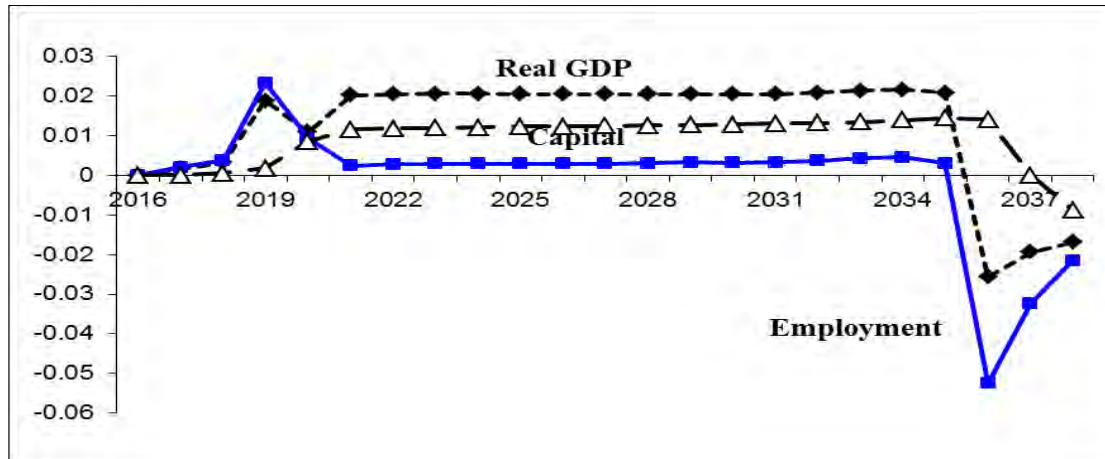


Figure 18 Income-side real GDP, national (% change)



The rehabilitation phase entails retiring working capital in the mine. This results in a fall in real GDP below base in the project region. Although some employment remains at the mine during the rehabilitation phase, aggregate regional employment falls below base due to the persistence of higher than base wages (see Figure 12).

Investment in the project pushes up wages in other sectors of the economy thus reducing the competitiveness of industries that are not beneficiaries of the project. Consequently, export-oriented sectors including agriculture and mining other than non-ferrous ores, plus other manufactures suffer output losses relative to base (Table 30). Indeed, during the rehabilitation phase, higher wages reduce non-ferrous ores output relative to forecast (reflecting the change in output in the rest of WA).

Other Services has an output gain relative to forecast. This is because state-wide aggregate consumption rises relative to forecast. Increased consumption increases demand for those services which are relatively non-traded. Therefore, state-wide output of Other Services rises to satisfy increased state-wide demands.

Table 30: WA industry outputs (\$m change, 2016 prices)

	2016	2017	2018	2019	2020	2021	2024	2027	2030	2033	2036	2038
Agriculture	0.0	-0.1	-0.2	-1.2	-1.2	-2.4	-2.9	-3.0	-3.0	-3.0	-0.1	0.2
Mining	0.0	-0.3	-0.6	-3.5	-3.4	-7.1	-9.1	-9.4	-9.1	-9.0	3.4	4.3
NonFeOres	0.0	0.0	0.0	0.0	0.0	167.0	164.6	168.2	176.2	188.6	-143.5	-152.2
Other Manuf	0.0	0.0	-0.1	-0.3	-0.4	-1.0	-1.6	-1.8	-1.8	-1.8	-1.1	-0.7
Oth NonFeMtl	0.0	0.0	-0.1	-0.3	-0.3	3.3	4.5	4.9	4.9	4.9	-0.6	-1.3
Utilities	0.0	0.0	0.0	-0.1	-0.1	0.3	0.4	0.5	0.6	0.6	-0.2	-0.1
Construction	0.0	1.9	4.3	22.1	19.9	5.3	1.6	-0.3	-1.3	-1.9	-1.7	-0.5
Trade	0.0	0.2	0.5	2.7	2.1	3.8	3.1	2.7	2.5	2.3	-3.6	-3.4
Hotels/Cafes	0.0	0.0	0.1	0.4	0.3	1.1	1.2	1.4	1.7	1.9	-0.1	-0.2
Transport	0.0	0.0	-0.1	-0.3	-0.5	0.8	0.4	0.4	0.5	0.6	-0.9	-0.6
Info/Med/Telec	0.0	0.0	0.0	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.1	0.0
Fin/Insur	0.0	0.0	0.0	-0.2	-0.2	-0.4	-0.6	-0.6	-0.6	-0.6	-0.4	-0.2
Rent/Hire/REst	0.0	0.0	0.0	-0.1	-0.2	0.2	0.2	0.3	0.4	0.4	-0.4	-0.6
Owner/Dwelling	0.0	0.0	0.0	0.0	0.2	0.3	1.7	2.8	3.5	4.1	4.4	4.1
ProSciTchSrv	0.0	0.0	0.0	0.1	-0.2	-0.6	-1.5	-1.7	-1.8	-1.8	-2.0	-1.3
AdmSupSrv	0.0	0.0	0.0	-0.2	-0.4	0.2	-0.5	-0.7	-0.7	-0.7	-1.9	-1.3
GovAdmSafety	0.0	0.0	-0.1	-0.6	-0.7	-0.5	-1.1	-1.2	-1.2	-1.0	-1.5	-0.8
Education	0.0	0.0	-0.1	-0.4	-0.7	-1.4	-2.1	-2.2	-2.1	-1.9	-1.0	0.2
HealthSocAs	0.0	0.0	0.0	0.0	-0.4	-1.0	-2.0	-2.1	-2.0	-1.9	-0.7	0.7
OthServices	0.0	0.0	0.0	0.2	0.0	9.3	8.0	7.6	7.5	7.5	-10.4	-10.3

5.5 The welfare impact of the project

Welfare is calculated at the national level as the net present value of the year-on-year deviations in private and public consumption minus the real discounted change in net foreign debt in the final year of the simulation:

$$dWELF = \sum_d \sum_t \frac{dCON(d,t) + dGOV(d,t)}{(1-r)^t} - \frac{dNFL(z)}{(1-r)^z}$$

where dCON and dGOV are the deviations in real household and government spending in region d and year t; dNFL is the deviation in real net foreign liabilities in the final year (z) of the simulation; and r is the discount rate. Since dWELF is a stock figure, and usual macro variables such as GDP are reported as flows, dWELF is multiplied by the discount rate to provide an annualised figure.

Welfare is calculated from a national perspective. This is because state-wide macro results may include inter-state migration.

The direct calculation of welfare is \$88m in annualised terms (4% discount rate). There are various reasons why a CGE model computes a different outcome. In the case of this project, a strengthening of the labour market during the construction and operational phases makes a positive contribution to income, and in turn welfare. But the gradual choking off by higher wages should result in a smaller welfare gain than a direct calculation. One CGE impact that makes a positive contribution to welfare is a terms-of-trade gain. This arises through the lower than base outputs of other export-oriented industries (Table 30). Exports face down-sloping export demand curves, so that small decreases in output relative to base will increase export prices relative to base. By assumption, import supplies so are infinitely elastic, so that imports are not affected. GDP includes exports but not imports. Private and public consumption, from which we calculate welfare, include imports but not exports. Since export prices have risen relative to import prices, this implies that the percentage change in spending power (i.e., consumption) is larger than the percentage change in real income (based on GDP). The welfare gain calculated from the CGE model is \$123 million annualised, showing that the terms-of-trade gain dominates the choking off impact of higher real wages, relative to the direct spreadsheet calculation.

6. Indirect impacts

6.1 Introduction

The previous section assessed the importance of this mining operation to the economy of the region, the State and of Australia.

In addition, there are substantial indirect benefits for the wider Australian community. While these benefits are more general in nature, they are significant to the overall performance of the economy and the well-being of communities. These benefits include regional development, government revenues, and the deepening of industrial capacity across the State.

6.2 Regional development

The region is at the margins of economic development areas in Western Australia. The economy is highly dependent on the mining industry for employment and volatile international commodity prices mean a fluctuating local economy. With the terms of trade pressures and changes in long-term climate adversely affecting the pastoral sector, there is limited scope for any substantial expansion of the industry in this area. The mining sector thus provides the only real potential to provide substantial new investment in this area.

The lack of population and local infrastructure means that mining companies rely on long distance commuting with short stay mining camps to house the workforce. Lack of local employment and education services reduce the desire of families to live in remote areas.

This increase in jobs in the region will bring a significant boost for the small local community and for local businesses. Importantly, the project will contribute to the decentralisation of industry away from metropolitan areas. Support for decentralisation is shown by the willingness of State Governments in Australia to offer financial incentives to new industries and firms to move away from capital cities.

Benefits of decentralisation take two forms. The first arises from diverting growth away from capital cities where growth has the potential to create social, economic and environmental costs. The second accrues to the area in which growth occurs, because such areas are often too small for the effective delivery of business and government services, and expansion creates new business opportunities in these support services.

The growth of regional cities like Kalgoorlie and Geraldton is crucially dependent on achieving a critical mass of industries. Without this mass, the local labour market does not contain the range of skills necessary to attract firms away from a metropolitan location. Potential decentralising firms see difficulties in a regional location arising from the narrow range of skills available. That is, if one of its workers were to resign and move away, a thin local labour market would be unlikely to provide a suitably skilled replacement. The firm would have to provide its own skilling program for workers and this would raise its costs compared with a metropolitan location. Achievement of a critical mass of industries in a decentralised region overcomes this problem by adding depth to the local labour market. Such a development is likely to be self-sustaining and attract further industries.

Another feature of this development of labour market depth is the spillover effect that it has on industries already existing in the region. The larger labour market together with the improved skill base is likely to make existing regional firms more efficient because of their utilisation of the improved labour market.

The importance of demand-size argument – a variant of the critical-mass argument – also extends to infrastructure provision in the region. Infrastructure items such as roads, electricity and gas provision, water supply, ports, airports, education and training facilities, cultural and civic amenities, wholesale and retailing facilities, and specialised service providers are traditionally subject to economies of scale in the provision of services. These lower the cost of third parties that also use the infrastructure service.

A prominent feature of Australian economic development has been the decline of non-metropolitan cities. Mining and mineral processing is important, therefore, in both a national and a regional sense because it goes against the trend of centralisation of industrial development in Australia. Reversing this trend has been an important component of the platforms of all political parties, and clearly must be valued highly by the Australian community.

The Commonwealth Department of Finance Handbook of Cost Benefit Analysis (Canberra: AGPS, 1991, p34) recommends that the “analysis assume that labour, as with other resources, is fully employed”. However, the reality is that, particularly in rural areas, unemployment is both high and persistent, and it seems likely that major projects will lead to a lower level of unemployment than would otherwise be the case. Moreover, it seems reasonable to assume that the larger the direct employment base of the project, the larger the benefit in reducing overall unemployment is likely to be.

6.3 Government revenues

Governments at all levels benefit from the investment and employment created by the project. Local Government benefits from a higher rate base through the establishment of industrial work sites and the additional housing associated with the operating workforce.

The State Government receives payroll tax, royalties and stamp duties. Royalties on the uranium oxide concentrate are estimated at \$28 million a year for the life of the project. This could represent more than \$420 million over the 15-year project life.

Payroll tax is estimated at between \$1.3 and \$2.2m a year for the project employees alone, based on an annual Western Australian wages and salaries bill of between \$23m and \$40m. Were the full multiplier impact through the economy to result in full payroll tax payments (at 5.5% of the payroll), the State Government would collect from \$3.9m to \$7.0m from employers in the State.

The Commonwealth Government will receive custom duties on imported plant and equipment, PAYE tax on employees, and company tax on profits from the project. Personal taxation for wage and salary earners, applied to direct employment only, is estimated to be between \$7.3m and \$12.8m a year. The amount will be far greater if the multiplier effect through the economy sees all wages and salaries taxed at the personal tax level.

Company tax payments are difficult to estimate but the base case at this stage anticipates annual payments of about \$60 million. Actual payments will be highly dependent on uranium prices.

If some of the project workforce comes from the existing pool of unemployed people in the region there should also be annual savings in unemployment payments to the Federal Government.

Perhaps more important for this region is the employment opportunities created for Aboriginal People and youth who would otherwise find opportunities challenging.

Appendix 1: Dynamic VU-TERM Model

Depicting small regions in computable general equilibrium framework

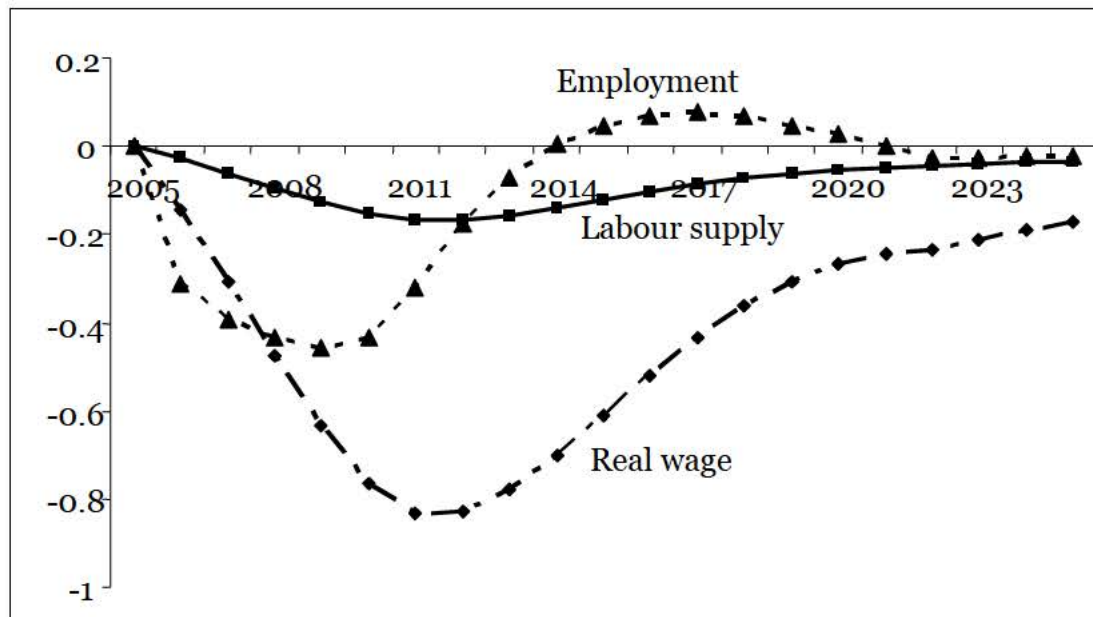
The regions of the master database are statistical sub-divisions. These split capital cities into many regions, and represent some regional centres (e.g., Kalgoorlie-Boulder City Part A) as separate regions.

Labour market – forecast v. policy scenario

In the theory of regional labour market adjustment, if regional labour market conditions improve or deteriorate relative to forecast, adjustment occurs in the short term mainly via changes in employment. Regional wages adjust sluggishly, with gradual adjustment in regional labour market supply (i.e., through migration between regions).

Real wages will fall or rise to close the gap between employment and slowly adjusting labour supply. Once the deviation in employment is equal to the deviation in labour supply, real wages reach a turning point (either they bottom out, in the case of a weakening labour market, or peak, in the case of strengthened labour market conditions). Within this theory, adjustment in the longer term occurs via a combination of altered regional labour supply and real wages that deviate relative to those in other regions. Weakened labour market conditions in a region can lead to unemployment in the short run and a lower real wage in the region in the long run (Figure 19).

Figure 19: Weakened regional labour market with eventual recovery (% change from forecast)



From: [Simon Williamson](#)
To: s22
Subject: RE: UPDATE: Proposed Yeellirrie Uranium Mine - Social and Economic Information [SEC=UNCLASSIFIED]
Date: Wednesday, 18 July 2018 4:25:39 PM
Attachments: [YTN-2017 Annual Report-web.pdf](#)

Hi s22 I apologise for the delay in getting this to you. Here is a quick reply. I was waiting on some material from Canada which still hasn't arrived so I'm sending you a summary and will then provide whatever else I can once I hear back from Canada. (It seems like our Canadian office is on summer holiday - a bit like January in Australia!)

Our operations in Canada are located in Northern Saskatchewan.

Cameco has long partnered with the communities in the Athabasca Basin region of northern Saskatchewan which is home to a number of first nations and a number of communities and towns occur in the vicinity. For at least the last 15 to 20 years, Cameco has worked with these communities providing employment, business development, community engagement and community investment. Today a significant percentage (approximately 50%) of the northern workforce is made up of local first nations people. Much of the contracting and mine support services are also provided by local businesses that have developed with Cameco's support and the communities have also benefitted from Cameco's involvement. (I have requested information from Canada to provide support to these claims)

More recently, to continue to advance the environmental, social, cultural and economic well-being of residents in the Athabasca Basin region, an industry and regional partnership was formalized in mid-2016. The Yá thi Néné Collaboration Agreement (CA) between Cameco, Orano and seven Athabasca Basin communities (Black Lake First Nation, Fond du Lac First Nation, Hatchet Lake First Nation, Stony Rapids, Wollaston Lake, Uranium City and Camsell Portage) outlines mutual commitments and benefits of continuing our long-term collaboration.

A copy of the 2017 report is attached.

In Australia, for our Kintyre project, Cameco reached an Agreement with the Martu about the mine and Martu participation and financial and other benefits that would flow to the Martu from the development and operation of the mine.

The Agreement sets out Cameco's commitment to employment, business development, community engagement, community investment and heritage protection in the event the Project is developed.

During the Kintyre exploration program in 2012 to 2014 we undertook to employ Martu. Over the two to three years of drilling activity we employed about 60 men and women from the Pilbara and Kimberley regions as nominated by the Martu co-ordinator. They were employed in a range of roles and received significant training and mentorship while on site. For example, about 20 received Certificate II Surface Extractive Operations qualifications in Plant Operatorship on the Loader, Grader & Excavator.

Others received more basic job ready training including getting drivers licenses and other support. At all times, we had a full time mentor on site assisting with addressing the myriad of

issues that come when you take people out of their community into a foreign camp environment and full time work.

Many of these men and women have gone on to work at other mine sites in the region following the completion of the exploration program and the suspension of the Kintyre project.

Cameco continues to work with the Martu to support their community initiatives and also provides contract work opportunities as required. For example we have a clean- up project going on this month and I have four Martu working with me on this job.

Cameco also has a presence in the two communities nearest the Yeelirrie Project, Leonora and Wiluna and continues to make a contribution to the social fabric of these communities primarily through sport and education.

We support a number of education initiatives in Wiluna including the Murlpirrmarra Foundation and the Shooting Stars Foundation. We also provide support for local sporting clubs and some community groups.

In the event the Project were to proceed, Cameco would look to establish an agreement with the local community including the indigenous population similar in structure to the agreement we have in Northern Saskatchewan.

I'll be back to you soon with some more.

Regards
Simon

From: s22 [mailto:s22@environment.gov.au]
Sent: July 16, 2018 11:24 AM
To: Simon Williamson
Subject: UPDATE: Proposed Yeelirrie Uranium Mine - Social and Economic Information
[SEC=UNCLASSIFIED]

Hi Simon

We are in the process of progressing the proposed decision and attached conditions to release for comment as soon as possible. When we last spoke, you mentioned there were advantages for the indigenous community if the mine were to go ahead. I wanted to confirm whether you were able to gather any further information on this and/or any other social and economic data that we have not already been provided?

Regards - s22

s22

Post Approvals Strategies Section | Assessment (WA, SA, NT) & Post Approvals Branch
Environment Standards Division | Department of the Environment and Energy
GPO Box 787 Canberra ACT 2601
Tel: s22

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Yá thi Néné

Joint Implementation Committee



2017 Report

to community members of

Black Lake Denesuline
First Nation

Camsell Portage

Fond du Lac Denesuline
First Nation

Hatchet Lake Denesuline
First Nation

Stony Rapids

Uranium City

Wollaston Lake

Partnering for

Prosperity

Message from the Joint Implementation Committee

The Yá thi Néné Collaboration Agreement (CA) is an industry and regional partnership intended to promote and enhance the environmental, social, cultural and economic well-being of residents in the Athabasca Basin of northern Saskatchewan.

The CA was signed between Cameco, Orano (formerly AREVA), and the seven Athabasca Basin communities of Black Lake First Nation, Fond du Lac First Nation, Hatchet Lake First Nation, Stony Rapids, Wollaston Lake, Uranium City and Camsell Portage in mid-2016.

The Yá thi Néné Lands and Resources (YNLR) office supports the work of the CA on behalf of Athabasca communities. Guided by its board of directors, with representation from all communities, the YNLR serves as a key contact point between industry, government and residents in the Athabasca Basin communities.

Significant progress has been made in 2017. Aligned with values of the CA and the four pillars of engagement, examples include:

Workforce Development

- Promotion of education and workforce development opportunities for Athabasca residents, including the development of a new scholarship program;
- Employment of two summer students to support the Yá thi Néné Land and Resources office.

Business Development

- Coordination with Eligible Businesses including: West Wind Aviation Limited Partnership, Team Drilling Limited Partnership, as well as Provider of Choice Points Athabasca Contracting Limited Partnership.

Community Engagement and Environmental Stewardship

- Support AJES in addressing community engagement and community environmental capacity.

Community Investment

- Preserving the language, culture and traditional land use of the Denesuline First Nation communities through a biannual, on-the-land Science and Culture Camp.

Partnering for
Prosperity

Joint Implementation Committee Members



Ray MacDonald
Black Lake



Paul Denechezhe
Hatchet Lake



Cherina Adam
Fond du Lac



Denise Bougie
Uranium City



Glenn LaFleur
Orano



Jonathan Huntington
Cameco



Business Development

In 2017, the Business Advisory Committee met twice, reviewing the ongoing progress toward achieving the business development objectives of the collaboration agreement.

The Eligible Businesses are:

- PACL
- Flyer Electric
- Athabasca Catering
- West Wind Aviation
- Athabasca Basin Security
- Points North Group of Companies
- Team Drilling
- Tru-North RV, Auto and Marine
- Arctic Beverages

From 2016 to 2020, the business development objective is for Cameco and Orano to spend \$250 million with the Eligible Businesses from the Athabasca Basin. By the end of 2017, spending reached approximately \$192 million - or 77% - of that goal.

2018 will be a challenging year for the uranium mining companies, but they remain committed to continue working collaboratively with Eligible Businesses in the Athabasca Basin.

During the year the BAC gained a new member, Mr. Ray Macdonald, to replace the outgoing Mr. Rick Robillard, who joined the uranium mining companies as the community liaison for Stony Rapids / Black Lake. Attendance was perfect for the year, by all BAC members.



Community Investment

With two annual payments (2016 and 2017) from Cameco and Orano flowing to the Athabasca Community Trust in 2017, several worthy projects received funding in the Athabasca Basin.

Here are some of the many projects that were approved for funding in 2017:

- Arena renovations (Black Lake)
- Playground (Fond du Lac)
- Christmas Festival (Hatchet Lake)
- Early literacy (Stony Rapids)
- Housing renovations (Hatchet Lake)
- Canoe Quest (Fond du Lac)
- Home efficiency renovations (Black Lake)
- Nutrition program (Stony Rapids)
- Culture camp (Hatchet Lake)
- Fire Hall (Fond du Lac)
- Playground (Black Lake)

Under the guidance of a Corporate Trustee (TD Wealth) and trustees (members of the Communities), there are permitted uses for community investment payments.

Our Progress

Workforce Development



The 2017 Athabasca Basin Employment Numbers as of November 30, 2017 include:

Joint Orano / Cameco Employees

Black Lake (Liaison)
1 Athabasca resident employee
Fond du Lac (Liaison)
1 Athabasca resident employee

Orano Canada:

McClean Lake 41 Athabasca Basin Employees
(24 have their pick up points outside the Athabasca Basin)

Total Orano Employees: 41 Athabasca Basin Employees

Cameco Corporation:

Cigar Lake 32 Athabasca resident employees
+ 10 Athabasca urban employees
Key Lake 2 Athabasca urban employees
McArthur River 3 Athabasca resident employees
+ 4 Athabasca urban employees
Rabbit Lake 11 Athabasca resident employees
+ 8 Athabasca urban employees

Total Cameco Employees: 70 Athabasca Employees

- Orano Canada has met its obligation to hire an Environmental Trainee in the 2017.
- Cameco Corporation is still in the process of hiring in 2018.
- Orano Canada and Cameco have met their summer employment obligation for 2017. They hired 5 student positions each.
- Orano Canada has hired a Mine Site Elder for McClean Lake in 2017.
- Cameco Corporation is hiring a new Cigar Lake Elder in 2018.
- The JIC has recommended and reviewed the 2017 performance objectives for each Community Relations – Liaison.

Environment and Engagement



The Athabasca Joint Engagement and Environmental Subcommittee (AJES) held four meetings in 2017.

Several members took part in a tour of the Beaverlodge decommissioned properties

in Uranium City. In addition, a community meeting and supper was held in Hatchet Lake where individuals could speak directly to the AJES members about environmental concerns and Cameco and Orano operations.

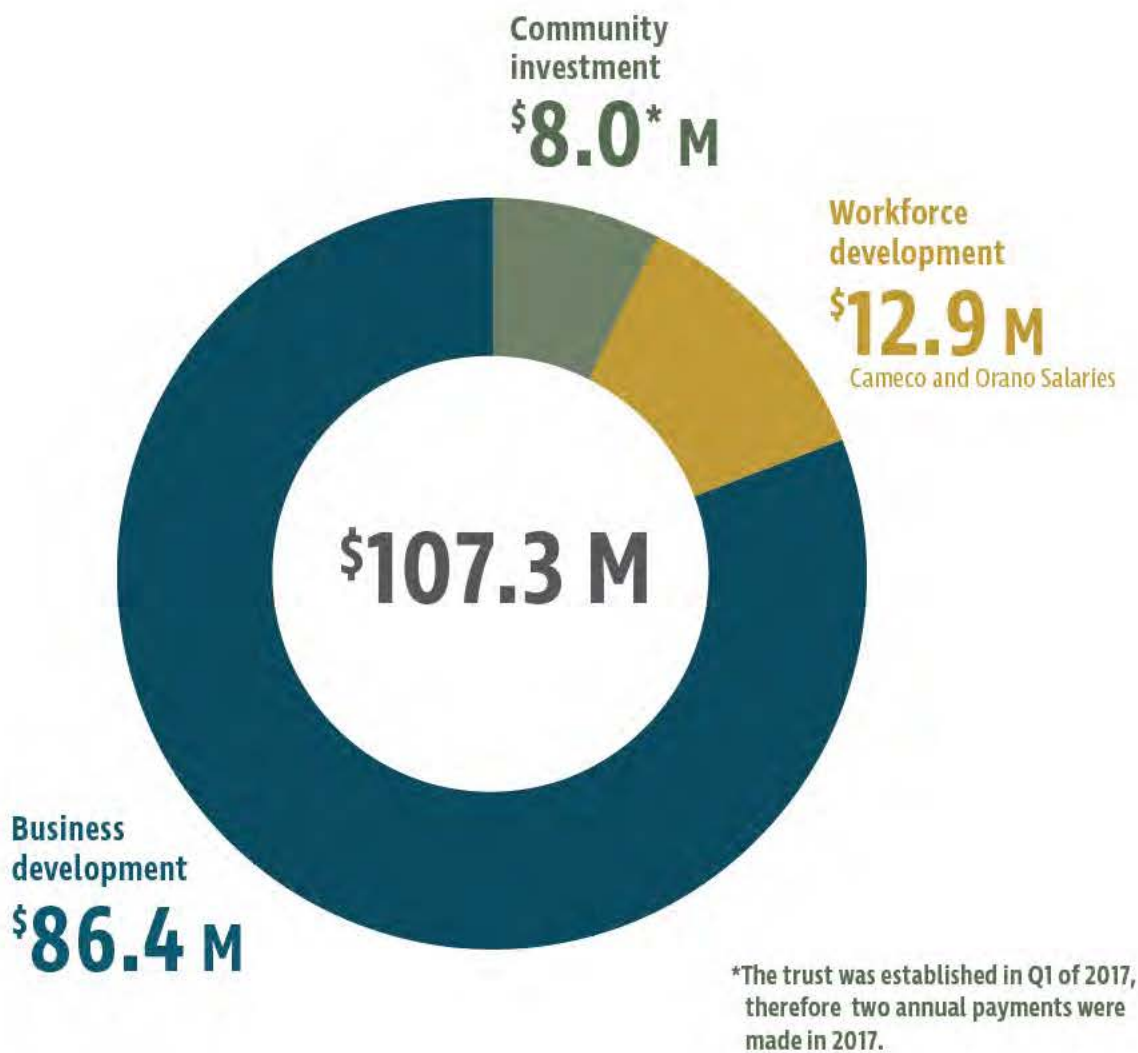
Several topics were presented and discussed during the meetings. The McClean Lake licensing renewal, Saskatchewan

Woodland Caribou study results, site monitoring and regulatory overview were a few of the topics discussed throughout the year. Following a review of the Community Based Environmental Monitoring Program (CBEMP), which was the new name given to the Athabasca Working Group (AWG) monitoring program, the AJES accepted to alter the program over the next four years which will focus on the traditional food consumption in each of the communities.

The subcommittee continued to receive updates on the activities at Cigar Lake, Rabbit Lake and McClean Lake during the subcommittee meetings throughout the year and discussed the 2018 exploration activities for Cameco and Orano.

The committee members for 2017 were Diane McDonald (YTN), Georgie McDonald (Fond du Lac), Paul Denecheze (Hatchet Lake) Denise Bougie (Municipalities), Carolanne Inglis-McQuay (Orano), and Janna Switzer (Cameco).

2017 Financial Highlights



For more information:

**Ya'thi Néné Lands and
Resources Office**
306-686-2250
referrals@yathinene.com



www.facebook.com/YathiNene/

7th November 2017

Yeelirrie Uranium Project DoEE Site Visit

Yeelirrie Homestead

cameco.com



► Yeelirrie Project

Development operating life	22 years, including 3 years of pre-production dewatering , mining and construction, 12 years of mining , 15 years of processing and 4 years of decommissioning and closure
Open Pit	Shallow depth alluvial deposit with mineralisation from surface to about 10 metres deep. 9 kms long x 1 km wide (average)
Clearing	Project footprint of approximately 2421.8 ha
Mining Rate	Average mining rate of 8Mtpa of ore and waste
Tailings	All tailings deposited in open pit at rate of approx. 3Mtpa
Production	3850 tonnes UOC (average) per annum



► Work Completed to Date

- Ecophysiological studies
- Review of potential translocation sites
- Seed viability testing
- Population dynamics studies
- Study of the rehabilitation population

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Cameco

► Impacts

- **Development of the Project will result in**
 - removal of 30% of the known population of the species
 - removal of 100% of the Western population genotype



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Cameco

► Management of Western Genotype

- To address the impact on the Western Genotype, Cameco has proposed to re-establish populations at natural locations and in re-constructed locations (Translocation) with two objectives:
 - To establish new populations of the Western genotype
 - To establish the populations over a number of sites to minimise risk
- Current proposals include:
 - Translocation at 4 natural locations
 - Re-construction of 2 sites within the open pit using surface and subsoil taken from adjacent habitat

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Cameco

► Proposals to Translocate

- Implement a comprehensive research program
- Undertake a trial translocation program
- Undertake a report on the potential suitability of each natural translocation site.
- Implement translocation
- Implement site re-construction
- Collect seed and store

12

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► Potential Translocation Sites



13

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► Management of Eastern Genotype

- Improve the protection of the population by fencing the area
- Investigate and implement options for the long term protection of the area including through changes in land tenure and/or land ownership
- Collect seed and store with the DPaW seed bank
- Undertake bi-annual population dynamics survey to identify population condition and trend and analyse the status of the population through PVA statistical analysis

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► State Position

In their Report and Recommendations the EPA concluded that the Environmental Objective for Flora (Atriplex) could be met.

- Position reached after considerable involvement and after numerous presentations and site visits by technical specialists and senior people from OEPA, EPA and Dept of BCA (DPaW).
- EPA recommended the suite of conditions that appear in the Ministerial Statement.
- The Conditions
 - ♦ sets out a research plan,
 - ♦ requirements for translocation, and
 - ♦ recognises the time potentially required to demonstrate success – 20 years.

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Cameco

► Current status

Plan for Trial Translocation submitted to DBCA for final review.

Money in 2018 budget to implement Trial.

Materials to fence Eastern population purchased. Fence to be erected in 2018.

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Cameco

► Subterranean Fauna - History

- Study and Project area are within the uppermost reaches of the Carey palaeochannel (Lake Miranda catchment)
 - Yeelirrie PEC
 - Albion Downs PEC (not impacted by the proposal)
- Total number of species within the study area:
 - 73 stygofauna
 - 45 troglafauna
- No listed species
- Large sampling effort

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► Project area



18

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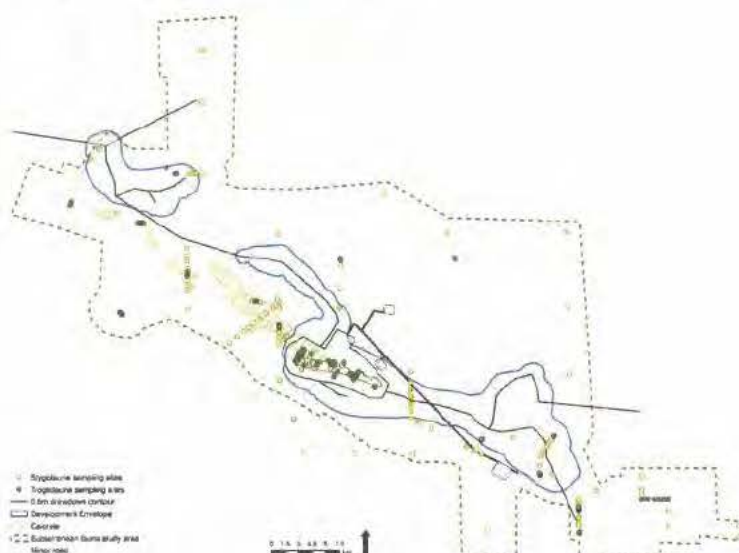
► Work Completed to Date

- **Nearly 800 deliberately collected subterranean fauna samples collected from Yeelirrie by Subterranean Ecology (2011):**
 - 448 troglofauna samples
 - 347 stygofauna samples
 - collected over six rounds of sampling between 2009 and 2010.
- **Cameco undertook additional sampling and drilling in 2015:**
 - February 2015 – first round of reference sampling around the western and southern boundary of drawdown (20 bores)
 - June/July 2015 – second round of reference sampling around the western and southern boundary of drawdown (46 bores)
- **Review and reassessment in 2015**

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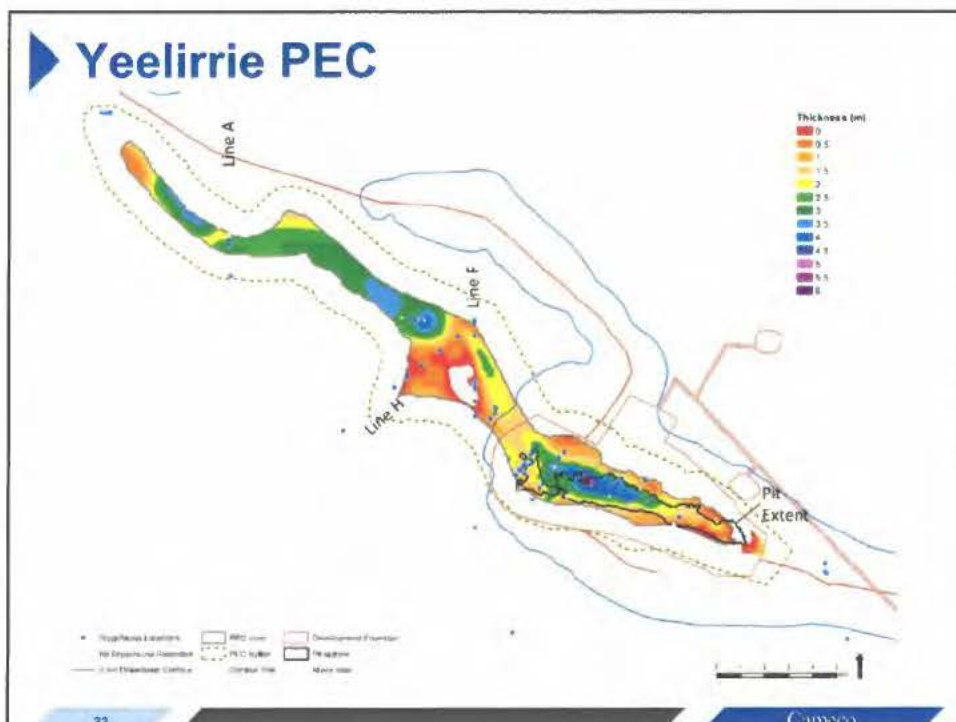
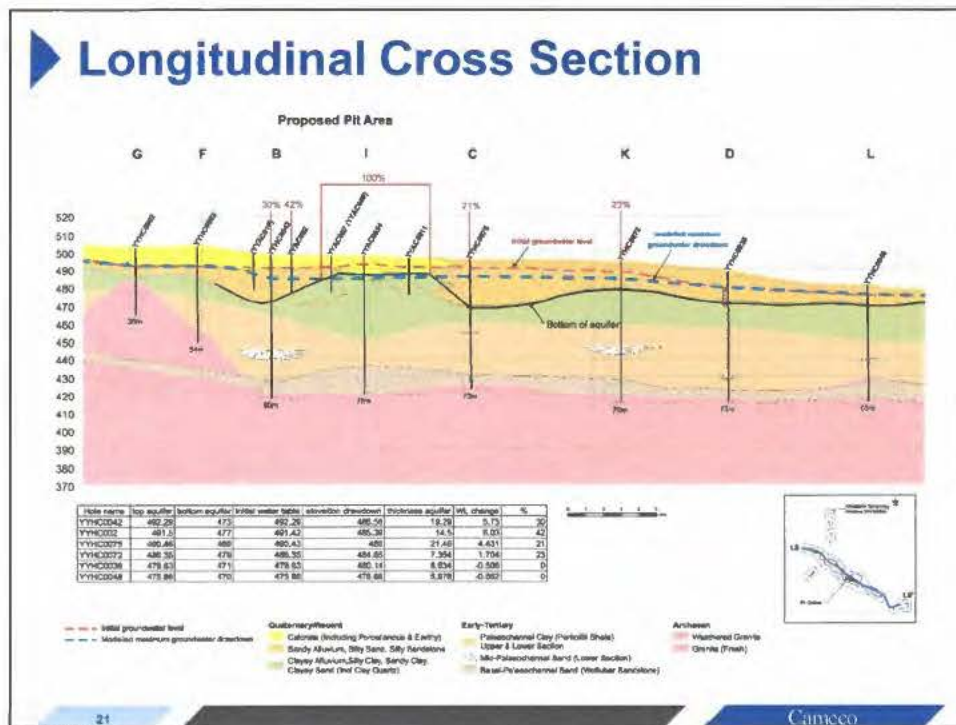
Cameco

► Sampling Locations



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Physical Impacts

Stygofauna and PEC

- > 0.5 m drawdown
 - Long-term recession groundwater levels;
 - Saturated calcrete thickness; and
 - Ability to monitor and manage.
- Impacts to the PEC
 - 42% of area
 - 43% of volume
- Impacts of solute transport are expected to be minor to negligible

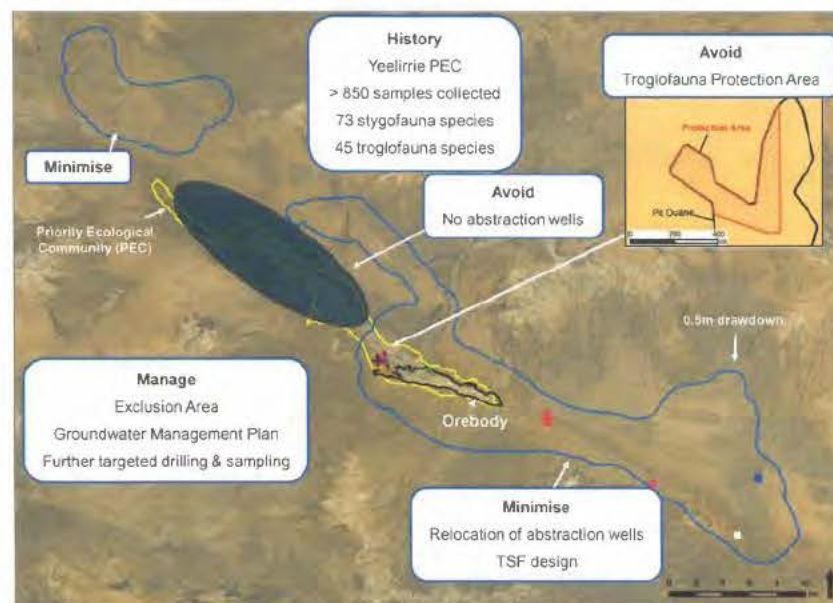
Troglofauna

- Loss of habitat through excavation of the mine pit

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Impact Mitigation



24

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► Impact Mitigation

	Area (Ha)	Volume (m3)
Total size of the PEC	4184	81,963,327
Affected by 0.5m drawdown	1,777 (42%)	35,517,742 (43%)
Area excavated for mining	727 (17%)	16,382,466 (20%)
Total habitat remaining after mining	3,457 (83%)	65,580,861 (80%)

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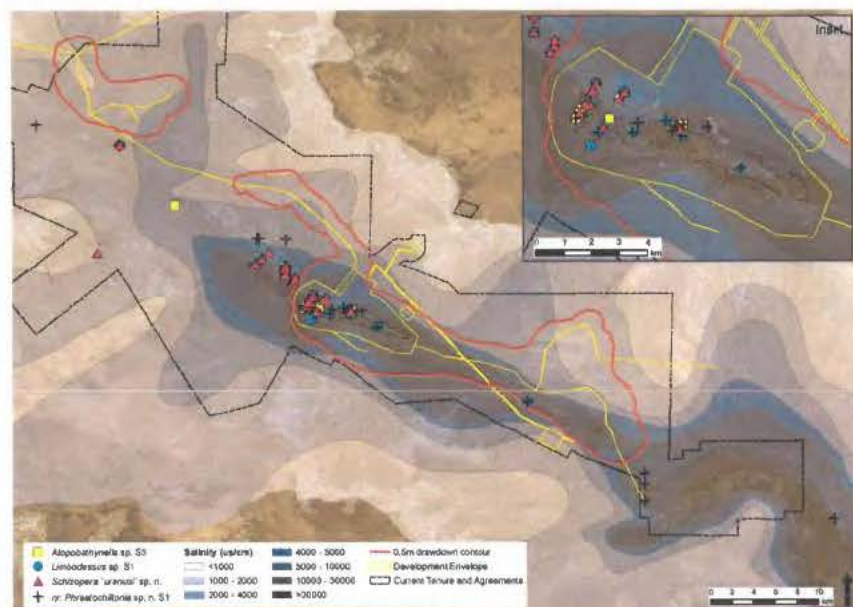
► Impact Mitigation

	Stygofauna	Troglofauna	Total
If abstraction wells within the palaeochannel NW of mine pit	~50 (60%)	5 (11%)	~55 (47%)
PER	11 (15%)	5 (11%)	15 (13%)
Troglofauna Protection Area	11 (15%)	1 (2%)	12 (10%)
Further Optimisation	8 (11%)	1 (2%)	9 (8%)

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Salinity



Review of Lake Way Calcretes



► Review of Lake Way Calcretes

70 species of stygofauna identified

Hinkler Well Calcrete

- 33 species
- 21 (64%) species recorded from other calcretes

Lake Violet Calcrete

- 38 species
- 25 (66%) species recorded from other calcretes

Uramurdah Calcrete

- 36 species
- 23 (64%) species recorded from other calcretes

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► Review of Lake Way Calcretes

Displayed Salinity Tolerances

- Some syncarid and copepod species recorded in hypersaline groundwater > 70ppt
- Numerous species found to be tolerant of relatively wide ranges of salinity
 - *Dussartcyclops uniarticulatus* 1ppt to 25 ppt
 - *Chiltoniidae* and *Limnodessus* spp 1 ppt to 38 ppt
 - *Schizopera austindownsi* from 19 ppt to 78 ppt
 - *Brevisomabathynella* sp. SAM2 38 ppt to 72 ppt
 - *Atopobathynella watti* 5ppt to 65 ppt

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► Surrogacy *Stuart Halse (Bennelongia)*

EAG12

- Biological surrogates
- Physical surrogates

Stygofauna

- Likely to extend outside impact area: 6
- May extend outside impact area: 5* (1 singleton)

Troglofauna

- May extend outside impact area: 1 (specie is a singleton)

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► Surrogacy

Stygofauna

- **Enchytraeidae sp. Y4** – located on south eastern end of 0.5m drawdown in low salinity groundwater. Pumping strategy amended to push location outside of impact zone.
- **Enchytraeidae sp. Y6** – This species was collected at a single bore, YYD22, at the western end of the proposed mine pit and near to the limit of >0.5 m groundwater drawdown. Identification was genetic and based on a single animal; the other three enchytraeid worms in the same sample were assumed to be Enchytraeidae sp. Y6. Depth to watertable was about 6 m and groundwater salinity was approximately 10 g/L TDS.
- **Enchytraeidae sp. Y6** – it is inferred that Enchytraeidae sp. Y6 is likely to be more widespread at Yeelirrie, based on surrogate biological and habitat evidence. The related species, Enchytraeidae sp. Y5, has been collected in the north-west sector at depths to groundwater of about 6 m and salinities of 6-25 g/L TDS and in the south-east sector at about 10 g/L TDS. These parameters straddle those of Enchytraeidae sp. Y6, with both species appearing to occupy the same habitat. It appears likely that Enchytraeidae sp. Y6 has a similar distribution. In fact, it is possible that Enchytraeidae sp. Y6 has been collected more widely in existing samples but not identified because of the small numbers of specimens analysed genetically.
- Two species on Enchytraeidae recorded in the Pilbara have a range of 220km.

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► Surrogacy

Stygofauna

Novanitocrella "araia" sp. n. – known from a single animal. The only other described species of the genus has a known linear range of 20km, therefore it is reasonable to assume that the range of this species could extend a short distance to the west of the mine pit in groundwater of similar salinity.

Novanitocrella "araia linec" ssp.n. – collected in three samples from two bores about 400 m apart (YYHC0036C and 37C) in the area of groundwater drawdown south-east of the mine pit. Groundwater salinity was about 11-14 g/L TDS.

The distance between records of *Novanitocrella 'araia' sp. n.* and *Novanitocrella 'araia linec' ssp. n.* is about 12 km and it is considered that they represent related species separated by a recent isolation event, so that it is unlikely their ranges overlap. The species appear to have similar salinity preference and the factors controlling their ranges are unknown.

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► Surrogacy

Stygofauna

- **Philosciidae sp. N. Y2** - this isopod species was collected as five specimens in four samples from two bore holes (YYD22 and YYAC36) about 400 m apart at the western end of the proposed mine pit and area of groundwater drawdown.

Terrestrial isopods often have restricted ranges (Judd *et al.* 2003) and subterranean philosciids have sometimes been shown to be restricted to single calcretes or to have mine-scale distributions (Cooper *et al.* 2008; Taiti and Humphreys 2001). Bore YYD22 contained two other species known only from the drawdown area (*Enchytraeidae* sp. Y6 and *Schizopera emphysema*), which suggests an unusual habitat may have been sampled (nine species of stygofauna were recorded in it altogether) and *Philosciidae* sp. n. Y2 may have a patchy distribution because of its occurrence in this unusual habitat. Based on modelled salinity, the range of *Philosciidae* sp. n. Y2 would be expected to extend west into the north-west sector but other factors may also be involved in determining the distribution of the species.

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► Surrogacy

Stygofauna

Shizopera akolos, Shizopera emphysema, Shizopera sp. 7439

- 14 species or subspecies of Shizopera have been collected from Yeelirrie.
- Shizopera uranusi sp. n shown to be widespread across a range of salinity at Yeelirrie as was *Schizopera austindownsi* in Lake Way.
- Three species or subspecies are known only from impact zone within the north western end of the mine pit
- Species described as a surface invading species that might be expected to be widespread
- Reasonable expectation that their range could extend to the north west beyond the impact zone where groundwater of similar water quality exists.

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► Surrogacy

Stygofauna

- **Kinnecaris "lined"** – located on the fringe of the borefield. Tolerance of salinity. Located where groundwater is estimated to be 10m deep and drawdown modelled to be approx 1 m.
- **Atopobathynella sp. "line K"** – also located on fringe of drawdown impact zone. Atopobathynella at Yeelirrie and at Lake Way are relatively widespread, and have a tolerance to a salinity range from fresh to about 15g/l TDS. Reasonable to assume that this species could be more widespread. The pumping strategy can be amended to push location outside of impact zone.
- **Halicyclops cf. eberhardi sp.B** – collected from a single bore on the periphery of the proposed pit and near the western boundary of the area of groundwater drawdown. Two other species or subspecies of Halicyclops have been collected. H. sp B occurs in the middle of the range of one of the other species. The variety of ranges of similar species suggests there are no fixed barriers that determine distribution. Modelled salinity suggests H. sp. B may occur within a narrow band west of the area of groundwater drawdown as well as further east.

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Camco

► Surrogacy

Troglofauna

- **Trichorhina sp.n.F** – three of the four species of the isopod *Trichorhina* collected in the study area are known from single bores, with *Trichorhina* sp. n. F being represented by a single animal within the proposed mine pit.

The fourth species, *Trichorhina* sp. n. G occurs in multiple bores in the northwest part of the Yeelirrie calcrete with a linear range of about 14 km.

Trichorhina sp. n. F may have a small range but further sampling may show it occurs outside the mine pit due to the fact that the related *Trichorhina* sp. n. G occurs in multiple bores in the northwest part of the Yeelirrie calcrete with a linear range of about 14 km.

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► Management and Mitigation: Commitments

- **Develop and implement an outcome-based Subterranean Fauna Management Plan**
- **Committing to and managing the 0.5m drawdown**
- **Not exceeding the groundwater quality or absolute groundwater level threshold criteria beyond the mapped 0.5m contour**
- **Establishing a Troglofauna Protection Area**
 - Prior to impacting the Troglofauna Protection Area, Cameco will undertake additional troglofauna sampling and habitat mapping in order to improve knowledge and confirm surrogacy predictions;
- **Undertaking further groundwater investigations of the wellfields during the DFS**

38

Cameco

► Why we think the impacts are over estimated

- Poor sampling design – not linked to geology, hydrology or salinity (driven by land access)
- No recognition of surrogacy positions
- No recognition of ability to manage/modify the groundwater abstraction (to reduce impact on three species)
- Assessment of impact at 0.5m drawdown

39

Camco

► Review of proposed Federal Condition

Proposed condition – *“Demonstrate that no species would be made extinct by the implementation of the Project, prior to the commencement of the Project”*.

For Subterranean fauna, the proposed Condition doesn't recognise the inherent difficulties associated with sampling for and describing species, including,

- Inadequate sampling technique
- Morphology vs genetic differentiation to determine what is a species
- Uncertainty around niche habitat and the difficulty in locating replicate habitat for sampling
- Goes against historical EPA decisions, eg Gorgon
- Is not realistic and unlikely to be achieved – ever!

40

Camco

► EPA's decision

The EPA's Report and Recommendations provided a way forward for Government,

- *considers that uncertainty surrounding the potential for serious or irreversible damage may be mitigated (Section 5, pg 77).*
- *recommended mitigation measures including...*
 - *Sampling and identification outside the impact area*
 - *Restricting the groundwater drawdown to that modelled in the PER document.*
 - *Monitoring which includes thresholds, triggers, contingency actions, and reporting.*
 - *Establishing a Troglifauna Protection Area.*
 - *Development of an industry-funded research program with the long-term aim of reducing the uncertainty surrounding the conservation of subterranean fauna.*

41

Camco

► EPA's decision

Typical approval conditions

Historically, conditions dealing with subterranean fauna (in the main), require preparation and implementation of a Subterranean Fauna Management Plan.

Some require ongoing surveys, eg. Gorgon, MS800, Cond 11.1(iv)

"in respect of any species that has only been found in the Gas Treatment Plant site as at the date of this Statement, the continuation of surveys for that species until it is found elsewhere"

42

Camco

► Federal approval

The proposed Federal condition “demonstrate that no species would be made extinct by implementation of the project, prior to the commencement of the Project” is probably unachievable and unrealistic, given the uncertainty surrounding sampling and naming of subterranean fauna.

Cameco (and the State) considers the risks are manageable and that the approval of the Project provides an opportunity to address some of the uncertainties surrounding the factor for the net benefit of the environment.

The EPA considers the uncertainty surrounding the potential for serious or irreversible damage may be mitigated by further scientific investigation, research and study to determine if the restricted species extend beyond the Impact Area, or a compelling case is made that their habitat is continuous and extensive well beyond the impact area.

43

Cameco

► Questions

Thank you



cameco.com



MC17-013140

FOI190428
Document 3g

30 MAY 2017

Minister for Environment; Disability Services
Deputy Leader of the Legislative Council

Your Ref: EPBC Ref 2014/7138
Our Ref: 62-00636; 62-01214

Hon Josh Frydenberg MP
Minister for the Environment
Department of Environment and Energy
GPO Box 787
CANBERRA ACT 2601

Attention: Major Projects West Section

VIP

Min No: MC	Link:
Division: ESD	Date: 30/5
DLO: [Signature]	
RECEIVED 30 MAY 2017	
Environment and Energy Minister	
<input type="checkbox"/> Covering Brief	<input type="checkbox"/> Departmental Reply
<input type="checkbox"/> Minister Reply	<input checked="" type="checkbox"/> Appropriate Action
<input type="checkbox"/> CoS/Adviser Reply	<input type="checkbox"/> For Information
<input type="checkbox"/> Refer to:	<input type="checkbox"/> Campaign <input type="checkbox"/> Advice/Min

Dear Minister

Josh

**INVITATION TO COMMENT ON PROPOSED APPROVAL DECISION EPBC
2014/7 EXTENSION OF THE WILUNA URANIUM MINE PROJECT**

Thank you for your letter dated 30 March 2017 in which you sought comment on the proposed approval decision for the Extension to the Wiluna Uranium Mine Project. I understand you have also written to the Western Australian Minister for Mines and Petroleum, Hon Bill Johnston MLA, regarding the same matter. This response is on behalf of the WA Government.

I note the conditions that you propose to attach to the approval are primarily based on the WA approval issued in the form of Ministerial Statement No. 1051 in January 2017. I have no comment on these proposed conditions.

For your information, since the issuing of Ministerial Statement 1051, a sighting of the endangered Night Parrot (*Pezoporus occidentalis*) has been confirmed in WA and, following an examination of habitat characteristics in the area of the sighting, I am advised that there is potential for the species to occur in the near vicinity or within the impact footprint of the Extension of Wiluna Uranium Mine Project.

The WA Government is currently considering its response to this new information. This new information may be relevant to your proposed decision.

Yours sincerely

 Hon Stephen Dawson MLC
MINISTER FOR ENVIRONMENT

cc Hon Bill Johnston MLA, Minister for Mines and Petroleum

24 MAY 2017

Level 12, Dumas House, 2 Havelock Street, West Perth, Western Australia 6005
Telephone: +61 8 6552 5800 Facsimile: +61 8 6552 5801 Email: minister.dawson@dpc.wa.gov.au

EPBC Act Environmental Report: Coordinates - Area

Report created: **25 May 2009 11:19**

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the [caveat](#) for interpretation of information provided here.

- **Summary**
- **Details**
 - [Matters of NES](#)
 - [Other matters protected by the EPBC Act](#)
 - [Extra Information](#)
- **Caveat**
- **Acknowledgments**

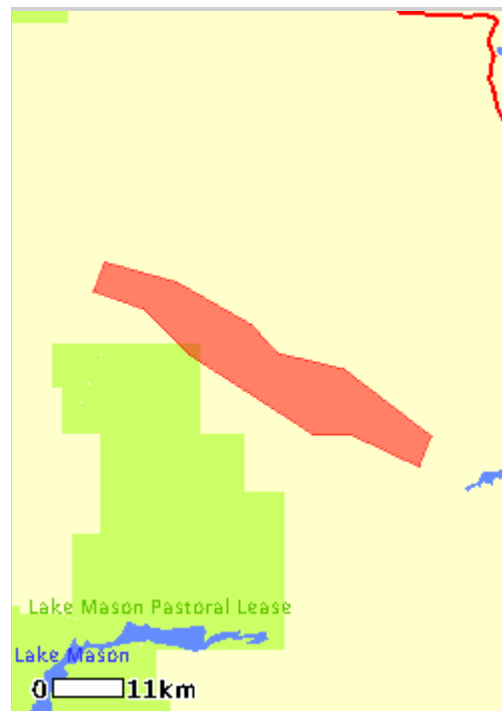


Summary

Matters of National Environmental Significance

World Heritage Properties: None**National Heritage Places:** None**Wetlands of International** None**Significance:****(Ramsar Sites)****Commonwealth Marine** None**Areas:****Threatened Ecological** None**Communities:****Threatened Species:** 3**Migratory Species:** 6

Other Matters Protected by the EPBC Act

Commonwealth None**Lands:****Commonwealth** None**Heritage Places:****Listed Marine** 4**Species:****Whales and Other** None**Cetaceans:****Critical Habitats:** None**Commonwealth** None**Reserves:**

This map may contain data which are © Commonwealth of Australia (Geoscience Australia), © 2007 MapData Sciences Pty Ltd, PSMA

Coordinates:

-27.0249,119.5939, -26.9787,119.6107, -
27.0102,119.7240, -27.0773,119.8415, -
27.1214,119.8814, -27.1466,119.9863, -
27.2515,120.1227, -27.2998,120.1038, -
27.2494,119.9968, -27.2494,119.9380, -
27.1235,119.7429, -27.0522,119.6715

Buffer:

10 km

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Report Summary for Extra Information		<div>Details</div> <div>Matters of National Environmental Significance</div>
Places on the RNE:	2	
State and Territory Reserves:	None	
Other Commonwealth Reserves:	None	
Regional Forest Agreements:	None	
Invasive Species:	6	
EPBC Act Referrals:	1	
Environmental Grants:	Not included in search	
Other Important Wetland Sites:	None	
National Pollutant Inventory:	Not included in search	
Threatened Species [Resource Information]		
Name	Status	Type of Presence
Birds		
Acanthiza iredalei iredalei Slender-billed Thornbill (western) [25967]	Vulnerable	Species or species habitat likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Egernia kintorei Great Desert Skink, Tjakura, Warrarna, Mulyamiji [1410]	Vulnerable	Species or species habitat may occur within area
Migratory Species [Resource Information]		
Name	Status	Type of Presence
Migratory Terrestrial Species		
Birds		
Leipoa ocellata Malleefowl [934]	Migratory	Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]	Migratory	Species or species habitat may occur within area
Migratory Wetland Species		
Birds		
Ardea alba Great Egret, White Egret [59541]	Migratory	Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]	Migratory	Species or species habitat may occur within area
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]	Migratory	Species or species habitat may occur within area

Name	Status	Type of Presence
<u>Ardea alba</u> Great Egret, White Egret [59541]	Migratory	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [[Resource Information](#)]

Name	Status	Type of Presence
Birds		
<u>Apus pacificus</u> Fork-tailed Swift [678]	Listed - overfly marine area	Species or species habitat may occur within area
<u>Ardea alba</u> Great Egret, White Egret [59541]	Listed - overfly marine area	Species or species habitat may occur within area
<u>Charadrius veredus</u> Oriental Plover, Oriental Dotterel [882]	Listed - overfly marine area	Species or species habitat may occur within area
<u>Merops ornatus</u> Rainbow Bee-eater [670]	Listed - overfly marine area	Species or species habitat may occur within area

Extra Information

Places on the RNE [[Resource Information](#)]

Note that not all Indigenous sites may be listed.

Indigenous

[Yeelirrie Pool Mythological and Occupation Site WA](#)

[Yeelirrie Station Mythological Site WA](#)

Invasive Species [[Resource Information](#)]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.

Name	Status	Comments
Mammals		
<u>Capra hircus</u> Goat [2]	Feral	Species or species habitat likely to occur within area
<u>Felis catus</u> Cat, House Cat, Domestic Cat [19]	Feral	Species or species habitat likely to occur within area
<u>Oryctolagus cuniculus</u> Rabbit, European Rabbit [128]	Feral	Species or species habitat likely to occur within area
<u>Vulpes vulpes</u> Red Fox, Fox [18]	Feral	Species or species habitat likely to occur within area
Plants		
<u>Carrichtera annua</u> Ward's Weed [9511]	Invasive	Species or species habitat may occur within area
<u>Cenchrus ciliaris</u> Buffel-grass, Black Buffel-grass [20213]	Invasive	Species or species habitat may occur within area

EPBC Act Referrals [Resource Information]

Further details about the referral including its current status if still active are available in its PINK report; click on the referral's title.

Title	Reference	Status
Referrals for Approval		
BHP Billiton Yeelirrie Development Company Pty Ltd/Mining/Shire of Wiluna/WA/Yeelirrie Uranium Mine	2009/4906	Not yet determined

Caveat

The information presented in this report has been provided by a range of data sources as [acknowledged](#) at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the *Environment Protection and Biodiversity Conservation Act 1999*. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Commonwealth land mapping is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under "type of presence". For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the [migratory](#) and [marine](#) provisions of the Act have been mapped.

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as [extinct or considered as vagrants](#)
- some species and ecological communities that have only recently been listed
- [some terrestrial species](#) that overfly the Commonwealth marine area
- migratory species that are very [widespread, vagrant, or only occur in small numbers](#).

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites;
- seals which have only been mapped for breeding sites near the Australian continent.

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see <http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html>.

Other Matters Protected Under the Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land,

when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage/index.html>.

Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at <http://www.environment.gov.au/epbc/permits/index.html>.

Acknowledgments

This database has been compiled from a range of data sources. Environment Australia acknowledges the following custodians who have contributed valuable data and advice:

- [New South Wales National Parks and Wildlife Service](#)
- [Department of Sustainability and Environment, Victoria](#)
- [Department of Primary Industries, Water and Environment, Tasmania](#)
- [Department of Environment and Heritage, South Australia Planning SA](#)
- [Parks and Wildlife Commission of the Northern Territory](#)
- [Environmental Protection Agency, Queensland](#)
- [Birds Australia](#)
- [Australian Bird and Bat Banding Scheme](#)
- [Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [Queensland Herbarium](#)
- [National Herbarium of NSW](#)
- [Royal Botanic Gardens and National Herbarium of Victoria](#)
- [Tasmanian Herbarium](#)
- [State Herbarium of South Australia](#)
- [Northern Territory Herbarium](#)
- [Western Australian Herbarium](#)
- [Australian National Herbarium, Atherton and Canberra](#)
- [University of New England](#)
- Other groups and individuals

[ANUcliM Version 1.8, Centre for Resource and Environmental Studies, Australian National University](#) was used extensively for the production of draft maps of species distribution. The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

[See log of system/dataset changes](#)

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

2009/4906

Report created: 12/12/18 17:40:18

[Summary](#)

[Details](#)

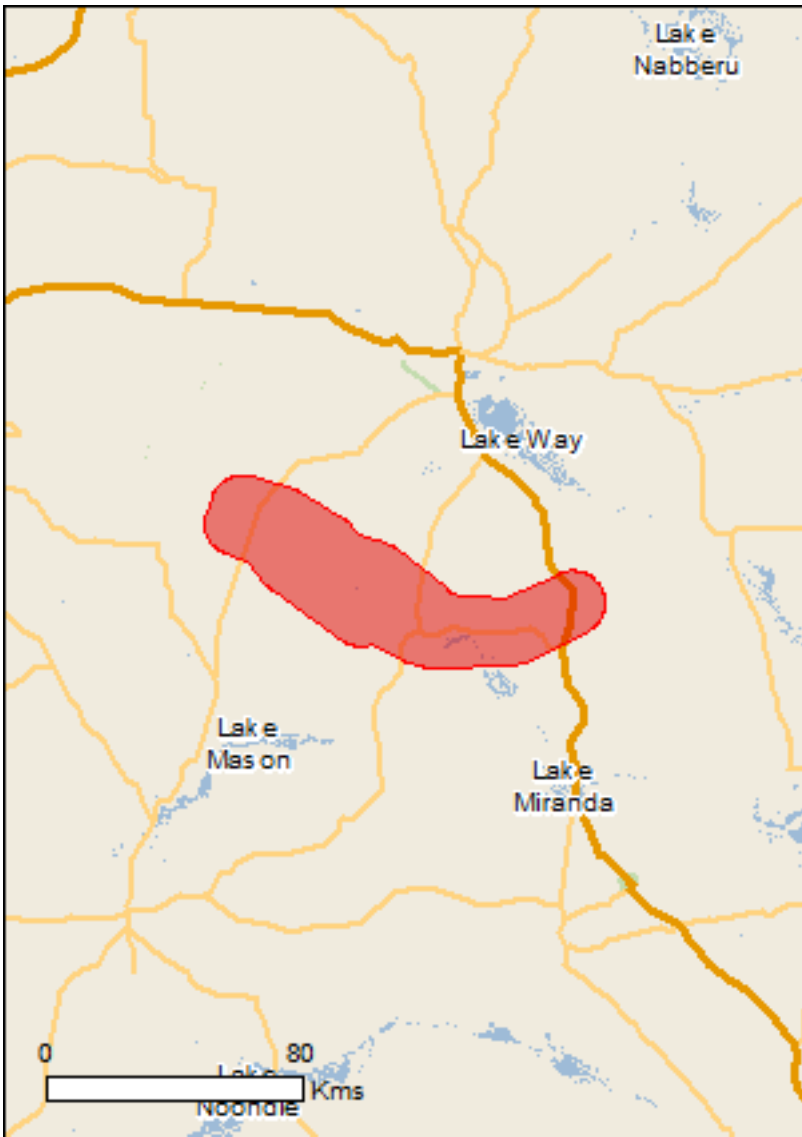
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

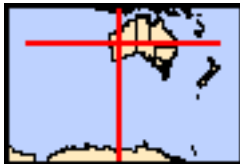
[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010



Summary

Matters of National Environment Significance

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Significance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Threatened Ecological Communities:	None
Threatened Species:	4
Migratory Species:	6

Other Matters Protected by the EPBC Act

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	9
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	10
Nationally Important Wetlands:	None
EPBC Act Referrals:	3
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Threatened Species		[Resource Information]
Name	Status	Type of Presence
BIRDS		
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Polytelis alexandrae Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat may occur within area
PLANTS		
Atriplex yeelirrie [88538]	Endangered	Species or species habitat known to occur within area
Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus		
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans		
Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves		[Resource Information]
Name		State
Kaluwiri		WA

Invasive Species		[Resource Information]
Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit,		
Name	Status	Type of Presence
Mammals		
Camelus dromedarius		
Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris		
Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus		
Goat [2]		Species or species habitat likely to occur

Name	Status	Type of Presence
Equus asinus Donkey, Ass [4]		within area Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area

Plants	
Carrichtera annua Ward's Weed [9511]	Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]	Species or species habitat may occur within area

EPBC Act Referrals

[Resource Information]

Further details about the referral or advice - including its current status if still active - are available in its PINK report; click on the title.

Referral			
Title	Reference	Referral Outcome	Assessment Status
Yeelirrie Uranium Mine	2009/4906	CA	Comments on Proposed Decision Sought-Assessment Decision
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	NCA	Referral Decision Made-Close
Clearing for Mt Keith Satellite Project, WA	2017/8001	NCA	Referral Decision Made-Close

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Department of Land and Resource Management, Northern Territory](#)
- [-Department of Environment and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [-Forestry Corporation of NSW](#)
- [-Australian Tropical Herbarium, Cairns](#)
- [-eBird Australia](#)
- [-Australian Government – Australian Antarctic Data Centre](#)
- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

s22

From: Kingsley Dixon s47F
Sent: Tuesday, 27 June 2017 4:30 PM
To: s22
Subject: Re: Follow-up: Atriplex yeelirrie [SEC=UNCLASSIFIED]

Categories: YEELIRRIE URANIUM

Thanks s22

I think you have nicely phrased what we require:

To determine the success of a translocated population a detailed genetic analysis is required that will determine the comprehensive 'micro-genetic' diversity of the impacted population that will describe the population genetic structure spatially and also through sampling of seed generated from the plants. (noting that seed may have higher diversity than the adult plant population).

The translocated population will then be assessed over a five year period and then at five year periods up to 15 years (the likely generation time for the species) in terms of:

- genetic representativeness of the translocated population established at three years and progeny and seed generated annually up to 5 years.
- population growth, development and demographic diversity matching or exceeding the pre-disturbance population.
- recruitment ecology and natural regeneration understood including factors influencing seedling recruitment, plant fecundity and seedling establishment as assessed to the reference community (the pre-disturbance population) and that these factors are operating in the translocated population.
- where genetic representativeness is less than 85% of the measured genetic diversity that corrective genetic plantings are undertaken and that these reinforcement actions result in stable genetic representativeness as found in the pre-disturbance population (this will require additional resources as it is likely that an additional three years from the time of corrective plantings will be required to ensure genetic representativeness is sustained in resultant progeny).

At the conclusion of the five year period is it expected that in comparison to the pre-disturbance population that the following parameters are met:

- the translocated population will match growth, development, fecundity and genetic representativeness (>85% of the measured diversity of the pre-disturbance population).
- the translocated population has the reproductive and regeneration capacity to ensure the on-going viability of the translocated population.

Importantly the study should also assess the edaphic and ecological specialisation of the species to ensure that across a range of soil types including the translocation site that limits to plant growth and development are fully understood in comparison to the pre-disturbance population.

As I think I mentioned Dr s47F is a specialist in rare flora micro-genetics and works across a number of sites in the mid-west so skilled in the region - I would recommend that a person with this skill set is needed to undertake this type of fairly technically challenging work

Hope this is useful - please cut and paste if you like.

All the best

Kingsley

On 27 Jun 2017, at 12:01 pm, s22 s22 <s22@environment.gov.au> wrote:

Hi Kingsley

Thank you for the phone discussion on *Atriplex yeelirrie* last week; it was very valuable.

I have been reading over the information we discussed and I am considering the best way forward in terms of achieving a self-sustaining population of the western *Atriplex yeelirrie*; however, I am grappling with the question of what success looks like - how will we know when the proponent has succeeded in achieving this? Do we assume that by carrying out a micro-genetic study of the western population of *Atriplex yeelirrie* (including translocating the genetic material from this study to different sites; analysing the natural regeneration of the species; undertaking corrective genetic work and carrying out (ongoing) genetic modelling) we will achieve this? Or is there another measure that we should be considering to determine success?

Your thoughts would be welcomed.

Regards

s22

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