OLYMPIC DAM EXPANSION

DRAFT ENVIRONMENTAL IMPACT STATEMENT 2009

EXECUTIVE SUMMARY

bhpbilliton

resourcing the future

DISCLAIMER

The Draft Environmental Impact Statement (Draft EIS) has been prepared by Arup Pty Ltd and ENSR Australia Pty Ltd (Arup/ENSR) on behalf of BHP Billiton Olympic Dam Corporation Pty Ltd (BHP Billiton) for submission to the Commonwealth Minister for Environment, Heritage and the Arts under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth), the South Australian Minister for Mineral Resources Development under the *Development Act 1993* (SA) and the *Roxby Downs (Indenture Ratification) Act 1982* (SA) (and the indenture scheduled to that Act) and the Northern Territory Minister for Natural Resources, Environment and Heritage under the *Environmental Assessment Act* and the *Environmental Assessment Administrative Procedures* (together, the Ministers). The Draft EIS has been prepared for that purpose only and no one other than the Ministers should rely on the information contained in the Draft EIS to make any decision.

In preparing the Draft EIS, Arup/ENSR and BHP Billiton have relied on information provided by specialist consultants, government agencies and other third parties available during preparation. BHP Billiton has not fully verified the accuracy or completeness of that information, except where expressly acknowledged in the Draft EIS.

The Draft EIS has been prepared for information purposes only and, to the full extent permitted by law, BHP Billiton, in respect of all persons other than the Ministers, makes no representation and gives no warranty or undertaking, express or implied, in respect of the information contained in the Draft EIS and does not accept responsibility and is not liable for any loss or liability whatsoever arising as a result of any person acting or refraining from acting on any information contained in the Draft EIS.

NOTE ON CURRENCY

Where possible, the contents of the Draft EIS are up to date as at 9 December 2008. This was not possible where parts of the Draft EIS were prepared from information provided by third parties (as discussed above) prior to the document being concluded.

COPYRIGHT

ISBN 978-0-9806218-0-8 (set)
ISBN 978-0-9806218-1-5 (summary)

CONTENTS

CONTENTS

PREFACE

BHP Billiton is seeking the approval of the Australian, South Australian and Northern Territory governments for a significant expansion of its existing mining and processing operation at Olympic Dam in northern South Australia (Figure 1).

Should all necessary approvals be granted, BHP Billiton would commit to substantial capital investment at Olympic Dam and elsewhere, which would more than double direct employment at Olympic Dam, provide significant opportunities to third-party businesses, and increase considerably government and export revenues.

The expansion is centred on the creation of a new open pit mine that would lift ore production six-fold and require expanded minerals processing facilities. Major support infrastructure would also be built, including a coastal desalination plant, a new power line and possibly a gas-fired power station, a rail line, an airport, port facilities, a village to accommodate workers, and more housing, retail, commercial and community facilities in the Roxby Downs township where much of Olympic Dam's operational workforce would continue to live.

The proposed expansion is a large and complex project. A detailed and technical Draft Environmental Impact Statement (Draft EIS) has been prepared to comply with the guidelines set by the three governments and to explain the impacts and benefits of the proposed actions. The Draft EIS informs decision-makers and stakeholders about the need for the project, potential environmental, social, cultural and economic issues arising in the construction and operation phases and at closure, and how these issues would be managed. In preparing the Draft EIS, BHP Billiton has consulted widely and taken account of the views of stakeholders potentially affected by the proposal and others with a broader interest in the project's implications.

The public exhibition of the Draft EIS extends this consultation and engagement by providing the opportunity for individuals, groups and organisations to express their views about the proposal before the Australian, South Australian and Northern Territory governments decide whether or not to approve the project. Information about how and when to make a submission is provided at the end of this summary document.

The geographic area studied for the Draft EIS has been termed the EIS Study Area. It extends beyond the area of mining and minerals processing operations at Olympic Dam and the Roxby Downs township to take in the land in the wider region of South Australia and in Adelaide and Darwin on which it is proposed to establish infrastructure. The EIS Study Area provides a context for understanding and assessing local and regional impacts. The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) does not require impacts beyond Australia's jurisdiction to be assessed.

To ensure the Draft EIS is widely accessible, there is an electronic resource at <www.bhpbilliton.com/odxeis>, which simplifies and clarifies some of the complex studies that support the Draft EIS through animations and modelling simulations.

This Executive Summary is not a reproduction of the Draft EIS in miniature. It seeks to explain the project as a whole and the main impacts and benefits in the places where the project would be located, but does not attempt to cover every feature of the project, nor every impact it would have.

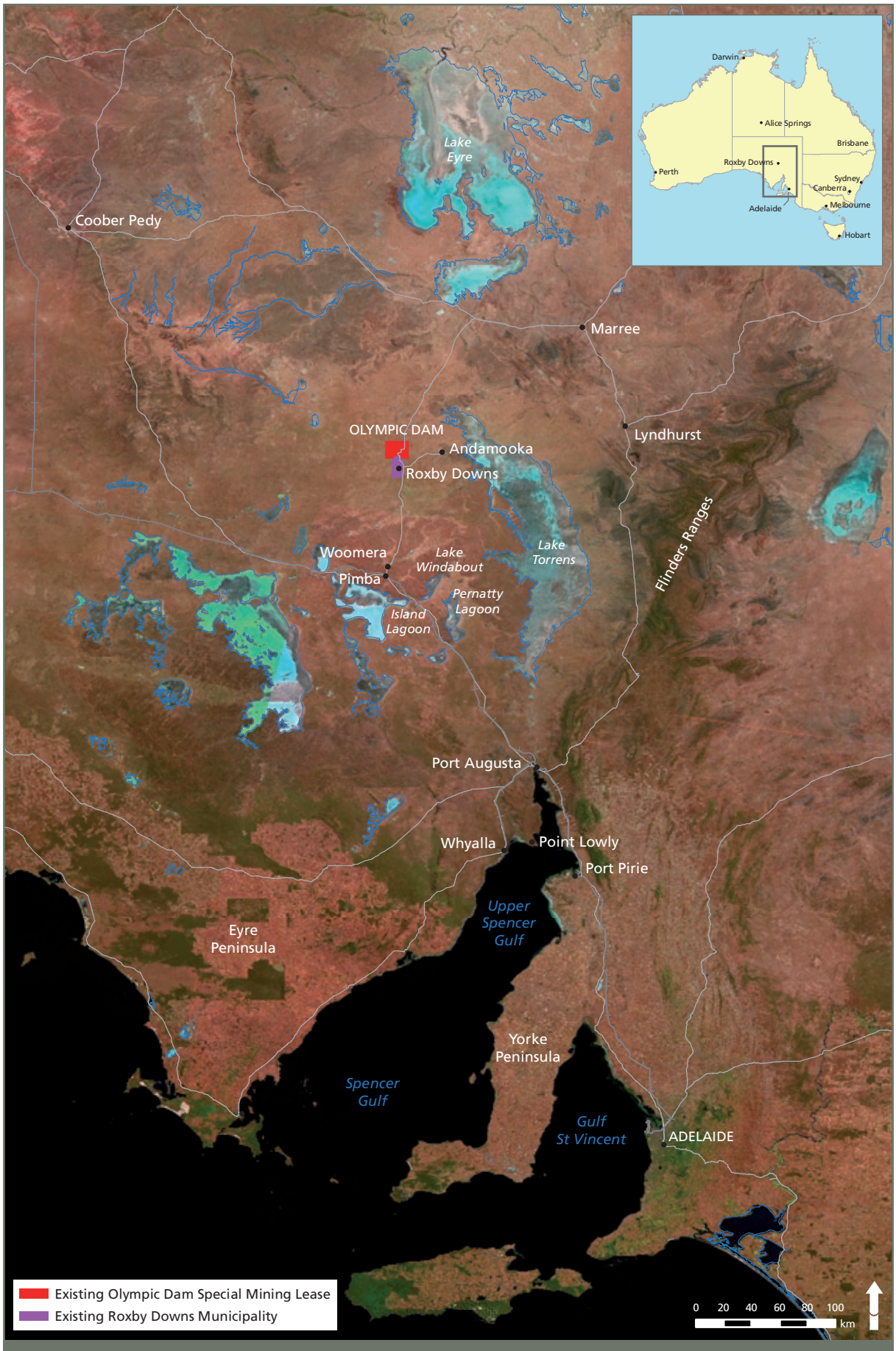


Figure 1 Location of Olympic Dam

OVERVIEW OF THE PROPOSED EXPANSION

The project

The proposed expansion would be a progressive development, requiring construction activity over a period of 11 years to increase production to the levels shown in Table 1. Off-site infrastructure would be built and operational in time to deliver inputs to, and export products from, the expanded operation as required (Figure 2).

When dates are mentioned in the context of the project activities it has been assumed that all necessary approvals would be obtained in 2010 and work commenced soon afterwards. The project configuration is based on an 11 year construction period, however the project schedule ultimately will depend on the timing and nature of government approvals and the final investment decision of the BHP Billiton Board.

As it is difficult to make predictions about markets and technologies over the very long term, BHP Billiton has set the timeframe for the assessments in the Draft EIS at 40 years. However, the size of the mineral resource suggests that mining could continue well beyond that time.

The quantities, plans and designs referred to in the Draft EIS are the best estimates based on the scope of the project as defined at the time of writing. The assessments in the Draft EIS have addressed worst-case scenarios, so that the findings are, as far as possible, insensitive to future changes. The likelihood and consequences of unplanned events have also been characterised by standard risk assessments.

The new open pit mine would operate simultaneously with the existing underground mine. The existing smelter would be expanded and new concentrator and hydrometallurgical plants would be built to process the additional ore.

The major items of infrastructure required to support the expansion of mining and minerals processing would include:

- a 280 megalitre per day (ML/d) coastal desalination plant at Point Lowly on the Upper Spencer Gulf (to supply 200 ML/d of additional water via a 320 km pipeline connection to Olympic Dam and with the potential to supply 80 ML/d for the South Australian Government to replace River Murray water to Upper Spencer Gulf and Eyre Peninsula regions)
- either a new 270 km electricity transmission line from Port Augusta to Olympic Dam, or a gas pipeline from Moomba and a new gas-fired power station at Olympic Dam, or a hybrid solution that is a combination of these two supply methods
- a 105 km rail line to connect Olympic Dam to the national rail network near Pimba, to move product and supplies by rail instead of road
- a new airport to replace the existing airport at Olympic Dam
- a landing facility on the Upper Spencer Gulf to unload equipment from barges, and an access corridor to a pre-assembly yard on the north-western outskirts of Port Augusta
- additional port facilities in South Australia at Outer Harbor and in the Northern Territory at the Port of Darwin to import supplies and export product
- a new accommodation village for workers (named Hiltaba Village)
- expansion of the Roxby Downs township, 14 km south of the mine, where most of Olympic Dam's operational workforce lives.

Project need

Olympic Dam has the world's fourth largest copper resource and by far the largest known uranium resource, but as a producer, the current operation is the sixteenth largest in copper and third in uranium. The main objective of the proposed expansion is to unlock the full potential of the deposit to meet the growing world demand for copper and uranium.

Copper

Olympic Dam's main product is copper and it would remain so after the expansion. Copper is used in a wide variety of applications because it conducts electricity and heat efficiently, resists corrosion, is strong, readily workable and can be recycled.

A significant gap is emerging world-wide between copper demand and supply. World copper production must grow from the current rate of 13 million tonnes per annum (Mtpa) to about 20 Mtpa to match projected demand (Figure 3). To put this into context, Olympic Dam currently produces about 200,000 tonnes per annum (tpa) of copper. Therefore, another 35 mines the size of Olympic Dam's current operation would be required to meet the predicted world demand for copper by 2018.

Uranium

Uranium is a relatively common element, as abundant as tin and 1,000 times more abundant than gold. It provides isotopes for medical, industrial and scientific uses, but its main use is to generate electrical power – currently providing 16% of the world's baseload electricity in 30 countries.

Olympic Dam produces uranium oxide that is exported to enrichment plants for further processing. Most of the existing nuclear power reactors and those under construction require enriched uranium fuel in which the proportion of the U-235 isotope has been increased from the natural level of 0.7% to about 4%.

The end of the Cold War saw the wide-scale decommissioning of nuclear warheads. From the year 2000 approximately 30 tonnes of military-grade uranium has been used in nuclear power plants, displacing mine production of about 10,600 tonnes of uranium oxide per year, which represents about 13% of the world's requirements for uranium oxide. However, the stockpile of available military uranium is declining and will be substantially depleted by 2013. This leaves new mine supply of uranium oxide to fill the gap and accommodate the growth in demand for nuclear electricity generation.

There are 439 nuclear reactors operating throughout the world today. An additional 36 reactors are under construction, a further 97 are planned for construction in the next 15 years and a further 221 are proposed to be built by 2030 (Figure 4). This will translate into an electricity generating capacity of 524 gigawatts of electricity (GWe) requiring a doubling of global mine production to about 92,000 tpa of uranium oxide. Olympic Dam currently produces about 4,000 tpa of uranium oxide and is the world's third largest producer. A further 13 mines the size of Olympic Dam's current operation would be required to meet the predicted demand to 2030.

Gold and silver

In proposing this very large project, BHP Billiton is primarily responding to forecasts of growing world demand for copper and uranium oxide. Gold and silver are valuable by-products of the minerals processing at Olympic Dam.

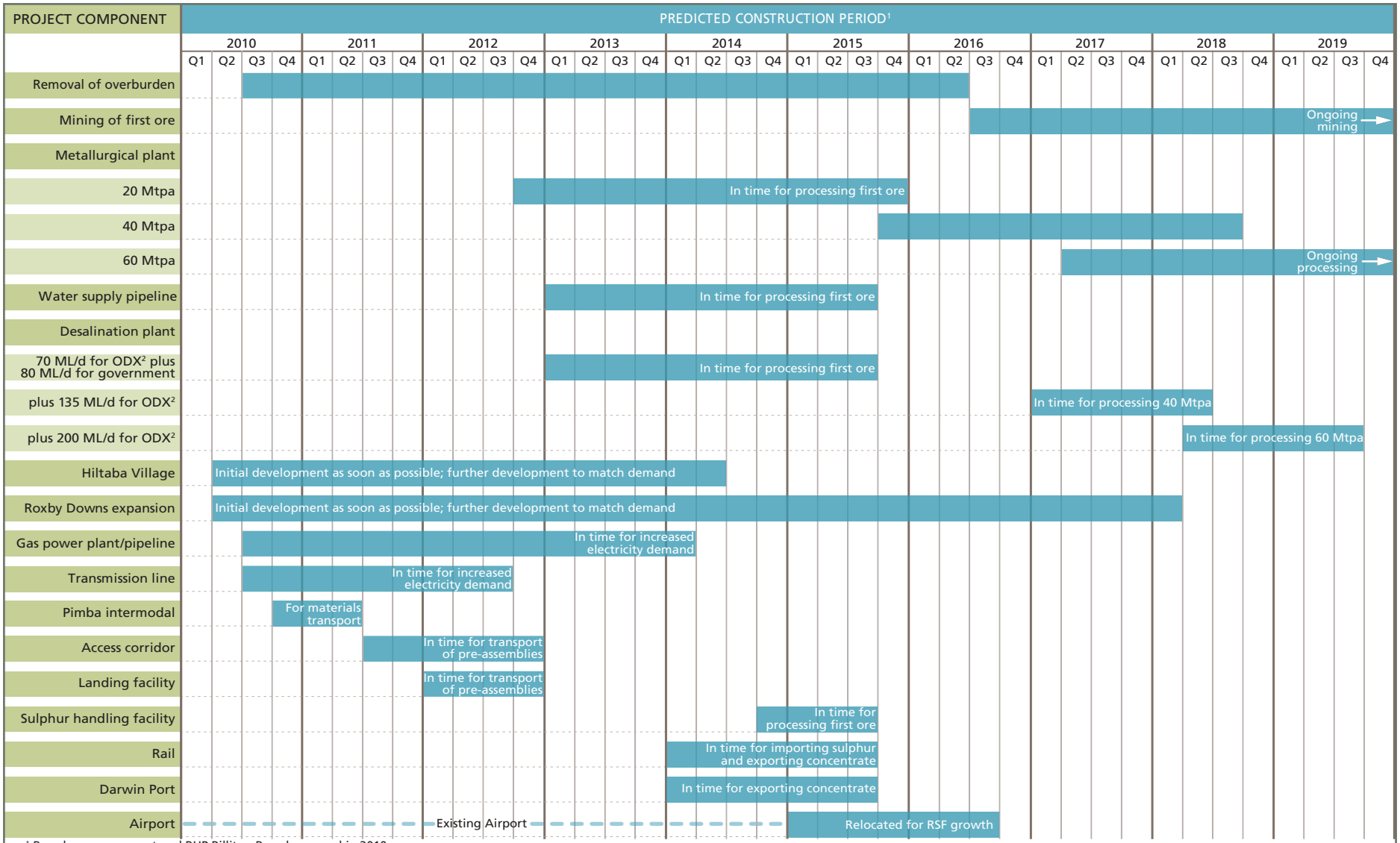
Gold is used mainly as a store of wealth, and in jewellery, collectibles and industrial and medical applications. Silver can be a lower cost substitute for gold in these applications, and is also widely used in electronics, solar panels and as a medical and domestic anti-bacterial agent.

Table 1 Production summary

Production measure	Existing operation[1]	Proposed expansion	Combined operations
Quantity of ore recovered (million tonnes per annum)	12	60	72
Copper concentrate (tonnes per annum)	600,000	1,800,000	2,400,000
Refined copper (tonnes per annum)	235,000	515,000[2]	750,000[2]
Uranium oxide (tonnes per annum)	4,500	14,500[2]	19,000[2]
Gold bullion (ounces per annum)	100,000	700,000[2]	800,000[2]
Silver bullion (ounces per annum)	800,000	2,100,000[2]	2,900,000[2]

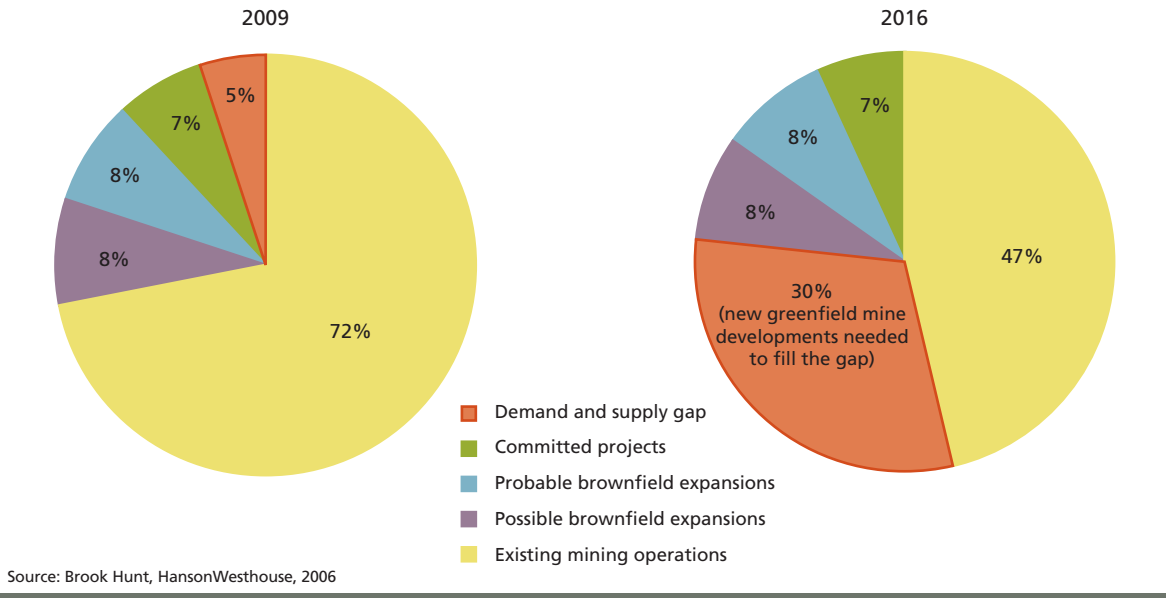
[1] Nameplate design capacity. (Nameplate capacity refers to the maximum continuous capacity of the Olympic Dam operation within specific ore grade and composition parameters, measured in tonnes or ounces of refined product).

[2] Includes on-site and overseas production.



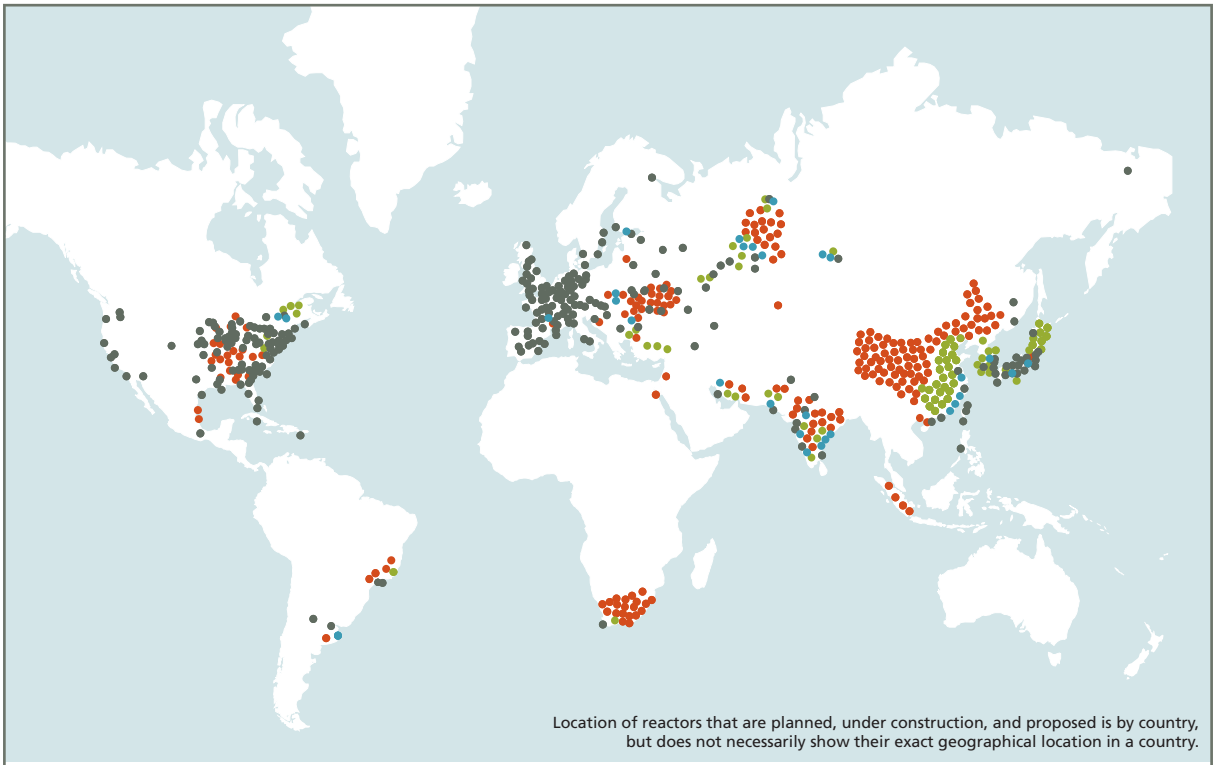
[1] Based on government and BHP Billiton Board approval in 2010
[2] ODX - Olympic Dam Expansion

Figure 2 Predicted timing of construction for major project components



Source: Brook Hunt, HansonWesthouse, 2006

Figure 3 Predicted gap in global copper demand and supply



Location of reactors that are planned, under construction, and proposed is by country, but does not necessarily show their exact geographical location in a country.

- Operational (power plants) – 439 reactors
- Under construction (reactors) – 36 reactors
- Planned (reactors) – 97 reactors
- Proposed (reactors) – 221 reactors

Sources: International Nuclear Safety Centre at ANL, August 2005
World Nuclear Association, 2008

Figure 4 Existing and proposed nuclear power reactors

THE PROPONENT

The BHP Billiton Group is the world's largest diversified resources company. It has more than 39,000 employees working in more than 100 operations in 25 countries. Olympic Dam is one such operation and is managed by BHP Billiton (Olympic Dam Corporation) Pty Ltd (hereafter BHP Billiton).

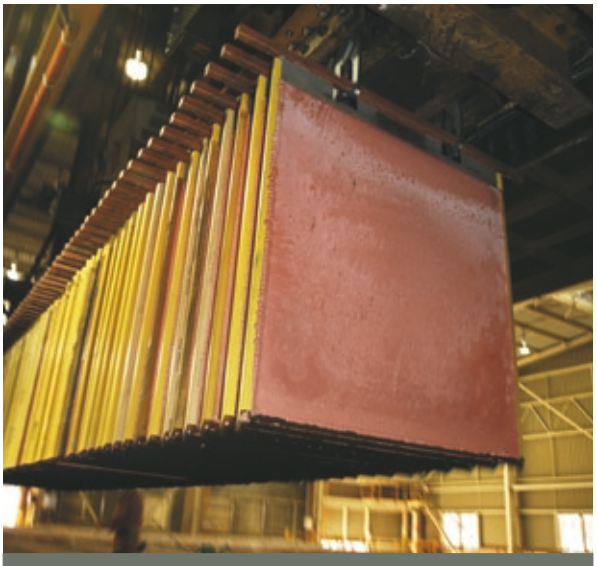
BHP Billiton is the proponent for the proposed expansion. It has developed the expansion project based on its 20 years of understanding gained from the existing operation, the lessons learnt from previous expansion projects and the global knowledge and experience of the BHP Billiton Group.

BHP Billiton promotes a mutually beneficial relationship between the company, its employees and contractors, the environment and the communities in which it operates. Central to the BHP Billiton operating philosophy is its desire to be regarded by the community as a valued citizen.

BHP Billiton commits to reducing impacts and enhancing benefits in undertaking the expansion project; to continuous improvement to the health, safety and environmental performance of its operation; and to maintaining constructive relationships and ongoing engagement with the local and regional communities, including Aboriginal groups.

In seeking to maximise the value of Olympic Dam for its shareholders, the company recognises that the resource is owned by the State Government on behalf of the people of South Australia. BHP Billiton believes the expansion would maximise the value of the resource to the state and to the nation as a whole.

Copper anode casting in the smelter



Copper cathode in the electrorefinery

STAKEHOLDER CONSULTATION AND ENGAGEMENT

Consultation to date

There is renewed public interest in South Australia in the impacts and benefits of mining following an upsurge in exploration in recent years that has led to the development of some new mines. Expansion of the resources sector is being strongly encouraged by the South Australian Government to diversify the State's economy and meet challenging targets in the South Australian Strategic Plan.

For the past 20 years, Olympic Dam has been South Australia's largest mine and it is likely to remain so in the foreseeable future.

While refined copper is the major product from Olympic Dam, it is also a large producer of uranium oxide and the proposed expansion would make it by far the largest producer of uranium oxide in the world. As a result, Olympic Dam has attracted a high level of public interest. BHP Billiton has sought to keep interested stakeholders, including opponents or critics, aware of the performance of the operation and recognises that the scale of the proposed expansion is encouraging even more public interest.

Since 2005, BHP Billiton has implemented a consultation and engagement program to identify issues and concerns about the expansion, and these issues have been considered in planning and designing the expansion. The program of consultation and engagement included:

- local and state-wide newspaper advertising of information and consultation sessions
- a dedicated telephone line, email address and web site to provide project information and receive feedback
- local community focus groups, briefings and workshops in Roxby Downs, Andamooka and Woomera, Upper Spencer Gulf, on the Eyre Peninsula and in the Northern Territory
- two telephone surveys of more than 1,700 people in metropolitan Adelaide, Upper Spencer Gulf, Eyre Peninsula, the Mid North and the Far North of South Australia to canvass attitudes to the expansion and more general mining issues
- displays at public events including the Royal Adelaide Show, the Eyre Peninsula Field Days at Cleve and the Roxby Downs Market Days.

The common themes from feedback so far about impacts and benefits of the proposed expansion have been:

- local (Roxby Downs, Andamooka, Woomera) – concerns about housing supply and affordability, the provision of community services, water supply and use, and potential impacts on animals and plants
- regional (Upper Spencer Gulf and Eyre Peninsula) – maximising benefits from employment and business opportunities, concerns about whether attracting people to work at Olympic Dam would deplete the workforce in regional communities and businesses, impacts of the desalination plant on the general marine environment and on fisheries and aquaculture in particular, and impacts of the landing facility on the environment, access to the gulf and its potential impact on residents of coastal homes
- metropolitan Adelaide – maximising benefits from employment and business opportunities, water supply and use, potential impacts of the desalination plant, how and when the mine ultimately would close, and potential impacts on animals and plants

Olympic Dam expansion project stand at the Roxby Downs Market Day

- Northern Territory – concerns about the rail transport of concentrate from Olympic Dam to the Port of Darwin, water and dust management at the East Arm facilities, and cumulative impacts on Darwin Harbour from increased industrialisation from a number of projects.

Public consultation

With the publication of the Draft EIS, the Australian, South Australian and Northern Territory governments invite public comment before considering whether or not to approve the expansion.

In line with the governments' requirements, the Draft EIS will be put on display for 14 weeks, during which time the public can provide comment to the South Australian Department of Planning and Local Government. This is explained further at the end of this document.

The day-to-day operations at Olympic Dam are regulated by an Indenture Agreement ('Indenture') between the South Australian Government and BHP Billiton, which was ratified by the South Australian Parliament in the *Roxby Downs (Indenture Ratification) Act 1982*. Any amendments to the Indenture negotiated between BHP Billiton and the State Government to allow the project to proceed would also have to be ratified by the South Australian Parliament. As a consequence, such amendments would also be subject to public scrutiny and debate in the South Australian Parliament.

Consultation booth at the Royal Adelaide Show

THE EXISTING OLYMPIC DAM OPERATION

Mining and processing

Mining at Olympic Dam began in 1988, initially producing 45,000 tpa of copper plus associated products of uranium oxide, gold and silver.

Between 1997 and 1999 there was a major expansion of the mine and minerals processing plant. Immediately after this expansion, Olympic Dam produced refined copper at a rate of just over 200,000 tpa for three years. More recently, with lower grade ore, annual copper production has averaged about 180,000 tonnes, with 4,000 tonnes of uranium oxide, 80,000 ounces of gold and 800,000 ounces of silver.

The Olympic Dam ore body begins about 300 m below the surface and continues to a depth beyond 1 km. The underground operation includes crushing stations, vertical shafts and an automated rail network, used to produce and transport crushed ore to the surface, where it is moved along conveyors to the processing plant (Figure 5).

When the ore reaches the surface it is sent to a concentrator, where it is further crushed and water is added to form a slurry, which is passed through a series of flotation stages to separate the metals, producing a copper-rich concentrate and uranium-rich tailings (Figure 6).

The concentrate is leached in acid to remove residual uranium and to produce a neutral slurry, which is dried before being fed into the smelter to produce copper anodes. The copper anodes are then processed in the refinery to produce high purity copper cathodes. The residue from the refining process is treated separately to recover gold and silver.

The tailings from the concentrator pass into the hydrometallurgical plant to extract the uranium, which is then heated and dried to produce uranium oxide.

Copper produced at Olympic Dam is sold to markets in Australia and Asia. The uranium oxide is sent to converters overseas for further processing into fuel used in nuclear power reactors in Asia, Europe and North America. All of the gold and silver is sent to the Australian Mint in Perth.

Olympic Dam provides an annual report on its environmental performance. The Environment Management and Monitoring Report is submitted to the South Australian Government to comply with the Indenture. The report is available publicly.

Regulatory compliance and reporting

The standards specified in the various Acts and regulations that apply to Olympic Dam have been adopted as the minimum standard at the existing operation. BHP Billiton's objective is to exceed these minimum requirements by adopting leading practices in mining and minerals processing.

Olympic Dam has generally complied with these performance objectives and environmental standards, although there have been a few exceptions:

- seepage from the existing tailings storage facility was the subject of an inquiry by a South Australian Parliamentary Committee in 1995. The inquiry found that the original tailings system did not sufficiently provide for the decanting of excess liquor, although there had been no adverse environmental impact nor risk to occupational or public health and safety. Evaporation ponds were established as a remedial measure

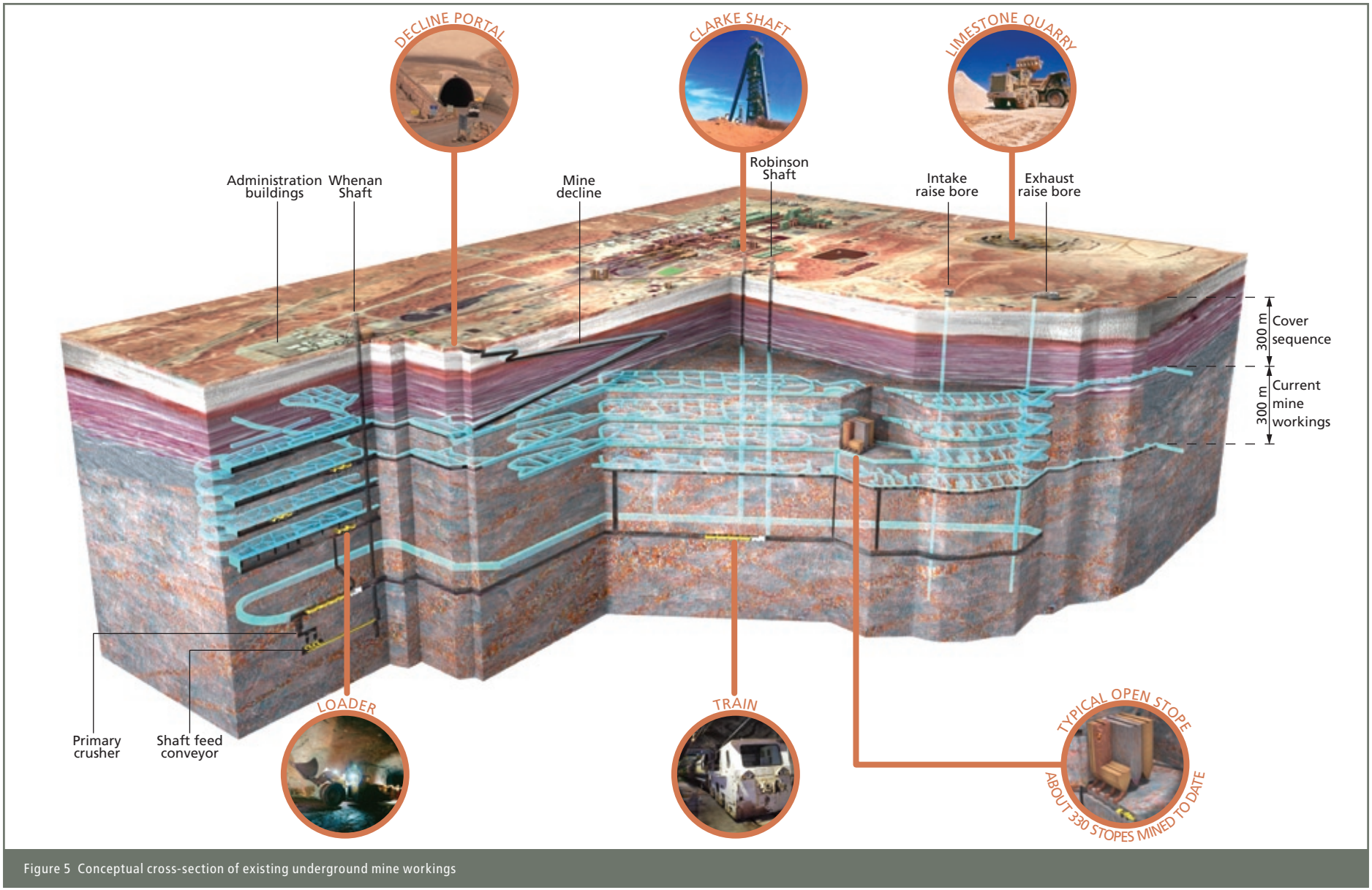
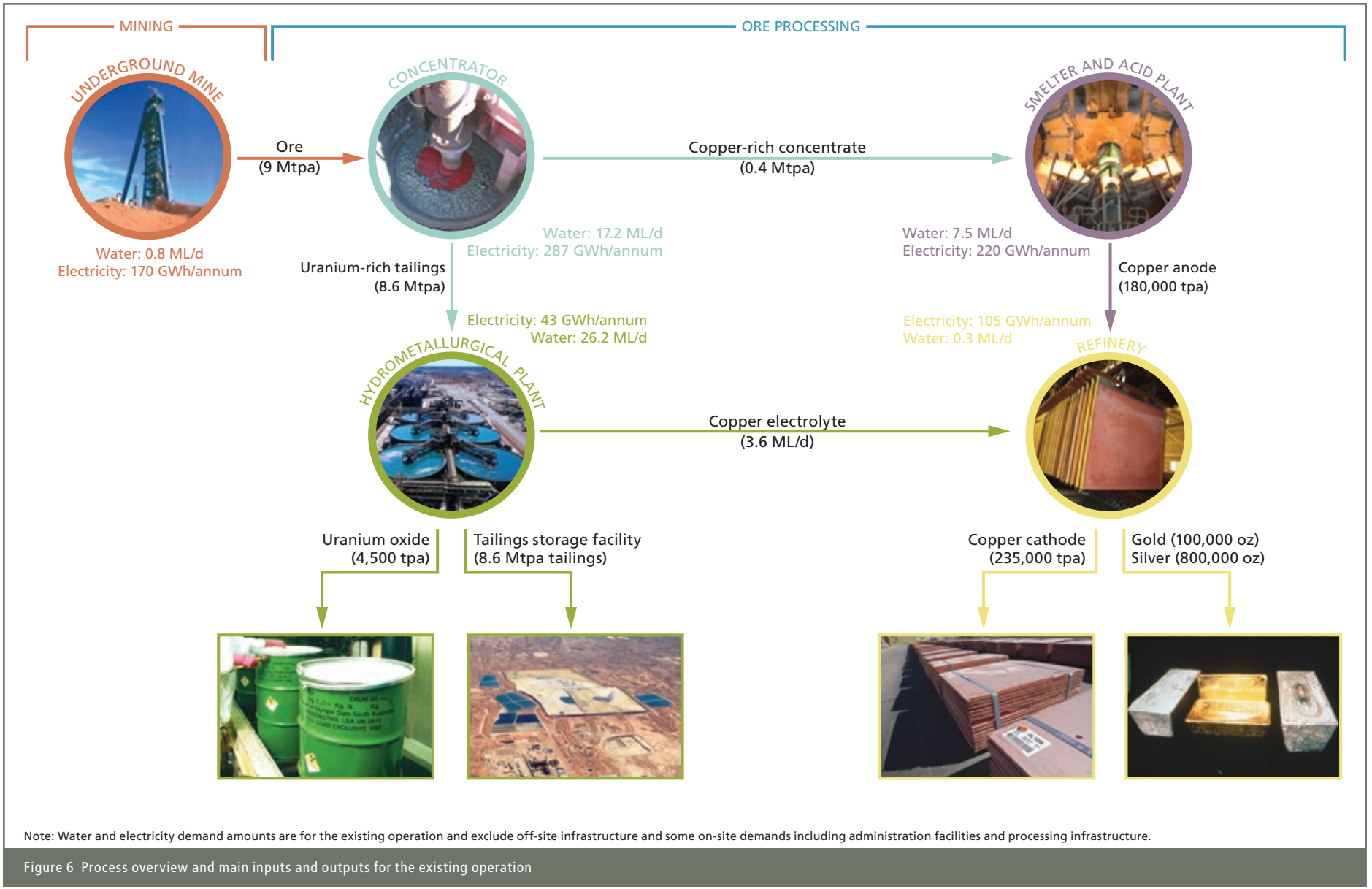


Figure 5 Conceptual cross-section of existing underground mine workings



Note: Water and electricity demand amounts are for the existing operation and exclude off-site infrastructure and some on-site demands including administration facilities and processing infrastructure.

Figure 6 Process overview and main inputs and outputs for the existing operation

- the evaporation ponds contain tailings liquor, which is acidic. Contact with this liquor has been causing bird deaths and Olympic Dam has undertaken a range of projects to minimise fauna interaction with the tailings system
- when operation of the smelter's acid plant has been interrupted, because of power failures for example, there have been brief periods when untreated sulphur dioxide gas has been released.

These exceptions, and any other incidents raising safety or environmental issues, have been reported to regulators. Improving the safety and environmental performance in these areas has been a specific objective of the expansion proposal.

Arid Recovery

In 1997, Olympic Dam established Arid Recovery, an 86 square kilometre fenced reserve from which rabbits, cats and foxes have been eradicated. The objective is to facilitate the restoration of arid zone ecosystems generally and re-introduce locally extinct species of fauna. Most of Arid Recovery is located to the immediate north of Olympic Dam, although the southern section was deliberately located within the Special Mining Lease to provide an opportunity to monitor interactions between threatened species and a large-scale mining operation.

Arid Recovery is a collaborative project between BHP Billiton, government agencies, academic institutions and community volunteers that has successfully re-introduced a number of locally extinct species such as the Greater Bilby, Burrowing Bettong, Western Barred Bandicoot and the Greater Stick-nest Rat.

Greater Bilby *Macrotis lagotis*

Burrowing Bettong *Bettongia lesueur*

Western Barred Bandicoot *Perameles bougainville*

Greater Stick-nest Rat *Leporillus conditor*

THE OLYMPIC DAM EXPANSION

Mining

The original development of Olympic Dam as an underground mining operation reflected commodity markets of 25 years ago. The ore body had not been fully explored, the minerals were less valuable and the 300 m thick cover of unmineralised sediments overlying the ore body (overburden) presented insurmountable cost constraints that prevented open cut mining. Underground mining, on the other hand, was able to extract higher-grade ore selectively to enhance the viability of the initial operation.

The situation today is different.

Drilling of the ore body undertaken by BHP Billiton since 2005 has more than doubled the resource estimate from 3.98 billion tonnes of total mineral resource to 8.34 billion tonnes (Table 2). At the same time, the expected demand and prices for the minerals means underground mining is no longer the preferred option for such a large ore body. Consequently, open pit mining has become the most feasible option for mining more of the resource. Underground mining can extract only about 25% of the ore containing recoverable quantities of copper, uranium, gold and silver, while an open pit would extract up to 98% as large zones of lower-grade mineralisation that were uneconomical for underground mining can be profitably bulk mined (Figure 7).

When viewed from above, the Olympic Dam ore body is shaped like a frying pan. The proposed open pit would mine the 'pan' and the underground operation would continue to take ore from the 'handle'.

It would take about five years of mining to remove the deep layer of overburden and expose the first section of the ore body. During this time, about 410 million tonnes per annum (Mtpa) of material would be removed from the open pit. Over 40 years, the footprint of the pit would grow to be 4.1 km long, 3.5 km wide and 1 km deep (Figure 8). Eventually, mining the open pit would produce 60 Mtpa of ore, equivalent to an annual rate of refined copper production of 515,000 tonnes.

The open pit operation would entail:

- dewatering of local aquifers to control inflows of highly saline groundwater into the pit and maintain the stability of the pit wall
- drilling and blasting to yield the optimal fragmentation of rock for ease of loading and haulage and to minimise dust and vibration
- loading the fragmented rock by electric rope shovels into haul trucks that would take the ore to a stockpile adjacent to the pit rim, ready for crushing and conveying to the metallurgical plant, and the mine rock (i.e. overburden and low-grade mineralised material) to the rock storage facility for long-term storage or to the tailings storage facility to be used to build perimeter walls.

BHP Billiton is very experienced in open pit mining and the practices of rock drilling, blasting, loading and haulage. There are no practical alternatives to the conventional open pit mining methods proposed for the expansion. In terms of scale of mining, BHP Billiton considered a range of mining rates and found lower ore production rates failed to optimise economies of scale.

Rock storage facility

As mentioned above, it would take about five years of mining to remove the deep layer of overburden (or mine rock) before the ore body was reached. This mine rock would be moved from the open pit to the rock storage facility (RSF). As the mine progressed the RSF would grow. The design incorporates selectively placing potentially reactive mine rock into the RSF.

The ultimate footprint of the RSF would cover approximately 6,720 hectares (ha), and it would eventually be about 150 m high. Its location and structural design have taken account of the following:

- a distance of 500 m would be retained between the RSF and Arid Recovery to reduce potential impacts from dust
- space would be required for the expanded metallurgical plant and mine maintenance industrial area
- providing a separate stockpile of low-grade ore in the event that it became economically viable to process this material in the future
- the costs of double handling and haulage, and the balance between horizontal and vertical haulage
- access to allow haul trucks to travel to the edges of the RSF
- distancing the RSF from Roxby Downs and Hiltaba Village, to minimise potential dust and noise impacts
- minimising the footprint of the RSF without compromising safety, construction, operability and long-term stability.

Processing

The expansion would require the following additional ore processing facilities (Figure 9):

- a new concentrator, built in stages, to grind the ore, then extract the minerals by flotation to produce:
  - a copper-rich concentrate containing recoverable quantities of uranium oxide, gold and silver
  - a uranium-rich tailings, which contains the majority of the uranium and the remainder of the copper, gold and silver
- a new hydrometallurgical plant to extract the uranium and the remaining copper from the concentrator tailings. This plant would have an ultimate capacity equivalent to 60 Mtpa ore, and be built in stages of 20 Mtpa ore capacity, corresponding to the progressive ramp up of ore production from the open pit
- upgrades to the existing electro-refinery and smelter, which would continue processing ore from either the existing underground operation or the open pit.

The proven metallurgical processes used in the existing plant, which are determined by the composition of the ore body, would continue to be used for the expansion. The proposed expansion does, however, add the sale of copper concentrate (containing some uranium, gold and silver) to the existing suite of refined metal products to provide the optimum return on capital invested.

Under this configuration:

- about 350,000 tpa of refined copper would be produced at Olympic Dam from 800,000 tpa of copper-rich concentrate derived from higher-grade ore fed to the processing circuit (this would almost double the existing on-site production of refined metal)
- about 1.6 Mtpa of copper-rich concentrate containing some uranium, gold and silver (hereafter termed concentrate) would be exported for further processing. This concentrate would be derived from lower-grade ore and is expected to yield about 400,000 tpa of refined copper and recoverable quantities of uranium oxide, gold and silver. At this stage, the likely location for further processing is China.

Very few mining projects extract and process ore to final product at the same site. This is because it is difficult to match the operating parameters of an on-site smelter with the changing mineralogy, grade and volumes of ore being extracted from the mine. The result often requires ore to be stockpiled and blended in an attempt to produce a more consistent feed to the smelter, or to have the smelter operating below capacity and therefore, inefficiently. Creating the ability to choose the volume and grade of ore sent to the on-site smelter and exporting the excess as concentrate would provide Olympic Dam with greater operating efficiency.

Table 2 Olympic Dam ore resources and reserves[1]

	Tonnes (Mt)	Copper (%)	Uranium[2] (kg/t)	Gold (g/t)	Silver (g/t)
Total resources	8,339	0.88	0.28	0.31	1.50
Total reserves	473	1.86	0.60	0.76	3.95

[1] Sourced from BHP Billiton Mineral Resource and Ore Reserve Declaration as at 30 June 2008. The information contained in this table that relates to the Mineral Resource Estimation for the Olympic Dam Deposit is based on information compiled by Shane O'Connell who is a member of the Australasian Institute of Mining and Metallurgy. Shane O'Connell has sufficient experience which is relevant to the style of mineralisation and type of deposit under consideration and the activity which he is undertaking to qualify as a Competent Person as defined in the 2004 Edition of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves. Shane O'Connell consents to the inclusion in the table of the matters based on his information in the form and context in which it appears.

[2] As uranium oxide (U_3O_8).

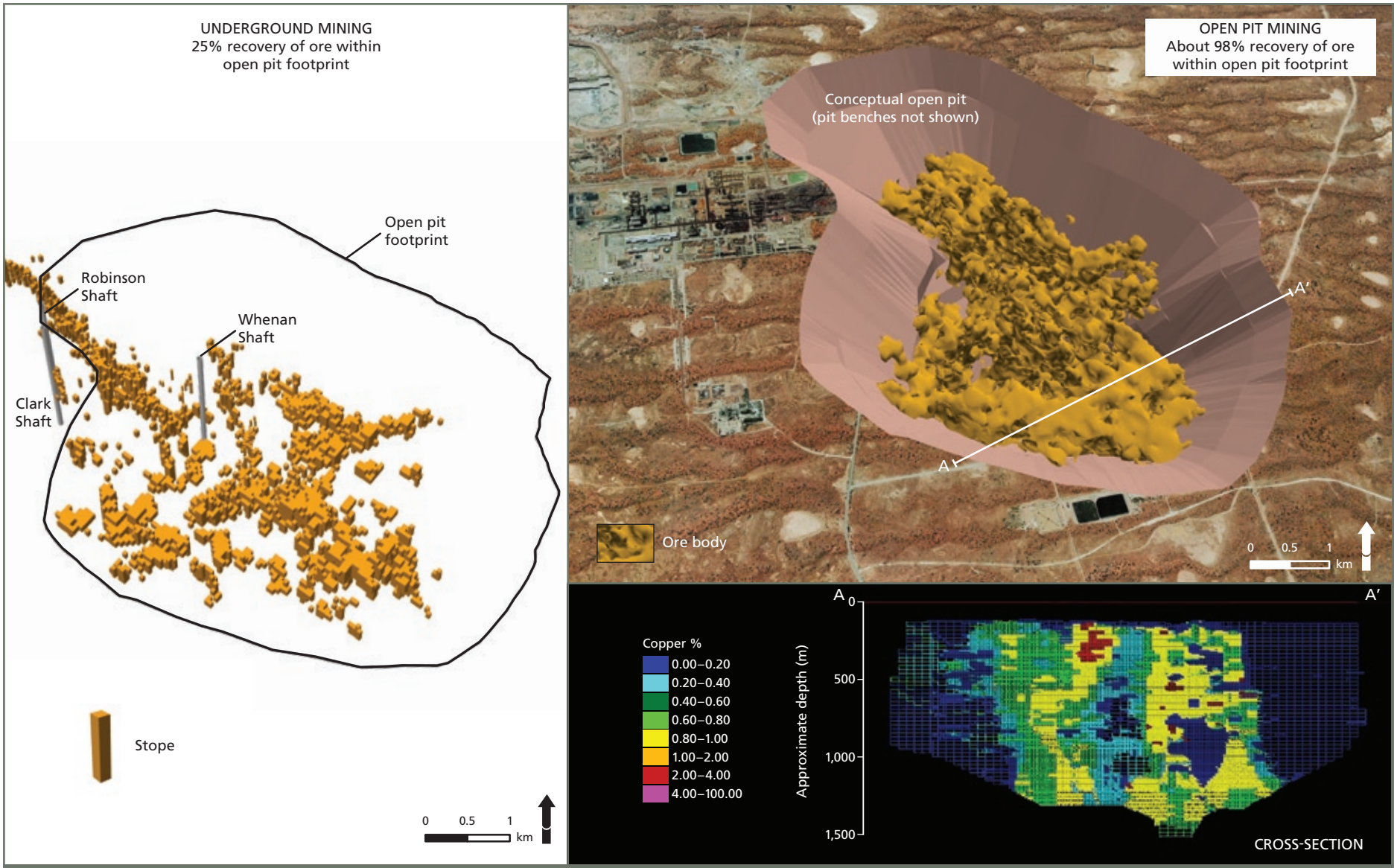


Figure 7 Potential ore recovery from underground versus open pit mining

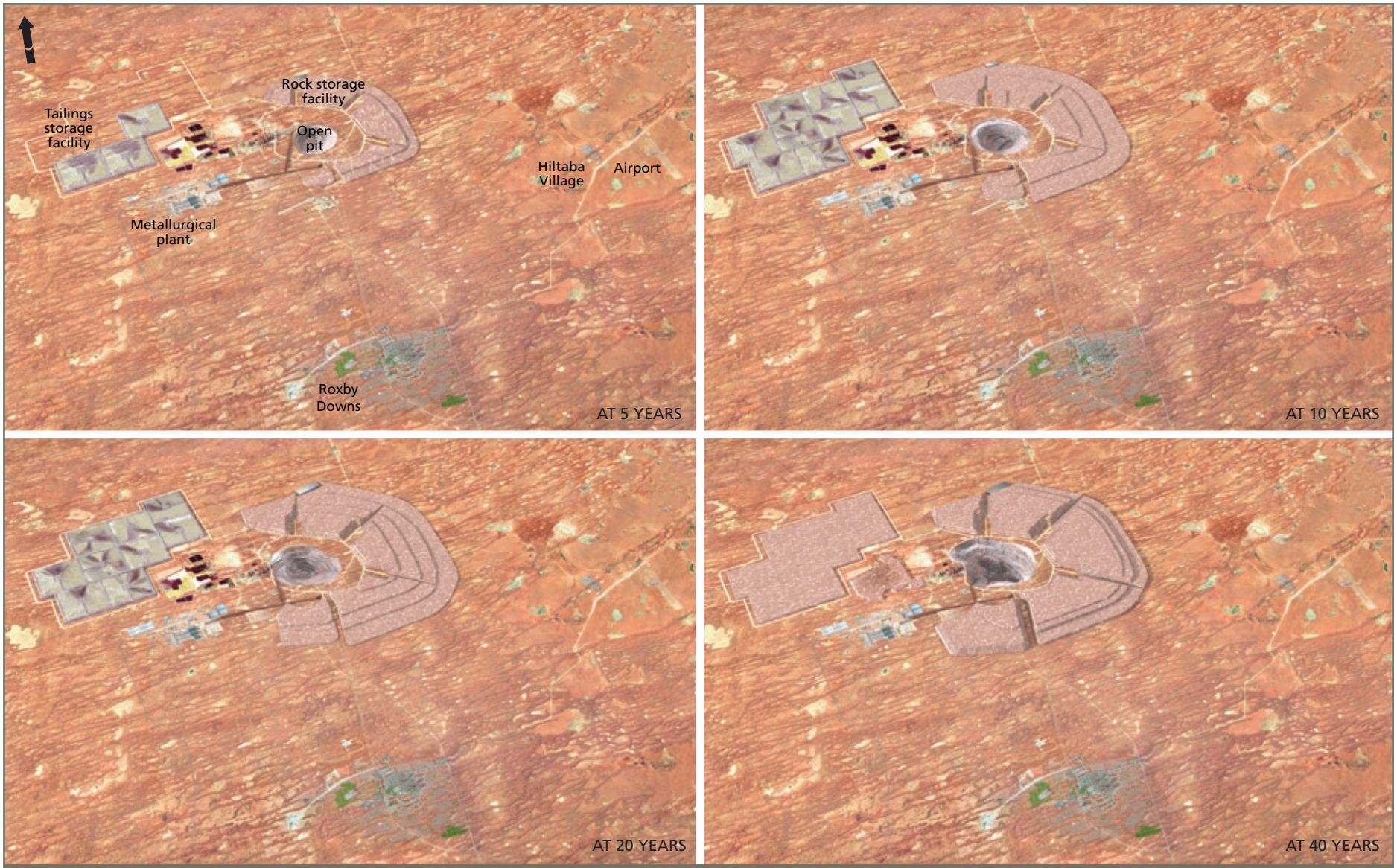
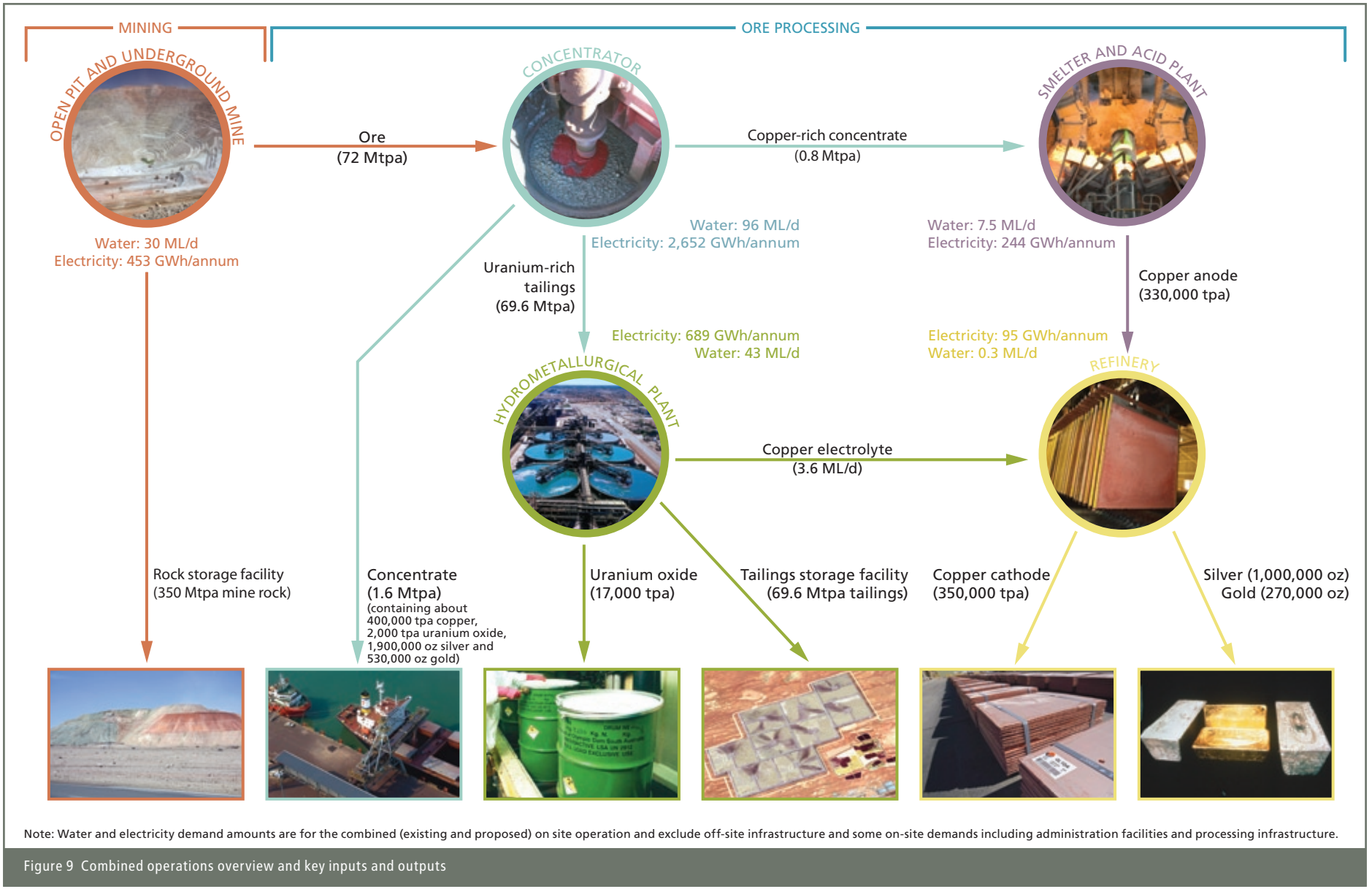


Figure 8 Conceptual development of the proposed expansion



Note: Water and electricity demand amounts are for the combined (existing and proposed) on site operation and exclude off-site infrastructure and some on-site demands including administration facilities and processing infrastructure.

Figure 9 Combined operations overview and key inputs and outputs

BHP Billiton ships concentrates between its mines and other countries on a regular basis and Olympic Dam has been shipping uranium oxide without incident for more than 20 years.

Tailings storage facility

The expansion would generate approximately 58 Mtpa of tailings at full production, and would require up to nine storage cells in addition to the four existing storage cells that currently receive approximately 10 Mtpa of tailings.

The tailings would be deposited into the storage cells from a pipeline that would circle the embankment of each cell. Each section of beach would be allowed to dry and consolidate before receiving more tailings. The perimeter embankment would be progressively raised as each cell was filled with tailings.

The design of the cells would take advantage, and build on, 20 years' experience operating the existing tailings storage facility (TSF) at Olympic Dam. More detail of the design of the TSF is provided later in this summary.

Alternative methods for managing the tailings were considered, assessed and rejected. These options were to:

- construct a central discharge (hub) onto radial spokes in a circular TSF. This option was rejected because storage would have been inefficient and the footprint would have been much larger
- co-dispose of tailings mixed in with mine rock in the RSF. This option was rejected because there would have been poor structural strength and greater seepage to the groundwater
- locate the TSF within the RSF. This option was rejected because with the large mining fleet involved there would have been operational inefficiencies and safety risks.

If mining of the open pit at Olympic Dam were to continue beyond 2050, the RSF and TSF would grow and ultimately abut each other.

Water supply

The current operation uses an average 37 megalitres per day (ML/d) of water and the expansion would require an additional average of 216 ML/d. A small portion of this demand (25 ML/d for dust suppression) could be met by a salt water wellfield some 30 km from Olympic Dam.

Identifying a source for the additional supply has been a complex and difficult issue. Naturally available water is a public resource on which there are many legitimate and competing claims. Moreover, known sources of supply have limits.

Olympic Dam already operates a small plant near the existing operation to desalinate groundwater piped from the Great Artesian Basin (GAB). To deal with the potential constraints on future supply, BHP Billiton has elected to manufacture more of its own fresh water by establishing a much larger desalination plant on the coast. This option would not compete for existing supplies and would be comparable in cost to the alternatives. It also would create a new South Australian Government water supply option for the towns in Upper Spencer Gulf and Eyre Peninsula regions that currently take water from the River Murray.

Seawater desalination is a widely used and proven technology, with more than 12,300 plants operating in 147 countries.

About 1,500 of the world's desalination plants in 96 countries, including the existing plant at the current Olympic Dam operation, use reverse osmosis, and this method is proposed for the new plant. Seawater would be pumped through fine membranes to produce low-salinity product water and high-salinity return water. The return water would be a combination of brine (which is about twice as salty as seawater) and small quantities of anti-scalant chemical used to prevent scale accumulating on the membranes of the plant.

The location of a coastal desalination plant for Olympic Dam requires an environment where the performance standards for intake water quality and return water discharge could be met. Sites at Point Lowly, Port Augusta, Whyalla, south of Whyalla, south of Port Pirie and at Ceduna were assessed against the following criteria:

- proximity to Olympic Dam with clean, deep water (i.e. greater than 20 m) in a high-energy environment (i.e. water of the required intake quality and where the return water could be rapidly diluted and dispersed)
- accessibility and constructability of the water supply pipeline
- availability of, and access to, land and utilities (e.g. power, road and telecommunications infrastructure).

Point Lowly meets the criteria and became the preferred option. Extensive biological studies have been carried out in the vicinity along with biological testing of key species. This work is discussed in more detail later in this summary document.

The modular desalination plant would be constructed progressively as the mine was ramped up to full production. The water would be pumped by pipeline 320 km to Olympic Dam. The pipeline would be buried for its entire length, except for about 1.5 km where it would intersect watercourses.

The return water would be discharged at sea through a specially designed diffuser, where it would be mixed with the ambient seawater by the strong currents and high-energy environment off Point Lowly (Figure 10). The start of the diffuser would be at least 400 m off-shore, positioned on the sea floor in at least 20 m of water and oriented at right angles to the direction of the prevailing current. The return water, which is denser than the ambient seawater, would be released under pressure from the diffuser and directed towards the surface, creating jets of up to 5 m that would enhance mixing with seawater driven by prevailing currents.

Extensive modelling of Spencer Gulf and the locale of the preferred site has indicated that the return water would disperse rapidly, ensuring sensitive marine life such as cuttlefish would not be affected.

The alternatives to a coastal desalination plant that were assessed and rejected were:

- a third wellfield in the GAB – the two existing wellfields supplying the current operation could not sustain the additional demand. It would have been necessary to establish a third wellfield much further into the GAB to ensure the GAB springs were protected. The resulting production of much warmer water would have been technically difficult and very expensive to cool to the required temperature and pipe to Olympic Dam
- Adelaide treated wastewater – the majority of Adelaide's treated sewage effluent is routinely discharged to the sea. The option of using this water via a 600 km pipeline to Olympic Dam was rejected because of its variable quality, and the existing and likely demands in the future for its use by industry on the Adelaide Plains
- River Murray water – at a very early stage, BHP Billiton rejected the River Murray option because it would have run counter to government initiatives to remedy the ecological stresses of drought and of increased water abstraction from the river.

Electricity supply

The electricity demand for the proposed expansion would increase over time, ultimately requiring about 650 MW of electricity, consuming 4,400 GWh annually. This would be in addition to the existing operation's 125 MW, and 870 GWh annually, which represents about 10% of South Australia's current baseload demand.

A new electricity supply source for the proposed expansion would not be needed until 2013. South Australia would require new baseload electricity generation capacity by about 2012, even if the Olympic Dam expansion did not proceed.

The proposed desalination plant would require 35 MW of electricity, which would be supplied by a new 25 km 132 kV transmission line from the Cultana substation. The electricity for the desalination plant would not be required until 2015, and would be supplied by renewable energy sourced from the National Electricity Market (NEM).

To supplement the primary electricity demand, BHP Billiton would build a substantial cogeneration power station at Olympic Dam. This would capture the waste heat, which is generated from the burning of sulphur to produce the sulphuric acid required for the new hydrometallurgical plant. Over time, and as the operation reached full capacity, this waste heat would be used to generate up to 250 MW.

Expressions of interest were sought from energy companies to supply the remaining electricity required for the expansion. BHP Billiton recognises the potential of local solar energy, regional geothermal, and the state's wind resources, and has had meetings with many specialist renewable energy companies. The expression of interest also included the need for energy companies to identify renewable energy supply options.

At present, no commercially viable solar or wind energy solution has been identified at the baseload scale required. A concentrated solar thermal study for a supplementary supply of up to 150 MW is ongoing. This would remain a future opportunity for the expansion.

Commercial ventures continue to investigate potential geothermal heat anomalies in the Olympic Dam region, with the intention of proving the feasibility of baseload power generation. As no proven supply currently exists at the scale required for the expansion, this would remain an opportunity for the future.

The NEM would typically be the first choice for electricity supply. However, the expansion's demand would be sufficiently large in its own right to attract new investment in generation capacity in the NEM, or to justify BHP Billiton establishing its own power station at Olympic Dam to supply the expansion's needs.

In order to maintain commercial and technological flexibility, given significant electricity supply is not required until 2013, BHP Billiton is putting forward two proven primary electricity supply options in the Draft EIS – a 275 kV transmission line between Port Augusta and Olympic Dam, a distance of 270 km, to draw on the NEM; and a 600 MW combined cycle gas turbine (CCGT) power station at Olympic Dam to be supplied by a pipeline from Moomba. The ultimate arrangement could comprise either option or a hybrid of both and would permit the future adoption of renewable energy supplies should they prove viable.

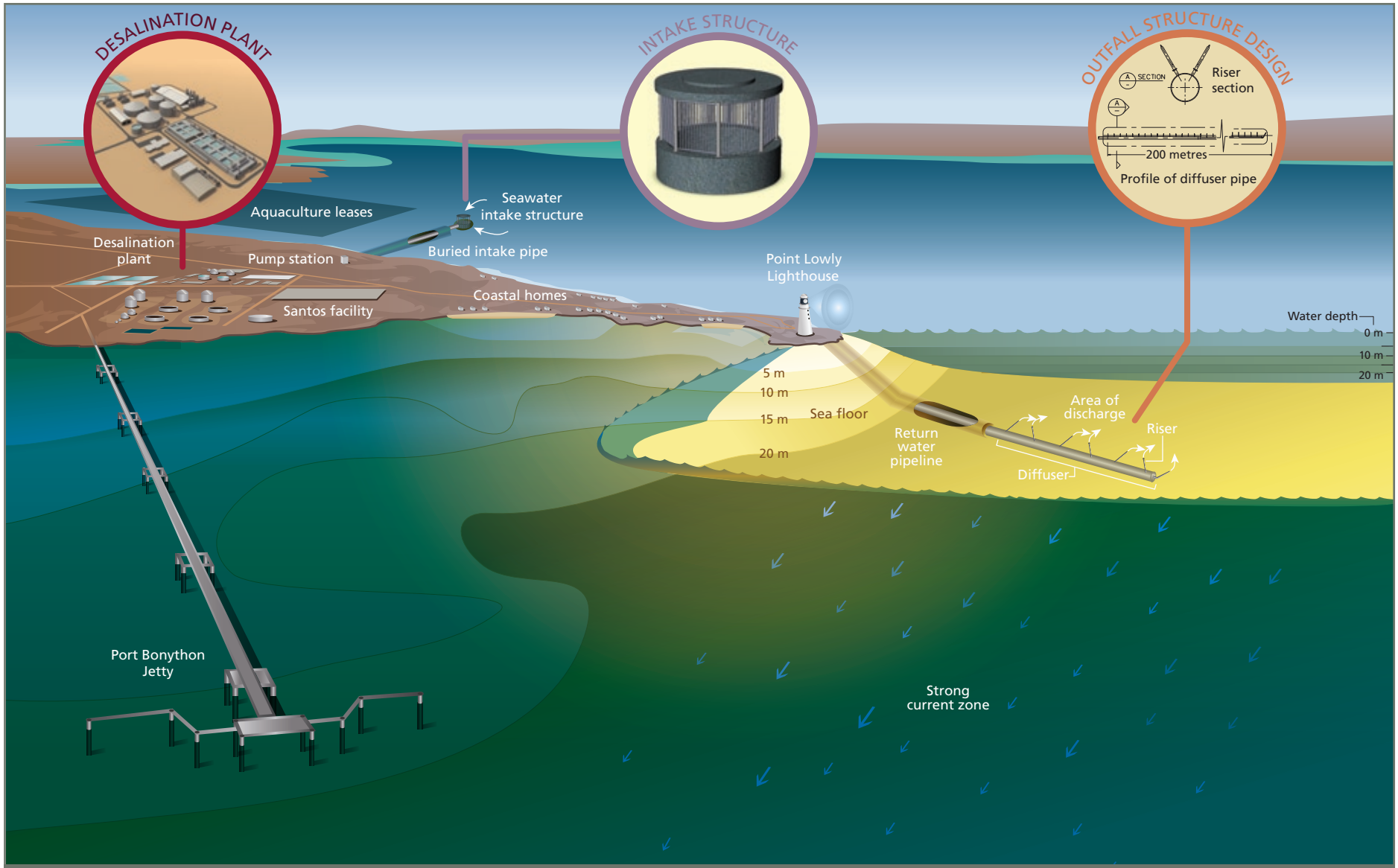


Figure 10 Conceptual layout of the proposed desalination plant and intake/outfall infrastructure at Point Lowly

The transmission line would require 700 towers built to a height of 40 m, and would run parallel to the existing line between Port Augusta and Olympic Dam. It would be designed with spare capacity to meet the reasonably foreseeable demand for power at Olympic Dam and in the Roxby Downs area, and to provide 50 MW required for the OZ Minerals copper mine at Prominent Hill, about 130 km north-west of Olympic Dam.

The CCGT power station would be supplied with natural gas from the Moomba gas hub. Three alternative alignments are being evaluated for the 45 petajoule per annum buried gas supply pipeline (Figure 11):

- Option 1 – 440 km directly from Olympic Dam to Moomba
- Option 2 – 400 km from Olympic Dam linked to the existing Moomba to Adelaide gas pipeline at an existing compressor station
- Option 3 – 560 km from Olympic Dam to Moomba via the existing compressor station and a parallel pipeline to Moomba from that point.

Materials handling and transport

The existing operation requires about one million tonnes per annum (Mtpa) of supplies and product to be transported primarily by road to and from Olympic Dam. These are mainly copper cathodes, sulphur, diesel and various reagents used in the metallurgical plant. The proposed expansion would increase transport volumes to about 4.8 Mtpa, mainly due to the new concentrate product (1.6 Mtpa), increased sulphur usage (from 80,000 tpa to about 1.8 Mtpa) and increased diesel usage (from about 25 ML/a to about 430 ML/a).

The materials handling and transport method chosen for the expansion would maximise the bulk transport of materials by rail with some transport to continue by road. The capital cost for this option is higher than continuing road only transport, but the selected option would have lower long-term operating costs and would reduce road transport significantly (Figure 12). The infrastructure required to deliver this transport solution is discussed in the following sections (see also Figure 13).

Rail

Rail would be the primary mode for transporting goods and products to and from Olympic Dam. A 105 km rail line would be built to link Olympic Dam to the existing interstate rail line near Pimba. An average of three train movements is expected each day between Port Adelaide and Olympic Dam, and one train per day would transport concentrate to the Port of Darwin.

An overpass would be built 15 km north of Woomera to separate road and rail traffic.

Once the rail line was operational the bulk of materials (which would include concentrate, sulphur and diesel) would be transported by rail, providing a significant and ongoing reduction in road traffic for the operation.

BHP Billiton would still need to transport some materials (such as oversized equipment) by road after the rail spur was built, but at much reduced volumes.

Intermodal facility

An intermodal facility would be constructed at Pimba to maximise the transport of materials by rail before the new rail spur was built. Materials would be railed to the facility on the existing rail network and transferred to trucks for delivery to Olympic Dam, and vice versa.

Landing facility

Some components of the expansion would be prefabricated as modules in other parts of Australia or overseas. Because of their bulk and irregular dimensions (up to 15 m wide by 15 m high and 500 tonnes in weight), a landing facility would be needed at the coast to unload these modules prior to transporting them by road to Olympic Dam.

The preferred location for the landing facility is around 10 km south of Port Augusta on the western shore of Upper Spencer Gulf at Snapper Point, north of O'Connell Court. The site would be linked by a dedicated access corridor to a pre-assembly yard at Port Augusta.

The preferred location avoids the need for dredging a navigational channel, avoids impacts on mangroves, and limits disturbance to the owners of coastal homes. Site options further to the south were also constrained by the operational requirements of the Australian Department of Defence Cultana Training Area.

The facility would be a pier, rather than a causeway, to ensure negligible impact on tidal flow, wave propagation and shoreline stability.

Ocean going ships would moor in deep water in Upper Spencer Gulf and offload the modules onto barges to bring them to the landing facility. On landing, the modules would undergo a quarantine inspection in a 2 ha yard adjacent to the facility and then be trucked as over-dimensional loads on the dedicated access corridor to the Port Augusta pre-assembly yard, where they would be further prepared for movement on the Stuart Highway to Olympic Dam.

Road transport

The Stuart Highway between Port Augusta and Pimba, and Olympic Way between Pimba and Olympic Dam, would be used to carry oversized loads that could not be carried by rail. These loads would be:

- up to 5.5 m wide – on average twice a day
- police escorted loads up to 8 m wide – on average every four to five days
- loads greater than 8 m wide – on average once every three to four days.

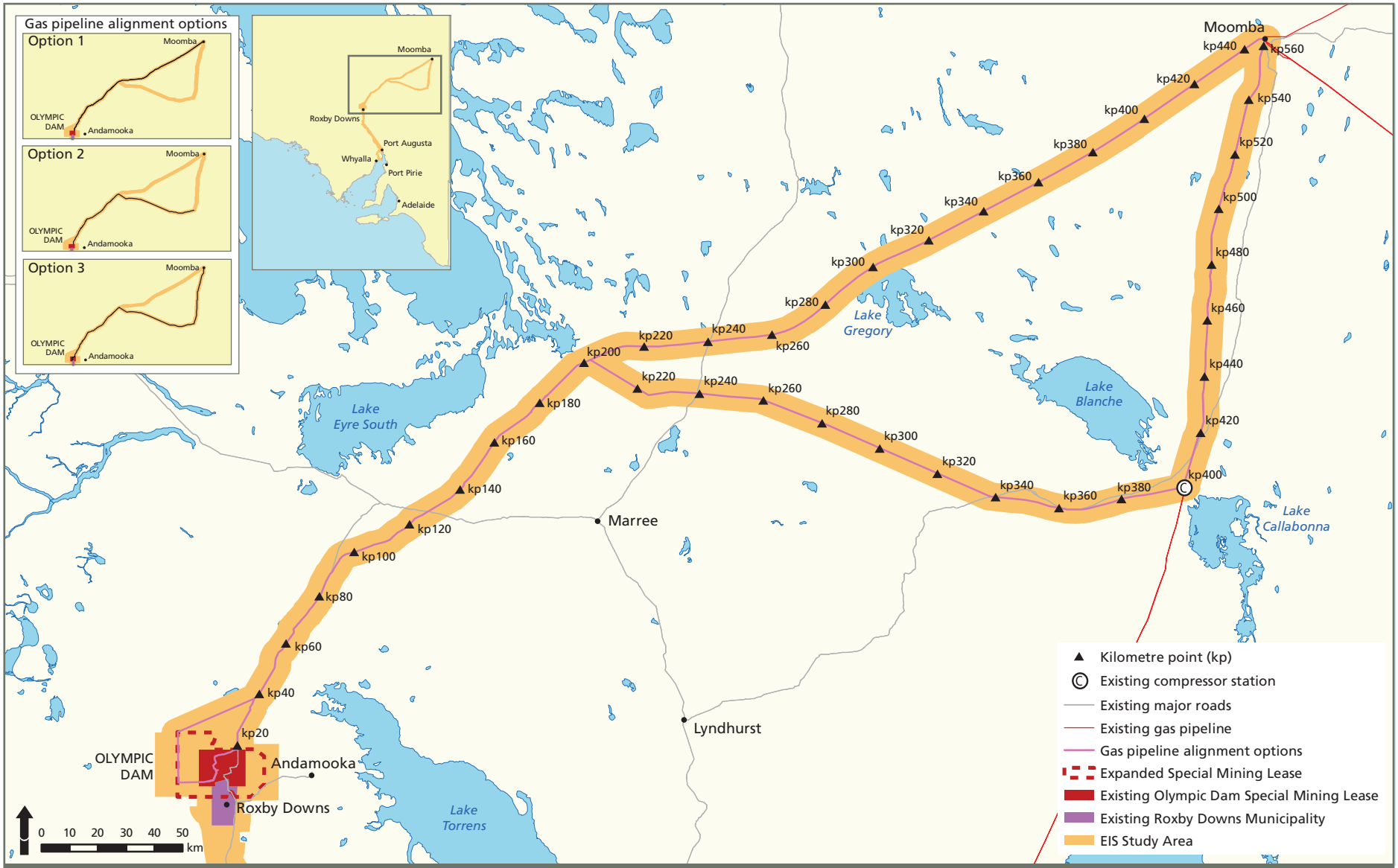


Figure 11 Gas pipeline corridor options

To ensure the safety of this arrangement and to minimise delays and inconvenience to other road users, BHP Billiton would, by arrangement with the South Australian Department for Transport, Energy and Infrastructure, establish additional passing bays on these roads. Where practicable, these loads would also be moved outside peak traffic times.

The following upgrades would also be needed within and around Roxby Downs because the construction and operation of the expansion would change the volumes and types of road traffic using the local road network:

- road extensions, new distributors, improved intersections and traffic management measures in Roxby Downs
- relocating Borefield Road.

Outer Harbor

An additional 1.7 million tonnes of sulphur and 400 million litres of diesel would be imported each year through Adelaide's Outer Harbor, which already receives smaller volumes of these commodities for the existing operation.

The increased volume of sulphur would require the construction of new bulk off-loading and storage facilities likely to be operated by third parties (Figure 14). The additional volumes of diesel would be accommodated by existing third-party facilities.

Outer Harbor has access to rail and can receive the Panamax-class vessels required for the large shipments of sulphur and diesel.

Additional product (refined copper and a portion of uranium oxide) would be exported via existing facilities at Outer Harbor.

Alternative South Australian ports were investigated but are not the preferred option on the basis of the impact, availability and cost of dredging channels for Panamax-class access and upgrading facilities.

Port of Darwin

The Port of Darwin (East Arm) is already used by BHP Billiton to export a portion of the uranium oxide produced at Olympic Dam. The expanded operation would use facilities at East Arm to export additional uranium oxide and up to 1.6 million tonnes per annum of concentrate.

The additional export of uranium oxide would require minor modifications to the existing storage and handling facilities.

New storage, handling and loading facilities would be required at East Arm for the concentrate (Figure 15). The concentrate is an odourless black powder, insoluble in water, with a uranium content of up to 2,000 parts per million (compared to 900,000 parts per million for the uranium oxide already shipped from the port). However, the uranium in the concentrate would still be sufficient for the product to be considered radioactive

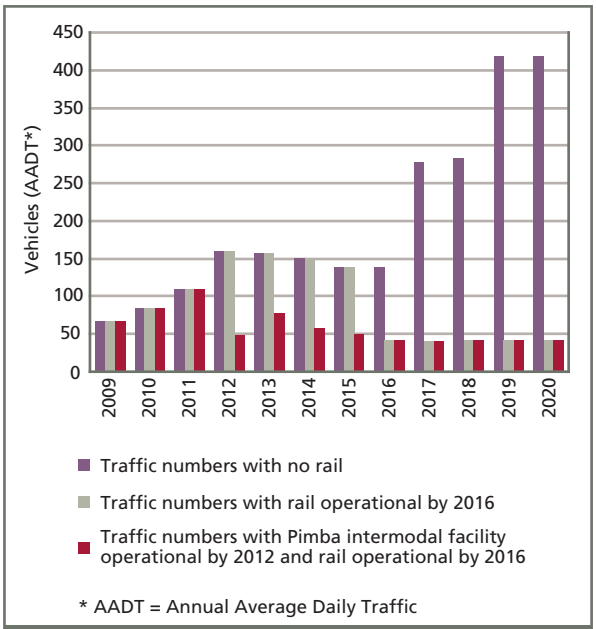


Figure 12 Traffic numbers reducing with rail and intermodal facility

and therefore would be transported according to the requirements of the Australian Radiation Protection and Nuclear Safety Agency's Code of Practice for the Safe Transport of Radioactive Material.

Dedicated closed rail wagons would transport the material from Olympic Dam to the Port of Darwin using the existing rail line and the proposed spur linking the operation to Pimba. A closed system would prevent the release of dust during transportation and at the storage and handling facility at East Arm. The concentrate would be transferred from the storage facility to dedicated export vessels in enclosed conveyors and a dedicated BHP Billiton ship loader to be installed on the East Arm wharf.

Wash-down facilities would be installed within the enclosed handling area to clean the wagon exteriors after unloading. This wash-down water would be recycled on-site for reuse until it became too dirty, when it would be transported back to Olympic Dam for disposal on-site.

Olympic Dam Airport

Development of the rock storage facility would encroach on the existing airport at Olympic Dam Village, requiring it to be moved. A new airport would be built about 17 km east of Roxby Downs on the Andamooka Road. A new all-weather runway would handle Code 4C class aircraft such as the Boeing 737-800 or A320 and the airport would support both day and night flights.

Figure 13 Transport infrastructure

Figure 14 Indicative location and configuration of the Outer Harbor sulphur handling facility at Port Adelaide

Conceptual layout of proposed Port Augusta landing facility

Figure 15 Proposed location and indicative configuration of the Port of Darwin facilities

Workforce and accommodation

Constructing the various elements of the proposed expansion would require a construction workforce averaging 4,000 and reaching a peak of about 6,000 during the 11 years until full production was reached. Over the long term, a doubling of the existing operational workforce is planned. Table 3 and Figure 16 shows the labour predictions for the construction period based on full-time equivalent positions.

BHP Billiton proposes two options to accommodate the increased workforce:

- the new Hiltaba Village would be built between Roxby Downs and Andamooka to accommodate up to 10,000 people in motel-style en-suite single rooms, with recreational and retail areas. The existing Olympic Village accommodation would be decommissioned and those workers would also be accommodated at the new village
- the expansion of Roxby Downs up to 10,000 people (currently 4,500).

Fourteen locations to the north, south and east of Roxby Downs were investigated for the accommodation village for the construction workforce. The preferred location is about midway between Roxby Downs and Andamooka on the road linking the two towns. This location was chosen to reduce possible social impacts and disruption in Roxby Downs and Andamooka and to reduce dust and noise impacts associated with establishing and operating the open pit mine.

The Roxby Downs Draft Master Plan, which is being released for public comment with the Draft EIS, has been developed with input from residents of the town, service providers and others with an interest in the future of the town. In addition to new housing subdivisions in Roxby Downs, it allows for a range of new and expanded education, health and other community services and for an expansion of retail, commercial, sport and recreational activities (Figure 17).

Table 3 Projected peak labour requirements

Year	Construction	Operation	Total
2010	1,500	100	1,600
2011	2,700	400	3,100
2012	2,700	1,100	3,800
2013	3,900	1,900	5,800
2014	5,000	2,300	7,300
2015	5,900	2,700	8,600
2016	5,900	3,000	8,900
2017	4,800	3,300	8,100
2018	4,800	3,300	8,100
2019	4,700	3,500	8,200
2020	2,300	3,800	6,100
2021	1,200	3,900	5,100
2022	0	4,000	4,000

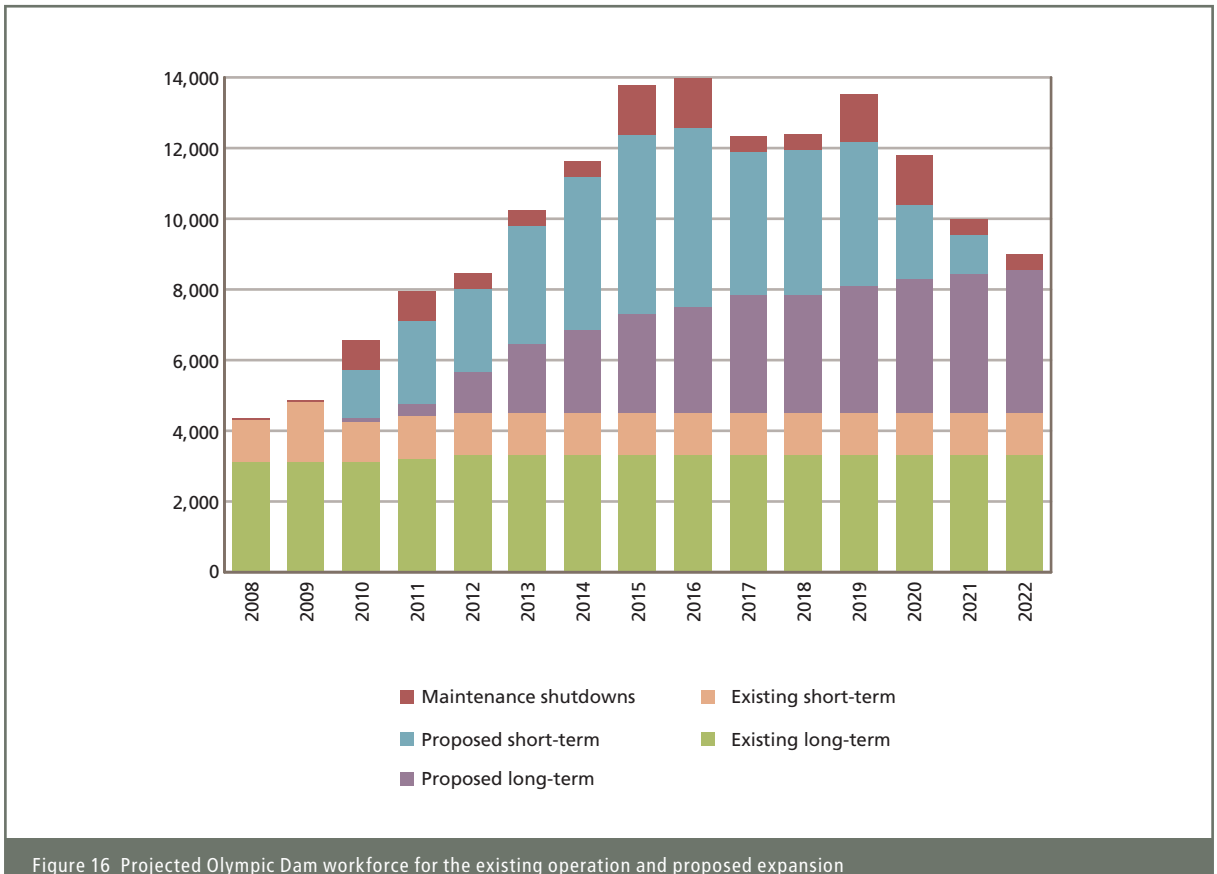


Figure 16 Projected Olympic Dam workforce for the existing operation and proposed expansion

Figure 17 Conceptual features of the expanded Roxby Downs including new road infrastructure

MANAGING THE IMPACTS OF THE EXPANSION

Mining, processing and linear infrastructure

The size of the new mine would be its distinguishing characteristic. By 2050, it would be larger in area than any other Australian mine except the Morwell open cut coal mine in the Latrobe Valley of Victoria, and it would be more than three times as deep.

The open pit mine (Figure 18) and adjacent rock storage facility (RSF) and tailings storage facility (TSF) would cover about 12,130 ha – about 70% of the overall expansion project's footprint.

BHP Billiton would seek from the South Australian Government an extension of the boundaries of the Special Mining Lease to accommodate the areas required by the RSF and TSF.

Most of the approximately 17,000 ha of native vegetation and associated fauna habitat that would require clearing for the expansion is close to the existing mine and is already disturbed to some degree. Twenty-one vegetation associations (or types) would be affected, each relatively widespread and abundant in the rangelands of South Australia. The amount of each vegetation association that would require clearing would vary between less than 1% and 6%. The overall loss across all vegetation associations would be 1.3% within the EIS Study Area.

Occupational health and safety

A rigorous and systematic approach to health and safety is embedded in the business culture of the BHP Billiton Group. Formal construction safety plans and management focus would be applied to all aspects of the project.

Although the BHP Billiton Group operates many open pit mines around the world in a range of different environments, open pit mining at Olympic Dam would be new, and many of the health and safety issues would be different from those experienced in the existing underground mine.

A management priority would be to reinforce the safety culture and share knowledge by exposing appropriate employees to other large open pit mining operations and refining the existing mine safety management plan to accommodate open pit mining.

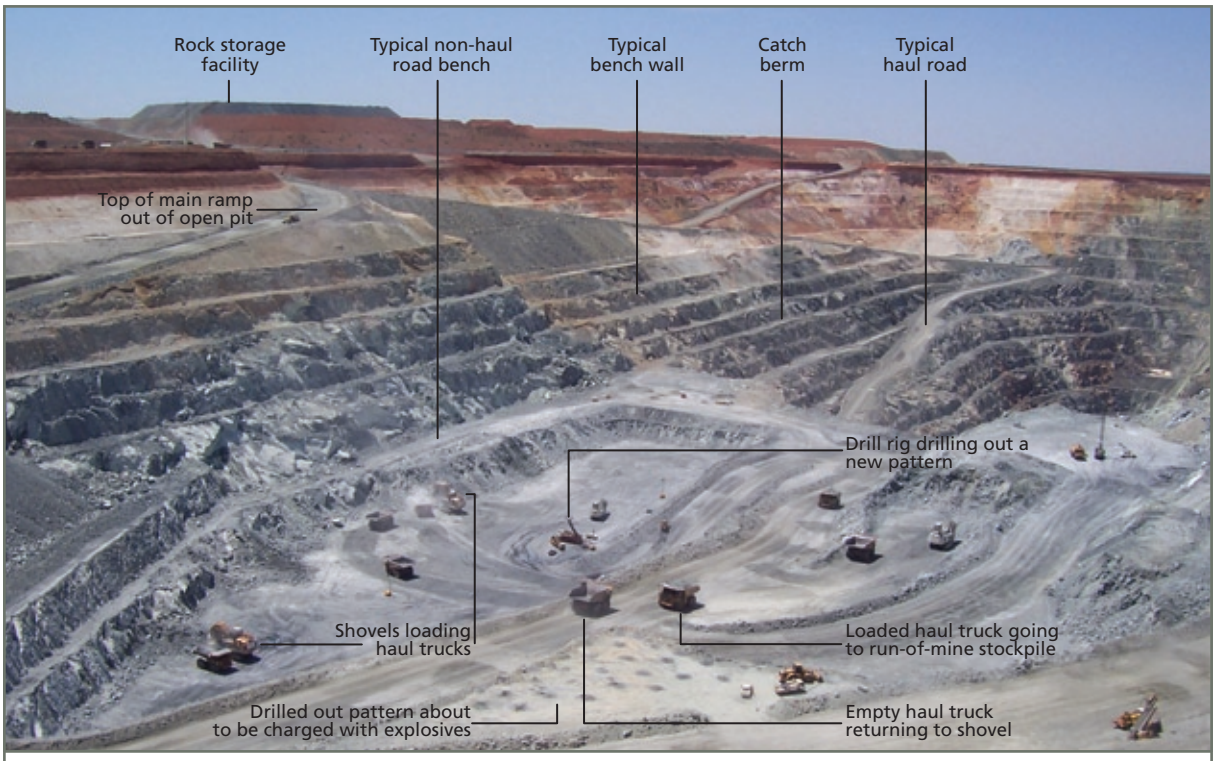
The BHP Billiton Group's commitment to health and safety is inherent in the company's policies, standards and systems. While the existing operation has a significantly better safety record compared to the Australian mining industry average, major efforts would continue towards achieving the overriding target of Zero Harm to employees, contractors and members of the public.

Biodiversity

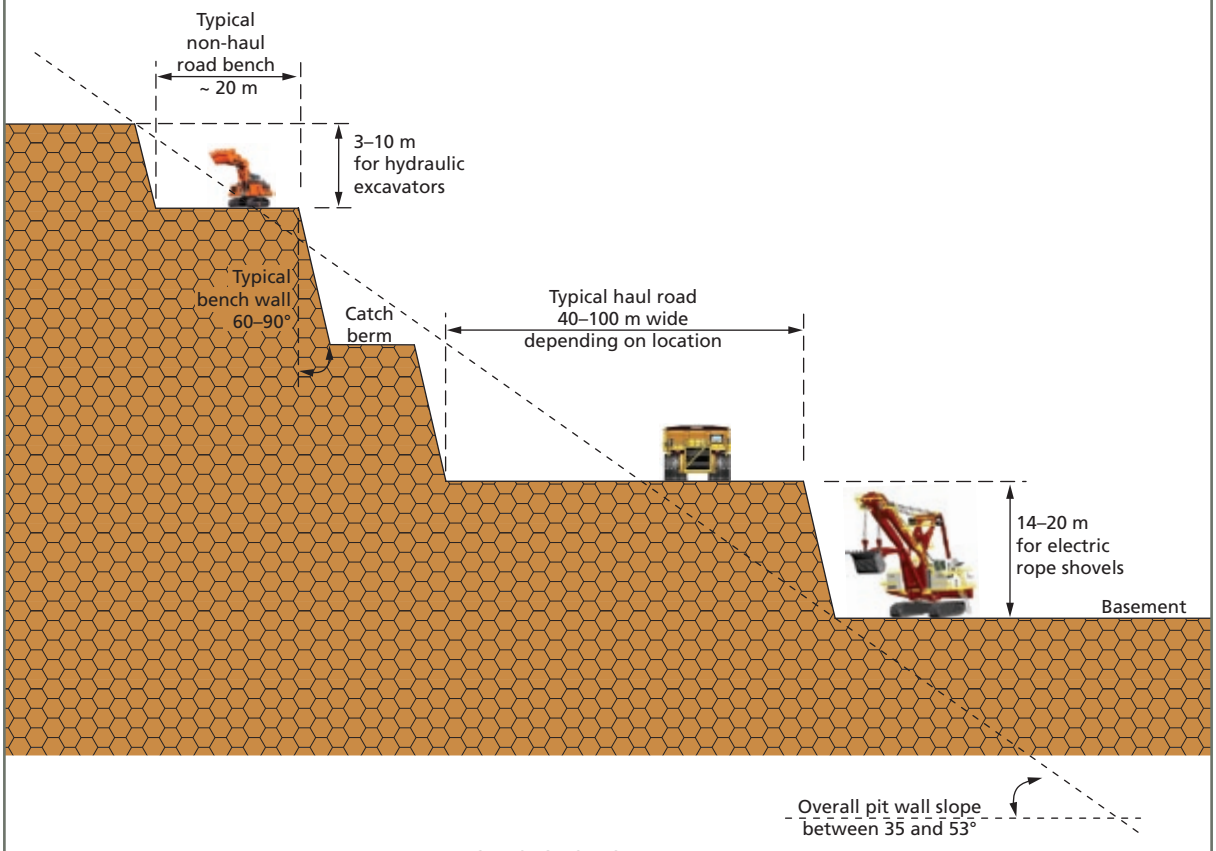
As a result of research and conservation programs undertaken in the region over the past 20 years, much is known about the biodiversity of the rangelands of South Australia. The scientific staff at Olympic Dam have regularly published papers on their research to share the information with other interested parties. This work would continue as the operation expanded.

Listed plants

Eleven threatened plant species may be affected by the expansion, however the residual impact on each of these species has been assessed as negligible.



TYPICAL OPEN PIT



TYPICAL SECTION OF THE PIT WALL

Figure 18 A typical open pit mine

Known locations of threatened plants would be avoided where practicable, marked as 'no-go' areas on construction drawings and fenced off with flagging tape and hazard netting.

The clearance of vegetation is an undesirable but necessary part of any major development project. Where practicable, BHP Billiton has chosen sites and alignments for infrastructure for the expansion that would reduce the impact of this clearing.

No endangered communities protected under the *Environment Protection and Biodiversity Conservation Act 1999* would be disturbed, and the clearing would not affect the regional or state-wide conservation status of any of the relatively widespread and abundant vegetation types.

Some 334 ha of Mulga woodland would be cleared – less than 1% of the 70,236 ha of this provisionally listed vulnerable community in the EIS Study Area. Mulga has been listed in South Australia because post-fire regrowth is susceptible to grazing by cattle, sheep and rabbits. It is, however, a common vegetation association of the Special Mining Lease, the infrastructure corridors and in central and northern South Australia generally.

The South Australian *Native Vegetation Act 1991* allows native vegetation to be cleared provided the losses are offset (this is termed significant environmental benefits, SEB). The SEB may include the acquisition of land for conservation, payment to the Native Vegetation Fund, or a combination of both. BHP Billiton proposes to offset the required vegetation clearance by setting aside 128,278 ha of land, or almost eight times the area of land to be disturbed. To maximise the ecological benefit of this offset, BHP Billiton proposes to provide this land in areas that link to existing conservation reserves, which in turn would also assist the South Australian Government to meet its target of establishing a nature link corridor within the rangelands of South Australia.

Listed animals

Eighteen threatened animals and five listed migratory birds may be affected by the expansion. These can be grouped as follows:

- species reintroduced to Arid Recovery – no direct impact would occur to these five threatened mammals (the Burrowing Bettong, Greater Stick-nest Rat, Greater Bilby, Numbat and Western-barred Bandicoot) as the expansion avoids Arid Recovery. There is the potential for indirect impact from elevated dust, noise and light entering the southern parts of Arid Recovery, potentially reducing the quality of existing habitats
- mobile species that utilise habitats in which short-term disturbance is proposed – there are two mammal and one bird species (the Ampurta, Dusky Hopping-mouse and Thick-billed Grasswren) that use the habitats where the gas supply pipeline may be built. Each of these species is mobile and has the opportunity to avoid the short-term disturbance activities and move back into the area after construction and rehabilitation
- slow moving species that utilise habitats in which short-term disturbance is proposed – individuals of four threatened reptile species (the Woma Python, Carpet Python, Pernatty Knob-tailed Gecko and Common Bandy-Bandy) may fall into the open trench required to bury the gas and water supply pipelines. Control measures to reduce the number of animals that fall into the open trench and to remove them from the trench safely would be used
- species that utilise the habitats provided by the Olympic Dam operation – ten listed threatened or migratory birds (the Common Sandpiper, Great Egret, Musk Duck, Sharp-tailed Sandpiper, Red-necked Stint, Banded Stilt, Blue-billed Duck, Grey Plover, Caspian Tern and Freckled Duck) are attracted to the areas of open water produced by the operation. Individuals of these species more commonly inhabit the water provided by the sewage treatment plant lagoons, but some move to the tailings storage facility ponds where they may die. In the expansion, no additional evaporation ponds would be established and the rest of the open liquor areas in the TSF would be designed to restrict access by birds, and over time to reduce the liquor accessible to birds from the current operation (see the 'Tailings' section on page 41 for details). However, some impact to birds that favoured the TSF beaches would remain. Research would continue to look for ways to reduce this impact
- the remaining species, the Plains Rat, occurs in environments over a wide area of the arid zone of South Australia with cracking clay soils such as gibber plains and gilgai. It is known from habitats within the Special Mining Lease, Arid Recovery and the northern sections of the infrastructure corridor on the Arcoona Plains and inhabits disturbed areas near the existing metallurgical plant at Olympic Dam. Some individuals would inevitably be displaced by construction activities, and the permanent loss of suitable habitat would be 2% of that available to them in the local area.

The loss of habitat for threatened species would be offset to some extent by the inclusion of similar habitats in the large-scale area to be conserved as an SEB.

Dust

The main impact of the mine and RSF outside their own footprints would be from dust generated by blasting, loading haul trucks, truck movements on haul roads, unloading mine rock on the RSF, and conveying ore to the stockpiles at the metallurgical plant (Figure 19).

Dust management has two elements:

- pre-emptive controls – these controls would involve suppressing dust on haul roads by using water trucks, covering conveyors and conveyor transfer points and using large haul trucks to minimise dust lift-off from vehicle traffic (that is, using a smaller fleet of large haul trucks rather than a larger fleet of small haul trucks, which in turn reduces dust generation)

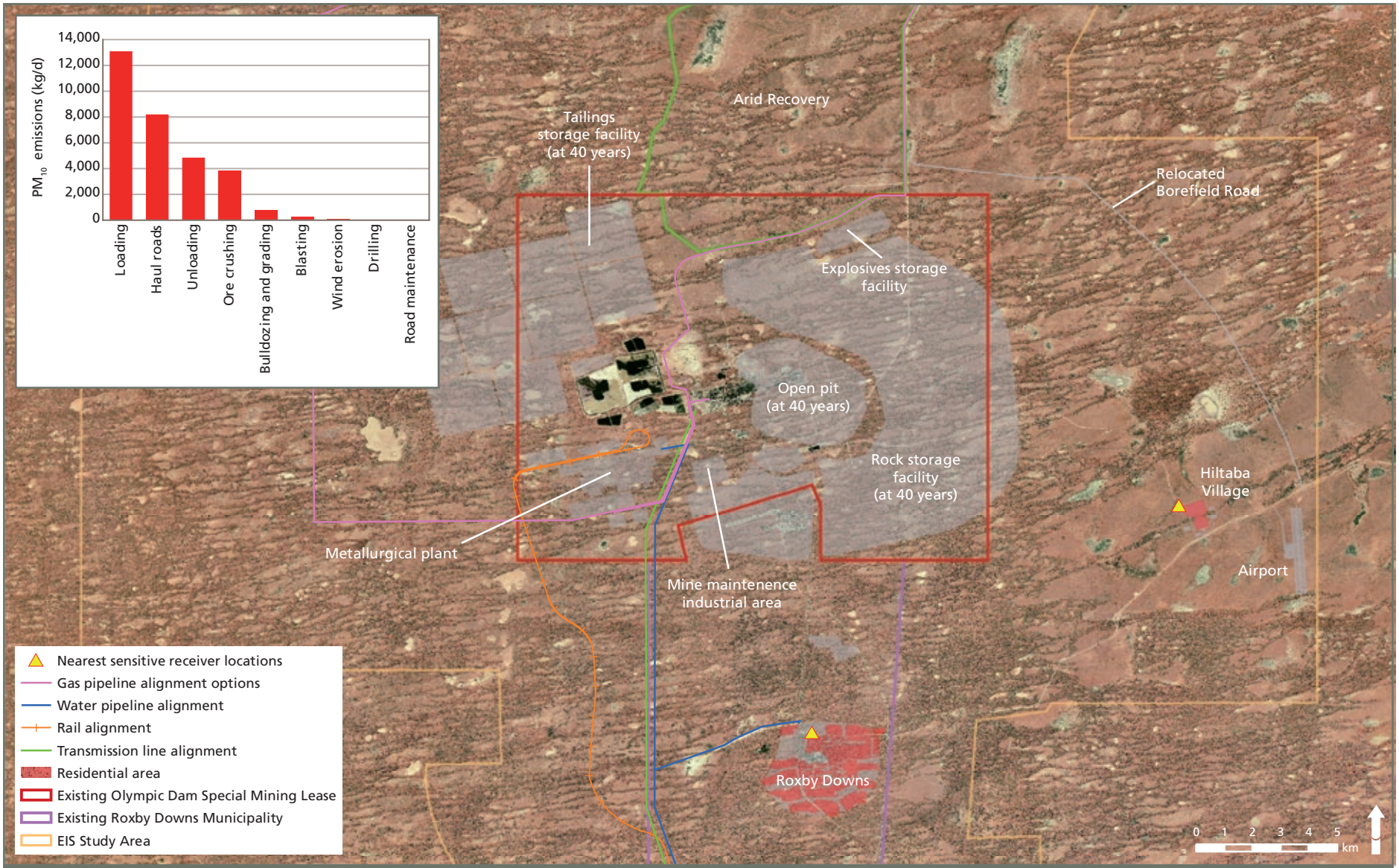


Figure 19 Location of sensitive receivers in the vicinity of Olympic Dam and dust generation sources for the proposed expansion

- real-time response system – this would monitor the weather and fugitive dust around the mine and towards sensitive receptors such as Roxby Downs and Hiltaba Village, identify impending exceedances and direct remedial action at specific dust sources. The actual response on any given day would depend on a number of operational factors, the wind direction, and the weather forecast. Mitigation measures could include relocating dust-generating activities (the mine area is large enough to provide scope to do this), modifying blast designs or increasing dust suppression watering.

Air quality modelling that includes the pre-emptive control measures shows that under adverse weather conditions (for example, winds blowing directly towards Roxby Downs or Hiltaba Village) all compliance limits would be met except for small dust particles averaged over a 24-hour period. An analysis of daily weather data collected at Olympic Dam over the past 12 years suggests that such weather conditions may occur up to 10 days per year.

In response to this finding, BHP Billiton is establishing and trialling a real-time monitoring and response system at Roxby Downs and the site of Hiltaba Village. Dust control measures could be pre-emptive and integrated into normal operations (for example, by scheduling specific activities or servicing plant when unfavourable weather was forecast). However, there may be occasions when there would be no alternative but to shut down certain activities until the weather changed.

BHP Billiton has made allowance for a level of operational inefficiency and cost from these real-time response measures. They would be expensive and therefore provide incentive to further control dust at the source.

Radiation

Radiation is a hazard of mining and processing radioactive ores. Over its 20 years of operation, Olympic Dam has maintained a strong focus on protecting employees, contractors and members of the public from radiation, using effective design and management practices. This would continue with the expanded operation.

Internationally accepted measurements and limits express radiation levels in terms of 'effective dose' measured in sieverts. Occupational doses in mining are in the range of millisieverts (mSv – one-thousandth of a sievert) and the primary radiation protection limits are:

- 20 mSv per year for occupational exposure
- 1 mSv per year above background for members of the public.

Underlying the dose limits is the principle that doses must be 'as low as reasonably achievable.' This is called the ALARA principle.

Average occupational radiation doses for the expanded operation would continue to be controlled, with miners in the new open pit expected to receive an annual dose of 3.5 mSv, which is the same as underground miners and less than one-sixth the international limit. Depending on the location of their work, employees in the metallurgical plant would be expected to receive 2–5 mSv.

Members of the public at the closest long-term residential area (Roxby Downs) would be expected to receive approximately 0.17 mSv per year above background levels, which is about one-sixth the international limit for public doses. Radiation exposure from dust generated from the expanded operation is expected to be negligible. To put this into context, to receive the radiation dose limit of 1 mSv per year from dust, the dust deposition at Roxby Downs would need to be more than 300 times greater than the predicted level or about 160 times greater than the applicable legislative limit.

Radiation doses are measured through a monitoring program audited by regulatory authorities, which currently involves up to 1,500 radiation measurements per month at Olympic Dam.

Noise

BHP Billiton has undertaken acoustic modelling to assess the expected noise impacts of the open pit operation. This has predicted:

- compliance with noise limits under favourable and neutral weather conditions (i.e. winds blowing away from Roxby Downs and Hiltaba Village or no wind)
- probable non-compliance, in the absence of mitigation measures, for some 95 nights per year, under temperature inversions. Inversions occur on very still nights when the wind is not mixing the air, and the warmer air rising from the Earth's surface is trapped by a layer of cooler air in the atmosphere. During these periods noise that would otherwise disperse is trapped and reflected.

The mitigation measures under investigation to reduce noise are:

- the use of air horns and reversing alarms of differing frequencies and volumes
- noise-reduction systems on mine haul trucks
- acoustic treatment applied to accommodation units
- operational measures to relocate activities further from the receivers.

Groundwater

The main components of the groundwater in the Olympic Dam region are:

- the Andamooka Limestone water table, typically occurring about 50 m below ground in the area of the mine. This groundwater is as saline as seawater (20,000–60,000 mg/L) and rainfall recharge is very low at 0.1–0.2 mm/year. The water moves very slowly from Olympic Dam (on a timescale of centuries) to discharge at the northern end of Lake Torrens

- the Tent Hill aquifer underlies the Andamooka Limestone aquifer at a depth of 160–200 m below ground in the area of the mine. The two aquifers are separated by a layer of low permeability quartzite. The groundwater in the Tent Hill aquifer has a salinity ranging from that of seawater at about 35,000 mg/L to over 100,000 mg/L.

Neither of these two aquifers is connected to the Great Artesian Basin (GAB), the southern boundary of which lies some 90 km north of Olympic Dam. Near the edge of the GAB, where the aquifers are close to ground level, the pressurised groundwater reaches the surface and forms GAB springs. The nearest of these springs is about 90 km north of Olympic Dam.

The open pit would intersect both the Andamooka Limestone and Tent Hill aquifers. The existing underground mine already drains small volumes of groundwater from these aquifers, with a localised drawdown effect evident in the regional monitoring bore network.

Dewatering rates for the new open pit are estimated at up to 15 ML/d (180 L/s) initially, falling within five years to around 5 ML/d (60 L/s). The extent of the drawdown effect from the open pit has been estimated at distances of 20 km in the Andamooka Limestone aquifer and around 45 km in the Tent Hill aquifer. There are no third-party bores or groundwater-dependent springs within this drawdown zone. The hydrogeologically separate aquifers of the GAB, approximately 90 km to the north, would not be affected.

Studies have also been conducted to identify the effects of acid drainage and metal leaching from the expanded operation into the groundwater. BHP Billiton has collected and analysed more than 2.5 million samples from drill cores within the boundary of the open pit to understand the mineralisation of the ore body. The sampling has also identified where the geochemically reactive material (typically oxidisable sulphur minerals) to be stored in the RSF is located within the ore body, how reactive it is, when it would be mined and how much reactive and non-reactive material would be stored in the RSF (Figure 20). This knowledge would be applied to avoid acid drainage and metal leaching from the base of the RSF, and BHP Billiton would selectively place the reactive material within the RSF in the following manner:

- a layer of non-reactive rock (Class C and D material) would be placed at the bottom of the RSF. The action of dumping and levelling this material would also compact it to reduce the flow of water through the RSF and, in turn, reduce seepage
- the low-grade ore (Class A material) would be stockpiled separately within the RSF so it could be processed in the future if the economic return was favourable. Stormwater run-off from the low-grade ore stockpile would be managed within the Special Mining Lease
- the reactive material (Class B material) would be encased in the RSF by benign (Class C) and neutralising (Class D) material. This would allow water that had become acidic from contact with reactive material to be neutralised before it reached the base of the RSF. The concentration of metals in the water would also bind to the non-reactive material, but some seepage of water containing metals would still occur
- the outer slopes of the RSF would contain non-reactive material only, avoiding the risk of future erosion exposing reactive material.

Metallurgical plant emissions

The ore processing facilities at Olympic Dam have been operating for 20 years and the principal emissions, including particulates, sulphur dioxide and nitrogen oxides, are closely monitored.

During this time, emissions to air have been successfully treated to comply with ambient air quality standards for all but two occasions. The two exceptions occurred when an interruption to the power supply triggered a standard safety procedure, which involved bypassing the sulphur dioxide scrubbers and discharging untreated gas from the acid plant directly to the atmosphere.

The existing operation therefore provides a working example from which design improvements could be made for the new facilities and their environmental effects predicted.

Improvements to process technology have been designed for the expansion project to enable the scaled-up metallurgical plant to meet point source and ambient (ground-level) air-quality criteria under normal operations and to significantly reduce the frequency of bypass events by constructing the acid plants with sufficient capacity to capture sulphur dioxide emissions.

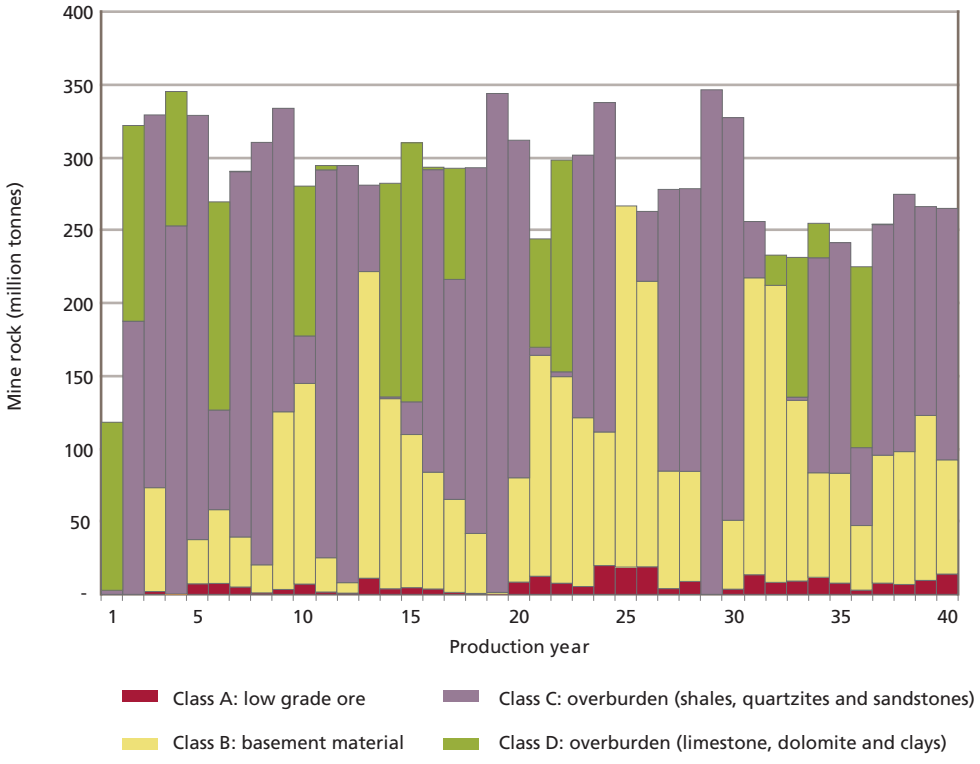
Tailings

The design of the tailings storage facility (TSF) would reflect improvements identified from operating experience at Olympic Dam and the BHP Billiton Group's knowledge acquired from its global operations.

From the environmental standpoint, the TSF for the expansion presented three main challenges: minimising the footprint; protecting fauna from acid liquor; and controlling seepage.

Minimising the footprint

Minimising the footprint of the TSF required a change in the construction method to allow it to be built higher. The existing system is constructed using an upstream embankment raise method, where each successive embankment lift is placed on top of previously consolidated tailings. The TSF cells for the expansion would be built with a centreline raise method that uses mine rock from the open pit. It would be inherently stronger and more stable, enabling the TSF design height to increase from the current 30 m to 65 m.



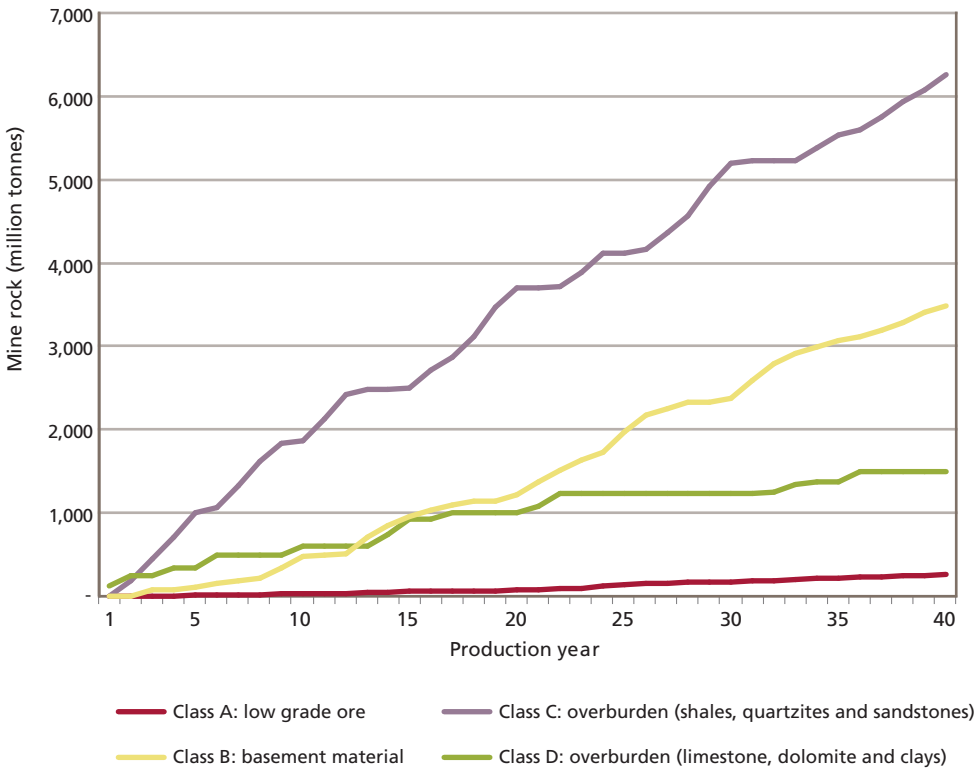


Figure 20 Mine rock extraction by class over time

Protecting fauna

The existing operation consists of 400 ha of tailings storage facilities and 133 ha of evaporation ponds. The ponded liquor is acidic (pH less than 2 on deposition, rising to pH 3.5 after one month) and therefore toxic to fauna if ingested. The TSF water bodies attract fauna and particularly birds, because there is no permanent natural surface water in the Olympic Dam region. Several measures used to deter fauna from visiting the TSF over the past decade have met with varying degrees of success, but none have resolved the issue.

The following additional measures would be implemented for the expansion:

- no new evaporation ponds would be constructed
- the TSF decant ponds and balance ponds (which are essential to recover and reuse water) would be netted or covered to restrict bird access
- ongoing optimisation of the expanded operation's water balance would occur with the aim of eliminating the use of existing evaporation ponds over time
- ongoing research into measures of deterring fauna from visiting the TSF.

Controlling seepage

The mass of deposited tailings loses part of its moisture to seepage, which produces a mound in the groundwater below the existing TSF. This groundwater gravitates towards the underground workings. In the absence of control measures, the volume of seepage associated with the expansion would probably exceed the permissible height of the TSF groundwater mound, which is 20 m below ground level. To avoid this, seepage of liquor from the tailings mass would be controlled by underdrainage to the central decant pond, depositing thickened tailings and providing larger TSF cell beaches for evaporation.

Managing other wastes

Olympic Dam currently generates 4,420 tpa of solid waste, which is managed at an on-site centre covering about 14 ha. The centre has a transfer station where about half of the materials are diverted for reuse or recycling and the balance is placed in a solid landfill. By weight, the largest waste is steel. Other large waste sources are paper, cardboard, plastic, clean fill and concrete.

The volume of solid waste generated by the expansion would increase to about 18,800 tpa during the construction phase but reduce to 11,400 tpa for the long-term operation. The most significant growth would be in used tyres, which would increase from the existing 25 tpa to about 8,090 tpa because of the much larger vehicle fleet required for the open pit. In the absence of a practical recycling option, Olympic Dam would adopt the practice used at most mines and use some of the tyres as traffic barriers, and the remainder would be stockpiled or disposed of in the RSF at mapped locations. The additional volumes of other solid wastes would be handled in an expanded waste management centre. BHP Billiton would continue to fund research into opportunities to reuse and recycle waste materials, with a particular focus on tyre recycling.

Liquid waste, in the form of sewage and grey water, would increase from an existing 0.3 ML/d to about 4 ML/d. It would continue to be treated at an on-site facility producing effluent suitable for restricted access irrigation reuse in accordance with government regulations.

An estimated 12 cubic metres of low-level radioactive waste is produced at Olympic Dam annually in the form of personal protective equipment, laboratory equipment, and geological and processing sample wastes generated following analysis for radionuclides, but is not returned to the processing circuit. This would increase to 48 cubic metres annually on completion of the expanded project.

After a review of disposal options and government approval in 2006, low-level radioactive waste has been packaged and disposed of within the TSF. Inventories of the waste and its disposal locations are recorded so that it can be managed in the event of future disturbance if the tailings were to be reprocessed. This disposal practice would continue for the expanded project.

Land users

The bulk of the land required to support the proposed expansion (28,793 ha or 86% of the land tenure to be permanently changed) is located on pastoral leases held by BHP Billiton. The tenure of the remaining 4,600 ha which would be permanently changed comprises:

- 3,946 ha of the Roxby Downs Municipality (including 3,400 ha within the expanded SML)
- 440 ha of pastoral land
- 120 ha of vacant Crown land
- 44 ha of freehold land
- 50 ha of Commonwealth land.

In some cases, both land tenure and use would change, and in others, only tenure would change. In general, the project has been planned in consultation with existing land users so that their activities could continue.

The sites the expansion would use at Adelaide's Outer Harbor and the Port of Darwin are existing commercial facilities.

Desalination plant

A seawater desalination plant would be built at Point Lowly in Upper Spencer Gulf.

Upper Spencer Gulf supports a productive marine ecosystem that is defined by several habitats including tidal flats and mangrove woodlands, seagrass meadows in the shallow subtidal zone, intermittent rocky reefs on the west coast and deep channels further off-shore. These habitats support an abundance of marine organisms. Of particular note are commercial fisheries and the breeding aggregation of the Australian Giant Cuttlefish at Whyalla and Point Lowly.

Spencer Gulf progressively narrows and becomes shallower and more saline as it extends from the Great Australian Bight north towards Port Augusta. Annual salinity ranges at Point Lowly are 40–43 g/L. For most of the time, the tidal currents are strong, especially where the gulf narrows between Point Lowly and Ward Spit, where velocities of 1 m/s are common in the main channels off Point Lowly and near Fairway Bank (Figure 21) (an animation for this topic is available at <www.bhpbilliton.com/odxeis> and on the disc accompanying the Executive Summary). However, the gulf also has an unusual regime of fortnightly 'dodge' tides, where the astronomic tidal constituents cancel each other out to produce short periods (one to two days) of very low tidal currents.

The potential impact from the discharge of desalination plant return water into the gulf has been the subject of intense public interest. BHP Billiton has devoted much attention to investigating the potential effects and developing a design to meet a conservative interpretation of acceptable performance. This work has included:

- terrain mapping of the sea floor, and computer modelling of the tides, salinity, water exchange and return water dispersion from 13 alternative sites within the gulf
- a number of conservative measures have been built into the return water dispersion modelling and ecotoxicology studies, including: peak (not average) discharge flows; lowest effect concentrations for a range of species; safety factors built into the national guidelines; unrealistically continuous exposure to diluted return water (rather than intermittently as would occur in reality); and a combination of least favourable seasonal conditions (summer), dodge tides and wind conditions
- laboratory ecotoxicology bioassays with manufactured brine diluted with Point Lowly seawater to examine thresholds of effect on 15 test species. The bioassay tests were conducted at different levels of brine dilution and included mortalities, growth inhibition, germination, reproduction, juvenile and adult growth, larval growth, larval development and hatching
- extensive biological studies, including more than 100 hours of scuba diving, to understand the marine ecosystems and the impact of return water on different species, including the Australian Giant Cuttlefish.

Dispersion of return water

The location and design of the outfall pipe has the greatest potential for reducing impacts on the marine environment. Investigations for the Draft EIS conclude that locating the return water diffuser seaward of the line shown on Figure 22 would prevent adverse impact on the general marine environment, cuttlefish, commercial fisheries and aquaculture.

The findings in summary are:

- the predicted long-term increase in salinity at Point Lowly of 0.07 g/L is significantly less than the natural depth related variation (1.3 g/L) and seasonal variation (3 g/L)
- during a dodge tide, when tidal movement is at its lowest, salinity would increase by no more than 9% above background levels at 100 m from the outfall pipe. When tidal movement was at its highest, greater dispersion would be achieved with salinity predicted to be 1% above background levels at 100 m
- a species protection trigger value (SPTV), essentially a safe level of return water dilution, was derived using 10 species most relevant to Upper Spencer Gulf (five species more than the national guidelines). The 'safe' dilutions of return water required to protect 99% and 100% of species from experiencing inhibitory effects in background water of 41 g/L salinity are 1:45 (one part return water to 45 parts seawater) and 1:85 respectively. The area where return water dilution is less than the safe level has been termed the zone of ecological effect
- the return water from the desalination plant would not affect the Australian Giant Cuttlefish because the zone of ecological effect and the breeding habitat are well separated vertically and would never overlap (Figure 23). This is because the higher salinity return water is heavier than normal seawater and would therefore fall towards the sea floor. This natural process creates a vertical separation between the higher salinity return water and the cuttlefish breeding habitat, which extends from the surface to a depth of less than 10 m
- there are several aquaculture leases in Upper Spencer Gulf. The closest is 5 km to the north of the proposed outfall. Even in periods of very low tidal movement when the zone of ecological effect covers the largest area, the closest boundary of the aquaculture leases would still be more than 2.5 km away
- commercial and recreational fish species move throughout the gulf, including within the zone of ecological effect. Commercial fish species tested by BHP Billiton were found to be less sensitive to increasing salinity levels. Dispersion modelling showed that the zone of ecological effect for fisheries species would typically extend no more than 100 m from the outfall.

Accumulation of salt in Spencer Gulf

Natural salinity levels measured in Upper Spencer Gulf in 2008 are about the same as those measured 25 years ago despite high levels of evaporation (equivalent to 318 desalination plants the size of the proposed plant annually). This implies that accumulated salt is effectively removed from the gulf.

This occurs because salt is removed in 'slugs' of high salinity water, which move down the eastern side of the gulf, while lower salinity water moves up the western side. This natural process flushes Spencer Gulf and would ensure that the slight increase in salinity from the operation of the Point Lowly desalination plant would not lead to a long-term accumulation of salt (an animation for this topic is available at <www.bhpbilliton.com/odxeis> and on the disc accompanying the Executive Summary).

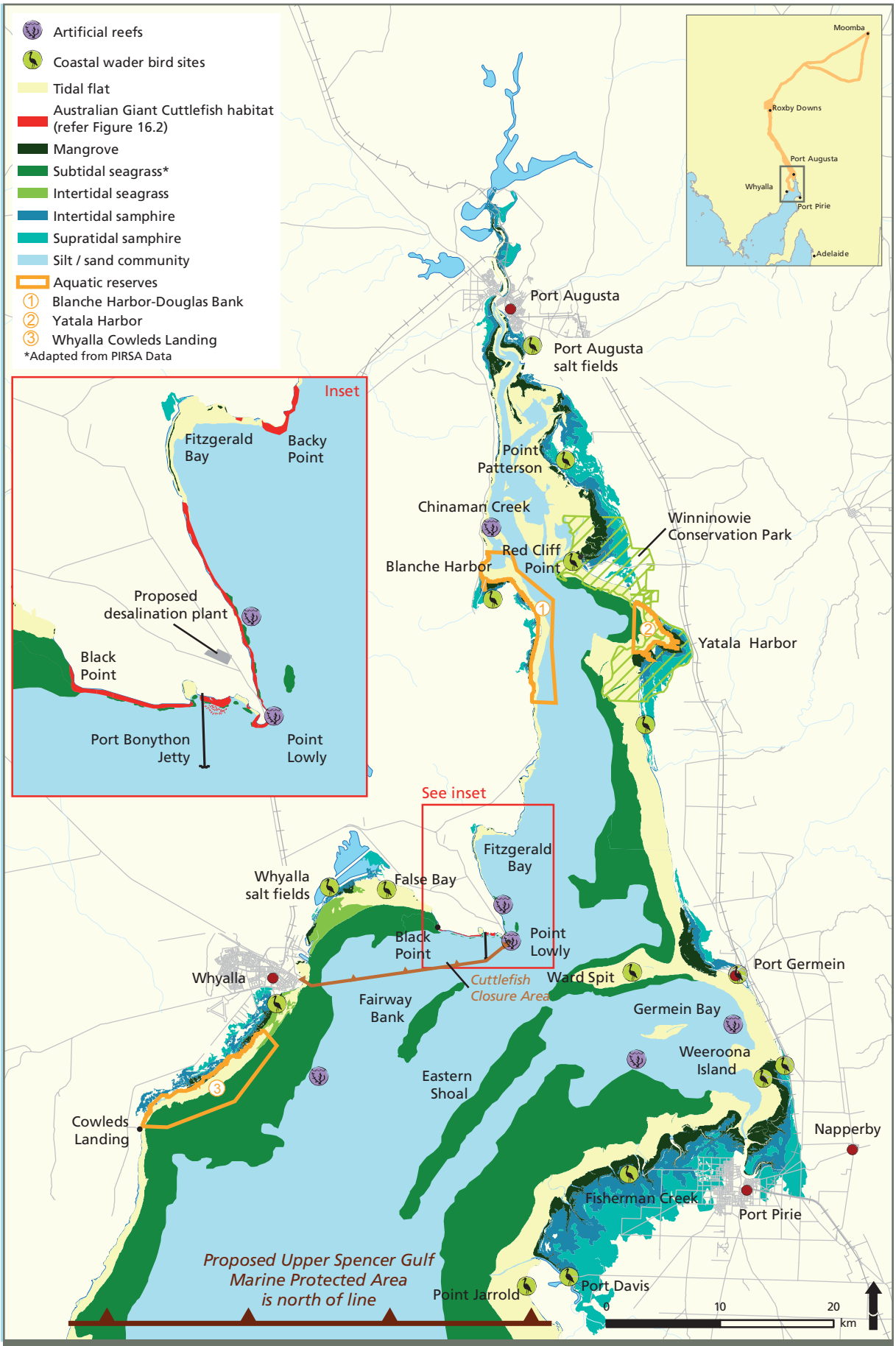


Figure 21 Principal marine habitat types and conservation areas in Upper Spencer Gulf

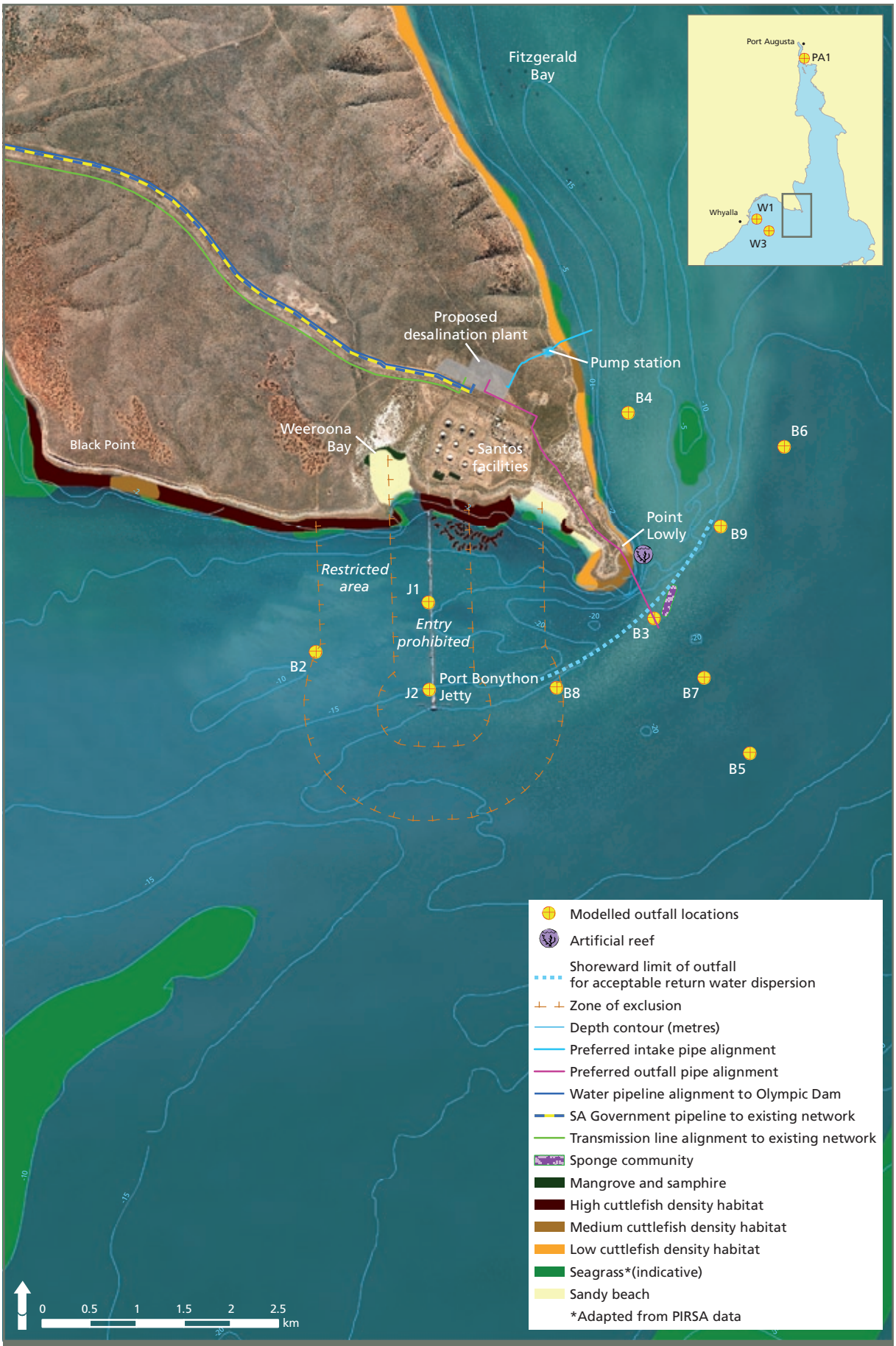


Figure 22 Modelled return water outfall locations

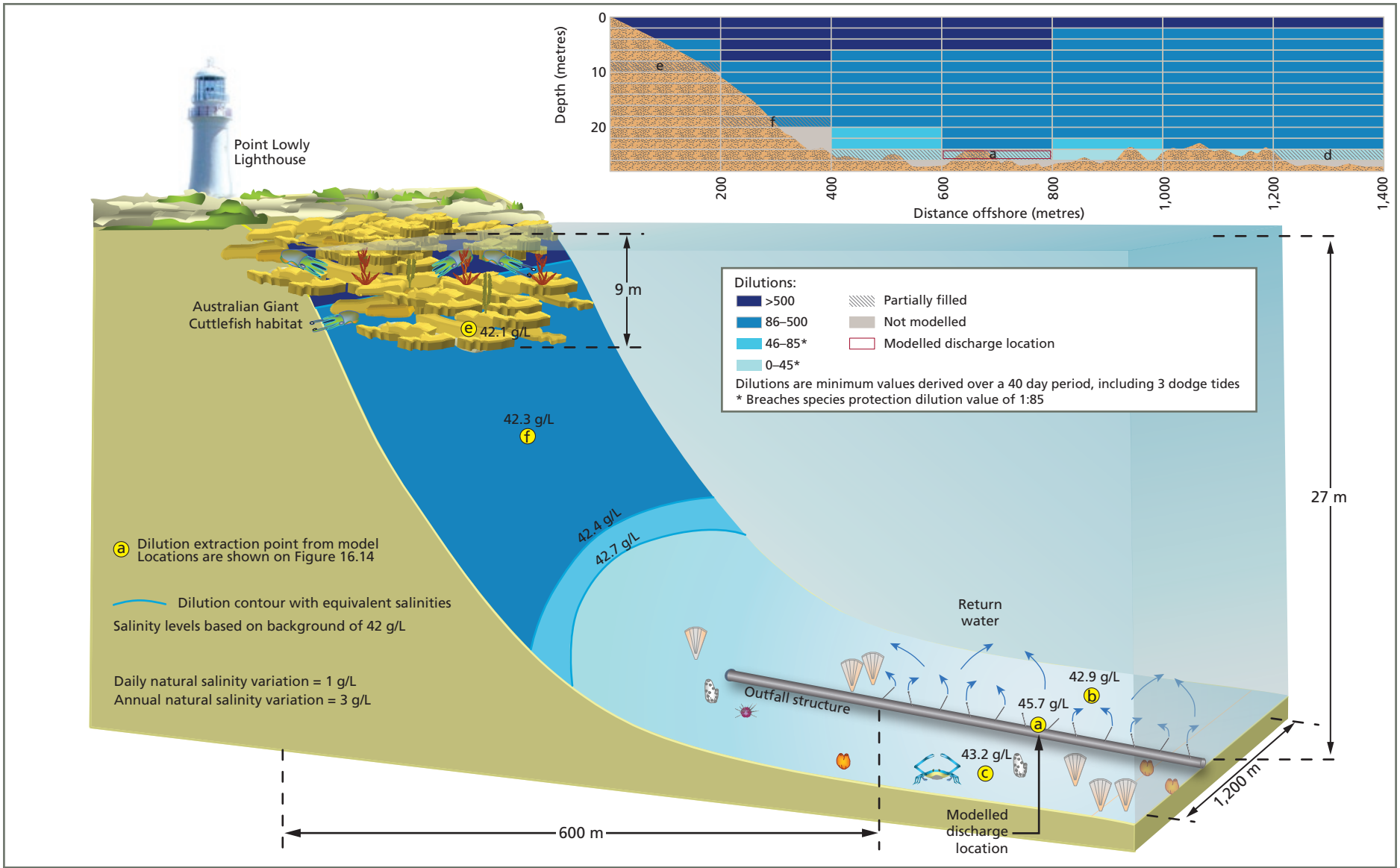


Figure 23 Conceptual locations of key sites showing maximum increases in salt concentration over a 40 day model period

Intake pipe

There has been some community concern about the potential impact of the intake pipe to entrap both large and small marine organisms. However, the large diameter of the intake pipe, at 3 m, would result in the velocity of the intake water being about 0.2 m/s, which is lower than the generally prevailing tidal velocities in the area, allowing mobile species to swim away.

Drifting marine organisms and larvae could be trapped (impinged) within the intake screens or taken up (entrained) within the intake water. However, this would not result in a long-term population decrease to the extent that a species would decline.

Construction

The rocky reef habitat near Whyalla and Point Lowly is the site of the only known mass aggregation of spawning Australian Giant Cuttlefish in the world. Females attach hundreds of eggs to the rocky substrate under ledges or in caves between May and September each year and hatching continues through October. While the Australian Giant Cuttlefish is not a listed species, the annual breeding event has become an important tourism attraction in its own right and also attracts the interest of scientists and recreational divers. To avoid potential impacts on the cuttlefish during the installation of the intake and outfall pipes, construction activities in the rocky reef habitat off Point Lowly would be restricted to 1 November through to 1 May.

Less than 400 m^2 of cuttlefish breeding habitat (or 0.06% of breeding habitat in Upper Spencer Gulf), would be directly affected by the construction activities. The reef in this area would be reinstated to maintain habitat value.

Landing facility

There are 13 properties within 750 m of the proposed landing facility (all to the south) and 13 properties adjacent to the access corridor to the proposed pre-assembly yard. Coastal home owners have expressed concern about the impact of the landing facility on the character and ambience of the area and the local coastal environment. BHP Billiton has consulted with them to discuss how disturbance to their lifestyles and the visual and noise impacts of the facility can be minimised.

Visually, the area is characterised to the north-east by the Playford and Northern Power Stations, the southern Flinders Ranges across Spencer Gulf to the east, and the nearby shrubby hills and escarpments of the Defence Department's Cultana Training Area to the west.

The views from coastal homes some 200 m to the south of the landing facility would be most affected. The landing facility would interpose an industrial element into the middle ground of the long view north-east to the power stations.

The visual impact of the access corridor linking the landing facility to the pre-assembly yard and ultimately to the Stuart Highway varies according to the openness of the terrain, the presence of screening vegetation and the offset from existing roads and viewpoints.

The landing facility would off-load up to 280 vessels during the first seven years of the expansion, and very occasionally thereafter. Modelling indicates that noise limits would be exceeded at the 13 coastal homes south of the facility while barges were being unloaded. This would occur during daylight hours over a period of 3 days, about every 11 days. Mitigation arrangements are currently being discussed with potentially affected landholders.

Road transport

The transport of large pieces of equipment to Olympic Dam would involve moving over-dimensional loads along the Princes Highway, Stuart Highway and Olympic Way. Approximately 11,500 over-dimensional loads would require transport between 2010 and 2020, peaking at approximately 45 per week in 2011.

Most over-dimensional loads (94%) would be less than 8 m wide and therefore could be managed within existing government policies and guidelines. Some over-dimensional loads (about two per week) would be wider than 8 m, and require special attention as vehicles would not be able to pass these loads in either direction of travel. Where practicable, these loads would not be moved in peak traffic times.
To address this issue further and reduce travel delays to a maximum of 45 minutes, BHP Billiton would build nine passing bays on the Stuart Highway and six on Olympic Way. Over-dimensional loads less than 8 m wide could also use the passing bays to allow built up traffic to pass.

Electricity supply

South Australia would require new baseload electricity generation capacity by about 2012 even if the expansion project did not proceed. With this in mind, BHP Billiton has sought expressions of interest from companies interested in supplying electricity, including from renewable energy sources, to Olympic Dam. There is considerable market interest and discussions with suppliers are the subject of continuing commercial negotiations. BHP Billiton is also seeking approval to build its own gas-fired plant at Olympic Dam.

Greenhouse gas emissions

The need to address greenhouse gas emissions through accelerated action is acknowledged in the BHP Billiton Group's Climate Change Position.

Greenhouse gas emissions from the current Olympic Dam operation are about 900,000 tpa of carbon dioxide equivalents, which would increase as a result of the proposed expansion. Commitments to reduce greenhouse gas emissions for the proposed expansion have been made, including the construction of a 250 megawatt cogeneration plant at Olympic Dam and sourcing the electricity for the desalination plant from renewable energy. With these measures in place, the predicted

peak emissions from the expanded operation would be 4.7 Mtpa of carbon dioxide equivalents (with a reportable component of 3.3 Mtpa as per the National Greenhouse and Energy Reporting (Measurement) Determination 2008). This may be reduced by a further 600,000 tpa as the total electricity demand for the expansion is likely to be sourced from a gas-fired power plant (whether that be located at Olympic Dam or elsewhere).

If power was sourced via an electricity transmission line from the national electricity market, electricity consumption would make up about 55% of emissions from the expanded project, with the on-site use of diesel contributing about 25% and the remaining 20% coming from other sources such as explosives.

The peak emissions of 4.7 Mtpa in 2020 would add 9.8% to South Australia's predicted annual greenhouse gas emissions, 0.74% to the predicted national total and 0.009% to predicted global emissions.

The Australian Government has announced it will create a market based mechanism in 2010 to identify the most economical way to reduce carbon emissions. BHP Billiton supports the broad scope and objective of this initiative.

It is BHP Billiton's goal to reduce greenhouse gas emissions (reportable under the National Greenhouse and Energy Reporting (Measurement) Determination 2008) to an amount equivalent to at least a 60% reduction (to an amount equal to or less than 40%) of 1990 emissions, by 2050.

McKinsey & Company's Australian carbon reduction method has been used by BHP Billiton to understand the pathway to achieve this goal at the Olympic Dam operation. It applies the following steps:

- determine a business as usual baseline for future emissions
- identify a range of realistic emission reduction opportunities for the project, and for each opportunity, determine the cost to build and operate it and the reduction in emissions this would achieve
- generate carbon reduction cost curves to establish the best value for money opportunities.

An indicative carbon reduction cost curve to reduce the carbon footprint by 2050 for the Olympic Dam operation is shown in Figure 24. The likely cost of the mitigation is represented on the vertical scale and the potential greenhouse gas reduction on the horizontal scale.

For the purpose of providing context to global emissions, the abatement potential of the uranium oxide produced at Olympic Dam has been estimated. At full operating capacity, the expanded operation would produce up to 19,000 tpa of uranium oxide, which when used in nuclear power plants by customer countries would produce about 756,000 GWh of electricity each year. If for example this was used to substitute electricity supplied by typical fuel mixes in Australia, China and the United States of America, it would reduce direct greenhouse gas emissions by 615 Mtpa, 687 Mtpa and 438 Mtpa of carbon dioxide equivalents, respectively. This compares to Australia's total 2006 carbon emissions of 575 Mt of carbon dioxide equivalents.

Roxby Downs and Andamooka

Roxby Downs has a population of 4,500 and is now the largest town in South Australia north of Port Augusta. It is governed by an administrator appointed by the South Australian Government. The town is characterised by a young age profile, a high proportion of families with children, and higher than average incomes and population mobility.

The settlement of Andamooka dates back to the early 1930s, when opals were discovered in the region. It has a population of 500 and opal mining is no longer the only source of income in the town, with a number of residents employed at Olympic Dam.

The large increase in population associated with constructing and operating the expansion would bring change to Roxby Downs and Andamooka, increase the demand for services, and give rise to law and order challenges. To date, these issues have featured prominently in BHP Billiton's local community consultation.

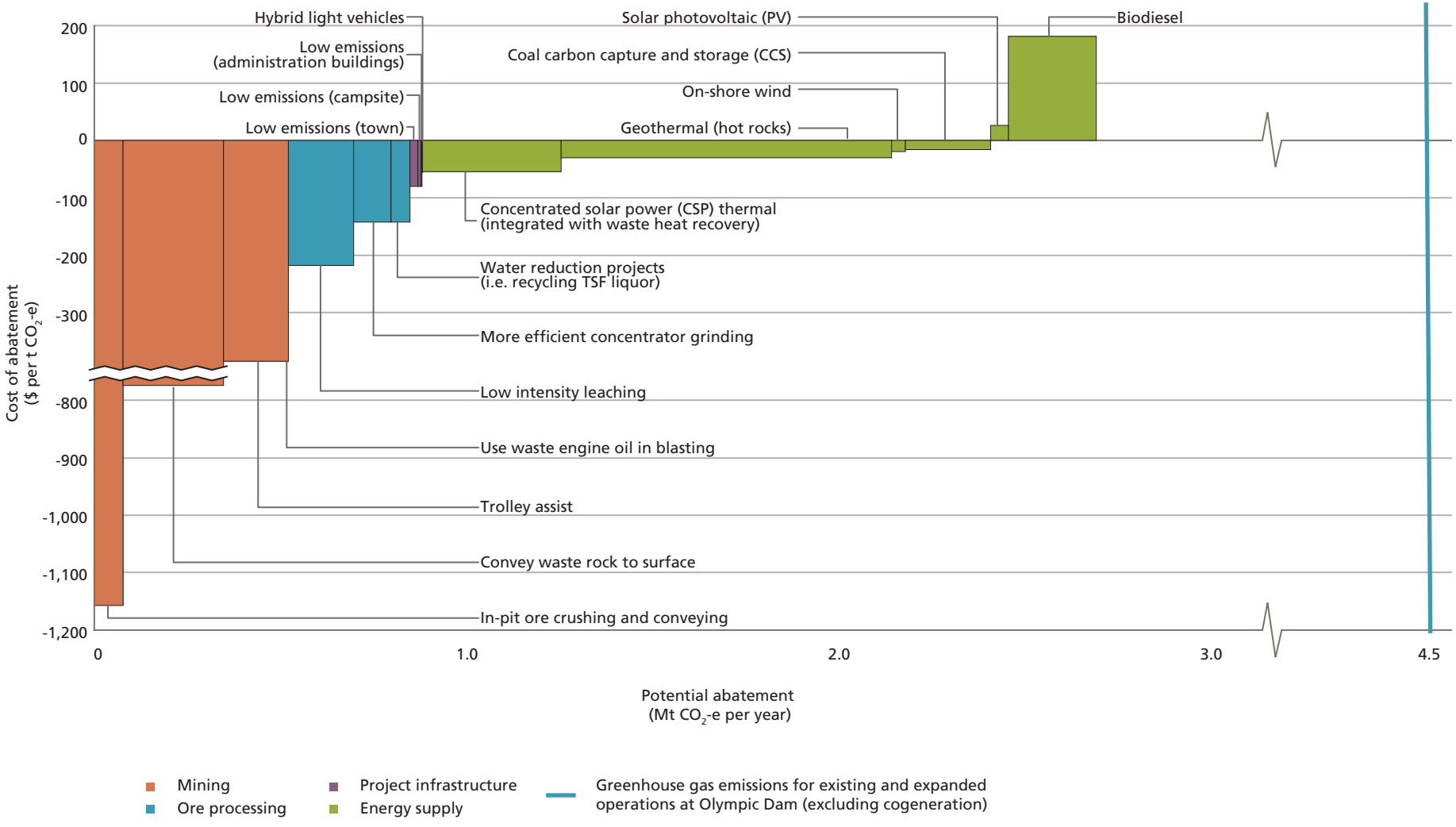
Labour supply

To accommodate the large construction workforce, BHP Billiton's preferred option is to build a new village (Hiltaba Village) midway between Roxby Downs and Andamooka on the road linking the two towns. BHP Billiton favours this option:

- because residents of Roxby Downs and Andamooka expressed a clear preference to accommodate the construction workforce outside both towns
- to reduce impacts on the residents of Hiltaba Village from dust and noise from the open pit and rock storage facility
- to minimise disturbance to Aboriginal heritage sites.

Recruiting the large construction workforce will be challenging. A study commissioned by BHP Billiton from the National Institute of Labour Studies forecast demand for tradesmen and women, semi-skilled workers and labourers would be greater than the expected supply.

BHP Billiton would continue to drive industry initiatives and support government and other programs to increase the number of people ready to work in the industry. While the expansion would compete with and draw labour from other industries, the short-term impacts of the forecast labour shortage would be outweighed by the longer-term benefits of large scale and stable employment opportunities with the Olympic Dam operation.



Sources: A cost curve for carbon abatement, McKinsey & Company; BHP Billiton analysis

Figure 24 Indicative greenhouse gas carbon abatement cost curve for the expanded operation at 40 years

Crime

The township of Roxby Downs has fewer criminal offences per capita than South Australia. While there is no reason to believe this would change, experience suggests that higher rates of crime and anti-social behaviour could occur during the construction phase of the expansion.

Measures to reduce potential impacts include:

- locating Hiltaba Village between the townships of Roxby Downs and Andamooka
- providing Hiltaba Village as a fully self-contained accommodation village to encourage the workforce to remain there for social and recreational activities (Figure 25)
- providing security at the village, carrying out workforce inductions and education programs, applying codes of behaviour, enforcing the company's drug and alcohol policy including random testing as part of a fitness for work program, and continuing to support other community safety initiatives.

Housing and accommodation

Providing enough residential accommodation at an acceptable cost and standard in an isolated area has been a continuing challenge for Olympic Dam.

Several mechanisms are proposed to encourage the availability and affordability of accommodation for the expanded operation with the aim of establishing long-term house prices reflecting the stable demand of a long-life industry. These mechanisms include:

- provision in the Roxby Downs Draft Master Plan for 2,500 additional residential allotments
- planning for a diversity of accommodation, including units and two, three and four bedroom houses
- building sufficient houses to achieve a 5% vacancy rate in the longer term
- collaborating with the South Australian Government to respond to particular housing affordability issues in Roxby Downs
- constructing Hiltaba Village to cater for up to 10,000 people
- accommodating the workforces required to build transport, energy and water infrastructure in short-stay accommodation in other townships and in the case of the gas pipeline, in mobile work camps.

Roxby Downs would require more community services and facilities for the larger operational workforce at Olympic Dam. The Roxby Downs Draft Master Plan provides land for a range of new and expanded community services, and sport and recreational spaces and facilities. BHP Billiton would continue to collaborate with the South Australian Government to provide required services and facilities.

Monitoring of social indicators

A common shortcoming of large mining projects is a lack of ongoing monitoring to establish whether the social outcomes predicted actually occur. To address this issue with the expansion of Olympic Dam, BHP Billiton would work with the local community, relevant government and non-government agencies to monitor and respond to changes in the social environment. The aim would be to develop social indicators to measure the effectiveness of programs intended to reduce the potential social impacts and maximise the predicted benefits.

Some indicators that could be monitored include:

- employment and recruitment, including labour drawdown
- business activity
- housing supply and affordability
- education and training
- community participation
- criminal activity
- the provision of infrastructure and services
- support services (including financial and personal)
- community satisfaction.

Aboriginal cultural heritage

Archaeological and some ethnographic sites within the area provide evidence of historic Aboriginal use of the land. Because of the lack of surface water, Aboriginal occupation was generally characterised by movement across the lands in the project area from time to time, rather than permanent settlement. The wider Olympic Dam region is rich in surface scatters of stone artefacts and quarries.

Aboriginal heritage sites and values in the Olympic Dam region have been extensively surveyed and studied. Since mining was first proposed in the late 1970s, continuing field surveys, salvage works and discussions with Aboriginal communities have furthered the understanding of Aboriginal cultural heritage in the EIS Study Area.

Three groups, the Barngarla, Kokatha and Kuyani, have claimed native title interests in the Olympic Dam region. A fourth group, the Nukunu, have claimed a native title interest in the southern sections of the linear infrastructure corridor. Four groups, the Dieri, Arabunna, Adnyamathanha and Yandruwandha/Yawarrawarrka, have claimed an interest in the area of the proposed gas pipeline corridor options.

The majority of ground disturbing activities associated with the expansion would occur within areas of interest to the Barngarla, Kokatha and Kuyani. Since BHP Billiton became the owner of Olympic Dam in 2005 its engagement with these groups has focused on developing an agreement that would:

- establish a protocol to manage the impacts of the expanded operation on Aboriginal cultural heritage values

Figure 25 Conceptual layout of Hiltaba Village

- support the advancement of Aboriginal communities through training, employment and business development opportunities
- enable BHP Billiton to expand and continue to operate Olympic Dam with mutual respect and cooperation among the parties to the agreement.

The Olympic Dam Agreement has now been developed and provides for:

- establishing a trust for regional Aboriginal community development
- payments into the trust by BHP Billiton over the remaining life of the Olympic Dam operation for the benefit of the Barngarla, Kokatha and Kuyani and other Aboriginal communities in the region
- a Heritage Management Protocol with agreed impact minimisation and mitigation measures and an ongoing regime to protect Aboriginal heritage
- establishing an Aboriginal training and employment plan to facilitate opportunities for Aboriginal people within the expanded operation.

Economics

The Olympic Dam operation currently contributes $1.7 billion annually to the Gross State Product (GSP) of South Australia.

The estimated contribution to GSP over a 30-year timeframe from the start of the expansion would be $45.7 billion in net present value (NPV) above the business-as-usual case (that is, the alternative outcome if the expansion does not proceed), or an average annual increase of $6.9 billion at full operating capacity (Figure 26).

Over the past three years, royalty revenue to the South Australian Government from the existing operation has averaged nearly $60 million per year. This is predicted to increase more than four-fold on completion of the expanded operation.

The existing operational workforce for Olympic Dam would double to more than 8,000.

The existing operation places contracts in South Australia with a total value of more than half a billion dollars each year. Through tendering procedures for construction of the expansion and ongoing operational activities, BHP Billiton would continue to maximise local industry participation consistent with commercial practice. The company would continue to work with the Industry Capability Network and industry organisations to ensure South Australian and Australian companies remained aware of opportunities provided by the expansion and the ongoing operation.

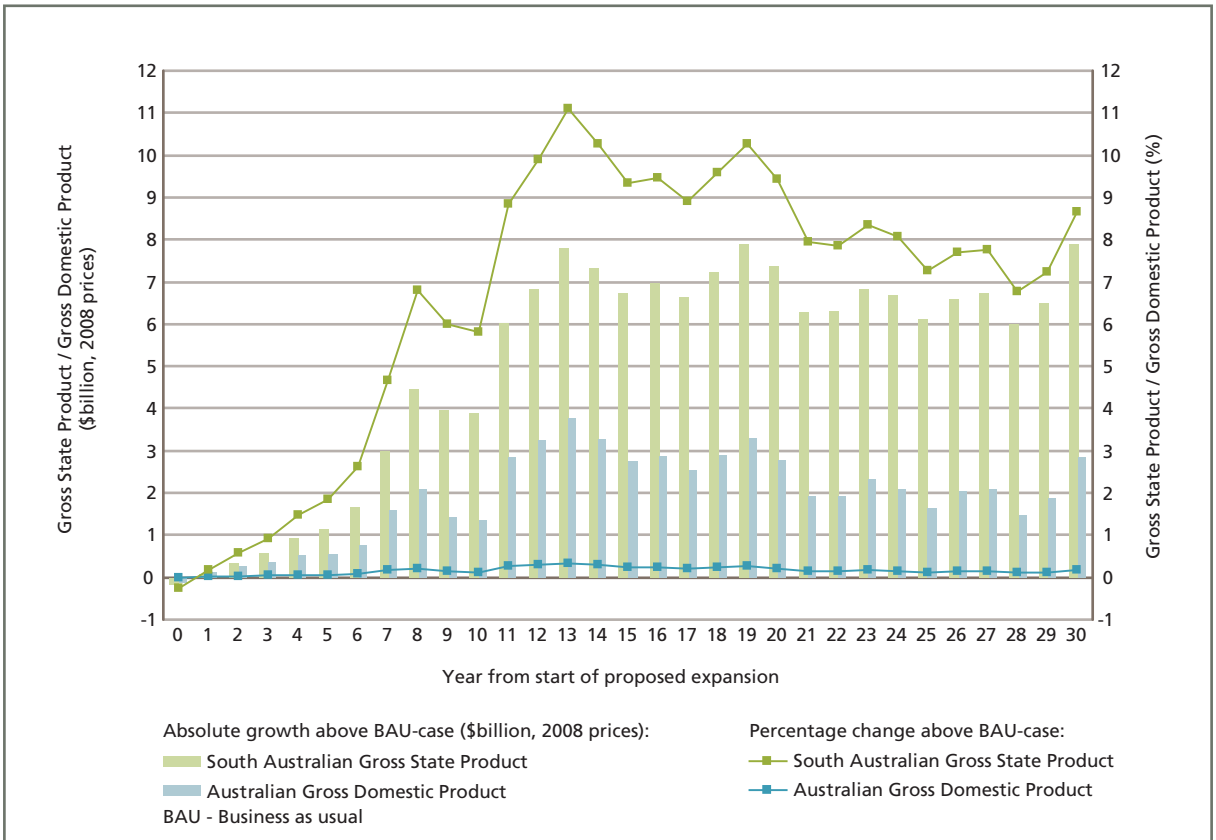


Figure 26 Gross State and Domestic Product

The expansion project includes the export of a new product, concentrate, via the Port of Darwin. The estimated contribution to the Northern Territory GSP over the modelled 30-year timeframe would be $936 million. While this is a significant contribution to the Northern Territory, the bulk (80%) of the total operating costs for the expansion project would remain in South Australia.

Rehabilitation and closure

Olympic Dam would follow the BHP Billiton Group's Closure Standard, the guiding principles being:

- closure planning would be incorporated into the design, construction and operation phases
- rehabilitation and stabilisation of disturbed areas as soon as it is safe and practical to do so
- reuse and recycling of redundant assets during operations and at mine closure
- decommissioning infrastructure in accordance with environmental, health and safety objectives.

As the existing Olympic Dam Rehabilitation and Closure Plan is updated to address new requirements resulting from the expansion, there would be consultation with interested stakeholders. The major considerations arising from the expansion would be:

- the open pit and pit walls would be left generally as they were, but with haul roads blocked to prevent vehicle access, a perimeter bund for the same purpose and a perimeter fence with warning signs
- when mining was finished (nominally after 40 years but almost certainly much later), the mine void would fill slowly with rainfall and, to a lesser degree, groundwater inflow. The water level would rise over many years until the water entering the pit reached equilibrium with the water removed by evaporation. This would result in a lake at the bottom of the pit, several hundred metres below the pit rim. Over the centuries, the salinity would rise until, eventually, a salt crust formed.

The RSF and TSF have been designed so that their outer surfaces comprise benign mine rock and therefore would not release acid to surface waters even in the event of long-term erosion. They would have the scale and appearance of the natural mesas of central and northern South Australia and vegetation growth would be similarly slow and sparse.

Contaminated soils would be remediated and disturbed surfaces would be recontoured and revegetated where practicable.

Buried infrastructure would be decommissioned and left in the ground. Above ground facilities owned by BHP Billiton would either be removed from the site or buried on-site. A priority would be to maximise the reuse and recycling of infrastructure.

The ultimate future of Roxby Downs and the nearby airport would be determined by the community and government at the appropriate time.

Environmental management programs

The environment is managed at Olympic Dam in accordance with the operation's AS/NZS ISO 14001:2004 certified environmental management system. The system creates a framework within which:

- the commitments made in previous Environmental Impact Statements and the conditions of government approval are operationally defined
- licence conditions are met
- contractual arrangements with third-party suppliers are drawn up to ensure that conditions are met
- environmental performance is monitored and reported, so that remedial measures can be taken if needed
- emerging issues are recognised and addressed
- there is independent auditing.

A series of new environmental management programs and revisions to existing programs would address the requirements for the expanded project. The programs would include:

- use of natural resources
  - land disturbance
  - marine disturbance
  - spread of pest plants and animals
  - aquifer level drawdown
- storage, transport and handling of hazardous material
  - chemical/hydrocarbon spillage
  - radioactive process material spillage
  - transport of radioactive material
- operation of industrial systems
  - fugitive particulate emissions
  - noise emissions
  - point-source emissions
  - saline aerosol emissions
  - radioactive emissions
  - greenhouse gas emissions
- generation of industrial waste
  - marine discharge
  - containment of tailings and mine rock
  - major storage seepage
  - stormwater discharge
  - fauna interaction with the operation
  - waste disposal
  - radioactive waste
- employment and accommodation of people
  - community interactions
  - workplace interactions.

BHP BILLITON'S MAJOR COMMITMENTS

BHP Billiton is seeking government approval to build and operate a new open pit mine at Olympic Dam that would deliver a six-fold increase in ore production. The expansion requires construction of major infrastructure including a significant enhancement of on-site minerals processing facilities, a coastal desalination plant, additional electricity supply, a landing facility and access corridor, a rail spur, port facilities, a new airport, a new accommodation village, and expanded housing and new commercial, retail, recreational and sporting facilities in Roxby Downs.

BHP Billiton has made many specific commitments about the planning, construction and ongoing operation of the expanded project in the Draft EIS. The following is a high-level summary of some of the major commitments; the Draft EIS elaborates on these and other commitments.

Expansion

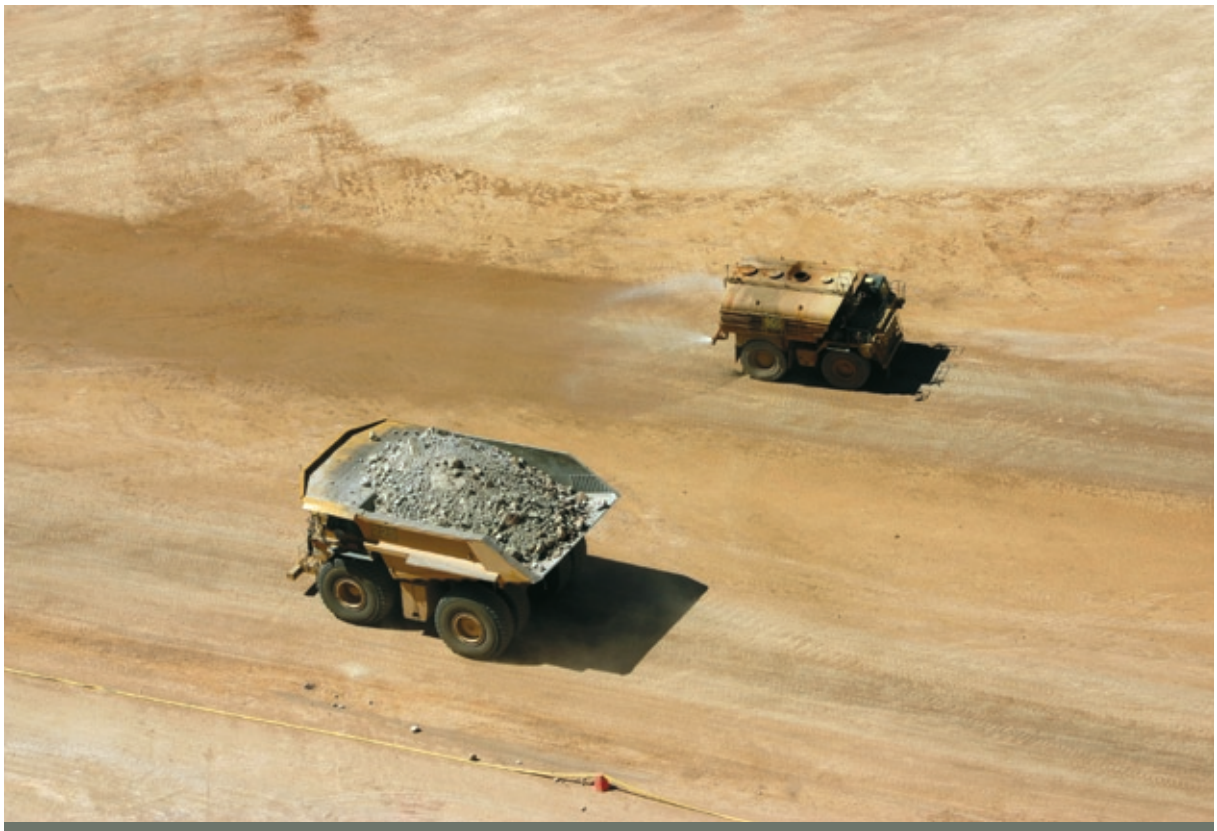
In making a substantial capital investment to transform world-scale resources into a world-class mining and minerals processing operation, BHP Billiton commits to:

- avoiding known locations of threatened species of plants and animals where practicable
- setting aside 128,278 ha of land for conservation purposes, almost eight times more than the land disturbance necessary to construct the expanded project
- pre-emptive controls and a real-time response system to manage dust impacts
- controlling workforce and members of the public radiation exposures to within recognised international limits
- mitigation measures to reduce noise impacts of the open pit operation
- improved use of process technology to keep emissions within regulated air quality criteria
- changes to processing and tailings management to increase acidic liquor recycling and ensure the long-term stability of the tailings storage facilities
- for the construction phase of the desalination plant intake and outfall pipes, avoiding work in rocky reef habitat during the annual breeding season of the Australian Giant Cuttlefish
- ongoing consultation and engagement with affected landowners to minimise disturbance to their lifestyles and amenity
- management of Aboriginal cultural heritage through implementation of the Olympic Dam Agreement
- support for Aboriginal training, employment and business development
- maximising the participation of South Australian, Northern Territory and Australian businesses
- a major revision and annual updating of the Environmental Management Programs to ensure the performance outcomes and risk management strategies documented in the Draft EIS are achieved during the construction and operation phases of the expansion.

Ongoing operation of the expanded project

BHP Billiton also commits to:

- maintaining a primary focus on 'Zero Harm' through continuous improvement to health, safety and environmental performance
- constructive relationships and continuing engagement with local and regional communities, including Aboriginal groups
- establishing a trust to support community and business development initiatives for Aboriginal communities in northern South Australia
- a major and sustained contribution to the South Australian economy measured by the increase in Gross State Product, employment, government and export revenues
- applying a goal to reduce greenhouse gas emissions (reportable under the National Greenhouse and Energy Reporting (Measurement) Determination 2008) to an amount equivalent to at least a 60% reduction (to an amount equal to or less than 40%) of 1990 emissions, by 2050
- operating the desalination plant without detriment to the marine environment
- ongoing monitoring of social indicators and working with the South Australian Government to reduce social impacts and enhance benefits
- continued support of Arid Recovery consistent with BHP Billiton's roles as instigator and foundation member
- a 'closed system' to transport, store and convey concentrate from Olympic Dam to the ship's hold at the Port of Darwin
- manage the transportation of people and material in a safe, effective and socially-acceptable manner
- regular revision of the rehabilitation and closure plan for the mine.



Watering of haul roads for dust suppression

NEXT STEPS

The next steps in the EIS process are summarised in Table 4.

It is open to the Australian, South Australian and Northern Territory governments to approve the expansion with or without conditions, or to reject it.

Subject to government decisions, the BHP Billiton Board would make the final investment decision soon afterwards.

Table 4 Next steps in the process

Anticipated timing	Step
May 2009	Draft EIS on public exhibition for 14 weeks
May/June 2009	Public meetings convened by the Australian, South Australian and Northern Territory governments in Adelaide, Port Augusta, Roxby Downs, Whyalla, Darwin and Alice Springs
August 2009	Close of period for public exhibition of Draft EIS and for written submissions to government
February 2010	BHP Billiton submits the Supplementary EIS to respond to public submissions
July 2010	The Australian, South Australian and Northern Territory governments make their decisions based on the Draft EIS, the public submissions and the Supplementary EIS, which together form the final Environmental Impact Statement

HOW TO OBTAIN MORE INFORMATION AND MAKE YOUR VIEWS KNOWN TO GOVERNMENT

Hard copies of the Draft EIS documentation are available for viewing at the following locations.

Australian Capital Territory

- Department of the Environment, Water, Heritage and the Arts Central Library, John Gorton Building, King Edward Terrace, Parkes, Canberra.

South Australia

- Barr Smith Library, University of Adelaide, North Terrace Campus, Adelaide
- Conservation Council of South Australia, Level 1, 157 Franklin Street, Adelaide
- Department of Planning and Local Government, Level 5, Roma Mitchell House, 136 North Terrace, Adelaide
- State Library of South Australia, corner of North Terrace and Kintore Avenue, Adelaide
- Flinders University Central Library, Flinders University, Sturt Road, Bedford Park
- University of South Australia Library, North Terrace, Adelaide
- Port Adelaide Enfield Council, 163 St Vincent Street, Port Adelaide
- Port Augusta City Council, 4 Mackay Street, Port Augusta
- Port Augusta Public Library, 4 Mackay Street, Port Augusta
- Roxby Downs Community Library, 7 Richardson Place, Roxby Downs
- Municipal Council of Roxby Downs, Richardson Place, Roxby Downs
- Corporation of the City of Whyalla, Civic Building, Darling Terrace, Whyalla
- Alex Ramsay Library, 20–28 Ramsay Street, Whyalla Stuart
- Civic Library, 3 Patterson Street, Whyalla.

Northern Territory

- Alice Springs Public Library, corner of Leichhardt and Gregory Terraces, Alice Springs
- Environment, Heritage and The Arts Division (Department of Natural Resources, Environment, The Arts and Sport), 2nd Floor, Darwin Plaza, 41 Smith Street Mall, Darwin
- Development Assessment Services (Department of Planning and Infrastructure), Information Desk, Ground Floor, Cavenagh House, corner of Cavenagh and Knuckey Streets, Darwin
- Minerals and Energy Information Centre, Department of Primary Industry, Fisheries and Mines, 3rd Floor, Paspalis Centrepoint, 48 Smith Street Mall, Darwin
- Northern Territory Library, Parliament House, State Square, Mitchell Street, Darwin
- Casuarina Library, 17 Bradshaw Terrace, Casuarina
- City Library, Civic Centre, Harry Chan Avenue, Darwin
- Karama Library, Karama Shopping Centre, corner of Kalymnos Drive and Karama Crescent, Karama
- Nightcliff Library, 10–12 Pavonia Place, Nightcliff
- The Environment Centre of the Northern Territory, Unit 3, 98 Woods St, Darwin
- Northern Land Council, 45 Mitchell St, Darwin
- Katherine Town Public Library, Level 1 Randazzo Building, Katherine Terrace, Katherine
- Litchfield Council, 7 Bees Creek Road, Freds Pass
- Environment Hub, Shop 9 Rapid Creek Business Village, Pearce Place, Millner
- Palmerston City Library, Goyder Square, The Boulevard, Palmerston
- Tennant Creek Public Library, Civic Centre, Peko Road, Tennant Creek.

The Draft EIS documentation can be viewed at <http://www.planning.sa.gov.au/> and <http://www.bhpbilliton.com/odxeis>, and is available for purchase by contacting:

- The Department of Planning and Local Government ph 08 8303 0752
- The Municipal Council of Roxby Downs ph 08 8671 0010
- The Port Augusta City Council ph 08 8641 9100
- The Corporation of the City of Whyalla ph 08 8640 3444

The costs to purchase the Olympic Dam Expansion Draft EIS documentation are:

- Draft EIS Executive Summary and electronic copy of all Draft EIS documentation (in PDF format on DVD) – no cost
- Draft EIS Main Report – $50
- Draft EIS Appendices – $20 for each appendix or $300 for the complete set.

All monies generated by the sale of Draft EIS documentation will be donated to the Royal Flying Doctor Service.

Telephone enquiries about the Draft EIS can be made to the Assessment Branch, Department of Planning and Local Government, on 08 8303 0752.

Lodging a submission

For your submission to the government about the Draft EIS to be considered, **it must be in writing and submitted by the close of submissions date to:**

The Minister for Urban Development and Planning
ATTENTION: Manager, Assessment Branch
Department of Planning and Local Government
RE: Proposed Olympic Dam Expansion
GPO Box 1815
Adelaide SA 5001

Or it may be submitted electronically to:

OlympicDamEIS@state.sa.gov.au

The Department of Planning and Local Government will distribute the written submissions to the Australian and Northern Territory governments and to BHP Billiton.

ABBREVIATIONS

Acronyms

ALARA	as low as reasonably achievable
Draft EIS	Draft Environmental Impact Statement
EIS	Environmental Impact Statement
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GAB	Great Artesian Basin
GSP	Gross State Product
NEM	National Electricity Market
RSF	rock storage facility
SEB	significant environmental benefit
TSF	tailings storage facility

Units of measurement

g	gram
GL	gigalitres
GWh	gigawatt hours
ha	hectare
kg	kilogram
km	kilometre
kW	kilowatt
L	litre
m	metre
ML	megalitre
ML/d	megalitre(s) per day
m/s	metre(s) per second
mSv	millisieverts
Mtpa	million tonnes per annum
MW	megawatt
oz	ounce
pH	degree of alkalinity/acidity
t	tonne
tpa	tonne(s) per annum