OLYMPIC DAM EXPANSION

DRAFT ENVIRONMENTAL IMPACT STATEMENT 2009

APPENDIX E
NORTHERN TERRITORY TRANSPORT OPTION AND ASSESSMENT AGAINST OVERARCHING COMMONWEALTH ACTS AND PRINCIPLES

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APPENDIX E

NORTHERN TERRITORY TRANSPORT OPTION AND ASSESSMENT AGAINST OVERARCHING COMMONWEALTH ACTS AND PRINCIPLES

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APPENDIX E1

EPBC Act

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E1 EPBC ACT

E1.1 INTRODUCTION

The proposed expansion to the Olympic Dam mining and processing operation was referred by BHP Billiton under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on 15 August 2005.

The Australian Government (the Department of Environment and Water Resources, now the Department of Environment, Water, Heritage and the Arts) deemed the Olympic Dam expansion a controlled action under the EPBC Act on 2 September 2005. The Act outlines seven matters of National Environmental Significance (NES) against which the significant impact of actions is assessed. Of these, five matters were identified as pertaining to the proposed Olympic Dam expansion and were designated as controlling provisions for the project. The identified controlling provisions were:

- wetlands of international importance
- listed threatened species and ecological communities
- listed migratory species
- protection of the environment from nuclear actions
- the protection of the environment from actions involving Commonwealth land.

These provisions are discussed throughout the Draft EIS. This appendix collates and summarises the assessment findings that are relevant to the controlling provisions of the EPBC Act.

E1.2 OVERVIEW OF CONTROLLING PROVISIONS AND ASSESSMENT METHODS

This section provides an overview of the matters of National Environmental Significance (NES) that are applicable to the project and assessments undertaken to provide a basis for the impact assessment described in Section E1.3.

E1.2.1 Wetlands of international importance

The database searches indicated that there are two wetlands of international importance listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* in the search area – Coongie Lakes and Lake Pinaroo (see Figure E1.1). Coongie Lakes lies in the far north-east of South Australia near Innamincka, approximately 470 km from Olympic Dam. Lake Pinaroo is located within Sturt National Park, 24 km south-east of Cameron Corner (the junction of the New South Wales, Queensland and South Australian borders, 430 km from Olympic Dam). Most of the upper Cooper Creek system in South Australia is listed under the Ramsar Convention as the Coongie Lakes Wetland of International Importance.

The nearest infrastructure to the wetlands would be the gas pipeline from Moomba to Olympic Dam (via the three alternative routes). At its closest point the pipeline would be approximately 1.5 km from the boundary of the Coongie Lakes Ramsar area, approximately 102 km south-west of Coongie Lake and approximately 132 km west of Lake Pinaroo.

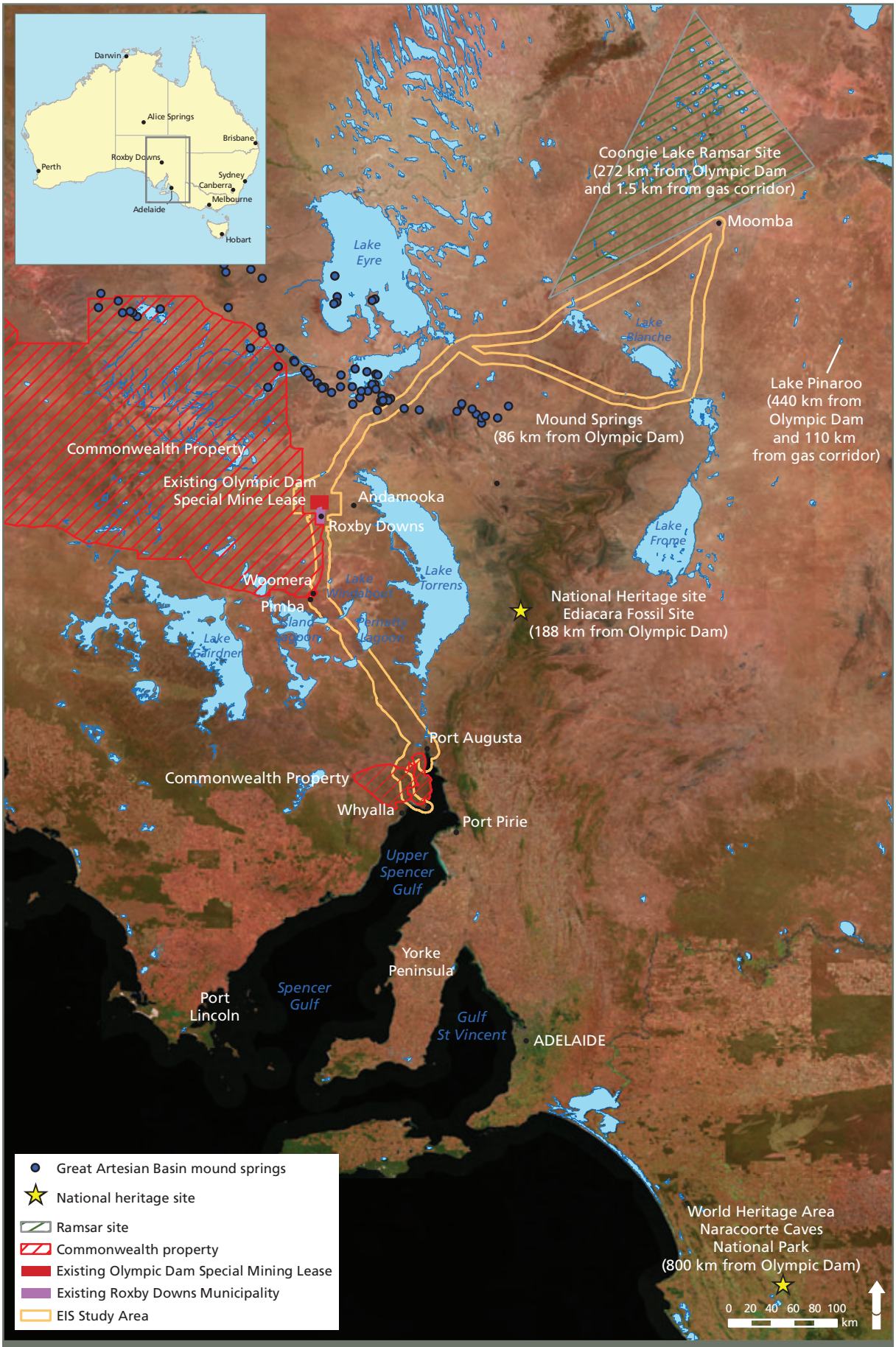

Figure E1.1 Sites of national and international importance

E1.2.2 Listed threatened species and communities

Terrestrial ecology assessment

The assessment of terrestrial ecology (including threatened species and ecological communities) involved:

- a desktop review and compilation of relevant data from the past 25 years of published reports and databases associated with the wider environs of Olympic Dam and the EIS Study Area (see Figure E1.2)
- field surveys to identify and map vegetation associations, and to identify flora and fauna species and their preferred habitats
- an iterative process of risk and impact assessment, project design refinement and identification of management measures as discussed in Chapter 1, Introduction, of the Draft EIS. This also included the establishment of a significant environmental benefit (SEB) strategy, in accordance with guidelines provided by the South Australian Native Vegetation Council.

Details of the assessment method are provided in Chapter 15, Terrestrial Ecology, and Appendix N of the Draft EIS.

Marine ecology assessment

The assessment of marine ecology relevant to listed species under the EPBC Act involved:

- a literature review of desalination plants, the effects of salinity on marine species and records pertaining to the marine environment of the study area, including Port Adelaide, the Port of Darwin and Commonwealth waters near the Port of Darwin
- additional marine surveys to assess the distribution and composition of the marine communities
- ecotoxicity studies to assess the tolerance of marine species to various salinity and anti-scalant concentrations
- hydrodynamic modelling to assess dispersion of the desalination plant return water plume and sediment plume from trenching activity on the seafloor
- an iterative process of risk and impact assessment, project design refinement and identification of management measures as discussed in Chapter 1 of the Draft EIS.

Details of the assessment method are provided in Chapter 16, Marine Environment, and Appendix O of the Draft EIS.

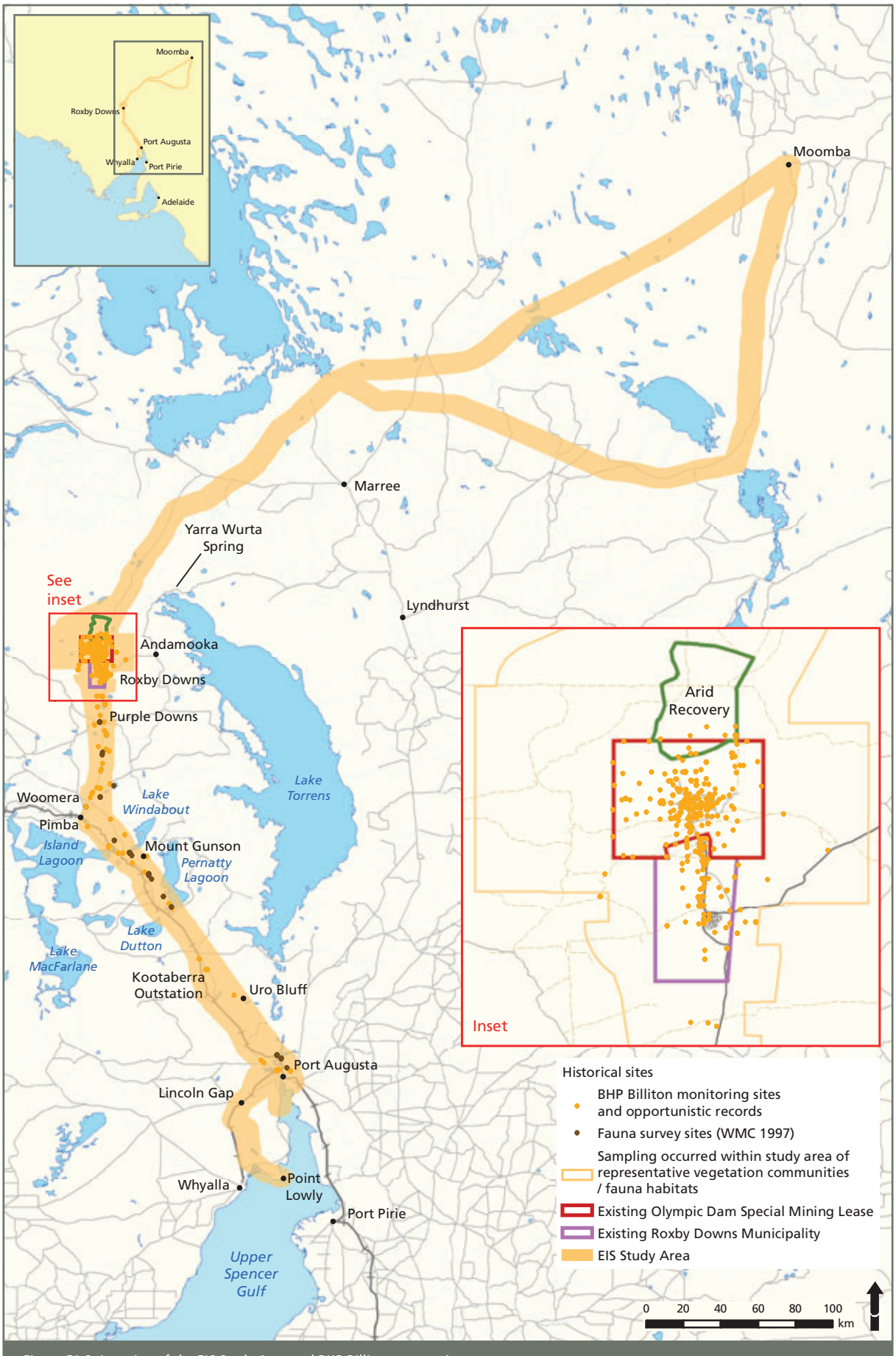

Figure E1.2 Location of the EIS Study Area and BHP Billiton survey sites

E1.2.3 Listed migratory species

The listed migratory species were included as part of the terrestrial and/or marine ecology assessments based on desktop reviews of previous monitoring records. Details of the assessment method are provided in Chapter 15, Terrestrial Ecology, and appendices N1, N6, N10 and N11 of the Draft EIS.

The potential interactions between the tailings storage facility beaches and shorebirds is currently being studied by Donato Environmental Services.

E1.2.4 Protection of the environment from nuclear actions

The proposed expansion involves the mining and milling of uranium ore, transport, handling and export of uranium oxide and concentrate, and the subsequent decommissioning and rehabilitation of the area in which the activity would occur. The potential impacts of these activities are discussed throughout the Draft EIS and Appendix E4 for export of product via the Port of Darwin. Radiological effects are assessed in relation to Terrestrial Ecology (Chapter 15), Health and Safety (Chapter 22), Rehabilitation and Closure (Chapter 23) and Hazard and Risk (Chapter 26). As such, they are not reproduced here: this appendix focuses on those NES matters relevant to ecological effects of the proposed expansion.

E1.2.5 Protection of the environment from actions involving Commonwealth land

The impacts to Commonwealth land, which includes land owned or leased by the Commonwealth or a Commonwealth agency reserve, were assessed by identifying Commonwealth land in the vicinity of the EIS Study Area, the values and current uses of this land, and applying the impact assessment method outlined in Chapter 1, Introduction, of the Draft EIS to determine the level of residual impact. This section of the EPBC Act empowers the Department of Environment, Water, Heritage and the Arts to review potential impacts to the whole environment of Commonwealth land, not just NES matters. As a consequence, this issue is also addressed throughout the Draft EIS. However, this appendix includes some discussion of those Commonwealth lands relevant to the proposed expansion and summarises potential impacts on these lands.

E1.2.6 Matters of national environmental significance not relevant to the project

The NES matters not identified as controlling provisions (i.e. World Heritage properties, National Heritage places and Commonwealth marine areas) are not addressed in this appendix. These NES matters are not relevant to the proposed expansion because:

- the nearest World Heritage sites to the EIS Study Area are the Australian Fossil Mammal Site (Naracoorte Caves) in the south-east of South Australia (approximately 800 km from Olympic Dam) (see Figure E1.1) and the Willandra Lakes Region in south-western New South Wales (approximately 700 km from Olympic Dam)
- the nearest National Heritage place to the EIS Study Area is the Ediacara Fossil Site located on the western side of the Flinders Ranges in South Australia (approximately 185 km from Olympic Dam)(see Figure E1.1)
- Spencer Gulf (the site of the desalination plant and landing facility) and Gulf St Vincent (the site of port facilities) in South Australia are part of State rather than Commonwealth waters; Beagle Gulf (the site of port facilities at Darwin) is outside Commonwealth waters
- Appendix C (Risk Assessment) of the Draft EIS established no unacceptable risk of a shipping incident occurring in Commonwealth waters.

The above sites and areas are too far from the project to be impacted, or at no credible risk of being affected.

E1.3 ASSESSMENT OF POTENTIAL IMPACTS ON MATTERS OF NES

The Department of Environment, Water, Heritage and the Arts (DEWHA) has developed administrative guidelines to assist proponents in identifying whether their project may potentially have a significant impact on matters of National Environmental Significance (NES) listed within the EPBC Act.

The following assessment of potential impacts on matters of NES has been guided by the EPBC Act Policy Statement 1.1 'Significant Impact Guidelines Matters of National Environmental Significance' (DEH 2006).

E1.3.1 Project alternatives

The preferred project configuration was determined after considering 53 alternatives for major project components (see Chapter 4, Project Alternatives). The assessment process was based on BHP Billiton's proprietary risk management standard, which requires consideration of health, safety, environmental, community and economic issues during management of BHP Billiton projects. As such, potential impacts on matters of NES were taken into consideration when assessing project alternatives. The assessment of each option against the EPBC Act Guidelines is given in Table E1.1.

Although most project alternatives were considered to have no credible risk of affecting matters of NES, seven components were considered to have a credible risk, as follows:

- *Continue existing underground method and expand operations by establishing a new open pit mine*. This is the chosen project component and is therefore assessed in greater detail in Sections E1.3.3 – E1.3.5.
- *A paddock system for storage of tailings as used in the existing operation with design modifications (e.g. no requirement for evaporation ponds)*. This is the chosen project component and is therefore assessed in greater detail in Sections E1.3.4 and E1.3.5.
- *A paddock system with no design modifications*. This alternative would not have taken the opportunity presented by the expansion project to reduce impacts on birds (including EPBC Act listed migratory species) and was therefore rejected.
- *A third wellfield in the Great Artesian Basin (GAB)*. Extraction of 200 ML/day of water for the primary water supply from Great Artesian Basin (GAB) wellfields was considered to have significant implications with respect to matters of NES. Many of the GAB springs in the region are known to support critically endangered wetland communities. Modelling of groundwater drawdown associated with the expansion of the GAB wellfields (i.e. Wellfield C) demonstrated that flows of some GAB springs, known to support endangered communities, would decline if the required primary water demand of 200 ML/d was extracted. The risk to these communities was considered unacceptable, and the GAB Wellfield C alternative was therefore rejected.
- *Extraction from the River Murray*. Extracting 200 ML/day of water from the River Murray was considered to be unacceptable as it would further reduce environmental flows within the river. Additional extraction may exacerbate adverse effects on the Coorong (a Ramsar wetland of international importance). For these and other reasons, the option was rejected.
- *Location of coastal seawater desalination plant*. Listed threatened marine species utilise, on occasion, South Australian coastal waters and Spencer Gulf and therefore all investigated locations of the desalination plant have a potential to impact these species. The assessments reported in Chapter 16, Marine Environment, of the Draft EIS establish that the potential to impact listed marine species from the preferred Point Lowly site is negligible.
- *Thirteen alternative locations for Hiltaba Village and the airport to the north, south and east of Roxby Downs*. The possible presence of a population of the endangered Thick-billed Grasswren in Cottonbush habitat on gibber plains near Roxby Downs was considered when locating camp and airport infrastructure. Impacts on Thick-billed Grasswrens were considered to be unlikely as surveys failed to detect the bird in the area, and most of the Cottonbush habitat would be avoided when locating infrastructure. The residual impact on the Thick-billed Grasswren was considered to be negligible.

Table E1.1 Assessment of project alternatives against matters of NES

Project component	Options investigated[1]	Credible risk to matters of NES	Notes
Mining method	**Continue existing underground method and expand operations by establishing a new open pit mine**	Yes	Vegetation/habitat clearance may adversely affect a number of threatened species (including plants, small mammals, birds and a gecko) Air emissions may adversely affect the habitat of threatened small mammals introduced to Arid Recovery
	Expand existing underground mining operations	No	
Production rate	**Expand to 750,000 tpa of refined copper equivalent plus associated products**	No	
	Expand to <750,000 tpa of refined copper equivalent plus associated products	No	
	Expand to >750,000 tpa of refined copper equivalent plus associated products	No	
Processing ore	**Upgrade existing processing plant to full capacity and export the additional concentrate**	No	
	Construct a new plant at Olympic Dam to process all of the recovered ore	No	
	Upgrade existing processing plant to full capacity and construct a new plant in Upper Spencer Gulf to process the additional concentrate	No	
Location of port to export copper concentrate containing uranium	**Port of Darwin**	No	
	Port Adelaide	No	
	Port Bonython	No	
	Whyalla	No	

Table E1.1 Assessment of project alternatives against matters of NES (cont'd)

Project component	Options investigated[1]	Credible risk to matters of NES	Notes
Tailings storage method	**A paddock system as used in the existing operation with design modifications (e.g. no requirement for evaporation ponds)**	Yes	Wet tailings beaches containing acidic liquor may adversely affect listed migratory shorebirds
	A paddock system with no design modifications	Yes	The TSF ponds and evaporation ponds containing acidic liquor may adversely affect listed migratory shorebirds
	Co-disposal of tailings with mine rock	No	
	A central discharge system	Yes	The TSF ponds and evaporation ponds containing acidic liquor may adversely affect listed migratory shorebirds
	Co-locating the tailings and mine rock storage facilities	Yes	The TSF ponds and evaporation ponds containing acidic liquor may adversely affect listed migratory shorebirds
	Thickening tailings above 55% solids – applied to all options	Yes	The TSF ponds and evaporation ponds containing acidic liquor may adversely affect listed migratory shorebirds
	Neutralising the tailings	No	
Primary water supply	**Coastal seawater desalination plant**	No	
	Expand existing extraction from the Great Artesian Basin (GAB)	Yes	Groundwater drawdown associated with extraction of the primary water supply for the expansion from the Great Artesian Basin may adversely affect endangered GAB spring communities
	New groundwater extraction from the Arckaringa Basin	No	
	Adelaide treated wastewater (i.e. use primary sewage treatment plant water)	No	
	Extraction from the River Murray	Yes	Extraction of water from the River Murray may exacerbate adverse effects on the Coorong (a Ramsar wetland of international importance)
Location of coastal seawater desalination plant	**Point Lowly**	Yes	Listed marine species utilise Upper Spencer Gulf and the potential impacts on these species are discussed in Chapter 16, Marine Environment
	South of Whyalla	Yes	
	Port Augusta	Yes	
	South of Port Pirie	Yes	
	Whyalla	Yes	
	Ceduna	Yes	Listed marine species utilise waters off Ceduna and therefore would carry a potential for impact or risk
Options for managing desalination plant return water	**Return to the sea**	No	
	Land-based discharge	No	
	Discharge to an inland salt lake	No	
	Deep well injection	No	
Primary electricity supply	**From the national electricity market (i.e. the grid)**	No	
	A purpose built onsite gas-fired power plant	No	
	Dedicated low carbon emission energy sources – wind and/or solar	No	
	Dedicated low carbon emission energy source – geothermal	No	
Hiltaba Village (construction workforce accommodation)	**On Andamooka Road, 16 km east of Roxby Downs**	No	
	Thirteen alternative locations to the north, south and east of Roxby Downs	Yes	Clearance of Cottonbush habitat on gibber plains may adversely affect a population of the threatened Thick-billed Grasswren
Transporting materials	**Maximise bulk transport via rail with remaining materials transported by road**	No	
	Continue existing all-by-road method	No	

Table E1.1 Assessment of project alternatives against matters of NES (cont'd)

Project component	Options investigated[1]	Credible risk to matters of NES	Notes
Location of landing facility	**Site 1 (Snapper Point south of O'Connell Court – about 10 km south of Port Augusta)**	No	
	Site 2 – Shack Road, about 16 km south of Port Augusta	No	
	Site 3 – Shack Road, about 18 km south of Port Augusta	No	
	Site 4 – Shack Road, about 21 km south of Port Augusta	No	
	Area 1 – Shack Road, about 2 to 8 km south of Port Augusta	No	
Location of port to import sulphur and diesel	**Port Adelaide**	No	
	Port Augusta	No	
	Port Pirie	No	
	Whyalla	No	
	Port Bonython	No	
	Interstate ports	No	

[1] Bold indicates the chosen project component.

E1.3.2 Wetlands of international importance

In determining the potential impact of the mine expansion project on the wetlands of international importance, the DEWHA guidelines note that an action is likely to have a significant impact on the ecological character of a declared Ramsar wetland if there is a real chance or possibility that it will result in:

- areas of the wetland being destroyed or substantially modified
- a substantial and measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland
- the habitat or life cycle of native species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected
- a substantial and measurable change in the water quality of the wetland, for example, a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity or human health
- an invasive species that is harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the wetland.

The EPBC Act Protected Matters Search Tool indicated that the proposed gas pipeline from Moomba to Olympic Dam would be located within the same catchment area as the Coongie Lakes and Lake Pinaroo Ramsar wetlands. There is, however, no significant hydrological connection between the pipeline routes and the wetlands.

In view of the significant distance between the proposed pipeline route (irrespective of the route option chosen) and the wetlands, there is no credible risk of any of the above outcomes occurring as a result of the pipeline development.

E1.3.3 Threatened ecological communities

In determining the potential impact of the mine expansion project on listed ecological communities, the guidelines note that an action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- reduce the extent of an ecological community
- fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines
- adversely affect habitat critical to the survival of an ecological community
- modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns
- cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting

- cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:
  - assisting invasive species, that are harmful to the listed ecological community, to become established
  - causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community
- interfere with the recovery of an ecological community.

The various ecological communities in the EIS Study Area are described in Chapter 15, Terrestrial Ecology, Section 15.3.2 and Appendix N1. Two endangered ecological communities listed under the EPBC Act require consideration in regard to the proposed expansion:

- A 'community of native species dependent on natural discharge of groundwater from the Great Artesian Basin' is present on the northern edge of the gas pipeline corridors where it traverses the Reedy Springs GAB springs complex on Murnpeowie Station (see Figure E1.1). There would be no impact on this community, as the GAB springs and the vegetation they support would be completely avoided by the pipeline and any ancillary infrastructure (e.g. construction camps, pipe stacking sites, mainline valves) by a distance of several kilometres. Furthermore, no water would be extracted from GAB springs or groundwater wells within 20 km of the springs during construction.
- The Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia is mapped as possibly occurring within a broad general area that overlaps the buffer zone of the infrastructure corridor to the east of Port Augusta (DEWR 2007). Vegetation surveys failed to detect Peppermint Box in the EIS Study Area.

In relation to the EPBC Act, the proposed expansion would not result in any significant impacts on the above communities. In particular, there is no reasonably foreseeable chance or possibility that the project would reduce the extent of, or fragment, these communities.

E1.3.4 Listed threatened species

In determining the potential impact of the proposed expansion on endangered species, the guidelines note that an action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of a population
- reduce the area of occupancy of the species
- fragment an existing population into two or more populations
- adversely affect habitat critical to the survival of a species
- disrupt the breeding cycle of a population
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat
- introduce disease that may cause the species to decline
- interfere with the recovery of the species.

In determining the potential impact of the proposed expansion on vulnerable species, the guidelines note that an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of an important population of a species
- reduce the area of occupancy of an important population
- fragment an existing important population into two or more populations
- adversely affect habitat critical to the survival of a species
- disrupt the breeding cycle of an important population
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
- introduce disease that may cause the species to decline
- interfere substantially with the recovery of the species.

Flora

Table E1.2 provides a list of flora from the EPBC database that have been recorded or have the potential to occur in the EIS Study Area. The table also provides a summary of the assessment and potential impacts of the proposed expansion on listed flora species.

The assessment of potential impacts on listed species was undertaken in two stages. All EPBC listed species known or predicted to occur in the EIS Study Area were subject to a screening process, based on their distribution and ecology/resilience, to determine whether they are at credible risk of being affected by the project (see Appendix N6). Those species having a credible risk of being affected were then subject to an additional level of assessment (see Chapter 15, Terrestrial Ecology).

Two flora species listed under the EPBC Act were identified by the desktop assessment as having credible risk of being affected by the proposed expansion (i.e. *Eleocharis papillosa* and *Frankenia plicata*; see Table E1.2). Neither species was detected during surveys conducted for the EIS.

Eleocharis papillosa is found in temporary wetlands and there are database records for two locations in the gas pipeline corridor, more than 2 km from the corridor centreline. All confirmed records of *Frankenia plicata* are from the Breakaways (north-west of the study area), however there is an un-vouchered record from the gas pipeline corridor.

The likelihood of either species occurring in the area that may potentially be disturbed is low. However, further searches will occur when the exact location of the disturbance footprints is known. The surveys will target those vegetation types that are known to support the listed threatened species (refer Chapter 15, Terrestrial Ecology, Section 15.5.4). In the event that any threatened species are identified during these surveys, one of two management measures would be followed:

- Where possible infrastructure alignments would be adjusted to avoid areas that contain listed threatened plants.
- Before disturbance, areas found to contain listed threatened plants and in close proximity to disturbance works would be marked as no-go areas on construction design drawings and in the field with flagging tape and/or hazard fencing.

In relation to the guidelines, the proposed expansion is unlikely to result in any significant impacts on flora that is listed under the EPBC Act. In particular, there is no reasonably foreseeable chance or possibility that the expansion would result in a long-term decrease to population size, reduction in the area of occupancy, fragmentation of an existing population or modification of habitat to the extent that the species are likely to decline.

Table E1.2 Potential impacts on terrestrial flora listed under the EPBC Act and occurring or likely to occur in the project area in South Australia

Species name	Common name	EPBC status[1]	SA status	Credible risk to species[2]	Project hazard	Mitigation measures	Residual impact[3]
Austrostipa nullanulla	Club Spear-grass	V		No	n.a.[4]	n.a.	n.a.
Brachyscome muelleri	Corunna Daisy	E	E	No	n.a.	n.a.	n.a.
Caladenia tensa	Greencomb Spider-orchid	E		No	n.a.	n.a.	n.a.
Eleocharis papillosa	Dwarf Desert Spike-rush	V	R	Yes	Corridor clearance	Survey disturbance footprint, attempt to identify, mark and avoid plant(s)	Negligible
Eriocaulon carsonii	Salt Pipewort	E	E	No	n.a.	n.a.	n.a.
Frankenia plicata		E	V	Yes	Corridor clearance	Survey disturbance footprint, attempt to identify, mark and avoid plant(s)	Negligible
Halosarcia flabelliformis	Bead Glasswort	V		No	n.a.	n.a.	n.a.
Maireana melanocarpa	Black-fruit Bluebush	V		No	n.a.	n.a.	n.a.
Prasophyllum pallidum	Pale Leek-orchid	V	R	No	n.a.	n.a.	n.a.
Pterostylis sp. (Eyre Peninsula R. Bates 19474)		V	V	No	n.a.	n.a.	n.a.
Pterostylis xerophila	Desert Greenhood	V	V	No	n.a.	n.a.	n.a.
Senecio megaglossus	Superb or Large-flower Groundsel	V	E	No	n.a.	n.a.	n.a.
Swainsona pyrophila	Yellow Swainson-pea	V	R	No	n.a.	n.a.	n.a.

[1] Status: R = rare; V = vulnerable; E = endangered.
[2] See Appendix N6 for the description of the screening process to identify species at credible risk of being impacted by the project.
[3] See Chapter 1, Table 1.3 of the Draft EIS for the description of residual impact criteria.
[4] n.a. = not applicable.

Terrestrial fauna

Table E1.3 provides a list of fauna from the EPBC database that have been recorded or have the potential to occur in the EIS Study Area. The table also provides a summary of the assessment and potential impacts of the proposed expansion on threatened fauna.

As for flora, the assessment of potential impacts on threatened terrestrial fauna was undertaken in two stages. All EPBC Act-listed species known or predicted to occur in the EIS Study Area were subject to a screening process, based on their distribution and ecology/behaviour, to determine whether they are at credible risk of being affected by the expansion (see Appendix N6). Those species having a credible risk of being affected were then subject to an additional level of assessment (see Chapter 15, Terrestrial Ecology).

The screening process showed that 16 EPBC Act-listed fauna species would be at credible risk of being affected by the proposed expansion (see Table E1.3).

Of the four threatened bird species recorded in the EIS Study Area (Plains Wanderer, Thick-billed Grasswren Eastern subspecies and Thick-billed Grasswren Gawler Ranges subspecies and Slender-billed Thornbill Western subspecies), the Thick-billed Grasswren Eastern subspecies was considered to be at credible risk of being affected by the proposed expansion.

The residual impact on several small mammals and a lizard was assessed as low or moderate (see Chapter 1, Introduction, Table 1.3 of the Draft EIS). The impact on each of these species in relation to the EPBC Act guidelines is discussed below.

Ampurta *Dasycercus hillieri* and Dusky Hopping-mouse *Notomys fuscus*

The Ampurta is known to occur in Strzelecki Desert dunefields north of the gas pipeline corridor and may occur on the corridor. The Dusky Hopping-mouse is known to occur on the gas pipeline corridor option south of Moomba, in the dunes of the Strzelecki Desert, and may also occur on the gas pipeline option south-west of Moomba. Both of these species are generally distributed sparsely and widely across very extensive habitats.

Construction of the gas supply pipeline would have a localised and short-term impact on these species, if they were present. Individual animals may be affected by vegetation removal, earthworks or entrapment in the pipeline trench. In a regional context, the proposed expansion would affect a negligible percentage of available habitat, which is very extensive. It is unlikely that there would be any significant effects at a population level. Mitigation measures outlined in Section 15.5.10 would ensure that mortality from trench entrapment is very low.

In relation to the EPBC Act Guidelines, the proposed expansion is not predicted to have a significant impact on the Ampurta or Dusky Hopping-mouse. In particular, there is no reasonable or foreseeable chance or possibility that the expansion would result in a long-term decrease to population size, reduction in the area of occupancy, fragmentation of an existing population or modification of habitat to the extent that the species are likely to decline.

Table E1.3 Potential impacts on terrestrial fauna listed under the EPBC Act and occurring or likely to occur in the project area in (a) South Australia and (b) at the Port of Darwin

(a) South Australia

Species name	Common name	EPBC status[1]	SA status	Credible risk to species[2]	Project hazard	Mitigation measures	Residual impact[3]
Mammals							
Bettongia lesueur lesueur	Boodie, Burrowing Bettong	V	E	Yes	Noise, dust and other emissions from the mine	Recent extension to Arid Recovery SEB Offsets	Moderate
Dasycercus hillieri	Ampurta	E		Yes	Corridor clearance Open gas supply pipeline trench	SEB offsets Trench management plan	Low
Dasycercus cristicauda	Mulgara	V	E	No	n.a.[4]	n.a.	n.a.
Leporillus conditor	Wopilkara, Greater Stick-nest Rat	V	V	Yes	Noise, dust and other emissions from the mine Open trench	Recent extension to Arid Recovery SEB Offsets Trench management plan	Moderate
Macrotis lagotis	Bilby	V	V	Yes	Noise, dust and other emissions from the mine Open trench	Recent extension to Arid Recovery SEB Offsets Trench management plan	Moderate
Myrmecobius fasciatus	Numbat	V	E	Yes	Noise, dust and other emissions from the mine	Recent extension to Arid Recovery SEB Offsets	Moderate
Notomys fuscus	Dusky Hopping-mouse, Wilkiniti	V	V	Yes	Corridor clearance	SEB offsets	Low
Notoryctes typhlops	Marsupial Mole, Itjari Itjari	E	V	No	n.a.	n.a.	n.a.
Nyctophilus timoriensis	Greater Long-eared Bat	V	V	No	n.a.	n.a.	n.a.
Perameles bougainville	Western Barred Bandicoot	E	E	Yes	Noise, dust and other emissions from the mine	Recent extension to Arid Recovery SEB Offsets	Moderate

Table E1.3 Potential impacts on terrestrial fauna listed under the EPBC Act and occurring or likely to occur in the project area in (a) South Australia (cont'd)

Species name	Common name	EPBC status[1]	SA status	Credible risk to species[2]	Project hazard	Mitigation measures	Residual impact[3]
Pseudomys australis	Plains Rat	V	V	Yes	Clearance for open pit, RSF, TSF, Hiltaba Village, airport and other infrastructure Open trench Noise, dust and other emissions from the mine Open trench	Recent extension to Arid Recovery SEB Offsets Trench management plan	Moderate
Reptiles							
Nephrurus deleani	Pernatty Knob-tail Gecko	V	R	Yes	Open trench Corridor clearance	Trench management plan SEB Offsets	Low
Terrestrial birds							
Acanthiza iredalei iredalei	Slender-billed Thornbill (Western subspecies)	V	R	No	n.a.	n.a.	n.a.
Amytornis textilis modestus	Thick-billed Grasswren (Eastern subspecies)	V		Yes	Corridor clearance Noise, dust and other emissions from the mine	SEB Offsets	Negligible
Amytornis textilis myall	Thick-billed Grasswren (Gawler Ranges subspecies)	V		No	n.a.	n.a.	n.a.
Leipoa ocellata	Malleefowl	V, Mi	V	No	n.a.	n.a.	n.a.
Pachycephala rufogularis	Red-lored Whistler	V	R	No	n.a.	n.a.	n.a.
Pedionomus torquatus	Plains-wanderer	V	E	No	n.a.	n.a.	n.a.
Migratory / water / marine birds							
Actitis hypoleucos	Common Sandpiper	Mi, Ma	R	Yes	TSF	Cover open water with netting or similar (see Section 15.5.7)	High
Apus pacificus	Fork-tailed Swift	Mi, Ma		No	n.a.	n.a.	n.a.
Ardea alba	Great Egret	Mi, Ma		Yes	TSF	Cover open water with netting or similar (see Section 15.5.7)	Moderate
Ardea ibis	Cattle Egret	Mi, Ma	R	No	n.a.	n.a.	n.a.
Arenaria interpres	Ruddy Turnstone	Mi, Ma	R	No	n.a.	n.a.	n.a.
Calidris acuminata	Sharp-tailed Sandpiper	Mi, Ma		Yes	TSF	Cover open water with netting or similar (see Section 15.5.7)	Moderate

Table E1.3 Potential impacts on terrestrial fauna listed under the EPBC Act and occurring or likely to occur in the project area in (a) South Australia (cont'd)

Species name	Common name	EPBC status[1]	SA status	Credible risk to species[2]	Project hazard	Mitigation measures	Residual impact[3]
Calidris alba	Sanderling	Mi, Ma	R	No	n.a.	n.a.	n.a.
Calidris canutus	Red Knot	Mi, Ma		No	n.a.	n.a.	n.a.
Calidris ferruginea	Curlew Sandpiper	Mi, Ma		No	n.a.	n.a.	n.a.
Calidris ruficollis	Red-necked Stint	Mi, Ma		Yes	TSF	Cover open water with netting or similar (see Section 15.5.7)	Moderate
Calidris tenuirostris	Great Knot	Mi, Ma	R	No	n.a.	n.a.	n.a.
Charadrius leschenaultii	Greater Sand-plover	Mi, Ma	R	No	n.a.	n.a.	n.a.
Charadrius veredus	Oriental Plover	Mi, Ma		No	n.a.	n.a.	n.a.
Cuculus saturatus	Oriental Cuckoo	Mi, Ma		No	n.a.	n.a.	n.a.
Diomedea exulans gibsoni	Gibson's Albatross	V, Mi, Ma	V	No	n.a.	n.a.	n.a.
Gallinago hardwickii	Latham's Snipe	Mi	V	No	n.a.	n.a.	n.a.
Haliaeetus leucogaster	White-bellied Sea-Eagle	Mi, Ma	E	No	n.a.	n.a.	n.a.
Hirundapus caudacutus	White-throated Needletail	Mi, Ma		No	n.a.	n.a.	n.a.
Hirundo rustica	Barn Swallow	Mi, Ma		No	n.a.	n.a.	n.a.
Limosa lapponica	Bar-tailed Godwit	Mi, Ma	R	No	n.a.	n.a.	n.a.
Limosa limosa	Black-tailed Godwit	Mi, Ma	R	No	n.a.	n.a.	n.a.
Macronectes giganteus	Southern Giant-petrel	E, Mi, Ma	V	No	n.a.	n.a.	n.a.
Macronectes halli	Northern Giant-petrel	V, Mi, Ma		No	n.a.	n.a.	n.a.
Merops ornatus	Rainbow Bee-eater	Mi,Ma		No	n.a.	n.a.	n.a.
Numenius madagascariensis	Eastern Curlew	Mi, Ma	V	No	n.a.	n.a.	n.a.
Pandion haliaetus	Osprey	Mi, Ma	E	No	n.a.	n.a.	n.a.
Philomachus pugnax	Ruff	Mi, Ma	R	No	n.a.	n.a.	n.a.
Plegadis falcinellus	Glossy Ibis	Mi, Ma	R	No	n.a.	n.a.	n.a.
Pluvialis squatarola	Grey Plover	Mi, Ma		Yes	TSF	Cover open water with netting or similar (see Section 15.5.7)	Moderate
Puffinus carneipes	Flesh-footed Shearwater	Mi, Ma	R	No	n.a.	n.a.	n.a.
Rostratula benghalensis	Painted Snipe	V, Mi, Ma	V	No	n.a.	n.a.	n.a.

Table E1.3 Potential impacts on terrestrial fauna listed under the EPBC Act and occurring or likely to occur in the project area in (a) South Australia (cont'd)

Species name	Common name	EPBC status[1]	SA status	Credible risk to species[2]	Project hazard	Mitigation measures	Residual impact[3]
Sterna albifrons	Little Tern	Mi, Ma	E	No	n.a.	n.a.	n.a.
Sterna caspia	Caspian Tern	Mi, Ma		Yes	TSF	Cover open water with netting or similar (see Section 15.5.7)	Moderate
Thalassarche bulleri	Buller's Albatross	V, Mi, Ma	V	No	n.a.	n.a.	n.a.
Thalassarche cauta	Shy Albatross	V, Mi, Ma		No	n.a.	n.a.	n.a.
Thalassarche impavida	Campbell Albatross	V, Mi, Ma		No	n.a.	n.a.	n.a.
Tringa glareola	Wood Sandpiper	Mi, Ma	R	No	n.a.	n.a.	n.a.
Tringa nebularia	Common Greenshank	Mi, Ma		No	n.a.	n.a.	n.a.
Tringa stagnatilis	Marsh Sandpiper	Mi, Ma		No	n.a.	n.a.	n.a.

[1]Status: R = rare; V = vulnerable; E = endangered; Mi = migratory; Ma = marine
[2]See Appendix N6 for the description of the screening process to identify species at credible risk of being impacted by the project
[3]See Chapter 1, Table 1.3 of the Draft EIS for the description of residual impact criteria
[4] n.a. = not applicable

Table E1.3 Potential impacts on terrestrial fauna listed under the EPBC Act and occurring or likely to occur in the project area in

(b) Port of Darwin

Species name	Common name	EPBC status[1]	NT status	Credible risk to species[2]
Mammals				
Dasyurus hallucatus	Northern Quoll	E	CE	No
Megaptera novaeangliae	Humpback Whale	V, Mi, Ma		No
Xeromys myoides	False Water Rat	V		No
Terrestrial Birds				
Erythrotriorchis radiatus	Red Goshawk	V	V	No
Erythrura gouldiae	Gouldian Finch	E, Mi		No
Geophaps smithii smithii	Partridge Pigeon	V	V	No
Migratory species				
Actitus hypoleucos	Common Sandpiper	Mi		No
Anseranas semipalmata	Magpie Goose	Mi, Ma		No
Apus pacificus	Fork-tailed Swift	Mi, Ma		No
Ardea alba	Great Egret	Mi, Ma		No
Ardea ibis	Cattle Egret	Mi, Ma		No
Arenaria interpres	Ruddy Turnstone	Mi		No
Calidris alba	Sanderling	Mi		No
Calidris tenuiostris	Great Knot	Mi		No
Charadrius leschenaultii	Large Sand Plover	Mi		No
Charadrius mongolus	Mongolian Plover	Mi, Ma		No
Charadrius veredus	Oriental Plover	Mi, Ma		No
Coracina tenuirostris melvillensis	Melville Cicadabird	Mi		No
Glareola maldivarum	Oriental Pratincole	Mi		No
Haliaeetus leucogaster	White-bellied Sea-Eagle	Mi	V	No
Hirundo rustica	Barn Swallow	Mi, Ma		No
Limosa lapponica	Bar-tailed Godwit	Mi		No
Limosa limosa	Black-tailed Godwit	Mi		No
Merops ornatus	Rainbow Bee-eater	Mi,Ma		No
Numenius minutus	Little Whimbrel	Mi		No
Numenius phaeopus	Whimbrel	Mi		No
Pluvialis squatarola	Grey Plover	Mi		No
Poecilodryas superciliosa cerviniventris	Derby White-browed Robin	Mi		No
Rhipidura rufifrons	Rufous Fantail	Mi		No
Sterna albifrons	Little Tern	Mi, Ma	V	No

[1] Status: R = rare; V = vulnerable; E = endangered; CE = critically endangered; Mi = migratory; Ma = marine.
[2] See Attachment A for the description of species and the assessment of whether the species is at credible risk of being impacted by the project.

Plains Rat *Pseudomys australis*

The Plains Rat occurs in environments with cracking clay soils over a wide area of the arid zone of South Australia, from north-west of Lake Eyre to west of Lake Torrens. It is known to occur on the gibber plains and gibber covered swales of the Special Mining Lease (SML), the Arcoona Plains to the south of Olympic Dam and on the gas pipeline corridors near Screech Owl Creek (south of Lake Eyre South). They form complex systems of burrows, often associated with drainage depressions (gilgais) on gibber plains (Brandle et al. 1999). Populations of the Plains Rat fluctuate dramatically in response to environmental conditions (Brandle and Moseby 1999). No populations of the Plains Rat are permanently associated with particular 'refugia'. Rather, Plains Rat populations consist of a number of dynamic regional populations utilising a network of primary core areas, with rare widespread dispersal occurring between regions (Moseby et al. 1999). The Plains Rat is g enerally sparsely and widely distributed across very extensive habitats.

The loss of Plains Rat habitat (chenopod shrubland) within the SML would comprise only about 2% of the chenopod shrubland in the EIS Study Area. Some populations of the Plains Rat in the vicinity of the expanded mine would be displaced by construction activities. Some emigration of Plains Rats from areas of intensive construction activities to adjacent suitable habitat would probably occur. The construction of the gas and water supply pipelines would result in localised, short-term disturbance that would affect a small percentage of Plains Rat habitats. Although some communities may be affected, it is unlikely to have significant effect on Plains Rat populations. Mitigation measures outlined in Chapter 15, Terrestrial Ecology, Section 15.5.11 would ensure that mortality from open trench entrapment was very low.

In relation to the EPBC Act Guidelines, the proposed expansion is not likely to result in significant impacts on this species. In particular, there is no reasonable or foreseeable chance or possibility that the expansion would result in a long-term decrease to population size, reduction in the area of occupancy, fragmentation of an existing population or modification of habitat to the extent that the species is likely to decline.

Small mammals introduced to Arid Recovery

Established in 1997, Arid Recovery is an ecosystem restoration initiative within, and immediately north of, the Olympic Dam SML. It is a partnership between BHP Billiton, the community group Friends of Arid Recovery, the South Australian DEH and the University of Adelaide. The program is based around an 86 km^2 (8,600 ha) fenced reserve from which all foxes, rabbits and cats have been eradicated.

The program has reintroduced locally extinct native fauna within the fenced area, including the threatened Greater Stick-nest Rat *Leporillus conditor*, Burrowing Bettong *Bettongia lesueur*, Greater Bilby *Macrotis lagotis*, Western Barred Bandicoot *Perameles bougainville* and the Numbat *Myrmecobius fasciatus*. The first four species are breeding and have been successfully established in Arid Recovery.

Dust, noise, light and gaseous emissions from the expanded operation may reduce the quality of habitat in the southern part of Arid Recovery. This may result in a long-term decrease in the abundance of fauna in the southern part of Arid Recovery, but their viability in the northern part of the area is unlikely to be affected. Fauna may move into the northern section of Arid Recovery, where the effects of emissions are predicted to be negligible. Arid Recovery was significantly expanded to the north in 2006.

In relation to the EPBC Act Guidelines, the threatened species within Arid Recovery are unusual in that they are not naturally occurring populations. Nevertheless, air and noise emissions may reduce the value of some habitat in the southern sections of Arid Recovery, but these impacts are not predicted to substantially affect the recovery of the species.

Thick-billed Grasswren (eastern subspecies) – *Amytornis textilis modestus*

Thick-billed Grasswrens are sedentary birds that typically occupy territories of approximately four to five hectares. In the Roxby Downs–Andamooka region they usually occupy gibber plains vegetated with emergent chenopod shrubs including Old-man Saltbush *Atriplex nummularia omissa*, Cottonbush *Maireana aphylla*, Black Bluebush *M. pyramidata* and Swamp Canegrass *Eragrostis australasica*, particularly the dense vegetation where run-off collects or along watercourses (NPWS 2002). They shelter at the base of shrubs, in animal burrows or in ground crevices, and nest at the base of chenopod shrubs (Rowley and Russell 1997). A recovery plan for the Thick-billed Grasswren (eastern subspecies) has been prepared (NSW National Parks and Wildlife Service 2002).

Although the species is reasonably common further north in the Lake Eyre catchment, there have been few Thick-billed Grasswren records south of the Dog Fence or the Roxby Downs–Andamooka region (John Read unpublised data, Read et al. 2000). There have been several confirmed records of the Thick-billed Grasswren about 50 km east of Olympic Dam, near Andamooka, and two records about 20 km to the north near Arid Recovery (A Black, Honorary Associate South Australian Museum, pers. comm., 12 December 2007).

Although suitable habitat for the Thick-billed Grasswren occurs in Cottonbush low shrubland on the gibber plain about 2.5 km south-west of the proposed Hiltaba Village and near the proposed airport, surveys of the area could not confirm the presence of Grasswrens in the area (see Appendix N7). Suitable habitat also exists within the pipeline supply corridors, although the species was not recorded in the field assessment of these areas. The loss of about 8 ha of Cottonbush low shrubland at the airport site would represent about 5% of Cottonbush low shrubland, and about 0.002% of chenopod shrubland in the EIS Study Area. An additional 10 ha would fall within the airport perimeter fence and therefore be exposed to noise impacts. Only a small proportion of available habitat would be affected, however, and birds would be likely to move from the affected areas to adjacent areas of suitable habitat.

Suitable habitat would be identified and set aside to offset the loss of Thick-billed Grasswren habitat near the proposed airport. For example, setting aside more of the Red Lake paddock (north of Arid Recovery), where a population of Thick-billed Grasswrens has recently been observed (J Read, pers. comm., 12 February 2008), may be a suitable offset. A significant proportion of the pastoral land included in the package of offsets would contain dense chenopod shrubland along watercourses or drainage depressions that would potentially provide suitable habitat for the Thick-billed Grasswren.

The residual impact of the proposed expansion on the Thick-billed Grasswren (eastern subspecies) would be negligible.

Pernatty Knob-tailed Gecko *Nephrurus deleani*

The Pernatty Knob-tailed Gecko occurs in the dunefield and sandplain land system where it builds burrows at the base of low vegetation. Within its known range, important habitat occurs in the dunes along a 50 km section of the infrastructure corridor between Island Lagoon and Dutton Lake (Ehmann 2005).

The Pernatty Knob-tailed Gecko is vulnerable to impact as it is territorial, not highly mobile, difficult to detect during the day and susceptible to heat stress should it become trapped in the open trench during construction of the water supply pipeline. Nevertheless, construction of the water supply pipeline and transmission line would result in only short-term impacts to the gecko. Measures to mitigate potential impacts of the open trench on the gecko are presented in Chapter 15, Terrestrial Ecology, Section 15.5.10. In addition, pre-construction surveys would be undertaken to determine whether final positions or alignments of infrastructure should be moved to minimise potential impacts on habitat. A management plan would be developed prior to construction to ensure that appropriate management and mitigation measures were implemented.

In relation to the EPBC Act Guidelines, the proposed expansion is not predicted to have significant impacts on this species. In particular, there is no reasonable or foreseeable chance or possibility that the expansion would result in a long-term decrease to population size, reduction in the area of occupancy, fragmentation of an existing population or modification of habitat to the extent that the species is likely to decline.

Marine fauna

Eight species of marine fauna listed as threatened under the EPBC Act were identified from relevant databases as potentially occurring in Upper Spencer Gulf and eight at the Port of Darwin (Table E1.4).

The potential impact to each species in Upper Spencer Gulf was considered in terms of the following criteria:

- their occurrence in Upper Spencer Gulf
- their mobility
- the availability of suitable habitat in Upper Spencer Gulf
- the potential for return water from the desalination plant and construction activities to affect the habitat of these species
- the likely sensitivity of these species and their food resources to return water and construction impacts.

Two of the threatened species have never been recorded in or near Point Lowly. These are the Loggerhead Turtle and Leatherback Turtle (see Appendix O3). The risk to these species was therefore considered to be very low.

Six of the threatened species have been recorded in or near the study area but are highly mobile (see Appendix O3). These include the threatened Humpback Whale, Southern Right Whale, Australian Sea-lion, Great White Shark, Green Turtle and Hawksbill Turtle. These species have extensive suitable habitat in areas of Upper Spencer Gulf outside the area potentially affected by return water. Although increased shipping movements in Spencer Gulf increase the risk of whales being hit by ships, the risk is considered negligible (i.e. not a credible risk as per the Draft EIS risk assessment; see Appendix C).

The potential impact to each species in Darwin Harbour was considered in terms of the development activities proposed at the Port of Darwin. These activities would occur on cleared or reclaimed land where industrial development is already occurring.

No disturbance of natural vegetation or habitat would occur. Emissions or discharges to sea from any plant or equipment that is in contact with concentrate would not occur. Concentrate storage, handling and conveying facilities would be enclosed, resulting in no planned escape of fugitive dust to the environment. Stormwater run-off from areas that contact concentrate would be controlled and treated on-site and ultimately returned to Olympic Dam rather than being discharged into the harbour. As in Upper Spencer Gulf, shipping movements would increase in Darwin Harbour, but there would be negligible risk of collision with fauna.

It is concluded therefore that threatened marine species would be at no credible risk from the construction or operation of the desalination plant, landing facility and port facilities.

In relation to the EPBC Act Guidelines, the proposed expansion is not predicted to have significant impacts on these species. In particular, there is no reasonable or foreseeable chance or possibility that construction or operation of the proposed desalination plant, landing facility or port facilities would fragment or decrease the size of populations, affect critical habitat, disrupt breeding cycles or introduce disease or pests that may adversely affect these species.

Table E1.4 Potential impacts on marine fauna listed under the EPBC Act and occurring or likely to occur in the project area in (a) Upper Spencer Gulf and (b) at the Port of Darwin

(a) Upper Spencer Gulf

Scientific name	Common name	AUS status[1]	SA status	Credible risk
Sharks				
Carcharodon carcharias	Great White Shark	V, Mi	P	No
Mammals				
Balaenoptera edeni	Bryde's Whale	Mi, W	P	No
Caperea marginata	Pygmy Right Whale	Mi, W	R, P	No
Eubalaena australis	Southern Right Whale	E, W, Mi	V, P	No
Megaptera novaeangliae	Humpback Whale	V, W, Mi	V, P	No
Neophoca cinerea	Australian Sea-lion	V	V, P	No
Lagenorhynchus obscurus	Dusky Dolphin	Mi, W	R, P	No
Reptiles				
Caretta caretta	Loggerhead Turtle	E, Mi, Ma	E	No
Chelonia mydas	Green Turtle	V, Mi, Ma	V	No
Dermochelys coriacea	Leatherback Turtle	V, Mi, Ma	V	No
Eretmochelys imbricata	Hawksbill Turtle	V, Mi, Ma		No

[1] Status: R = rare; V = vulnerable; E = endangered; Mi = migratory; Ma = marine; W = whale; P = protected.

(b) Port of Darwin

Scientific name	Common name	AUS status[1]	NT status	Credible risk
Mammals				
Balaenoptera edeni	Brydes's Whale	Mi, Ma		No
Dugong dugong	Dugong	Mi, Ma		No
Oracaella brevirostris	Irrawaddy Dolphin	Mi, Ma		No
Orcinus orca	Killer Whale	Mi, Ma		No
Sousa chinensis	Indo-Pacific Humpback Dolphin	Mi, Ma		No
Tursiops aduncus (Afafura Sea/Timor Sea population)	Spotted Bottlenose Dolphin	Mi, Ma		No
Sharks				
Pristis microdon	Freshwater Sawfish	V	V	No
Pristis zijsron	Green Sawfish	V	V	No
Rhincodon typus	Whale Shark	V, Mi		No
Reptiles				
Caretta caretta	Loggerhead Turtle	E, Mi, Ma	E	No
Chelonia mydas	Green Turtle	V, Mi, Ma		No
Crocodylus porosus	Saltwater Crocodile	Mi, Ma		No
Dermochelys coriacea	Leatherback Turtle	V, Mi, Ma	V	No
Eretmochelys imbricata	Hawksbill Turtle	V, Mi, Ma		No
Lepidochelys olivacea	Olive Ridley Turtle	E, Mi, Ma		No
Natator depressus	Flatback Turtle	V, Mi, Ma		No

[1] Status: R = rare; V = vulnerable; E = endangered; Mi = migratory; Ma = marine; W = whale; P = protected.

Further to the assessment against the EPBC Act administrative guidelines, and as per Section 139 of the Act, the proposed expansion would not be inconsistent with Australia's obligations under the Biodiversity Convention, Apai Convention, CITES, a listed species recovery plan or threat abatement plan.

E1.3.5 Listed migratory species

In determining the potential impact of the proposed expansion on listed migratory species the guidelines note that an action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles)
- destroy or isolate an area of important habitat for a migratory species
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species
- seriously disrupt the life cycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

In South Australia, 39 species of listed migratory birds and seven species of marine fauna were identified from database and literature searches as having geographic ranges that overlap the EIS Study Area (see Tables E1.3 and E1.4). Of these, six bird species were considered to be at credible risk of being affected by the expansion of the TSF at Olympic Dam. Of the marine fauna, none were considered to be at credible risk of being affected by the proposed expansion.

In the Northern Territory, 22 species of listed migratory birds and 14 species of marine fauna were identified from database and literature searches as having geographic ranges that overlap the EIS Study Area (see Tables E1.3 and E1.4). None were considered to be at credible risk of being affected by the development of facilities at the Port of Darwin.

BHP Billiton bird monitoring at the existing tailings retention system (TRS) has recorded visits by eight listed migratory species. Of these, occasional mortalities associated with interactions with the TRS acid liquor have been recorded for six species: the Great Egret *Ardea alba*, the Sharp-tailed Sandpiper *Calidris acuminata*, the Red-necked Stint *Calidris ruficollis*, the Caspian Tern *Sterna caspia*, the Common Sandpiper *Actitis hypoleucos* and the Grey Plover *Pluvialis squatarola*.

Impacts on migratory birds that are attracted to the TRS would be affected by two significant changes as a result of the expansion project. The area of wet tailings beaches would increase by about 3,300 ha, and this may attract and result in mortality of those migratory species attracted to beach habitats (e.g. Common Sandpiper *Actitis hypoleucos* and Grey Plover *Pluvialis squatarola*). The second change is that the new tailings storage design avoids areas of free or exposed acidic liquor (i.e. no new evaporation ponds and covered or netted central decant ponds and balance ponds). This reduces the attractiveness of the TRS to those migratory (and other threatened) birds that prefer open water.

The residual impact of the expanded TSF facilities on migratory birds has been categorised as moderate to high for migratory species. This reflects the potential for long-term impacts to these species, and therefore the need for greater management attention to minimise potential impacts and risk. Mortalities of individuals of these species are expected to comprise a relatively small percentage of the populations and would not adversely affect a species viability (see Appendix N11 for details).

In relation to the EPBC Act Guidelines, the proposed expansion is unlikely to result in any of the outcomes being deemed significant. In particular, there is no reasonable or foreseeable chance or possibility that the proposed expansion would seriously disrupt the life cycle for an ecologically significant proportion of the population of any of the listed migratory species.

E1.3.6 Protection of the environment from actions involving Commonwealth land

Lands that fall under the ownership of the Australian Government and within the EIS Study Area are the Department of Defence establishments of the Woomera Prohibited Area (WPA), and the Cultana Training Area (CTA) and also land owned by the Australian Rail Track Corporation (ARTC). In total, Commonwealth land accounts for 2.2% of the land tenure of the EIS Study Area. Approximately 50 ha of the Commonwealth land would be disturbed by the various project components.

Woomera Prohibited Area (WPA)

The WPA is declared under Regulation 35 of the *Defence Force Regulations 1952 (Commonwealth)* as an area for 'the testing of war material'. It is an instrumented air weapons test and evaluation range and is used for a variety of purposes including rocket testing. The area extends from north of the Woomera township to just south of Coober Pedy, with the south-eastern corner approximately 450 km north-north-west of Adelaide (see Figure E1.3). Roxby Downs Municipality borders the eastern sections of the WPA. The existing Olympic Dam Special Mining Lease (SML) is about 6 km from the eastern boundary but the proposed extension to the SML will be directly adjacent to the WPA boundary.

The eastern two-thirds of the WPA is primarily owned by the South Australian Government, except for small Commonwealth-owned areas. The South Australian Government leases most of these areas as pastoral stations.

About 2 ha of the WPA would be directly impacted by the proposed expansion. This would occur about 4 km to the north-east of the Woomera township where the proposed rail would be within Commonwealth land for about 700 m.

Cultana Training Area (CTA)

The CTA extends from Point Lowly, north-east of Whyalla, to approximately 10 km west of Port Augusta (see Figure E1.3). It occupies about 48,000 ha, although the Department of Defence plans to at least double its size by acquiring adjoining pastoral properties to the west. The CTA is used by the Australian Army for training, and wheeled and tracked vehicle manoeuvres. With the additional land, it could also be used for major armoured and mechanised exercises previously undertaken only in the north of Australia.

In the area between Port Augusta and Point Lowly, the water supply pipeline would run along an easement that borders the CTA from kilometre point (kp) 6 to kp 15, then along the western boundary of the CTA through land owned by the Department of Lands (Crown Leasehold) (from kp 19 to 26). Furthermore, the alignment of the proposed pipeline would run through the proposed expansion area of the CTA between kp 15 and 48. As the pipeline would be buried and appropriate rehabilitation measures utilised, the long-term change in land use would be minimal. The access corridor from the proposed landing facility to the pre-assembly yard on the western outskirts of Port Augusta would require the disturbance of an 18 ha strip of land on the boundary of the CTA. This would be a long-term change to land use.

The impacts on the CTA operations as a result of the project are considered negligible.

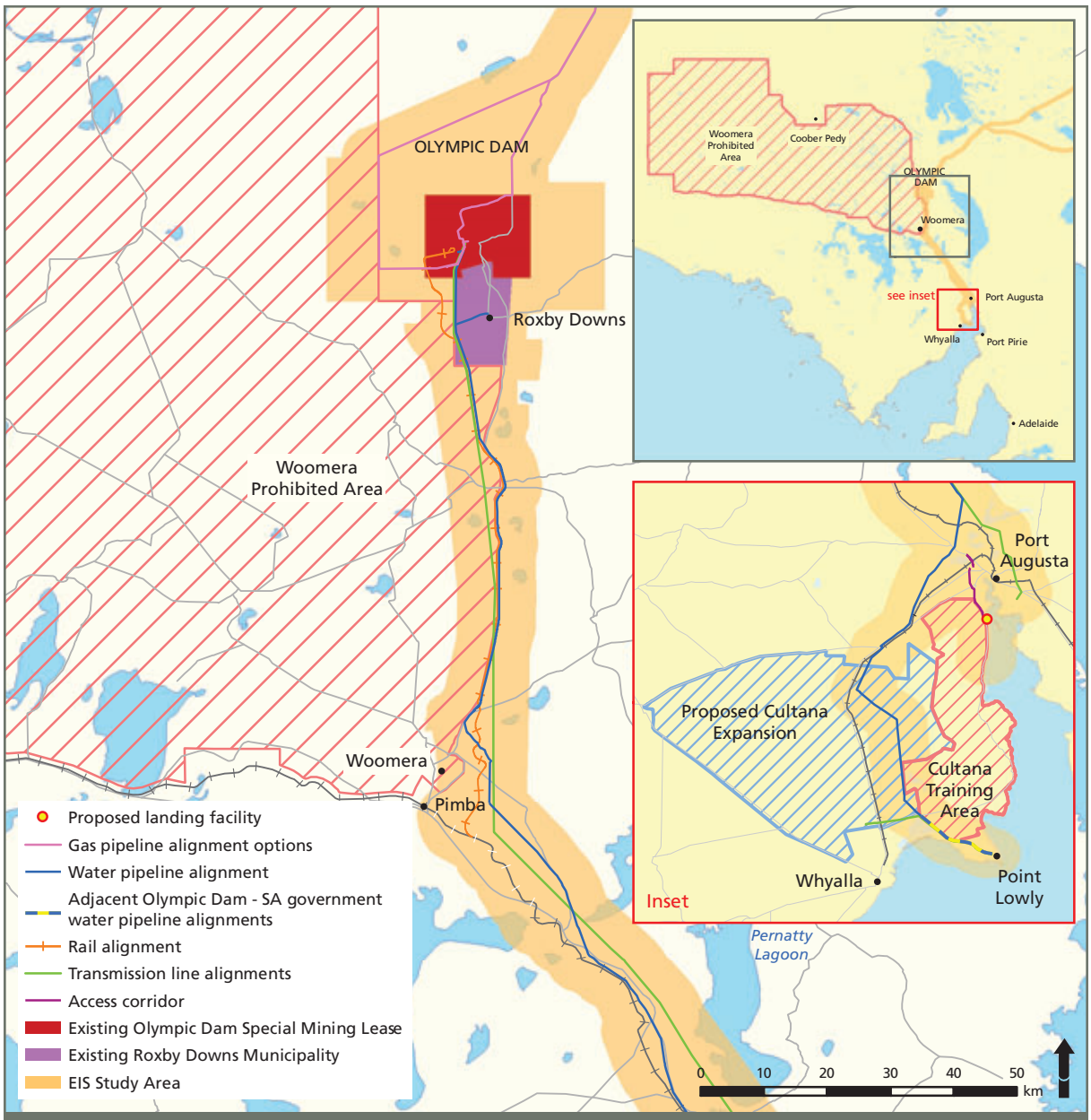

Figure E1.3 Department of Defence lands within the EIS Study Area

National Rail

The land owned by Australian Rail Track Corporation Pty Ltd (National Rail) is a corridor surrounding the existing rail network (see Figure E1.4). This corridor varies in width over different sections (from 50 to 80 m from Whyalla to Port Augusta and approximately 400 m from Port Augusta to Pimba).

For the majority of National Rail property within the EIS Study Area, the land is not impacted by the proposed expansion infrastructure. However, 30 ha of the proposed Pimba intermodal facility would be located on an area of Commonwealth land (National Rail). Although the land use change would be long-term, in the context of the vast areas of like habitat in the local environs, the impact to the environment would be insignificant.

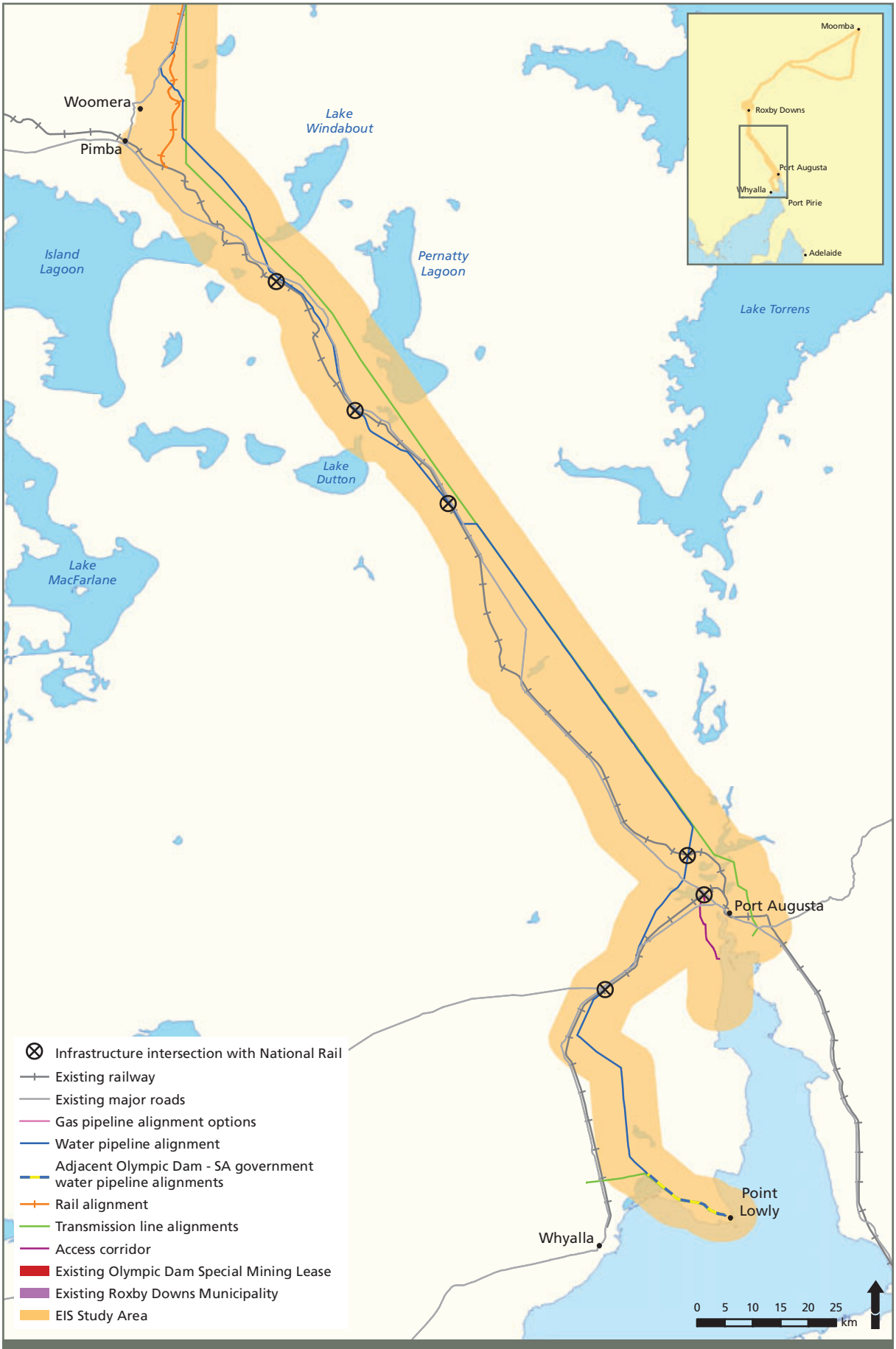

Figure E1.4 National Rail infrastructure within the EIS Study Area

E1.4 SUMMARY AND CONCLUSIONS

Nationally threatened species potentially occurring within the EIS Study Area included 13 plant species and 25 animal species in South Australia, and 15 animal species in the Northern Territory. Nationally listed migratory species included 39 bird species and seven marine species in South Australia, and 24 bird species and 14 marine species in the Northern Territory.

These species were initially screened to derive a list of species at credible risk from the proposed expansion project (see Tables E1.2, E1.3 and E1.4), and then assessed against the DEWHA guidelines. It is concluded that the residual impact on each species would not be significant as per the criteria defined in the DEWHA guidelines (see Table E1.5).

The assessment findings that relate to controlling provisions for the proposed Olympic Dam expansion under the EPBC Act are summarised in Table E1.6.

Table E1.5 Assessment of nationally listed species at credible risk of being affected by the expansion project

Species name	Common name	Status (Aus)	Significant impact[1]	Comment
Plants				
Eleocharis papillosa	Dwarf Desert Spike-rush	V	No	Negligible impact on species resulting from corridor clearance
Frankenia plicata		E	No	As above
Mammals				
Dasycercus hillieri	Ampurta	E	No	Some mortalities may occur associated with the open trench, but effects on the population size would be insignificant
Notomys fuscus	Dusky Hopping-mouse, Wilkiniti	V	No	As above
Pseudomys australis	Plains Rat	V	No	As above
Arid Recovery spp.				
Bettongia lesueur lesueur	Boodie Burrowing Bettong	V	No	Species introduced to Arid Recovery. Air emissions and noise may reduce the value of some habitat, but the impact would not interfere substantially with the recovery of the species
Leporillus conditor	Wopilkara, Greater Stick-nest Rat	V	No	As above
Macrotis lagotis	Bilby	V	No	As above
Myrmecobius fasciatus	Numbat	V	No	As above
Perameles bougainville	Western Barred Bandicoot	E	No	As above
Reptiles				
Nephrurus deleani	Pernatty Knob-tailed Gecko	V	No	Some mortalities may occur associated with the open trench, but effects on the population size would be insignificant
Bush birds				
Amytornis textilis modestus	Thick-billed Grasswren (Eastern sub-species)	V	No	Some preferred habitat would be cleared (Cottonbush *Maireana aphylla*), but there is abundant similar habitat in the region
Migratory birds				
Actitus hypoleucos	Common Sandpiper	Mi	No	Ongoing mortalities would occur on the TRS, but effects on population sizes would be insignificant
Ardea alba	Great Egret	Mi, Ma	No	As above
Calidris acuminata	Sharp-tailed Sandpiper	Mi, Ma	No	As above
Calidris ruficollis	Red-necked Stint	Mi	No	As above
Pluvialis squatarola	Grey Plover	Mi	No	As above
Sterna caspia	Caspian Tern	Mi	No	As above

[1] Assessment based on DEH (2006) guidelines.

Table E1.6 Summary of assessment findings

Matters of NES	Number of species or features			Total records to consider	No. species or features risk of significant impact
	Spencer Gulf	OD and corridors	Darwin		
Wetlands of international significance (RAMSAR)		2		2	0
Threatened ecol. communities		2		2	0
Threatened terrestrial species					
Plants		13		13	0
Mammals		11	3	14	0
Birds		6	3	9	0
Reptiles		1		1	0
Threatened marine species					
Marine Mammals	3			3	0
Fish/Sharks	1		3	4	0
Reptiles	4		6	10	0
Listed migratory species					0
Birds		39	24	61	0
Marine species (whales, turtles etc.)	7		14	21	0

E1.5 REFERENCES

DEH (2006) EPBC Act Policy Statement 1.1 Significant Impact Guidelines. Australian Government Department of Environment and Heritage. <http://www.environment.gov.au/epbc/publications/pubs/nes-guidelines.pdf>.

DEWR (2007) EPBC Act Policy Statement 3.7 Nationally Threatened Species and Ecological Communities Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia and Iron-grass Natural Temperate Grassland of South Australia, June 2007. Department of the Environment and Water Resources.

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ATTACHMENT A

POTENTIAL IMPACTS ON NATIONALLY LISTED FAUNA AT THE PORT OF DARWIN IN A 50 SQUARE KILOMETRE AREA CENTRED ON EAST ARM

Status

Letters under columns AUS and NT represent the category listed in the *Environment Protection and Biodiversity Conservation Act 1999* and the *Territory Parks and Wildlife Conservation Act* (CE = critically endangered, E = endangered, V = vulnerable, Mi = migratory, Ma = marine, W = whales and other cetaceans).

Letters under column CAMBA/JAMBA/CMS represent allocation of species to international migratory bird agreements (C = China – Australia Migratory Birds Agreement, J = Japan – Australia Migratory Birds Agreement, B = Bonn Convention).

Attachment A

Species name	Common name	Status			Distribution, ecology and behaviour	Potential impact	Credible risk to species
		AUS	NT				
Threatened species							
Mammals							
Dasyurus hallucatus	Northern Quoll	E	CE		It occurs in a wide range of habitats, but the most suitable habitats appear to be rocky areas. It is also common in many eucalypt open forests. It has been recorded from the Charles Darwin National Park. Cane toads represent the primary threat to the Northern Quoll	No preferred habitat for this species would be impacted	No
Megaptera novaeangliae	Humpback Whale	V, Mi, W, Ma			The Humpback Whale occurs in all major oceans, mostly in coastal and continental shelf waters. There are two main populations in Australian waters that migrate along the east coast and west coast. The Humpback Whale breeds in warm waters at low latitudes, and migrates to summer in higher latitudes	No oceanic habitat would be impacted	No
Xeromys myoides	False Water Rat	V			In the Northern Territory, it is known from only 10 records at 6 sites (South Alligator River in 1903, Daly River floodplain in 1972, two sites on the Tomkinson River in 1975, Melville Island in 1975 and Glyde River floodplain in 1998 and 1999) (Threatened Species of Northern Territory Fact Sheet). Its habitats comprise mangrove forests, freshwater swamps and floodplain saline grasslands	No mangroves, freshwater swamps or saline grasslands would be removed	No
Terrestrial Birds							
Erythrotriorchis radiatus	Red Goshawk	V	V		Tropical open woodland, edges of rainforest and dense riverine vegetation. Nests in trees that are taller than 20 m and within 1 km of a permanent watercourse or wetland. Foraging usually occurs in open forests and gallery forests, taking mostly medium to large birds	No preferred habitat for this species would be impacted	No
Erythrura gouldiae	Gouldian Finch	E, Mi			Dry environments such as open woodland and grassy areas	No preferred habitat for this species would be impacted	No
Geophaps smithii smithii	Partridge Pigeon	V	V		The diet of the Partridge Pigeon comprises seeds, mostly of grasses but also from *Acacia* and other woody plants. It is largely sedentary, although may make local-scale movements (up to 5-10 km) in response to seasonal variations in water and food availability	No preferred habitat for this species would be impacted	No

Attachment A (cont'd)

Species name	Common name	Status			Distribution, ecology and behaviour	Potential impact	Credible risk to species
		AUS	NT				
Reptiles							
	Loggerhead Turtle, Green Turtle, Leatherback Turtle, Olive Ridley Turtle, Hawksbill Turtle, Flatback Turtle	E, V, Mi, Ma	E, V, Not Threatened		Only the Loggerhead and Leatherback Turtles are threatened in the NT, though the Loggerhead Turtle does not breed in the NT. Leatherbacks have been reported to breed from the Sir Edward Pellew Islands, near Maningrida, Danger Point on Cobourg Peninsula and Palm Bay on Croker Island. All species have global oceanic habitats, with diets varying from shellfish, crabs, sea urchins and macroplankton to seagrass	No preferred foraging or nesting habitat would be impacted for any of the five marine turtles	No
Sharks							
Pristis microdon	Freshwater Sawfish	V	V		Sawfish have a saw-like snout, called a rostrum, which has electro-sensitive pores that allow sawfish to detect movement of buried prey in the ocean floor. The rostrum acts like a metal detector as the sawfish hovers over the bottom, looking for hidden food. It is also used as a digging tool to unearth buried crustaceans. The species inhabits sandy or muddy bottoms of shallow coastal waters, estuaries, river mouths and freshwater rivers and lakes. Usually found in turbid channels of large rivers over soft mud bottoms	No preferred habitat for this species would be impacted	No
Pristis zijsron	Green Sawfish	V	V		The Green Sawfish is widely distributed in the northern Indian Ocean, around Indonesia and Australia. It is the most commonly encountered sawfish species in Australian waters. In the Northern Territory, specimens have been collected only in Buffalo Creek in Darwin Harbor	No preferred habitat for this species would be impacted	No
Rhincodon typus	Whale Shark	V, Mi, Ma			The whale shark has a broad distribution across most tropical and warm temperate seas. The best known populations in Australia are around Ningaloo Reef, in north-western Australia. Its distribution and status in waters around the Northern Territory is poorly known, although there are at least some anecdotal records (Threatened Species of Northern Territory Fact Sheet). It feeds primarily by suction filter feeding, and its diet includes a broad range of plankton, small crustaceans and small schooling fish	No oceanic habitat would be impacted	No
Migratory species							
Actitus hypoleucos	Common Sandpiper	Mi		C, J, B	Inhabits coastal and inland wetlands. It breeds in Eurasia and migrates to Australia	No preferred habitat for this species would be impacted	No
Anseranas semipalmata	Magpie Goose	Ma			Open wetlands, swamps, farmlands and major watercourses	No preferred habitat for this species would be impacted	No
Apus pacificus	Fork-tailed Swift	Mi, Ma		C, J	Except at their breeding grounds in the northern hemisphere, individuals of this species spend all day, and most if not all night, hunting insects, resting and sleeping	No potential to impact this species	No

Attachment A (cont'd)

Species name	Common name	Status			Distribution, ecology and behaviour	Potential impact	Credible risk to species
		AUS	NT				
Ardea alba	Great Egret	Mi, Ma		C, J	Found in most of the tropical and warmer temperate parts of the world. Prefers shores of lakes, ponds and rivers; freshwater and saltwater marshes, mudflats, shallow lagoons, estuaries. Requires trees or shrubs near the water for nesting	No preferred habitat for this species would be impacted	No
Ardea ibis	Cattle Egret	Mi, Ma		C, J	Found on most continents and across most of Australia. Common and widespread throughout northern and eastern Australia. Found in grasslands, woodlands and wetlands and also uses pastures and croplands. Commonly forages in wetland areas	No preferred habitat for this species would be impacted	No
Arenaria interpres	Ruddy Turnstone	Mi		C, J	Turnstones are non-breeding migrants in Australia, breeding in eastern Siberia and Alaska and arriving in Australia about October each year. Preferred habitat is beaches where shingle and masses of seaweed are mixed with stretches of sand	No preferred habitat for this species would be impacted	No
Calidris alba	Sanderling	Mi			Sanderlings are non-breeding migrants to Australia, preferring sea beaches and sandy ocean shores. They seldom move further inland than coastal lagoons. They eat insects and other small invertebrates in the sand as the waves ebb	No preferred habitat for this species would be impacted	No
Calidris tenuriostris	Great Knot	Mi		C, J, B	Mobile species, mainly inhabits coastal area. Thousands flock from north-eastern Siberia to Eighty-Mile Beach, around Arnhem Land and the Gulf of Carpentaria each year. They prefer tidal muds and sand flats, feeding on gastropods and other invertebrates	No preferred habitat for this species would be impacted	No
Charadrius leschenaultii	Large Sand Plover	Mi			This species can be found around the whole coast of Australia between October and January. They prefer tidal muds and sand flats, feeding on small crustaceans and molluscs, crabs and shrimps being preferred	No preferred habitat for this species would be impacted	No
Charadrius mongolus	Mongolian Plover	Mi, Ma			Arrives in September-October each year from breeding grounds in eastern Siberia. The species inhabit tidal and mud flats in bays, inlets, and estuaries around the Australian coast	No preferred habitat for this species would be impacted	No
Charadrius veredus	Oriental Plover	Mi, Ma			Arrives in October each year from breeding grounds in Asia. The species inhabits inland bare ground, often bare plains, road verges and flat edges of lakes and lagoons. Occasional visitor to sea shores	No preferred habitat for this species would be impacted	No
Coracina tenuirostris melvillensis	Melville Cicadabird	Mi			This species lives in monsoon forests and mangrove swamps from Broome to the Macarthur River in the Northern Territory, and including Melville Island. It eats fruit, seeds, insects and their larvae	No preferred habitat for this species would be impacted	No
Glareola maldivarum	Oriental Pratincole	Mi			Arrives in October-November each year from breeding grounds in Asia. Although related to shorebirds, they differ in that they flock like swallows to feed aerially on swarming beetles, termites, grasshoppers and crickets	No preferred habitat for this species would be impacted	No
Haliaeetus leucogaster	White-bellied Sea-Eagle	Mi	V		Coast and near coastal areas across Australia. Mainly coastal but is also found in large rivers and lakes. Feeds mainly on aquatic animals such as fish, turtles and sea snakes, but takes birds and mammals as well	No preferred habitat for this species would be impacted	No

Attachment A (cont'd)

Species name	Common name	Status			Distribution, ecology and behaviour	Potential impact	Credible risk to species
		AUS	NT				
Hirundo rustica	Barn Swallow	Mi, Ma			Most populations breed in Asia but some southern populations appear sedentary. Forages in open country and cultivated lands	No preferred habitat for this species would be impacted	No
Limosa lapponica	Bar-tailed Godwit	Mi		C, J, B	Arrives in August-September each year from breeding grounds in north-eastern Siberia and Alaska. The species inhabit saline and tidal mud flats and sands of coastal inlets and nearby salt pans	No preferred habitat for this species would be impacted	No
Limosa limosa	Black-tailed Godwit	Mi		C, J, B	Arrives in September each year from breeding grounds in northern Eurasia. Unlike the Bar-tailed Godwit, this species ranges inland to frequent shallow open muddy lagoons and swamps. They return to staging beaches along the north-west coast and in the Gulf of Carpentaria before leaving Australia in March to breed	No preferred habitat for this species would be impacted	No
Merops ornatus	Rainbow Bee-eater	Mi, Ma		J	Widely distributed across Australia except in desert areas. Commonly found in woodland and timbered plains throughout Australia capturing insects whilst in flight. Breeds throughout most of its range. Southern populations move to northern Australia, New Guinea and Indonesia over winter	No preferred habitat for this species would be impacted	No
Numenius minutus	Little Whimbrel	Mi			Arrives in September-October each year from breeding grounds in central and north-eastern Siberia. The species inhabit bare, dry sub-coastal plains, airfields and suburban lawns	No preferred habitat for this species would be impacted	No
Numenius phaeopus	Whimbrel	Mi			Breeds in Arctic, inhabiting coastal environments such as mangroves, mud flats and islets while in Australia	No preferred habitat for this species would be impacted	No
Pluvialis squatarola	Grey Plover	Mi			Arrives in September each year from breeding grounds in Russia, Alaska and Canada. The species inhabit tidal sand and mud flats, feeding on crustaceans, marine worms and other invertebrates	No preferred habitat for this species would be impacted	No
Poecilodryas superciliosa cerviniventris	Derby White-browed Robin	Mi			The species lives in tropical monsoon forests and mangrove swamps from Derby in Western Australia across to western Queensland. It eats mainly insects and larvae and occasionally small crabs and molluscs	No preferred habitat for this species would be impacted	No
Rhipidura rufifrons	Rufous Fantail	Mi			There are two distinct races of this species, the migratory race moves from Australia into islands in the south-western Pacific in March-April and back into Australia in September-October. This race inhabits rainforests and wet sclerophyll forests	No preferred habitat for this species would be impacted	No
Sterna albifrons	Little Tern	Mi, Ma	V		Migrating from eastern Asia, found on the north, east and south-east Australian coasts. Coastal, preferring sheltered environments, although it may occur several kilometres from the sea in harbours, inlets and rivers. Nests in small, scattered colonies in low dunes or on sandy beaches just above high tide mark near estuary mouths or adjacent to coastal lakes and islands	No preferred habitat for this species would be impacted	No

Attachment A (cont'd)

Species name	Common name	Status			Distribution, ecology and behaviour	Potential impact	Credible risk to species
		AUS	NT				
Marine species							
Balaenoptera edeni	Bryde's Whale	Mi, W, Ma			Pronounced, 'broo-dess' whale, they prefer tropical and temperate waters, and coastal rather than pelagic. Their diet is composed almost entirely of fish	The proposed works may contribute to a cumulative impact on this species in tropical waters due to increased shipping	No
Crocodylus porosus	Saltwater Crocodile	Mi, Ma			Coastal rivers and swamps extending well inland via major rivers and billabongs	Several hundred saltwater crocodiles are removed from Darwin Harbour each year. The proposed project would not impact this species	No
Dugong dugon	Dugong	Mi, Ma			The Dugong prefers calm, sheltered, shallow and nutrient-rich waters that support seagrass	No seagrass would be impacted by the proposed works	No
Orcaella heinsohni	Australian Snubfin Dolphin	Mi, W			Australian Snubfin Dolphin occurs in tropical waters of New Guinea and northern Australia. They prefer shallow estuaries, and are quiet and inconspicuous	The proposed works may contribute to a cumulative impact on this species in tropical waters or estuaries due to increased shipping	No
Orcinus orca	Killer Whale	Mi, W			Killer Whales are voracious predators. They hunt singly or in groups feeding on fish, seals and other cetaceans. They are usually found in groups and are commonly seen in Australian waters, and occasionally close inshore	The proposed works may contribute to a cumulative impact on this species in tropical waters due to increased shipping	No
Sousa chinensis	Indo-Pacific Humpback Dolphin	Mi, W			This species is usually found in near shore tropical waters. When undisturbed they are slow swimmers	The proposed works may contribute to a cumulative impact on this species in tropical waters or estuaries due to increased shipping	No
Tursiops aduncus (Arafura Sea / Timor Sea population)	Spotted Bottlenose Dolphin	Mi, W			This population has geographic variation to other bottlenose dolphins – in particular, morphological variation between inshore and offshore animals	The proposed works may contribute to a cumulative impact on this species in tropical waters or estuaries due to increased shipping	No
Pseudorca crassidens	False Killer Whale	W			False Killer Whales are found in tropical to warm temperate zones, generally in relatively deep, offshore waters, but also in semi-enclosed seas and bays. They eat primarily fish and cephalopods	The proposed works may contribute to a cumulative impact on this species in tropical waters due to increased shipping	No

APPENDIX E2

Ecological sustainability

CONTENTS

E2 ECOLOGICAL SUSTAINABILITY

Section 4 of the joint government EIS guidelines requires that the EIS:

- Provide a framework in which decision makers may consider the environmental, economic and social aspects of the proposal
- Specifically address all relevant matters under the requirements of the EPBC Act.

E2.1 INTRODUCTION

The principles of Ecologically Sustainable Development (ESD), including the precautionary principle, have played an integral role in BHP Billiton's decision making processes in respect of the expansion project during the selection of preferred alternatives and the design, planning and assessment phases. BHP Billiton is committed to continuing to take into account the principles of ESD throughout the construction and commissioning, operational and decommissioning phases of the project.

This appendix examines the role of the principles of ESD in the assessment and approval process, as relevant to the project under the EPBC Act. This appendix complements the Draft EIS, which sets out a wide array of environmental, social and economic considerations, and analyses the likely impacts of the project on various aspects of the environment.

In recognition of the importance of ESD, the design, planning and assessment phases of the project have been conducted in accordance with the principles of ESD, through:

- incorporation of risk assessment in the decision making process
- adoption of high standards for environmental and occupational health and safety performance
- ongoing consultation with regulatory and community stakeholders.

E2.2 THE CONCEPT OF ESD

E2.2.1 Background

Over the last three decades, there has been increasing global awareness of the concept of sustainable development. In 1987, the United Nations World Commission on Environment and Development, through the Brundtland Report *Our Common Future*, adopted what has become a popular definition of sustainable development, being:

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

In recognition of the importance of sustainable development, in June 1990, the Australian Government released the document *Ecologically Sustainable Development: A Commonwealth Discussion Paper* which introduced the term 'ecologically sustainable development' and aimed to institute a process of discussion on what Australians needed to do to embrace ESD. From this, the Australian Government developed a National Strategy for Ecologically Sustainable Development (NSED), which was adopted by all levels of Australian Government in 1992. The NSED defines ESD as:

Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased.

The NSED has the goal of:

Development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends.

The core objectives of the NSED are to:

- enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations
- provide for equity within and between generations
- protect biological diversity and maintain essential processes and life support systems.

The NSED recognises that the participation of all levels of government, business, unions and the community is essential to facilitate the implementation of ESD in Australia. Part 1 of the NSED provides:

Private enterprise in Australia has a critical role to play in supporting the concept of ESD while taking decisions and actions which are aimed at helping to achieve the goal of this Strategy. Many have already been active participants in the ESD process, including taking significant individual steps to ensure that Australia's economy and production base are put on an ecologically sustainable footing.

The principles of ESD have been adopted on a federal level in Australia by the EPBC Act.

E2.2.2 ESD under Commonwealth legislation

The objects of the EPBC Act are identified in Section 3 of the Act as being:

(a) to provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance; and

(b) to promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources; and

(c) to promote the conservation of biodiversity; and

(ca) to provide for the protection and conservation of heritage; and

(d) to promote a co-operative approach to the protection and management of the environment involving governments, the community, land-holders and indigenous peoples; and

(e) to assist in the co-operative implementation of Australia's international environmental responsibilities; and

(f) to recognise the role of indigenous people in the conservation and ecologically sustainable use of Australia's biodiversity; and

(g) to promote the use of indigenous peoples' knowledge of biodiversity with the involvement of, and in co-operation with, the owners of the knowledge.

The principles of ESD are set out in Section 3A of the EPBC Act as being:

(a) decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations;

(b) if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;

(c) the principle of inter-generational equity - that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;

(d) the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making;

(e) improved valuation, pricing and incentive mechanisms should be promoted.

The EPBC Act sets out mandatory considerations and factors the Minister must take into account in deciding whether or not to grant approval to a project. Section 136 (as it applies to the expansion project) relevantly provides:

(1) In deciding whether or not to approve the taking of an action, and what conditions to attach to an approval, the Minister must consider the following, so far as they are not inconsistent with any other requirement of this Subdivision:

(a) matters relevant to any matter protected by a provision of Part 3 that the Minister has decided is a controlling provision for the action;

(b) economic and social matters.

Factors to be taken into account;

(2) In considering those matters, the Minister must take into account:

(a) the principles of ecologically sustainable development: and

(b) the assessment report relating to the action; and

(c) if the action was assessed under Division 5 or 6 of Part 8 (which deal with public environment reports and environmental impact statements) – the report or statement about the action finalised by the designated proponent.

In addition, the EPBC Act provides that the Minister must consider the precautionary principle in making decisions. In the following terms:

(1) The Minister must take account of the precautionary principle in making a decision listed in the table in subsection (3), to the extent he or she can do so consistently with the other provisions of this Act.

(2) The precautionary principle is that lack of full scientific certainty should not be used as a reason for postponing a measure to prevent degradation of the environment where there are threats of serious or irreversible environmental damage.

Section 391(3) lists the decisions in which the Minister is required to take into account the precautionary principle. These relevantly include the Minister's decision whether or not to approve the taking of an action under section 133 of the EPBC Act.

E2.2.3 ESD under relevant State and Territory legislation

The principles of ESD have been adopted on a State level in South Australia by the Development Act 1993 (Development Act).

Section 3 of the Development Act articulates the objects of the Act as follows:

The object of this Act is to provide for proper, orderly and efficient planning and development in the State and, for that purpose –

(a) to establish objectives and principles of planning and development; and

(b) to establish a system of strategic planning governing development; and

(c) to provide for the creation of Development Plans –

(i) to enhance the proper conservation, use, development and management of land and buildings; and

(ii) to facilitate sustainable development and the protection of the environment; and

(iia) to encourage the management of the natural and constructed environment in an ecologically sustainable manner; and

(iii) to advance the social and economic interests and goals of the community; and

(d) to establish and enforce cost-effective technical requirements, compatible with the public interest, to which building development must conform; and

(e) to provide for appropriate public participation in the planning process and the assessment of development proposals; and

(ea) to promote or support initiatives to improve housing choice and access to affordable housing within the community; and

(f) to enhance the amenity of buildings and provide for the safety and health of people who use buildings; and

(g) to facilitate –

(i) the adoption and efficient application of national uniform building standards; and

(ii) national uniform accreditation of buildings products, construction methods, building designs, building components and building systems.

Section 46B of the Development Act provides specific requirements for the EIS process which relevantly include:

(1) This section applies if an EIS must be prepared for a proposed development or project.

(4) The EIS must include a statement of –

(a) the expected environmental, social and economic effects of the development or project;

(c) if the development or project involves, or is for the purposes of, a prescribed activity of environmental significance as defined by the Environment Protection Act 1993, the extent to which the expected effects of the development or project are consistent with –

(i) the objects of the Environment Protection Act 1993.

Section 3 of the *Environment Protection Act 1993* (SA) defines a prescribed activity of environmental significance as an activity specified in Schedule 1. These activities relevantly include, for example, manufacturing and mineral processing works. Accordingly, the project would be subject to the provisions of Section 46B(4)(c)(i).

Section 10 of the *Environment Protection Act 1993* (SA) sets out the objects of the Act, which are concerned with promoting the principles of ESD. Section 10 relevantly states:

(1) The objects of this Act are –

(a) to promote the following principles ("principles of ecologically sustainable development"):

(i) that the use, development and protection of the environment should be managed in a way, and at a rate, that will enable people and communities to provide for their economic, social and physical well-being and for their health and safety while –

(A) sustaining the potential of natural and physical resources to meet the reasonably foreseeable needs of future generations; and

(B) safeguarding the life-supporting capacity of air, water, land and ecosystems; and

(C) avoiding, remedying or mitigating any adverse effects of activities on the environment;

(ii) that proper weight should be given to both long and short term economic, environmental, social and equity considerations in deciding all matters relating to environmental protection, restoration and enhancement; and

(b) to ensure that all reasonable and practicable measures are taken to protect, restore and enhance the quality of the environment having regard to the principles of ecologically sustainable development, and –

(i) to prevent, reduce, minimise and, where practicable, eliminate harm to the environment –

(A) by programmes to encourage and assist action by industry, public authorities and the community aimed at pollution prevention, clean production and technologies, reduction, re-use and recycling of material and natural resources, and waste minimisation; and

(B) by regulating, in an integrated, systematic and cost-effective manner –

- *activities, products, substances and services that, through pollution or production of waste, cause environmental harm; and*
- *the generation, storage, transportation, treatment and disposal of waste; and*

(ii) to co-ordinate activities, policies and programmes necessary to prevent, reduce, minimise or eliminate environmental harm and ensure effective environmental protection, restoration and enhancement; and

(iii) to facilitate the adoption and implementation of environment protection measures agreed on by the State under intergovernmental arrangements for greater uniformity and effectiveness in environment protection; and

(iv) to apply a precautionary approach to the assessment of risk of environmental harm and ensure that all aspects of environmental quality affected by pollution and waste (including ecosystem sustainability and valued environmental attributes) are considered in decisions relating to the environment; and

(v) to require persons engaged in polluting activities to progressively make environmental improvements (including reduction of pollution and waste at source) as such improvements become practicable through technological and economic developments; and

(vi) to allocate the costs of environment protection and restoration equitably and in a manner that encourages responsible use of, and reduced harm to, the environment with polluters bearing an appropriate share of the costs that arise from their activities, products, substances and services; and

(vii) to provide for monitoring and reporting on environmental quality on a regular basis to ensure compliance with statutory requirements and the maintenance of a record of trends in environmental quality; and

(viii) to provide for reporting on the state of the environment on a periodic basis; and

(ix) to promote –

(A) industry and community education and involvement in decisions about the protection, restoration and enhancement of the environment; and

(B) disclosure of, and public access to, information about significant environmental incidents and hazards.

The Northern Territory statute which regulates the environmental assessment of the components of the project in that jurisdiction is the *Environmental Assessment Act 1982*. This statute does not expressly incorporate the principles of ESD.

E2.2.4 Principles of ESD

The principles of ESD include five key concepts:

Long-term and short-term economic, environmental, social and equitable considerations

The principles of ESD require the effective integration of environmental considerations and resources in decision making. This may include consideration of ecosystems; people; communities; natural and physical resources; the qualities and characteristics of locations, places and areas; and the social, economic and cultural aspects of these things in the present and future.

The concept of equitable considerations may include, for example, the idea of intra-generational equity, being that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for its own generation.

The precautionary principle

Environmental assessment involves predicting what the environmental outcomes of a development are likely to be. The precautionary principle reinforces the need to take risk and uncertainty into account.

The precautionary principle is the principle that lack of full scientific certainty should not be used as a reason for postponing a measure to prevent degradation of the environment where there are threats of serious or irreversible environmental damage.

The practical application of the precautionary principle has, in recent times, been the subject of much Australian judicial and legal academic commentary, including that the precautionary principle should only be applied when two thresholds are met:

- there is a threat of serious or irreversible environment damage:
  - this requires a consideration of many factors, and consultation with experts and relevant stakeholders and right holders
  - where the threat of environmental damage is negligible, the precautionary principle cannot apply
- there is scientific uncertainty as to the nature and scope of the threat of environmental damage:
  - the degree of scientific uncertainty required is at least "considerable" scientific uncertainty.

Once the two thresholds are met, the burden shifts to the proponent of a project to demonstrate that there is no threat, or that the threat is negligible. Thus the function of the precautionary principle is to shift the burden of proof to require a proponent to address the threat of serious or irreversible damage, notwithstanding that there is scientific uncertainty about the threat.

In the application of the precautionary principle, the measures adopted should be proportionate to the potential threat.

Inter-generational equity

Inter-generational equity is the concept that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

Conservation of biological diversity and ecological integrity

Biological diversity, or "biodiversity", is considered to be the number, relative abundance and genetic diversity of organisms from all habitats (including terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are a part) and includes diversity within species and between species, as well as diversity of ecosystems. For the purposes of the Draft EIS, ecological integrity is considered in terms of ecological health.

Improved valuation, pricing and incentive mechanisms

This principle of ESD requires that environmental factors be included in the valuation of assets and services. This may include concepts such as:

- polluter pays – those who generate pollution and waste should bear the cost of containment, avoidance or abatement
- the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of waste
- environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

This principle reflects the idea that if the real value of natural resources is incorporated into the cost of using those resources, it is more likely that those resources will be used in a sustainable manner, adequately managed, and not wasted.

E2.3 PROPONENT'S COMMITMENT TO PRINCIPLES OF ESD

BHP Billiton has historically embraced, and continues on an ongoing basis to demonstrate a commitment to, the principles of ESD. BHP Billiton's firm commitment to the principles of ESD is recognisable in the existing environmental initiatives in respect of Olympic Dam and other BHP Billiton projects.

As discussed in Chapter 1 of the Draft EIS, BHP Billiton is governed by a series of corporate standards including a Charter, Sustainable Development Policy, Health Safety Environment and Community Management Standards, and a Guide to Business Conduct. These standards promote a mutually beneficial relationship between BHP Billiton, the environment, the communities in which it operates and the people indigenous to these communities.

Additionally, the BHP Billiton Charter, Health Safety Environment and Community Management Standards and Guide to Business Conduct articulate BHP Billiton's commitment to environmental responsibility and sustainable development.

BHP Billiton's Sustainable Development Policy heralds sustainable development through consideration of social, environmental, ethical and economic aspects over time. This policy states that BHP Billiton is dedicated to:

- setting and achieving targets that promote the efficient use of resources and include reducing and preventing pollution
- enhancing biodiversity protection by assessing and considering ecological values and land use in activities.

As part of BHP Billiton's commitment to ESD, BHP Billiton has also developed a Climate Change Position. It is focused on increasing understanding of life cycle emissions of products and improving management of energy and GHG emissions from production. BHP Billiton identifies greenhouse gas (GHG) emissions as a sustainability challenge in its Sustainable Development Policy, recognising the need to mitigate the potential impact of GHG emissions. Correspondingly, BHP Billiton has fashioned an action plan to address this challenge, comprising a commitment to:

- use energy as efficiently as possible
- control the emissions produced at BHP Billiton sites
- work on ways to reduce emissions produced in customer consumption of BHP Billiton products both now and in the future.

In accordance with the principle of inter-generational equity, the BHP Billiton Sustainable Development Policy contains an aspirational goal of zero harm to people, host communities and the environment, with particular focus on eliminating BHP Billiton environmental impacts over time.

As part of BHP Billiton's Sustainable Development Policy, and in recognition of its commitment to biodiversity, BHP Billiton sites are required to maintain land management plans, and many are actively engaged in biodiversity related programs. As part of BHP Billiton's environmental commitment, BHP Billiton has identified a long-term opportunity beyond its site specific activities to engage in regional biodiversity issues. BHP Billiton will continue to work with the communities in which it operates and with other stakeholders to develop its approach to biodiversity offsets, with its primary aim being to avoid or minimise harm to biodiversity.

E2.4 GLOBAL CONTEXT OF THE EXPANSION PROJECT

E2.4.1 Increased demand for electricity

Minerals-based industrial materials and the provision of adequate, reliable and affordable energy are essential to meeting the needs and aspirations of people in both developed and developing countries. Overall, the increase in world energy demand from 2004 to 2030 is expected to be in excess of 50%. In this same period, electricity growth is expected to double, particularly having regard to the fact that currently approximately two billion people (concentrated in the developing world) have no access to electricity.

The 2007 United Nations Intergovernmental Panel on Climate Change has identified the "supply of secure, equitable, affordable and sustainable energy [as] vital to future prosperity". The 2007 UNIPCC further observed:

- demand for all forms of energy continues to rise to meet growth in economies and world population
- security of energy supply together with GHG reduction goals are co-policy drivers for many governments seeking to ensure that future generations will be able to provide for their own well-being without their need for energy services being compromised
- a mix of energy sources (including fossil fuels, renewable energy and nuclear power) is highly likely to be required to meet the growing demand for energy services globally.

E2.4.2 Climate change and greenhouse effect

The relationship between the emission of GHGs and global warming is well established. The increase in global average air and surface temperatures and the widespread melting of ice and rising sea levels evidences the undeniable warming of the global climate system. These impacts are especially pronounced in the Australian context, with the annual mean temperature in Australia increasing by 0.9 °C since 1910. Climate change is likely, in turn, to intensify existing environmental problems. Research indicates that even if all GHG emissions ceased today, Earth would still be committed to an additional warming of 0.2–1.0 °C by the end of the century. The momentum of the world's fossil fuel economy precludes the elimination of GHG emissions over the near-term, and thus future global warming is likely to be above 1 °C.

The Garnaut Climate Change Review Draft Report released in July 2008 reinforced the widespread view that the failure to curtail global greenhouse gas emissions will impact heavily upon climate change. Natural ecosystems are considered to be vulnerable to climate change, and projected changes in climate are likely to have diverse ecological implications. In the absence of appropriate mitigation strategies to combat global climate change, there will potentially be serious ecological repercussions stemming from rising temperatures, changes in rainfall patterns and rising sea levels. The different responses of various flora and fauna populations to the impacts of climate change in Australia may result in a decline in biodiversity, increased prominence of weed and pest species, and changes in the geographical range of habitable areas for various species. The expansion and contraction of habitable areas with changing climate could prove challenging, particularly for species that are threatened or endangered.

E2.4.3 The Stern Review

The Stern Review on the Economics of Climate Change, a review conducted by Sir Nicholas Stern for the British Government and published in October 2006, analysed the effects of climate change and global warming on the global economy and concluded that strategies must be developed to reduce GHG emissions in response to the threat of global climate change. In particular, the Stern Review noted that:

- the risk of the worst impacts of climate change can be substantially reduced if GHG levels in the atmosphere are stabilised between 450 and 550ppm CO_2 equivalent by 2050
- global emissions from the power sector comprise 24% of total global GHG emissions
- under business as usual conditions, total power sector GHG emissions are expected to have a three-fold increase above current levels by 2050
- the countries expected to experience the fastest growth in emissions are those expected to have the most economic growth. China may account for over one third of the global increase in GHG emissions expected to occur by 2030 in the absence of climate change mitigation policies
- in order to adhere to the 2050 stabilisation trajectory range of 450–550ppm CO_2 equivalent, the power sector will need to rely on electricity production that is up to 60% decarbonised.

The Stern Review identified four main ways in which GHG emissions could be reduced. They are:

- to reduce demand for emission-intensive goods and services
- to improve energy efficiency, by getting the same outputs for fewer inputs
- to switch to technologies which produce fewer emissions and lower the carbon intensity of production
- to reduce non-fossil fuel emissions, particular land use, agriculture and fugitive emissions.

E2.4.4 Increased demand for uranium

BHP Billiton, like many other participants in the global energy market, including international governments and theorists, recognises the inevitable growth in the role of uranium in the global energy market. In order to meet global energy demand, and in particular to cater for the rapidly increasing energy needs of Asia's productive industries and growing population, nuclear power is increasingly being viewed as either the preferred primary energy option or secondary energy option to conventional fossil fuels.

The Garnaut Draft Report identified a recent global surge in demand for uranium, with countries such as China expanding their capacity for nuclear power. Based on projected strong growth in global demand for energy of all types, uranium will be an essential part of the world's energy supply for the future. The increased role for uranium in the global energy market has largely arisen as a result of:

- the increasing economic viability of nuclear power when the rising costs of conventional fossil fuels are taken into account
- the relatively low GHG emissions associated with nuclear power in comparison to the use of traditional fossil fuels such as coal.

Nuclear energy is progressively emerging as an economically competitive option for electricity generation. The recent sustained increases in fossil fuel prices have resulted in greater interest in nuclear energy due to the significant role that fuel costs play in fossil energy generation costs compared to nuclear energy. Future advancements in nuclear reactor and fuel cycle technology will further increase the economic viability of nuclear power, and considerably enhance the efficiency with which uranium resources are utilised. Once established, nuclear power plants may have low operating, maintenance and fuel costs.

There is little doubt that coal and other traditional fossil fuels will continue to play an integral role in the global supply of electricity in the coming decades. There is, however, widespread awareness of the need to reduce the extent, and mitigate the effects, of GHG emissions and associated climate change. Nuclear power has been repeatedly identified, and increasingly come to be accepted, as a realistic means of reducing GHG emissions from electricity generation.

The Stern Review identified the use of a mix of energy sources as the preferred approach to reducing greenhouse gas emissions in order to tackle climate change. The Stern Review expressly stated that to meet the recommended stabilisation trajectory of 450-550ppm CO_2 equivalent by 2050, the electricity sector will have to be decarbonised through a combination of measures including the use of renewable energy, carbon capture and storage, and nuclear energy. The 2007 UNIPCC identified the expanded use of nuclear power as one of a range of potentially cost effective mitigation options for GHG emissions which may lead to a diverse range of co-benefits including:

- mitigation of air pollution impacts
- energy supply security (through increased energy diversity)
- technological innovation

- reduced fuel costs
- increased employment.

These co-benefits have the potential to be detectable on a local, regional and global level, by the current as well as future generations.

In the context of sustainable development, the question is not whether uranium will play a role, but rather how humankind can realise the economic benefits associated with its use, while at the same time preventing harmful environmental impacts.

Australia has significant uranium deposits, including 38% of the world's low cost uranium deposits. This places Australia in a position to benefit from the global increase in demand for uranium.

E2.4.5 Regulatory provisions applying to uranium mining

The mining, transport, export and sale of uranium products is extensively regulated on an Australian domestic and international level. BHP Billiton is committed to safe handling and transport of uranium, and compliance with its obligations in this area. To that end, BHP Billiton complies with the *Code of Practice for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing 2005*. A summary of the regulatory provisions is provided below with Draft EIS Appendix E3 providing further details.

Mining and milling of uranium ore

Generally, to carry out mining operations in South Australia for any radioactive mineral (a term which is defined to include uranium), a mining company must be the holder of a mining lease or retention lease upon which the Minister has endorsed an authorisation to carry out mining operations for that purpose pursuant to the *Mining Act 1971* (SA). BHP Billiton's mining operations of radioactive minerals in connection with the Olympic Dam project are, however, subject to authorisation under specific legislation: the *Roxby Downs (Indenture Ratification) Act 1982*.

In addition, a licence is required under the *Radiation Protection and Control Act 1982* (SA) to carry out operations for the mining or milling of radioactive ores (defined to mean an ore or mineral containing more than the prescribed concentration of uranium or thorium). The Radiation Act also prohibits the handling of a radioactive substance without a licence and requires registration of any premises in which an unsealed radioactive substance is kept or handled as well as sealed radioactive sources.

A licence is also required under the *Australian Radiation Protection and Nuclear Safety Act 1988* (Cwlth).

Transport of uranium within Australia

The Commonwealth legislation governing the transport of uranium is the *Nuclear Non-Proliferation (Safeguards) Act 1997* (Cwlth). BHP Billiton currently holds a permit to possess nuclear material or associated items, a permit to possess nuclear material or an associated item for the purposes of transporting the material or item, and a permit to establish a facility.

There is no specific transportation permit or approval required in South Australia to transport nuclear material but the *Radiation Protection and Control (Transport of Radioactive Substances) Regulations 2003* requires consignors and carriers to comply with certain requirements in the *Code of Practice for the Safe Transport of Radioactive Substances*. In addition, the *Code of Practice for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing 2005* applies to the existing operation and would apply to the proposed expansion.

A licence is required under the *Radioactive Ores and Concentrates (Packaging and Transport) Act 1980* (NT) for the transport of nuclear materials through the Northern Territory.

Export and sale of uranium

To export uranium, permission is required pursuant to regulation 9 of the *Customs (Prohibited Exports) Regulations 1958*.

Transport of dangerous goods by sea is governed by the *Navigation Act 1913* (Cwlth).

Australia's international obligations concerning the safe handling and transport of uranium

Australia's international obligations relating to the handling and transport of uranium are complex. There are myriad conventions that bear upon the safe handling and transport of uranium. Key treaties that apply to the export of uranium from Australia are:

- The Treaty on the Non-Proliferation of Nuclear Weapons. As required, Australia has entered into an agreement with the International Atomic Energy Agency (IAEA) for the application of safeguards. The agreement provides that in the case of export out of Australia, nuclear material subject to safeguards is regarded as Australia's responsibility up until the time at which the recipient State assumes responsibility and no later than the time at which the material reaches its destination. The point at

which the transfer of responsibility takes place is determined in accordance with suitable arrangements to be made by the States concerned. The relevant reporting obligations are also set out in the agreement.

- The Convention on the Physical Protection of Nuclear Material sets out levels of physical protection that must be applied to nuclear material during international transport and during storage incidental to international transport.
- The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter bans dumping of radioactive and industrial waste at sea.
- The Convention on Early Notification of a Nuclear Accident requires parties to notify IAEA of an accident or emergency involving the transboundary release of radioactive materials.
- The Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency facilitates prompt provision of international assistance following a nuclear accident or radiological emergency.
- The Convention for the Safety of Life at Sea specifies minimum standards for construction, equipment and operations of merchant ships carrying dangerous goods such as nuclear material. Flag states are responsible for ensuring that ships under their flag comply with the requirements of the Convention.
- The United Nations Convention on the Law of the Sea provides that ships carrying nuclear substances shall carry documents and observe special precautionary measures established for such ships by international agreements.

E2.5 PROJECT SUSTAINABILITY

The design, planning and assessment processes associated with the expansion project have been carried out applying the principles of ESD, through:

- incorporation of risk assessment and analysis at various stages in the project design and environmental assessment and within decision-making processes
- adoption of appropriate, best in class, standards for environmental and occupational health and safety performance
- consultation with regulatory and community stakeholders
- optimisation of the economic benefits to the community and wider Australian economy arising from the development of the expansion project.

The following subsections describe the consideration and application of each of the principles of ESD to the project.

E2.5.1 Long-term and short-term economic, environmental, social and equitable considerations

In the course of preparing the Draft EIS, BHP Billiton examined the potential long-term and short-term environmental, social, cultural and economic impacts of the project. In doing so, BHP Billiton developed and implemented a clear, transparent and repeatable framework to identify the possible impacts, benefits and risks associated with the construction, ongoing operation and decommissioning of the project.

The potential impacts of the project have been assessed by leading experts in a number of fields through the carrying out of specialist studies on soils, surface water, groundwater and geochemistry, air quality, noise and vibration, terrestrial ecology, the marine environment, cultural heritage, social environment, visual amenity, uranium and radiation, and rehabilitation planning. The outcomes of each of these studies are summarised in the chapters of this Draft EIS which relevantly deal with each of these issues and where appropriate are provided in full in the supporting appendices.

E2.5.2 The precautionary principle

The impact and risk assessment procedures designed and implemented for the project have evaluated the potential for harm to the environment arising out of development associated with the project. Where potential for harm to the environment has been identified, BHB Billiton has identified measures which may be implemented, where practicable, to manage and minimise this potential harm.

An extensive range of measures has been adopted as components of the project design to minimise the potential for either serious or irreversible damage to the environment, including the development of environmental management and monitoring and compensatory measures that would be implemented during construction and operation of the project.

The application of the precautionary principle to the project is reflected in:

- Adoption by BHP Billiton of external and internal codes of practice, guidelines, standards and principles covering exploration, environmental management, rehabilitation and community relations activities.
- Examples of such codes, guidelines, standards and principles that have been adopted by BHP Billiton include:
  - BHP Billiton's Charter

- BHP Billiton's Sustainable Development Policy (a component of the existing Olympic Dam operation's AS/NZS ISO 14001:2004 certified environmental management system)
- BHP Billiton's Health Safety Environment and Community Management Standards
- BHP Billiton's Climate Change Position
- BHP Billiton's Guide to Business Conduct
- the Olympic Dam Environmental Management Program (a component of the existing Olympic Dam operation's AS/NZS ISO 14001:2004 certified environmental management system)
- the Olympic Dam Monitoring Program (a component of the existing Olympic Dam operation's AS/NZS ISO 14001:2004 certified environmental management system)
- Enduring Value – the Australian Minerals Industry Framework for Sustainable Development (an initiative of the Minerals Council of Australia).

• Comprehensive study, planning, evaluation and development of the project proposal. The planning and design of the project has taken place over several years, and is currently at selection phase. BHP Billiton has made substantial efforts, through a team comprising more than 200 professional engineers, scientists and planners from BHP Billiton, and more than 400 local, national and international consultants, to identify potential short and long-term effects of the project. The Draft EIS was prepared considering many years of site specific baseline environmental studies in respect of Olympic Dam and the region surrounding it. Project planning and environmental impact assessment was conducted on an iterative basis, with the outcomes of environmental studies and modelling being fed back into option selection, project planning, design of mitigation measures and the environmental assessment process.

• Extensive consultation has taken place with a wide range of individuals and organisations, including government, industry, service providers, key community stakeholders and the general public. The stakeholder consultation and engagement process, and its results, are discussed in detail in Chapter 7 and Appendix H of the Draft EIS. A variety of consultative and assessment mechanisms were used to engage stakeholders in relation to the project. These included:
  - the creation and distribution of fact sheets on key elements of the project
  - holding public meetings and focus group meetings
  - conducting one-on-one discussions with stakeholders
  - creating a website (www.olympicdameis.com)
  - establishing an email address, 1300 telephone line and fax line to facilitate inquiries and information sharing
  - conducting community consultation and engagement events
  - consultation with the Kokatha, Barngarla and Kuyani Aboriginal groups
  - consultation and engagement team members attending major public events, including the Royal Adelaide Show and the Cleve Field Days
  - conducting telephone surveys.

• Objective and comprehensive environmental impact and risk assessment of the project. A team of recognised experts, with extensive relevant experience, was formed to conduct the detailed assessment of key issues for the Draft EIS. The process and outcomes of these studies are discussed in various chapters of the Draft EIS and its accompanying appendices.

• Comprehensive environmental management systems (EMS). BHP Billiton is committed to implementing an EMS which adequately addresses substantive risks of harm to the environment associated with the various components of the expansion project. Chapter 24 of the Draft EIS examines the areas of the existing Olympic Dam EMS that require review and amendment to address components of the expansion project for the planning and design, construction and operation phases, and identifies proposed EM Programs to address each of these issues. Chapter 24 also identifies review mechanisms and auditing procedures which will be implemented as part of the project EMS.

Each of these aspects have been incorporated into the project through the environmental assessment process.

E2.5.3 Inter-generational equity

The goal of inter-generational equity will continue to play an integral role in the decisions made, and actions undertaken, by BHP Billiton in the context of the expansion project.

The concept of inter-generational equity has been addressed in the design and planning phase, and will continue to be relevant to the construction and commissioning, operation, and decommissioning phases of the project through:

• Assessment of the likely social impacts of the project, including the distribution of impacts between stakeholders (see Chapter 19 of the Draft EIS).

• Design and implementation of monitoring initiatives and management measures, where required, in relation to the potential impacts of the project during construction and commissioning, operation and decommissioning on land, water, flora, fauna and

other affected aspects of the environment (see Chapters 10–24 of the Draft EIS). These measures aim to mitigate impacts and risks of environmental degradation in order to, amongst other things:

  - ensure biodiversity and ecological integrity are not compromised during the project
  - retain options for future generations with respect to the use of natural resources.
- Development and continuing refinement of a comprehensive rehabilitation strategy (see Chapter 23 of the Draft EIS), ecological offsets strategy (see Chapter 15 and Appendix N of the Draft EIS), and flora and fauna management and monitoring measures to be implemented to manage the short-term ecological impacts of the project (see Chapters 15 and 16 of the Draft EIS).
- Responding to concerns expressed by the community during public consultations, through consideration of issues raised during stakeholder consultation as part of the project alternative selection process (see Chapter 7 of the Draft EIS).
- Undertaking investigation and assessment of heritage values represented in the project area, and adopting strategies to minimise impacts on Aboriginal and non-Aboriginal cultural heritage sites where required (see Chapters 17 and 18 of the Draft EIS).
- Implementation of responsible waste management strategies which will promote safety and mitigate the risks of environmental degradation of natural resources on site (see Chapters 2, 5, 23 and 26 of the Draft EIS).

The analysis undertaken by BHP Billiton, together with numerous experts, for the Draft EIS identified material benefits to current and future generations which are likely to come about as a result of the construction and operation of the project. These include the following:

- The generation and maintenance of employment:
  - The project would benefit the current and future generations through the generation and maintenance of employment. The proposed expansion of Olympic Dam would give rise to substantial new employment opportunities locally, regionally and state-wide. The Olympic Dam workforce currently consists of approximately 3,200 employees, split between permanent employees (about 1,500) and contractors (about 1,700). An additional short-term contract workforce is engaged periodically on an as needs basis (such as for smelter shutdowns).
  - The project is expected to require an increase in the operational workforce at Olympic Dam from about 100 in 2009 to about 3,900 by 2016. In addition, a construction workforce averaging about 6,000 workers over the six year period from 2010 to about 2015 and reaching a peak of more than 7,000 by 2013 is predicted.
  - The size of the total Olympic Dam workforce (including shutdowns and the existing workforce) would peak at over 14,000 in 2015. Figure 19.10 of the Draft EIS shows the total Olympic Dam workforce numbers (existing and proposed), including the maintenance shutdown and other short-term contractors.
  - The approximate number of jobs created by the construction and operation phases of the offsite water, energy and transport infrastructure required for the project are listed in Table 19.13. These total over 1,000 construction employees and 240 operational employees.
  - The project is expected to provide significant indirect employment opportunities which are discussed in Section 19.5.1 of Chapter 19 of the Draft EIS.
- Environmental offsets: As discussed in Chapter 15 of the Draft EIS, BHP Billiton will set aside significant portions of land for conservation, and make payments to the Native Vegetation Fund, in order to offset vegetation clearance associated with the project. The conservation and revegetation areas will result in long-term environmental gains in terms of wildlife habitat values, securing land and soil structures, and an increase in carbon sequestration capacity.
- BHP Billiton will incur the costs of the mitigation measures: BHB Billiton will incur the costs of the mitigation measures and current and future generations will not therefore be required to bear the economic cost to carry out measures necessary to manage and maintain the state of the environment.
- Creation of infrastructure: The desalination plant, water supply pipeline, power station, gas supply pipeline, electricity transmission line, rail line, port facilities, and villages established for the purposes of the project have the potential to be used for the benefit of future generations after the completion of mining operations at Olympic Dam (see Chapter 23).
- Short and long-term economic benefits: The project will stimulate the local, regional and national economy, and provide valuable export earnings. This, in turn, is likely to result in benefits such as improved social welfare and improvements to infrastructure for the current and future generations (see Draft EIS Chapter 21 for details).

E2.5.4 Conservation of biological diversity and ecological integrity

The project site and its surrounding area have some recognised ecological values, which include listed or otherwise significant flora and fauna species, habitat for migratory birds and an endangered ecological community.

Chapter 15 of the Draft EIS details the existing terrestrial ecology, the proposed location and extent of vegetation clearance associated with the project, the effects of this clearance, and related management and compensatory measures. Chapter 16 of

the Draft EIS details the existing marine environment, the potential impacts of the construction and operation of the proposed desalination plant and port facilities on the marine environment, and proposed management measures. In addition, in accordance with ESD principles, the project addresses the conservation of biodiversity and ecological integrity by proposing a comprehensive environmental management framework designed to conserve ecological values and long-term species diversity as far as practicable (see Chapter 24).

Throughout the design and planning of the project, BHP Billiton has taken into account the need to conserve biological diversity and ecological integrity as far as practicable. This ideal will remain at the forefront of BHP Billiton's decision making and actions in the construction and commissioning, operation and decommissioning phases of the project.

BHP Billiton's awareness of the need to conserve biological diversity and ecological integrity as far as practicable is evidenced by:

- The project infrastructure having been designed to minimise impacts on the existing environment where practicable. For example, BHP Billiton intends to minimise the project's impact on birds by ensuring that no new evaporation ponds are established at the Olympic Dam site for the purposes of the expansion project, and by covering the central decant ponds with netting (or similar) in order to prevent access by birds (see Chapter 15).
- The implementation of proven operating systems and pollution control structures for the project. The potential for environmental degradation will be minimised through training of personnel, environmental auditing and the development of contingency plans in case of an emergency which is likely to impact on the environment (see Chapter 24).
- The adoption of environmental offset strategies and compensatory measures designed to augment the range and extent of native vegetation and fauna habitat resources in the project region. These initiatives will lead to a residual environmental benefit to the project region (see Chapter 15).
- The existence of BHP Billiton's monitoring programs for listed threatened species (see Chapter 15).

E2.5.5 Improved valuation, pricing and incentive mechanisms

One of the most common broad underlying goals or concepts of sustainability is economic efficiency, including improved valuation of the environment. Resources should be carefully managed to maximise the welfare of society, both now and for future generations. Consideration of economic efficiency, with improved valuation of the environment, aims to overcome the underpricing of natural resources and has the effect of integrating economic and environmental considerations in decision making, as required by ESD.

By identifying and adopting appropriate strategies and measures to minimise the potential for damage to the environment as integral components of the project, the cost of those measures forms part of the total project cost, thereby enabling the value and price of environmental resources, and their protection, to be more accurately reflected.

E2.5.6 Climate change and greenhouse effect

The greenhouse effect is the phenomenon whereby certain gases, known as greenhouse gases (GHGs), capture heat radiated from the earth and re-radiate it back to earth. This mechanism affects the thermal balance that controls the earth's climate. It is now widely accepted that the thermal balance may be disturbed by steadily increasing concentrations of certain GHGs, principally CO_2, which is the inevitable product of the combustion of fossil fuels. Other GHGs are much less by volume than CO_2 but their effect in the atmosphere is significant because they are more effective as GHGs. To overcome this, the *National Greenhouse and Energy Reporting Act, 2007* (Cth) specifies that GHGs are to be measured in carbon dioxide equivalents (CO_2-e), a process achieved by using a value commonly known as the global warming potential of a GHG.

The greenhouse gas assessment of the project (see Chapter 13 of the Draft EIS) includes Scope 1 emissions (direct emissions from the project) and Scope 2 emissions (indirect emissions from the consumption of purchased electricity). It also includes transport related emissions generated within Australia as Scope 3 emissions. The assessment shows that total greenhouse gas emissions for the existing Olympic Dam operation are around 1.1 Mtpa CO_2-e. The assessment goes on to show that total greenhouse gas emissions for the project will peak at around 5.8 Mtpa CO_2-e. Potential greenhouse gas emissions attributable to the expansion project are therefore some 4.7 Mtpa CO_2-e.

For the purposes of providing global emissions context, an indicative calculation of the abatement potential of the uranium oxide produced at Olympic Dam has been undertaken. Uranium oxide production would be up to 19,000 tonnes in some years. This would be used by countries to produce around 756,000 GWh of electricity, more than three times Australia's average consumption. 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 carbon emissions by 615 Mtpa, 687 Mtpa and 438 Mtpa of carbon dioxide equivalents, respectively.

E2.6 MATTERS OF NES AND ESD CONSIDERATIONS

The principles of ESD have influenced the manner and extent to which possible impacts on the matters of National Environmental Significance (NES) that are the subject of the controlling provisions applicable to the project have been assessed and addressed in the planning and design of the project (see Draft EIS Appendix E1 for details). The principles of ESD will continue to guide BHP Billiton in the context of matters of national environmental significance in the construction and commissioning, operational and decommissioning phases of the project.

E2.6.1 Project impact on Ramsar wetlands

The Minister nominated Sections 16 and 17B of the EPBC Act as controlling provisions for the purpose of the expansion project. Consequently, the Minister will be obliged to consider matters relevant to the ecological character of any declared Ramsar wetlands in deciding whether or not to approve the project and what conditions to attach to the approval.

BHP Billiton has specifically integrated the principles of ESD into its environmental assessment and design of the project in the context of declared Ramsar wetlands by way of conducting desktop studies to identify the two declared Ramsar wetlands in the EIS Study Area, their ecological characteristics and values, and assessing potential impacts based on their location. In response, the project has been designed to avoid the infrastructure associated with the project intersecting with, or otherwise adversely affecting, identified Ramsar areas.

E2.6.2 Project impact on listed threatened species and ecological communities

The Minister nominated Sections 18 and 18A of the EPBC Act as controlling provisions for the purpose of the project. Consequently, the Minister will be obliged to consider matters relevant to various categories of listed threatened species and listed threatened ecological communities in deciding whether or not to approve the project, and what conditions to attach to the approval.

BHP Billiton has specifically integrated the principles of ESD into its environmental assessment and design of the project in the context of listed threatened species and ecological communities by way of:

- Conducting a desktop review and compilation of relevant data from the past 25 years of published reports and databases associated with the EIS Study Area.
- Carrying out field surveys to identify and map vegetation associations and to identify flora and fauna species and their preferred habitats, and conducting an iterative process of risk and impact assessment and project design refinement in response.
- Conducting a literature review of desalination plants and the effects of salinity on marine species, additional marine surveys to assess the distribution and composition of the marine communities in the EIS Study Area, ecotoxicity studies to assess the tolerance of marine species to various toxicity levels, hydrodynamic modelling to assess the dispersion of the brine plume from the proposed desalination plant, and conducting an iterative process of risk and impact assessment and project design refinement in response.
- Establishing appropriate management measures to address the risk of impacts to threatened terrestrial and marine species or ecological communities, a comprehensive rehabilitation strategy, and ecological offsets strategy which includes, for example, the establishment of a significant environmental benefit strategy in accordance with guidelines provided by the South Australian Native Vegetation Council (see Chapters 15, 23 and 24 of the Draft EIS).
- Establishing a program of ongoing monitoring. BHP Billiton will undertake further vegetation surveys as detailed design refines and confirms the disturbance footprint of the project. In the event that threatened species are identified during these surveys, BHP Billiton will adhere to the following management protocol (based on the circumstances):
  - where clearance of listed threatened plants cannot be avoided, seeds or clippings of the plants will be collected for subsequent propagation and planting as part of the rehabilitation of the disturbed area
  - where clearance of threatened plants can be avoided, the area containing the plants will be marked as a no-go area on construction design drawings and in the field with flagging tape and or hazard fencing, so as to avoid disturbance during construction works.

E2.6.3 Project impact on listed migratory species

The Minister nominated Sections 20 and 20A of the EPBC Act as controlling provisions for the purpose of the project. Consequently, the Minister will be obliged to consider matters relevant to listed migratory species in deciding whether or not to approve the project and what conditions to attach to the approval.

BHP Billiton has specifically integrated the principles of ESD into its environmental assessment and design of the project in the context of listed migratory species by way of:

- Conducting desktop reviews of previous monitoring records (as part of the terrestrial and marine ecology assessments undertaken) and ongoing monitoring studies (including regular monitoring of GAB spring fauna, monitoring of birds on the TRS, and field sampling of small mammals and reptiles).
- Designing the project infrastructure to minimise impacts on migratory species which visit the project area. For example, BHP Billiton intends to minimise the project's impact on migratory bird species by ensuring that no new evaporation ponds are established at the Olympic Dam site for the purposes of the expansion project, modifying the design of the proposed processing plant to increase the volume of liquor recycled back into the plant, and covering the central decant ponds with netting (or similar) in order to restrict access by birds.
- Establishing suitable management measures throughout the construction and operational phases of the project, a comprehensive rehabilitation strategy and an appropriate ecological offsets strategy (see Chapters 15, 23 and 24 of the Draft EIS).

E2.6.4 Impact of the project on the environment

The Minister nominated sections 21 and 22A of the EPBC Act as controlling provisions for the purpose of the project. Consequently, pursuant to section 136(1)(a) of the EPBC Act, the Minister will be obliged to consider matters relevant to the environment in deciding whether or not to approve the project and what conditions to attach to the approval. The environment which is required to be considered, is relevantly confined to the environment in Australia: see section 5(2) of the EPBC Act.

The Draft EIS considers in detail the likely impacts of the project on the environment. The extent to which the principles of ESD have been taken into account in the design, planning and assessment processes associated with the project in relation to the various aspects of the environment is explained in Section 2.5 of this appendix.

E2.6.5 Impact on the environment of activities on Commonwealth land

The Minister nominated Sections 26 and 27A of the EPBC Act as controlling provisions for the purpose of the project. Consequently, the Minister will be obliged to consider matters relevant to the environment and, specifically, the environment on Commonwealth land, in deciding whether or not to approve the project and what conditions to attach to the approval. The extent to which the principles of ESD have been taken into account in the design, planning and assessment processes associated with the project in relation to the various aspects of the environment is explained in Section 2.5 of this appendix.

The Defence establishments of Woomera Prohibited Area and the Cultana Training Area, and land owned by Australian Rail Track Corporation Pty Ltd, account for the Commonwealth land within the EIS Study Area for the project. The principles of ESD have been taken into account specifically in the context of Commonwealth land through detailed consideration of the existing land use, and the likely impact of the project on the Woomera Prohibited Area, Cultana Training Area and land owned by Australian Rail Track Corporation Pty Ltd, through a desktop review, relevant local government plans, aerial photographs and land use maps, information from various governmental and private organisations (including the Department of Defence), numerous field visits, two helicopter reconnaissance surveys over the EIS Study Area, and the stakeholder consultation and engagement program. While about 50 ha of Commonwealth land would be disturbed, the assessment of impacts in the Draft EIS concludes this would have an insignificant impact in the context of the local environment.

APPENDIX E3

Product stewardship

THE OLYMPIC DAM EXPANSION IN THE CONTEXT OF THE INTERNATIONAL NUCLEAR FUEL CYCLE

ANDREW LEASK
BSc (Eng), CEng, FIET, CMgr, FCMI
Consultant

PO Box 286
Dickson ACT 2602
arleask@gmail.com

ANDREW LEASK
BSc (Eng), CEng, FIET, CMgr, FCMI
Consultant

PO Box 286
Dickson ACT 2602
arleask@gmail.com

THE OLYMPIC DAM EXPANSION IN THE CONTEXT OF THE INTERNATIONAL NUCLEAR FUEL CYCLE

1 PURPOSE

The purpose of this Appendix is to:

(a) explain the civil nuclear fuel cycle (NFC) and to show how copper concentrate containing uranium (concentrate) produced from the Olympic Dam expansion and the combined operations at Olympic Dam would form a part of the NFC

(b) discuss the various controls and safeguards in place under international and domestic law which would cover the whole of the NFC from the mining and milling of uranium in Australia through export, transport, processing, storage and use in China, which is the current preferred export destination

(c) describe the systems and controls that BHP Billiton proposes under its incorporated structure with end users of the concentrate in China, and the uranium stewardship program which would apply comprehensive product stewardship principles to the safe handling, transport and use of Australian uranium produced from concentrate from the Olympic Dam expansion.

Although this appendix assumes that China is the preferred export destination there are a range of alternative destinations available in line with applicable law and policy described in this appendix, and final decisions are yet to be made and approvals obtained.

This appendix should be read in conjunction with Appendix E2 on the ESD Principles (Ecologically Sustainable Development Principles).

ANDREW LEASK
BSc (Eng), CEng, FIET, CMgr, FCMI
Consultant

PO Box 286
Dickson ACT 2602
arleask@gmail.com

1.2 Abbreviations

Table One: Abbreviations

AONM	Australian Obligated Nuclear Material
ASNO	Australian Safeguards and Non-Proliferation Office
AUA	Australian Uranium Association
CPPNM	Convention on the Physical Protection of Nuclear Material
DSGL	Defence and Strategic Goods List
Early Notification Convention	Convention on Early Notification of a Nuclear Accident
ESD	ecologically sustainable development
HSEC	health safety and environment committee
IAEA	International Atomic Energy Agency
ICMM	International Council on Mining and Metals
NFC	civil nuclear fuel cycle
NNWS	NPT non-nuclear weapon state
NPT	Treaty on the Non-Proliferation of Nuclear Weapons
NSG	Nuclear Suppliers Group
NWS	NPT nuclear weapon state
SOLAS	International Convention for the Safety of Life at Sea
SSAC	State System of Accounting and Control of Nuclear Material
SUA Convention	Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation
USONM	United States Obligated Nuclear Material
WNA	World Nuclear Association

ANDREW LEASK
BSc (Eng), CEng, FIET, CMgr, FCMI
Consultant

PO Box 286
Dickson ACT 2602
arleask@gmail.com

2 THE INTERNATIONAL NUCLEAR FUEL CYCLE

2.1 Overview

The international nuclear fuel cycle (NFC) may be described as:

The series of steps involved in supplying fuel for nuclear reactors and managing the resulting waste products. It includes the mining, conversion and enrichment of uranium; fabrication of fuel elements and their use in a reactor; reprocessing to recover the fissionable material remaining in the spent fuel; possible re-enrichment of the fuel material; possible re-fabrication into more fuel; waste processing; and long-term storage or disposal.

A diagram illustrating the NFC is shown in Figure 1 below.

While uranium is a common element in the earth, the mining of uranium occurs only in a few countries. As at 2007, Canada and Australia accounted for approximately 45% of global production while other countries including Niger, Russia, Kazakhstan, Namibia, Uzbekistan, South Africa and the USA accounted for the remainder of production[1]. Given that Australia has about 36% of the world's known reserves of uranium, it has a pivotal role in providing reliable energy to other countries which elect to use nuclear power as part of their energy supply mix.

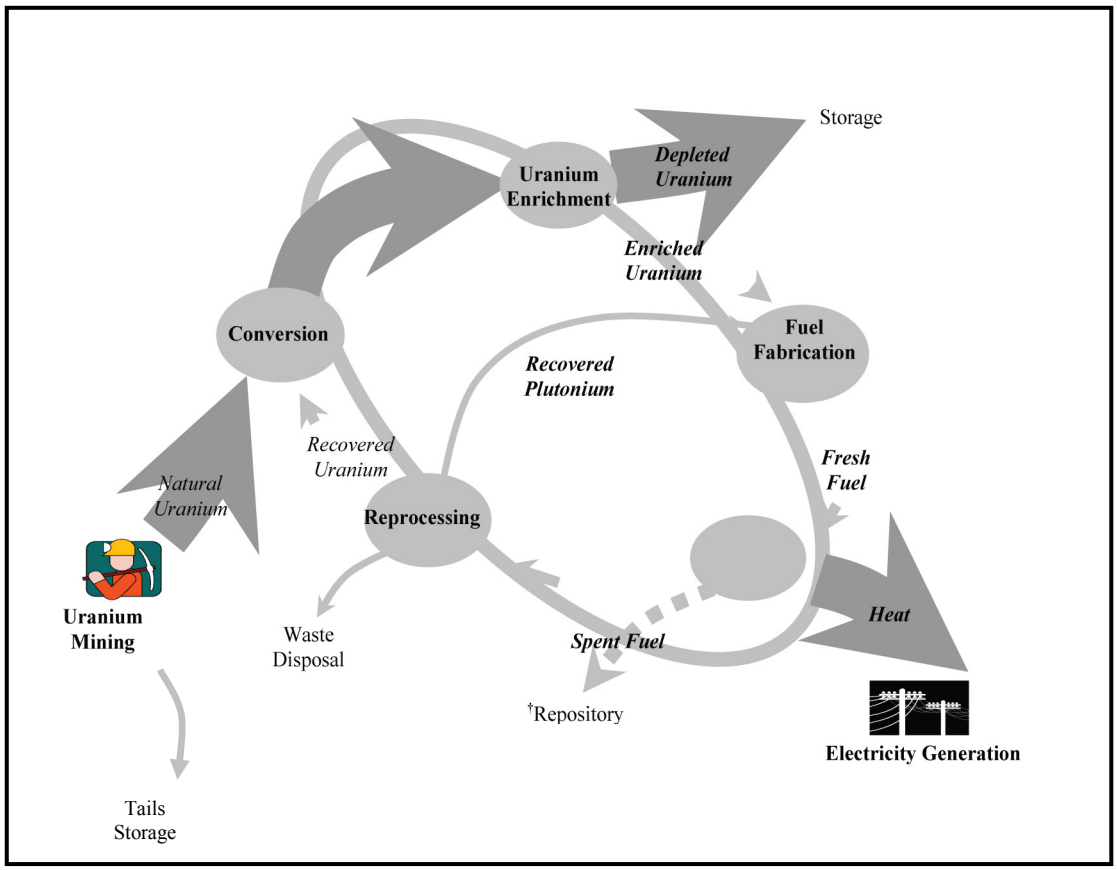

Figure 1: Nuclear Fuel Cycle

[1] Source: ASNO (2004)

PO Box 286
Dickson ACT 2602
arleask@gmail.com

The global extent of the existing NFC is greater than is often understood. For example, as at October 2008, there were 439 nuclear power plants in operation in 30 countries providing approximately 16% of global electricity supply. A further 36 nuclear reactors are currently being built in 12 different countries, whilst 99 reactors are planned or ordered and an additional 232 reactors are proposed, which would bring the total number of countries relying on nuclear energy to 40 by around the middle of this century. There are also commercial scale reprocessing plants in 4 countries, conversion plants in 6 countries and enrichment plants in 8 countries. The majority of these facilities are in EU countries, North America, the Russian Federation and North Asia (China, Japan, and the Republic of Korea).

Around the world, scientists in more than 50 countries use nearly 300 research reactors to investigate nuclear technologies and to produce radioisotopes for medical diagnosis and cancer therapy. Meanwhile, on the world's ocean, nuclear reactors have powered over 400 ships.

2.2 The Stages of the Nuclear Fuel Cycle (NFC)

Set out below is a more detailed description of the various stages of the NFC shown in Figure 1. Understanding the various stages is important in providing context to the way Australian uranium produced from Olympic Dam, may be used in the NFC.

(a) Mining and Processing

The first stage of the NFC is mining and processing. There are three primary methods used to mine uranium:

(i) open-pit mining

(ii) underground mining

(iii) in-situ leach processing where minerals are dissolved underground and the solution containing the minerals is pumped to the surface for mineral recovery.

At Olympic Dam, the uranium is currently mined underground and will expand to an open pit operation as part of the expansion project. The ore is recovered through mechanical (milling) and chemical processing. Olympic Dam is proposing to export its uranium in two forms, as a uranium oxide (uranium ore concentrate, UOC), which is the current practice, and in its copper concentrate. The concentrate to be exported would contain up to 2000 ppm uranium. The Olympic Dam ore body contains around 400–800 parts per million (ppm) uranium and the uranium oxide exported is about 99% uranium oxide (U_3O_8).

ANDREW LEASK
BSc (Eng), CEng, FIET, CMgr, FCMI
Consultant

PO Box 286
Dickson ACT 2602
arleask@gmail.com

(b) Conversion

The next stage of the NFC is conversion. At a conversion plant, uranium is first refined to uranium dioxide, which can be used as fuel for reactor types using natural (non-enriched) uranium fuel. However, most uranium for power reactor fuel is converted into uranium hexafluoride (UF_6) in preparation for enrichment. Conversion is a chemical process by which the uranium oxide—otherwise known as U_3O_8—is converted into UF_6, which is a solid at atmospheric pressure below a temperature of 57 ºC and gaseous above this temperature. As a highly corrosive and chemically toxic substance, UF_6 is transported as a solid in purpose-built secure cylinders. Consequently, conversion plants are subject to strict regulation covering the environment, safety and security.

(c) Uranium Enrichment

Following conversion, the next stage of the NFC is the enrichment of uranium. Uranium found in nature consists largely of two isotopes, U_{235} and U_{238}. Energy is produced in the form of heat in nuclear reactors from the "fission" or splitting of the U_{235} atoms. Natural uranium contains 0.7% of the U_{235} isotope. The remaining 99.3% is mostly the U_{238} isotope which does not generally contribute directly to the fission process in power reactors.

Most common types of nuclear power reactors require fuel with higher than natural levels of the fissile isotope U_{235}. To achieve this, natural uranium must be enriched (using UF_6 feedstock). The enrichment process yields a higher concentration, typically between 3.5% and 5% U_{235}, by removing over 85% of the U_{238}.

There are two enrichment processes in large scale commercial use; gaseous diffusion and gas centrifuge. These processes use the physical properties of molecules of U_{235} and U_{238} to separate the isotopes. The product at this stage of the NFC is enriched uranium hexafluoride. This is re-converted to enriched uranium dioxide (UO_2) before being fabricated into fuel elements.

(d) Fuel Fabrication

Following enrichment the uranium is ready for fuel fabrication. Reactor fuel is normally manufactured as ceramic pellets. These are formed from pressed UO_2 which is baked at high temperature. The pellets are encased in metal tubes to form fuel rods, which are arranged into a fuel assembly ready for loading into a reactor core.

The dimensions of fuel assemblies are controlled very tightly to ensure consistency in the performance of fuel bundles and reactor operations.

PO Box 286
Dickson ACT 2602
arleask@gmail.com

(e) Power Reactor

In a reactor, fission (splitting the atom) releases energy that, either directly or indirectly, produces steam to drive a turbine and generator and, in turn, produces electricity. This is comparable to the burning of coal, gas or oil in a fossil fuel power plant. Typically in a power reactor, fuel bundles or elements are replaced every 12–24 months, with usually one third of the core being replaced during each refuel. Spent fuel is normally stored in ponds on-site pending either reprocessing to recover uranium and plutonium, or long term disposal.

(f) Reprocessing

In a reprocessing plant, spent fuel is separated into uranium and plutonium (for possible reuse) and waste (containing highly radioactive fission products). Reprocessing allows the uranium and plutonium to be recycled into fresh fuel, and leads to greatly reduced volumes of waste.

(g) Spent Fuel Repository

Power reactors are usually able to hold spent fuel for well over 30 years. After 40 to 50 years of storage, the radioactivity level of the fuel falls to 0.1% of its original level. Given this and the fact that the volumes of waste are relatively small, final disposal facilities—as opposed to storage facilities—have not been established yet on a commercial scale, although the final disposal technology has been demonstrated at the trial plant stage. Furthermore, spent fuel offers a significant energy resource that could be reprocessed in the future; hence there has been a reluctance to permanently dispose of it.

Current thinking on best practice management of spent fuel and nuclear waste from reprocessing is placement in deep geological repositories. By way of example, the USA is now building a national repository at Yucca Mountain in Nevada while Sweden and Finland have proposed deep geological repositories for final disposal.

The proposed method in Sweden for the repository of high level waste will see the spent nuclear fuel encapsulated in copper. The copper canisters will then be deposited in geologically stable bedrock, embedded in clay, at a depth of about 300 metres. When deposition is finished the tunnels and rock caverns will be sealed.

The tunnels will be about 250 metres long and spaced at a distance of about 40 metres from each other. Deposition holes will be spaced at intervals of about six metres on the floor of the tunnels. The copper canisters will be placed in the deposition holes and surrounded by a buffer of bentonite. When deposition is finished, the tunnels and shafts will be filled with a mixture of crushed rock and bentonite.

PO Box 286
Dickson ACT 2602
arleask@gmail.com

2.3 Australian Government Policy

Under current Federal Government policy, Australia's direct involvement in the NFC is restricted to its early stages. That is, the mining of uranium, the production of uranium oxide and concentrate, and the safe handling and transport of both products to certain countries for conversion, enrichment and fabrication into fuel for nuclear power generation. South Australian and the Northern Territory Government policies also limit activities within their jurisdiction to the early stages of the NFC.

The Olympic Dam expansion project would not require any change to the scope of current Federal or State Government policies regarding nuclear activities in Australia. BHP Billiton is proposing to export concentrate (as well as currently approved uranium oxide) with China as the preferred destination for this concentrate. Under such circumstances, China would produce uranium oxide from that concentrate for subsequent use in the civil NFC.

Export of concentrate would require a specific export permit from the Australian Government through the Department of Resources Energy and Tourism. Furthermore, before concentrate exports to China could commence, the Australian Government would also need to have in place a new nuclear safeguards agreement with China to ensure that any uranium extracted in China would remain exclusively in peaceful use and be subject to the current bilateral Nuclear Materials Transfer Agreement once in the form of uranium oxide.

2.4 Australian Obligated Nuclear Material (AONM)

As a prelude to discussing safety, security and safeguards controls across the NFC, it is important to understand the concept of "Australian Obligated Nuclear Material" management (AONM).

The international nature of nuclear material management means that uranium from many sources is routinely mixed during processes such as conversion and enrichment. Uranium is termed a "fungible" commodity, that is, at these processing stages uranium from any source is identical to uranium from any other source. Accordingly, it is not possible to physically differentiate the origin of the uranium. This characteristic also applies a number of other commodities, such as oil. The fungibility of uranium has led to the establishment of conventions used universally in the industry.

The obligations under Australia's various bilateral safeguards agreements are applied to AONM. AONM is a shorthand way of describing the nuclear material which is subject to the provisions of the Australian bilateral safeguards agreements discussed below.

Those other countries that apply bilateral safeguards comparable to Australia's, principally the U.S. and Canada, also use this approach. These countries attach a safeguards "obligation" to the nuclear material they upgrade (process, enrich, fabricate), which results in "multi-labelling". For example, AONM enriched in the U.S. will also become U.S. obligated nuclear material (USONM), and its subsequent use will have to meet the requirements of both Australian and U.S agreements. This is a common situation and, a significant proportion of AONM is also characterised as USONM and is accounted for both to the Australian Safeguards and Non-Proliferation Office (ASNO) and its U.S. counterpart, the U.S. Department of Energy.

PO Box 286
Dickson ACT 2602
arleask@gmail.com

3 SAFETY, SECURITY AND SAFEGUARDS CONTROLS ACROSS THE NFC

Although Australia's direct role in the NFC is restricted to uranium mining, Australia and BHP Billiton would have some control over the use of concentrate sourced from Olympic Dam. The export and use of the concentrate from the Olympic Dam expansion would be subject to a range of international, domestic and contractual controls relating to nuclear safety, nuclear security and nuclear safeguards which are currently applied to all AONM in the international nuclear fuel cycle.

Nuclear safety focuses on minimising the possibility and consequences of the accidental release of hazardous materials, while nuclear security focuses on the physical protection of nuclear material and installations, particularly in relation to threats such as terrorism. Nuclear safeguards are applied to ensure the peaceful use of, amongst other things, nuclear material such as AONM.

These safeguards or controls can be broadly broken into five elements:

(a) The first element of control is **international treaties and conventions** to which Australia and China are parties (Refer section 5.1).

(b) The second element consists of **Australian Government policy and legislative controls** on the production, export and use of uranium which seek to give domestic effect to the International Treaties and Conventions to which Australia is a party (Refer section 5.2).

(c) The third element consists of **bilateral safeguards agreements** that Australia has in place with a range of countries including China, to ensure that Australia's significant nuclear non-proliferation obligations under International treaties and conventions are met (Refer section 5.3). The Australian Government only agrees to the sale of Australian uranium to countries with which it has a bilateral safeguards agreement. Under these safeguards agreements Australia imposes conditions to ensure that Australian uranium is used exclusively for peaceful purposes, is accounted for in full and appropriate standards of physical protection are implemented. Australia has such a bilateral nuclear material transfer agreement with China (2007) that permits the sale of uranium oxide.

(d) The fourth element of control on the NFC consists of **export control regimes,** such as the Zangger Committee, through which participating governments apply consistent export controls covering strategic materials and equipment used in the NFC (Refer section 5.4).

(e) Lastly, controls are applied through **contractual conditions** with purchasers of controlled materials and items, and joint venture partners. In the case of the proposed sale of concentrate to China, BHP Billiton would have contractual controls in place, as well as the BHP Billiton Uranium Stewardship Program, to ensure the application of good international practice in nuclear safety and nuclear security at each stage of the NFC (refer section 7.7).

Each of these controls is discussed in more detail below in the context of the various stages that the concentrate will pass through in the NFC.

PO Box 286
Dickson ACT 2602
arleask@gmail.com

4 BHP BILLITON'S MINING EXPERTISE

The controls relating to the beginning of the NFC, namely at the stage where the uranium would be mined and milled at Olympic Dam and transported to a port as uranium oxide and concentrate, have been discussed in detail in the main body of the draft EIS (see Chapter 6) and, therefore, are not repeated in this Appendix. In terms of its expertise, through an ongoing philosophy of continuously improving its uranium logistics processes over the past 20 years, BHP Billiton has extensive experience in the safe, secure, efficient and effective transport of drummed uranium oxide throughout the world.

This is reflected through the movement of over 2,800 ISO shipping containers involving over 52,000 tonnes of uranium oxide without incident from the Olympic Dam mine site to overseas conversion facilities.

BHP Billiton has developed improved methods of packaging, securing and stowing uranium oxide, and has promoted and set associated national and international standards through external bodies such as the Australian Uranium Industry Framework and the World Nuclear Transport Institute.

5 SAFETY, SECURITY AND SAFEGUARDS CONTROLS ON THE EXPORT OF CONCENTRATE

5.1 International Treaties and Conventions

Australia has entered into a range of international treaties and conventions (under international law) designed to facilitate the peaceful use of nuclear energy while minimising the potential for proliferation. Further, this international legal framework seeks to ensure that the nuclear fuel cycle is managed safely and that appropriate security is applied at each stage. In the case of the Olympic Dam expansion project, this regime is applied to ensure the application of safeguards and the safe and secure export of concentrate.

Essentially, the fundamental objective of all safeguards measures under these treaties is to ensure that nuclear energy remains exclusively in peaceful use and is not diverted for the production of nuclear weapons or other nuclear explosive devices.

The *Treaty on the Non-Proliferation of Nuclear Weapons* (NPT) is the centrepiece of the nuclear non-proliferation regime. Under this treaty, ratified by Australia 35 years ago, non-nuclear weapon states (NNWS), such as Australia, have accepted comprehensive nuclear safeguards to verify compliance with their commitment not to manufacture or produce nuclear weapons in exchange for undertakings on facilitating access to nuclear energy for peaceful purposes. China is also a signatory to a number of international non-proliferation, safety and security treaties and conventions, including the NPT as a nuclear weapon state.

Australia has agreed to accept safeguards on "all source or special fissionable material" in all peaceful nuclear activities within its territory, under its jurisdiction or carried out under its control anywhere, for the exclusive purpose of verifying that such material is not diverted to nuclear weapons or other nuclear explosive devices.

PO Box 286
Dickson ACT 2602
arleask@gmail.com

Australia's obligations under the NPT also include an agreement to apply the safeguards set out in the agreement between Australia and the International Atomic Energy Agency (IAEA) for the Application of Safeguards (Safeguards Agreement). The requirements under the Safeguards Agreement are then effected into Australian domestic law through the *Nuclear Non-Proliferation (Safeguards) Act 1987,* which is discussed below.

Australia's reporting obligations are set out in Article 93 of the IAEA Safeguards Agreement. Australia is required to report to the IAEA on the nuclear materials it holds and their location, and to accept visits by IAEA auditors and inspectors to independently verify Australia's material reports and to physically inspect the nuclear materials concerned to confirm their physical inventories.

Of particular relevance to the Olympic Dam expansion is Article 92 of the IAEA Safeguards Agreement. This article provides that in the case of export out of Australia, nuclear material subject to safeguards is regarded as Australia's responsibility up until the time at which the recipient State assumes responsibility and no later than the time at which the material reaches its destination. The point at which the transfer of responsibility takes place is determined in accordance with suitable arrangements to be made by the States concerned. In the context of the Olympic Dam expansion, this would be addressed in the administrative arrangements pursuant to a new nuclear transfer agreement and contract arrangements between BHP Billiton and its joint venture partners. This is discussed further in section 7.7 below.

In 1997, in an effort to strengthen the safeguards system, the IAEA Board of Governors approved a *Model Additional Protocol* (AP). The new measures provide increased access for inspectors to information about current and planned nuclear programs and to more locations on the ground.

The second major treaty under international law, which will control the concentrate exported from Olympic Dam, is the *Convention on the Physical Protection of Nuclear Material* (Physical Protection Convention). That Convention requires signatories (which include Australia and China) not to undertake, or authorise the undertaking of any international export of nuclear material unless assurances are provided that the nuclear material will be protected to the levels required by the Convention.

PO Box 286
Dickson ACT 2602
arleask@gmail.com

While the Physical Protection Convention focuses primarily on nuclear material being shipped in international commerce, it also contains other important requirements related to domestic security measures. As a party to the Physical Protection Convention, Australia is obliged to make the following legal provisions:

(a) to make certain physical protection arrangements and ensure specific defined levels of physical protection for international transport of nuclear material

(b) to cooperate in the recovery and subsequent protection of stolen nuclear material

(c) to make specific acts (for example, theft of nuclear materials and threats or attempts to use nuclear material to harm the public) punishable offences under Australian law

(d) to prosecute or extradite those accused of committing such acts.

In 2005, a diplomatic conference agreed on amendments to strengthen the Physical Protection Convention. Key amendments included new express requirements for domestic use, storage and transport, a new offence of sabotage and requirements on State Parties to establish robust and comprehensive domestic security regimes for nuclear material and nuclear facilities. Australia ratified the amended Convention in 2008. China was supportive of the amendments but had not yet completed its ratification process at the time of writing.

In addition to the NPT and the Physical Protection Convention, Australia must also give consideration to non-binding but authoritative recommendations developed by the IAEA on the Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC 225). These recommendations provide much greater technical detail than the general requirements set out in the Physical Protection Convention.

In summary, there is a range of control measures applicable to Australia and China under international law including the NPT, the Physical Protection Convention and the IAEA recommendations to ensure that the concentrate exported from Olympic Dam expansion project (and the uranium oxide extracted from it) would be subject to comprehensive safety and security controls and used exclusively for peaceful, non-military purposes.

Set out below is the next element of control that covers how Australia as a State party to these international law conventions introduces those treaty and convention obligations into Australian domestic law.

PO Box 286
Dickson ACT 2602
arleask@gmail.com

5.2 Australian Government Uranium Export Policy and legislation

5.2.1 Overview

In accordance with Australian Government policy, any concentrate produced from the proposed Olympic Dam expansion project would be exported on the basis that any uranium extracted from it would be used exclusively for peaceful purposes, that is, for electrical power generation. Government policy on the peaceful use of Australian uranium has always imposed this peaceful use stipulation.

After Australia ratified the NPT in 1973, an inquiry with the powers of a Royal Commission was conducted into whether Australia should mine its uranium and if so, under what conditions. As a result of what became known as the Fox inquiry, in 1977 the Australian Government determined it would only supply uranium to Non Nuclear Weapon States (NNWS) that were a party to the NPT. While this policy did not state that nuclear weapon states (NWS) had to be parties to the NPT, it did specify that exports to NWS would require an assurance of peaceful use and that any Australian uranium exported would be covered by IAEA safeguards.

In accordance with this policy, the Australian Government will only allow Australian uranium to be used in countries which have:

(a) signed the Nuclear Non-Proliferation Treaty (NPT)

(b) implemented a Bilateral Safeguards Agreement with Australia (see details below)

(c) for exports to NNWS, which does not include China, they must also have an International Atomic Energy Agency (IAEA) safeguards Additional Protocol in force.

As part of its ratification process for international treaties and conventions, Australia enacts implementing legislation to introduce its international commitments under those treaties and conventions into domestic Australian law. In the case of uranium and nuclear exports two pieces of Federal legislation are relevant.

5.2.2 Nuclear Non-Proliferation (Safeguards) Act 1987 (Cth)

The first is the *Nuclear Non-Proliferation (Safeguards) Act 1987* (Safeguards Act). The Safeguards Act forms the legislative basis for nuclear safeguards activities and gives effect to Australia's safeguards obligations under:

(a) The NPT

(b) Australia's NPT safeguards agreement and the Additional Protocol with the IAEA

(c) Agreements between Australia and various countries (and Euratom) concerning transfers of nuclear items, and cooperation in peaceful uses of nuclear energy

(d) the Convention on the Physical Protection of Nuclear Material (Physical Protection Convention or CPPNM).

PO Box 286
Dickson ACT 2602
arleask@gmail.com

Control over nuclear material and associated items in Australia is exercised under the Safeguards Act by issuing permits for their possession and transport while the communication of information contained in sensitive nuclear technology is controlled through the grant of authorities. BHP Billiton currently holds a section 13 permit to possess nuclear material or associated items for the purpose of transporting the material or item, and a section 16A permit to establish a facility.

The Safeguards Act also establishes a statutory office of Director of Safeguards which, since 2004 has been formally known as the Director-General of ASNO. The Director-General's functions include ensuring the effective operation of Australia's safeguards system, and of Australia's system of bilateral safeguards agreements (see earlier discussion above).

The Safeguards Act also empowers the Minister:

- to grant, vary or revoke permits or authorities
- to make declarations or orders in relation to material, equipment or technology covered by the Safeguards Act
- to appoint inspectors to assess compliance with the Safeguards Act and with Australia's NPT safeguards agreement with the IAEA.

The Minister has delegated most of these powers (with certain exceptions such as granting of permits to uranium mines and for nuclear activities) to the Director-General of ASNO.

5.2.3 Recent amendments

In 2003 and 2007, the Safeguards Act was amended to strengthen arrangements for the application of non-proliferation safeguards to, and the protection of, nuclear material, facilities and associated information. Specifically, the amendments:

(a) broadened the class of material which may be declared as associated material, to ensure effective controls on the full range of materials which are specially suited for use in NFC activities or prohibited activities such as the production of nuclear weapons

(b) introduced a permit requirement for establishing any new nuclear or related facility in Australia

(c) introduced offences for conduct which breaches procedures set as a permit condition and intended to protect proliferation sensitive information, and for unauthorised communication of information which could prejudice the physical security of nuclear material

(d) provided that a permit under the Safeguards Act may prescribe an area to which the permit holder must restrict access

(e) updated penalty provisions

(f) implemented amendments to the Physical Protection Convention

PO Box 286
Dickson ACT 2602
arleask@gmail.com

(g) provided a framework for the application of non-proliferation safeguards to a nuclear facility that has been shut down

(h) updated penalties for serious offences in the Safeguards Act

(i) extended the geographical jurisdiction for non-proliferation offences.

The second key legislative instrument is the *Customs (Prohibited Exports) Regulations 1958* which are made under the *Customs Act 1901*. Under those regulations an export licence is necessary to export radioactive material, (including refined uranium, plutonium and thorium). Regulation 9 gives the Minister for Resources, Energy and Tourism the responsibility to approve permits for the export of nuclear material. Before making any such approval, the Minister will consult with the Minister for Foreign Affairs to ensure that Australia's nuclear non-proliferation obligations (security and safeguards etc) and policy requirements will be met.

Regulation 13E is also relevant to the NFC although not to the export of concentrate from Olympic Dam expansion project. It is the responsibility of the Minister for Defence and states that any item contained within the Defence and Strategic Goods List (DSGL), requires authorisation prior to export. The DSGL includes a range of defence and dual-use goods that could be used in a military program, such as materials, equipment, assemblies, software, technologies, and associated test, inspection and production equipment. Specifically, Regulation 13E and the DSGL implement the Zangger and NSG control lists which are discussed later.

5.3 Bilateral Safeguards Agreements

At present, Australia has 22 nuclear safeguards agreements in force covering 39 countries plus Taiwan. These treaty-level Bilateral Safeguards Agreements are concluded between Australia and the recipient country of nuclear items, and serve as a mechanism for applying conditions in addition to IAEA safeguards. These conditions may include for example, restrictions on retransfers, high enrichment and reprocessing. See ASNO 2007-08 Annual Report pages 18-20 and 64 (http://www.asno.dfat.gov.au/annual-report-0708/ASNO_2007_08_ar.pdf).

The key point is that Australia's safeguard's requirements are based on IAEA safeguards. IAEA safeguards provide the basic assurance that nuclear material is not being diverted from peaceful to non-peaceful purposes. It should be noted that IAEA safeguards are generally not concerned with origin attribution, that is, the 'flag' and conditions attached by suppliers (for the IAEA there are limited exceptions, e.g. under certain non-NPT safeguards agreements). Rather, this is the purpose of bilateral safeguards agreements.

The application of Australia's requirements starts with a careful selection of those countries eligible to receive nuclear material. It is generally a minimum requirement that, in the case of NNWS, countries must meet the NPT full scope safeguards standard. That is, IAEA safeguards must apply to all existing and future nuclear activities. Since 2005, for supply to NNWS, the IAEA safeguards Additional Protocol has been added as a prerequisite.

PO Box 286
Dickson ACT 2602
arleask@gmail.com

In the case of NWS, such as China, there must be a treaty-level assurance that nuclear material will be used only for peaceful purposes and will not be diverted to military or explosive purposes, and that IAEA safeguards will apply to that nuclear material.

In addition, other principal conditions in Australia's bilateral safeguards agreements for the use of AONM including the following:

(a) First, none of the following actions can take place without Australia's prior consent:

  (i) transfers of the AONM to third parties

  (ii) enrichment to 20% or more in the isotope uranium-235

  (iii) reprocessing.

(b) Provision for fallback safeguards or contingency arrangements in case NPT or IAEA safeguards cease to apply in the country concerned.

(c) An assurance that internationally agreed standards of physical security will be applied to nuclear material in the country concerned.

(d) Detailed 'administrative arrangements' between ASNO and its counterpart organisation, setting out the procedures to apply in accounting for AONM.

(e) Regular consultation regarding the operation of the agreement.

(f) Provision for the removal of AONM in the event of a breach of the agreement.

A further control included in agreements with China, Russia, and Japan is that AONM can be used only at predetermined facilities agreed between the parties. The list of such facilities is known as the Delineated Nuclear Fuel Cycle or Eligible Facilities List. For nuclear weapon states, such as China, facilities which process, use or store AONM must also be subject to the safeguards agreement which that state has with the IAEA. The specific agreements that Australia has in place with China for AONM are discussed in section 7 below.

PO Box 286
Dickson ACT 2602
arleask@gmail.com

5.4 Export Control Regimes

Further international controls are the two export control regimes known as the Zangger Committee and the Nuclear Suppliers Group.

(a) The Zangger Committee

The Zangger Committee comprises major nuclear suppliers that have developed a common approach to implementing the NPT and supplying nuclear material to states outside of the NPT based on certain safeguards and assurances. The Committee was formed in 1971 and comprises 35 member states.

(b) The Nuclear Suppliers Group

The NSG aims to prevent civilian nuclear trade from contributing to nuclear weapons programs in NNWS. NSG guidelines deal with the transfer of nuclear-related items to all NNWS regardless of their NPT status. The NSG includes all the major suppliers of nuclear technology.

NSG guidelines also require recipient governments to provide assurances that transferred items will not be diverted to unsafeguarded nuclear facilities or nuclear explosive activities. The guidelines set out re-transfer provisions and requirements for the physical protection of nuclear material and facilities. They also require particular restraint with respect to trade in facilities, technology or equipment that may be used for uranium enrichment or plutonium reprocessing.

While these export control regimes do not have the same legal status in international law as the NPT, participating governments—which include Australia and China—implement the control lists in domestic law, thus aligning export controls and strengthening the international nuclear non-proliferation regime.

Membership of these two regimes has increased significantly in recent years and NSG participating governments have become generally more transparent about their export arrangements for nuclear material and engaged in outreach with non-members. Other countries have harmonised their export control systems with these regimes.

Australia is an active participant in international dialogue on sensitive nuclear technology issues. In the NSG, Australia is working towards adopting agreed criteria, including strict non-proliferation measures which recipient states would need to meet before any supplier would transfer sensitive nuclear technology. Australia supports NSG endorsement of the IAEA Additional Protocol as a condition of nuclear supply.

PO Box 286
Dickson ACT 2602
arleask@gmail.com

6 SAFETY AND SECURITY CONTROLS ON INTERNATIONAL NUCLEAR TRANSPORT

In addition to the Physical Protection Convention and other treaties discussed earlier, the physical transport of radioactive material in international waters is regulated by specific international instruments:

(a) For maritime transport, which is relevant to the export of uranium oxide and concentrate, the International Maritime Dangerous Goods Code is the key document. This has been made mandatory through incorporation into the text of chapter VII of the *International Convention for the Safety of Life at Sea* (SOLAS Convention).

(b) The SOLAS Convention specifies minimum standards for construction, equipment and operations of merchant ships carrying dangerous goods such as nuclear material. Flag states are responsible for ensuring that ships under their flag comply with the requirements of the SOLAS Convention.

(c) Also relevant are the IAEA Regulations for the Safe Transport of Radioactive Material (IAEA Transport Regulations) which are incorporated by the above two conventions. The IAEA Transport Regulations address all categories of radioactive material, ranging from very low activity material, such as ores and ore concentrates, to very high activity material, such as spent fuel and high level waste. They establish requirements for the marking, labelling and placarding of conveyances, documentation, external radiation limits, operational controls, quality assurance, notification and the approval of certain shipments and package types.

There are also a number of other international instruments which address the transport of nuclear material:

(a) Articles 22 and 23 of the United Nations *Convention on the Law of the Sea* prescribe certain conditions for the carriage of “nuclear substances” through sea lanes or territorial seas.

(b) The *Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation* (SUA Convention), as amended by the 2005 SUA Protocol, allows for the transfer of nuclear material where the transfer is consistent with a state’s obligations under the NPT.

(c) The 1994 *Convention on Nuclear Safety* imposes certain obligations with regard to trans-boundary emergency planning. As a party to the Convention, Australia is obliged to take appropriate steps to ensure that it has in place on-site and off-site emergency plans that cover the actions to be taken in the event of an emergency. The plans need to be tested before the nuclear installation goes into operation and subsequently be subjected to tests on a routine basis. However, the Convention only applies to the operation of nuclear power reactors and therefore imposes no practical obligations on Australia at present.

PO Box 286
Dickson ACT 2602
arleask@gmail.com

(d) The Convention on Early Notification of a Nuclear Accident (Early Notification Convention) and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (Assistance Convention) cover situations in which an accident involving activities or facilities in one State has resulted or may result in a trans-boundary release that could be of radiological safety significance for other States. The Assistance Convention and the Early Notification Convention were both signed by Australia on 26 September 1986.

(e) The Early Notification Convention requires State Parties, in the event of an accident at a nuclear reactor, at a NFC facility, or at a radioactive waste management facility (among others), to notify those States which may be physically affected by the accident. Parties are obliged to provide exact information in order to facilitate the organisation of counter-measures.

(f) The Assistance Convention is a framework agreement designed to establish a general basis for mutual assistance in the event of a nuclear accident or radiological emergency. Under the Convention, State Parties are required to cooperate among themselves and the IAEA must provide prompt assistance in the event of a nuclear accident or radiological emergency in order to minimise its consequences and to protect life, property and the environment from the effects of radiological release.

All of these conventions and the controls they introduce ensure that the concentrate exported from the Olympic Dam expansion project will be subject to a range of international requirements and standards focused on minimising the risk of environmental harm in addition to the secure and safe transport and handling of the AONM.

7 SAFETY, SECURITY AND SAFEGUARDS CONTROLS FOR AONM IN CHINA

7.1 Management of AONM in China

As noted above, the Australian Government strictly controls the export and use of AONM and only allows uranium exports to countries which are parties to the NPT and which are covered by a Bilateral Safeguards Agreement.

Furthermore, in the case of exports of nuclear material to nuclear weapons states such as China, the Australian Government requires an additional treaty level assurance that IAEA safeguards will apply to that nuclear material and that any nuclear material supplied (which would include that in the concentrate) will be used only for peaceful purposes and will not be diverted to military or explosive purposes.

The Australian Government obtains that assurance from Bilateral Safeguards Agreements with China, which are discussed below. The range of safety, security and safeguards controls that will apply to the AONM as it passes through the NFC in China is also summarised below.

PO Box 286
Dickson ACT 2602
arleask@gmail.com

In the case of exporting concentrate to China (as opposed to exports of uranium oxide) where China would extract uranium solely for nuclear energy production, an additional Australia-China bilateral safeguards agreement would have to be developed.

A new agreement would ensure peaceful use obligations apply to any uranium extracted, that uranium oxide produced by this means would be subject to the current bilateral Nuclear Materials Transfer Agreement and that contained uranium would be accounted for in full (whether in the form of concentrate, uranium oxide or waste).

7.2 Bilateral Safeguards Agreements with China

There are two specific bilateral arrangements which are already in force between Australia and China:

(a) "*The Agreement Between the Government of Australia and the Government of the People's Republic of China for Cooperation in the Peaceful Uses of Nuclear Energy"*

(b) "*The Agreement Between the Government of Australia and the Government of the People's Republic of China on the Transfer of Nuclear Material".*

These two bilateral safeguards agreements impose a comprehensive set of controls on the export and use of AONM, which will apply equally to concentrate from the proposed Olympic Dam expansion project. Those controls will include:

(a) the application of IAEA safeguards to any AONM exported to, processed, used and stored in China

(b) strict accounting and control measures and physical protection requirements for the AONM (discussed below)

(c) that AONM can only be used at facilities listed in the Delineated Chinese Nuclear Fuel Cycle Program which is an annexure to the Bilateral Safeguards Agreement. Safety standards and a good operating record are some of the factors which are taken into account when agreeing this facilities list

(d) restrictions on the ability of China to transfer the AONM it purchases to a third party (at a minimum that third party must be a country which is also covered by a bilateral safeguards agreement with Australia).

PO Box 286
Dickson ACT 2602
arleask@gmail.com

7.3 Accounting and Control of AONM

As noted above, the Australian Government would impose strict accounting and control measures on the export and use of the concentrate. Once the concentrate left Australian waters the Australian Government and BHP Billiton would continue to monitor the uranium component of the concentrate (as AONM) through a series of accounting and reporting systems which are summarised below.

(a) Nuclear Material Accountancy Regime

Australia has a safeguards agreement with the IAEA that requires Australia to "*establish and maintain a system of accounting for and control of all nuclear material subject to safeguards under the Agreement*".

This system is known as the State System of Accounting and Control of Nuclear Material (SSAC). In Australia, the Safeguards Act implements this specific obligation of SSAC through ASNO.

Since Australia exports uranium only to NPT parties, which have in force a safeguards agreement with the IAEA[2], each recipient of AONM, including China, will also operate equivalent state arrangements.

The SSAC has two primary objectives covering domestic and international obligations. The domestic objective is to account for and control AONM in the State and to contribute to the detection of possible losses, or unauthorised use or removal of AONM. The international objective is to provide the essential basis for the application of IAEA safeguards pursuant to the provisions of an Agreement between the State and the IAEA, and to ensure the full implementation of peaceful use commitments by bilateral partners processing, storing and using AONM.

ASNO is also charged to ensure that the peaceful use commitments and other treaty commitments are met in each country which uses, processes or stores AONM. The results of this work are presented in the ASNO annual report tabled in the Australian Federal Parliament each year.

Australia's bilateral partners (such as China) which are holding AONM are required by ASNO to maintain detailed records of transactions involving the AONM, and ASNO's counterpart organisations in those bilateral partner countries are required to submit to ASNO regular reports, consent requests, transfer and receipt documentation.

[2] In the case of NNWS an AP is required as well

PO Box 286
Dickson ACT 2602
arleask@gmail.com

The IAEA also receives reports covering the use and shipment of uranium in the international NFC. ASNO accounts for AONM on the basis of information and knowledge from multiple sources, including the IAEA, as well as:

- reports from each bilateral partner
- shipping and transfer documentation
- calculations of process losses and nuclear consumption, and nuclear production
- knowledge of the fuel cycle in each country
- regular liaison with counterpart organisations and with industry
- reconciliation of any discrepancies with counterparts.

Although the above measures are essentially designed to track Australian nuclear product, adherence to these measures provides a means of monitoring the risk of unintended environmental impact as the nuclear product progresses through the NFC.

7.4 Safety Systems at nuclear installations

The future of nuclear energy depends upon the nuclear industry achieving and demonstrating an acceptable, consistent and competent safety record in all applications. Safety of operations and the protection of the workers and public remain fundamental to the industry. The nuclear industry is one of the most highly regulated and controlled, with national regulation based on international requirements where systems of constant review and transparent auditing lead to ongoing improvements. Despite this, the industry understands the challenges and importance of safety and continues to strive for improvements.

A broad overview of the systems of safety and actual performance is presented here.

Within the nuclear industry, safety audits and reviews are conducted routinely and rigorously. At an international level, the IAEA undertakes detailed annual industry wide reviews, which are submitted to the Board of Governors and the results used to strengthen worldwide efforts on nuclear, radiation, transport and radioactive waste safety, and emergency preparedness. The latest review, (Nuclear Safety Review for the Year 2007 GC(52)INF/2 (IAEA 2007)) was published in 2008 and provides an overview of safety of the industry, identifying areas for improvement.

IAEA 2007 reinforces the dual responsibilities for nuclear safety with National governments being responsible for establishing and maintaining effective legal and governmental framework for safety, and facility operators being ultimate responsibility for implementing safety requirements and demonstrating improvements in safety. IAEA 2007, also notes that during the reporting period, the nuclear industry continued to show a strong safety performance.

The IAEA also seeks annual external independent recommendations and opinions on current and emerging nuclear safety issues from the International Nuclear Safety Group (INSAG). This group consists of experts in safety working in regulatory, research, academic

PO Box 286
Dickson ACT 2602
arleask@gmail.com

and industry organizations. In its most recent report (letter to Director General IAEA, dated 25 August 2008), INSAG noted that;

> "The safety performance of nuclear power plants has improved significantly in recent decades, at least as revealed by objective indicators – e.g., capacity factors, unplanned shutdowns, radiation exposure to workers, radiation releases to the environment – albeit with some leveling off in performance in recent years."

In addition to these broader industry wide reviews, nuclear power programs in individual countries, regulatory systems and facility operations undergo regular reviews. Recently, the IAEA commenced a program of reviews of regulatory agencies in member states and it is known as the Integrated Regulatory Review Service (IRSS)).

While the IAEA does not have direct responsibility for nuclear safety within a member state, it is a credible authority on nuclear matters and maintains a continuous focus on safety. State jurisdictions have established their own regulatory frameworks. For example, in the US, the regulator is the Nuclear Regulatory Commission which routinely reports on safety performance (i.e. Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other facilities 2006).

The actual safety performance of the industry can be judged by considering a number of performance indicators, including, radiation doses to employees, and traditional safety statistics such as accident rates and also the number of nuclear related incidents, a summary of which is presented below.

Occupational Radiation Exposures

The unqualified authoritative organization on radiation doses and impacts is the United Nations Standing Committee on the Effects of Atomic Radiation (UNSCEAR). This body reviews radiation related research from across the world and collates the findings. A summary of occupational exposure within the nuclear industry can be seen in Figure 2 and is from the most recent publication (UNSCEAR 2000). These figures show improvements (i.e. a reduction) in doses in the industry between 1975 and 1995, but later results have yet to be collated.

PO Box 286
Dickson ACT 2602
arleask@gmail.com

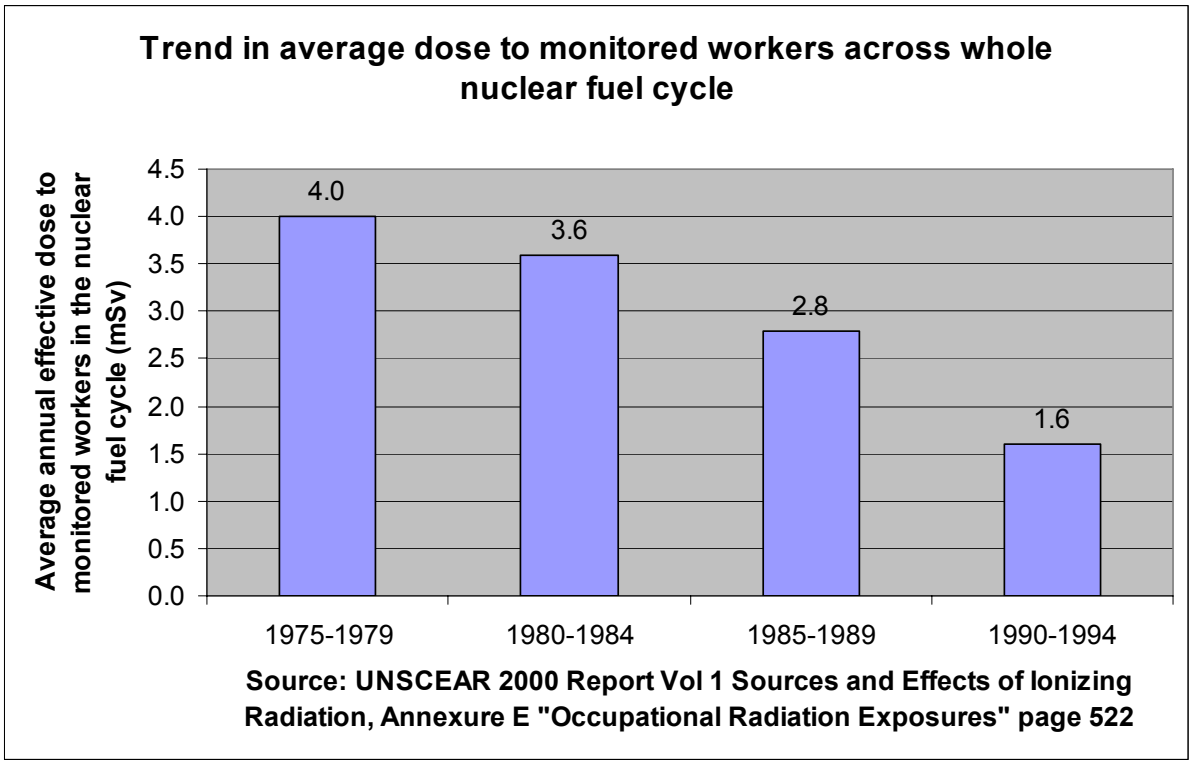

Figure 2: Trends in average doses to monitored workers across the whole of the nuclear fuel cycle

Other sources of information can be referred to for later dose results, for example, the European Study on Occupational Radiation Exposures (http://www.esorex.eu/) and the US Department of Energy Occupational Radiation Exposure Report 2005. In Europe, reported average worker doses in the nuclear fuel cycle fell from 2.2 mSv/y in 1996 to 1.3 mSv/y in 2004. In the US, averages doses fell from 1.4 mSv/y in 1997 to 1.0 in 2006.

The more recent exposure information confirms the continuous improvement in radiation exposure noted in the long term by UNSCEAR.

Industrial Safety

Industrial safety refers to the broader occupational and health issues and is usually measured by the number of reportable incidents or workplace accidents and incidents that occur which result in time off work. There is some discrepancy in how these statistics are defined in different countries, so comparisons should be used with care. However, within countries it is possible to identify the key trends.

Operating experience in the UK (Safety Overview of the Major UK Nuclear Licensees Annual Update – Jan 2007), indicates an improvement in reportable incident rate over the period 1990 to 2005/06, with employee and contractor injury rates averaging at approximately 1.2 injuries per million hours worked by 2005/2006. This compared to a whole of workforce average of 2004/5 of 3 (HSC – Health and safety statistics, national statistics, UK).

In the US, the indicator for general safety is the number of accidents resulting in lost work, restricted work or fatalities and this has improved from 1.9 per million hours worked in 1997

PO Box 286
Dickson ACT 2602
arleask@gmail.com

to 0.6 per million hours worked in 2007. This compares to 11 for the US mining industry and 10 for US private industry as a whole in 2007 (US department of Labour statistics).

The general safety of the nuclear industry is better than that for other industries, providing an indication of the robust safety culture that generally exists.

Nuclear Incidents

Safety within the nuclear industry depends upon the detailed analysis of any and all incidents and the rapid sharing of information of findings in order to prevent recurrences elsewhere. The sharing of safety advances and improvements is not bound by business confidentiality restraints. As an example of this, the OECD/NEA with the IAEA, co-ordinates the International Incident Reporting System (IRS) and the IAEA operates and incident and emergency centre which quickly disseminates information on any incidents or event.

The number of reported incidents can be seen in Figure 3 (from Nuclear Power Plant Operating Experiences from the IAEA/NEA Incident Reporting System 2002-2005 NEA no.6150). The main aim of the reporting system is to share learnings and operating experience, however, the system also shows improvements over time.

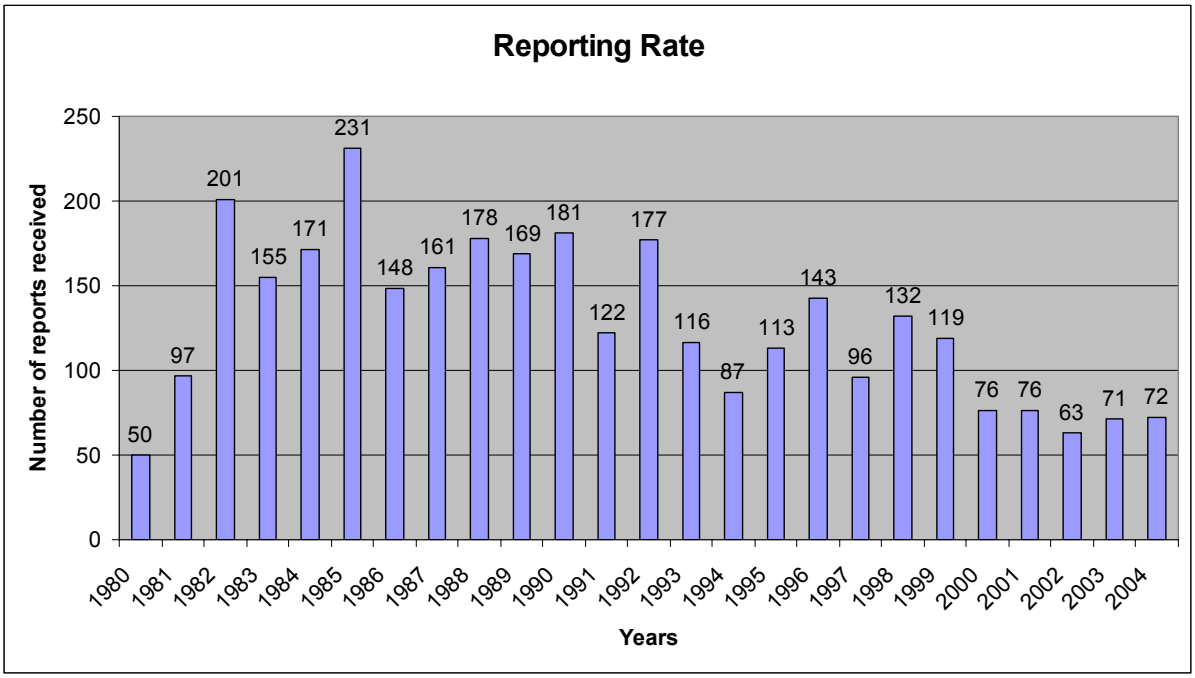

Figure 3: Number of Incidents Reported to IRS

Transport Safety

Nuclear materials have been transported safely and routinely for over 45 years. During this period there has not been a transport incident that has caused significant radiological damage to people or the environment (http://www.wnti.co.uk/nuclear-transport-facts/facts-and-figures/key-facts).

While these are facts about nuclear safety, the industry does not rest on these facts and aims for continuous improvement in all areas of safety (Strengthening the Global Nuclear Safety Regime (INSAG Series)).

PO Box 286
Dickson ACT 2602
arleask@gmail.com

Set out below is a summary of some of the typical systems that are in place at nuclear installations in support of nuclear safety.

(a) Defence-in-depth

A technique widely adopted to ensure nuclear safety involves applying a series of complementary and overlapping measures known as "defence-in-depth".

The objective of defence-in-depth is to ensure that no single human error or equipment failure at one level of defence, or a combination of failures at more than one level of defence, can lead to harm to the public or the environment. Defence-in-depth involves:

(i) Care in selecting sites

(ii) Robust design, including passive safety features, secondary containment, independent heat removal and reactor shut down systems

(iii) High quality construction

(iv) Multi-channel reactor protection systems

(v) Fault prevention and appropriate containment building

(vi) Fostering a culture of safety-awareness which supports a consultative approach to health and safety management among all staff

(vii) Inspection by an independent regulatory authority.

(b) Operational safety

Operational safety of nuclear facilities is achieved by:

(i) The use of remote handling equipment for many operations in the core of the reactor

(ii) The use of physical shielding

(iii) Time limits on work in areas with significant radiation levels.

These measures are supported by continuous monitoring of individual doses to ensure very low radiation exposure as shown in Figure 4 and Figure 5.

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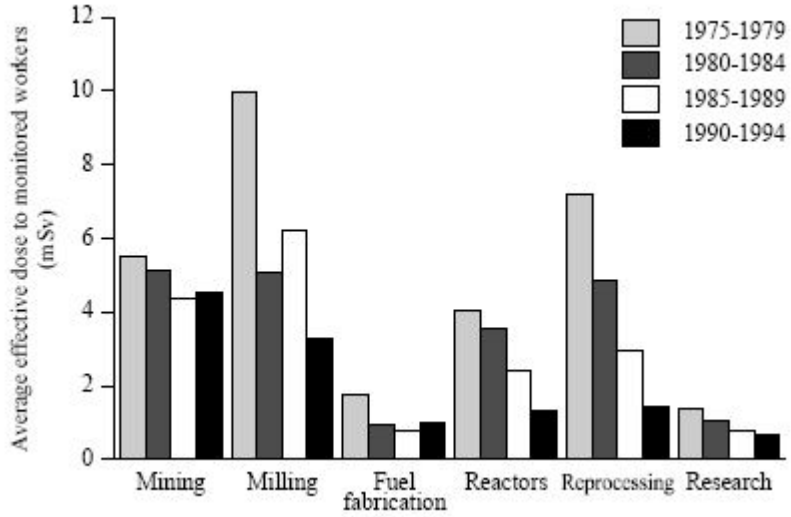
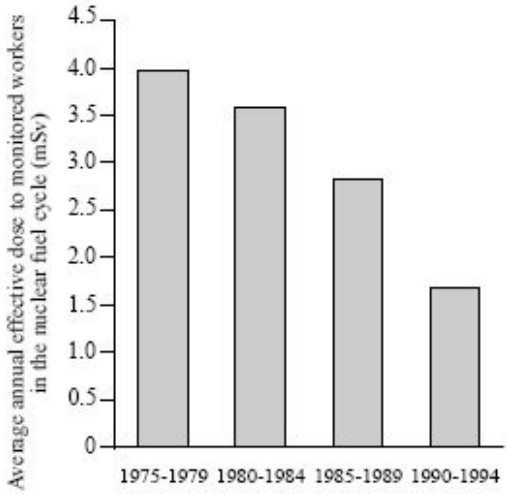
Dickson ACT 2602
arleask@gmail.com



Source: **UNSCEAR 2000 Report Vol 1** ***Sources and Effects of Ionizing Radiation*****, Annexure E "Occupational Radiation Exposures" page 522**

Figure 4: Trends in average dose to monitored workers in the nuclear fuel cycle (by sector)



Source: **UNSCEAR 2000 Report Vol 1** ***Sources and Effects of Ionizing Radiation*****, Annexure E "Occupational Radiation Exposures" page 522**

Figure 5: Trend in average dose to monitored workers across the whole nuclear fuel cycle

PO Box 286
Dickson ACT 2602
arleask@gmail.com

(c) Importance of containment structures

The experiences at Three Mile Island and Chernobyl highlight the critical importance of containment structures in the event of an accident.

Containment structures can be defined as:

Structural features of a facility, containers or equipment which are used to establish the physical integrity of an area or items (including safeguards equipment or data) and to maintain the continuity of knowledge of the area or items by preventing undetected access to, or movement of, nuclear or other material, or interference with the items. Examples are the walls of a storage room or of a storage poll, transport flasks and storage containers. The continuing integrity of the containment itself is usually assured by seals or surveillance measures (especially for containment penetrations such as doors, vessel lids and water surfaces) and by periodic examination of the containment during inspection.

The ultimate barrier is the containment building, which is typically a large reinforced concrete structure designed to both retain any radioactive release and to protect the internal structures from external hazards such as missiles, fires or explosions. The walls of this structure are typically at least one metre thick.

(d) Passive safety features

Increasingly, generators now reflect not only the defence-in-depth approach, but also include "passive safety" features, that is systems that close down the reactor using natural processes that require no external intervention or power supply. These are referred to as failsafe systems.

The main passive safety features are a negative temperature coefficient and a negative void coefficient, which means that beyond an optimal level, as the temperature increases the efficiency of the reaction decreases and that if any steam has formed in the cooling water there is a decrease in moderating effect so that fewer neutrons are able to cause fission and the reaction slows down automatically.

(e) Nuclear security

In the last several years, a body of research into nuclear security has shown that, in the event of an accident, radioactive material is not readily mobilized beyond the immediate internal structure. The containment structure would still be highly effective in preventing release, even if ruptured. In its report “Safety of Nuclear Power Reactors” (June 2008—see http://www.world-nuclear.org/info/info06.html), the World Nuclear Association states, ‘The risks from western nuclear power plants, in terms of the consequences of an accident or terrorist attack, are minimal compared with other commonly accepted risks. Nuclear power plants are very robust.’

PO Box 286
Dickson ACT 2602
arleask@gmail.com

7.5 Significant Incidents at Nuclear Facilities

The most serious *accidents* in the nuclear industry have occurred at Chernobyl in 1986 and Three Mile Island in 1979.

While there is no question that the events at Three Mile Island and Chernobyl were significant, it is important to put them in context. At Three Mile Island, the reactor pressure vessel and the containment building prevented all but a very minor release of radioactive gas that had no physical effect on the neighbouring population even though serious core damage had occurred releasing both intense heat and radioactivity. In fact, the experience at Three Mile Island demonstrated the strength of the design of the reactor, as well as the importance of containment structures. At Chernobyl, a meltdown of the nuclear fuel combined with a steam explosion resulted in large amounts of radioactive materials being released. However, in contrast to Three Mile Island, a number of factors at Chernobyl (Russian RBMK type reactor) contributed to and exacerbated the impacts of the accident:

(a) the design of the reactor was intrinsically unstable

(b) there was no containment structure (unlike Western power reactors)

(c) the experiment that the operators were conducting involved them overriding safety systems which is completely contrary to the operating procedures.

In both cases, there was poor emergency response planning and poor communication between government officials and the community, which exacerbated the impact. Since 1986, technical and operating standards have been improved at Russian built reactors, and a recurrence of Chernobyl is most unlikely. Nonetheless, the enduring emotional impacts on the community of these accidents cannot be underestimated.

A further example of the robustness of modern nuclear power plants is the earthquake in July 2007 in the vicinity of Japan's Kashiwazaki-Kariwa nuclear power plants. Although the earthquake far exceeded the design factors of the reactors, the reactors were safely shutdown and all safety equipment was maintained, demonstrating that designs had ample safety margins. Minimal quantities of radioactivity were released.

In addition to these other incidents at facilities have occurred and have resulted in minor environmental and safety impacts. An overview of reporting systems can be seen at: http://www-ns.iaea.org/databases/.

7.6 Contractual controls

In addition to the controls and safeguards outlined above, there are a number of provisions under the proposed Joint Venture (JV) contract and the supplementary concentrate supply agreement which would have a support role in ensuring the safe management, transport, handling, use and storage of concentrate in China.

For example, under the draft terms of the proposed agreements, BHP Billiton may suspend the delivery of concentrate produced at Olympic Dam to China if the Chinese JV company failed to comply with relevant Chinese or Australian regulations and relevant uranium handling standards.

PO Box 286
Dickson ACT 2602
arleask@gmail.com

It would be a condition precedent under the supply agreement that all inter-governmental agreements relating to nuclear safeguards to which Australia is a party, must be in force between Australia and the country receiving the concentrate (in this case, China) prior to the export of concentrate. In other words, no concentrate would be supplied until such bilateral agreements are signed and are in force.

There will also be an independent metallurgical auditor on-site at the combined copper-uranium production plant in China who will ensure that no product has been diverted and that all material is accounted for and remains exclusively in peaceful use.

Finally, the proposed JV Company would have to ensure the design and construction of the facility complied with international practice including all appropriate environmental and uranium safeguards and that the facility will be suitable for leaching and refining uranium oxides as well as smelting and refining copper concentrate that has been pre-leached for uranium oxide.

There would be requirements for the management systems of the facility including that the general manager had high professional qualifications and experience and must report to and be responsible to the board of directors.

Extensive IAEA safeguards reinforced by the Australian bilateral safeguards regime, supported by the JV and concentrate supply agreements give BHP Billiton significant confidence that the concentrate would be handled and produced safely in China during the lifetime of Olympic Dam.

7.7 Waste streams and controls

In broad terms there are potentially four waste streams arising from the processing in China of concentrate from the Olympic Dam expansion, namely:

(a) smelter dust and off-gases from the smelter

(b) tailings from the uranium oxide production plant (the raw material here would be the concentrate) and radioactive slag from the copper smelter

(c) tailings from the enrichment of AONM

(d) waste from any reprocessing of AONM. However, this activity is expressly prohibited by Australia under the Bilateral Safeguards Agreement with China.[3]

Spent reactor fuel is not a waste as such. It is a source of energy given that reprocessing allows for the recovery of uranium and plutonium for recycling. However, spent fuel could eventually be categorised as waste by China when it is placed irrecoverably in long-term repositories.

[3] Agreement Between the Government of Australia and the Government of the People's Republic of China on the Transfer of Nuclear Material (Annex C).

PO Box 286
Dickson ACT 2602
arleask@gmail.com

There are a range of controls which apply to ensure the safe management of these waste streams including the following:

(a) Uranium Accounting Report and Waste Management Plan

The Australian Government has required BHP Billiton to develop a detailed Uranium Accounting Report to track the waste streams containing AONM as part of the process for considering export approval. Under that regime Olympic Dam will develop a waste management plan to ensure the waste containing AONM is properly accounted for and controlled.

(b) BHP Billiton experience will assist JV Partners

While there would be some process differences between the current Olympic Dam operations and the proposed China JV operations, as noted in section 4 of this appendix, BHP Billiton has had considerable experience over many years in managing these wastes safely and securely. This experience would be brought to bear in its JV arrangements.

(c) Contractual Controls

Under the JV arrangements with its Chinese customers (discussed above), the customer's operation will apply international standards in relation to security, safety, nuclear material accounting and the environment.

(d) International Standards

The first binding legal instrument to directly address radioactive waste management on a global scale was the 1997 *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management,* which came into force in June 2001 (Joint Convention).

The Joint Convention establishes an international legal framework for harmonising national waste management practices and standards, and imposes obligations on Contracting Parties in relation to the trans-boundary movement of spent fuel and radioactive waste. These obligations would be mainly based on the concepts contained in the IAEA Code of Practice. The obligations imposed by the Joint Convention include a requirement to establish and maintain a legislative and regulatory framework to govern the safety of spent fuel and manage radioactive waste.

Further, the Joint Convention creates an obligation to ensure that individuals, society and the environment are adequately protected against radiological and other hazards through appropriate siting, design and construction of facilities and by making provisions for ensuring the safety of facilities both during their operation and after their closure.

There are also strict controls on the movement of radioactive waste to prevent one country disposing of it in another. One such control is the IAEA Code of Practice on the International Trans-boundary Movement of Radioactive Waste (IAEA Code of Practice), which was adopted by consensus at the IAEA General Conference in 1990. The code recognises the sovereign right of every state to prohibit the movement of radioactive waste into, from or through its territory.

PO Box 286
Dickson ACT 2602
arleask@gmail.com

The code also calls on states to ensure that trans-boundary movements are undertaken in a manner consistent with international safety standards, and only take place with the prior notification and consent of the sending, receiving and transit states, and in accordance with each states' respective laws and regulations.

7.8 ESD and Product Stewardship

BHP Billiton is committed to the principles of Ecologically Sustainable Development (ESD), intergenerational equity and other long-term environmental considerations which are fundamental tenets of sustainability. Part of this commitment involves promoting and implementing stewardship principles on a whole of life cycle basis for the raw materials that it produces, including concentrate.

BHP Billiton's Stewardship Program aims to ensure that its activities, and those of the purchasers and users of its products, are technically appropriate, environmentally sound, financially profitable and socially responsible.

Those stewardship principles and their application to the export and use of concentrate in China, including the wastes mentioned above, are discussed in more detail in the paragraphs below.

(a) What are stewardship principles?

Stewardship principles are a set of formal principles that engages all players in the life cycle of a commodity where the responsibility of using a certain commodity such as uranium oxide is shared by all players in every sector in the NFC – from exploration and mining to spent fuel recycling and management, from the production of medical resources to the operation of nuclear power.

(b) Involvement in the Australian Uranium Association

BHP Billiton was a founding member, and currently chairs the Board of Directors, of the Australian Uranium Association (AUA) whose members include the country's leading uranium exploration, mining and exporting businesses.

The AUA was established in 2006 for the following purposes:

- to enable businesses involved in the exploration, mining and exporting of uranium oxide to contribute to emerging policy debates about the expansion of the industry
- to enable the safe, efficient and productive development of the uranium industry
- to obtain a better understanding of the global context in which the uranium industry operates
- to ensure stakeholder and public confidence in the industry.

PO Box 286
Dickson ACT 2602
arleask@gmail.com

(c) The Uranium Stewardship Principles

In September 2006, the AUA established a Uranium Stewardship Working Group (chaired by BHP Billiton) (Working Group).

The Working Group established a programme aimed at ensuring that all uranium oxide and its by-products are managed in a safe, environmentally responsible, economically and socially acceptable manner. At present, the Working Group is developing the Uranium Stewardship Principles (Principles) which are supplementary to the broader Australian Minerals Industry's commitment to sustainable development[4] and to the AUA's Charter and Code of Practice.

In developing the Principles and the Uranium Stewardship Program, a number of other authorities were consulted including:

- Australian Government – to promote stewardship principles both in Australia and recently through APEC economies
- intergovernmental agencies who work closely with the IAEA
- non-government organisations (NGOs) – BHP Billiton hosts regular stakeholder conferences and has sought feedback from NGOs on what would constitute uranium stewardship; and
- investment organisations – both BHP Billiton and the World Nuclear Association have conducted dialogues in Australia and in London with the aim of seeking feedback on what would constitute uranium stewardship. It is proposed to hold another dialogue at the Global Nuclear Fuel Cycle Conference in Sydney in April 2009.

The Working Group has developed and BHP Billiton has committed to the following Stewardship Principles, with the goal of reducing as far as practicable any residual risk for harm to people and the environment:

- support the safe and peaceful use of nuclear technology
- act responsibly in the areas that we manage and control
- operate ethically with sound corporate governance
- uphold and promote fundamental human rights
- contribute to social and economic development of the regions in which we operate
- provide responsible sourcing, use and disposition of uranium oxide and its by-products
- encourage best practice and responsible behaviour throughout the NFC
- improve continually in all areas of our performance
- communicate regularly on progress
- review and update as necessary.

[4] As outlined in Enduring Value - The Australian Minerals Industry Framework for Sustainable Development

PO Box 286
Dickson ACT 2602
arleask@gmail.com

(d) Consistency with the World Nuclear Association Principles

It is important to note, in the context of the NFC, that the Principles being developed by the AUA also reflect the global principles being developed under the auspices of the World Nuclear Association (WNA).

The WNA is a global private-sector organization that seeks to promote the peaceful worldwide use of nuclear power as a sustainable energy resource for the coming centuries. Specifically, the WNA is concerned with nuclear power generation and all aspects of the NFC, including mining, conversion, enrichment, fuel fabrication, plant manufacture, transport, and the safe disposition of spent fuel.

The WNA has the following specific functions:

- to facilitate members interacting on technical, commercial and policy matters and promoting wider public understanding of nuclear technology
- to serve as the pre-eminent global forum and commercial meeting place for those engaged in providing the world's largest source of safe, economic and environmentally friendly energy
- to provide a respected information service on nuclear energy and to speak pro-actively on behalf of nuclear energy amongst policymakers, opinion leaders, the media and the public.

In April 2006 the WNA established a Uranium Stewardship Working Group (chaired by BHP Billiton). The Working Group comprises over 80 members from all sectors and services of the uranium life cycle.

The WNA has agreed to the same Stewardship principles as outlined above and has developed a Code of Practice to support those principles which has recently been finalised (see attached supplement).

(e) Application of the Stewardship Principles to concentrate export

When applied to the export of concentrate, the Uranium Stewardship Program and the adoption of the Principles, means that BHP Billiton would have a direct responsibility in the areas and functions that it controls and operates, and a shared concern in those areas and functions where others have a direct responsibility.

BHP Billiton will continue to work with all other entities in all sectors of the life cycle of uranium and its by-products to reduce opportunities for harm to people and the environment. Since entering the nuclear industry in 2005, BHP Billiton has supported leadership in the development of national and international Uranium Stewardship Working Groups that assist global players in the life cycle of uranium to work together to provide assurance that no harm comes to people and the environment as a result of using uranium as a fuel source.

While the verifiable standards for uranium stewardship are still being developed, several interim measures are currently in place that either reflect national and international regulation, or company (eg BHP Billiton HSEC Standards) or industry values (eg ICMM's Sustainable Development Principles and Minerals Council of Australia's Enduring Value).

The performance criteria associated with the BHP Billiton HSEC standards are verified in a triennial audit and also verified by some of the company's customers (eg Vattenfall's ESD questionnaire and site audit). The development of the Stewardship Principles and performance criteria will reflect the shared responsibility and shared concern by all players in the uranium life cycle. These performance criteria will cover not only the primary sectors in the NFC (mining, conversion, enrichment, fuel fabrication, power generation and waste disposal) but also the links between the sectors (eg the transport connections).

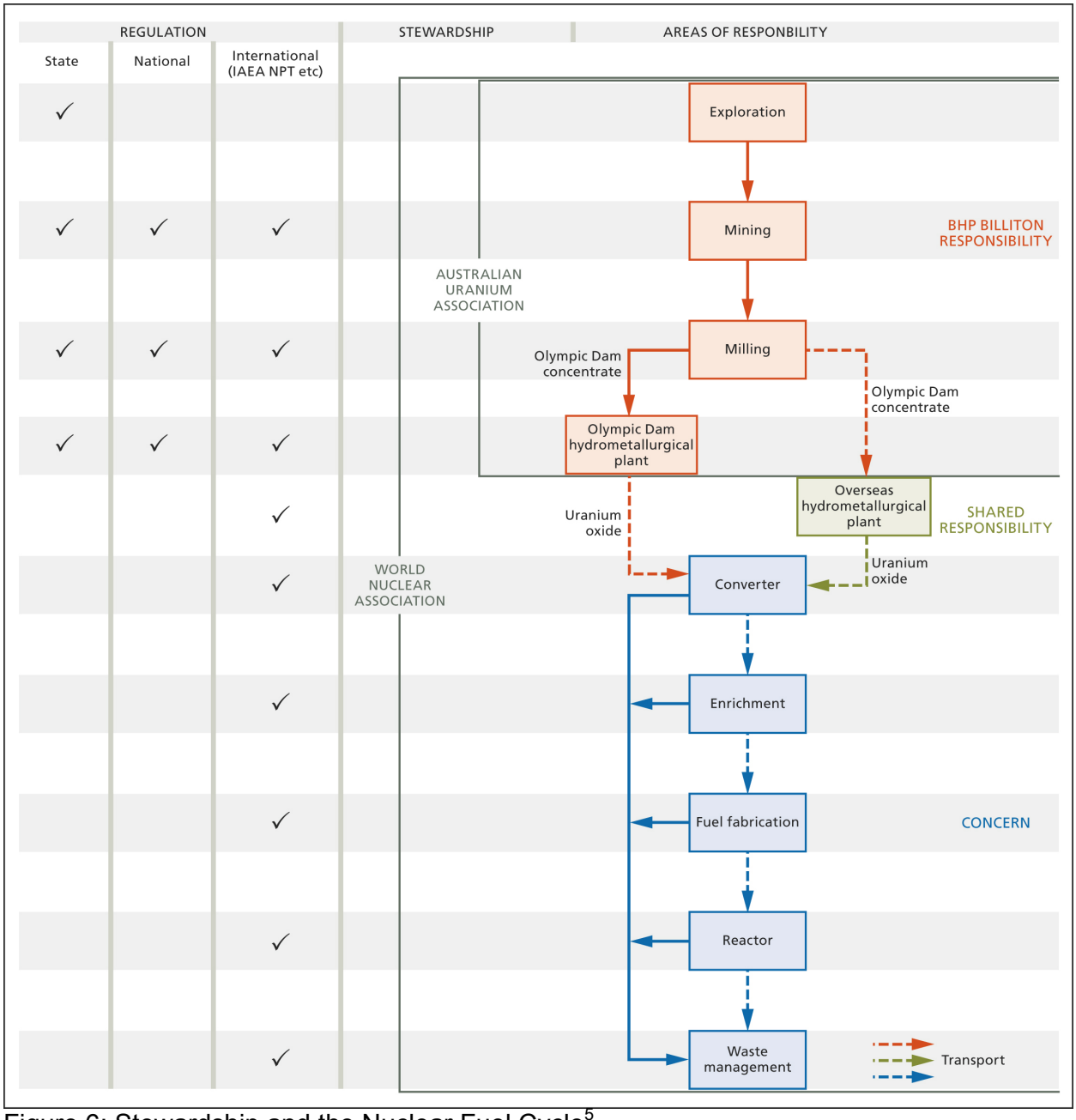


Figure 6: Stewardship and the Nuclear Fuel Cycle[5]

[5] The Australian Uranium Association (AUA) and the World Nuclear Association (WNA) are recognised non-government organisations which, with the full participation of the Australian and international nuclear industries respectively, set benchmarks and coordinate industry standards and stewardship programs. These organisations do not implement such standards: that responsibility lies with industry and Governments

PO Box 286
Dickson ACT 2602
arleask@gmail.com

7.9 No Wastes to be returned to Australia

There is no intention on the part of BHP Billiton or the Australian Government that any of the waste streams from the NFC discussed in section 7.8 above would be returned to Australia.

The return of the waste to Australia would be contrary to long standing Australian Government policy as well as being contrary to international practice which dictates that the country which produces the nuclear waste is also responsible for its management and long term disposal. In accordance with that approach, all of the waste streams would be managed in China in accordance with domestic and international regulatory requirements. Accordingly, the proposed Olympic Dam expansion would not require a long-term nuclear waste facility in Australia.

APPENDIX E4

Port of Darwin

CONTENTS

E4 PORT OF DARWIN

E4.1 INTRODUCTION

BHP Billiton is proposing to expand its existing mining and minerals processing operation at Olympic Dam, located about 575 km by road north-north-west of Adelaide in South Australia (see Figure E4.1). The Draft EIS presents the findings of environmental, social, cultural and economic assessments undertaken to determine the potential impacts of, and benefits from, the proposed expansion. It is the primary source of information for public comment and the Australian, South Australian and Northern Territory governments' decision about whether the proposed expansion can proceed.

The proposed expansion is seeking government approval for the project configuration detailed in Chapter 5 of the Draft EIS (Description of the Proposed Expansion). This configuration would increase total production to 750,000 tonnes per annum (tpa) of refined copper equivalent, 19,000 tpa uranium oxide, 800,000 ounces per annum (oz/a) gold and 2.9 million oz/a silver. The 750,000 tpa of refined copper equivalent would consist of:

- about 350,000 tpa of refined copper processed at Olympic Dam from 800,000 tpa of the copper-rich concentrate. This concentrate would be derived from higher-grade ore
- about 1.6 Mtpa of the copper-rich concentrate to be exported via the Port of Darwin for processing by overseas customers. This concentrate would be derived from the lower-grade ore and is expected to yield about 400,000 tpa of refined copper. The exported concentrate would also have recoverable quantities of uranium oxide, gold and silver and is hereafter termed 'concentrate'.

About 30% of the uranium oxide produced at Olympic Dam has been exported via the Port of Darwin since January 2005.

BHP Billiton has developed objectives for the health, safety, environment, community and economic components of the proposed expansion. These are being addressed in the environmental assessment process and would continue to be met in the planning, construction and operation phases, and on closure. The objectives are to:

- enhance the safety and environmental performance of the Olympic Dam operation
- maximise the value of the deposit for the benefit of the BHP Billiton Group shareholders, the nation and the community
- maintain a major source of employment in South Australia
- enhance the current opportunities, lifestyle and amenities for local and regional communities
- enhance the relationship and communication with traditional land claimant groups
- design, construct, operate and decommission an expanded operation that minimises the impact on, and maximises the benefits to, the environment and community.

The Draft EIS addresses the requirements of the joint Australian and South Australian government EIS guidelines, published in January 2006 (see Appendix A1) and the South Australian Government guidelines published in November 2008 (see Appendix A2). It also addresses the requirements of the Northern Territory Government guidelines, which provide requirements specific to the proposed Northern Territory Transport Option (see Appendix A3 for the 'Guidelines for Preparation of an Environmental Impact Statement, Olympic Dam Expansion (NT Transport Option) Project'; Northern Territory Department of Natural Resources, Environment, The Arts and Sport November 2008).

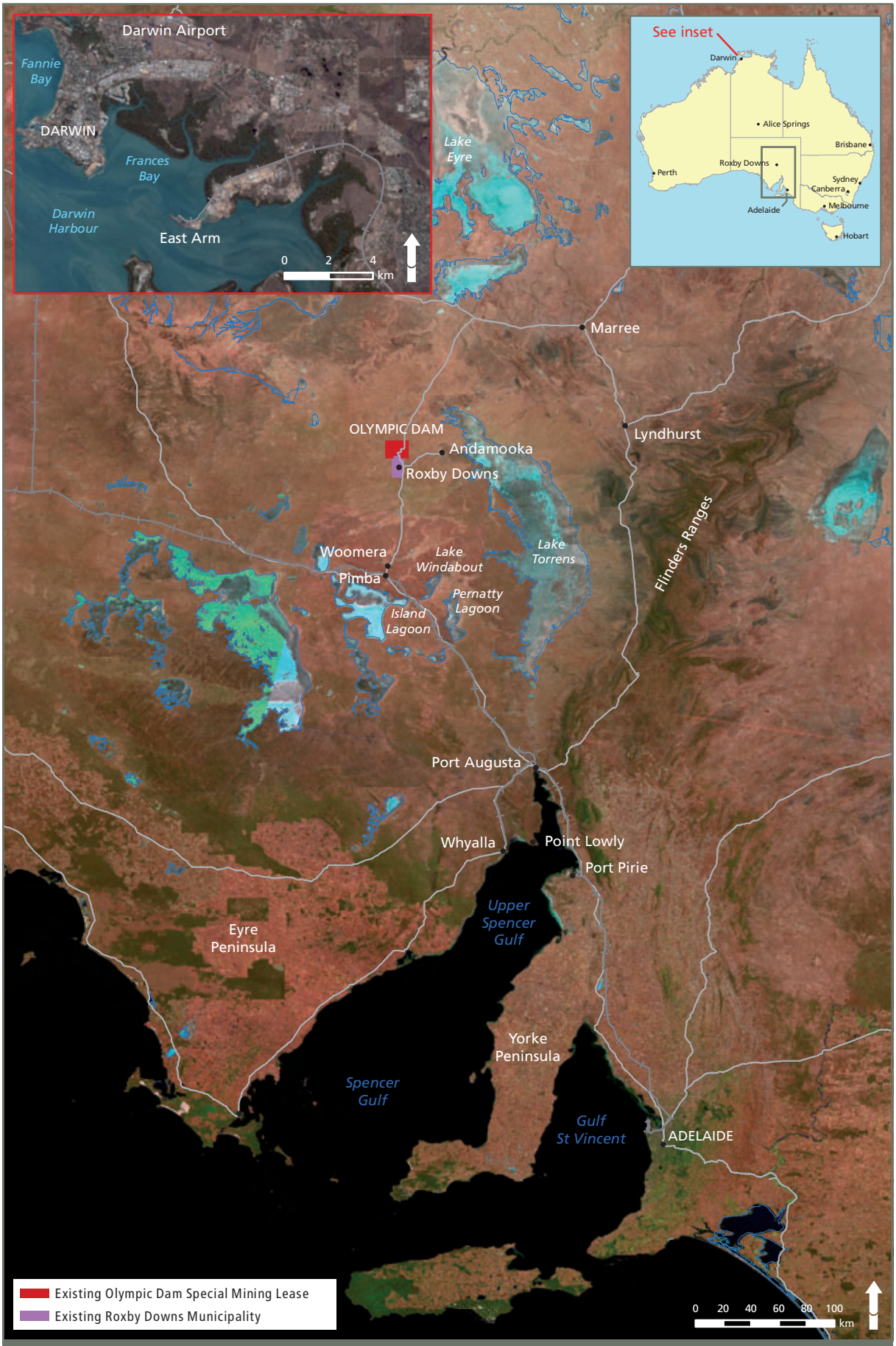


Figure E4.1 Location of Olympic Dam

This appendix has been provided as a collation of the information presented throughout the Draft EIS so that issues relevant to the NT Transport Option could be more easily accessible to the reader.

It is noted that no formal agreement between BHP Billiton and the Northern Territory Government for the proposal described in the Draft EIS or this appendix is in place. If and when required, BHP Billiton would undertake commercial discussions with the Northern Territory Government and other relevant parties to establish suitable agreements to locate the proposed facilities at the Port of Darwin, East Arm.

E4.2 DESCRIPTION OF THE PROPOSAL

E4.2.1 Timing

If the expansion project receives all necessary approvals, open pit mining at Olympic Dam is scheduled to begin in 2010. More than 300 m of cover sequence (overburden) is to be removed before the economic ore is reached, and this would take about five years. As such, the export of additional uranium oxide and the new concentrate product through the Port of Darwin would not commence until about 2016. For the purpose of the Draft EIS, the life-of-mine has been assessed at 40 years. The large size of the mineral resource, however, suggests that mining at Olympic Dam would continue well beyond this.

The proposed expansion would increase the production of uranium oxide from about 4,000 tpa to 19,000 tpa, which equates to an increase from 200 to about 900 shipping containers per annum. Olympic Dam currently exports uranium oxide via the Port of Darwin and Outer Harbor (Port Adelaide), and this is expected to continue for the expanded operation. The exact quantity of uranium oxide to be exported via the Port of Darwin is yet to be determined. Irrespective of the increased volume of containers, no new facilities to accommodate the additional uranium oxide are anticipated.

New facilities would be required, however, to accommodate the new concentrate product. A description of the proposed facilities is provided in Section E4.2.3. It is expected that it would take two years to construct these facilities.

Once operational, a daily train service would transport concentrate from Olympic Dam to the East Arm storage facility. The concentrate would be conveyed to a Panamax-class vessel approximately every two weeks. No additional rail movements would be required to transport the uranium oxide containers; these would be attached to the concentrate train as required.

E4.2.2 Uranium oxide

Uranium oxide is packed and sealed into 200 litre drums, which are then sealed inside standard ISO (or equivalent) shipping containers at Olympic Dam. Some of these containers would then be railed from Olympic Dam to the Port of Darwin on the existing Adelaide to Darwin rail line (plus the new 105 km rail line built to connect Olympic Dam to the national rail network). Other containers containing uranium oxide would be exported via Outer Harbor in South Australia.

The timing of rail movements for the uranium oxide would be determined by shipping schedules, with the containers despatched from Olympic Dam at a time that minimised the storage time between train arrival and vessel arrival at the Port of Darwin.

As occurs at present, the uranium oxide would arrive at the Berrimah Freight Terminal and be immediately transferred by road to the Tolls distribution terminal at East Arm for short-term storage in a secure, dedicated and Australian Safeguards Non Proliferation Office (ASNO) approved facility. The uranium oxide is then transported by road from the Tolls terminal to the East Arm wharf for loading on the nominated export vessel. The short-term storage area at the Toll facility accommodates Olympic Dam (BHP Billiton), Heathgate Resources and Ranger (ERA) uranium oxide containers for export.

All transport by road and rail currently complies, and would continue to comply, with relevant legislative requirements and conforms to Transport Plans approved by ASNO and the South Australian and Northern Territory governments (see Appendix E3 for details).

E4.2.3 Concentrate

The proposed expansion is a progressive ramp-up of ore production and minerals processing over an 11-year construction period. The volume of concentrate to be exported would also ramp up, reaching about 1.6 Mtpa by about 2020 (with an allowance for a production variation of 20%). To minimise dusting, the concentrate would be maintained at a moisture content between 8 and 11%, which would result in the volume of concentrate increasing from 1.6 Mtpa dry to 1.8 Mtpa wet. Reference to volume in this appendix and throughout the Draft EIS refers to the dry weight of 1.6 Mtpa.

The following sections describe the facilities required to transport, store and handle the Olympic Dam concentrate. It is noted that the final location of the proposed facilities at East Arm would depend on the availability of land. Given the long lead time before the facilities are required (i.e. about 2016), and the Darwin Port Corporation's plans to make additional land available by

reclamation close to the East Arm wharf, the assessment has been developed on the basis that a land based storage and handling solution would be available. In other words, for the purpose of the Draft EIS, no reclamation of land would be undertaken by BHP Billiton to construct or operate the required facilities.

Characteristics of the concentrate

The current Olympic Dam operation extracts ore and trucks it to a series of primary crushers for crushing and conveying to an ore stockpile. Ore from the stockpile is conveyed to grinding mills, where it is further crushed, with the addition of water, to form a slurry prior to progressing to the separation stage. Olympic Dam uses a conventional flotation process to separate the bulk of the copper-bearing minerals from the mined ore, producing a copper-rich concentrate and uranium-rich tailings (see Chapter 5, Description of the Proposed Expansion for details). This method of mining and producing concentrates would continue for the proposed expansion. Up to 1.6 Mtpa of the Olympic Dam copper-rich concentrate would be railed to the Port of Darwin for export.

The concentrate is an odourless black powder (averaging 25–40 microns), which is insoluble in water. The moisture content would be maintained between 8% and 11%, thus avoiding the potential for excessive dust generation (if too dry) or becoming a slurry (if too wet). Table E4.1 provides the composition of the concentrate.

Most of the uranium in the original ore passes into the uranium-rich tailings, from which it is extracted as uranium oxide at Olympic Dam. However, some remains within the copper-rich concentrate. The uranium content in the concentrate is expected to be between 1,000–2,000 ppm (compared to 900,000 ppm for the uranium oxide). The uranium content in the concentrate is sufficient for it to be considered radioactive under South Australian and Northern Territory legislation. As such, it would be transported as specified by the Australian Radiation Protection and Nuclear Safety Agency's 'Code of Practice for the Safe Transport of Radioactive Material 2008'.

Table E4.1 Composition of the concentrate

Element	Abbreviation	Content
Copper (%)	Cu	31–36
Iron (%)	Fe	24–27
Lead (%)	Pb	<1
Silicon (%)	Si	2–3.5
Gold (ppm)	Au	7
Silver (ppm)	Ag	43
Uranium oxide (ppm)	U_3O_8	1,000–2,000

Site selection, location and layout

BHP Billiton understands that the Darwin Port Corporation is revising the current East Arm Master Plan and that further facility location options may be available in the future. The Draft EIS includes concept layouts based on the current understanding of land availability. However, the ultimate location of the facilities could be anywhere within the area proposed for future development in the current East Arm Master Plan (see Figure E4.2), and would be determined with the Northern Territory Government and Darwin Port Corporation based on available land closer to the required time.

While this flexibility in site location is appropriate, it does not affect the ability to assess the environmental issues associated with the proposal because the Draft EIS and this appendix clearly define the design controls and management measures that would be implemented to facilitate acceptable environmental and social outcomes.

Figure E4.3 shows the concept plan for the preferred location and layout of the new concentrate handling facilities. This location provides the following advantages:

- it is within the existing area of the Darwin Port Corporation's East Arm Master Plan
- the BHP Billiton facilities would be integrated and aligned with existing infrastructure
- it locates the required infrastructure on lands that are already ecologically degraded (on the basis that the footprint areas would be reclaimed by Darwin Port Corporation and available ahead of BHP Billiton's infrastructure requirements)
- it minimises transfer distances from storage facilities to ship loader
- it segregates BHP Billiton's infrastructure from the port activities into a secure area.

To demonstrate that a land-based solution is available irrespective of future reclamation, an alternative concept layout has been prepared and is shown in Figure E4.4. This location is less favourable as it is located further from the wharf.

Figure E4.2 Potential location of facilities – allowing for future port development

Figure E4.3 Concept layout – currently preferred option

Figure E4.4 Concept layout – land-based option

Proposed infrastructure

The total footprint area required for the proposed facilities would depend on their ultimate location. For the preferred option as shown in Figure E4.3, the area would be about 16 ha, comprising approximately:

- 12 ha for the rail loop and embankments
- 4 ha for the concentrate storage shed, ancillary infrastructure of office buildings and maintenance areas
- 0.2 ha for the rail unload and wash-down facility for the wagons.

The footprint area would be slightly smaller if a rail spur and embankment, rather than a rail loop, were constructed. However, the rail loop would provide increased operational efficiency.

Closed system

A closed transportation system would be implemented to transport, handle and load the concentrate for export because the concentrate contains low levels of uranium and triggers the requirement to be handled and transported as a radioactive substance. As part of the closed system, rail wagons and the transfer from rail wagon to the concentrate storage shed at the East Arm facility would be enclosed. The storage shed would be fitted with automatic doors, and a negative pressure particulate filtration and building ventilation system would be installed. Water recycling systems for washing the outside of the rail wagons after tipping their load would also be installed. The closed system would extend to the ship loading activities via enclosed conveyors, dedicated ships, as well as shipping to designated ports (although the latter is outside the scope of the EIS). Figure E4.5 illustrates the major components of this system and further details are provided below.

Rail operations

When operating at full capacity and exporting 1.6 Mtpa of concentrate, a daily train service to the East Arm facility would be required. The rail configuration would comply with the appropriate legislative requirements, safety procedures as stipulated by the South Australian and Northern Territory governments, and the operating guidelines and standards of the rail track owners (the Australian Rail Track Corporation (ARTC) and Australian Pacific Transport (APT)).

It is anticipated that the train would be up to 1.8 km long and carry about 5,000 tonnes. The maximum train operating speed would be 80 km/h, and dedicated wagon rolling stock rated at 23 tonne per axle would be used. All wagon rolling stock would have clearly displayed signs advising that it is conveying radioactive material. Rail wagons would be effectively sealed with suitable covers which would be fitted so that concentrate would not escape under routine conditions of transport.

When the trains arrive at the BHP Billiton East Arm facilities, the locomotive would be disconnected and diverted outside the rail unloading facility. Rail wagons would be moved through the unloading facility using a wagon indexer, and the covers would be removed to discharge the concentrate and replaced after it has been discharged.

The wagons would be unloaded inside an enclosed facility utilising a tippler operation to discharge the concentrate into an underground bin/conveyor for movement to the storage facility. Automatic doors at either end of the unloading facility would rise and drop between each rail car.

The external surfaces of each rail wagon would be washed immediately after the unloading operation to remove dust particles. The water used to wash the rail wagons would be collected and treated to recover concentrate particles that may have attached to the outside of the wagon during unloading (i.e. tippling). The treated water would be contained in on-site storage tanks for reuse in subsequent wash cycles, and any collected solids would be placed on the concentrate stockpile for export. This would create a zero discharge water decontamination system.

From time to time (preliminary estimates suggest about every four to six months), a proportion of the wash-down water would be removed from the system which would then be 'topped up' with replacement water. The removed water would be discharged into a holding tank or similar unit and be railed back to Olympic Dam to be disposed of within the Olympic Dam tailings storage facility or incorporated into the Olympic Dam process.

Preliminary estimates suggest that up to 0.6 megalitres (ML) would be required to wash the external surfaces of the rail wagons. Depending on the method used to treat the wash-down water (and thus the retention time to allow solids to separate), and the frequency of topping up the wash-down water system, the annual water demand may be up to 2.5 ML.

Unloading station

The unloading (or dump) station would be a reinforced concrete structure, cast *in situ*, with the internal design incorporating lifting equipment, monorails and lift wells, as required. It would also provide sufficient space to enable maintenance and housekeeping functions.

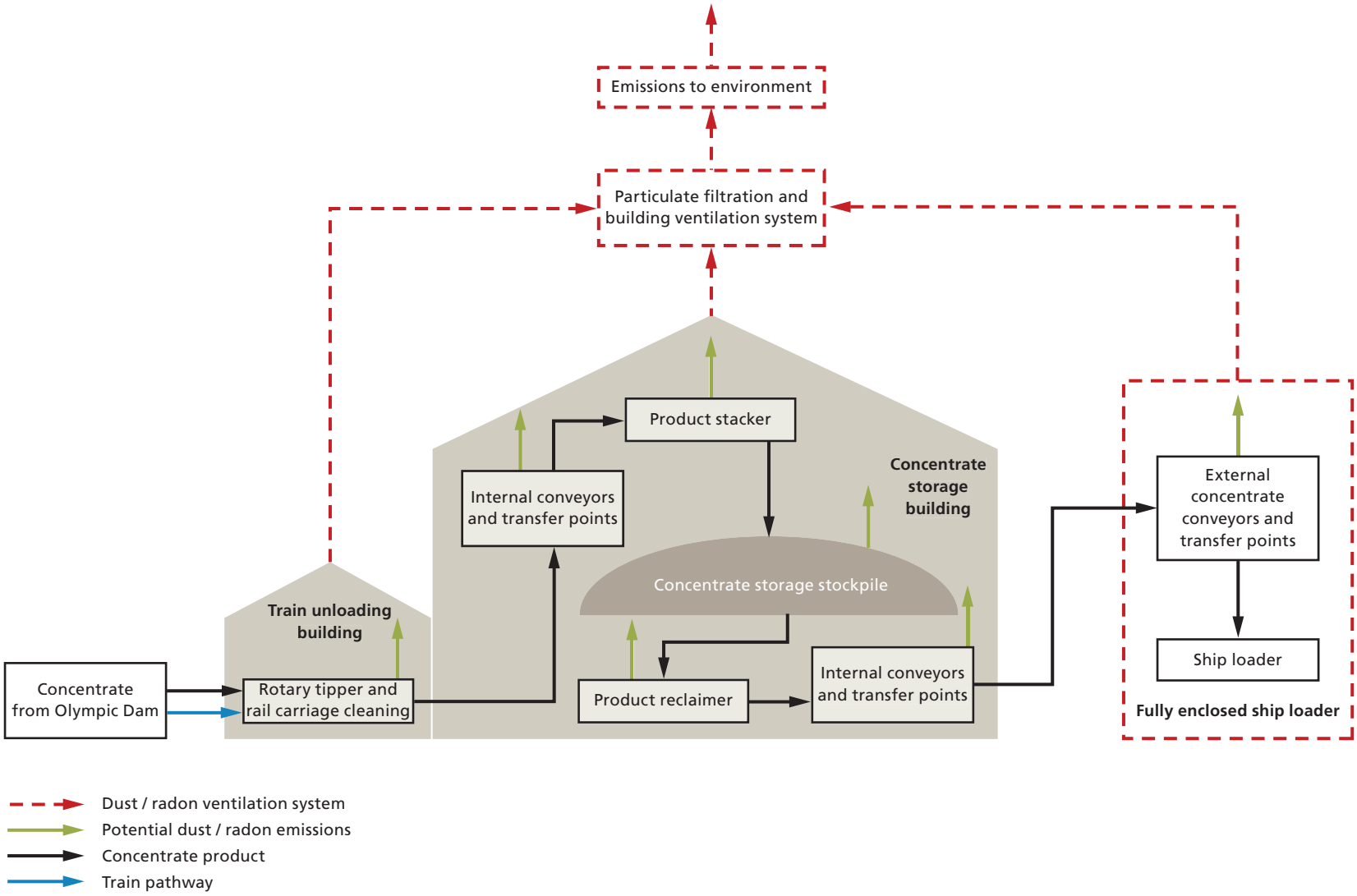


Figure E4.5 Closed storage and handling process

Below ground, the unloading station would include the following equipment:

- dump hopper
- belt feeder
- transfer to conveyor
- dust extraction bag house/ventilation system
- access stairs
- collection sump
- sump pump (slurry).

The rail wagons would be rotated to discharge their load into the hopper. A conveyor would move the discharged load onto a stockpile to await export. Above ground, the unloading station would be enclosed in a steel framed building to ensure the operation is contained and protected from the weather.

Conveying and materials handling

Safety and quality control underpin the BHP Billiton Group operating philosophy, and this is particularly important for conveying and materials handling. All conveyor transfer points would contain fully enclosed spoon chutes, with dust curtains at entry and exit points. Dust suppression mist sprays would be located within the skirts after the loading point and would cover the full width of the conveyed material.

The following steps are proposed to minimise and manage potential spillage:

- elevated conveyor galleries would be enclosed and have sealed floors
- floor drains would be provided as required for wash-down of the gallery floors
- conveyor filling ratio and belt speed would be selected to reduce the risk of spillage
- wash-down water/slurry would be recycled on-site providing a zero discharge rail wagon decontamination system.

The alignment of the conveyor from the storage shed to the wharf would depend on the ultimate site layout of the storage facility. Irrespective of the location, the conveyor would be enclosed and elevated.

The wharf conveyor would feed the ship loader via a travelling tripper. Again, the conveyor would be enclosed with suitable protection over the longitudinal slot to allow the passage of the tail of the ship loader, but not to provide a conduit for dust emissions under normal operating conditions. A certified belt weigher (0.5% accuracy) would be provided on the berth conveyor after the loading skirts. A nominal design capacity of 1,200 tonnes per hour would be used for the conveyors.

Concentrate storage shed

The storage shed would be a dry stockpile facility with a capacity of 90,000 tonnes.

As part of the closed system, the concentrate storage shed at the East Arm facility would be a fully enclosed building fitted with automatic doors and a dust management system. Ventilation equipment would include scrubbers, filtration and dust suppression. The ventilation system would provide negative pressure and allow for the collection and filtering of concentrate stockpile emissions and particulate emissions produced by the reclaim equipment. The ventilation and filtering system is hereafter collectively termed the particulate filtration system.

Product would be reclaimed from the stockpiles and transferred into reclaim hoppers using front-end loaders. Each hopper would have a sufficient volume to accommodate the required flow characteristics, with maintenance access provided to dust filters. A means of flow control would be provided at each hopper.

Ship wharf loader

The existing East Arm wharf infrastructure has the capacity to cater for an additional ship loader. A dedicated wharf loader would be required to transfer the concentrate into the export vessel. The ship loader would be:

- a 1,200 t/h travelling ship loader with rail spacing designed to match the existing East Arm rails
- loading into a Panamax-class ship with 170 m hatch length
- fitted with appropriate spillage, wash-down collection and dusting control devices.

Ship calls

Based on the Panamax vessels loading approximately 60,000–65,000 tonnes per call, it is anticipated that there would be approximately 24–27 calls per year to East Arm, or about one call every two weeks.

Loading time is expected to be about 50 hours per call, subject to berth requirements, tide and weather conditions (noting that loading would not occur during periods of heavy rainfall, storms, or cyclone events).

Office buildings and maintenance area

Strict procedures and controls would be implemented to maintain separation between areas where concentrate is handled and those areas which have not been exposed to concentrate.

Before operating equipment could be removed from designated concentrate handling areas, wash-down procedures would be followed before the equipment was transferred to nominated clean areas for repair or maintenance.

Utilities and services

The utilities and service requirements for concentrate storage and handling at East Arm are shown in Table E4.2.

Table E4.2 Utility and service requirements

Utility	Requirement
Electricity	Would be supplied from existing East Arm infrastructure
Communications	Would connect with existing East Arm infrastructure
Water	Annual demand may be up to 2.5 ML
	Connected to existing East Arm infrastructure and supplemented where practical with collected stormwater.
	30 L/s @ 200 kPa (if fire appliances in attendance)
	30 L/s @ 700 kPa (if fire appliances not in attendance)
	Fire storage capacity: 500,000 L water tank if mains insufficient
Waste water	Sanitary waste: would connect with the existing East Arm infrastructure
	Wash-down bay: laundry area collected, treated and recycled
	Industrial waste from workshop, drainage sediment and wash-down sediment removed from site and disposed of in accordance with NT Government/BHP Billiton procedures
Fuel, oils	Mobile plant: 10,000 L diesel stored and bunded to Australian Standards
	Small quantities of oils, lubricants, industrial solvents and cleaning material

Security

BHP Billiton would collaborate with the Darwin Port Corporation and relevant regulatory authorities and agencies to develop and implement a site-specific security management plan. The plan would include the installation, monitoring and maintenance of appropriate security measures around the proposed unloading, storage, and office and maintenance areas to prevent unauthorised access to the facilities. Such measures may include secure mesh fencing with razor wire, closed-circuit television and sensor movement detectors, alarm systems and 24-hour security patrols.

As the handling system of conveyors and transfer towers from the storage facility to ship loader is enclosed, all access points would be locked and secure at all times. Alarm systems and remote sensors would be fitted at access points and connected into the overall security control system for the facilities.

As the proposed facilities are within the Port of Darwin jurisdiction, the Australian Government maritime ports security program would also apply. All construction and operation employees would be required to possess and carry a Maritime Security Identification Card. Visitor access would be strictly controlled at all times and would comply with both BHP Billiton and Port of Darwin requirements.

Construction phase

The concentrate storage shed and rail spur would be constructed to withstand flooding in a 1-in-100 year ARI rain event, which would include concrete perimeter bunding and require the facilities to be constructed to align with the existing height levels for East Arm facilities.

Infrastructure would be constructed to the necessary cyclone rating building standard codes and requirements for facilities as stipulated by government regulations and the Darwin Port Corporation.

The construction phase would involve the following:

- civil works – bulk earthworks, access roads, road and rail structures, laying of rail track, security works, utilities and stormwater drainage controls
- buildings and structures – storage facilities, workshops, administration and support facilities and building services
- materials handling equipment – ship loaders, rail loaders and unloaders, conveyors and associated equipment
- procurement of major equipment – locomotives, rolling stock, front-end loaders and other required mobile or fixed plant and equipment
- integrated logistics support – maintenance arrangements, consumables, recruitment, training, administrative systems and permits and access requirements.

Rehabilitation and decommissioning

The BHP Billiton Group implements a closure standard that requires all operations to develop, review and update closure plans as required. Either the existing Olympic Dam Closure Plan would be updated to include the proposed East Arm facilities, or a site-specific plan would be developed. The BHP Billiton Group Closure Standard identifies the following principles for rehabilitation and closure, and these principles would be adopted for the rehabilitation and decommissioning of the proposed East Arm facilities:

- closure planning is incorporated into the design, construction and operation phases
- progressively rehabilitate and stabilise disturbed areas as soon as possible
- seek opportunities to reuse/recycle redundant assets during operations and on closure
- infrastructure is decommissioned in accordance with environmental, health and safety objectives.

The timing of decommissioning for the proposed facilities would depend on the operating life of the Olympic Dam mine. For the purpose of the Draft EIS, closure has been assumed at Year 40 (or 2050). However, based on the large size of the Olympic Dam mineral resource, it is likely that the operation would extend beyond this time.

Workforce

Construction

It is anticipated that up to 50 personnel would be required to construct the concentrate storage and handling facilities and that these personnel would be accommodated in Darwin. Most would be civil construction workers, including tradespersons (electrical, mechanical and fabrication), intermediate production and transport workers (such as plant operators, drivers and construction workers), labourers (such as concreters), and a small number of supervisors and managers.

Operation

It is anticipated that there would be an office building, small maintenance facility and warehouse near the concentrate storage shed. Approximately 50 personnel would be required during the operation phase of the concentrate handling facility.

All site personnel would remove site-based clothing, shower and change into non-work clothes when leaving site. All work clothes would be retained on-site and laundered.

E4.3 PROJECT ALTERNATIVES

Chapter 4 of the Draft EIS (Project Alternatives) discusses the major alternatives investigated for the Olympic Dam expansion. Three of these are of specific relevance to the NT Transport Option:

- the decision to expand Olympic Dam
- the decision to export concentrate rather than process all of the concentrate at Olympic Dam
- the port from which the concentrate would be exported.

E4.3.1 Decision to expand Olympic Dam

Chapter 3 of the Draft EIS (Project Justification) discusses the drivers that support the proposed Olympic Dam. These are largely focused on maximising the economic return of the world-class ore body. The following discusses the consequences of not proceeding with the expansion.

Not proceeding with a feasible development project would typically entail the inverse of its benefits and drawbacks. However, if the project does not proceed as planned, then it may well remain as a development option for the future, with these costs and benefits merely deferred.

Nonetheless, the consequences of the forgone benefits (especially) and impacts do have some immediacy:

- the time value of money means that collateral benefits now are preferable to later
- a new development adds to the critical mass of the industry, from which a number of benefits flow beyond the confines of the project itself.

Thus the consequences of not proceeding fall into two groups: specific benefits (and costs) forgone or delayed; and strategic opportunity costs.

The specific benefits and costs which would be forgone mainly comprise the economic benefits of the project over the first 30 years expressed as increases above the business-as-usual case (BAU case) projections in net present value (NPV) terms. These include (see Chapter 21, Economic Assessment, for details):

- $18.7 billion in Australia's gross domestic product (GDP)
- $45.7 billion in gross state product (GSP) in South Australia
- $22.6 billion in gross regional product (GRP) in the Northern Statistical Division
- $936 million in gross state product (GSP) in the Northern Territory
- private consumption of goods and materials in Australia would be around $21.8 billion higher than otherwise. The benefits of this increase in living standards would be concentrated in South Australia.

Other benefits which would be forgone include:

- business opportunities in South Australia and the Northern Territory
- 4,000 new full-time jobs plus a peak of 6,000 short-term jobs (over and above the current Olympic Dam workforce)
- a legal trust to hold funds for the long-term benefit of Aboriginal communities in northern South Australia
- the potential to supply water to the Upper Spencer Gulf and Eyre Peninsula areas from the Point Lowly desalination plant (with the South Australian Government's participation) thereby reducing the region's current reliance on the River Murray by up to 30 GL per annum of water (see Chapter 4, Project Alternatives, for details).

In addition, some improvement opportunities created by the proposed expansion would be lost, for example:

- improvements to water management and the opportunity for a long-term reduction in the exposure of water birds to acidic solutions
- redundancy in the acid plant to avoid emissions of untreated sulphur dioxide off-gases
- electricity cogeneration to use waste heat from the acid plants
- the greater range and diversity of facilities and opportunities in Roxby Downs that would come with a larger population.

On the other hand, the impacts of the project described in the Draft EIS would not occur, notably:

- a major increase in the project footprint and associated vegetation clearance and habitat loss
- increased dust, noise and radon emissions
- the amenity and safety impacts of construction traffic.

The immediate opportunity costs of the 'no project' option have been listed above. There are broader consequences as well.

Only the largest and most capable mining companies in the world could deliver a project on the scale of the proposed Olympic Dam expansion. Such projects are rare, so the opportunity cost in economic and human capital (i.e. upskilling many people) of not proceeding with the project would be deferred or lost.

For the mining sector as a whole, to lose a project of this scale would be to forgo a rare opportunity for stability and continuity. In this industry, most mines open and close within a timeframe of a decade or two. A mine with a life of many decades or perhaps half a century or more would become a cornerstone for the development of human capital (i.e. a workforce of skilled professionals and experienced tradespersons from which other mines and industries may benefit). Individual mines may come and go, but skilled personnel will always be needed to extract and process metals to meet global demands.

For the broader community, no expansion project would mean the opportunity to develop a more diverse and resilient regional economy and to improve access to human services facilities would be lost.

E4.3.2 Decision to export concentrate

Thirteen of the 20 largest copper mines in the world export concentrate to other smelters where it is processed to make the final product (i.e. high purity copper cathodes). Olympic Dam currently processes the ore to final product because its ore body contains recoverable quantities of uranium oxide, gold and silver and because removing uranium from the final copper product makes the copper more saleable.

Selected option

The selected option is to upgrade the existing metallurgical plant (particularly the smelter and refinery) to produce up to 350,000 tonnes per annum (tpa) of refined copper, and construct a new concentrator and hydrometallurgical plant to produce enough concentrate to feed the upgraded smelter and to export up to 1.6 Mtpa. Although the exported concentrate would contain recoverable quantities of copper, uranium oxide, gold and silver, this option still provides the optimal return on investment to BHP Billiton.

The selected option removes the operating constraint that is inherent in trying to match the design capacity of an on-site smelter with the volume of ore mined. This means that at any given time, the volume and grade of ore extracted would vary depending on the distribution and mineralisation of the ore within the basement material being mined. Smelters, on the other hand, have an optimal design capacity. Therefore the variable supply of ore typically results in either large ore stockpiles required to blend the various grades of extracted ore, or the smelter operating under capacity or inefficiently. The selected option allows for an unconstrained mining operation to supply more than enough ore of a consistent high grade to operate the on-site smelter at its design capacity and to export the additional concentrate.

Reasons for rejecting other options

Construct a new plant at Olympic Dam to process all recovered ore

This alternative was rejected because:

- the capital cost for the additional smelter would not provide the optimal return on investment
- the lower copper grade and lower copper-to-sulphur ratio of the southern ore body would necessitate a different smelting technology than that currently used at Olympic Dam (i.e. two-staged smelting instead of single-staged smelting). Running two smelters with different technologies would increase the complexity of on-site metallurgical processing.

Upgrade the existing on-site smelter and construct a new metallurgical plant in Upper Spencer Gulf to process the additional concentrate

This alternative is not preferred because:

- the capital cost for the additional metallurgical plant would not provide the optimal return on investment
- a tailings storage facility (TSF) would be required adjacent to the metallurgical plant in Upper Spencer Gulf and no acceptable site was identified.

It is possible to avoid the coastal storage of tailings as discussed above by leaching the concentrate at Olympic Dam prior to transporting the leached concentrate to a coastal smelter. However, this option would require materials to be transported to Olympic Dam for the on-site leaching (including >1.6 Mtpa of sulphur), constructing the additional TSF at Olympic Dam and constructing a new smelter somewhere in Upper Spencer Gulf. Of the options investigated, this alternative carries the highest economic cost.

E4.3.3 Selected port from which to export concentrate

In selecting the location of a port to export concentrate, BHP Billiton investigated the following alternatives:

- Port of Darwin
- Port Adelaide
- Port Bonython
- Whyalla.

The Port of Darwin was selected because:

- the East Arm wharf at the Port of Darwin already has sufficient capacity to accommodate the large Panamax-class vessels preferred for transporting bulk materials
- the existing East Arm wharf can accommodate a new bulk loading facility for the transfer of the Olympic Dam concentrate to the vessel
- the export of bulk materials from the Port of Darwin is already supported by the Northern Territory Government under the Australasian Trade Route major project

- Olympic Dam has an existing relationship with the Darwin Port Corporation through the current export of uranium oxide
- the cost is comparable to other options investigated
- the relocation of the Port of Darwin from the capital city to East Arm avoids potential social issues associated with urban encroachment on port facilities.

Port Adelaide was rejected because:

- a new wharf would be required to accommodate the new bulk loading facility
- urban encroachment at Port Adelaide exacerbates the potential social issues surrounding the export of bulk materials such as concentrate.

Neither Whyalla nor Port Bonython has the capability to accommodate the vessels required for the expansion. In addition, the port at Whyalla is privately owned and therefore access constraints are expected. If these issues could be overcome in the future and if BHP Billiton determined that it wished to export concentrate from either of these ports, use of the ports would be subject to obtaining the relevant environmental and other consents from the Australian and South Australian governments. The use of these ports is not the subject of approval sought pursuant to the Draft EIS.

E4.4 LEGISLATIVE FRAMEWORK

E4.4.1 Assessment and approvals process

The studies and investigations undertaken for the proposed Olympic Dam expansion have occurred over a number of years. The project configuration has been modified over time to maximise its environmental performance, operational efficiency and economic return. Initially, processing of the ore was to have been undertaken solely at Olympic Dam, and to have required both Australian and South Australian governments' assessment and approval, resulting in a collaborative assessment process being developed. As the project configuration was modified and further defined, the use of the Port of Darwin to export concentrate triggered the involvement of the Northern Territory Government. The requirements of the Northern Territory Government's assessment process have been integrated into the existing collaborative process.

The proposed Olympic Dam NT Transport Option requires assessment from the Northern Territory Minister for Natural Resources, Environment and Heritage under the provisions of the *Environmental Assessment Act* and the *Environmental Assessment Administrative Procedures* and approval from the Northern Territory Transport and Infrastructure Minister to undertake works at the Port of Darwin under the *Darwin Port Corporation Act*. The 'Guidelines for Preparation of an Environmental Impact Statement, Olympic Dam Expansion (NT Transport Option) Project' (Northern Territory Department of Natural Resources, Environment, The Arts and Sport November 2008) provide requirements specific to proposed works in the Northern Territory (see Appendix A3).

The stages and the timing of the assessment process are described in Table E4.3. The specific requirements of the project under the relevant Northern Territory Government legislation are discussed in Section E4.4.2.

Table E4.3 Key stages and timing of the Northern Territory Government assessment process

Stage	Stage description	Northern Territory Government process
1	Submission of start-up documents by proponent	Notice of Intent – lodged 4 June 2008
2	Decision on start-up documents	Proposal is environmentally significant and warrants assessment under the *Environmental Assessment Act* – decision dated 2 September 2008
3	Decision on level of assessment	Assessment to be by means of an EIS – decision dated 2 September 2008
4	Development of EIS guidelines	Draft guidelines related to proposed activities at the Port of Darwin developed by the NT Government were placed on public display 18 October to 31 October 2008 and Final Guidelines published in November 2008
5	Preparation of Draft EIS	Guidelines require a Draft EIS to be prepared and submitted (note: one single Draft EIS to satisfy the processes of the three governments)
6	Public exhibition of Draft EIS	A 40 business-day public exhibition of the Draft EIS and during that period, a government-organised public meeting in Darwin is to be held. During this period written submissions are to be sent to the South Australian Department of Planning and Local Government for compilation and forwarding to the Northern Territory Government Department of Natural Resources, Environment, The Arts and Sport (NRETAS) and BHP Billiton
7	Preparation and lodgement of Supplementary EIS	A Supplementary EIS is required to address written submissions received (by the South Australian Department of Planning and Local Government) during the public exhibition period (note: one single Supplementary EIS to satisfy the processes of the three governments)
8	Government assessment	NRETAS to prepare an assessment report for the Minister for Natural Resources, Environment and Heritage in an agreed timeframe of 30 business days
9	Minister's decision	Northern Territory Transport and Infrastructure Minister decision on approval or not, plus any conditions of approval, within an agreed timeframe of 30 business days

E4.4.2 Northern Territory Government legislation

The proposal would be undertaken in accordance with relevant Northern Territory Government legislation. Table E4.4 provides an indicative, but not exhaustive, list of the relevant Acts. During the detailed design phase of the project, the types of activities and/or processes to be undertaken would be refined. At that time the specific approvals required, and the responsibility (whether of BHP Billiton or its contractors) for obtaining those approvals would be determined. Applications for necessary activity approvals would be discussed with, and submitted to, the relevant government agencies at the appropriate stage of the proposed works for assessment and decision, leading to a permit or licence.

Table E4.4 Relevant Northern Territory legislation and approvals requirements

Act	Purpose/Objective	Relevance to the project	Approvals and legislative requirements	Administering agency
Crown Lands Act	To manage and regulate Crown lands	Some of the proposed infrastructure at the Port of Darwin may be located on Crown land	A Crown lease or licence may be required if development is to be on land owned by the Crown	Department of Planning and Infrastructure (Land Administration Division)
Dangerous Goods Act, Dangerous Goods Regulations, Dangerous Goods (Road and Rail Transport) Act 2003 and *Dangerous Goods (Road and Rail Transport) Regulations*	To provide for the safe storage, handling and transport of certain dangerous goods	Dangerous goods may be handled, stored and used at the Port facility	BHP Billiton would require a licence to keep or convey certain dangerous goods in excess of relevant prescribed amounts In addition, BHP Billiton would require a licence to transport dangerous goods by road or rail, or specific licences to import, manufacture, sell, purchase, store or possess explosives	Department of Justice (NT WorkSafe)
Darwin Port Corporation Act, Port By-Laws and *Darwin Port (Handling and Transport of Dangerous Cargoes) By-Laws*	To provide for the establishment of the Darwin Port Corporation for the control and management of the Port of Darwin, and for related purposes	The proposed expansion includes the use of the Port of Darwin for the export of uranium oxide and concentrate	BHP Billiton would require the consent of the Darwin Port Corporation to build infrastructure having its foundations below the high water mark in the Port of Darwin BHP Billiton would need to ensure that any stevedores it used at the port held a licence from the Darwin Port Corporation to conduct a stevedoring business at the Port of Darwin BHP Billiton would comply with Australian Standard AS 3846-2005 in relation to the handling and transport of dangerous cargoes in port areas, adopted by the Darwin Port Corporation in relation to the Port of Darwin	Darwin Port Corporation
Fisheries Act	To manage the aquatic resources of the Territory in accordance with the principles of ecologically sustainable development, and to ensure appropriate protection of fish and fish habitat	The proposed expansion involves the construction and operation of facilities within the Port of Darwin	A permit would be required if fish or aquatic life were to be stunned, injured, killed or detrimentally affected by the proposed activities	Department of Regional Development, Primary Industries, Fisheries and Resources
Heritage Conservation Act, Northern Territory Aboriginal Sacred Sites Act	Provides for the protection of archaeological places and sites, and objects of prehistoric, historic, social, scientific or aesthetic value	Not applicable as all footprint areas would be on previously disturbed land	No specific requirements. If archaeological places or items are discovered, however, these would need to be reported and a permit obtained for any work on, or removal of, heritage sites and items	Department of Natural Resources, Environment, The Arts and Sport Minister for Indigenous Policy (Heritage Advisory Council)
Northern Territory Rail Safety Act	To develop, implement, monitor and continuously improve a rail safety administration and regulation regime promoting safe railway ownership and operation in the Territory	The proposed expansion includes construction of a rail loop/spur at East Arm to extend from the existing rail line, and rail operations	Rail safety accreditation would be sought prior to owning railway infrastructure and/or operating rolling stock in the Northern Territory	Department of Planning and Infrastructure
Planning Act	To plan the use and development of land contained within designated planning areas (which may or may not be subject to a planning instrument) and to all other freehold land	Land at the Port of Darwin would be required to be developed for the storage and handling facilities needed for the export of concentrate	An application would be made to the Development Consent Authority for consent to develop land	Department of Planning and Infrastructure

Table E4.4 Relevant Northern Territory legislation and approvals requirements (cont'd)

Act	Purpose/Objective	Relevance to the project	Approvals and legislative requirements	Administering agency
Public Health Act and *Public Health (General Sanitation, Mosquito Prevention, Rat Exclusion and Prevention) Regulations*	To maintain public health	The development of land at the Port of Darwin has the potential to contribute to the ponding of stormwater that may create a mosquito breeding habitat	No approval required. As an occupier of land, however, BHP Billiton would have a general duty to prevent the establishment of areas that could act as mosquito breeding places	Department of Health and Families
Radiation Protection Act 2004 (not yet commenced)	To provide for the protection of people and the environment from the possible harmful effects of radiation through the safe control of the use of all radiation sources	The proposed expansion would include the transport, storage and handling of radioactive copper concentrate containing uranium (see Chapter 5, Description of the Proposed Expansion)	Requires a licence to possess copper concentrate containing uranium, in accordance with the *Code of Practice for Radiation Protection* and *Radioactive Waste Management in Mining and Mineral Processing 2005 (Commonwealth)* (see Table 6.3)	Department of Health and Families (Environmental Health Program)
Radiation (Safety Control) Act	To make provision for the control, regulation, possession, use and transport of radioactive substances and radiation apparatus	The proposed expansion would include the transport, storage and handling of radioactive copper concentrate containing uranium (see Chapter 5, Description of the Proposed Expansion)	Requires a licence to possess copper concentrate containing uranium, in accordance with the *Code of Practice for Radiation Protection* and *Radioactive Waste Management in Mining and Mineral Processing 2005 (Commonwealth)* (see Table 6.3)	Department of Health and Families
Radioactive Ores and Concentrates (Packaging and Transport) Act	To make provision for the safe packaging, storage and transport of radioactive ores and concentrates	The existing Olympic Dam operation holds a licence under the Act for the transport of uranium oxide through the Port of Darwin. The proposed expansion would include the transport, storage and handling of copper concentrate containing uranium	Requires a licence for the transport of radioactive material (section 13(a)) and to authorise the storage of radioactive material on licensed premises (section 13(b))	Department of Justice (NT WorkSafe)
Soil Conservation and Land Utilization Act	For landholders/developers to make provision for the prevention of soil erosion and for the conservation and reclamation of soil	Soil disturbance would occur during site preparation for the construction of facilities at the Port of Darwin	No approvals required. BHP Billiton, however, would have a general duty to prevent and manage soil erosion	Department of Natural Resources, Environment, The Arts and Sport
Territory Parks and Wildlife Conservation Act	To make provision for the study, protection, conservation and sustainable utilisation of wildlife. This includes declaration and control of feral animals	The proposed expansion would involve the movement of material into and out of the Port of Darwin which has the potential to introduce pest or feral species	No approval required. BHP Billiton, however, would have a general duty to prevent the introduction of pest/feral species and, if declared by the Minister, to control feral animals and pests	Department of Natural Resources, Environment, The Arts and Sport
Waste Management and Pollution Control Act and *Waste Management and Pollution Control (Administration) Regulations*	To provide for the protection of the environment through encouragement of effective waste management and pollution prevention and control practices. The objective of the Act is to facilitate the implementation of national environment protection measures made under the *National Environment Protection Council (Northern Territory) Act*	The proposed expansion would involve construction and operation of storage and handling facilities for the export of uranium oxide and concentrate at the Port of Darwin	BHP Billiton would have a general environmental duty to prevent or minimise pollution (air, water and soil), to reduce waste and to notify of incidents causing, or threatening to cause, pollution An environmental protection approval would be required if the proposed activities generated and required disposal of wastes listed in Schedule 2 of the Regulations	Department of Natural Resources, Environment, The Arts and Sport

Table E4.4 Relevant Northern Territory legislation and approvals requirements (cont'd)

Act	Purpose/Objective	Relevance to the project	Approvals and legislative requirements	Administering agency
Water Act	To provide for the investigation, use, control, protection, management and administration of water resources in the Northern Territory	Relevant to several aspects of the proposed expansion	A licence or permit would be required if BHP Billiton needed to take or use surface water or groundwater	Department of Natural Resources, Environment, The Arts and Sport
Weeds Management Act 2001	To protect the Territory's economy, community, industry and environment from the adverse impact of weeds	The construction activities and the movement of materials into and out of the Port of Darwin have the potential to introduce weed species	Landholders are to take all reasonable measures to prevent their land being infested with a declared weed, to notify an officer of the presence of the declared weed and, if a declared weed exists on their property, comply with a weed management plan relating to the weed	Department of Natural Resources, Environment, The Arts and Sport
Workplace Health and Safety Act 2007 and *Workplace Health and Safety Regulations*	To promote occupational health and safety in the Territory	Relevant to several aspects of the proposed expansion	BHP Billiton would have a duty to ensure that the workplace was safe and that employees and the public were safe from injury and risks to health. A licence would need to be obtained to perform certain work (Schedule 3) BHP Billiton would need to notify the Work Health Authority (NT WorkSafe) if it proposed to undertake certain notifiable work (Schedule 5). BHP Billiton may also need to register certain items of plant (Schedule 1)	Department of Justice (NT WorkSafe)

E4.4.3 Local government requirements

Port of Darwin

BHP Billiton facilities are likely to be built within the East Arm Port 'future facilities' area, currently zoned 'Industry – Development' in the Northern Territory Planning Scheme for East Arm. Other future facilities at East Arm include berth extensions, bulk materials stockpile areas, marine industry support facilities and reclaimed hardstand.

The proposed use of the Port of Darwin to export uranium oxide and to store, handle and export concentrate is consistent with the East Arm Draft Masterplan (see Table E4.5).

Table E4.5 Northern Territory Planning Scheme and East Arm Masterplan

Industry – Development Zone	
Project components in this zone: concentrate storage and loading facility (see Figures E4.2 to E4.4)	
Provisions	**Comment**
To provide for the development of major strategic industries including gas-based, road, rail or port-related industries	The proposed concentrate storage and handling facility is required for the export of concentrate from the Port of Darwin. The proposed infrastructure includes a rail loop, concentrate storage shed, enclosed conveyor, wash-down facility, office buildings and maintenance area
To provide for major industrial development that is of strategic importance to the future economic development of the Territory	The proposed export of additional uranium oxide and concentrate would contribute to the future economic development of the Territory. Preliminary economic analysis (based on Selection Phase studies) indicates an initial $300 million in expenditure for the construction of the facility and an annual operating expenditure ranging between $7 million and $25 million. Economic modelling projections indicate that the proposed development could contribute $936 million (above the business as usual case) to the Northern Territory Gross State Product (GSP) over a 30-year period ($NPV_{7\%}$)
Development is to be assessed having regard to, among other things, the environmental impact and the effect on the surrounding development because of the processes involved, the method of manufacture, or the nature of the materials used, produced or stored	The construction and operation of the proposed facility has been assessed in detail in the Draft EIS, having regard to environmental, economic, cultural and social values
East Arm Masterplan	**Comment**
Future Facilities zone, including future berth extensions, bulk solids stockpile area, marine industry support services and future reclamation	The proposed concentrate storage and handling facility is consistent with the proposed intent of the Future Facilities zone

Local government areas

The existing Alice Springs–Darwin railway corridor, which is currently used to transport uranium oxide and would continue to be used for the additional uranium oxide and concentrate, traverses the following Northern Territory local government areas:

- MacDonnell Shire
- Municipality of Alice Springs
- Central Desert Shire
- Barkly Shire
- Roper Gulf Shire
- Municipality of Katherine
- Victoria Daly Shire
- Top End Shire
- Municipality of Palmerston
- Municipality of Darwin.

Other than increased use of the existing rail line, no alteration is proposed to the existing infrastructure and, as such, the operation of the rail line would remain consistent with the current requirements.

E4.5 PUBLIC INVOLVEMENT AND CONSULTATION

E4.5.1 Feedback to date

A broad range of community groups were consulted about the proposed transport option. These groups were identified by their proximity to the proposed transport route and Darwin Harbour. For example, the local governments of Alice Springs, Katherine, Tennant Creek, Darwin and Palmerston and the NT Cattlemen's Association (as a representative of the various pastoral properties along the route) were consulted. Groups which had a historical association with the region, such as the Larrakia Development Corporation and Larrakia Nation, were also consulted. Other groups such as the Amateur Fishermen's Association of NT Inc, the Australian Marine Conservation Society and the No Waste Alliance were consulted because of their pre-existing interest in the Port of Darwin and the nuclear industry.

A list of the groups that were offered the opportunity to engage with BHP Billiton is provided in Section E4.5.2.

In summary, the key issues raised during community consultation in the Northern Territory related to:

- the potential risk posed by the uranium component of the concentrate
- education of emergency personnel so that, in the event of a vehicle and train collision, medical assistance would not be hampered by concerns over potential exposure to radioactivity
- the need for a public education campaign about uranium and the radioactivity of the products transported through the Northern Territory.

These concerns have been noted and will form part of BHP Billiton's community consultation and engagement program. It is noted that emergency personnel are already familiar with response procedures associated with the current transport of uranium oxide. Further contact would be made before concentrate was railed to ensure that the risks and handling procedures were well understood.

Additional comments raised by groups are provided in Table E4.7.

Table E4.7 Community feedback to date

Group	Feedback
Darwin Harbour Advisory Committee	The committee requested that results of monitoring programs relevant to Darwin Harbour be publicly accessible
No Waste Alliance	Expressed concern that the increased volume of uranium being shipped from Australia could lead to increased pressure on the country to accept nuclear waste from power stations
No Waste Alliance and the Australian Marine Conservation Association (NT)	Expressed concern at the volume of material being transported but acknowledged that in committing to building closed sheds and conveyors and recycling waste water (before transporting to Olympic Dam for ultimate disposal) the company had addressed key issues surrounding dust and waste water management
Larrakia Development Corporation (plus other groups)	Noted that they would be more comfortable if BHP Billiton not only ensured that appropriate methods such as the closed handling system were introduced and monitoring, but that third-party agencies undertook the monitoring of the system
NT Cattlemen's Association (NTCA)	Made it clear that a very high standard of handling along the route and in particular at the Port of Darwin would have to be in place as many of their members had worked hard to develop a 'clean and green' image for their industry; in some cases seeking or achieving organic certification. They would not want this image or certification threatened by fugitive dust from the operation
NTCA and the Amateur Fishermen's Association of NT (AFANT)	Expressed concerns about the potential impact of copper on the aquatic environments, noting that copper is an algaecide. The AFANT said it regarded copper as a greater threat than uranium, which comprised a fraction of the concentrate and it considered it would be most important that marine monitoring was carried out to ensure that there was no copper contamination in the harbour
All of the above Darwin-based groups contacted	Expressed concern about the cumulative impacts of the industrialisation of Darwin Harbour. It was not BHP Billiton's proposal per se that caused concern but the fact that its development around 2014–2016 would come on the back of increased bulk shipments from the Port by other miners and the development of other resource based industries around the Port
Alice Springs and other regions along the transport route	Concerns focused on the increasing volumes of traffic along the rail line and in particular that a number of the rail crossings did not have sufficient long-distance visibility to allow a roadtrain to identify an oncoming train and stop in time
Alice Springs in particular	Expressed concern about the amount of freight that might be transported along the rail line by the time the BHP Billiton operation commenced because of the number of mining operations moving into the Territory. It was considered that a number of these resources might be identified and in operation before BHP Billiton started shipping concentrate. Again, it was not the single development per se that was the issue, rather it was the concern that increased freight movement through Alice Springs would impede emergency services access across the rail line

E4.5.2 Stakeholder list

The following lists the individuals, groups and communities that were provided with the opportunity to comment on the proposed NT Transport Option.

Government

- Members of Parliament
  - various Northern Territory Government Ministers, and shadow ministers
- Northern Territory Government agencies and service providers
  - NT Department of Minerals and Energy
  - NT Department of Health and Families
  - NT Ports Corporation
  - NT Land Development Corporation
  - NT Department of Natural Resources, Environment, The Arts and Sport
  - NT Department of Chief Minister
  - NT Department of Planning and Infrastructure
- Local Government
  - Alice Springs City Council
  - Darwin City Council
  - Palmerston City Council.

Non-government organisations and service providers

- NT Cattlemen's Association
- NT Chamber of Commerce
- NT Resource Council
- NT Industry Capability Network.

Community groups and environmental groups

- Amateur Fishermen's Association of NT Inc.
- Australian Marine Conservation Society (NT)
- NT Environment Centre
- No Waste Alliance
- Planning Action Network.

Indigenous groups

- Central Land Council
- Larrakia Development Corporation
- Larrakia Nation
- Northern Land Council.

E4.5.3 Community consultation plan

Due to the long lead time before the NT Transport Option is required (i.e. about 2016), it is envisaged that the community consultation plan would go through a number of phases prior to the commencement of exports. Then, as the operations are likely to continue over 40 years, it would evolve over time.

The community consultation plan would have five key phases, not all of which would apply to the entire geographic footprint of the NT Transport Option. The phases are:

- Stage one: this is the current engagement and education stage. It includes meeting with community groups prior to the release of the Draft EIS to explain the NT Transport Option and seek feedback. This stage involves meeting with community groups at various locations, providing fact sheets, distributing emailed updates and recording feedback.
- Stage two: covers the release of the Draft EIS and would cover the formal public meetings required by the governments (it is proposed that formal meetings be held in Darwin and Alice Springs) as well as informal meetings with key stakeholder groups so that they can raise issues related to the information provided in the Draft EIS.

- Stage three: would commence after public submissions on the Draft EIS close. It is intended to ensure that stakeholder groups are kept informed of progress in relation to approvals and the project. This would involve face to face meetings and electronic newsletters.
- Stage four: would commence shortly before construction commences at the Port of Darwin, and would ensure that key stakeholders such as local government, Indigenous groups and business and environmental groups are aware of the construction plans and have the opportunity to raise potential concerns about construction impacts (i.e. traffic and operational issues).
- Stage five: this would be an ongoing and evolving phase that would commence towards the end of the construction period. It would involve engagement with key stakeholder groups so that there was a clear understanding of the transport operations. This phase would also include updates for emergency services, including NT Police, NT Fire and Rescue Service, NT Emergency Services, St John Ambulance and NT WorkSafe. This phase would involve face to face meetings, email newsletters and training sessions aimed at developing specific procedures (in the event of an incident) to ensure BHP Billiton and the relevant Northern Territory Government agencies are able to respond adequately to an incident. This phase in particular would evolve over time as stakeholder groups and technologies change.

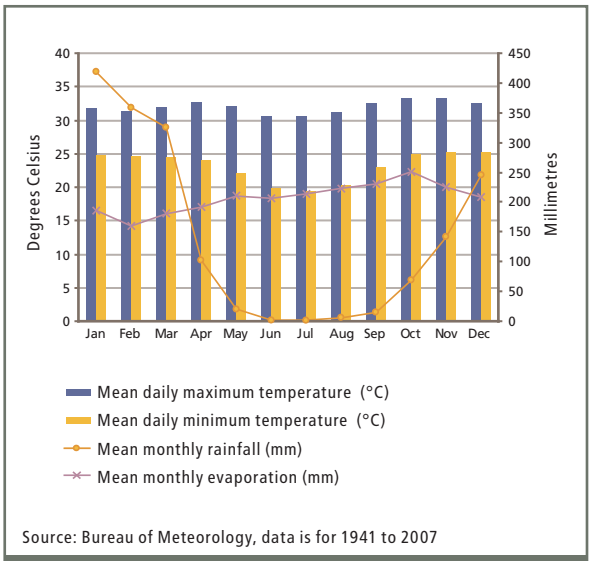
E4.6 EXISTING ENVIRONMENT

The newly proposed infrastructure would be constructed on degraded land. This may be land developed as future reclamation by the Northern Territory Government or it may be the current vacant land between the Vopak fuel terminal and the Ghan passenger terminal (see Figure E4.3 and Figure E4.4). With this in mind, this section focuses on the receiving environments that may be affected by the proposed works rather than presenting a detailed description of the existing environment of the Port of Darwin (see Darwin Port Expansion East Arm, Draft Environmental Impact Statement, Acer Vaughan 1993, for a description of the existing environment).

This section also presents Darwin's climatic conditions because these influence the level of risk and the potential impact of developments on the region. For example, rainfall intensity influences erosion risk and stormwater management.

E4.6.1 Climate

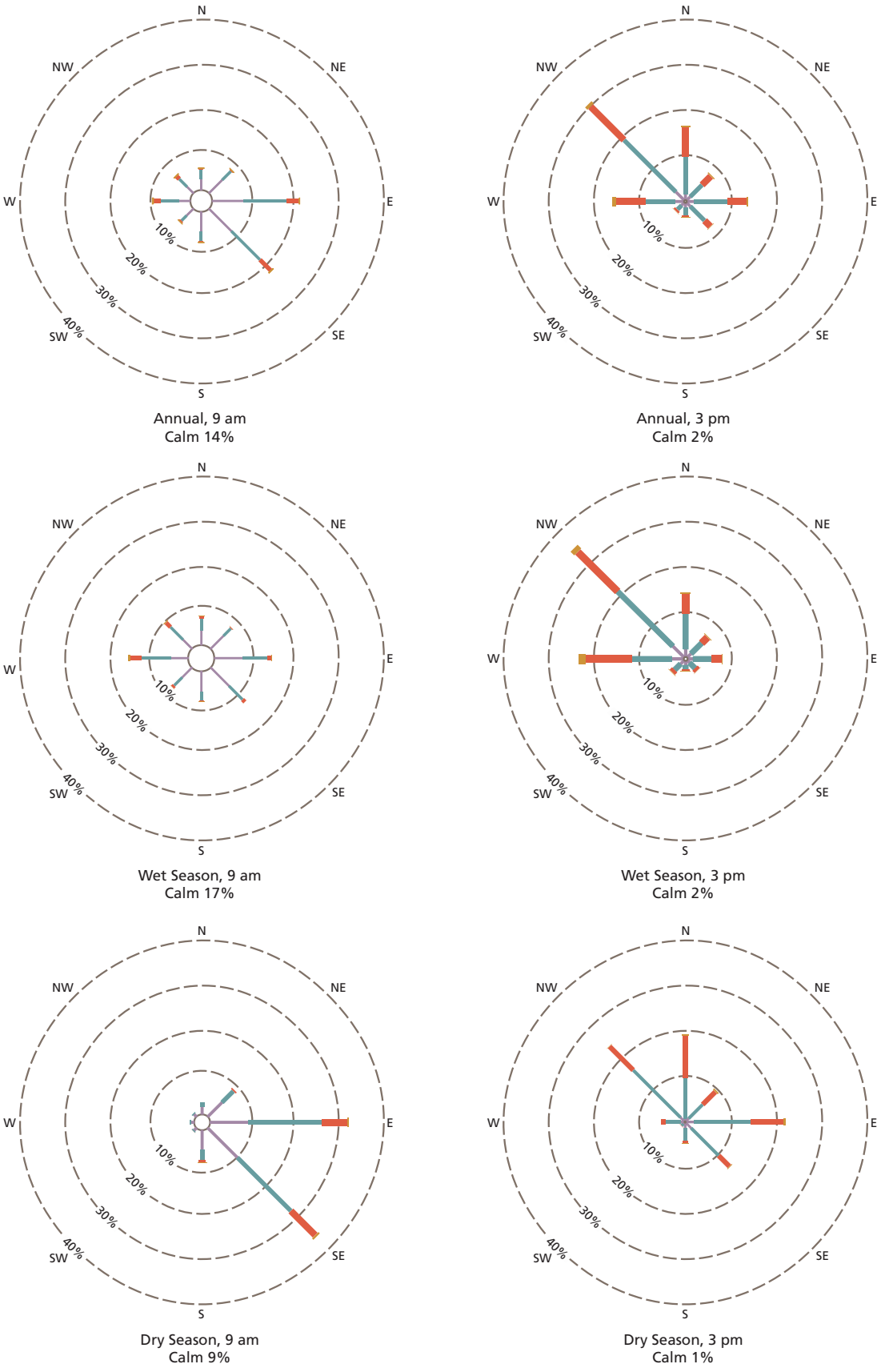
Darwin has an average monthly minimum and maximum temperature of 23 °C and 32 °C respectively, and an average relative humidity of 54%. The average annual rainfall measured at Darwin airport is around 1,700 mm, with a pan evaporation rate of about 2,500 mm. Figure E4.6 shows the monthly temperature and rainfall averages, illustrating that over 95% of the annual total rainfall occurs between October and April. On average, Darwin has 112 rain days per year.



Source: Bureau of Meteorology, data is for 1941 to 2007

Figure E4.6 Monthly climatic averages for Darwin

Figure E4.7 shows the annual average and seasonal average wind roses for Darwin for both the morning (9 am) and afternoon (3 pm). The wind roses of most relevance to the proposal are the morning and afternoon during the dry season when dust generation is most likely. Dust generation during the wet season is less likely due to more regular rainfall and therefore higher soil moisture.



Source: Bureau of Meteorology Annual and Wet Season data is for 1942 to 2004 Dry Season data is for 1954 to 2003

Figure E4.7 Average seasonal wind roses for Darwin

The average recurrence interval (ARI) is a measure of the frequency of a rainfall event. Storm data based on the ARI measurements are used to design the capacity of stormwater infrastructure and stormwater containment facilities. Table E4.6 summarises the ARI for rainfall events of five minutes, 24 hours and 72 hours duration. This shows the volume of rain measured in millimetres per hour (mm/h) that would need to fall for each of the ARI events shown.

Table E4.6 Design rainfall intensities for Darwin (mm/h)

ARI (year)	5 min	24 h	72 h
1	150	4.8	2.2
5	228	7.7	3.9
50	331	11.9	6.5
100	366	13.4	7.4

Storm events can occur at any time of the year and are generally intense and short. Common measures of storm activity are lightning strikes and the number of thunder days per year. The average annual lightning ground-flash density and days with thunder for Darwin are shown in Table E4.7, which also shows other Australian capital cities for context.

Table E4.7 Lightning ground-flash density and thunder days

	Darwin	Brisbane	Sydney	Adelaide	Melbourne
Lightning[1]	3.0–4.0	2.0–3.0	1.0–2.0	0.0–0.5	0.5–1.0
Thunder days per year	80–100	25–30	20–25	10–15	10–15

[1] Average annual lightning ground-flash density (flash/km²/annum).

Tropical cyclones are low pressure systems that develop over warm waters in the tropics and have sustained winds of 63 km/h or greater, with gusts in excess of 90 km/h (Bureau of Meteorology 2008). On average, 10 tropical cyclones develop in the Australian region each year and six cross the coast. Darwin is located in the tropical cyclone risk area (see Figure E4.8). Table E4.8 shows some of the cyclones that have occurred in the northern region.

Table E4.8 Northern region cyclone history

Tropical cyclone	Location (approximate) in relation to Darwin	Date	Maximum severity category	Estimated maximum wind gusts (km/h)
Helen	130 km south-west	January 2008	2	130
Monica	300 km east	April 2006	5	360
Ingrid	110 km north	March 2005	3	185
Thelma	<200 km north-west	December 1998	5	320
Tracy	0 km	December 1974	4	>217

Predictions of the occurrence and intensity of tropical cyclones in the Australian region due to global climate change suggest either no change or a decrease in the number of cyclones, but an increase in the frequency of severe (category 3–5) cyclones (CSIRO 2007).

Other relevant climate change predictions for the Darwin area from the Intergovernmental Panel on Climate Change (Hennessy et al. 2007) are:

- it is estimated that within 400 km of the Australian coast, there would be an expected increase in temperature of 0.1 to 1.0 °C by 2020, 0.3 to 2.7 °C by 2050 and 0.4 to 5.4 °C by 2080
- by the year 2100, it is estimated that global average temperatures may increase by 2.4 °C to 6.4 °C and global sea levels may rise by 26–59 cm, relative to 1980 levels, if greenhouse gas emissions continue to increase at current levels
- the projected change in annual average rainfall for the Darwin area ranges between ± 5% by 2020, ± 13% by 2050 and ± 27% by 2080. By the year 2030, however, the intensity of the daily rainfall event is likely to increase by up to 10%.

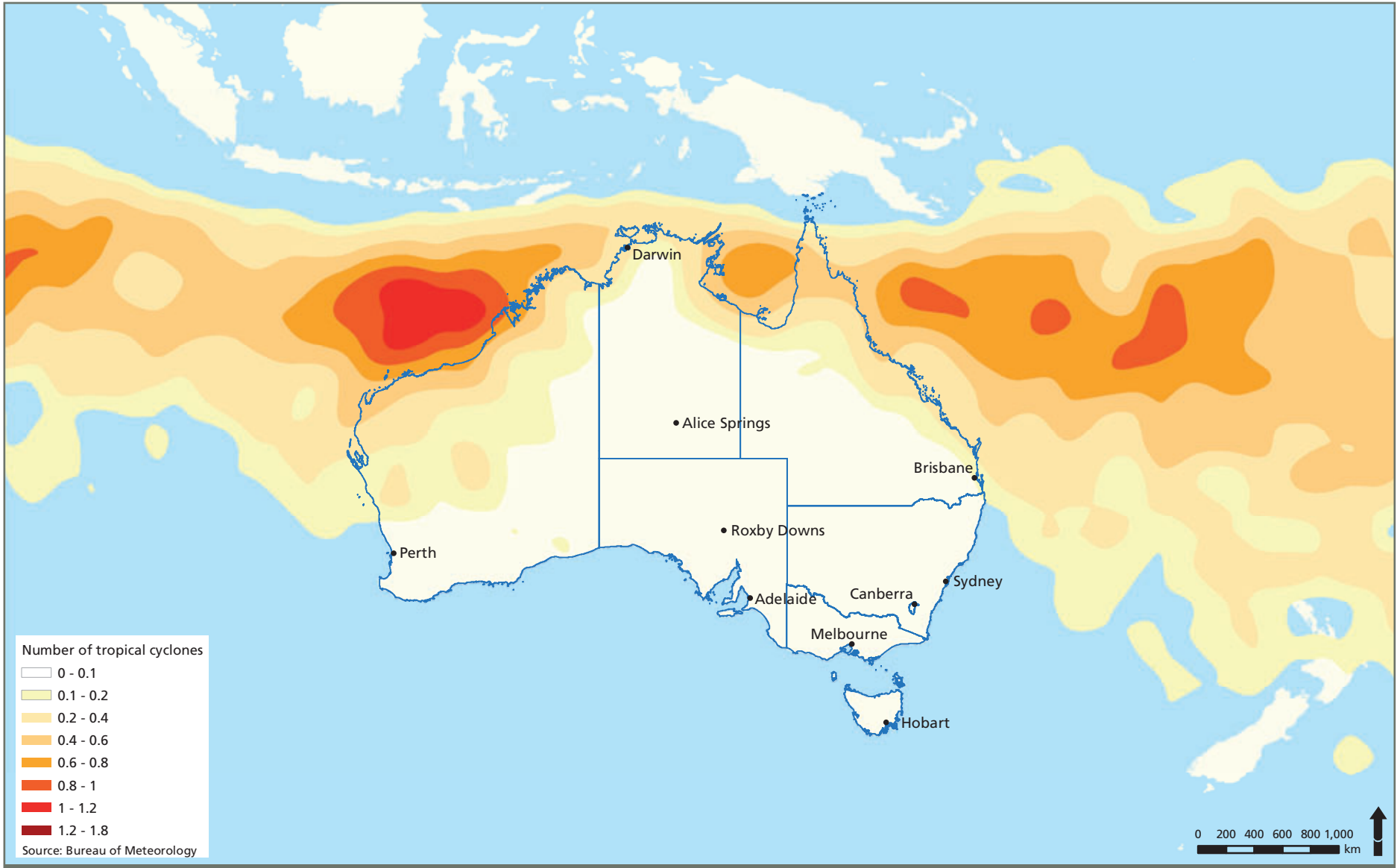


Figure E4.8 Average annual number of tropical cyclones

E4.6.2 Land use and tenure

The Port of Darwin is Australia's most northern deep water port and Australia's closest port to South East Asia. East Arm currently supports live cattle and mineral exports, a primary service and supply base for off-shore oil and gas projects, and heavy lift facilities and storage yards for bulk dry and liquid imports.

Olympic Dam's uranium oxide has been exported via the Port of Darwin since January 2005. Also of direct relevance to the proposal, the copper concentrate from OZ Mineral's Prominent Hill mine in South Australia will also be exported via East Arm.

The demand for facilities at East Arm is strong, and the Northern Territory Government is maximising the benefits of this growth for the Territory by revising the East Arm Master Plan. The revision will allow for increased berth face, reclamation of land, increased rail access, and large-tracts of industrially-zoned land designated for additional port related export-based industries (i.e. the Darwin Business Park).

The land required for the proposed storage and handling of the Olympic Dam concentrate would be located entirely within the Port of Darwin, East Arm (see Figure E4.2 to Figure E4.4). The area surrounding the proposed site is an industrial region known as the East Arm Precinct, which is approximately 4 km from the Stuart Highway. The rail connection from East Arm to Olympic Dam would be via the existing Adelaide to Darwin defined interstate rail network (DIRN).

Land use and land tenure information for the Northern Territory was obtained from the Northern Territory Government (Department of Planning and Infrastructure, the Land Titles Office and NT Atlas). Land tenure at the proposed site for the BHP Billiton facilities is currently a combination of Crown leases and freehold industrial allotments held by various parties. BHP Billiton would negotiate to occupy the land required for its facilities under freehold tenure or, alternatively, under a long-term lease.

The nearest Native Title claim listed on the National Native Title Register is the Bynoe claim, which covers 68,000 ha in the Bynoe, Charlotte and Cox Peninsula regions extending from the Finniss River in the south to Darwin Harbour in the north and including part of Darwin Harbour itself. The Bynoe claim is approximately 7 km from the East Arm wharf at its closest point.

There are 1,697 km of rail between the Northern Territory–South Australia border and the Port of Darwin. The rail corridor is held freehold from the border to Alice Springs, and from Alice Springs to Darwin under a Crown lease.

The tenure types and major land uses along the rail corridor discussed below are shown in Figure E4.9 and listed in Attachment E4.1. The majority of the Northern Territory section of the Adelaide to Darwin railway passes through pastoral land (held as Crown Leases, Aboriginal Land Trusts or under freehold). The rail corridor passes through 33 pastoral leases and 15 Aboriginal Land properties (held by Trusts or Corporations) between Darwin and the border. The railway crosses 28 named watercourses between Darwin and the border and passes through or within 1 km of seven conservation reserves (see Figure E4.9).

E4.6.3 Physical environment

Darwin is located within the Timor Sea drainage region, an area which drains more than 50 million megalitres of water from the Northern Territory every year. On a local scale, the Port of Darwin lies within the Darwin Harbour catchment. This catchment can be further divided into the sub-catchments of the Howard River, Elizabeth River, Blackmore River and the minor creeks and streams of the West Arm and Woods Inlet (Haig and Townsend 2003).

River flow and surface water run-off is highly seasonal, being highest during October and April, when more than 95% of the annual rainfall occurs. Surface waters are generally characterised by low salinity and neutral pH. The concentration of metals, nutrients and suspended materials is typically higher in run-off from urbanised and industrial areas compared to undisturbed areas (Padovan 2003).
The topography of the Darwin Harbour catchment ranges from flat intertidal and estuarine (marine) plains of negligible slope, through to undulating hills and plateaus. Elevations range from sea level at the coastal margins to around 140 m in the southern foothills (Haig and Townsend 2003).

The East Arm of the Port of Darwin is characterised by alluvial and estuarine plains with extensive intertidal flats of saline muds, clays and silts, foreshore areas of deposited sands and shells, and a hinterland of shallow gravelly, sandy soils (Haig and Townsend 2003; NRETA 2007). East Arm was constructed through the process of land reclamation and was formed from fill from the surrounding area. Surface water run-off from East Arm is managed through a series of stormwater drains and collection pits that ultimately discharge to the ocean.

Acid sulfate soils (ASS) are typically found in coastal areas below 5 m AHD and are particularly associated with estuarine clays. Risk mapping undertaken by CSIRO (CSIRO 2008) indicates that soils in this area have a high probability of generating acid when exposed to oxygen through activities such as excavation. These are referred to as potential acid sulfate soils (PASS).

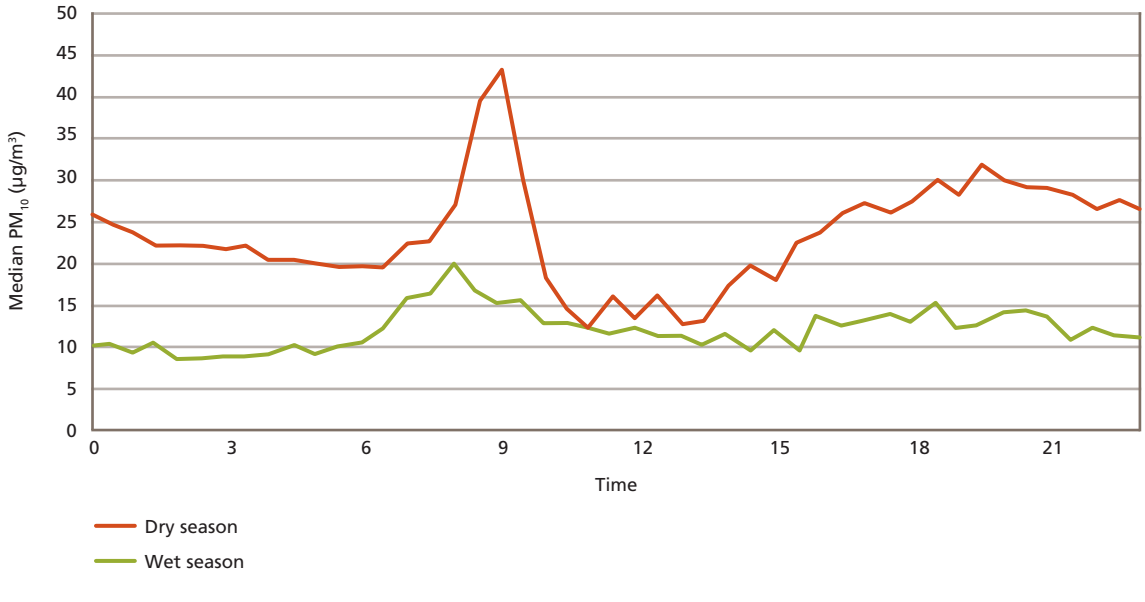
Groundwater in the Darwin Harbour region generally occurs in shallow unconfined aquifers. These aquifers pass through an annual cycle of drainage and discharge during the dry season and are recharged by direct infiltration of rainfall during the wet season. Consequently, water levels vary throughout the year and can range from near ground level to more than 10 m below ground level (Haig and Townsend 2003). Groundwater quality in coastal areas (including East Arm) is subject to tidal influence and is generally brackish to saline. Although groundwater beneath the reclaimed area of East Arm is not naturally occurring, saturation of the sediments would occur from seawater infiltration.

E4.6.4 Air quality

Existing air quality in the Darwin region has been monitored by CSIRO (CSIRO 2001) and more recently as a part of the Darwin LNG Project (URS 2005). Ongoing monitoring of particulate matter with a size fraction of 2.5 and 10 microns ($PM_{2.5}$ and PM_{10}) is undertaken by the Northern Territory Government in compliance with the requirements of the National Environment Protection (Ambient Air Quality) Measure (Air NEPM). A summary of this monitoring is presented in the following sections. No air quality monitoring is currently undertaken in Alice Springs, although a NEPM-compliant monitoring system is being considered by the Northern Territory Government (Northern Territory Government 2008). No monitoring of radioactive dust or other radiation hazards appears to be in place at East Arm.

Particulates

A study of PM_{10} particulate concentrations was undertaken in 2000 by CSIRO at both Berrimah (approximately 6 km north-east of East Arm) and Casuarina (approximately 13 km north of East Arm). Concentrations at both sites varied largely between 5–25 µg/m³, with some exceedances of the 50 µg/m³ criteria (consistent with local observations of smoke), peaking at 70 µg/m³ in early September 2000. An analysis of the seasonal variation of particulate concentrations shows that dry season concentrations are 10–15 µg/m³ greater than wet season concentrations, particularly in the evening and early morning (see Figure E4.10).



Source: CSIRO 2001

Figure E4.10 Variation in Darwin PM_{10} particulate monitoring results

NEPM compliance monitoring is undertaken at Casuarina for both PM_{10} and $PM_{2.5}$ particulates. PM_{10} concentrations agree with previous monitoring undertaken by CSIRO, with a maximum of 45.3 µg/m³ and an average of 11.9 µg/m³. $PM_{2.5}$ monitoring indicated a maximum concentration of 47.7 µg/m³ and an average concentration of 2.8 µg/m³ (see Figure E4.11). The NEPM Annual Compliance Reports note that the majority of high particulate concentration events are due to bushfire smoke (Northern Territory Government 2008).

Particulate samples obtained during the CSIRO study were subsequently analysed for lead, zinc and iron. The average lead concentration was determined to be approximately 2 ng/m³ at both Casuarina and Berrimah, significantly below the 500 ng/m³ NEPM criteria. Iron and zinc average concentrations were around 200 ng/m³ and 100 ng/m³ respectively.

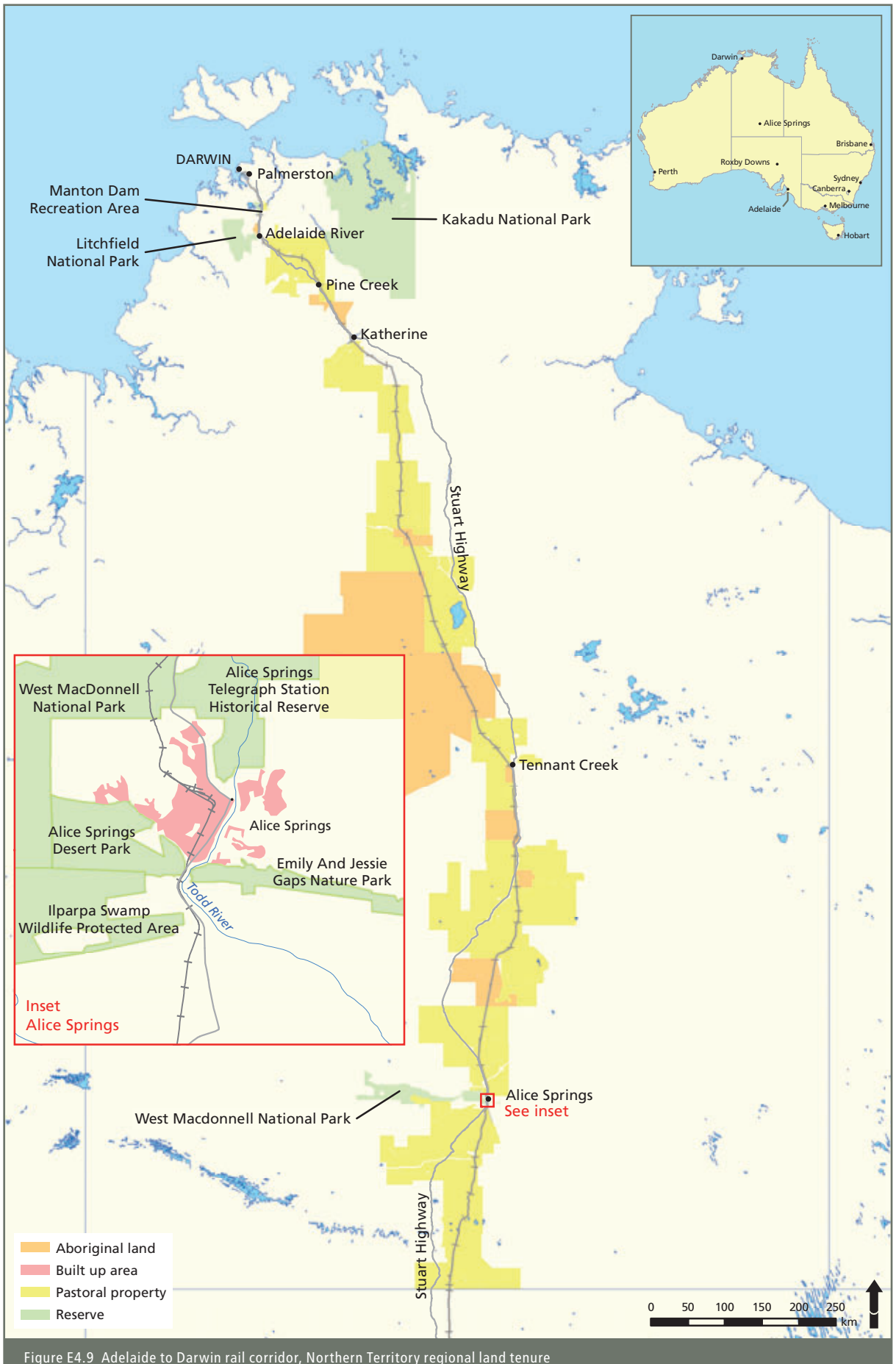
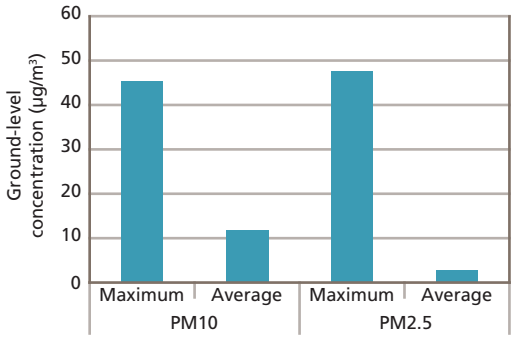


Figure E4.9 Adelaide to Darwin rail corridor, Northern Territory regional land tenure



Source: Northern Territory Government NEPM Annual Compliance Report 2007

Figure E4.11 Summary of Darwin particulate monitoring results

Nitrogen dioxide

The CSIRO undertook nitrogen dioxide (NO_2) monitoring at Berrimah in 2000 and early 2001. The results indicate an average NO_2 concentration of approximately 8.8 µg/m³, significantly less than the 246 µg/m³ NEPM criteria.

Sulphur dioxide

Monitoring of sulphur dioxide (SO_2) ground level concentrations has found that 24-hour average concentrations vary between approximately 1.4 µg/m³ at Berrimah (CSIRO 2001) and 5 µg/m³ at Darwin City, approximately 4 km across Darwin Harbour north-west of East Arm (URS 2005), both well below the NEPM criteria of 228 µg/m³. Peak one-hour maximum SO_2 concentrations varied between 0–42 µg/m³ in Darwin City and from 0–8 µg/m³ at Middle Arm Peninsula (approximately 2.4 km south-west of East Arm) against the criteria of 571 µg/m³.

Ozone

Ozone (O_3) monitoring undertaken at Berrimah in 2000 (CSIRO 2001) indicated concentrations between 12–25 parts per billion by volume (ppbv), which are relatively low compared to the NEPM criteria of 80 ppbv.

E4.6.5 Greenhouse gas

Current Australian greenhouse gas emissions are estimated at 576 Mtpa of carbon dioxide equivalents (CO_2-e), including land use change, of which the Northern Territory contributes 16.2 Mtpa (Department of Climate Change 2008a). In contrast to other states and territories in Australia, the majority of greenhouse gas emissions originate in the agricultural sector, largely from the burning of savannas. Stationary energy emissions (electricity production), typically the largest contributor in other states, is the second most significant emissions source in the Northern Territory.

Although state-by-state projections of future greenhouse gas emissions are not available, Abare Economics has published projections of Australia's emissions to 2050 (Abare 2007). Projections of future greenhouse gas emissions from the Northern Territory over the life of the proposed East Arm facility have been made using the Abare projections and the current proportion of Northern Territory emissions versus Australian total emissions (being 2.8%, Department of Climate Change 2008a). This data is summarised in Table E4.9.

Table E4.9 Projected Australian and Northern Territory greenhouse gas emissions excluding land use change (Mtpa CO_2-e)

Year	Current (2006)	2010	2020	2030	2040	2050
Australia	536	549	638	695	752	806
Northern Territory	15.2	15.4	17.9	19.5	21.1	22.6

E4.6.6 Acoustic environment

The existing noise environment in the Darwin region, including East Arm, was assessed in 2005 by URS for the Darwin LNG Project (URS 2005) and in 2006 by GHD for the Quarantine Waste Treatment Facility (GHD 2006). No baseline noise monitoring was found for Alice Springs or other communities along the existing rail corridor.

East Arm

The nearest sensitive receivers to East Arm have been identified as:

- Government House, approximately 4 km west of the East Arm wharf and adjacent to the Darwin CBD
- Berrimah, approximately 6 km north-east of the East Arm wharf
- Marlow Lagoon in Palmerston, approximately 7.2 km east of the East Arm wharf.

Results of previous baseline noise modelling at these locations and at the East Arm wharf are summarised in Table E4.10.

Table E4.10 Baseline noise levels (2005–2006)

Location	Noise level (dB(A) LA_{90})	
	Minimum	Maximum
East Arm wharf	30.9	32.3
East Arm boat ramp	33	60
Government House	38	42.6
Berrimah	39.4	45.8
Marlow Lagoon	25	47

Existing industrial activities that contribute to current noise levels at the East Arm wharf include bulk materials movement, livestock and container loading and unloading. Up to 700,000 tonnes of bulk manganese is exported from the East Arm wharf annually (Darwin Port Corporation 2008), and up to 170,000 tonnes of sulphuric acid is currently imported. This is expected to increase to around 300,000 tpa in the short term. Territory Resources Limited is targeting 2.5 Mtpa of iron ore exports from the Port by the end of 2009, an increase from the current 2 Mtpa (Territory Resources 2008). OZ Minerals Prominent Hill project has selected East Arm as the preferred location for its bulk handling facilities, expected to have a capacity of up to 250,000 tpa of copper concentrates (Darwin Port Corporation 2008).

Rail corridor

The existing rail line between Tarcoola and Darwin passes adjacent to several communities within the Northern Territory as listed from north to south in Table E4.11 (see Figure E4.9 for locations).

Table E4.11 Distance between existing rail line and sensitive receivers

Community	Distance to rail line (m)
Kulgera	11,650
Alice Springs	50
Wauchope	2,150
Tennant Creek	550
Newcastle Waters	33,750
Mataranka	32,200
Katherine	650
Pine Creek	350
Adelaide River	75
Palmerston (Marlow Lagoon)	25
Darwin (city centre)	8,600
Impadna siding	400
Hugh River	53,400

Existing rail traffic between the Tarcoola interchange and Darwin increases as the line heads north, commencing at approximately 10 trains per week at Tarcoola (BITRE 2008) increasing to 36 trains per week into Darwin, as trains from various mining and industrial centres join the line.

No baseline noise monitoring for communities along the existing rail line has been undertaken.

E4.6.7 Natural environment

The site of the proposed works would be existing degraded lands or areas of future reclamation. No intact native vegetation communities would be cleared for the proposal. Relevant sensitive receivers within the natural environment are (see Figure E4.12):

- Darwin Harbour – this is a relatively well protected but naturally turbid body of water (Currey 1988) that supports about 3,000 invertebrate species (Russell and Hewitt 2000), about 440 fish species and rich communities of marine invertebrates and reptiles, including six species of sea turtle (Australian Government 2006). The harbour is a significant area for recreational fishing, with target species being Snappers/emperors Lutjanus spp., Whiting Sillago spp., Tuskfish Choerodon spp., Barramundi Lates calcarifer, Trevallies Carangidae spp., Jewfish Protonibia diacanthus and Mud Crab Scylla serrata (Coleman 1998).
- Mangrove communities — the predominant feature of the intertidal zone is expansive mudflats and diverse mangrove communities (20,000 hectares and 36 species)(Brocklehurst and Edmeades 1996). The nearest mangrove communities to the proposed facilities lie north of the existing rail line at East Arm (see Figure E4.12).

Searches of the protected matters database under the Australian Government Environment Protection and Biodiversity Conservation Act 1999 established the following (see Attachment E4.2 for search results; reference below to 'search area' represents a 50 square kilometre area centred on East Arm):

- Kakadu National Park, located 120 km east of Darwin, is the nearest World Heritage Property, National Heritage Place and Wetland of International Significance (i.e. Ramsar site).
- Darwin Harbour is within Northern Territory waters. The Commonwealth marine area starts from three nautical miles off the coast.
- The nearest natural place on the Register of the National Estate is the Darwin Foreshore, which spans the coast from Bullocky Point in the south to Buffalo Creek in the north. Other places on the register include built structures, mainly historic residences, throughout Darwin. As such, the nearest Place on the Register of the National Estate to the proposal is about 4 km north-west.
- There are no listed threatened plants within the search area.
- There are 15 listed threatened animals (five terrestrial and 10 marine) that have geographic ranges that overlap the search area.
- There are 41 listed migratory species that have geographic ranges that overlap the search area.

Nationally listed species potentially occurring within Darwin Harbour include the threatened Humpback Whale *Megaptera novaeangliae*, Whale Shark *Rhincodon typus*, two species of sawfish and the six marine turtle species. Migratory species including dolphins (three species) and Dugong *Dugong dugon* are regularly observed.

Attachment E4.2 provides the listed threatened species and identifies potential impacts as a result of the proposal. The assessment for listed threatened species and listed migratory birds established that the proposed facilities do not have the potential to significantly affect any listed species.

E4.6.8 Cultural environment

Two flaked stone points were found near the higher sections of Quarantine Island during the archaeological survey for the Darwin Port Expansion – East Arm Draft Environmental Impact Statement (Acer Vaughan 1993). During the EIS, sites of cultural significance to Aboriginal people were identified on Catalina Island and the associated sandbar. No sites of cultural significance were identified near the proposed location of the facilities.

Approximately 80 non-Aboriginal heritage sites or places in the Town of Darwin, Darwin Harbour, Berrimah and East Arm are listed on the Register of the National Estate, Northern Territory Government Heritage Register or have been identified as having local heritage value.

Of these, only the Quarantine Anti-Aircraft Battery Site is near the area of the proposal (see Figure E4.12 for location). The site is listed on the Northern Territory Heritage Register and consists of revetted emplacements, the central bunker, and slabs where the administration, mess and kitchen building stood. It was established in 1941 to defend the south-west section of Darwin. It is described as highly significant, and is unique in Darwin and the Northern Territory.

The FreightLink Draft Environmental Management Plan (2005) also notes that a number of sites of heritage interest from the late 19th century to early 20th century are located close to the rail corridor, including the Pine Creek goldfields and the Adelaide River War cemetery (Dames and Moore 1984). The archaeological survey undertaken as part of the EIS studies in 1984 also identified 30 archaeological sites within the rail corridor. This is supported by the presence of stone flakes and artefacts from former Aboriginal habitation (Dames and Moore 1984).

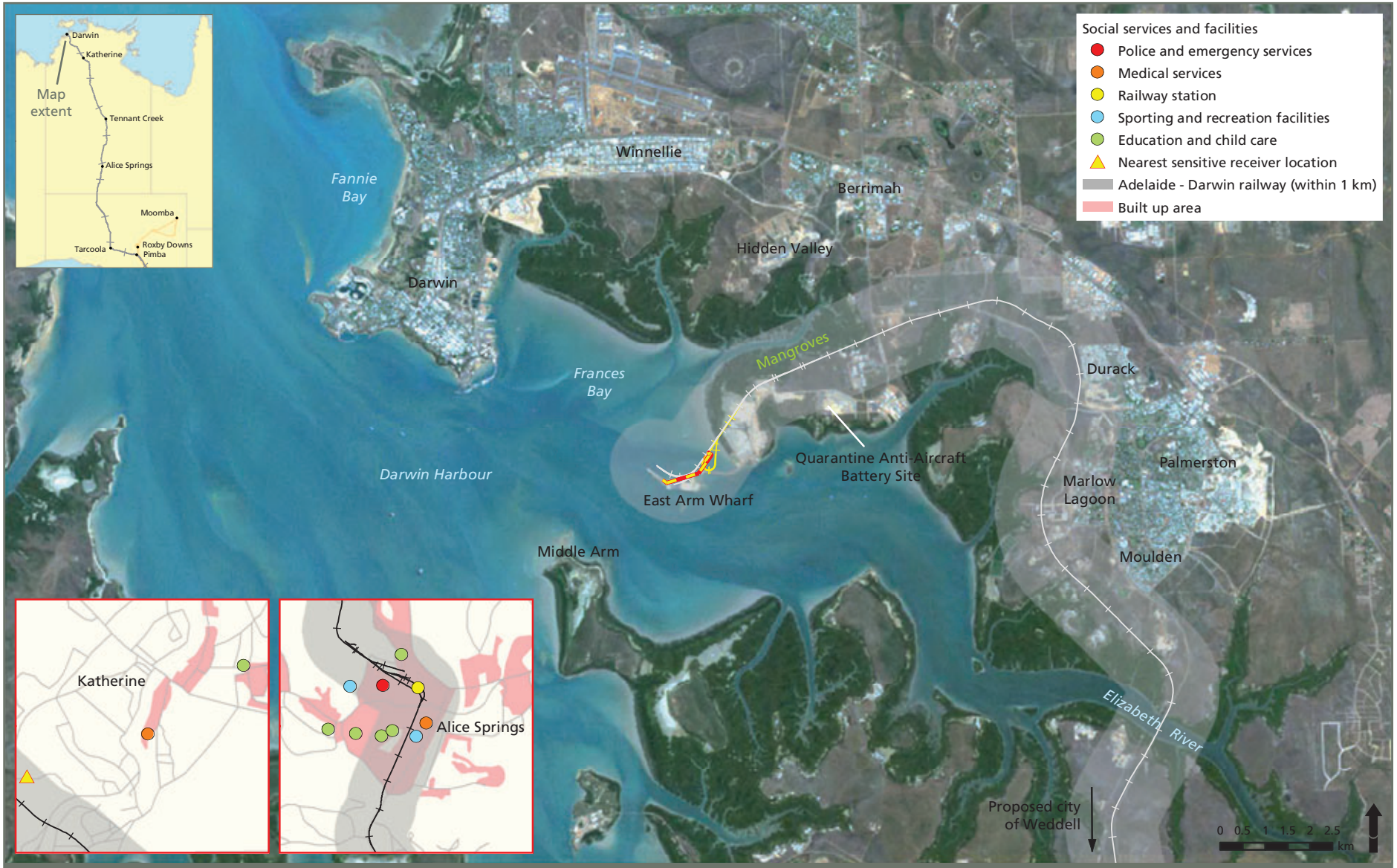


Figure E4.12 East Arm in the regional context

E4.6.9 Socio-economic environment

The existing operations at the Port of Darwin are industrial and are located well away from urban areas. The nearest residential or public areas that are considered sensitive receivers are (see Figure E4.12):

- 4 km north-west to Darwin CBD across Darwin Harbour
- 5 km north north-east to the Hidden Valley raceway
- 6 km north-east to the suburb of Berrimah (including Kormilda College)
- 6 km north to the suburb of Winnellie
- 7 km east to the suburb of Marlow Lagoon.

The existing rail corridor from Darwin to Olympic Dam passes within 1 km of 15 Aboriginal communities and five other towns/settlements in the Northern Territory (see Figure E4.13). These settlements are outlined in Table E4.12 (north to south), which also provides an indication of their approximate population size, and sensitive receptors within those settlements.

The distance of 1 km was chosen as this broadly reflects the distance at which noise from rail traffic reduces to background (unpublished data from the Olympic Dam Expansion Draft EIS). Population size is based on the ABS 2006 Census of Population and Housing for Urban Centres/Localities and Indigenous Locations (2007).

Table E4.12 Towns and settlements within 1 km of the Northern Territory rail corridor

Towns and settlements	Population	Sensitive receptors
City of Palmerston	23,600 people	Within 25 m of houses on the western side of Marlow Lagoon
		Within 100 m of houses on the western side of Durack
		Within 600 m of the Palmerston Christian School
		Within 800 m of houses on the western side of Moulden
Proposed City of Wedell	Proposed new satellite city	n.a.
Adelaide River	200 people	Within 75 m of houses
		Within 600 m of a primary school
Gulngarring	Less than 80 people	Within 800 m of the Aboriginal community
Amangal Indigenous Village	Less than 80 people	Within 500 m of the Aboriginal community
Pine Creek	250 people	Within 350 m of houses and 600 m of a primary school
		Within 900 m of the Pine Creek (Aboriginal) compound
Katherine	5,850 people	Within 650 m of houses on the western outskirts
Tennant Creek	2,900 people	Within 550 m of houses on the western outskirts
Adelaide Bore	Less than 80 people[1]	Within 900 m of the Aboriginal community
Artekerre	Less than 80 people	Within 1 km of the Aboriginal community
Alice Springs	21,600 people	Within 50 m of houses
		Within 250 m of the hospital and 450 m to two schools
		Between 200 m and 800 m of the Aboriginal communities of Nyewente, Akngwertnarre, Inarlenge, Ilyiperenye, Anthepe, Karnte, New Ilparpa, Mpwetyerre, Ilperle-Tyathe
Pwerte Marnte Marnte	Less than 80 people	Within 400 m of the Aboriginal community

[1] The Indigenous location of Nturiya/Pmara Jutunta/Adelaide Bore/Ileparratye/Petyale has approximately 265 people.

At the 2006 census, 34% of the Northern Territory population (or 66,000 people) lived in Darwin, of whom 9.4% were Indigenous (ABS 2007). Of those people in the labour force in Darwin (aged 15 years and over), over 96% were employed, and around 4% (or 1,280 people) were unemployed. The NT Government 2008–09 budget papers (NT Treasury 2008a) indicate that unemployment in the Northern Territory has increased from 3.8% in 2006–07 to 4.5% in 2007–08, although labour market statistics and other related indicators point to solid employment growth and continuing skills shortages. Occupations experiencing labour and skills shortages are professionals, associate professionals, trades, semi-skilled and unskilled occupations, with acute shortages in most trade occupations and engineering services (among other occupations). High levels of construction activity and major projects have contributed to the Northern Territory's employment growth.

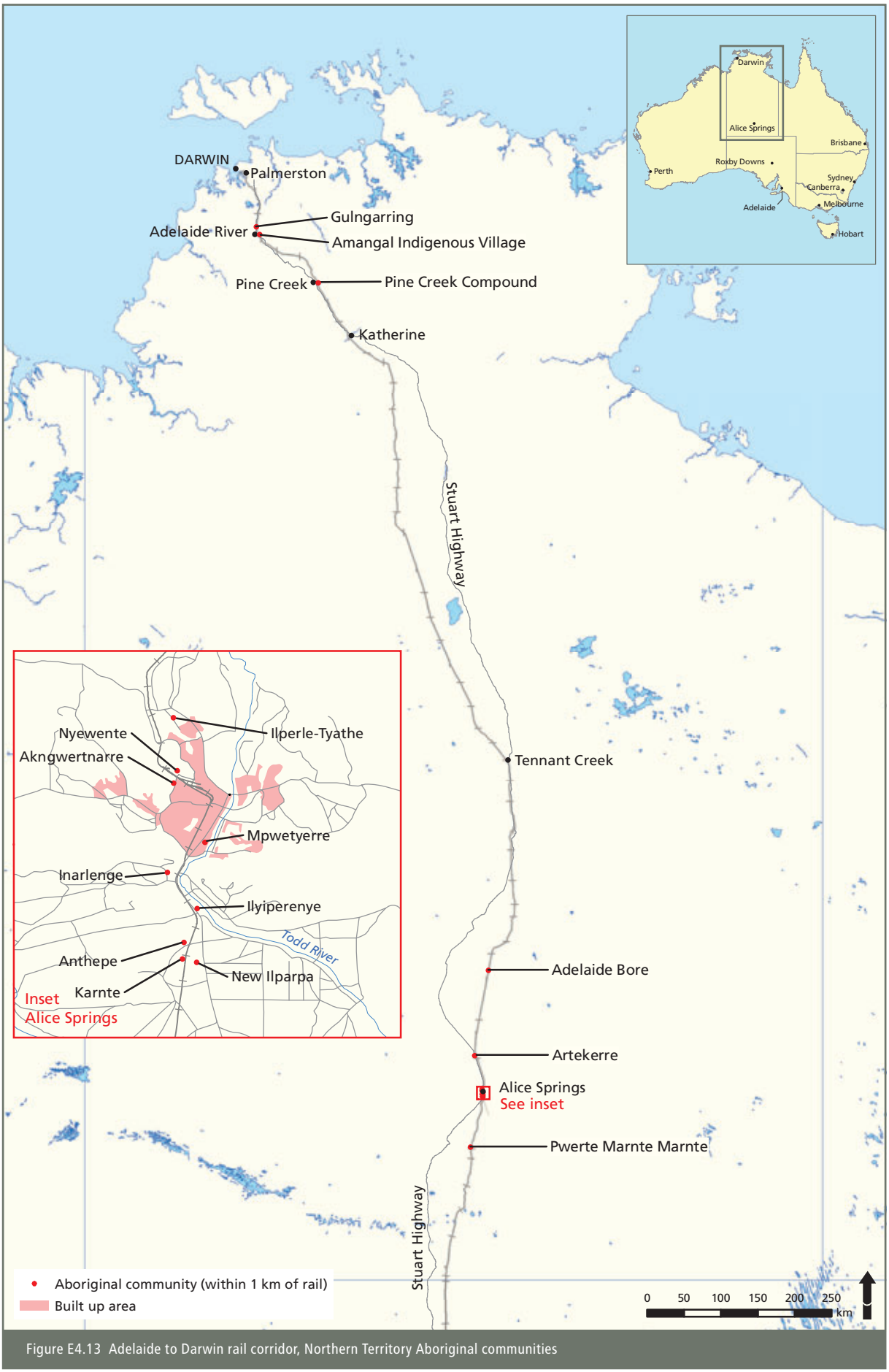


Figure E4.13 Adelaide to Darwin rail corridor, Northern Territory Aboriginal communities

In terms of output, mining is the largest industry in the Territory, accounting for 26% of GSP in 2006–07. Growth in the total value of mineral and energy production is expected to increase by 34.3% in 2008–09 (NT Treasury 2008b). High levels of mining exploration are also expected to continue, with the potential for more mining operations to use rail to transport their products to the Port of Darwin (see Table E4.13 and Figure E4.14).

Table E4.13 Potential mining operations using rail[1]

Company	Project	Location	Product
GBS Gold	Union Reefs	Pine Creek	Gold ore
Territory Iron	Frances Creek	Pine Creek	Gold ore
OM Holdings	Bootu Creek	Tennant Creek	Manganese
Territory Iron	Warrego	Tennant Creek	Magnetite
Peko Rehan	Peko Tailings	Tennant Creek	Magnetite
Arafura Resources	Nolans Bore	Alice Springs	Rare Earths
Olympia Resources	Harts Range	Alice Springs	Garnet sands
Altona Resources	Arckaringa	Arckaringa (SA)	Coal
Goldstream	Cairn Hill	Coober Pedy (SA)	Magnetite/copper/gold
Goldstream	Peculiar Knob	Coober Pedy (SA)	Iron Ore

[1] Sourced from NT Treasury (2008b).

The Northern Territory economy is the smallest in Australia, contributing 1.3% of GDP in 2006–07 (ABS 2007b). In recent years, the Northern Territory economy has experienced strong growth, recording the second highest GSP growth in 2006–07 behind Western Australia. This growth has been primarily driven by the mining industry, which accounted for 26% of GSP in 2006–07, and international exports of goods and services from the Territory, accounting for 35% of GSP (NT Treasury 2008b).

The Northern Territory economy is different from other Australian states in that it has an abundance of natural resources, relatively large tourism and public sectors, and a significant defence presence. The small size of the Territory economy and its commodity-focused base means that it is highly influenced by global economic conditions (NT Treasury 2008b).

The Darwin Port Corporation Annual Report 2006–2007 identified the following socio-economic performance:

- With the Northern Territory Government's provision of community service obligation funding, the Darwin Port Corporation provides support to the marine industry, development and management of the Darwin Wharf Precinct for tourism and recreation, and provision of port and reception facilities for cruise and naval vessels.
- The Darwin Port Corporation employs 67 staff, including a dedicated Environmental Officer.
- The 2006–07 financial year saw total trade through the Port of Darwin up 35% and exports up 134%, coinciding with the development of bulk mineral exports from central Australia.
- The increase in trade and shipping realised a 5% increase in revenue generation (from $8.5 million to $9.2 million) and the Port overall saw an increase in revenue from all activity and funding by around 24%, to $17.4 million for the year.

E4.6.10 Transport

The Adelaide to Darwin railway was completed in 2004, and provides the sole rail link between port facilities in South Australia and the Northern Territory. Between the Northern Territory – South Australia border and Darwin there are 1,697 km of rail line. The ARTC permits operations of trains at a maximum speed of 115 km/h.

The rail link carries approximately one-third of the freight volumes from Adelaide to Darwin (Department of Transport and Regional Services 2007). Mining is the largest single freight user of the rail link, which supports dedicated bulk mineral rail services from Bootu Creek and Frances Creek mines sites in the Northern Territory. OZ Minerals of South Australia is also proposing to transport copper concentrate by rail from its Prominent Hill mine. The rail link also supports regional and interstate passenger services through 'The Ghan', which runs twice weekly. At present, there are 36 train movements per week to and from Darwin (18 train movements each way).

The Tarcoola to Darwin rail line partly follows the alignment of the Stuart Highway and crosses the rail line at numerous locations (see Attachment E4.3 Northern Territory Transport Statement for locations). The Stuart Highway is the only sealed north-south link for the movement of freight and people across central Australia and provides access to the major centres of Darwin, Katherine, Tennant Creek, Alice Springs, Coober Pedy and Port Augusta, as well as pastoral stations, mining operations and tourist destinations. The Stuart Highway between Port Augusta and Darwin is predominantly a two-lane, two-way, single carriageway road.

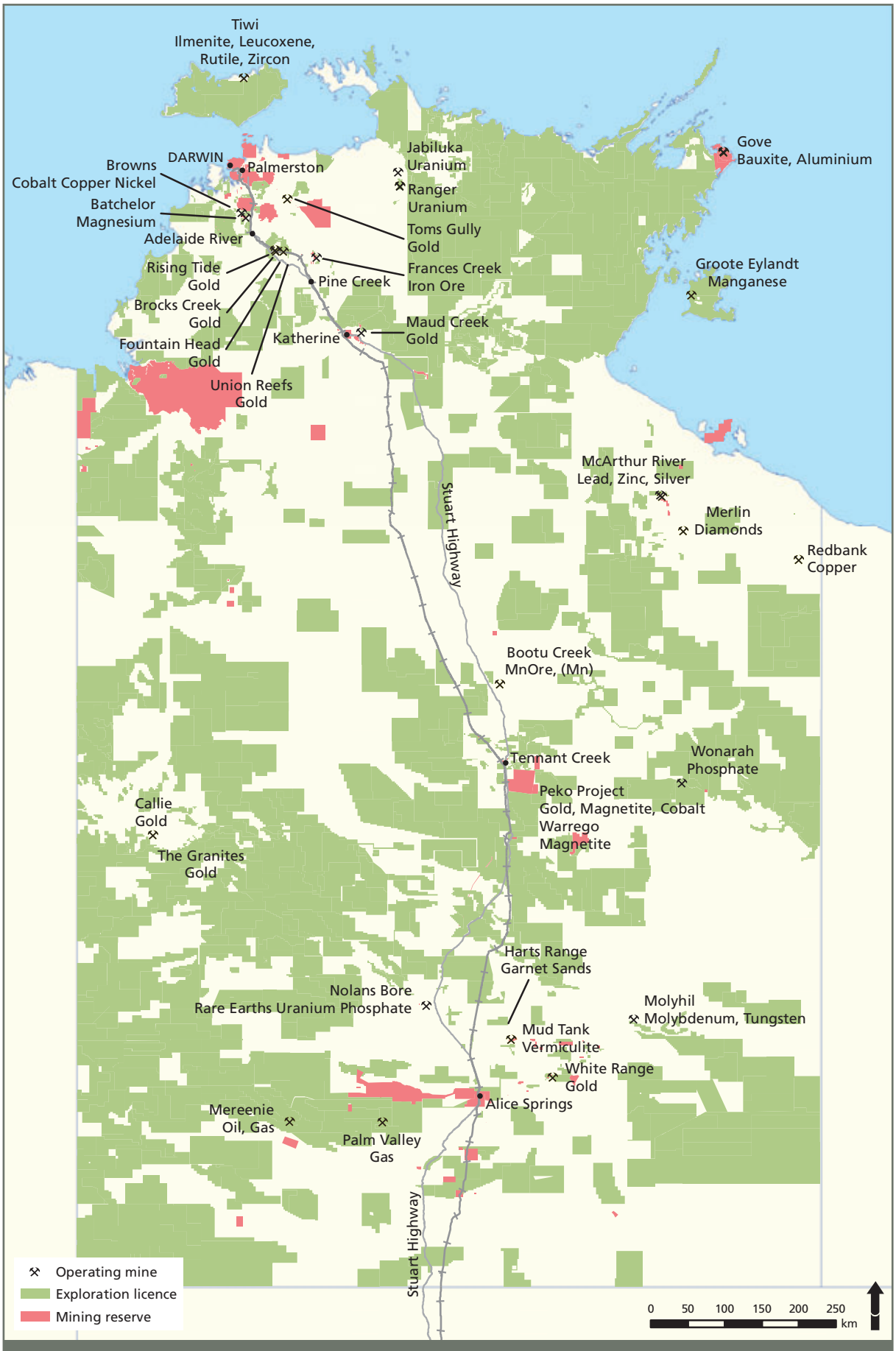


Figure E4.14 Mining operations and exploration in the Northern Territory

Within the Northern Territory, there are 228 road rail crossings (see Table E4.14 for a summary of level crossing types). This includes five road-over-rail overpasses (crossing the Stuart Highway at four locations and one crossing of the Victoria Highway, west of Katherine). Generally, active controls (i.e. boom gates or signalised crossings) are provided within the urban areas of Darwin and Alice Springs or at higher trafficked roads, including the Plenty Highway, Edith Falls Road, Kakadu Highway, Dorat Road and Batchelor Road. There are also numerous minor roads and tracks that provide access to townships and properties that cross the rail line.

Table E4.14 Rail crossing types[1]: Northern Territory – South Australian border to Darwin[2]

Railway section	Grade separated	Public active	Public passive	Pedestrian	Occupation active	Occupation passive
NT/SA border to East Arm	7	28	30	5	3	155

[1] Grade separated – physical separation of rail and road movements; active – control of the railway crossing by devices such as flashing signals, gates or barriers where the device is activated prior to and during the passing of a train through the crossing; passive – control of the railway crossing by signs and devices, none of which are activated during the approach or passage of a train and which rely on the road user, including pedestrians, detecting the approach or presence of the train by direct observations; pedestrian – locations that provide a pedestrian path across the rail line; and occupation – crossings that provide access to unnamed tracks, private property and mines etc.
[2] Sourced from Northern Territory Government Transport Group.

There are considerable differences in traffic volumes on roads that cross the rail line, with the largest volumes on roads that pass through urban areas in Alice Springs and Darwin.

A sample analysis of sightline compliance at rail crossings suggests that 100% of active crossings and 80% of all passive crossings conform to sightline standards (see Attachment E4.3 for further details). Data from the Northern Territory Department of Transport Road Safety for the five year period from January 2003 to December 2007 showed there were 11 reported casualty crashes at level crossings, not all of which involved a train (see Attachment E4.3 for details).

The AusLink Adelaide to Darwin Corridor Strategy (Department of Transport and Regional Services 2007) identifies a number of challenges and priorities for the rail and road network, including the potential for additional passing loops in the medium term, depending on future mining activity and growth in the freight task. The 2008–09 Northern Territory Budget also provided funding of $4.3 million for level crossing upgrades.

Darwin's Business Park is located at East Arm, and is strategically located near the rail freight terminal and East Arm wharf. The business park includes 13 existing or approved developments to the value of $200 million (as at April 2008), with seven new lots released in January 2008, and 11 lots planned for release in 2008–09 (Land Development Corporation 2008). It also incorporates the rail passenger terminal for the Ghan.

Berrimah Road provides the primary access to the Darwin Business Park, the Darwin Railway Passenger Terminal and East Arm wharf (see Figure E4.15). Traffic volumes in roads in the vicinity of Darwin, including on Berrimah Road, have grown significantly. The increase in traffic on Berrimah Road can be attributed mainly to the commencement of the Ghan passenger train service in 2004, and the increase in operations at the East Arm. Annual average daily traffic (AADT) on Berrimah Road, at the rail intersection 5 km west of Stuart Highway, was about 3,830 vehicles in 2007.

Public roads in the area are used by both commercial vehicles and the general public, with the latter accessing facilities at the rail passenger terminal and the East Arm boat ramp, east of the security gate to the East Arm wharf (see Figure E4.15).

The 2008–09 Northern Territory Budget provided funding for a number of capital infrastructure projects in and around the Darwin Business Park and East Arm (see Figure E4.15) (NT Treasury 2008b). These include:

- $110 million for the Tiger Brennan Drive Extension project (a joint Federal and NT Government initiative), including $10 million for Stage 1 (duplication of Berrimah Road from Wishart Road to Tiger Brennan Drive, due for completion end 2008); $89 million for Stage 2 (extension from Berrimah Road to the Stuart Highway, and an overpass at the Stuart Highway–Roystonea intersection planning, is underway); and $11 million for Stage 3 (Berrimah Road rail overpass)
- $59.5 million to improve bulk ship loading and environmental impacts at the Port of Darwin, including $35 million for an overland conveyor and $24.5 million for reclamation at East Arm and hardstand
- $4.6 million for continuing works to provide a new boat ramp and associated facilities at East Arm
- $2.5 million for Darwin Business Park and $1 million to develop industrial land to accommodate East Arm frontage.

Figure E4.15 Darwin Business Park and East Arm Wharf

E4.7 IMPACT ASSESSMENT APPROACH

The assessment undertaken applied a conceptual framework and iterative process which evolved throughout the project to identify impacts, benefits and risks (see Figure E4.16). The steps indicated on Figure E4.16, and explained in the following sections, are representative of the process that was followed, with the outcomes for the NT Transport Option presented in this appendix and relevant chapters of the Draft EIS.

The assessment considered project impacts and benefits to be consequences of known events or activities, and therefore certain to occur. For example, stormwater would run off from disturbed areas of the construction site during and after rainfall. The impact assessment focused on the consequence of the activity and the management measures that would reduce its impact (or, where relevant, maximise its benefit). The EIS team worked closely with the BHP Billiton management and design teams in an iterative process where designs were modified and management measures were added to minimise residual impacts and maximise residual benefits ('residual' being the impacts or benefits remaining after modifications and management measures had been applied).

In some cases, assessments were undertaken on several occasions, with design modifications or management measures applied each time, to establish a cost-effective and environmentally, socially and culturally acceptable outcome. This appendix describes the residual impacts and benefits, and categorises these into high, moderate, low and negligible to provide direction for future management attention.

The process involved (see Figure E4.16):

1. defining the project activity (e.g. preparing the construction site for foundations)

2. identifying the predicted impact (e.g. turbid stormwater run-off may be generated from disturbed areas)

3. assessing the consequence of this activity on a known value or the nearest sensitive receptor (e.g. in the absence of erosion and sediment control measures, stormwater of elevated turbidity, and therefore reduced water quality, could enter the adjacent mangroves or Darwin Harbour)

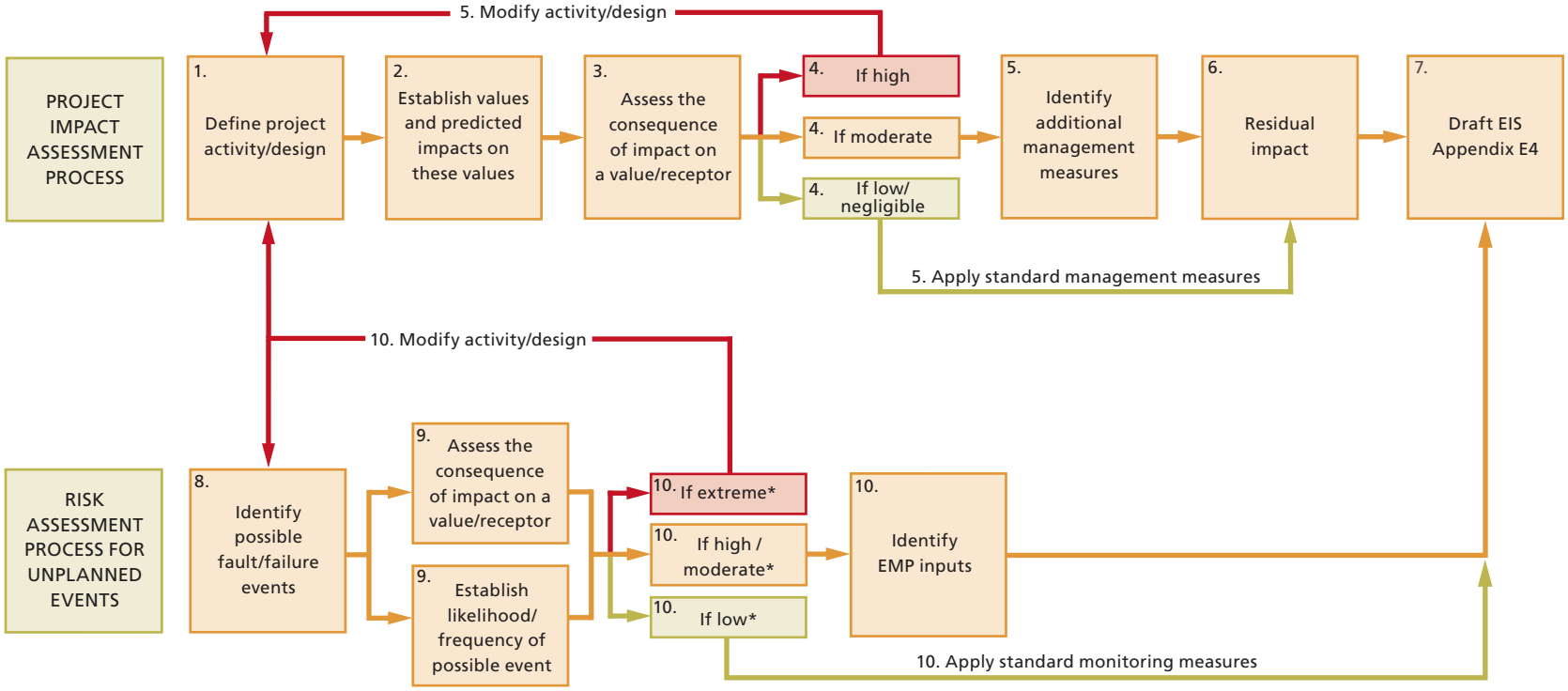
4. establishing the potential impact or benefit (e.g. the potential impact would be moderate, reflecting a short-term impact on a sensitive receiver)

5. depending on the level of potential impact, modifying the activity or the design of the project component (for a high impact), applying mitigation measures (for a moderate impact) or applying standard controls (for a low-level impact) (e.g. for the chosen activity the level is moderate so mitigation measures such as the preparation of an Erosion and Sediment Control Plan (ESCP) including silt fencing and appropriate stormwater management controls would be applied)

6. documenting the residual impact or benefit in this appendix (and where relevant within the Draft EIS) and categorising the residual impact as per the criteria in Table E4.15 to direct future management attention. For example, by implementing the measures within the ESCP to achieve the performance target turbidity levels, the stormwater run-off would be managed so that it would not cause detectable impacts in the mangroves or Darwin Harbour, and therefore the residual impact would be negligible

7. documenting all residual impacts and benefits in this appendix ensuring design modifications and management measures are captured as key commitments (see Section E4.13) or integrated into the ongoing Environmental Management Program (see Section E4.12).

The outcomes of the impact assessment for the NT Transport Option are provided in Sections E4.8 to E4.10.



* Categories as per AS4360
EMP - Environmental Management Plan
Numbers in boxes as per description in Section E4.7

Figure E4.16 Framework for assessment of major elements of the proposal

Table E4.15 Criteria used to categorise residual impacts and residual benefits

Category	Residual impact		Residual benefit
	Where legislated criteria exist[1]	Where legislated criteria do not exist	Where legislated criteria do not exist
None/negligible	A change below detectable limits	No detectable impact	No detectable benefit
Low	An effect but within compliance limits/standards	Short-term impact[2] to a common or local receiver[3]	Short-term local benefit
Moderate	A short-term non-compliance[4]	a) Short-term impact to a sensitive or state-wide receiver[5] b) Long-term[6] impact to a common or local receiver	a) Short-term state-wide benefit b) Long-term local benefit
High	A regular or consistent non-compliance	Long-term impact to a sensitive or state-wide receiver	Long-term state-wide benefit

[1] Includes listed flora and fauna species (including listed migratory birds).
[2] Short-term impact / benefit is a period of <3 years, corresponding with the maximum time to construct off-site infrastructure.
[3] A common receiver is defined for the purpose of the Draft EIS as one that is not afforded additional protection under legislative Acts or Regulations and a local receiver is defined as one within the EIS Study Area.
[4] Short-term non-compliance of a daily limit for air and noise and a period of <3 years for listed species.
[5] A sensitive receiver is defined for the purpose of the Draft EIS as one that is afforded additional protection under a legislative Act or Regulation or a critical population group.
[6] Long-term impact / benefit is a period of >3 years.

E4.8 STORAGE AND LOADING FACILITY IMPACTS AND MANAGEMENT

E4.8.1 Air quality

The proposed concentrate handling facilities are to be designed as a closed system in which all generated fugitive dusts would be captured and cleaned prior to the release of ventilation gases to the atmosphere (see Section E4.2.3 for a description of the proposed closed system and installed dust mitigation measures). A combination of wet scrubbers and dust baghouses would be used to capture the fugitive dust generated within the storage and loading facilities and conveyors, these typically have a cleaning efficiency of greater than 99%. As a result of the closed system design of the facility and the implementation of fugitive dust collection and cleaning systems, it is expected that there would be no change in ambient air quality at the nearest sensitive receivers.

In order to ensure the robustness of the fugitive dust cleaning systems, a particulate monitoring station would be established at a suitable location adjacent to the site before construction commenced. Monitoring would continue during construction and operation of the facility. Additionally, the ventilation discharge stacks would be sampled during facility commissioning, and at regular intervals thereafter to ensure the effectiveness of the fugitive dust collection and cleaning systems.

E4.8.2 Noise

As there are no Northern Territory-specific noise criteria, South Australian criteria have been used in the assessment of potential noise impacts at East Arm. The South Australia Environment Protection (Noise) Policy 2007 (SA EPA 2007) sets criteria for noise levels at sensitive receivers originating from new industrial facilities during construction and operation. A summary of these criteria is shown in Table E4.16.

Table E4.16 Noise criteria for sensitive receivers

Source	Noise criteria (dB(A))	
	Day (7 am to 10 pm)	Night (10 pm to 7 am)
Construction noise	45 (continuous)	NA[1]
	60 (maximum)	
Operational noise	47	40

[1] The noise policy restricts construction activity to between 7 am and 7 pm where such noise might affect sensitive receivers.

Construction noise would consist of general light and heavy vehicle movements (engine noise and reversing beepers) and general intermittent construction noise. Noise sources associated with the operation of the concentrate handling facility would be generated largely from train shunting and unloading and electric motors on conveyors, ship loading facilities and the ventilation systems. Due to the nature of the closed system design, the majority of these noise sources would be generated within buildings and enclosures, providing noise attenuation.

During construction of the Darwin LNG project, it was noted that no construction noise was audible at Darwin CBD, East Arm port or Palmerston. Although a low-frequency hum was noted on some occasions, its source could not be identified (URS 2005).

Given the existing baseline noise levels at the sensitive receivers, the distance between the proposed concentrate handling facilities and the sensitive receivers, and the existing bulk handling activities currently undertaken at East Arm, it is likely that the proposed development would have a negligible effect on noise levels at sensitive receivers during both construction and operation.

E4.8.3 Surface water and soils

The additional infrastructure proposed for construction at East Arm has the potential to change existing drainage patterns and increase stormwater run-off velocities because of the larger areas of impervious surfaces. The closed system however would ensure that stormwater from the site would not come into contact with the concentrate product. The potential effects of stormwater run-off are discussed below.

Erosion and sediment control

The closed system would prevent stormwater coming into contact with the concentrate product. Therefore, the most significant issue for the proposal in terms of surface water would be the potential for erosion and the resulting sedimentation during the construction phase.

Soil erosion from industrial sites can be a major source of sediment pollution to adjacent water bodies. The risk of erosion is increased during large rainfall events and from areas subject to increased run-off from hardstand areas.

First-flush stormwater run-off from the site would be directed to on-site detention basin(s) for settling of sediments before being discharged into the established Port of Darwin stormwater detention system, as per the Port of Darwin's Draft Stormwater Management Plan. Also, given the proximity of the site to the sensitive marine environment of Darwin Harbour, additional erosion control measures would be implemented. Specifically, an erosion and sediment control plan (ESCP) would be developed as follows:

- to include marked-up design drawings that show the location, extent and type of erosion control measures proposed
- to be in accordance with the objectives and requirements of the Northern Territory Erosion and Sediment Control guidelines (NRETA 2008).

The monitoring program would be developed to ensure erosion and sediment control measures are inspected and maintained as required, following each potentially erosive rainfall event (this would be determined during the Environmental Management Program (EM Program) and ESCP preparation). The monitoring program would be implemented during the construction phase and continue during post-construction until the disturbed areas were stabilised.

With the successful implementation of these control measures, the residual impact on the environment from erosion and the resulting sedimentation is categorised as low, representing an effect but within compliance standards.

Stormwater and drainage patterns

The hardstand areas (i.e. concentrate storage shed and office buildings) would occupy about 4 ha. This is a relatively small area compared with the total area of East Arm. Nevertheless, rainfall that falls on this new impervious area could change drainage patterns and increase flow velocities. The first-flush rainfall events would be collected and diverted to an on-site detention basin, allowing flow velocities to be controlled. The residual impact of the proposed facilities on stormwater run-off and drainage patterns is therefore categorised as negligible.

Zero water discharge system

Section E4.2.3 described the water recycling system for the proposed concentrate shed. This can be summarised as follows:

- the external surfaces of each rail wagon would be washed to remove dust particles immediately after unloading operation. This washing exercise would occur within a fully enclosed shed
- the water used to wash the rail wagons would be collected and treated to recover concentrate particles that may have attached to the outside of the wagon during unloading
- the treated water would be contained in on-site storage tanks for reuse in subsequent wash cycles, and any collected solids would be placed on the concentrate stockpile for export
- about every four to six months, when the recycled water became too dirty, some of it would be removed from the system, discharged into a holding tank or similar unit and railed back to Olympic Dam to be disposed of within the Olympic Dam tailings storage facility
- the volume of water removed from the system would be made up with new water from collected stormwater or the existing East Arm water supply infrastructure.

The proposed system would result in zero discharge of contaminated rail wagon wash-down water.

Soil and groundwater contamination

As discussed above, the concentrate storage and loading facilities would be managed in a closed system, which would include negative pressure and automatic doors for the storage shed and dedicated enclosed conveyors. Rail carriages would be sealed with suitable covers to ensure the load was contained during transport. Uranium oxide would be transported in sealed drums within sealed shipping containers. Therefore, the likelihood of contamination leading to environmental harm is low and the residual impact of soil and groundwater contamination from the storage and transport of uranium oxide and concentrate is categorised as negligible.

BHP Billiton treats spillages of all process materials and products seriously because Olympic Dam material may be radioactive. Systems and procedures are in place to ensure that spills are identified, reported, cleaned up and investigated to prevent recurrence.

Olympic Dam operational procedures require all spills (or loss of containment spills) to be reported internally as environmental incidents. At Olympic Dam, the frequency, duration and severity of all spillages, including information on the quantity of material and type of material, are currently monitored.

A process to notify external agencies if the spill triggers the external reporting level is also in place. Reporting criteria are based on volume of spillage and whether the spill has occurred inside or outside a bund which has been designed for the purpose of containing any spill.

As part of contingency management, all parts of the existing plant have undergone hazard and operability (HAZOP) reviews to identify the potential for spills and the likelihood of spillages. These reviews would occur for any new plant or facilities, including facilities at the Port of Darwin. Controls include bunding requirements and access and egress for cleanup. Those areas which require specific legislative requirements for spillage prevention, control and management are also addressed in the detailed design stage. This process would occur for all new plant during the detailed design stage of the proposed expansion.

In the event of a spillage, there are a number of controls available for operational personnel to contain spills including temporary bunds and spill kits for spillage response. Operational and emergency response personnel are trained in their use.

Fuel storages and other hazardous materials would be appropriately bunded as required by Northern Territory and Australian standards. The residual impact of soil and groundwater contamination associated with storage of fuels and other chemicals is categorised as low. Risks as a result of accidental spills and other unplanned events are addressed in Section E4.11.

The Darwin Port Corporation considers the material used at the East Arm for land reclamation to be 'clean fill' (GHD 2006). Therefore it is unlikely that contaminated soils would be encountered during construction of the facilities. However, strategies would be included in the management plan in the event of encountering contaminated soils.

Acid sulfate soils

The construction of facilities at East Arm would be in reclaimed land and therefore would not disturb acid sulfate soils (ASS). However, trenching below 5 m AHD may be required to install some service infrastructure. If so, testing would be undertaken for potential and actual ASS prior to such ground disturbance in these areas. An ASS management plan would be implemented for areas that exceed action criteria as listed in Table E4.17 or other relevant Northern Territory guidelines. Given the minimal trenching required, the planned ASS testing in risk areas and the ease of management of ASS if identified, the residual impact for potential disturbance to ASS at East Arm is categorised as low.

Table E4.17 Criteria to determine significance of disturbance

Type of material		1–1,000 tonnes disturbed		>1,000 tonnes disturbed	
Texture range (McDonald et al. 1990)	Approximate clay content (%)	Oxidisable sulphur (%S)[1]	Total actual acidity (molH+/t)[1,2]	Oxidisable sulphur (%S)[1]	Total actual acidity (molH+/t)[1,2]
Coarse texture – sands to loamy sands	≤5	0.03	18	0.03	18
Medium texture – sandy loams to light clays	5–40	0.06	36	0.03	18
Fine texture – medium to heavy clays and silty clays	≥40	0.1	62	0.03	18

[1] Calculated on an oven dry basis.
[2] Moles of hydrogen ions per tonne of soil. A measure of soil acidity.

E4.8.4 Flora and fauna

No clearance of terrestrial vegetation or mangroves, or disturbance to marine communities would occur at the Port of Darwin as all development would occur on previously cleared or Darwin Port Corporation reclaimed land.

Stormwater detention basins would be installed as one of the first construction activities, with overflows directed to the East Arm stormwater management systems in place at the time. This would ensure that erosion of earthworks associated with the construction of buildings, rail embankments and other infrastructure did not lead to the discharge of sediment-laden stormwater into the harbour.

Potential impacts associated with ongoing storage and loading of uranium oxide and concentrate, and increased shipping operations on fauna and flora are primarily related to the potential introduction of exotic species on the hulls of ships or from the discharge of ballast water.

Management of ballast water discharges would be consistent with the requirements of Darwin Ports Corporation and national ballast water management standards currently being developed to meet Australia's commitment to the International Convention for the Control and Management of Ships' Ballast Water and Sediments (DAFF 2008; IMO 2008).

Winnowing of sediments by the additional ship movements within the Port of Darwin would be consistent with the normal operation of the harbour. The slight increase in average turbidity of the harbour would result in negligible ecological effects within the harbour.

The proposed development at East Arm would not adversely affect any listed threatened species or listed migratory species (see Attachment E4.2 for details).

Residual impacts on the marine environment of Darwin Harbour from construction operations, ongoing operation of the facilities and increased shipping movements would be negligible.

E4.8.5 Mosquito breeding

Land reclamation and construction activities in or adjacent to tidal areas at East Arm have the potential to create new mosquito breeding sites, which could significantly affect the quality of life of nearby residents, the incidence of mosquito-borne diseases and the cost of management and control of mosquitos. The Northern Territory Department of Health and Families has issued detailed construction guidelines for tidal areas to prevent mosquito breeding (Northern Territory Coastal Management Committee 1998). The Darwin Port Corporation would be responsible for ensuring that the construction guidelines were followed during land reclamation at East Arm. BHP Billiton would ensure that the guidelines were followed during construction of storage and loading facilities at East Arm.

The stormwater retention basin(s) and associated stormwater drain(s) that would be constructed at the site may provide suitable mosquito breeding sites. As such, any receptacles or depressions with the potential to store water for more than three days would be avoided, and stormwater drains would be kept clear of vegetation and be free-draining to avoid formation of mosquito breeding habitat. The risk of creating additional mosquito breeding habitat would be minimised by ensuring that the design engineers and construction contractors consulted closely with personnel with ecological expertise during the design and construction of the facilities. In particular, the Medical Entomology Branch of the Northern Territory Department of Health and Families would be consulted during the design phase of the project.

Prior to construction, a mosquito management plan for the site would be prepared by appropriately qualified personnel. Issues to be considered would be pond depth, angle of bund sides, material used in bunds, control of aquatic and semi-aquatic vegetation and the discharge sites for overflow water.

E4.8.6 Cultural heritage

The land at the Port of Darwin (East Arm) that would support the new infrastructure has had its native title extinguished. BHP Billiton would continue to consult with the Larrakia Development Corporation to develop an Industry Participation Plan.

Although the Quarantine Anti-Aircraft Battery Site is located in the Darwin Business Park (see Figure E4.15) it would not be disturbed or affected by the construction or operation of the proposed BHP Billiton facilities. If non-Indigenous relics were found during construction or operation of the facility, they would be managed in accordance with *Heritage Conservation Act 1991*. The finding would be reported to the Department of Natural Resources, Environment, The Arts and Sport, and a permit would be obtained for any work on, or removal of, a heritage item.

E4.8.7 Visual amenity

The development of additional storage and loading facilities at the Port of Darwin would be consistent with the existing industrialised character of the Port of Darwin. The proposed facilities would be approximately 5 km south-east of the Darwin CBD, across Frances Bay, and 3 km south-west of the nearest urban area at the suburb of Berrimah. As such, the visual impact of the proposed facilities from the nearest public viewpoints would be negligible.

E4.8.8 Waste management

Only small volumes of general office waste, sewage and putrescible wastes would be generated by the proposed facility. Licensed contractors would dispose of these in local waste management facilities.

Low-level radioactive wastes may be generated on-site, including:

- rail wagon wash-down water
- mechanical components and equipment that have been in contact with the concentrate, such as conveyor belts, dust bags from the ventilation system and used tyres
- personal protective equipment.

The zero discharge rail wagon wash-down water system has already been described. The other wastes mentioned above would be loaded into empty rail wagons within the enclosed rail shed and transported to Olympic Dam for disposal within the on-site waste management centre or tailings storage facility.

E4.8.9 Decommissioning and rehabilitation

The port facilities at the Port of Darwin would probably continue to be used as port facilities and/or as industrial sites by other commercial enterprises after the Olympic Dam operations had ceased. Before the mine was closed, future uses of the port facilities would be investigated.

One important component of closure would be to investigate radionuclide contamination at the site and, if necessary, take measures during rehabilitation to ensure that potential occupational and public exposure to radionuclides were within prescribed limits. If infrastructure, equipment or other materials were found to be contaminated with radionuclides, they would be transported to Olympic Dam for disposal within an appropriate facility.

If no future use for the port facilities was identified, the facilities would be decommissioned. All infrastructure would be removed and recycled, or removed to an appropriate landfill site. The site would be rehabilitated to a condition consistent with post-operational land uses, as agreed with stakeholders.

E4.9 TRANSPORT OF PRODUCT IMPACTS AND MANAGEMENT

E4.9.1 Rail noise

The transport of about 1.6 Mtpa of concentrate to East Arm would require one train per day each way (i.e. two trains per day, one fully loaded going to the Port of Darwin and one returning mostly empty to Olympic Dam). This would increase the rail movements into and out of the Port of Darwin from the current 36 trains per week to 50 trains per week, and from 10 trains per week at Tarcoola to 24 trains per week (see Traffic Management Section E4.9.3 below for further details on expected traffic volumes). The increased utilisation of the existing rail infrastructure would be within the design usage levels of the existing rail corridor. Although additional rail infrastructure may be required (BHP Billiton is proposing to hold further discussions in this regard), it has been determined that the existing rail corridor would be able to accommodate any such improvements.

Modelling of the noise impact of rail traffic on the proposed rail spur between Roxby Downs and Woomera (for a similar number of trains per week) indicates that the South Australian Environment Protection Authority criteria for rail noise at the nearest sensitive receivers (being 60 dB(A) continuous and 85 dB(A) maximum) would be met at a distance of 100 m or more from the rail line. Noise levels as a result of train movements would approach typical background noise levels at a distance of approximately 1 km from the rail line. Receivers closer than 100 m from the rail line may receive noise levels that exceed the criteria depending on local topography and meteorological conditions.

In practice, the addition of two trains per day would be likely to have a negligible impact on sensitive receivers currently situated adjacent to the existing rail line and presently exposed to the noise of 5–6 trains per day. The additional trains would be no louder than the trains that currently travel the rail line.

E4.9.2 Road noise

There would be an increase in road traffic associated with the movement of additional volumes of containerised uranium oxide between the Darwin Business Park and the East Arm wharf of approximately 15 heavy vehicles per week along Berrimah Road.

However, there is a significant distance to the nearest sensitive receiver (around 3 km) and it would be an insignificant increase over the existing AADT road traffic volumes of around 3,830 vehicles per day (see Traffic Management Section E4.9.3 for further details on expected traffic volumes). As a consequence, the additional road traffic is predicted to have a negligible impact on nearby sensitive receivers.

E4.9.3 Traffic management

The impacts of changes in transport in the Northern Territory as a result of the proposed expansion of Olympic Dam have been assessed. A summary is provided below and further details are provided in Attachment E4.3.

The rail line between Adelaide and Darwin crosses a number of active and passive level crossings. The increased rail usage would increase the potential for delays to the travelling public at these crossings. Train lengths would be up to 1,800 m long (the maximum length allowed on the rail network), which would result in a typical delay of up to 120 seconds, based on a travelling speed of 80 km/h. The length of delays would depend on the speed of the train. For example, in Alice Springs speed limits of 20 km/h apply in some areas, which could result in delays in the order of 8 minutes. The queuing and delay associated with each level crossing would also depend on the traffic volumes at the time. BHP Billiton would follow established train operating procedures to minimise impacts on residents and motorists. Given the infrequent occurrence of the train movements, this is not expected to have a significant impact on traffic movements near the Port of Darwin, Alice Springs or elsewhere in the Northern Territory.

There would also be an increase in road traffic into the Darwin Business Park as a result of the transport of equipment and material for the construction of the proposed facilities at East Arm and the associated workforce. The proposed expansion would also cause heavy vehicle traffic within the Darwin Business Park to increase as a result of the increased volumes of uranium oxide being transported from the Toll facility, for approximately 2.5 km along Berrimah Road to the entrance/gatehouse, and then to the East Arm wharf for export (see Figure E4.15 for locations).

The total volume of uranium oxide to be exported via the Port of Darwin has not yet been determined. However, for the purpose of the traffic impact assessment, if the total volume was exported (i.e. an increase to the total of 900 containers per year), this would increase truck movements by a corresponding 900 per year (based on one container per truck), or an average of 15 trucks per week (although most truck movements are likely to occur in conjunction with the nominated export ship movements and therefore would not be evenly distributed throughout the year). Based on the traffic data at the Berrimah Road rail intersection (i.e. AADT of about 3,830 vehicles per day) the impact of an additional 15 trucks per week (on average) for the transport of increased volumes of uranium oxide would be negligible. While Berrimah Road is also used by members of the general public transiting to and from the Ghan rail passenger terminal and East Arm boat ramp, the transport of industrial goods along this carriageway is common.

The affect of the likely increase in road traffic movements is therefore considered negligible. Planned improvements to Berrimah Road as part of the Tiger Brennan Drive extension will also provide better access to Darwin's East Arm Port for freight vehicles. In addition, the road-over-rail bridge, which will accommodate dual rail tracks, will also reduce traffic delays caused by trains transiting the East Arm.

E4.10 PROJECT-WIDE ISSUES

E4.10.1 Health and safety

The health and safety of its employees and contractors are a priority for BHP Billiton. Although safety within the mining industry has improved significantly over recent years, health and safety improvements remain a priority. The health and safety of members of the community in which BHP Billiton operates are also a priority.

BHP Billiton's overriding commitment to health and safety is reflected in group policy and group-wide standards. These underpin systems and practices to prevent accidents and to control and minimise exposure to toxic or hazardous materials and situations.

The movement of large volumes of concentrate is a common activity for the BHP Billiton Group. However, the activities making up the NT Transport Option provide challenges not previously encountered within the domain of the Olympic Dam operation.

BHP Billiton would install dedicated facilities at the Port of Darwin for the handling of the concentrate. The dedicated equipment would consist of an enclosed concentrate storage shed, an enclosed conveyor system, and shiploader. Dedicated ships would be used to transfer product to overseas destinations. All installed equipment would be based on proven technologies and processes and would take into account what was learned from Olympic Dam experiences.

The overall philosophy of the concentrate handling system is that the concentrate would be enclosed at all times, with no opportunity for dust emissions to the atmosphere.

Product would be delivered to the concentrate storage shed in dedicated rail wagons fitted with effective lids. Once the product was loaded at Olympic Dam, the lids would be fitted and the product would be sealed until the wagons were emptied in the negative pressure unloading facility at the Port of Darwin within a ventilated concentrate storage shed. The product would be reclaimed using air-conditioned front-end loaders with filter scrubbers into a negatively pressured conveyor system which would transfer the material to an enclosed ship loader.

The concentrate storage shed has been designed with clean and dirty (i.e. concentrate contact) areas, requiring operators to change and shower at the end of shift to avoid the spread of contamination away from the facility. The system has been designed to minimise entry by non-essential personnel. For example, locomotive drivers would not need to enter the 'dirty' area at any time, thereby minimising their potential radiation dose.

Within the shed, there may be dust produced through product handling and reclaim activities, although the predicted moisture levels (8–11%) should keep the dust levels low. As a backup, operators would be in air-conditioned equipment. If it did become dusty, respiratory protection would provide adequate control.

Much of the machinery would be automated, therefore safety systems such as conveyor trip systems would be an integral part of the design. Access to the shed would be restricted during reclaim activities to ensure that persons were not present when loaders were operating.

There are specific licensing requirements for storing and using hazardous substances and dangerous goods, including specific licences to own, use and dispose of these substances. Licences are currently held by the existing operation and would be sought for the expanded operation.

Bulk storage facilities for hazardous liquids would be designed and constructed according to applicable standards and legislation. As a minimum, the South Australian Environmental Protection Authority (SA EPA) standards would be used, which require bund sizes and volumes to be 120% of the net capacity of the largest tank and 133% for flammable material.

All chemicals delivered to the Port facility (not just hazardous or dangerous) would be managed through a central store area. Stores personnel would undergo regular training to ensure that dangerous goods were stored safely to comply with dangerous goods regulations and requirements. Material safety data sheets would also be provided to users with each consignment of chemicals and materials. Personnel would also receive appropriate training in the safe use and handling of hazardous material.

Dust emissions

Airborne pollutants consist of dusts and gases. Atmospheric dust is made up of a range of different constituents from inert material through to irritants and toxics. Pollutant gases are generated from industrial and natural processes. The health effects of prolonged exposure to dusts and gases are well documented (Lewis 1999; Harris 2000) and may include respiratory tract irritation, infections, allergic responses, and in extreme cases, poisoning or cancer. Other factors that influence the particular impact on health include the size of the dust particles and exposure period to the pollutants. International and national exposure limits are developed to ensure that any effects of airborne pollutant exposure are minimised or non-existent.

Acceptable exposure limits are determined at an international level and are based on extensive toxicological and epidemiological studies. In Australia, the National Exposure Standards for Atmospheric Contaminants in the Occupational Environment (NOHSC:1003 (1995)) provides the acceptable exposure standards that are adopted by the industry to protect employees.

Dust control for the NT Transport Option is based on the philosophy of a 'closed system', which prevents the emission of dust to the outside environment.

Environmental emissions of dust are expected to be negligible.

It is difficult to estimate dust levels in the concentrate shed because they would depend on moisture levels, activities in the shed and the amount of material in the building. A similar (but smaller) concentrate storage shed at Olympic Dam has been used to estimate potential dust levels within the Port of Darwin shed. Levels at Olympic Dam indicate that dust levels could reach a maximum of 2 mg/m^3. However, average levels are expected to be much lower than this. The shed would be negatively pressured and ventilated, with extraction air passing through a baghouse. Therefore extended emissions are expected to be non-existent.

Other potential sources of dust from the process outside of the concentrate shed occur along the transfer system. However, transfer points on conveyors would be ventilated using extraction and baghouse systems and conveyors would be enclosed and connected to the extraction ventilation system. Wind can also cause dusting, but the system is being designed to be enclosed, therefore there would be no opportunities for wind to interact with and entrain dust.

During the rail transport of uranium oxide and the concentrate, there would be negligible dust emissions during routine operations due to the uranium oxide being transported in sealed drums in shipping containers and the concentrate stored in rail wagons fitted with lids.

With the enclosed concentrate system, the dust is not expected to have an impact on the safety of members of the public. An approved monitoring program would verify this.

Construction and commissioning

The magnitude of the construction activities for the NT Transport Option would be significant with up to 50 construction workers required to build the concentrate storage facility and the materials handling system (including enclosed conveyor and transfer systems).

Construction activities have a reputation for being one of the more hazardous industrial activities in Australia. However, there have been significant safety improvements over recent years through a focus on management systems, field procedures, training and behavioural programs.

BHP Billiton Group has a record of good health and safety performance at its sites during construction activities. For example, at its most recent large-scale construction project (BHP Billiton's Ravensthorpe Project), BHP Billiton completed 25 million exposure hours without a fatality. The health and safety record during previous construction at Olympic Dam is also good.

Construction encompasses a wide range of activities. The key health and safety considerations identified through risk assessment and industry experience are:

- excavation
- surface mobile equipment and light vehicles
- scaffolding and lifting equipment
- special work conditions including working at heights and working in confined spaces
- construction material and disposal
- fuel and chemicals
- noise and dust
- hot work and isolation
- fatigue management.

Construction of the facilities that make up the NT Transport Option would probably be outsourced to a project management organisation which would in turn subcontract components of construction work to other construction companies. All contractors would be required to comply with contract conditions based on HSEC standards. The project management organisation would provide shared services, such as emergency response, health and safety advice and assistance, auditing and training.

In all construction projects, a particular period of higher risk occurs at the time of commissioning and handover. This is the period when construction activities are nearing completion and the components of plant are gradually tested and handed over to operational personnel. The systems controlling safety during construction make way for the operational safety and process control systems. During this period, significant attention would be given to commissioning safety systems that bring together the construction needs and the operational systems needs.

The risk assessment for the NT Transport Option involved reviewing the construction risk register for the proposed full expansion and identifying those construction risks that were relevant to the NT Transport Option construction activities. The main construction safety risks relate to working at height and incidents with mobile equipment (see Section E4.11 for details).

Given the BHP Billiton safety systems, the level of attention afforded to construction activities would be significant and good safety performance outcomes are expected.

E4.10.2 Radiation protection

Radiation exposure is one of the potential hazards encountered in the mining, milling and handling of radioactive ores and can be controlled through effective design and management practices. Radiation hazards are often misunderstood and an overview of radiation exposure, as an educational tool, is provided in Appendix S1 of the Draft EIS. The following sections provide more specific information of relevance to radiation protection, and how these then relate to the NT Transport Option.

Approach to radiation safety

Olympic Dam uses international standards and Australian legislation as the basis for its systems of radiation protection. The International Commission on Radiological Protection (ICRP), which is the premier international body for radiation protection has recommended a 'system of dose limitation' that has been widely adopted overseas and in Australia. The system has three key elements:

- justification – a practice involving exposure to radiation should only be adopted if the benefits of the practice outweigh the risks associated with the radiation exposure
- optimisation – radiation doses received should be as low as reasonably achievable, taking into account economic and social factors (the ALARA principle)
- limitation – individuals should not receive radiation doses greater than the recommended limits.

The system is incorporated into legislation in Australia through the:

- *Northern Territory of Australia Radiation (Safety Control) Act 1999* (and supporting Radiation (Safety Control) Regulations 2007)
- *South Australian Radiation Protection and Control Act 1982* (Ionising Radiation Regulations 2000, Transport of Radioactive Substances Regulations 2003)
- ARPANSA Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (2005)
- ARPANSA Code of Practice for the Safe Transport of Radioactive Material (2008).

Radiation limits are expressed in terms of the 'effective dose' measured in sieverts. Occupational doses in mining are in the range of millisieverts (1 mSv is one thousandth of a sievert) and the primary radiation protection limits are:

- an annual limit to a worker of 20 mSv
- an annual limit to a member of the public of 1 mSv above background.

In both cases, the dose received may be averaged over a five-year period when assessing compliance with the limits. There is an absolute annual limit of 50 mSv per year (mSv/y) for workers.

Method of assessing radiation exposure

There are three primary ways (known as exposure pathways) by which workers can be exposed to radiation. These are through irradiation by gamma radiation, inhaling radioactive dust and the radioactive decay products of radon gas and ingestion of radioactive material.

The method used for determining doses to workers follows the internationally accepted practice defined by the ICRP (see Appendix S for further details of the method). This involves:

- identifying how the workers could be exposed (i.e. the exposure pathways)
- measuring the radiation levels to which workers are exposed using radiation monitoring equipment such as dust samplers and personal gamma monitors
- combining the radiation levels and the time spent in those levels, to provide a measure of exposure
- applying an internationally accepted conversion factor which takes into account specific characteristics of the exposure thereby providing a standardised measure of the estimated dose received by the worker
- combining the doses received from each of the pathways to establish the total dose received.

The basis for this method is the government approved monitoring program for radiation that involves both workplace and individual sampling. At Olympic Dam, approximately 1,500 radiation measurements are taken each month under the program and regulatory authorities routinely check the results.

Current radiation doses to Olympic Dam workers

For comparison purposes, current radiation dose levels for Olympic Dam are provided. In the mine, the average dose to full-time underground workers, between 2001 and 2007, was 3.5 mSv/y. The most highly exposed work-group received an average of 5.9 mSv/y, while the highest individual dose in any year was 9.9 mSv (compared to the applicable limit of 20 mSv).

Radiation exposures in the metallurgical plant can be separated into the smelter and the remainder (i.e. the concentrator, hydrometallurgical plant and refinery). Between 2001 and 2007 the average dose for smelter workers was 3.7 mSv/y, and the highest individual dose in any one year was 17.7 mSv. For the remaining areas, the average dose was 1.4 mSv/y, and the maximum individual annual dose was 7.2 mSv in the concentrator, 6 mSv in the hydrometallurgical plant and 9.5 mSv in the refinery.

Individuals in the maintenance and services group, who work throughout the plant, recorded an average dose of 1.3 mSv/y and a maximum individual dose of 8.3 mSv.

The low doses show that radiation exposures for workers at Olympic Dam are well controlled and that exposure levels are consistently below radiation protection limits.

Radiation protection for the NT Transport Option

The approach to radiation protection for the NT Transport Option would be identical to the approach adopted at Olympic Dam, which is to ensure that all radiation exposures are as low as reasonably achievable.

This assessment considers the radiation doses that would arise from the transport, storage and loading of concentrate. Specific exposure scenarios have been developed involving train operators, members of the public along the rail corridor and members of the public in Darwin. Doses to workers at the terminal and storage building at the Port of Darwin have been based on dose assessments from operations at Olympic Dam.

The dose assessments are based on assumptions and present the most conservative (worst case) situation. More detailed assessments will be available once further tests on the concentrate have been conducted.

The key assumptions in the dose estimates are:

- the concentrate has 2,000 ppm uranium content, with other uranium decay products in equilibrium
- 1.8 million tonnes (wet) of concentrate would be transported annually
- the concentrate would be transported in bulk, in rail wagons containing about 50 tonnes each, with approximately 120 wagons per train and at a rate of one train per day.

Dose assessments have been made for specific exposure scenarios with the following assumptions:

- member of the public standing at the edge of a rail easement approximately 5 m from a train with the train travelling at a walking pace of 4 km/h
- member of the public living 20 m from the rail easement with a loaded train passing the residence 365 times per year at 60 km/h
- resident of Darwin
- railway worker inspecting a train – assumes worker takes 45 minutes to inspect a train, once per week
- train crew – assumes 50 trips per year
- workers in the concentrate building at the Port of Darwin.

Estimated doses are based on the main pathways by which workers and members of the public can be exposed to radiation, which are:

- external gamma radiation
- inhaling radioactive dusts
- inhaling radon decay products.

Gamma dose rate

A conservative gamma dose rate of approximately 5 µSv/h at 1 m from a train of loaded wagons is assumed, based on estimates by Thomson and Wilson (1980) and advice from the Health Physics Society website (http://www.hps.org). This is similar to the gamma dose rate measured on containers of uranium currently being exported through the Port of Darwin. The gamma dose rate will drop off as the distance from the train increases. (Note that due to the effects of other carriages, the rate of drop off is not proportional to distance as would be expected.) The calculated doses are:

- gamma dose rate at 1 m from a loaded train – 5 µSv/h
- gamma dose rate at 5 m from a loaded train – 0.8 µSv/h
- gamma dose rate at 10 m from a loaded train – 0.2 µSv/h.

Dust dose rates

The most probable source of dust in the transport chain is rail wagon unloading and ship loading at East Arm. Both of these activities would occur as part of the 'closed system' therefore dust emissions are expected to be negligible. However, a worst case situation was identified (i.e. the 'closed system' fails) and an estimate of the potential exposure was made. In this case, a

conservative dust concentration in Darwin of one half of the limit recommended in the National Air Quality Standards, which is 50 µg/m^3 for PM_{10} dust averaged over a 24-hour period. In practice, dust emission is expected to be negligible due to the closed system of containment.

Dust emissions from passing trains are expected to be negligible. Wagons would have lids fitted to eliminate release of dust, and if there was any release, any exposure would be intermittent, occurring only for the short period when the trains were passing.

Radon decay products

An estimate of radon emanation from the concentrate has been made based on the most conservative case and assumes:

- all radon contained in the concentrate would be released during loading
- radon dispersion characteristics would be broadly similar to those at Olympic Dam.

Calculations show that with these assumptions, the amount of radon released from ship loading would be twice that released from Olympic Dam currently. Measurements at Olympic Dam show radon decay product doses for members of the public in Olympic Dam to be 20 µSv/y. Therefore, if the quantity emanating from the ship loader is assumed to be twice the Olympic Dam levels, the estimated maximum exposure levels would be 40 µSv/y at the nearest receptor in Darwin.

Radon decay product exposure during transport is expected to be negligible, as the product would be totally enclosed.

Dose estimates

Based on these assumptions, the estimated total doses have been summarised in Table E4.18 below.

Table E4.18 Estimated total doses

Dose Assessment	Gamma (mSv)	Dust (mSv)	Radon Decay Product (mSv)	Total (mSv) (limit is 1 mSv)
Public at edge of easement standing 5 m from a train	0.0008	0.000	0.000	0.0008
Public living within 20 m of a rail line	0.0018	0.000	0.000	0.0018
Resident of Darwin (worst case)	0.000	0.120	0.040	0.160
Resident of Darwin (likely case)	0.000	0.000	0.040	0.040
Railway worker – train inspection[1]	0.200	0.000	0.000	0.200
Train crew[1]	0.500	0.000	0.000	0.500

[1] Note that rail workers and train crew would be monitored as part of routine operations.

Dose estimates presented here are conservative and it is expected that actual doses would be much lower. A monitoring program would be implemented to confirm the low doses.

All estimated doses are less than the recommended annual dose limit to members of the public (1 mSv/y) and also less than the typical Australian natural background dose (about 2 mSv/y).

For workers in the concentrate storage and handling facility at the Port of Darwin, total doses of the order of 3 mSv/y (compared with the occupational dose limit of 20 mSv/y) are estimated based on current doses to Olympic Dam concentrator workers who are currently exposed to a similar material in a similar condition.

The assessment shows that member of the public doses along the rail line are small and that in a worst case the maximum potential doses in Darwin would be approximately 0.2 mSv/y.

Optimisation of radiation exposure

In addition to complying with dose limits, a key principle of radiation protection (as defined by the ICRP), is ensuring that radiation exposures are as low as reasonably achievable. The ICRP calls this 'optimisation' and it is known as 'the ALARA principle' in which ALARA means 'As Low as Reasonably Achievable'.

The design of the whole process making up the NT Transport Option has considered radiation safety as a core design aspect. Basing the transport around an enclosed system has effectively contained the material and therefore impacts are considered to be negligible. The most conservative dose estimates show that the predicted doses would comply with the dose limit of 20 mSv/y for workers and 1 mSv/y for members of the public.

In addition to the enclosed design commitment, BHP Billiton will look to further reduce the potential for radiation exposure through an 'optimisation program', which would address four main areas:

- radiation training and awareness – this would involve general awareness training of all expansion staff and targeted training of engineers and technical staff
- radiation risk assessment – this would involve formal radiation risk assessment workshops covering the design of all facilities and the overall expansion as a whole
- the establishment of mandatory design criteria for radiation protection
- the development of a program of research to obtain more information on the radiation parameters of the expansion.

In the operation phase, various methods would be employed to minimise exposures including the use of personal protective equipment (PPE) in particular situations, real-time monitoring to identify changes in exposure situations (thereby identifying where controls may be needed), investigations to ensure that the exposures remain low, training of all workers in radiation protection methods, and promoting a site-wide safety culture.

E4.10.3 Transport safety

A Traffic Impact Assessment (TIA) study was conducted for the NT Transport Option (see Attachment E4.3) to assess the broad impacts of the increase in transport requirements including road and rail. A review of seaport safety was also conducted. The key safety related transport issues relate to rail transport and ship transport and these are discussed below.

Rail transport

It is proposed that additional uranium oxide and the new product of concentrate from Olympic Dam would be transported by rail to the Port of Darwin for export. Once fully operational, there would be seven return rail trips between Olympic Dam and Adelaide each week (i.e. 14 movements per week). From a rail safety perspective, it is possible to assess the impacts of this additional usage.

The distance to the Port of Darwin from Olympic Dam is about 2,600 km. Over a full year of operations, this equates to about 1.9 million track km per year, of which 0.7 million km is in South Australia and 1.2 million km is in the Northern Territory.

The Australian Rail Safety Occurrence Data (May 2008) statistics indicate that 74,830,000 national freight train kilometres were travelled in 2007. Of these, 7,968,000 were in South Australia and 1,197,000 in the Northern Territory. Therefore, the proposed freight train traffic represents an increase of 20% in train traffic in South Australia and 100% of train traffic in the Northern Territory.

Although the number of train movements across the freight network in the Northern Territory are expected to increase by only 40%, the number of freight track kilometres travelled is expected to double.

The numbers and types of accident for South Australia and the Northern Territory are provided in Table E4.19.

Table E4.19 Safety related incidents for rail operations

Type of incident	Average annual numbers of incidents (2002–2007) – SA	Average annual numbers of incidents (2002–2007) – NT
Level crossing – people	3	0
Level crossing – vehicles	10	0.5
Derailments	20	2
Fatal accidents	4	0.3
Serious accidents	5	1
Running line or stock collisions	1	1
Collisions with people	2–3	1
Collisions with infrastructure	3	<1
Collisions with vehicles	2	<1

A relative increase in accident rates may be expected due to the increased rail operations.

Train driver fatigue is managed through specific legislative requirements. The arrangements for the railing of uranium oxide between Adelaide and Darwin (in operation since 2005) utilises relay manning, consisting of a four person crew, two of which are driving the train, while the other two rest in a separate wagon located behind the locomotives. In Darwin, the crew have a major break before returning to Adelaide.

Table E4.19 shows the number of crashes at road-rail intersections. This is relatively low, particularly given the period over which the figures have been assessed and the length of the rail network in the Northern Territory. In addition, the low number of incidents across the whole rail network indicates that the risk of an incident at a river crossing would be small.

Safety assessment of shipping operations

The sinking of a ship, although a sensational and potentially catastrophic event, is relatively isolated and rare. Such an event requires specialised emergency response and recovery. To assess the safety of shipping operations, a more meaningful indicator is in relation to serious shipping incidents.

The Lloyds Maritime Information Unit Casualty database lists shipping events that result in maritime casualties. In 2007, there were approximately 1,400 serious casualty related shipping events across the world with 10% occurring on bulk carriers (Lloyds Maritime Information Unit 2008).

The Major Hazard Incidents Data Service (MHIDAS 2002) database collates maritime incidents from around the world and it was reviewed to identify shipping and port incident trends. International data show that since records have been kept, shipping safety has continued to improve despite the large increase in shipping volumes in recent years. Of the incidents that did occur, over 50% were incidents that resulted in loss of containment and of those, 29% resulted in fire. The majority of incidents occurred during transport: 44% of incidents were caused by collisions, and only 15% occurred during loading or unloading.

In Australia, analysis of marine incidents between 1982 and 2008 show that there have been 254 incidents and accidents, with 39 fatalities. There were 79 ship groundings and 50 collisions. In terms of environmental pollution, of 335 spills recorded in 2000/2001, less than 5% were due to bulk shipping, with the majority due to recreational vessels or fishing boats. Proportionally, shipping in Australian waters records fewer incidents when compared to average international rates.

In recent times, the 'Ocean Crown' carrying BHP Billiton product ran aground off Chile and was successfully refloated with no loss of fuel or concentrate to the environment.

The Australian Maritime Safety Authority (AMSA) is the statutory body that would oversee the shipping of concentrate. In conjunction with AMSA, BHP Billiton has prepared an 'in principle agreement' on a transport plan covering the shipment of concentrate to overseas destinations.

Key requirements of the plan include:

- exclusive use ships
- collection of all bilge water which is stored in the ship for disposal appropriately on land
- ships to be fitted with gas fire extinguishing systems as concentrate is potentially combustible
- ships to ensure that there is no leakage outside of the cargo space
- details of shipping routes
- emergency response plans
- a radiation protection program and the carrying of radiation monitoring equipment.

In addition to this, a material safety data sheet (MSDS) is being developed for the concentrate, outlining its health and safety hazards.

Loss of a concentrate ship

Despite improving performance in the bulk carrier shipping industry, on average, 9 bulk carrier ships are lost each year across the world. Of these approximately 1 per year is a minerals bearing ship and 1 per year bears iron ore. The major cause of loss is ship grounding in 30% of cases and collisions in 18% of cases. Statistics indicate that the older a ship is, the more likely it is to be lost, with only 13% of ships lost when their age is less than 15 years. The total international fleet of bulk carriers numbers almost 6,200 vessels, therefore the chance of a loss of a concentrate ship is calculated to be less than 0.02% (Report to the Maritime Safety Committee 83rd session, Agenda item 27, International Maritime Organization, Bulk Carrier Casualty Report, submitted by the International Association of Dry Cargo Shipowners (INTERCARGO) July 2007).

However, BHP Billiton is intending to use dedicated ships to transport concentrate and would select these ships through RightShip, which is a recognised industry standard for dry bulk ship vetting focusing on strict HSEC requirements.
Therefore the likelihood of the loss of a concentrate ship is significantly lower than the industry wide statistics.

In the event of a shipping accident, effects of concentrate on the marine ecosystem are likely to be limited to the immediate vicinity of the ship. Although soluble copper compounds are toxic to aquatic organisms, copper sulphide is insoluble at the prevailing pH in

seawater (about 8.2), and therefore considerably less toxic (see BHP Billiton MSDS for copper sulphide). Ultimately, the copper sulphide would become covered by sediment and less available to biota. Should the accident occur in shallow water, the copper sulphide would probably be recovered.

BHP Billiton operates port facilities across the world and is a large volume shipper of metal concentrates. It has done this for many years without incident. The company is a leader in supplying raw materials like concentrates to customers around the world and is very experienced in the area. Appendix E3 of the Draft EIS provides further details on product stewardship.

Product transport safety

Currently, the uranium product (i.e. uranium oxide) is packed and sealed into 200 L drums, which are then sealed inside standard ISO (or equivalent) six metre shipping containers and transported by road to Port Adelaide. Most of the uranium oxide product is shipped from Port Adelaide, with about one-third of the product railed from Port Adelaide to the Port of Darwin for export. Transport by road and rail complies with all legislative requirements.

In the proposed NT Transport Option, the quantity of uranium oxide railed directly from Olympic Dam to the Port of Darwin would be expected to increase. The total volume would depend on commercial arrangements, however, and is not yet known.

Uranium oxide shipments must comply with two sets of requirements:

- Transport requirements are defined in the Code of Practice for the Safe Transport of Radioactive Materials, issued by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). This covers maximum radiation levels, packing and packaging, signs and labels and the documentation that must accompany each consignment.
- Security of the uranium is determined by the Australian Safeguards and Non-Proliferation Office (ASNO), which covers requirements to ensure the security of uranium oxide from theft.

Accidents create the potential for transport workers, rescue workers and bystanders to be exposed to radiation. Exposure could only occur if an accident was severe enough to breach both the transport container and the drums, releasing uranium oxide which was then inhaled. Given the structural integrity of both the containers and drums, such an outcome is unlikely. Also, it is anticipated that any potential exposures would be small because the exposure period would be low.

To clean up any resultant spillage of uranium oxide would require specialised clean-up equipment. Currently, containers with specialised equipment including PPE are held in readiness at Olympic Dam and in Adelaide. For the expanded operation, a clean-up container would accompany each train carrying uranium oxide and appropriate personnel on route (e.g. CFS/SES) would be trained in clean-up procedures. The clean-up would, however, be no more difficult than for other non-liquid dangerous goods spilt under similar conditions. Northern Territory Government officials (e.g. officers from Environmental Health or NT WorkSafe) and a BHP Billiton radiation safety officer would oversee the clean-up.

Transport plan for uranium oxide

The Olympic Dam uranium oxide transport plan was prepared to satisfy the specific licence requirements of the following government agencies:

- the Australian Safeguards and Non-Proliferation Office (ASNO)
- the SA Department of Premier and Cabinet
- the NT Government (Department of the Chief Minister).

The plan describes the procedures and processes for safely storing and transporting uranium oxide, from packaging to delivery, including the emergency response to potential incidents along transport routes. It also describes the roles and responsibilities of the various organisations involved. The plan is externally audited annually, with the three lead agencies (noted above) and the management of Olympic Dam reviewing the audit results, recommendations and actions.

Emergency response for the transport of concentrate

The existing Olympic Dam Corporation Emergency Incident Response Plan would be modified to address aspects of the concentrate transportation process. The plan would include the procedure for notifying Northern Territory emergency services of an incident and the caution required prior to the arrival of emergency service personnel.

In the event of an incident, the initial response would be to provide basic security, containment, control and restriction of access to the incident site. Access control equipment including bunting, flagging, and safety cones would be carried and used by agencies such as the NT Fire and Rescue Service, NT Police and the NT Emergency Services. All agencies would be trained in specific requirements relating to the concentrate.

Clean-up would involve trained personnel under the supervision of representatives from the appropriate state or territory government agencies. Spilled material would be collected into rail trucks and returned to Olympic Dam for treatment. The concentrate is insoluble in water; consequently, in the event of an incident involving spillage into a waterway, regular clean-up procedures as outlined in the emergency response plans would be implemented.

Any direct and sub-contracted service providers would be required to comply with all BHP Billiton policies and procedures with respect to this plan.

E4.10.4 Greenhouse gas emissions

The proposed facilities at East Arm are expected to use up to approximately 26 GWh of electricity supplied from the Northern Territory electricity grid during operation (i.e. from around 2016). Additionally, about 18 ML/y of diesel would be used to transport the uranium oxide and concentrate from Olympic Dam to East Arm. As the facility would be constructed on reclaimed land, no emissions from land use change are expected. As per the NT Environmental Impact Assessment Guideline: Greenhouse Gas Emissions and Climate Change, National Greenhouse and Energy Reporting (Measurement) Determination 2008 factors (Department of Climate Change 2008b) have been used to estimate likely greenhouse gas emissions resulting from the use of the electricity and diesel, as described in Table E4.20 and Table E4.21.

Table E4.20 NGER energy content and emission factors

Energy Source	Energy content (GJ/kL)	Emission factor (kg CO_2-e / kWh or GJ)		
		CO_2	CH_4	N_2O
Electricity	n.a.	0.69	n.a.	n.a.
Diesel	38.6	69.2	0.2	0.5

Table E4.21 Estimated greenhouse gas emissions for the Northern Territory component of the proposed expansion

Energy Source	Scope	Energy content	Greenhouse gas emission (t CO_2-e per annum)		
			CO_2	CH_4	N_2O
Electricity	2 (indirect emission)	26,000,000 kWh	17,940	n.a.	n.a.
Diesel	3 (indirect emission)	694,000 GJ	48,020	140	350
Sub-total			65,960	140	350
Total					66,450

The total greenhouse gas footprint for the Northern Territory components of the project would be approximately 66,450 tonnes of CO_2-e per annum, approximately 72% of which would consist of scope 3 emissions (material transport) and 28% being scope 2 emissions (off-site electricity generation). The estimated total greenhouse gas footprint is described in the context of current and projected future Northern Territory emissions in Table E4.22 below.

Table E4.22 Estimated Northern Territory project component greenhouse gas emissions in a Northern Territorian context (excluding land use change) (tpa CO_2-e)

Year	Current (2006)	2010	2020	2030	2040	2050
Northern Territory	15,200,000	15,400,000	17,900,000	19,500,000	21,100,000	22,600,000
NT Transport Option	Nil	Nil	66,450	66,450	66,450	66,450
Proportion of NT total (%)	0	0	0.37	0.34	0.31	0.29

E4.10.5 Social assessment

Employment and business opportunities

The proposed BHP Billiton facilities at East Arm are expected to employ up to 50 people during the construction phase from 2014 to 2015, and up to 50 operational staff from about 2016 onwards. BHP Billiton would prefer to employ locally or use local contractors. The proposed facilities are therefore expected to provide employment and business opportunities for local people and businesses.

The construction workforce would mainly comprise civil construction workers, including tradespersons (electrical, mechanical and fabrication), production and transport workers (such as backhoe operators, concreters, earth workers, metal workers, crane drivers, riggers and truck drivers), labourers, supervisors and managers. The operational workforce would consist of operators, maintenance staff, truck drivers, supervisors and a small number of managerial and administrative staff.

Direct business opportunities are likely to include civil engineering services and equipment and general site services, such as earthmoving equipment, cranes/hoists/lifts, concrete and steel supplies, logistics and transport and communications. There would also be indirect benefits, such as catering and equipment maintenance.

BHP Billiton would look at opportunities to develop employment and training and business opportunities for Indigenous people, through consultation with the Larrakia Development Corporation and development of an Industry Participation Plan. Opportunities would be limited by the size of the workforce required to construct and operate the proposed East Arm facilities, but could include environmental management opportunities for suitably qualified Indigenous people.

Amenity and wellbeing

The existing operations at East Arm are industrial and are located well away from urban areas, with the nearest residential or public areas being approximately 4 km north-west to Darwin CBD (in a straight line) (see Figure 4.17). The proposed facility is keeping with the surrounding land uses, and would not affect the amenity of East Arm. The assessment of air quality and noise on residents and other sensitive receivers during the construction and operation of the proposed facilities at East Arm concluded the impacts would be negligible (see Section E4.7).

A number of properties are located within 100 m of the existing rail line to Darwin. The closest residence is 25 m from the rail line at Marlow Lagoon in Palmerston (see Figure 4.17). The existing rail was completed in January 2004, and currently accommodates 36 train movements per week (two-way) into the Port of Darwin, which would increase by two trains a day (one each way) with the proposed transport of concentrate from the Olympic Dam expansion. The assessment of noise in Section E4.7.2 indicates that noise criteria would be met at 100 m from the rail line (based on South Australian criteria, as there are no noise criteria in the Northern Territory). Therefore those properties within 100 m would continue to experience elevated noise levels, with the NT Transport Options contributing an additional two train movements per day.

It is noted that there may be additional train movements in the future as more mining operations in the Northern Territory and South Australia use the rail network to transport their products to the Port of Darwin for export. This may result in a cumulative impact on nuisance and disturbance for residents living in close proximity to the existing rail line.

Community perceptions about the transport, storage and handling of the products containing uranium

A number of issues associated with the transport of increased volumes of uranium oxide and the new product of concentrate have been raised in community consultation (see Section E4.5). The potential impacts on the community from the transport, storage and handling of products containing uranium have largely been dealt with elsewhere in this appendix. This includes health and safety from radiation exposure issues associated with air quality (such as fugitive dust) and waste management (including the capture of stormwater and its return to Olympic Dam). Section E4.10.2 provides an overview of the potential risks of radiation exposure from an accidental spill.

It is recognised that the transport of both uranium oxide and concentrate along the Adelaide to Darwin rail line on trains that would display signs advising of the radioactive content of the product may raise community concerns. An education program providing details of the minimal impact of the product would be launched prior to the increased transport.

BHP Billiton also acknowledges that while specifically omitted from the government guidelines, the community would have interest in product stewardship. As such, Appendix E3 to the Draft EIS addresses this topic specifically. The broader guiding principles of Ecologically Sustainable Development (ESD) and how the expansion project, including the NT Transport Option, compares with these principles, is discussed in Appendix E2.

E4.10.6 Economic assessment

The economic effects of the proposed expansion, including the NT Transport Option, were projected using the Monash Multi-Regional Forecasting (MMRF) Green model. MMRF-Green is a dynamic, multi-sectoral, multi-regional model of the Australian economy developed and operated by the Centre of Policy Studies at Monash University. This computable general equilibrium model (CGE) provides comprehensive estimates of the economic effects of major projects at regional, state and national levels.

Projections were made for the impact of the proposed expansion over a 30-year period. Although the economic life of the mine would extend beyond this, economic modelling results are not projected past Year 30 because the outcomes become increasingly uncertain over longer timeframes. The economic effects do not necessarily coincide with when BHP Billiton invests capital. There will be lags in investment which vary across different industries.

The modelling was based on the best available estimates of financial expenditure from BHP Billiton's selection phase study. The results for Australia and South Australia are provided in Chapter 21 of the Draft EIS (Economic Assessment). The results relevant to the NT Transport Option are provided below.

Figure E4.17 Adelaide to Darwin railway corridor, Northern Territory towns and settlements

No commercial arrangements for the Port of Darwin facilities have been determined (i.e. capital and operating cost arrangements), and therefore, for the purpose of the model, no expenditure from the Northern Territory Government is assumed. It is noted, however, that some investment by the government would be required as part of land reclamation activities for the ongoing development at East Arm.

Due to the uncertainty in capital cost arrangements for infrastructure at the Port of Darwin, a conservative approach has been adopted whereby capital costs for this component of the project have not been included. As such, the model results provide an underestimate of the economic benefit to the Northern Territory.

Nevertheless, the modelling provides an indication of the 'direction of change' for the Northern Territory economy and the likely magnitude of that change. The economic modelling analysis shows that the proposed Olympic Dam expansion would provide a positive stimulus to the Northern Territory economy, with positive impacts for both gross product and local employment.

In examining the results presented below, it is important to note the following points:

- all results are presented relative to the base case or a 'business-as-usual' (BAU) scenario (i.e. where it is assumed that the Olympic Dam expansion does not occur). This means for example, that it would be inaccurate to say that as a result of the Olympic Dam expansion that 'GSP would increase by X per cent'. It would be more accurate to say that 'GSP would be X per cent higher than it would otherwise have been (in the base case), if the expansion had not proceeded'
- all impacts, except employment, are in constant (2008) prices
- all NPV calculations are taken over a 30-year period, including the construction phase, discounted at a conservative real social discount rate of 7% per annum.

The economic model results are presented in Table E4.23.

Table E4.23 Northern Territory economic benefits[1]

Economic measure	Average annual increase over BAU case			$NPV_{7\%}$ over 30 years
	Year 0–6	Year 7–11	Year 12–30	Year 0–30
Gross State Product (GSP)	$18m	$93m	$125m	$936m
Consumption/economic welfare	$30m	$116m	$136m	$1.1b
Investment	$91m	$220m	$44m	$1.2b
Government revenues	$0.9m	$4.7m	$6.3m	$47m

[1] Outputs of the MMRF-Green economic model.

The MMRF modelling shows that the increase in activity in the Northern Territory would stimulate its economy by nearly a billion dollars ($936 million in $NPV_{7\%}$) over the next 30 years. Consumption, a key proxy for the economic welfare of the Northern Territory community, would be over $1 billion higher than otherwise over that period. Investment in the Northern Territory would be more than $1.2 billion higher than otherwise over the next 30 years. Over the 30-year period, and in each of the key phases of the project, the MMRF modelling also predicts that an additional 250 jobs would be created in the Northern Territory as a result of the expansion project.

The modelling showed that the Olympic Dam expansion would contribute to an expansion in the rail, electricity supply, road, construction and water transport services industries greater than what would have been expected in the BAU case (Table E4.24).

Table E4.24 Top five expanding industries (Year 0 to Year 30)[1]

Industries	BAU case projected CAGR[2] (%)	Expansion scenario projected CAGR (%)	Real value added ($NPV_{7\%}$)
Rail transport services	1.4	1.4	$12m
Electricity supply	1.7	1.8	$14m
Road transport services	1.3	1.3	$46m
Construction transport services	1.1	1.1	$68m
Water transport services	1.0	1.1	$1m

[1] Outputs of the MMRF-Green economic model.
[2] CAGR – Compound annual growth rate.

There would not be any significant adverse economic impact as a result of product being shipped from the Northern Territory to overseas markets. The MMRF model shows that some export-focused and import-competing industries in the Northern Territory would be expected to grow effectively in line with the BAU case.

Overall, exports from the Northern Territory would be expected to grow in line with the BAU case (within 1% of base case projections on average from Year 0 to Year 30), with the long-term run deviation from the base case expected to be 0.1% of BAU case projections.

One of the priorities of the Northern Territory's Strategic Plan 2008–2011 (Department of the Chief Minister 2008) is to grow the Territory economy by:

- identifying and facilitating key economic opportunities
- attracting investment and developing new trade opportunities.

The MMRF-Green modelling shows that if the NT Transport Option proceeded, it would provide a positive stimulus to the Northern Territory economy with increases in GSP, investment and employment above the BAU case.

E4.10.7 Relationship to other projects

Over recent years, economic development in the Northern Territory has been strong, most notably in the off-shore oil and gas sectors, the resources sector and defence. There are several recent, planned and future projects that may interact, and in some cases compete for, facilities at the Port of Darwin. These are discussed below.

Darwin Business Park

Adjacent to the East Arm facilities, a 1,700 ha greenfield site encompasses 130 ha set aside for the Darwin Business Park and large tracts of industrially-zoned land designated for additional port-related export-based industries. The Land Development Corporation (LDC), a corporation of the Northern Territory Government, has as its primary focus the development and management of the industrial estate at East Arm, referred to as the Darwin Business Park. The Darwin Business Park provides direct links with berth, rail and road services for:

- cold storage facilities
- food processing and packaging
- pre-retail preparation facilities
- light assembly and manufacturing
- pick and pack distribution.

There are several large Australian companies which have established operations in the Darwin Business Park, including:

- TOLL Holding's major distribution and consolidation centre
- Vopak's Darwin Industry Fuel Terminal
- Natural Fuel/Babcock and Brown biodiesel production facility.

New investments proposed or under way within the Darwin Business Park include:

- Gwelo Developments 7,000 m^2 distribution facility for the import of building products from Asia
- Top Class Fruit Supply warehouse/cold storage facility for importing and exporting of Northern Territory produce to Australian capital cities and Asian markets
- Amcor Packaging warehouse
- Dawson's Diesel 2 ha warehouse for the repair and maintenance of mining equipment, imported and re-exported over the East Arm wharf
- Metcash (Independent Grocers) warehouse/distribution facility
- Extended Toll facilities
- Shaw's Transport facilities
- Glimmer Pty Ltd industrial development
- Andarwin Pty Ltd distribution and warehouse development.

AustralAsia Railway

The AustralAsia Railway provides rail line haul services for Australia's central freight corridor. The AustralAsia Railway, operated by FreightLink, connects southern Australian markets and resource based industries with direct railway connections to Darwin's deep-water berth and intermodal facilities at East Arm. The AustralAsia Railway provides (FreightLink 2007):

- a bulk minerals transport to support the fast developing mining industries located along the Adelaide–Darwin rail corridor, with new opportunities also emerging to channel mine products through both Darwin and Adelaide-based ports
- transport of bulk liquids (primarily petroleum products)
- logistics for the Australian Defence Forces (ADF) for the deployment of military resources for training exercises and the positioning of equipment and supplies for general operations
- general logistics, providing all-weather transport for a wide range of supplies and equipment.

Frances Creek Mine – Iron Ore

Frances Creek Mine, located near Pine Creek on the Stuart Highway, approximately 190 km south of Darwin, is the primary project for Territory Resources Limited (Territory Resources). Territory Resources Frances Creek Mine is expected to produce around 1.5 million tonnes of bulk iron ore increasing to 3 Mtpa in 2009 (Fraser 2007). The mine is located 15 km from the Alice Springs to Darwin railway line, giving the operations a direct link to the Port of Darwin.

Bootu Creek Manganese Project – Manganese

Bootu Creek Mine, owned by OM Holdings Limited and operated by Bootu Creek Resources Pty Ltd, commenced production of manganese during the second quarter of 2006. Bootu Creek is expected to produce around 600,000 tpa of manganese ore and has further exploration potential from the 1,750 km^2 tenement holdings which will extend the mine's operating life and increase production (OM Holdings 2006). The manganese ore is transported 60 km by road to the Muckaty rail siding where it is loaded into wagons (purpose-built hoppers) for the 822 km rail trip to the Port of Darwin.

Alcan Gove Mine – Bauxite and Alumina

Alcan Gove Bauxite Mine and aluminium refinery is located in Nhulunbuy on the Gove Peninsula, NT. Alcan mines bauxite and refines it into alumina which is supplied globally for the creation of aluminium and other products. Alcan Gove recently completed a US$2.3 billion capital expansion of the Gove alumina refinery. Construction of the refinery began in November 2004 and was completed early in 2007. At the peak of construction, the workforce reached 1,700 people. When fully commissioned, the increase in alumina production will be from 2 to 3.8 Mtpa. Alcan is a major manufacturer and exporter, making significant economic and social contributions to the communities within the Arnhem Land Region, the Northern Territory and Australia.

McArthur River Mine – Zinc and Lead

In October 2006 McArthur River Mine received approval to convert its underground zinc-lead mine into a 200 m deep open pit operation to allow for an additional 25 years of production. Once the mine has been converted to an open pit mine, it will generate approximately $328 million a year and will have a production capacity of over 400,000 tpa of bulk concentrates.

Ranger Mine – Uranium Oxide

Energy Resources Australia (ERA) owns and operates Ranger Uranium Mine at Jabiru, Northern Territory. Mining of uranium oxide is planned to be completed in 2012 and processing of the material will continue until 2020. Currently the mine has over 300 employees and produces 5,000 tonnes of uranium oxide concentrate annually.

Conoco Philips Liquid Natural Gas (LNG) Plant

Darwin has become Australia's second major international gas hub with the newly commissioned $1.75 billion Darwin LNG Plant. The first tanker of liquid natural gas embarked from Darwin Harbour in February 2006. The LNG Plant produces 3.2 Mtpa via a 500 km pipeline to the Bayu-Undan gas field in the Timor Sea. The LNG plant increased NT exports by $450 million per annum.

The Bayu-Undan gas field is operated by Conoco Philips Australia and has recoverable reserves of more than 3.4 trillion cubic feet of natural gas and approximately 400 million barrels of liquid hydrocarbons (LPG and condensate).

Major Defence Projects

Defence presence in the NT has doubled since the early 1990s. The number of Defence personnel and their families increased from 6,200 in June 1996 to an estimated 13,000 in June 2007 (Defence Support Division 2007).

Defence-related contracts play a major role in the economy for Northern Territory-based businesses. The Defence Support Division in the Department of Business, Economic and Regional Development identifies opportunities to expand defence-related businesses and activities throughout the territory.

Cumulative effects in consideration of other projects

Cumulative effects associated with the Port of Darwin relate principally to BHP Billiton gaining access to port land and facilities in light of the growing demand for the port, rather than the Olympic Dam expansion contributing to cumulative effects on the Darwin community. For the purpose of the Draft EIS, it has been assumed that land would be made available for the purpose of constructing and operating the facilities as described in this appendix at East Arm. Recognising that no commercial arrangements for the provision of such land have been made to date, the assessment undertaken took the approach of developing outcome-based management measures that would be robust to minor location changes.

The proposed expansion would contribute to increasing ship movements through Darwin Harbour (adding approximately 24–27 per year).

E4.11 RISK ASSESSMENT

E4.11.1 Introduction

The management of risk is an integral part of the proposed expansion at Olympic Dam. BHP Billiton has detailed internal requirements for assessing and managing risk for all stages of the project. The EIS process is only one part of the broader project development process. Subsequent phases include feasibility studies, detailed design, construction and operation with risk assessments conducted at each stage. The risk assessments conducted to date and reported here and in the Draft EIS should be seen within this broader perspective.

The risk assessment for the NT Transport Option was conducted as part of the wider risk assessment work for the whole of the EIS for the proposed expansion. The wider risk work considered all aspects of the expansion. Twenty-two workshops were conducted and based on a semi-qualitative approach, which involves assessing risks from a non-numeric perspective or through informed discussion. The approach depends on the knowledge and experience of participants and is typically quite conservative.

The risk assessment focused entirely on the health, safety, societal and environmental risks, excluding an evaluation of financial risk and exposure of BHP Billiton. Recognised standards were used and one aim was to identify risks as tolerable or intolerable. Intolerable risks require mitigation or control within the Draft EIS process, while tolerable risks are those that require further mitigation and control through the BHP Billiton Environmental Management Program (EM Program).

This section describes the risk assessment process as it applies directly to the NT Transport Option. Key risks are also identified.

E4.11.2 Assessment methods

The method used for risk assessment for the NT Transport Option was identical to that used for the wider Draft EIS (see Draft EIS, Appendix C, for details). For the purposes of completeness, a summary of the risk assessment process is described here.

Risk workshops were facilitated by a consultant from Arup Pty Ltd (Arup) who has over 20 years experience in risk work. The workshops provided a register of risks which were ranked by workshop participants in a standardised manner. Following this, all identified risks were incorporated into the BHP Billiton risk management system, for subsequent refinement and control as the project develops.

While all risks have been captured within the broader project expansion risk register, the list of potential risks was reviewed, summarised and prioritised to identify a list of the key project risks. Control and management of these risks were then captured within the project EM Program.

The main aims of the risk assessment work were:

- identification of intolerable risks – wherever the base risk level of an event or condition was assessed as 'intolerable', additional mitigation or control measures were applied. This process continued until the residual risk was reduced to a level that was tolerable
- development of a consolidated project risk register – tolerable risks were transferred to the project risk register, to be followed-up during the subsequent project development phase
- identification of key project risks – prioritised key project risks require further attention with the aim of reducing the level of risk in accordance with the principle 'As Low As Reasonably Practicable' (ALARP). Controls for these risk items are included in the individual EM Program

Risk assessment is based on establishing a standard way of assessing risk items: this is usually done using reference tables. For the Draft EIS, the tables were developed following an extensive literature review of the applicable standards and specifications, as listed below:

- HB 141:2004 – Risk Financing Guidelines

- HB 436:2004 – Risk Management Guideline – Companion to AS/NZS 4360:2004
- HB 240:2004 – Guideline to Managing Risk in Outsourcing
- HB 203:2006 – Environmental Risk Management – Principles and Process
- HB 105:1998 Risk Management – Companion to AS 2885 Pipelines – Gas and Liquid Petroleum
- WorkSafe Victoria Guidance Note 14 – Major Facilities Regulations – Guidance Note GN – 14 Safety Assessment
- HAZPAK – A Practical Guide to Risk Assessment, Catalogue No. 228 WorkCover Publication, WorkCover New South Wales
- Practical Application of Environmental Risk Management of the Gorgon Project
- The National Minerals Industry Safety and Health Risk Assessment Guideline (Professor Jim Joy and Dr Derek Griffiths Version 6 2007) publication of The University of Queensland, Australia, Minerals Industry Safety and Health Centre
- Australian Standard AS 2885 – Pipelines – Gas and Liquid Petroleum
- The BHP Billiton Group Proprietary risk management system
- Hazardous Industry Planning Advisory Paper: No. 4 Risk Criteria for Land Use Planning. Publication of the NSW Department of Planning
- Guidelines for Design and Maintenance of Overhead Distribution and Transmission Lines (1999) (HB C(b)1 Technical Guideline of the Electricity Supply Association of Australia ESAA)
- Hazard Identification and Analysis/Qualitative Risk Assessment Approach (BHP Billiton, HSEC toolkit No. T05, Revision 2.0 2003).

The risk assessment was based on a broad range of standards and codes to ensure that risks were appropriately considered.

In the risk assessment 'frequency' is defined as how often an event is likely to occur. Table E4.25 describes the six frequency levels, which are ranked according to the estimated incidence rate (number per unit time). The table also describes the probability (i.e. per cent), and the regularity of an event occurring.

Table E4.25 Frequency reference table

Descriptor	Level	General description[1]	Chance per annum[2]	Project basis (construction phase[3])	Frequency[4]	
Expected to happen	A	This event will occur – known to always occur in similar situations – Expected to occur several (many) times each year	99.9%	Many times during project	1/month	More than 10 times per annum
Almost certain	B	This event is expected to occur in most circumstances – Expected to occur at least once each year	>90%	At least once during project	1/year	One or more times per annum
Likely	C	This event may occur in some circumstances – May occur during any given year	10%	At least once in every 10 projects	1/10 years	Once every two to 10 years
Possible	D	This event might occur at some time – Not likely to occur in any given year, but is possible	1%	At least once in every 100 projects	1/100 years	Once every 11 to 100 years
Unlikely	E	This event could occur at some time – Very unlikely to occur in any given year	0.10%	At least once in every 1,000 projects	1/1,000 years	Once every 101 to 1,000 years
Rare	F	This event may only occur in very exceptional circumstances – Examples of this have occurred historically, but are not anticipated	<0.1%	At least once in every 10,000 projects	<1/1,000 years	Less than once every 1,000 years

[1] The intention is to describe the probability or frequency of an event on an annualised basis such that the impacts or exposure (risks) faced by society and the environment are recorded as those present during any given year of the life-of-mine, including the construction phase.
[2] The probability of an occurrence in any given year either during the construction or operation phase as appropriate.
[3] Relates to the number of occurrences during the construction phase.
[4] The frequency of an occurrence (or return period when considering natural events) during either the construction or operation phase as appropriate.

'Consequence' is defined as the magnitude of an event that could occur as a result of a failure. An event may have multiple consequences, which would affect different receptors.

Given the complex nature of the project, it was decided that a multidimensional risk assessment would be conducted for each of the following consequence factors:

- occupational health and safety
- social factors and cultural heritage
- flora and fauna
- soil and land
- water quality
- air quality.

The consequence table is based on a wide range of information including various standards, public consultation, actual assessed impacts and specialist and expert judgments. It is presented in Table E4.26, and provides a qualitative description of the magnitude of a potential event affecting each of the elements.

The combination of the frequency and consequence assessments provide the information needed to determine the level of risk and this can be seen in Table E4.27. The risk matrix indicates the risk level attributed to any combination of frequency and consequence.

Table E4.27 Risk matrix

			Consequences					
			1	2	3	4	5	6
			Minimal	Minor	Moderate	Serious	Major	Catastrophic
Frequency	A	10/y	H	E	E	E	E	E
	B	1/y	H	H	E	E	E	E
	C	1/10 y	M	H	E	E	E	E
	D	1/100 y	L	M	H	E	E	E
	E	1/1000 y	L	L	M	H	E	E
	F	>1/1000 y	L	L	L	M	H	E

E = Extreme; H = High; M = Moderate; L = Low

Existing mitigation or control measures were also considered during the workshops and these included:

- standard procedures and management systems mandated by BHP Billiton (and other relevant parties)
- known contracting procedures
- known or expected design criteria
- any other actions that are planned to be included in the delivery of the project.

E4.11.3 Assessment process

As part of the broader EIS risk assessment process, 22 workshops were conducted. Components of the NT Transport Option were considered during a number of these workshops and the relevant risks have been extracted and presented here. The majority of the risks were identified in the 'Copper Concentrate Shipment' and the uranium oxide section of the 'Transport' workshops with other aspects covered in workshops such as the construction workshop and the closure workshop. The risks were collated into a specific register, which was reviewed to identify any aspects that may have been missed in the broader workshops.

The areas considered in the 'Concentrate shipment' workshop were:

- transport of copper concentrate containing recoverable quantities of uranium oxide, gold and silver to the Port of Darwin
- rail unloading at the Port of Darwin
- material handling to and from stockpiles in the concentrate shed at the Port of Darwin
- storage at the Port of Darwin
- materials handling, reclaim from stockpile at the Port of Darwin
- shiploading
- shipping
- water management system
- construction and rehabilitation.

Category	Health and safety		Social/cultural heritage	Flora and fauna				Soil and land			Water quality	Air quality
				Listed flora and fauna		General flora and fauna						
	Injury and/or fatality	Radiation exposure		Effect on fauna behaviour	Effect on listed species viability	Effect on fauna behaviour	Effect on community	Contamination	Recharge	Habitat	Groundwater, surface water and marine water	
Minimal	No injury to the public Minor operator injuries requiring on-site treatment with immediate release		No impact or minor medium-term social impacts on local population Mostly reparable	Insignificant effect	Insignificant effect	Local short-term behavioural effect	Local short-term decrease in abundance of some species without reduction in local community viability	Insignificant effect	Insignificant effect	Insignificant effect	Minimal contamination or change with no significant loss of quality	Insignificant effect
Minor	Moderate level of injuries to the public requiring off-site (doctor) medical treatment Injuries to one or more operators requiring off-site medical attention including moderate reversible disability	Radiation worker >10 mSv / year but <20 mSv in 5 year period	Ongoing social issues Damage to items of cultural significance	Local short-term behavioural effect	Local short-term decrease in abundance with no lasting effects on local population	Local long-term behavioural effect that does not unduly affect the ecology of the species	Local long-term decrease in abundance of some species resulting in little or no change to community structure	Local contamination that can be immediately remediated	Local minor change in recharge patterns within sub-catchments	Disturbance of well-represented landform habitats	Local minor short-term reduction or change in water quality Local contamination or change that can be immediately remediated	Local short-term and minor exceedance of air quality standard
Moderate	Significant level of injuries to the public requiring hospitalisation Moderate irreversible disability or moderate impairment to one or more operators	Public / other >1 mSv / year but <5 mSv in 5 year period Radiation worker >20 mSv / year but <100 mSv in 5 year period	On going serious social issues Significant damage to structures / items of cultural significance	Local long-term behavioural effect that does not unduly affect the ecology of the species	Local long-term decrease in abundance without reduction in local population viability	Local long-term behavioural effect that significantly affects the ecology of the species	Regional long-term decrease in abundance of some species and/or local loss of some species diversity resulting in some change to the community structure	Local contamination that can be remediated in the long term	Local major change in recharge patterns within sub-catchments	Local loss of well represented landform habitats	Local minor long-term or widespread minor short-term, or local major short-term reduction or change in water quality Local contamination or change that can be remediated in the long term	Local minor long-term or widespread minor short-term, or local major short-term exceedance of air quality standard
Serious	Irreversible disability or impairment or serious injuries requiring long-term hospitalisation to one or more members of public Single operator fatality or multiple serious injuries	Public / other >5 mSv in 5 year period Radiation worker >100 mSv in 5 year period	Very serious widespread social impacts Irreparable damage to highly valued items	Local long-term behavioural effect that significantly affects the ecology of the species	Regional long-term decrease in abundance and/or local loss resulting in some reduction in regional population viability		Regional long-term decrease in abundance of numerous species and/or some loss of species diversity resulting in significant changes to community structure	Local contamination that cannot be remediated in the long term	Widespread major changes in recharge patterns within sub-catchments	Local loss of a unique landform habitat	Widespread (regional) major short-term reduction or change in water quality Local contamination or change that cannot be remediated in the long term	Widespread (regional) major short-term exceedance of air quality standard
Major	Single fatality of a member of public Several operator fatalities		Breakdown of social order Irreparable damage to highly valued items of cultural significance		Regional long-term decrease in abundance and/or local loss resulting in significant reduction in regional viabiility of the species		Regional long-term loss of numerous species resulting in the dominance of only a few species	Widespread contamination that can be remediated in the long term	Regional minor changes in recharge patterns		Regional long-term reduction or change in water quality Widespread contamination or change that can be remediated in the long term	Regional long-term exceedance of air quality standard
Catastrophic	Several fatalities of members of public Multiple operator fatalities		Complete breakdown of social order Irreparable damage to highly valued items of great cultural significance		Regional extinction of the species			Widespread contamination that cannot be immediately remediated	Regional major changes in recharge patterns		Widespread contamination or change that cannot be immediately remediated	

Table E4.26 Consequences look-up table

Workshop participants included experts in risk assessment, rail, transport, logistics, radiation, health, safety, ecology, water treatment, infrastructure, design, construction and social planning.

An NT Transport Option risk register was developed which included lists of potential hazardous events or situations and an assessment of the relative risk associated with that event or situation.

E4.11.4 Outcomes and management

Risk assessment summary

Approximately 203 risk events or risk situations were identified and assessed in the concentrate transport workshop. Of these, there were:

- 0 extreme risks (i.e. intolerable)
- 19 high risks (i.e. tolerable)
- 81 medium risks (i.e. tolerable)
- 103 low risks (i.e. tolerable).

A review of the transport risk workshop (uranium oxide section) identified the following additional risks applicable to the NT Transport Option:

- 0 extreme risks
- 1 high risks
- 23 medium risks
- 221 low risks.

A review of the construction risk workshop identified the following additional risks applicable to the NT Transport Option:

- 0 extreme risks
- 20 high risks
- 8 medium risks
- 13 low risks.

A review of the closure risk workshop identified the following additional risks applicable to the NT Transport Option:

- 0 extreme risks
- 1 high risks
- 13 medium risks
- 32 low risks.

No extreme and therefore intolerable risks were identified for the NT Transport Option.

Additional reviews conducted to identify if any risk issues had been missed in the wider risk assessment work established that all risks considered credible had been captured.

Should the NT Transport Option not proceed, the risks in not realising the project benefits are considered low.

Key risks

The method for identifying key risks for the NT Transport Option is consistent with the method used for the broader risk assessment of the expanded project. Any identified risk item that had been rated as 'high' in the risk assessment, in any of the consequence factors, was considered to be a key risk. Where there was repetition, the risks have been summarised with care to ensure that no causal factor information is lost.

The key social and environmental risks as established through the risk assessment process are listed in Table E4.28. The proposed management of these risks is addressed in the Draft EM Program (see Section E4.12 and Attachment E4.4).

BHP Billiton manages safety risk in a slightly different way to that of environment and community risk through its BHP Billiton Fatal Risk Control Procedures. In addition, BHP Billiton has undertaken an independent safety risk review based on Major Hazard Accident Events. Therefore, these risks have been presented in a slightly different manner.

The key safety related risks identified during the risk assessment process are listed in Table E4.29. The proposed management of these risks is addressed in the Draft EM Program (see Section E4.12).

As previously noted, all of the risks identified in the EIS risk review process (including those specific to the NT Transport Option) have been collated and form the basis of the BHP Billiton project risk register. No risks events or situations are lost.

An additional internal risk assessment was undertaken on the risks from the loss of a concentrate ship and is based on the safety review conducted in E4.10.3. While identified as a risk and therefore included in the project wide risk register, it was not ranked as a key project risk for the following reasons:

- the probability of a loss is generally low and is further reduced by the systems BHP Billiton would employ to select ships and providers
- the concentrate is insoluble in water and has high specific gravity meaning that any dispersion would be low.

Two additional risk items were identified through the detailed impact assessment process and these have been added to the NT Transport Option specific risk register, being:

- public perception associated with the train stopping in towns along the route to the Port of Darwin
- safety of conveyors and enclosed systems.

Risk assessment summary

The risk assessment used for the Draft EIS is comprehensive using a multi-dimensional consequence assessment. It is semi-quantitative, and therefore has a level of uncertainty that is mitigated largely by the conservative nature of the method. The process ranks risks as either extreme, high, medium or low in each of the consequence factors. Extreme risks are intolerable and (for the project to proceed) require immediate controls to reduce risk levels. Risks ranked as high in any of the consequence dimensions are considered to be key risks and are monitored formally within the project Environmental Management Program. Medium and low risks are controlled by the existing management process and captured within the project risk register.

The process is sufficiently robust to provide conservative quantification of risk and has been used extensively across the whole of the Draft EIS, identifying and quantifying over 4,900 risk events or situations.

Table E4.28 Key project environment and community risks

Residual impact	Project component	Project phase	Event	Cause
Wastes	Port of Darwin	Construction	Inadequate waste management practices	Failure to contain construction wastes
Effects on marine ecology from construction activities	Port of Darwin	Construction	Spill of fuel or chemicals into Darwin Harbour	Equipment failure and operator error
Contamination of other infrastructure	Port of Darwin and rail corridor	Operation	Spread of radioactive concentrate along rail line	Failure of washing and monitoring
Predicted ground level dust concentrations	Port of Darwin	Operation	Spillage during movement of material to and from stockpile at Port of Darwin	Failure of conveyor system and/or product enclosure system
Effects on coastal processes	Port of Darwin	Operation	Spillage of concentrate into Darwin Harbour during ship loading	Failure of materials handling system or dust control systems
Soil contamination	Port of Darwin	Operation	Loss of integrity of concentrate storage	Cyclonic rain storm
Water quality	Concentrate shed	Operation	Stormwater comes into contact with concentrate	Failure to exclude stormwater
Discharge of chemicals due to operator or control error	All operations	Operation	Leakage or spill of fuel	Failure of containment systems and/or inadequate bunding
Impacts on the public	Port of Darwin and rail corridor	Operation	Increased radiation levels	Inaccurate modelling of dust and radon patterns leading to increased area of influence
Impacts on the public	Rail corridor	Operation	Public outcry over rail transport of uranium oxide and concentrate	Public failure to understand actual risks of uranium oxide and concentrate transport

Table E4.29 Key project occupational health and safety risks

Project Component	Project Phase	Event	Cause
Whole of project	Construction	Unauthorised entry by construction workers into operations area	Failure of management and control procedures
Whole of project	Construction	Vehicle accidents	Increase in number of contractor vehicles during construction and failure of road safety systems
Whole of project	Construction	Collision or rollovers of surface mobile equipment	Failure of safety systems and operating procedures
Whole of project	Construction	Worker buried while working in trench	Failure of safety systems and/or lack of adequate shoring or benching
Whole of project	Construction	Interaction between construction and operations work areas resulting in such events as falling objects	Construction workers working in vicinity of operations personnel with different safety systems
Transport	Operation	Collision between Olympic Dam supply train and member of public vehicle	Inadequate warning of oncoming train or inattention
Port of Darwin and Olympic Dam	Operation	Accident to technicians while monitoring radioactivity levels of rail wagons	Failure of safety systems and operating procedures
Port of Darwin	Operation	Interaction between rail wagon tippler and worker	Operator fails to follow procedure or unauthorised entry
Port of Darwin and Olympic Dam	Operation	Accident during rail wagon lid fitting or removal	Failure to follow procedures or inadequate design
Port of Darwin	Operation	High dusting of concentrate in the concentrate shed	Loss of moisture in concentrate stockpile
Port of Darwin	Operation	Contact/collision between operator and reclaimer in concentrate shed	Unauthorised entry or failure to follow procedures
Port of Darwin	Operation	Operator engulfed in concentrate	Slumping of stockpile
Port of Darwin	Operation	Entrapment in moving machinery (i.e. conveyors)	Failure to follow procedures or inadequate design
Whole of project	Decommissioning	Transport accidents during removal of infrastructure at decommissioning	Increased number of trucks on the road

E4.12 ENVIRONMENTAL MANAGEMENT

E4.12.1 Introduction

Environmental issues are managed at Olympic Dam (where most of the proposed expansion activities are to occur) in accordance with the operation's AS/NZS ISO 14001:2004 certified environmental management system (EMS). The proposed expansion involves the continuation of existing activities (albeit on a larger scale) and the introduction of new activities, some of which are located outside the Olympic Dam Special Mining Lease, such as those associated with the NT Transport Option.

The existing environmental management process at Olympic Dam is a robust and proven system and is regularly reviewed and improved. An Environmental Management Framework (EM Framework) has been developed to integrate the management requirements for the proposed expansion into the EMS (see Draft EIS Chapter 24, Environmental Management Framework, for details). This section provides an outline of the EM Framework as it relates to the NT Transport Option.

E4.12.2 Overview of the EM Framework

The EM Framework has been developed as an overarching strategy to allow for integration of management requirements for the proposed expansion into the EMS currently implemented for the existing operation, and to demonstrate how environmental management requirements for the expansion would be addressed.

Hence, the EM Framework will be used to translate the relevant commitments and management measures contained in the Draft EIS into the planning documents, engineering designs, contract documents and the day-to-day construction and operation of facilities such as those associated with the NT Transport Option. The EMS would continue to be used as the mechanism through which environmental management, monitoring and reporting is implemented for the proposed expansion (including for activities at the Port of Darwin).

E4.12.3 Implementing the EM Framework

The EM Framework identifies the environmental objectives for the proposed NT Transport Option and outlines the process and environmental management documentation required for ensuring that the relevant Draft EIS commitments, management measures and monitoring requirements are implemented.

The EM Framework provides for:

- the integration of information from the Draft EIS that identifies the management requirements for the NT Transport Option
- the process for integration with the existing EMS
- the processes to manage the environmental obligations
- the process for implementing the environmental objectives
- the documentation to be reviewed, modified or developed and its timing.

E4.12.4 Activities to be managed

While some of the activities proposed for the expansion are already undertaken (such as transport of uranium oxide via rail to the Port of Darwin), new infrastructure (such as the proposed concentrate storage and handling facilities at the Port of Darwin) would be established. New management procedures and/or modifications to existing procedures are therefore required to ensure that the activities associated with the NT Transport Option are managed effectively.

E4.12.5 Integration with the existing environmental management system

The EMS would function as the robust tool for environmental management for activities associated with the NT Transport Option (as it already does for the existing Olympic Dam site). The EMS would undergo major review and update, as part of its continual improvement to incorporate the new environmental management and monitoring requirements, commitments and approval conditions resulting from the Draft EIS.

Key EMS documents would be reviewed and modified to include:

- legal and other requirements applying to BHP Billiton as a result of the proposed NT Transport Option. Key obligations would include EIS commitments and safeguards, conditions of approval (including those from the Northern Territory Government) and permit/licence conditions (including any issued by the Northern Territory authorities)
- clear and adequate direction for managing new environmental aspects
- necessary detail on required controls and mitigation measures to protect environmental values for the activities to be undertaken, including those relevant to the planning, construction, commissioning and operating of the facilities proposed for East Arm
- the development of monitoring programs to address risks and in response to requirements (including specific conditions set by the Northern Territory Government) for the monitoring of activities associated with the NT Transport Option.

When permits and licences are required for specific activities, applications would be discussed with, and submitted to, the relevant government agencies at the appropriate time (recognising that concentrate and additional uranium oxide would not be transported until about 2016).

E4.12.6 Meeting environmental obligations

The EMS would be used to meet environmental obligations (management, monitoring and reporting) and the Environmental Management Program (EM Program), a major component of the EMS, would describe the objectives and criteria to be met. The EM Program would be the mechanism by which environmental obligations would be described for the design, construction, operation and decommissioning of the facilities associated with the NT Transport Option. More detailed documents (Design Criteria and Environmental Objectives and Performance Criteria) would also be prepared and would form part of the tender and contract documentation to ensure that contractors were aware of their environmental obligations, and to provide BHP Billiton with a mechanism to monitor contractor performance and compliance. The proposed documents are discussed further in Sections E4.12.9–E4.12.11.

E4.12.7 Review, modification and development of EMS documentation

The EM Framework identifies the following key environmental management documents (of the EMS) that would be modified/developed for the design, construction, operation and decommissioning of the project components, including those associated with the NT Transport Option.

Environmental Management Program

The EM Program details the controls and mitigation measures in place to prevent or reduce impacts. The EM Program also details legal (and other) requirements and the government agency or body responsible for regulating each aspect.

The EM Program refers to the specific management and monitoring plans (and any other specific action plans that may be in place) to meet the environmental objectives and/or assessment criteria that have been set.

Monitoring Programs

Monitoring programs (MPs) are developed and implemented with the aim of measuring and assessing performance against the objectives, assessment criteria, control measures and legal requirements described in the EM Program.

All existing MPs currently implemented at Olympic Dam would be reviewed and modified to meet the new requirements resulting from proposed expansion activities and the activities at the Port of Darwin. As the proposed facilities at the Port of Darwin introduce a new environmental setting to the EMS, new MPs would be developed.

Management Plans

In the context of the EMS, management plans are developed as information documents to the EM Program and MPs (see Figure E4.18). They provide direction and background information on how a specific issue/aspect is managed and monitored to achieve the objectives. The Draft EIS has identified the need for development of specific management plans to ensure an informed approach is undertaken to managing and monitoring specific issues.

E4.12.8 Draft Environmental Management Program

The current EM Program (FY08–FY10) for the Olympic Dam operation has been used as the model for developing a Draft EM Program for the NT Transport Option. It incorporates the objectives, assessment criteria, commitments, standard measures and monitoring requirements identified during the environmental impact assessment process. The EM Program would also integrate key risk items identified for the expansion and include, where appropriate, contingency measures to manage those risks.

The following defines the various sections contained in the Draft EM Program.

The Draft EM Program for the NT Transport Option is provided in Attachment E4.4.

Scope

The Scope provides the context in which the particular program has been written. The Scope aims to provide on overview of the key issues related to the aspect that requires specific management.

Legal and other guidance

This provides an outline of the key legislation and/or guidance reference, such as a Code of Practice or industry guideline, as it relates to the scope of the particular program.

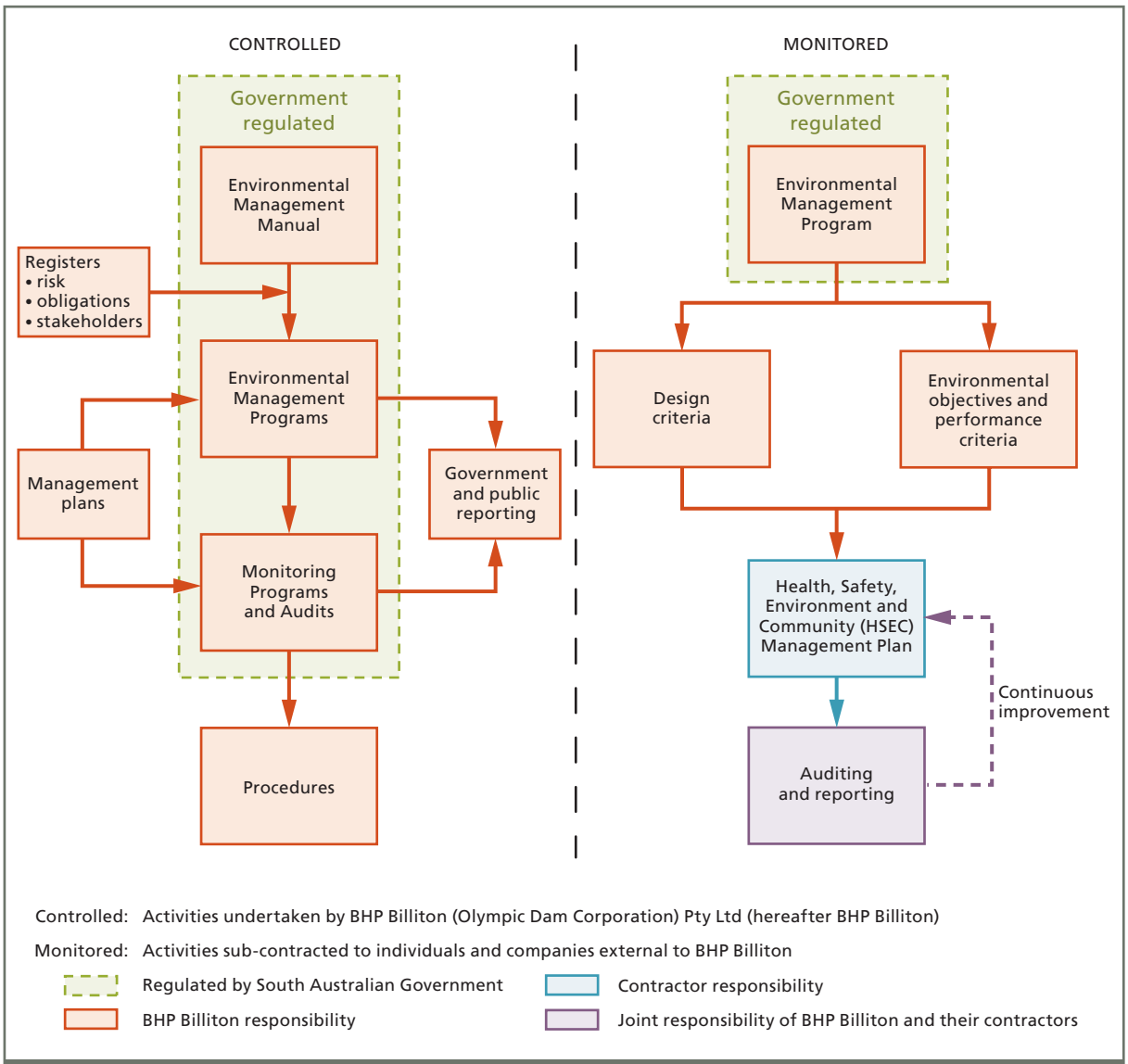


Figure E4.18 Proposed expansion environmental management process

Values

Values of the environment that are considered to be the most important and/or unique to the proposed expansion are identified here. These values provide the basis for which management and mitigation measures and monitoring programs are developed. The proposed expansion aims, via the EM Program, to enhance, protect and/or conserve these identified values.

Objectives

Specific objectives have been developed and presented within the EM Program for the proposed expansion. Objectives have been developed using the following criteria:

- based on the values that are required to be enhanced, protected and/or conserved for the project
- are to be the major environmental outcomes that BHP Billiton aims to achieve for the proposed expansion
- are measurable.

Objectives of the EM Program therefore address issues considered to have a residual risk of impact, are measurable and communicate the major environmental issues BHP Billiton would manage. Issues would be managed with the implementation of management plans, controls, contingency measures and continuous improvement.

Assessment criteria

Assessment criteria have been proposed for each objective in the EM Program and would be used by management to assess and demonstrate progress towards meeting objectives. Assessment criteria have been derived from a number of sources including

regulatory criteria (where applicable), applicable industry standards and Codes of Practice and from baseline surveys/assessments undertaken (and planned to be undertaken) for the proposed expansion.

The assessment criteria would inform the development of monitoring programs and the application of 'lead' and 'lag' indicators, as required.

As the project progresses with various project components constructed and commissioned, further refinement of assessment criteria through ongoing environmental assessments and monitoring would occur as part of the adaptive management of the expansion project.

Management Plans

Management Plans are developed as separate documents and typically function as technical (operational and adaptive) documents informing the EM Program and the measures and actions put in place for achieving the objectives. Management Plans provide background information commensurate to the Plan's application, compiled from various sources such as published literature, studies/surveys undertaken and codes of practice and guideline documents.

Controls/Management actions

Controls and management actions that have been identified as part of the impact assessment process are provided here. These controls and management actions would be used to perpetuate the culture of continuous improvement.

These controls and measures may, in appropriate circumstances, be modified or replaced with other appropriate measures during the course of the detailed design, construction, execution and decommissioning of the project.

Monitoring Programs

Monitoring Programs (MPs) have been (or would be) developed, as separate documents, for the proposed expansion. MPs are developed from the assessment criteria and therefore may include 'lead' and 'lag' indicators (where relevant) to trigger necessary management action or response.

MPs would state the assessment criteria to be measured and the methodology to be used, including, for example, details of responsibilities, adopted protocols, frequency, control and monitoring locations, instrumentation, data assessment (including quality assurance, quality control, accuracy of data) and reporting procedures. These would be relevant and organic documents that would be reviewed regularly as the project proceeded.

It is critical that the MPs be routinely revised to match the project and advances in legislative and environmental practices.

MPs would assess environmental performance relative to specific assessment criteria (and the associated objectives), as well as the performance of control measures and management actions implemented.

Contingency options for project risks

Contingency measures for key project risks would be determined during the subsequent stages (Definition and Execution) of the expansion project. The EIS risk assessment process has identified a comprehensive register of risks associated with the proposed expansion, and these have been fed into the BHP Billiton expansion project risk management system. The EIS risk process resulted in immediate control measures being applied to any risks identified as 'intolerable' to reduce the specific risk to a tolerable level.

Depending on the magnitude of risk, contingency measures for the identified tolerable risks would be developed using the principles of risk management. This is an iterative approach, which aims to eliminate or reduce the likelihood and/or consequence of incidents to a level considered to be as low as reasonably achievable or as low as reasonably practicable.

BHP Billiton applies risk reduction measures and controls in the stages where there is sufficient detail available to maximise the effectiveness of the controls. As a result, only some contingency options are identified in this Draft EM Program.

BHP Billiton responsible person

The BHP Billiton site personnel responsible for managing, implementing and maintaining particular components of the EM Program would be identified. This person/s would be familiar with the requirements of the EM Program and have a working relationship with key contacts within the government agencies (and other industry networking groups/agencies) relevant to that component of the EM Program.

Key government departments

This section lists the government department(s) primarily responsible for administering any legislative Acts and Regulations related to the scope of the program.

E4.12.9 Design criteria

The planning and design of the proposed expansion has taken several years. Studies that may refine the project configuration for the proposed expansion are continuing. The design of the project has been influenced by the assessments conducted as part of the Draft EIS to promote preferred environmental, social and cultural outcomes.

As the design documentation (e.g. design drawings and specifications) is developed, a compliance check will be conducted against the commitments in the Draft EIS and the controls in the EM Program to ensure that all relevant requirements for the design phase have been met. The design documentation would then be incorporated into the relevant contract documents to ensure the stated controls and commitments in the Draft EIS became part of the contractual arrangements.

E4.12.10 Environmental objectives and performance criteria

'Environmental Objectives and Performance Criteria' is a document to be developed from the EM Program (and hence includes the commitments in the Draft EIS, approval conditions, legal and regulatory requirements, and BHP Billiton standards) to communicate the environmental obligations relevant to the contract work. Information on the relevant industry, government and BHP Billiton guidelines, standards and codes of practice that could assist the contractor in achieving the environmental obligations would also be provided within the Environmental Objectives and Performance Criteria document.

The Draft EM Program provides the basis for developing the Environmental Objectives and Performance Criteria document, which would form part of BHP Billiton's tender and contract documentation prepared for contracts associated with the NT Transport Option.

E4.12.11 Health, safety, environment and community management plans

Contractors appointed to undertake tasks associated with the NT Transport Option would be required to develop a Health, Safety, Environment and Community (HSEC) Management Plan, specific to their contract works, and responding to the requirements stipulated in the Design Criteria and/or Environmental Objectives and Performance Criteria (and BHP contractual documentation). The HSEC Management Plan developed by the contractor would define environmental management strategies and controls in response to the environmental obligations specified in these documents.

A BHP Billiton representative would approve the HSEC Management Plan before the works and/or services commenced. The contractor would also be required to communicate the plan to all of its employees and sub-contractors' employees as part of formal inductions before performing works and/or services as part of the contract.

The contractor would be expected to review its performance against the HSEC Management Plan through internal checks and third-party audits with continuous improvement processes in place, and use formal processes to report the results to BHP Billiton. BHP Billiton would also review the contractor's HSEC Management Plan and undertake audit(s) against the plan.

E4.12.12 Environmental management auditing and reporting

Continual improvement

The process of continual improvement, through checking, reviewing and auditing, is incorporated within the BHP Billiton Group HSEC Management System. The EMS is audited and reviewed internally (i.e. within BHP Billiton) and externally through:

- scheduled internal and self-assessment audits
- scheduled corporate-level audits (BHP Billiton Group HSEC Management Standards)
- quarterly management reviews where Olympic Dam's leadership team reviews the EMS to ensure it remains suitable, adequate and effective
- verification audits, which are external audits required by BHP Billiton for the implementation of internal HSEC Management Standards or sustainability reporting
- environmental compliance audits (i.e. internal and external audits focusing on legal/regulatory matters)
- assessments and approvals for particular components of the system (by government regulators)
- annual external surveillance and three-yearly external certification auditing of the systems by the company that issues the ISO 14001 certificates.

The commitments and environmental requirements resulting from the EIS assessment process for the proposed expansion would be audited as part of the existing process of scheduled internal and external audits described above to ensure compliance with the requirements of the EMS.

The proposed audit schedule (see Table E4.30) is intended to be indicative only. Modifications would be expected with the roll-out of proposed activities, the regular review and update of the EMS documentation, and changes to legislation and regulations.

The audit schedule demonstrates the rigour of existing systems in place at Olympic Dam to manage activities and the effectiveness of the continual improvement process.

Table E4.30 Proposed environmental management audit schedule

Audit item	Audit criteria and general comments	Responsibility	Frequency
EMS – Environmental Management Manual	EIS commitments EIS approval conditions (if any)	BHP Billiton	Upon major review and update following approval of proposed expansion Annual ISO14001 internal audits Annual ISO14001 external surveillance audits Three-yearly ISO14001 external certification audits
EMS – Key Obligations for the Environmental Management Program and Monitoring Programs	EIS commitments EIS approval conditions (if any)	BHP Billiton	Upon major review and update following approval of proposed expansion and in response to the schedule of proposed expansion activities Annual ISO14001 internal audits Annual ISO14001 external surveillance audits Three-yearly ISO14001 external certification audits
EMS – Environmental Management Program and Monitoring Programs	Audit of EM Program would occur when proposed expansion operations commence and be updated as appropriate	BHP Billiton	Upon major review and update following approval of proposed expansion and in response to the schedule of proposed expansion activities Annual ISO14001 internal audits Annual ISO14001 external surveillance audits Three-yearly ISO14001 external certification audits
Contractual documents Design Criteria Environmental Objectives and Performance Criteria	Review of contractual clauses to ensure appropriate and sufficient clauses in place for identifying responsibilities and penalties for unsatisfactory performance in terms of environmental management against the EM Program Review of performance against Design Criteria and Environmental Objectives and Performance Criteria	BHP Billiton or delegated representative	Prior to: • finalising design specifications/tender documentation • issuing tender documents and contract documents • finalising contractual arrangements

Non-conformance and corrective action

In accordance with the BHP Billiton Group HSEC Management Standards, incidents (including near misses and community complaints) are reported, investigated, analysed and documented. Information gathered from the incident investigations is analysed to identify and monitor trends, and to develop prevention programs which include corrective and preventative actions taken to eliminate the causes of incidents. All employees, contractors and sub-contractors are required to adhere to both the HSEC Management Standards and the non-conformance and corrective action systems in place at Olympic Dam. This would be extended to the facilities associated with the NT Transport Option.

The principal environmental adviser at Olympic Dam provides a quarterly presentation to the Olympic Dam site leadership team at management review meetings, detailing audits completed for the quarter, instances of non-conformance, and recommendations arising from audits. Progress to rectify non-conformance and implement recommendations from previous audits are also reported and assessed.

Reporting

Reporting progress in a manner that satisfies the EMS, the BHP Billiton Group, site management and regulatory requirements would be undertaken for the planning and design, construction/commission, operation and decommissioning phases of the project.

Reporting against Environmental Objectives and Performance Criteria would be undertaken as part of contractual arrangements, performance reviews and/or contract reviews for monitored activities.

E4.13 COMMITMENTS

The transport of product to the Port of Darwin would not occur until about 2016. Commitments for the NT Transport Option are separated into those commitments that can be made now (generally design or outcome-based commitments), and those are listed in Table E4.31.

Standard management measures that may also be deemed to be commitments, but may be refined over time with technological advances and changes in management practices, are included in the Draft EM Program (see Attachment E4.4).

The commitments have resulted from the iterative process of assessing impacts and risks. They include modifications to designs and the application of management, monitoring and contingency measures to achieve acceptable outcomes.

It is noted that the commitments provided in this section are consistent with, or in addition to, normal business practice by BHP Billiton. It is implicit that BHP Billiton will comply with all necessary legal obligations and internal Health, Safety, Environment and Community (HSEC) standards.

The preceding sections have described the proposed NT Transport Option and the management measures that would be implemented during construction and ongoing operations. Commitments made to achieve a prescribed level of outcome, or to undertake certain activities to reduce impacts and maximise benefits, form an important component of the approach to environmental management.

Table E4.31 Commitments for NT Transport Option

Project component	Issue	Phase	Commitment statement
Transport and Logistics	Transport and handling of concentrate	Design	Rail wagons would be effectively sealed with suitable covers and fitted so that concentrate would not escape during transport
		Design/operation	The water used to wash the outside of the rail wagons would be collected and treated to recover concentrate particles that may have attached to the wagon during unloading (i.e. tippling). The recycled water would be transported to Olympic Dam by rail for disposal
		Operation	A 'closed system' would be used to transport, store and handle concentrate from Olympic Dam to the ship's hold at the Port of Darwin, to eliminate dusting
Safety	Workforce exposure to radiation Occupational health and safety (OH and S)	Design/operation	BHP Billiton would comply with internationally accepted radiation limits for workers and the public and would set a goal of maintaining doses at less than 50% of the internationally acceptable limits for workers
		Operation	A 'safety case' for the current operation is being conducted and would incorporate all components of the proposed expansion. This includes: • identifying the hazards and risks of the proposed expansion • describing how the risks are controlled • outlining the safety management system and its implementation • monitoring and review of effectiveness

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ATTACHMENT E4.1

LAND TENURE AND LAND USES ALONG THE ADELAIDE TO DARWIN RAILWAY

Pastoral leases

Within the Northern Territory, the railway corridor crosses the following pastoral leases:

Mount Cavenagh
Umbeara
Idracowra
Henbury
Orange Creek
Owen Springs
Bond Springs
Yambah
Aileron
Bushy Park
Woodgreen
Mount Skinner
Stirling
Neutral Junction
Murray Downs
Singleton
Tennant Creek
Phillip Creek
Powell Creek
Newcastle Waters
Murranji
Buchanan Downs
Hidden Valley
Avago
Tarlee
Cow Creek
Gorrie
Wyworrie
Bloodwood Downs
Lakefield
Manbulloo
Bonrook
Mary River West
Ban Ban Springs
Douglas
Bridge Creek

Settlements

The rail corridor passes within 1 km of the following major towns:

Alice Springs
Tennant Creek
Katherine
Pine Creek
Adelaide River
Darwin (including outlying suburbs)

Aboriginal communities

The following communities are located within 1 km of the railway corridor:

Pwerte Marnte Marnte
New Ilparpa
Karnte
Anthepe
Ilyiperenye
Mpwetyerre
Inarlenge
Akngwertnarre
Nyewente
Ilperle Tyathe
Artekerre
Adelaide Bore
Pine Creek Compound
Amangal Indigenous Village
Gulngarring

Aboriginal Land Trusts

The railway corridor crosses the following Aboriginal Lands, held either as Aboriginal Land Trusts (ALT) or owned by Aboriginal Corporations (AC):

Pwerte Marnte Marnte AC
Athenge Lhere ALT
Mpweringe – Arnapipe ALT
Ahakeye ALT
Warrabri ALT
Mungkarta ALT
Kanttaji ALT
Warumungu ALT
Yuturminyi AC
Karlantijpa North ALT
Muckaty ALT
Murranji ALT
Barnjarn AC
Wagiman (No. 2) ALT
Finniss River ALT

Conservation reserves

The railway corridor passes through or within 1km of the following reserve areas:

Manton Dam Recreation Area
West MacDonnell National Park
Alice Springs Desert Park
Charles Darwin National Park
Litchfield National Park
Alice Springs Telegraph Station Historical Reserve
Emily and Jessie Gaps Nature Park
Ilparpa Swamp Wildlife Protected Area

The rail corridor passes within 35 km of Kakadu National Park.

Watercourses

The railway corridor crosses the following watercourses within the Northern Territory:

Outounya Creek
Karinga Creek
Finke River
Roe Creek
Hugh River
Todd River
Sixteen Mile Creek
Harry Creek
Wycliffe Creek
McLaren Creek
Bonney Creek
Western Creek
King River
Katherine River
Edith River
Fergusson River
Cullen River
Pine Creek
McKinlay River
Saunders Creek
Margaret River
Howley Creek
Burrells Creek
Snake Creek
Adelaide River
Coomalie Creek
Manton River
Elizabeth River

ATTACHMENT E4.2

POTENTIAL IMPACTS ON NATIONALLY LISTED FAUNA AT THE PORT OF DARWIN IN A 50 SQUARE KILOMETRE AREA CENTRED ON EAST ARM

Status

Letters under columns AUS and NT represent the category listed in the Environment Protection and Biodiversity Conservation Act 1999 and the Territory Parks and Wildlife Conservation Act (CE = critically endangered, E = endangered, V = vulnerable, Mi = migratory, Ma = marine, W = whales and other cetaceans).

Letters under column CAMBA/JAMBA/CMS represent allocation of species to international migratory bird agreements (C = China–Australia Migratory Birds Agreement, J = Japan–Australia Migratory Birds Agreement, B = Bonn Convention).

Attachment E4.2

Species name	Common name	Status			Distribution, ecology and behaviour	Potential impact	Credible risk to species
		AUS	NT	C/J/B			
Threatened species							
Mammals							
Dasyurus hallucatus	Northern Quoll	E	CE		It occurs in a wide range of habitats, but the most suitable habitats appear to be rocky areas. It is also common in many eucalypt open forests. It has been recorded from the Charles Darwin National Park. Cane toads represent the primary threat to the Northern Quoll	No preferred habitat for this species would be impacted	No
Megaptera novaeangliae	Humpback Whale	V, Mi, W			The Humpback Whale occurs in all major oceans, mostly in coastal and continental shelf waters. There are two main populations in Australian waters that migrate along the east coast and west coast. The Humpback Whale breeds in warm waters at low latitudes, and migrates to summer in higher latitudes	No oceanic habitat would be impacted	No
Xeromys myoides	False Water Rat	V			In the Northern Territory, it is known from only 10 records at 6 sites (South Alligator River in 1903, Daly River floodplain in 1972, two sites on the Tomkinson River in 1975, Melville Island in 1975 and Glyde River floodplain in 1998 and 1999) (Threatened Species of Northern Territory Fact Sheet). Its habitats comprise mangrove forests, freshwater swamps and floodplain saline grasslands	No mangroves, freshwater swamps or saline grasslands would be removed	No
Terrestrial Birds							
Erythrotriorchis radiatus	Red Goshawk	V	V		Tropical open woodland, edges of rainforest and dense riverine vegetation. Nests in trees that are taller than 20 m and within 1 km of a permanent watercourse or wetland. Foraging usually occurs in open forests and gallery forests, taking mostly medium to large birds	No preferred habitat for this species would be impacted	No
Erythrura gouldiae	Gouldian Finch	E, Mi			Dry environments such as open woodland and grassy areas	No preferred habitat for this species would be impacted	No
Geophaps smithii smithii	Partridge Pigeon	V	V		The diet of the Partridge Pigeon comprises seeds, mostly of grasses but also from Acacia and other woody plants. It is largely sedentary, although may make local-scale movements (up to 5-10 km) in response to seasonal variations in water and food availability	No preferred habitat for this species would be impacted	No

Attachment E4.2 (cont'd)

Species name	Common name	Status			Distribution, ecology and behaviour	Potential impact	Credible risk to species
		AUS	NT	C/J/B			
Reptiles							
	Loggerhead Turtle, Green Turtle, Leatherback Turtle, Olive Ridley Turtle, Hawksbill Turtle, Flatback Turtle	E, V, Mi, Ma	E, V, Not Threatened		Only the Loggerhead and Leatherback Turtles are threatened in the NT, though the Loggerhead Turtle does not breed in the NT. Leatherbacks have been reported to breed from the Sir Edward Pellew Islands, near Maningrida, Danger Point on Cobourg Peninsula and Palm Bay on Croker Island. All species have global oceanic habitats, with diets varying from shellfish, crabs, sea urchins and macroplankton to seagrass	No preferred foraging or nesting habitat would be impacted for any of the five marine turtles	No
Sharks							
Pristis microdon	Freshwater Sawfish	V	V		Sawfish have a saw-like snout, called a rostrum, which has electro-sensitive pores that allow sawfish to detect movement of buried prey in the ocean floor. The rostrum acts like a metal detector as the sawfish hovers over the bottom, looking for hidden food. It is also used as a digging tool to unearth buried crustaceans. The species inhabits sandy or muddy bottoms of shallow coastal waters, estuaries, river mouths and freshwater rivers and lakes. Usually found in turbid channels of large rivers over soft mud bottoms	No preferred habitat for this species would be impacted	No
Pristis zijsron	Green Sawfish	V	V		The Green Sawfish is widely distributed in the northern Indian Ocean, around Indonesia and Australia. It is the most commonly encountered sawfish species in Australian waters. In the Northern Territory, specimens have been collected only in Buffalo Creek in Darwin Harbour	No preferred habitat for this species would be impacted	No
Rhincodon typus	Whale Shark	V, Mi, Ma			The whale shark has a broad distribution across most tropical and warm temperate seas. The best known populations in Australia are around Ningaloo Reef, in north-western Australia. Its distribution and status in waters around the Northern Territory is poorly known, although there are at least some anecdotal records (Threatened Species of Northern Territory Fact Sheet). It feeds primarily by suction filter feeding, and its diet includes a broad range of plankton, small crustaceans and small schooling fish	No oceanic habitat would be impacted	No
Migratory species							
Actitus hypoleucos	Common Sandpiper	Mi		C, J, B	Inhabits coastal and inland wetlands. It breeds in Eurasia and migrates to Australia	No preferred habitat for this species would be impacted	No
Anseranas semipalmata	Magpie Goose	Ma			Open wetlands, swamps, farmlands and major watercourses	No preferred habitat for this species would be impacted	No

Attachment E4.2 (cont'd)

Species name	Common name	Status			Distribution, ecology and behaviour	Potential impact	Credible risk to species
		AUS	NT	C/J/B			
Apus pacificus	Fork-tailed Swift	Mi, Ma		C, J	Except at their breeding grounds in the northern hemisphere, individuals of this species spend all day, and most if not all night, hunting insects, resting and sleeping	No potential to impact this species	No
Ardea alba	Great Egret	Mi, Ma		C, J	Found in most of the tropical and warmer temperate parts of the world. Prefers shores of lakes, ponds and rivers; freshwater and saltwater marshes, mudflats, shallow lagoons, estuaries. Requires trees or shrubs near the water for nesting	No preferred habitat for this species would be impacted	No
Ardea ibis	Cattle Egret	Mi, Ma		C, J	Found on most continents and across most of Australia. Common and widespread throughout northern and eastern Australia. Found in grasslands, woodlands and wetlands and also uses pastures and croplands. Commonly forages in wetland areas	No preferred habitat for this species would be impacted	No
Arenaria interpres	Ruddy Turnstone	Mi		C, J	Turnstones are non-breeding migrants in Australia, breeding in eastern Siberia and Alaska and arriving in Australia about October each year. Preferred habitat is beaches where shingle and masses of seaweed are mixed with stretches of sand	No preferred habitat for this species would be impacted	No
Calidris alba	Sanderling	Mi			Sanderlings are non-breeding migrants to Australia, preferring sea beaches and sandy ocean shores. They seldom move further inland than coastal lagoons. They eat insects and other small invertebrates in the sand as the waves ebb	No preferred habitat for this species would be impacted	No
Calidris tenuriostris	Great Knot	Mi		C, J, B	Mobile species, mainly inhabits coastal area. Thousands flock from north-eastern Siberia to Eighty-Mile Beach, around Arnhem Land and the Gulf of Carpentaria each year. They prefer tidal muds and sand flats, feeding on gastropods and other invertebrates	No preferred habitat for this species would be impacted	No
Charadrius leschenaultii	Large Sand Plover	Mi			This species can be found around the whole coast of Australia between October and January. They prefer tidal muds and sand flats, feeding on small crustaceans and molluscs, crabs and shrimps being preferred	No preferred habitat for this species would be impacted	No
Charadrius mongolus	Mongolian Plover	Mi, Ma			Arrives in September-October each year from breeding grounds in eastern Siberia. The species inhabit tidal and mud flats in bays, inlets, and estuaries around the Australian coast	No preferred habitat for this species would be impacted	No
Charadrius veredus	Oriental Plover	Mi, Ma			Arrives in October each year from breeding grounds in Asia. The species inhabit inland bare grounds, often bare plains, road verges and flat edges of lakes and lagoons. Occasional visitor to sea shores	No preferred habitat for this species would be impacted	No
Coracina tenuirostris melvillensis	Melville Cicadabird	Mi			This species lives in monsoon forests and mangrove swamps from Broome to the Macarthur River in the Northern Territory, and including Melville Island. It eats fruit, seeds, insects and their larvae	No preferred habitat for this species would be impacted	No
Glareola maldivarum	Oriental Pratincole	Mi			Arrives in October-November each year from breeding grounds in Asia. Although related to shorebirds, they differ in that they flock like swallows to feed aerially on swarming beetles, termites, grasshoppers and crickets	No preferred habitat for this species would be impacted	No

Attachment E4.2 (cont'd)

Species name	Common name	Status			Distribution, ecology and behaviour	Potential impact	Credible risk to species
		AUS	NT	C/J/B			
Haliaeetus leucogaster	White-bellied Sea-Eagle	Mi	V		Coast and near coastal areas across Australia. Mainly coastal but is also found in large rivers and lakes. Feeds mainly on aquatic animals such as fish, turtles and sea snakes, but takes birds and mammals as well	No preferred habitat for this species would be impacted	No
Hirundo rustica	Barn Swallow	Mi, Ma			Most populations breed in Asia but some southern populations appear sedentary. Forages in open country and cultivated lands	No preferred habitat for this species would be impacted	No
Limosa lapponica	Bar-tailed Godwit	Mi		C, J, B	Arrives in August-September each year from breeding grounds in north-eastern Siberia and Alaska. The species inhabit saline and tidal mud flats and sands of coastal inlets and nearby salt pans	No preferred habitat for this species would be impacted	No
Limosa limosa	Black-tailed Godwit	Mi		C, J, B	Arrives in September each year from breeding grounds in northern Eurasia. Unlike the Bar-tailed Godwit, this species ranges inland to frequent shallow open muddy lagoons and swamps. They return to staging beaches along the north-west coast and in the Gulf of Carpentaria before leaving Australia in March to breed	No preferred habitat for this species would be impacted	No
Merops ornatus	Rainbow Bee-eater	Mi, Ma		J	Widely distributed across Australia except in desert areas. Commonly found in woodland and timbered plains throughout Australia capturing insects whilst in flight. Breeds throughout most of its range. Southern populations move to northern Australia, New Guinea and Indonesia over winter	No preferred habitat for this species would be impacted	No
Numenius minutus	Little Whimbrel	Mi			Arrives in September-October each year from breeding grounds in central and north-eastern Siberia. The species inhabit bare, dry sub-coastal plains, airfields and suburban lawns	No preferred habitat for this species would be impacted	No
Numenius phaeopus	Whimbrel	Mi			Breeds in Arctic, inhabiting coastal environments such as mangroves, mud flats and islets while in Australia	No preferred habitat for this species would be impacted	No
Pluvialis squatarola	Grey Plover	Mi			Arrives in September each year from breeding grounds in Russia, Alaska and Canada. The species inhabit tidal sand and mud flats, feeding on crustaceans, marine worms and other invertebrates	No preferred habitat for this species would be impacted	No
Poecilodryas superciliosa cerviniventris	Derby White-browed Robin	Mi			The species lives in tropical monsoon forests and mangrove swamps from Derby in Western Australia across to western Queensland. It eats mainly insects and larvae and occasionally small crabs and molluscs	No preferred habitat for this species would be impacted	No
Rhipidura rufifrons	Rufous Fantail	Mi			There are two distinct races of this species, the migratory race moves from Australia into islands in the south-western Pacific in March-April and back into Australia in September-October. This race inhabits rainforests and wet sclerophyll forests	No preferred habitat for this species would be impacted	No
Sterna albifrons	Little Tern	Mi, Ma	V		Migrating from eastern Asia, found on the north, east and south-east Australian coasts. Coastal, preferring sheltered environments, although it may occur several kilometres from the sea in harbours, inlets and rivers. Nests in small, scattered colonies in low dunes or on sandy beaches just above high tide mark near estuary mouths or adjacent to coastal lakes and islands	No preferred habitat for this species would be impacted	No

Attachment E4.2 (cont'd)

Species name	Common name	Status			Distribution, ecology and behaviour	Potential impact	Credible risk to species
		AUS	NT	C/J/B			
Marine species							
Balaenoptera edeni	Bryde's Whale	Mi, W			Pronounced, 'broo-dess' whale, they prefer tropical and temperate waters, and coastal rather than pelagic. Their diet is composed almost entirely of fish	The proposed works may contribute to a cumulative impact on this species in tropical waters due to increased shipping	No
Crocodylus porosus	Saltwater Crocodile	Mi, Ma			Coastal rivers and swamps extending well inland via major rivers and billabongs	Several hundred saltwater crocodiles are removed from Darwin Harbour each year. The proposed project would not impact this species	No
Dugong dugon	Dugong	Mi, Ma			The Dugong prefers calm, sheltered, shallow and nutrient-rich waters that support seagrass	No seagrass would be impacted by the proposed works	No
Orcaella heinsohni	Australian Snubfin Dolphin	Mi, W			Australian Snubfin Dolphin occurs in tropical waters of New Guinea and northern Australia. They prefer shallow estuaries, and are quiet and inconspicuous	The proposed works may contribute to a cumulative impact on this species in tropical waters or estuaries due to increased shipping	No
Orcinus orca	Killer Whale	Mi, W			Killer Whales are voracious predators. They hunt singly or in groups feeding on fish, seals and other cetaceans. They are usually found in groups and are commonly seen in Australian waters, and occasionally close inshore	The proposed works may contribute to a cumulative impact on this species in tropical waters due to increased shipping	No
Sousa chinensis	Indo-Pacific Humpback Dolphin	Mi, W			This species is usually found in near shore tropical waters. When undisturbed they are slow swimmers	The proposed works may contribute to a cumulative impact on this species in tropical waters or estuaries due to increased shipping	No
Tursiops aduncus (Arafura Sea/ Timor Sea population)	Spotted Bottlenose Dolphin	Mi, W			This population has geographic variation to other bottlenose dolphins – in particular, morphological variation between inshore and offshore animals	The proposed works may contribute to a cumulative impact on this species in tropical waters or estuaries due to increased shipping	No
Pseudorca crassidens	False Killer Whale	W			False Killer Whales are found in tropical to warm temperate zones, generally in relatively deep, offshore waters, but also in semi-enclosed seas and bays. They eat primarily fish and cephalopods	The proposed works may contribute to a cumulative impact on this species in tropical waters due to increased shipping	No

ATTACHMENT E4.3
NORTHERN TERRITORY TRANSPORT STATEMENT

BHP Billiton

Olympic Dam Expansion Environmental Impact Statement

Northern Territory Transport Statement

BHP Billiton

Olympic Dam Expansion Environmental Impact Statement

Northern Territory Transport Statement

October 2008

Arup
Arup Pty Ltd ABN 18 000 966 165

Arup
Level 17 1 Nicholson Street, Melbourne VIC 3000
Tel +61 3 9668 5500 Fax +61 3 9663 1546
www.arup.com

Job number 085200-01

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Tables

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Appendices

1 Introduction

BHP Billiton is proposing to expand its existing mining and minerals processing operation at Olympic Dam (OD), located approximately 570km northwest of Adelaide in South Australia (See Figure 1).

This report provides a review of the transport impacts in the Northern Territory as a result of Olympic Dam Expansion (ODX) and should be read in conjunction with the EIS and Traffic Impact Assessment.

The key objectives of this assessment are as follows:

- To provide an overview of the existing transport conditions in the Northern Territory including the existing road/rail network and the existing road and rail movements;
- To describe additional rail movements generated during (ODX); and
- To provide a review of the impact of the additional rail movements associated with ODX.

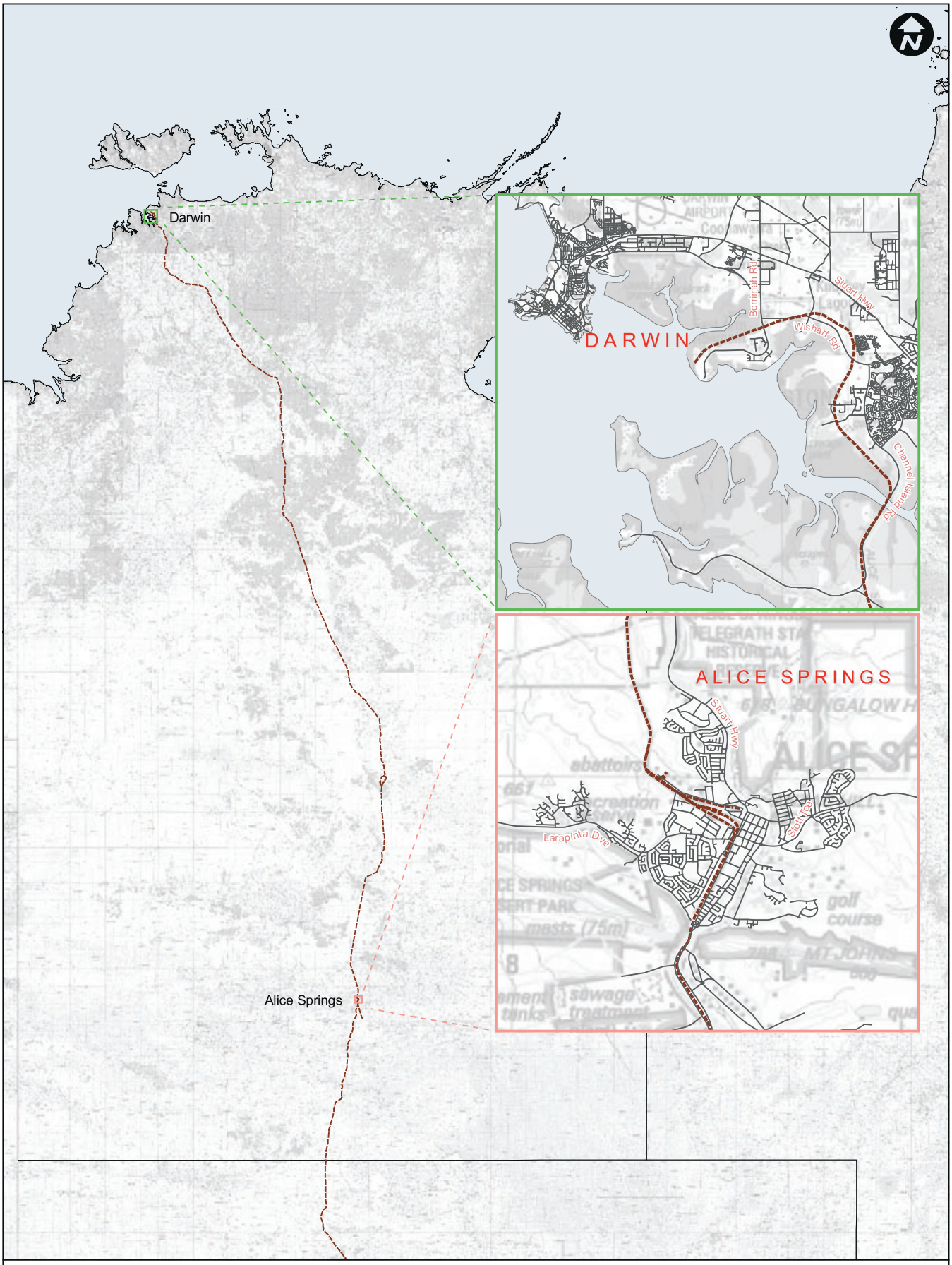
This assessment includes a review of the transport impacts of the proposed expansion from the years 2010 (dependant on government and BHP Billiton board approval) to 2020, with a focus on rail movements and impacts post 2016. From 2020 onwards, ODX is assumed to be operating in a steady state.

The traffic impacts for the operation of ODX depend on the number and frequency of transport trips. The impact of these trips on the road network is dependent on the mode of transport for commodities and exports.

As a part of ODX, a number of transport infrastructure improvements are proposed, which aim to increase the viability and use of rail transport for commodities and exports. The transport infrastructure improvements and the timing relating to these improvements are broadly described in Table 1.

Table 1 - Major Proposed Transport Infrastructure Summary

Timing	Transport Infrastructure	Description
2010 to 2011	Existing road network	Generally all materials, equipment, infrastructure, commodities and exports are transported by road (current situation), with the exception of Uranium Oxide Concentrate (UOC) which is transported by rail to Darwin.
2012 to 2015	Pimba Road/Rail intermodal facility constructed during 2011 and operational from 2012.	Some commodities and exports to be transported by rail between Port Adelaide and Pimba and by road between Pimba and Olympic Dam. Remaining items transported by road.
2016+	Rail spur construction is completed in 2015 and begins operation in 2016.	Most commodities and exports to be transported by rail, with the remainder on road.
Around 2016	Upgrade of East Arm facility	



Legend

----- Rail

FIGURE 1

Issue	Date	By	Chkd	Appd
P1	21-10-08	CJ	TK	PJC

Client
BHPBilliton

Job Title
Traffic Impact Assessment EIS

Drawing Title
Location and Scope

Kilometres
0 50 100 200

ARUP
Level 17,
1 Nicholson Street
Melbourne VIC 3000
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Drawing Status
Issue

Job No	Drawing No	Issue
85200-01	001	P1

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The proposed expansion involves the movement of materials, equipment, commodities and exports locally, nationally and internationally. For the Northern Territory, this would be limited to additional rail movements on the Tarcoola (South Australia) to Darwin line and local construction and operational road movements associated with improvements and increased operation at the East Arm Port of Darwin.

The impact of additional traffic movements on the road links between Olympic Dam and elsewhere in Australia are discussed and assessed within the Traffic Impact Assessment report which is appended to the EIS. The additional rail movements between Port Adelaide and Olympic Dam are also discussed in the Traffic Impact Assessment.

The additional rail movements between Olympic Dam and Darwin (carrying exports from the Olympic Dam site) would occur once the rail spur from Pimba to Olympic Dam is operational and the OD site is operating at the expanded rate (around 2016 onwards).

It is noted that a risk assessment has been undertaken and is included as a separate appendix within the EIS. The scope of this assessment includes transport related risks including those as a result of increased train movements.

2 Existing Conditions

In order to provide context to the components of the Olympic Dam Expansion in the Northern Territory, it is appropriate to establish the existing transport conditions. The proposal for Olympic Dam Expansion involves additional rail movements in the Northern Territory. However, the design of the existing rail network is such that there is an interface between the road and rail network (i.e. rail crossings). Accordingly, an overview is provided of the road network in the context of the interface with the existing rail line from the South Australian border to Darwin.

2.1 Road Responsibilities

The responsibility for the operation and management of roads in the Northern Territory is generally shared between local government authorities and the Northern Territory Government.

The Northern Territory Government lists the roads for which it is responsible. The key roads that cross the Tarcoola to Darwin rail line and are the responsibility of the Northern Territory Government include:

- Stuart Highway;
- Larapinta Drive, Alice Springs;
- Plenty Highway;
- Buchannan Highway;
- Victoria Highway;
- Edith Falls Road;
- Kakadu Highway;
- Dorat Road;
- Batchelor Road;
- Cox Peninsula Road;
- Wishart Road, Darwin;
- Channel Island Road, Darwin; and
- Berrimah Road, Darwin.

Other roads of note that are the responsibility of the local government and interface with the rail network include Bradshaw Drive, Espie Street and Lovegrove Drive in Alice Springs and Finn Road in Darwin.

In addition to the above, there are numerous other less significant roads, tracks and private property accesses which cross the Tarcoola to Darwin rail line.

2.2 Policy and Strategy Overview

While there are a number of publicly available strategic documents for the Northern Territory, the AusLink Adelaide to Darwin Corridor Strategy 2007 is a key study and provides an overview of the existing deficiencies and strategic direction for the transport corridor.

2.2.1 AusLink Adelaide to Darwin Corridor Strategy 2007

The AusLink Adelaide to Darwin Corridor Strategy 2007 provides an overview of the current and future challenges for the transport corridor including both the rail line and the road network. This study also summarises the short term deficiencies (to 2015) for the transport route. The key points for the Northern Territory relating to rail or the interface of road/rail already targeted under the first AusLink five year investment programme include:

- The Tiger Brennan Drive extension and staged duplication of Berrimah Road to Darwin's East Arm Port. This project is planned to provide better access to Darwin's East Arm Port for freight vehicles. The inclusion of a road over rail bridge that accommodates dual rail tracks as part of this project will eliminate traffic delays caused by trains using Darwin's East Arm Port rail line. Planning for this project is currently underway.
- A rail track work programme focussing on the reconstruction of a spur line and the placement of a new passing loop in the Northern Territory – this rail investment also involves FreightLink investment in a fleet which will allow for the double stacking of containers and facilitate the movement of additional freight.

These existing issues and improvements have been identified by the state and federal governments. The provision of and the quality of the rail corridor and interface with the public highway remains the responsibility of the federal and state governments and this study has assumed that these issues will be addressed as such.

2.3 Road Network

The road network within the Northern Territory is continuing to develop as funding becomes available. The Tarcoola to Darwin rail line partly follows the alignment of the Stuart Highway and crosses at numerous locations (discussed further in Section 2.5).

The Stuart Highway is the only sealed north-south link crossing central Australia. Running between Port Augusta and Darwin, it is also the only sealed link for the corridor's major centres of Darwin, Katherine, Tennant Creek, Alice Springs, Coober Pedy and Port Augusta. The Stuart Highway between Port Augusta and Darwin is predominately a two-lane, two-way, single carriageway road.

The key roads that cross the rail line in the vicinity of Darwin include Berrimah Road, Wishart Road, Channel Island Road, Finn Road and Cox Peninsula Road. These roads are generally sealed two lane, two-way, single carriageway roads and provide sub-regional connection to Darwin. Berrimah Road is the primary access to the East Arm port facility and is currently in the process of being upgraded (discussed further in Section 2.3.1). Berrimah Road also provides access to Darwin Business Park and the Darwin Railway Passenger Terminal.

Between Darwin and Alice Springs the rail line crosses Batchelor Road, Dorat Road, Kakadu Highway, Edith Falls Road, Victoria Highway, Buchannan Highway and Plenty Highway. In the vicinity of the rail corridor these roads are sealed two lane, two way, single carriageway roads, with the exception of the Buchannan Highway which is not sealed and Plenty Highway which is only sealed on the approach to the rail crossing. These roads provide wider regional access to places of interest within the territory and to the surrounding states.

The rail line crosses Lovegrove Drive, Larapinta Drive and Espie Street and Bradshaw Drive as the rail line passes through Alice Springs. While Lovegrove Drive and Espie Street provide local access, Bradshaw Drive and particularly Larapinta Drive are key circulation and traffic movement routes for Alice Springs.

In addition to the above, there are numerous minor roads providing access to local townships, property accesses and tracks that cross the rail line. These roads are generally unsealed and provide local access.

2.3.1 Future Network Improvements

As discussed in Section 2.2.1, the Tiger Brennan Drive Upgrade Project is currently underway. The Tiger Brennan Drive Project commenced in April 2008 and is currently proposed to be completed in two stages. The first stage involves the duplication of Berrimah Road between Tiger Brennan Drive and Wishart Road, a distance of approximately 1.7 km. The road improvement works will widen Berrimah Road from the current one lane in each direction to a divided road with two lanes in each direction. Appropriate turning lanes will be constructed at intersections. Access to the East Arm Port will be greatly improved and become more efficient as a result of these works.

The second stage of the project involves an extension of Tiger Brennan Drive from Berrimah Road to the Stuart Highway (approximately 7.5km), including an overpass at Stuart Highway/Roystonea Avenue. The contract for the design and construction of Stage 2 is scheduled to be announced in October 2008.

The project is being funded by the State and Federal Governments. Access to the East Arm Port will be improved and become more efficient as a result of the above works.

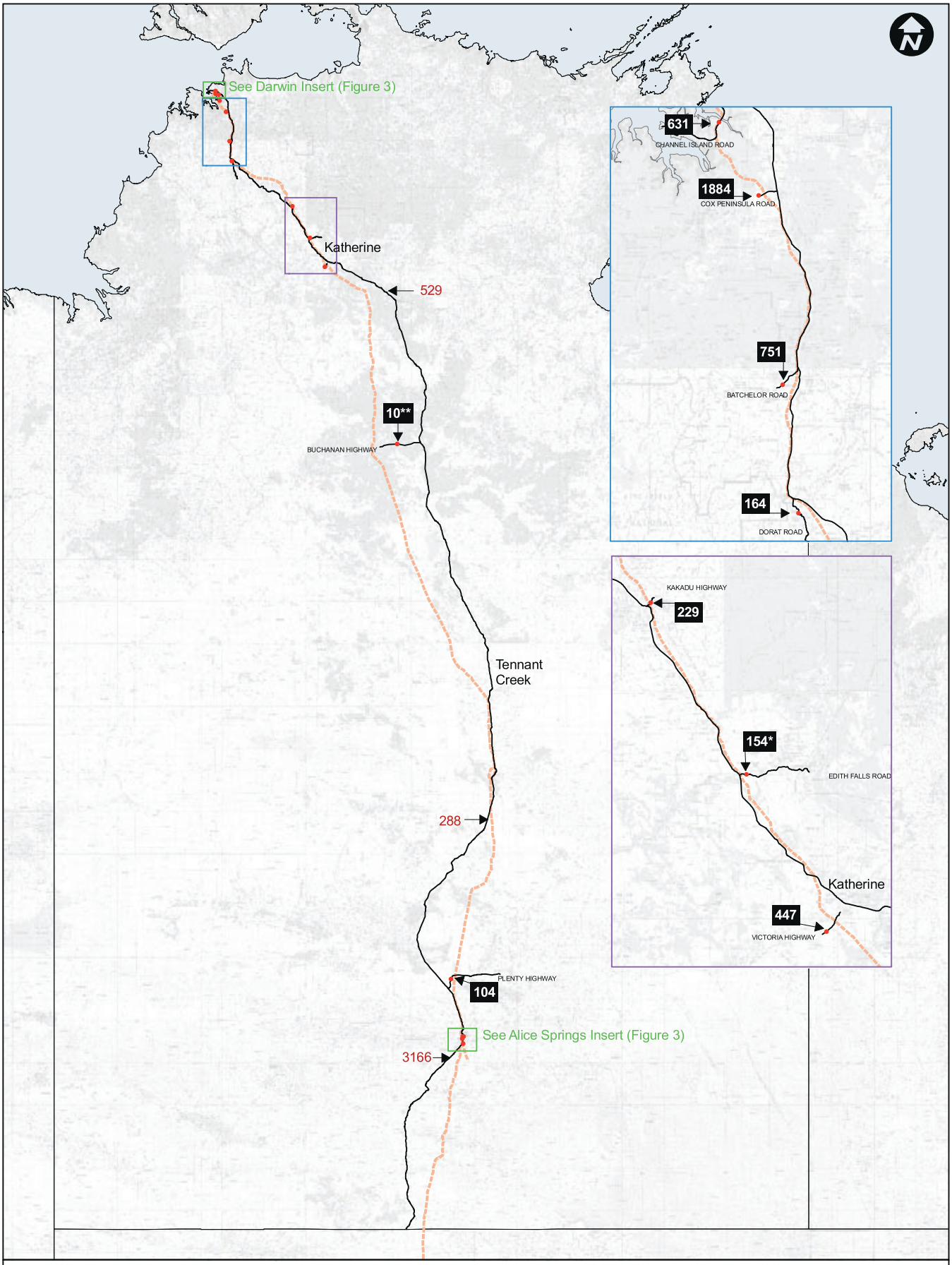
2.4 Traffic Data

Traffic data has been collated focusing on key roads that intersect the rail network. The sources for this data include the Annual Traffic Report 2006 prepared by the Territory Asset Management Services on behalf of the Northern Territory Government. The summary of the collated traffic data is shown in Table 2 and shown spatially in Figure 2 and Figure 3. While the Stuart Highway is predominately grade separated, traffic volume data is included to provide context and highlight the variation in traffic volumes between the remote and urban areas. It is noted that vehicle classification data is not available for the urban area counts.

The traffic data shown in Table 2, Figure 2 and Figure 3 demonstrate the difference in traffic volumes along roads that cross the rail line as the rail line passes through the urban areas of Alice Springs and Darwin.

Table 2 - Traffic Data

Road	Location	Survey Year	Cars/ Car Towing	Bus/2 Axle Trucks	Heavy Vehicles Volume	Total AADT
Larapinta Drive	NT/SA Border to Alice Springs	2006	-	-	-	16,262
Plenty Highway	Tennant Creek and Katherine	2006	89 (86%)	8 (8%)	7 (6%)	104
Buchanan Highway	32km East of Top Springs	2004	8 (80%)	1 (10%)	1 (10%)	10
Victoria Highway	Katherine and Darwin	2006	292 (65%)	98 (22%)	57 (13%)	447
Edith Falls Road	2km East of Stuart Highway	2005	-	-	-	154
Kakadu Highway	West of George Crs, Alice Springs	2006	192 (84%)	23 (10%)	13 (6%)	229
Batchelor Road	Between Bath and Hartley St, Alice	2006	499 (66%)	217 (29%)	35 (5%)	751
Dorat Road	3.5km west of Stuart Highway	2006	-	-	-	164
Cox Peninsula Road	16km east of Stuart Highway	2006	1717 (91%)	115 (6%)	52 (3%)	1,884
Channel Island Road	13km West of Stuart Highway	2007	-	-	-	631
Wishart Road	500m east of Stuart Highway	2007	-	-	-	11,487
Berrimah Road	5km West of Stuart Highway	2007	-	-	-	3,832
Stuart Highway	Darwin, East of Berrimah Road	2006	-	-	-	21,039
Stuart Highway	Between Katherine and Buchannan Highway	2006	-	-	-	529
Stuart Highway	Between Tennant Creek and Plenty Highway	2006	-	-	-	288
Stuart Highway	South of Bradshaw Drive, Alice	2006	-	-	-	11,402
Stuart Highway	North of Santa Teresa Road	2006	-	-	-	3,166



Legend

- Traffic Volume Location
- Key Roads
- Rail
- 104 Two-way AADT volume
- 3166 Stuart Hwy two-way AADT volume

Note: All traffic volumes are from 2006 data unless otherwise specified
* 2005 Traffic volume
** 2004 Traffic volume

FIGURE 2

Issue	Date	By	Chkd	Appd
P1	21-10-08	CJ	TK	PJC

Client
BHPBilliton

Job Title
Traffic Impact Assessment EIS

Drawing Title
Northern Territory AADT Traffic Volumes

Kilometres
0 50 100 200

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Drawing Status
Issue

Job No	Drawing No	Issue
85200-01	001	P1

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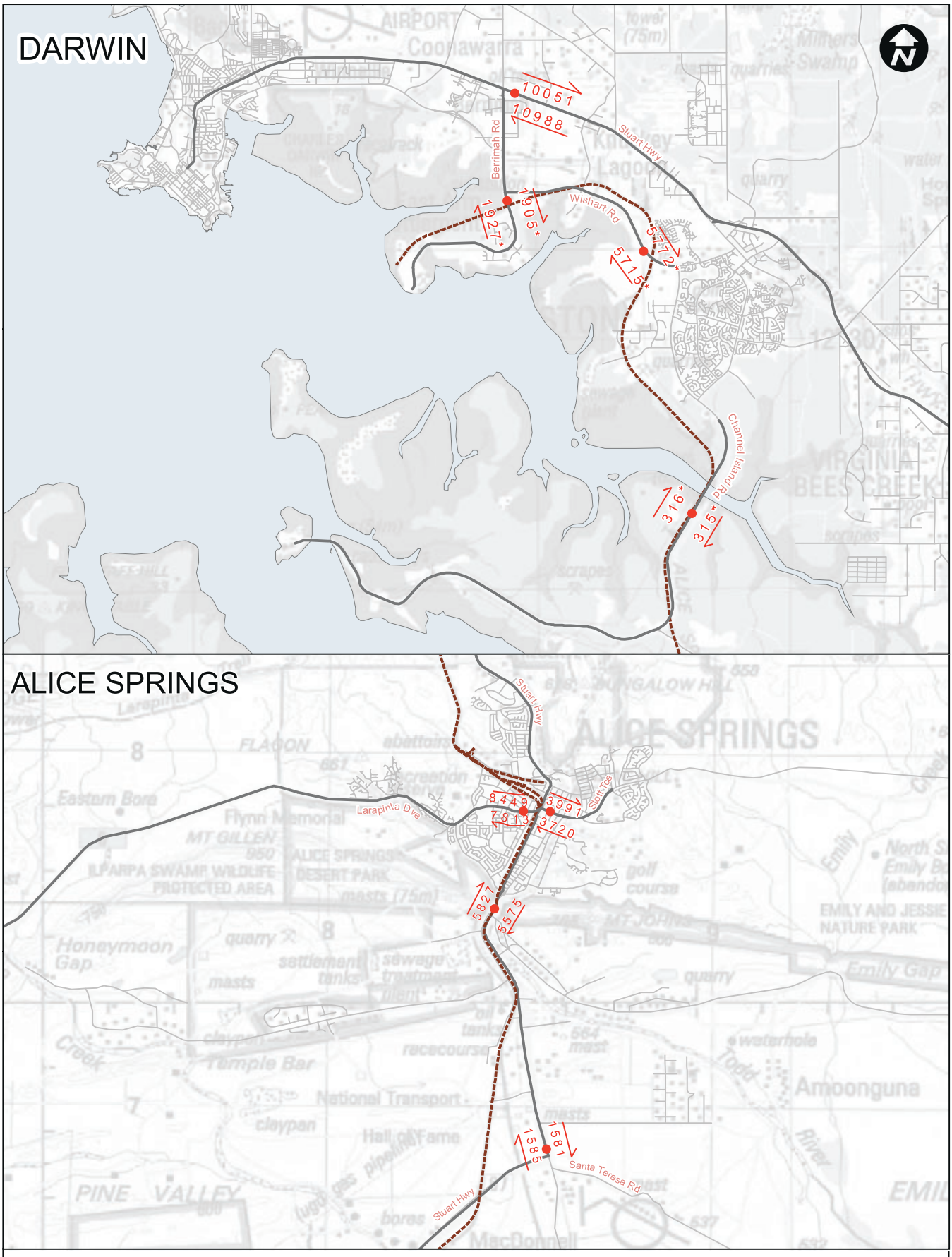

Legend

- Traffic Volume Location
- Railway
- Key Roads
- Other Roads

Note: All traffic volumes are from 2006 counts unless otherwise stated
* 2007 Traffic volumes
** 2005 Traffic volumes

FIGURE 3

Client
BHPBilliton

Job Title
Traffic Impact Assessment EIS

Drawing Title
Darwin and Alice Springs AADT Traffic Volumes

Issue	Date	By	Chkd	Appd
P1	21-10-08	CJ	TK	PJC

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NTS

Drawing Status
Issue

Job No	Drawing No	Issue
85200-01	001	P1

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2.4.1 Background Traffic Growth

The background traffic growth for the roads interfacing with the rail line has been determined from two sources. The projected growth along the Stuart Highway has been sourced from the AusLink study "Demand Projections for AusLink Non Urban Corridors: Methodology and Projections" (Bureau of Transport and Regional Economics (BTRE) – Australian Government, 2006). Growth rates for the key roads in Alice Springs and Darwin are based on average historical trends in traffic volume data averaged over a period of up to 11 years to 2007. This historical traffic data has been sourced from the Annual Traffic Report 2006 prepared by the Territory Asset Management Services (TAMS) on behalf of the Northern Territory Government and more recent available traffic data provided by TAMS. While average change in AADT is provided, it is noted that there is significant fluctuation in the growth rates from year to year.

A summary of the growth rates based on the above data sources are provided in Table 3.

Table 3 - Growth Rates on Key Road Links

Road	Location	Source	Annual Average Change - AADT
Stuart Highway	NT/SA Border to Alice Springs	AusLink*	2.34%
Stuart Highway	Alice Springs and Tennant Creek	AusLink*	2.49%
Stuart Highway	Tennant Creek and Katherine	AusLink*	2.21%
Stuart Highway	Katherine and Darwin	AusLink*	3.10%
Larapinta Drive	West of George Crs, Alice Springs	Historical Traffic Data	-0.74%
Plenty Highway	16km east of Stuart Highway	Average Change in AADT (97-06)	3.63%
Victoria Highway	13km West of Stuart Highway	Average Change in AADT (97-06)	1.31%
Kakadu Highway	500m east of Stuart Highway	Average Change in AADT (97-06)	3.51%
Batchelor Road	5km West of Stuart Highway	Average Change in AADT (97-06)	-0.78%
Cox Peninsula Road	4km West of Stuart Highway	Average Change in AADT (97-06)	1.55%
Channel Island Road	South of Elizabeth River Bridge	Average Change in AADT (00-05,07)	17.92%
Wishart Road	2km West of Elrundie Ave	Average Change in AADT (99-07)	4.17%
Berrimah Road	500m South of Wishart Road	Average Change in AADT (01-07)	10.82%

*AusLink study "Demand Projections for AusLink Non Urban Corridors: Methodology and Projections" (Bureau of Transport and Regional Economics (BTRE) – Australian Government, 2006)

The results shown in Table 3 indicate that there is significant growth in traffic volumes along roads in the vicinity of Darwin including Berrimah Road and Channel Island Road. The growth along Berrimah Road is likely to be attributed to an increase in operations at the East Arm facility and the commencement of operations of the Ghan passenger train service from Alice Springs to Darwin in 2004.

2.5 Rail Network

The Adelaide to Darwin railway provides the sole rail link between the coastlines of South Australia and the Northern Territory. This railway also supports regional and interstate passenger services, which are operated under one service known as 'The Ghan'. The Tarcoola to Darwin rail line is owned and operated by FreightLink.

The rail line from Tarcoola to Alice Springs was constructed in 1980 to replace the former narrow gauge railway. The line was upgraded as necessary as part of the construction of the link from Alice Springs to Darwin, completed in 2004.

In order to review the existing level crossing network, rail crossing information (location and type) for the rail line from the NT/SA border to Darwin has been provided by the Northern Territory Government's Transport Group.

Location of Road and Rail Crossings

Using the data provided by the Northern Territory Transport Group level crossings in the Northern Territory have been be described based on the following terms:

- Grade separated - physical separation of rail and road movements;
- Active - control of the railway crossing by devices such as flashing signals, gates or barriers where the device is activated prior to and during the passing of a train through the crossing;
- Passive - control of the railway crossing by signs and devices, none of which are activated during the approach or passage of a train and which rely on the road user, including pedestrians, detecting the approach or presence of the train by direct observations;
- Pedestrian - locations that provide a pedestrian path across the rail line; and
- Occupation - crossings that provide access to unnamed tracks, private property (mines, bores) etc.

Based on the data provided by the Northern Territory Transport Group, the number of rail crossings for each classification are summarised in Table 4.

Table 4 - Rail Crossing Types: Northern Territory/South Australia Border to Darwin

Railway section	Railway Crossing Facility					
	Grade Separated	Public Active	Public Passive	Pedestrian	Occupation Active	Occupation Passive
SA/NT Border to Darwin (East Arm)	7	28	30	5	3	155

The locations that are grade separated include the Stuart Highway (four locations), Victoria Highway, Crater Lake Road and overpass for Manton Dam Pump Station. Generally, active controls are provided within the urban areas of Darwin and Alice Springs or at roads of significance including the Plenty Highway, Edith Falls Road, Kakadu Highway, Dorat Road, Batchelor Road.

2.6 Rail Operations

Passenger and freight train frequencies along the track between Tarcoola and Darwin (current as of March 2008) were sourced from the ARTC freight train schedule and FreightLink.

The number of train movements along the railway between NT/SA border and Darwin varies along the route. The ARTC schedule indicates that there are seven trains each way per week that leave Tarcoola and enter the FreightLink operated rail line from Tarcoola to Darwin. This includes two “Ghan” passenger train services per week each way from Adelaide to Darwin.

There are an additional two trains per week each way which enter the rail network near Tennant Creek and seven trains per week each way which enter the rail network near Pine Creek.

It is noted that between Tarcoola and Alice Springs there may be additional trains entering the rail network from sidings serving the Prominent Hill mine in the near future. It is not clear how many or which direction they will travel at this time.

Based on the above, there are 18 train movements each way per week which arrive/leave Darwin, with a lesser number of train movements between Tennant Creek and the NT/SA border. Any additional trains on the rail network that are travelling to Darwin are required to be slotted within the existing schedule of 18 trains each way per week.

2.6.1 At-Grade Level Crossing Conformity

To establish an understanding of the rail network within the Northern Territory a sample of motorist sight lines at road crossings along the rail line has been undertaken. This high level analysis of level crossing conformity has been based on Australian Standard Railway Crossings (AS1742.7).

The sight line requirements have been assessed against the relevant requirements for passive control crossings treated with give way signs (S1 and S2) and the requirements for crossings treated with stop signs (S3). For simplicity, the parameter S1 has also been used to assess the motorist sight lines to crossings with active controls (flashing lights and boom gates). The parameter S1 is slightly more onerous, but comparable to the sight line assessment for active controls required under AS1742.7.

The parameter S1 is the minimum distance between an approaching road vehicle from the nearest rail at which the driver must be able to see an approaching train in time to stop if necessary before reaching the crossing (see Figure 4). The method for calculating S1 is defined in AS1742.7 and depends on a number of factors including vehicle deceleration coefficients, approach grade, reaction time and the design vehicle stopping, start-up and clearance parameters.

The parameter S2 is the minimum distance between the motorist and a train at which the road vehicle driver needs to be able to see the train in order to cross safely ahead of it (see Figure 4). The method for calculating S2 is defined in AS1742.7 and is dependant on a number of factors in addition to those for S1 including the train speed, vehicle speed, physical layout of the level crossing (stop lines, track width etc) and angle of the level crossing relative to the road.

A train, if present, needs to be visible to a road vehicle driver between any two points within the sight triangle.

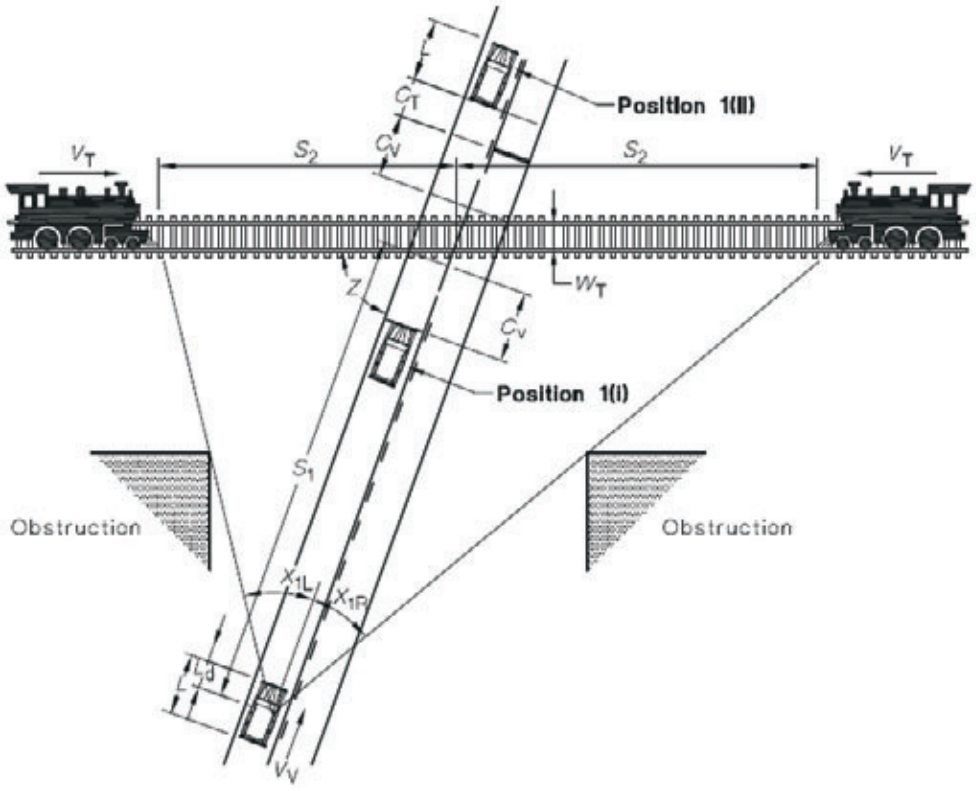


Figure 4 - Motorist sight line assessment (Parameters S1 and S2)

The parameter S3 applies for crossings treated with stop signs and is the minimum distance at which an approaching train must be seen in order for the design vehicle to start off and clear the crossing by a nominated safety margin (see Figure 5). The method for calculating S3 is defined in AS1742.7 and is dependant on some of the factors outlined above for S1 and S2 but also on the average acceleration of the design vehicle, grade correction factor, length of design vehicle and the sum of the driver perception time and the time to depress the clutch.

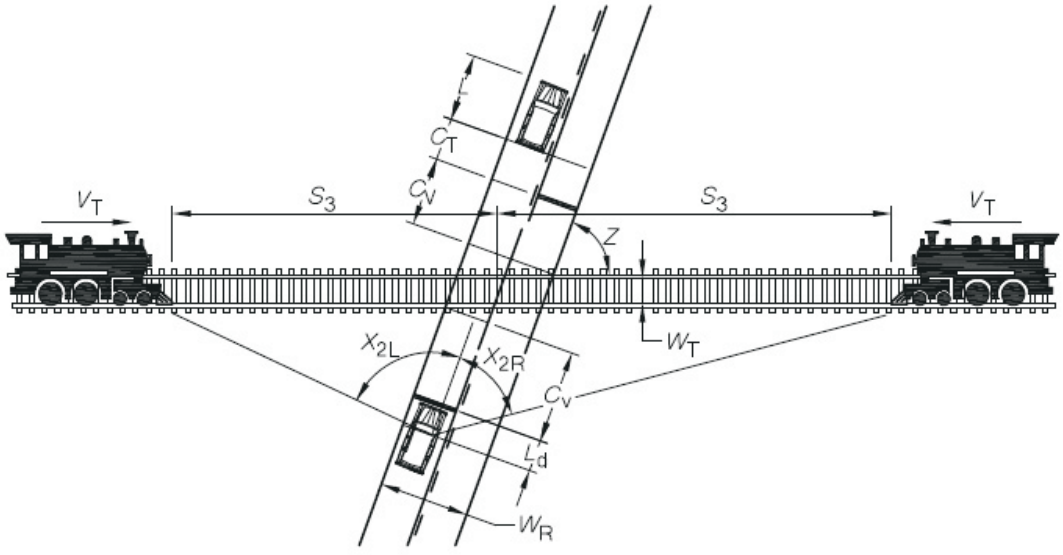


Figure 5 - Motorist sight line assessment (Parameter S3)

The findings of this high level analysis are included at Appendix A and should be considered a sample estimation of compliance with sight distance requirements. Based on this analysis it is estimated that:

- 100% of active crossings appear to conform to sight line standards;
- 80% of *passive* crossings appear to conform to sight line standards; and
- 15% of *all* crossing do not appear to conform to sight line standards.

It is noted that the assessments under AS1742.7 do not stipulate when a crossing should progress from one hierarchical step in the control to the next (i.e. passive control to active control and active control to separation). This decision would be made having regard to the compliance with AS1742.7 but also subject to the findings of a detailed engineering site inspection and the outcome of a risk assessment model such as ALCAM (Australian Level Crossing Assessment Model).

2.7 Crash Analysis

As a part of review the safety of the existing rail network in the Northern Territory, a crash analysis has been undertaken for the level crossings between the South Australia/Northern Territory border and Darwin. Data on all reported casualty crashes has been provided by Department of Transport Road Safety for the Northern Territory for the period 01 January 2003 to 31 December 2007 (five years).

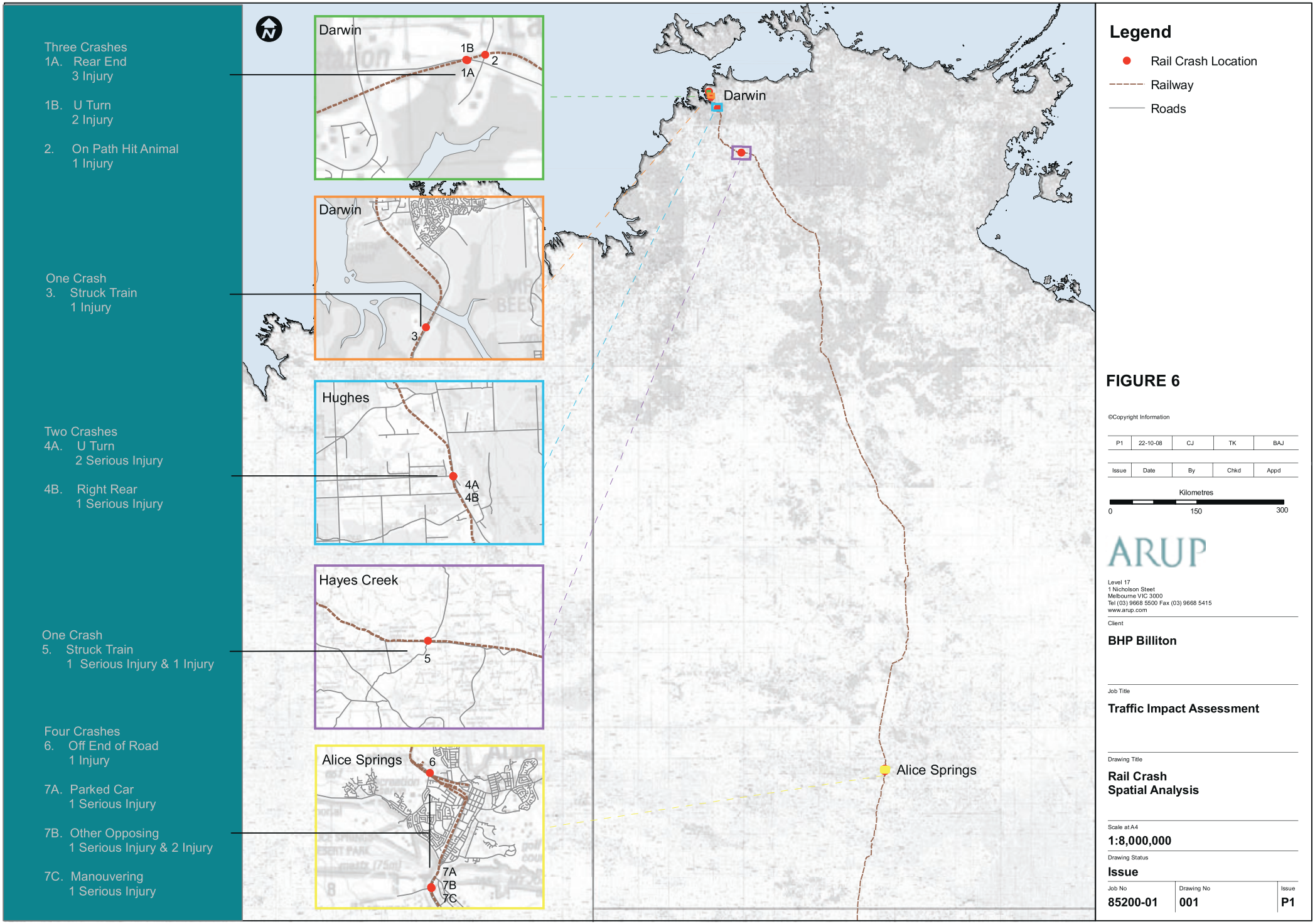
From this data, crashes at level crossings has been isolated using geographic information system software (ArcGIS) to limit the data to crashes within 50m of a level crossing. These crashes have been plotted in Figure 6 and are summarised in Table 5.

It is noted that within the above table there are a number of crashes that are unlikely to be related to the safety of the level crossings (e.g. vehicle strikes an animal). Those reported casualty crashes involving a train are highlighted in bold.

Table 5 - Level Crossing Crashes

Ref	Injury	Date	Crossing Type	Type of Crash
1A	Injury	22/02/2007	Active	Rear End
1B	Injury	1/03/2005	Active	U-turn
2	Injury	5/09/2007	Active	On Path Hit Animal (not ridden)
3	**Injury**	**20/10/2006**	**Passive**	**Struck Train**
4A	Serious	8/08/2007	Active	U-turn
4B	Serious	28/07/2006	Active	Right Rear
5	**Serious**	**12/12/2006**	**Passive**	**Struck Train**
6	Injury	21/04/2006	Active	Off-end of road (T-intersection)
7A	Serious	4/11/2005	Passive	Parked Vehicle
7B	Serious	26/07/2005	Passive	Other Opposing
7C	Serious	24/05/2003	Passive	Manoeuvring from footpath

Based on the above, the number of crashes within the vicinity of level crossings in the Northern Territory is relatively low particularly given that the analysis has been undertaken over a 5 year period and the rail network in the Northern Territory is of considerable length at around 1,650km.


Three Crashes
1A. Rear End
3 Injury
1B. U Turn
2 Injury
2. On Path Hit Animal
1 Injury
One Crash
3. Struck Train
1 Injury
Two Crashes
4A. U Turn
2 Serious Injury
4B. Right Rear
1 Serious Injury
One Crash
5. Struck Train
1 Serious Injury & 1 Injury
Four Crashes
6. Off End of Road
1 Injury
7A. Parked Car
1 Serious Injury
7B. Other Opposing
1 Serious Injury & 2 Injury
7C. Manouvering
1 Serious Injury
Darwin
1B
2
1A
Darwin
3
Hughes
4A
4B
Hayes Creek
5
Alice Springs
6
7A
7B
7C
Darwin
Alice Springs
Legend
Rail Crash Location
Railway
Roads
FIGURE 6
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P1 22-10-08 CJ TK BAJ
Issue Date By Chkd Appd
Kilometres
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Client
BHP Billiton
Job Title
Traffic Impact Assessment
Drawing Title
Rail Crash
Spatial Analysis
Scale at A4
1:8,000,000
Drawing Status
Issue
Job No
85200-01
Drawing No
001
Issue
P1
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3 Proposed Olympic Dam Expansion

3.1 Overview

Darwin Harbour includes both the East Arm and City Port facilities. Darwin's East Arm Port is strategically located at the end of the Adelaide–Darwin rail corridor and has replaced the City Port for all freight operations. The East Arm Port and adjacent area is being developed into a multi-modal transport and logistics hub.

The proposal for the Northern Territory Transport Option including the proposed changes to the East Arm facility is described in the Appendix to the EIS with the key points relating to transport highlighted as follows:

- Uranium Oxide Concentrate (UOC) is currently transported by road to Adelaide then via rail to Darwin. The UOC is transported via road from the Berrimah Rail Terminal to the Toll storage facility and then transported via road to the wharf for loading onto ships for export via sea;
- Rail will continue to be utilised for the transport of increased volumes of UOC from OD to Darwin as a result of ODX. The exact quantity of UOC containers exported via the Port of Darwin is yet to be determined and subject to further investigations consultation with stakeholders and approvals by government;
- For products transferred from Olympic Dam to Darwin, dedicated rail equipment on the existing Adelaide to Darwin line would be used;
- The proposed upgrade to the existing East Arm facility is still under investigation. The current preferred option includes a rail spur and rail loop to bring the unloader and storage facilities as close to the wharf as possible with an enclosed conveyor used to transfer export from the storage facility to the wharf; and
- There would be a daily train from Olympic Dam to the East Arm facility in either direction to transport copper concentrate produced at Olympic Dam for export to Darwin.

As discussed in Section 1, the required road movement of commodities for ODX will generally occur in South Australia. However, there would also be an increase in road traffic into the Darwin Business Park as a result of the transport of equipment and material for the construction of the proposed facilities at the East Arm and the associated workforce.

The proposed expansion would also increase heavy vehicle traffic within the Darwin Business Park, as a result of the increased volumes of UOC being transported from the toll facility, for approximately 2.5 km along Berrimah Road to the entrance/gatehouse, and then to the East Arm Wharf for export. Based on an increase in UOC from an estimated 200 to 950 containers per year, this would increase truck movements from 200 to 950 per year (based on one container per truck), or an average of 15 trucks per week. The majority of truck movements are likely to occur in conjunction with the nominated export ship movements.

Based on the traffic data at the Berrimah Road rail intersection (i.e. AADT of over 3,800 vehicles per day, two way), the additional 15 trucks per week for the transport of increased volumes of UOC would be negligible. While Berrimah Road is also used by members of the general public transiting to and from the rail passenger terminal and East Arm boat ramp, the transport of industrial goods along this carriageway is common. The impact from the likely increase in traffic movements is therefore considered minor.

Based on the above, it is appropriate for the assessment to focus on the movement of export via rail to the East Arm facility in Darwin having regard to the existing conditions established in Section 2.

3.2 Rail Movement, Impacts and Safety

The current logistics proposal for the Northern Territory is for one train per day each way between the NT/SA border and Darwin. This will increase the current movements arriving/leaving Darwin from 18 movements each way per week to 25 movements each way per week. The length of trains is expected to be 1,200 m long with 1,800 m being the maximum permissible length. The assumed maximum speed of existing and future freight trains is 80km/h.

From the increases in train movements discussed above, the addition of one train per day each way, or seven trains per week each way on top of a current traffic level of 18 trains per week each way will be likely to require some form of improvement to maintain the current level of service (LoS) on this line. While additional rail infrastructure may be required (BHP Billiton are proposing further discussions in this regard), it has been identified that the existing rail corridor would be able to accommodate any such improvements.

Rail Crossings – At-Grade Signalised Level Crossings

The proposed additional freight train movements for ODX are of either 1,200 m or 1,800 m length configuration. Boom gates close for 30 seconds prior to the arrival of a train as stipulated in ARTC's Track and Civil Code of Practice Appendix EFT-16-01. Table 6 shows total closure times for a maximum train speed of 80 km/h and for a speed of 70 km/h. The total delay to road traffic at an at-grade level crossing for these trains length at or close to their operating speed of 80 km/h is in the order of 90 to 120 seconds.

Table 6 - Closure Times for Different Train Lengths

Train length	Train speed	Closure time (secs)	TOTAL
80 km/h (max. speed)			
1200m train	54	30	84 sec
1800m train	81	30	111 sec
70 km/h			
1200m train	62	30	92 sec
1800m train	93	30	123 sec

The Olympic Dam expansion proposes seven extra trains each way per week in addition to the 18 trains per week that enter Darwin. The queuing and total delay associated with each level crossing location will be dependant on the traffic volumes at the time that the train passes through each level crossing. The delay to motorists will be minimal and is not expected to have a significant impact on traffic movements in Darwin, Alice Springs or the wider Northern Territory given that it is not a common event.

Rail Crossing Safety

The proposed increase in trains along the rail network increases the exposure for possible vehicle crashes relating to trains or rail crossing facilities. A risk assessment has been undertaken that is included as a separate chapter within the EIS. The scope of this assessment includes transport related risks.

4 Conclusions

The proposed Northern Territory Transport Option is being considered as a part of the Olympic Dam Expansion. This option involves the addition of one train per day each way between Olympic Dam and Darwin from about 2016 onwards for the movement of export from the mine.

The addition of one train per day each way, or seven trains per week each way on top of the current traffic level of 18 trains per week each way will be likely to require some form of infrastructure improvement to maintain the current LoS on the Tarcoola to Darwin rail line. It has been identified that the existing rail corridor would be able to accommodate any such improvements required.

The proposed increase in trains along the rail network increases the exposure for possible vehicle crashes relating to trains or rail crossing facilities. A risk assessment has been undertaken that is included as a separate chapter within the EIS. The scope of this assessment includes transport related risks.

Appendix A

At-Grade Rail Crossing Survey

Appendix A: At-Grade Railway Crossing Survey

Derivation of Sight Line Distances at Railway Crossings

Minor Road Crossing Give Way And Signalled

Assume
Semi trailer as max size vehicle
Speed <95km/h

Variable	Value	Units	Comments
Rt	2.5	seconds	fixed
Bt	1		vehicle type
Vv	90	km/h	straight road
Vv	50	km/h	bend
d	0.29		coefficient
G	0		flat gradient
Ld	1.5	m	fixed
Cv	3.5	m	fixed
Vt	115	km/h	max train speed
Wt	1.42	m	single rail width
Z	90	degrees	angle road/rail
Sin Z	0.893997		
Ct	5	metres	set
L	19	metres	length of semi

	Straight	Curved Approach
S1 (m)	**202**	**88**
S2 (m)	**294**	**265**

Major Road Crossing Give Way

Assume
B-Double as max size vehicle
Speed <95km/h

Variable	Value	Units	Comments
Rt	2.5	seconds	fixed
Bt	1.5		vehicle type
Vv	117	km/h	straight road
Vv	80	km/h	bend
d	0.28		coefficient
G	0		flat gradient
Ld	1.5	m	fixed
Cv	3.5	m	fixed
Vt	115	km/h	max train speed
Wt	1.42	m	single rail width
Z	90	degrees	angle road/rail
Sin Z	0.893997		
Ct	5	metres	set
L	36.5	metres	length B-Double

	Straight	Curved Approach
S1 (m)	**327**	**184**
S2 (m)	**366**	**329**

Minor Road Crossing With Stop Signs

Assume
Semi trailer as max size vehicle
Speed <95km/h

Variable	Value	Units	Comments
J	2	seconds	fixed
Alpha	0.36		vehicle type
Gs	1		flat gradient
Wr	7	m	fixed
Cv	3.5	m	fixed
Vt	115	km/h	max train speed
Wt	1.42	m	single rail width
Z	90	degrees	angle road/rail
Sin Z	0.893997		
Tan Z	-1.9952		
Ct	5	metres	set
L	19	metres	length of semi

	All
S3 (m)	**1218**

Major Road Crossing With Stop Signs

Assume
B-Double as max size vehicle
Speed <95km/h

Variable	Value	Units	Comments
J	2	seconds	fixed
Alpha	0.29		vehicle type
Gs	1		flat gradient
Wr	7.6	m	fixed
Cv	3.5	m	fixed
Vt	115	km/h	max train speed
Wt	1.42	m	single rail width
Z	90	degrees	angle road/rail
Sin Z	0.893997		
Tan Z	-1.9952		
Ct	5	metres	set
L	36.5	metres	length B-Double

	All
S3 (m)	**1712**

Formulae from Appendix D, Manual of uniform traffic control devices, Part 7: Railway crossings (Australian Standard):

$$S_1 = \frac{(R_T + B_T)V_v}{3.6} + \frac{V_v^2}{254(d+G)} + L_d + C_v$$

$$S_2 \quad S_2 = \frac{V_T}{V_v}\left(\frac{(R_T + B_T)V_v}{3.6} + \frac{V_v^2}{254(d+G)} + \frac{W_T}{\sin Z} + 2C_V + C_T + L\right)$$

$$S_3 = S_3 = \frac{V_T}{3.6}\left(J + G_s\left(2\frac{\frac{W_R}{\tan Z} + \frac{W_T}{\sin Z} + 2C_V + C_T + L}{a}\right)^{1/2}\right)$$

Appendix A: Rail Level Crossing - Sight Line Analysis

NT/SA Border to Darwin

ARUP

NUMBER	EXISTING TYPE	CONFORMS?	S1	S2	S3	Built-up?	Nearest Road	State / Nearest Town
1	GIVE WAY	YES	YES	YES	YES	NO	FINKE RD	NT
2	GIVE WAY	YES	YES	YES	YES	NO	FINKE RD	NT
3	GIVE WAY	YES	YES	YES	YES	NO	FINKE RD	NT
4	GIVE WAY	YES	YES	YES	YES	NO	HORSESHOE BEND RD	GHAN / ERLDUNDA
5	GIVE WAY	YES	YES	YES	YES	NO	STUART HWY	NT
6	GIVE WAY	YES	YES	YES	NO	NO	HUGH RIVER STOCK ROUTE RD	HUGH
7	GIVE WAY	YES	YES	YES	YES	NO	HUGH RIVER STOCK ROUTE RD	
8	GIVE WAY	NO	YES	NO	YES	NO	HUGH RIVER STOCK ROUTE RD	
9	GIVE WAY	YES	YES	YES	NO	NO	STUART HWY	NT
10	SIGNALISED	YES	YES	NO	NO	NO	STUART HWY	NT
11	GIVE WAY	NO	YES	NO	YES	YES	NORRIS BELL AVE	NT
12	STOP	NO	YES	YES	NO	YES	KARNTE RD	ROSS
13	STOP	NO	YES	NO	NO	YES	ILPARPA RD	NT
14	STOP	NO	YES	YES	NO	YES	COMMANAGE RD	NT
15	SIGNALISED	YES	YES	YES	NO	YES	BRADSHAW DR	FLYNN
16	SIGNALISED	YES	YES	NO	YES	YES	ESPIE ST	GILLEN/DESERT SPRINGS
17	SIGNALISED	YES	YES	NO	NO	YES	LARAPINTA DR	ALICE SPRINGS
18	SIGNALISED	YES	YES	NO	YES	YES	LOVEGROVE DR	CICCONE
19	GIVE WAY	YES	YES	YES	YES	NO	STUART HWY	NT
20	SIGNALISED	YES	YES	NO	YES	NO	STUART HWY	NT
21	GIVE WAY	NO	YES	NO	YES	NO	STUART HWY	NT
22	GIVE WAY	NO	YES	NO	YES	NO	STUART HWY	NT
23	STOP	YES	YES	NO	YES	NO	THE GARDEN	NT
24	STOP	YES	YES	NO	YES	NO	YAMBAH RD	NT
25	SIGNALISED	YES	YES	NO	YES	NO	PLENTY HWY	NT
26	STOP	YES	YES	YES	YES	NO	ADELAIDE BORE RD	NT
27	STOP	YES	YES	NO	YES	NO	MURRAY DOWNS RD	TARA
28	GIVE WAY	YES	YES	YES	YES	NO	ALI CURUNG RD	ALI CURUNG
29	STOP	YES	YES	YES	YES	NO	STUART HWY	NT
30	STOP	NO	YES	YES	NO	NO	STUART HWY	NT
31	STOP	NO	YES	NO	NO	NO	MCLAREN CREEK RD	NT
32	STOP	YES	YES	NO	YES	NO	STUART HWY	NT
33	STOP	YES	YES	YES	YES	NO	STUART HWY	NT
34	STOP	YES	YES	YES	YES	NO	STUART HWY	NT
35	STOP	YES	YES	NO	YES	NO	STUART HWY	NT
36	STOP	YES	YES	NO	YES	YES	STUART HWY	NT
37	STOP	YES	YES	YES	YES	YES	UDALL RD	TENNANT CREEK
38	STOP	YES	YES	YES	YES	NO	UDALL RD	NT
39	STOP	YES	YES	YES	YES	NO	WARREGO RD	NT
40	STOP	YES	YES	YES	YES	NO	WARREGO RD	WARUMUNGU
41	SIGNALISED	YES	YES	NO	YES	NO	STUART HWY	NT
42	STOP	YES	YES	YES	YES	NO	STUART HWY	NT
43	STOP	YES	YES	YES	YES	NO	STUART HWY	NT
44	GIVE WAY	YES	YES	YES	YES	NO	STUART HWY	NT
45	GIVE WAY	YES	YES	YES	YES	NO	STUART HWY	NT
46	STOP	YES	YES	YES	YES	NO	MURRANJI STOCK RTE	NT
47	GIVE WAY	YES	YES	YES	YES	NO	BUCHANAN HWY	NT
48	GIVE WAY	YES	YES	YES	YES	NO	BUCHANAN HWY	TANAMI EAST
49	STOP	YES	YES	YES	YES	NO	STUART HWY	NT
50	STOP	YES	YES	YES	YES	NO	LARRIMAH WESTERN CREEK RD	STURT PLATEAU
51	STOP	YES	YES	YES	YES	NO	DRY RIVER RD	NT
52	STOP	YES	YES	YES	YES	YES	NOVIS QUARRY RD	NT
53	GIVE WAY	NO	YES	NO	YES	YES	SHADFORTH RD	COSSACK
54	SIGNALISED	YES	YES	YES	YES	YES	FLORINA RD	NT
55	SIGNALISED	YES	YES	YES	YES	NO	JATBULA RD	NITMILUK
56	STOP	YES	YES	YES	YES	NO	STUART HWY	NT
57	SIGNALISED	YES	YES	YES	YES	NO	OLD STUART HWY	NT
58	STOP	YES	YES	YES	YES	YES	STUART HWY	PINE CREEK
59	SIGNALISED	YES	YES	YES	YES	NO	KAKADU HWY	NT
60	SIGNALISED	YES	YES	YES	NO	YES	DORAT RD	ADELAIDE RIVER
61	SIGNALISED	YES	YES	NO	NO	YES	COACH RD	STAPLETON
62	GIVE WAY	YES	YES	YES	YES	NO	STUART HWY	NT
63	SIGNALISED	YES	YES	YES	YES	NO	BATCHELOR RD	COOMALIE CREEK
64	STOP	YES	YES	YES	YES	YES	STUART HWY	NT
65	GIVE WAY	YES	YES	YES	YES	NO	STUART HWY	NT
66	STOP	YES	YES	YES	YES	NO	MANTON DAM RECREATION RES	LAKE BENNETT
67	STOP	YES	YES	YES	YES	NO	STUART HWY	MANTON
68	STOP	YES	YES	YES	YES	NO	LEONINO RD	ACACIA HILLS
69	SIGNALISED	YES	YES	YES	YES	NO	OLD BYNOE RD	NT
70	SIGNALISED	YES	YES	YES	NO	NO	KENTISH RD	NT
71	SIGNALISED	YES	YES	YES	NO	NO	LIVINGSTONE RD	NT
72	SIGNALISED	YES	YES	YES	NO	NO	COX PENINSULA RD	LIVINGSTONE
73	SIGNALISED	YES	YES	YES	YES	NO	MIDDLE ARM RD	NT
74	SIGNALISED	YES	YES	YES	YES	NO	MIDDLE ARM RD	NT
75	SIGNALISED	YES	YES	YES	YES	NO	FINN RD	NOONAMAH
76	GIVE WAY	YES	YES	YES	YES	NO	FINN RD	WEDDELL
77	SIGNALISED	YES	YES	YES	YES	NO	CHANNEL ISLAND RD	WICKHAM
78	SIGNALISED	YES	YES	YES	YES	NO	CHANNEL ISLAND RD	NT
79	GIVE WAY	NO	YES	NO	YES	NO	CHANNEL ISLAND RD	NT
80	STOP	NO	YES	NO	NO	NO	CHANNEL ISLAND RD	MITCHELL
81	SIGNALISED	YES	YES	YES	NO	YES	CATALINA RD	MARLOW LAGOON
82	SIGNALISED	YES	YES	YES	YES	YES	WISHART RD	DURACK
83	SIGNALISED	YES	YES	YES	NO	YES	TIVENDALE RD	TIVENDALE
84	SIGNALISED	YES	YES	YES	NO	YES	TIVENDALE RD	NT
85	SIGNALISED	YES	YES	NO	YES	YES	WISHART RD	WISHART
86	SIGNALISED	YES	YES	NO	YES	YES	BERRIMAH RD	EAST ARM

ATTACHMENT E4.4

Draft Environmental Management Program

The current EM Program (FY08–FY10) for the Olympic Dam operation has been used as the model for developing a Draft EM Program for the NT Transport Option and incorporates the commitments, mitigation measures, specific controls and monitoring requirements identified during the EIS impact and risk assessment processes. The Draft EM Program would continue to be reviewed and updated, and the associated environmental management and monitoring documentation would be developed, after the proposed expansion had been approved and in response to the project schedule. The aspects and impacts considered within the Draft EM Program for the NT Transport Option are:

- ID 1 USE OF NATURAL RESOURCES
  - ID 1.1 Land Disturbance
  - ID 1.3 Spread of Pest Plants and Animals
- ID 2 STORAGE, TRANSPORT AND HANDLING OF HAZARDOUS MATERIAL
  - ID 2.1 Chemical/Hydrocarbon Spillage
  - ID 2.3 Transport of Radioactive Material
- ID 3 OPERATION OF INDUSTRIAL SYSTEMS
  - ID 3.1 Fugitive Particulate Emissions
  - ID 3.2 Noise (and Vibration) Emissions
  - ID 3.5 Radioactive Emissions
  - ID 3.6 Greenhouse Gas Emissions
- ID 4 GENERATION OF INDUSTRIAL WASTES
  - ID 4.4 Stormwater Discharge
  - ID 4.6 Waste Disposal
- ID 5 EMPLOYMENT AND ACCOMMODATION OF PEOPLE
  - ID 5.1 Community Interactions
  - ID 5.2 Workplace Interactions

The Draft EM Program identifies the assessment criteria proposed to measure performance against the objectives. As the project progressed through the definition phase, and further data was collected from baseline studies, more specific assessment criteria would be defined and any design improvements or additional management measures would be captured. The objectives and assessment criteria would be continually reviewed, in consultation with government, over the life of the project, as the various project components were constructed and commissioned.

ID 1	USE OF NATURAL RESOURCES
ID 1.1	**Land Disturbance**

Scope for Port of Darwin

Port of Darwin facilities would be built on reclaimed land and hence not on natural topography or soils. However, with disturbance of the reclaimed land during the construction of proposed facilities, some issues may arise in relation to erosion and sedimentation off-site into stormwater drains and/or directly into the marine environment

Depending on where the reclaimed materials have been obtained from there might also be issues in relation to acid sulfate soils, contaminated soils, unearthing of foreign anthropogenic materials and/or unearthing of artefacts or items of archaeological significance

Legal and Other Guidance

- *Heritage Conservation Act, Northern Territory Aboriginal Sacred Sites Act*
- *Soil Conservation and Land Utilization Act*
- Northern Territory Erosion and Sediment Control guidelines

Values

- Coastal and surrounding marine environmental values

Objective(s)

- No significant adverse impacts to listed threatened species (Northern Territory, Commonwealth) populations in the expansion project area as a result of BHP Billiton's construction activities

Assessment Criteria

- To be developed

Management Plans

Environmental/Indigenous Heritage Clearance Permit (EIHCP)(OD Doc. 512)

- The EIHCP procedure would be reviewed to include possible events that may occur at the Port of Darwin

Erosion and Sediment Control Plan (new)

- An erosion and sediment control plan (ESCP) would be prepared for the construction of proposed facilities. The plan would include details of proposed erosion control measures and monitoring programs to ensure erosion and sediment control measures were inspected and maintained (E4.8.3)

HSEC Management Plan (new)

- HSEC Management Plans would be developed for construction activities by those undertaking the activities, in accordance with Environmental Objectives and Performance Criteria as part of contractual arrangements. HSEC Management Plans would be endorsed by BHP Billiton and would incorporate relevant controls/management actions, monitoring requirements and contingency measures as listed in this program (E4.12.11)

Controls/Management Actions

- Erosion protection measures would be implemented to limit sediment transport from the construction area into watercourses and coastal areas (E4.8.3)
- The infrastructure would be located on existing cleared land or on Darwin Port Corporation reclaimed land to avoid impacts on mangrove and other marine communities at the Port of Darwin (E4.8.4)
- For areas below 5m AHD at the Port of Darwin, where ground disturbance is to occur, further investigations would be carried out and an ASS management plan would be prepared if the sample analysis was found to exceed the applicable criteria (E4.8.3)

Monitoring Program(s)

- No specific monitoring program required

Risk Items

- No key project risks identified for land disturbance

Contingency Options

- To be developed as required

BHP Billiton Responsible Officer

- tba

Key Government Department(s)

- Department of Natural Resources, Environment, The Arts and Sport
- Minister for Indigenous Policy
- (Heritage Advisory Council)

ID 1	USE OF NATURAL RESOURCES
ID 1.3	**Spread of Pest Plants and Animals**

Scope

Pest plant and animal species cause a range of environmental and economic impacts throughout Australia and across a spectrum of industries. The construction activities and the movement of materials into and out of the Port of Darwin have the potential to introduce weed species and/or pest or feral animals

Of particular concern are mosquito breeding and biting insects, which in the Northern Territory cause concerns for human health

Legal and Other Guidance

- *Weeds Management Act 2001*
- *Territory Parks and Wildlife Conservation Act*
- *Public Health Act* and Public Health (General Sanitation, Mosquito Prevention, Rat Exclusion and Prevention) Regulations
- Construction Practice Near Tidal Areas of the Northern Territory – Guidelines to Prevent Mosquito Breeding, Department of Health and Community Services, June 1988

Values

- Native flora and fauna and biodiversity values
- Public health

Objective(s)

- No material increase in the abundance or area of infestation of pest species as a result of BHP Billiton's expansion activities in the expansion project area (as defined)

Assessment Criteria

- No material increase in abundance of existing declared pest species
- No introduction of new self-sustaining declared pest populations

Management Plans

Mosquito Management Plan (new)

- Developed prior to construction by appropriately qualified personnel in accordance with the Guidelines to Prevent Mosquito Breeding. Issues to be considered would be pond depth, angle of bund sides, material used in bunds, control of aquatic and semi-aquatic vegetation, and the discharge sites for overflow water (E4.8.5)

Ballast Water Management Plan (new)

- BHP Billiton would develop and implement a Ballast Water Management Plan for the management of ship ballast water for the protection of marine environmental values (E4.8.4)

HSEC Management Plan (new)

- HSEC Management Plans would be developed for construction activities by those undertaking the activities, in accordance with Environmental Objectives and Performance Criteria as part of contractual arrangements. HSEC Management Plans would be endorsed by BHP Billiton and would incorporate relevant controls/management actions, monitoring requirements and contingency measures as listed in this program (E4.12.11)

Controls/Management Actions

- Any receptacles or depressions with the potential to store water for more than three days should be avoided, and stormwater drains must be kept clear of vegetation and free-draining to avoid formation of mosquito breeding habitat (E4.8.5)
- Consult with personnel with ecological expertise during the design and construction of the facilities, including the Medical Entomology Branch of the Department of Health and Families (E4.8.5)
- Discharge of ballast water would be managed in accordance with the requirements of Darwin Port Corporation and national ballast water management standards (currently being developed) (E4.8.4)

Monitoring Program(s)

- No specific monitoring program required

Risk Items

- No key project risks identified for spread of pest plants and animals

Contingency Options

- To be developed as required

BHP Billiton Responsible Officer

- tba

Key Government Department(s)

- Department of Natural Resources, Environment, The Arts and Sport
- Department of Health and Families

ID 2	STORAGE, TRANSPORT AND HANDLING OF HAZARDOUS MATERIAL
ID 2.1	Chemical/Hydrocarbon Spillage

Scope

As with any industrial operation, a large variety of hydrocarbons, reagents and other chemicals may be transported, handled, stored and used at the Port of Darwin facilities. Spillage of chemicals and/or hydrocarbons can lead to the pollution of the surrounding environment and cause environmental harm and possible impact to human health

Primary, secondary and tertiary containment systems would be designed into the facilities to minimise the risk of spills entering the environment beyond the boundaries of the specific operating areas and procedures would be implemented to ensure proper storage, handling and use of chemicals/hydrocarbons

Legal and Other Guidance

- *Dangerous Goods Act* and Dangerous Goods Regulations
- *Dangerous Goods (Road and Rail Transport) Act 2003* and Dangerous Goods (Road and Rail Transport) Regulations
- AS1940 Storage and Handling of Flammable and Combustible Materials

Values

- Clean and safe workplace
- Existing quality of local soil and water resources (both surface and underground) and the marine environment

Objective(s)

- No significant contamination to soils, surface water or groundwater as a result of the storage, transport or handling of hazardous materials by BHP Billiton during expansion activities

Assessment Criteria

- No lasting significant contamination arising from uncontrolled loss of chemicals to the natural environment (area to be defined)

Management Plans

HSEC Management Plan (new)

- HSEC Management Plans would be developed for construction activities by those undertaking the activities, in accordance with Environmental Objectives and Performance Criteria as part of contractual arrangements. HSEC Management Plans would be endorsed by BHP Billiton and would incorporate relevant controls/management actions, monitoring requirements and contingency measures as listed in this program (E4.12.11)

Emergency Response Plan (OD Doc. 3788)

- The Emergency Response Plan would be updated to ensure any additional requirements of the expansion were incorporated, particularly for accidental spills associated with possible derailment, truck accident and vandalism (E4.10.3)

Management of Hazardous Materials (OD Doc. 4217)

- The existing procedure for the management of hazardous materials would be updated to include the Port of Darwin facilities. The procedures would ensure that spills were controlled at source, contained on-site and cleaned up according to the requirements of the MSDS. Spill containment and clean-up equipment would be available on-site at all times and personnel would be trained in the appropriate use of this equipment

Other Operational HSEC Plans (eg. OD Doc. 67957 (Security), OD Doc.48958 (Incident Management Team Plan) and OD Doc. 60140 (Confirmed Fire, Surface))

- Security operations, crisis management, fire control and other existing operational risk management plans would be reviewed to ensure requirements for the expansion were incorporated

Controls/Management Actions

- Fuel storages and other hazardous materials would be appropriately bunded in accordance with Northern Territory and Australian statutes (E4.8.3)
- Temporary bunds and spill kits would be stored on-site for use by trained personnel in the event of a spill (E4.8.3)
- All chemicals would be managed through a central store area, material safety data sheets provided, and appropriate training given to personnel in the safe use and handling of chemicals or hazardous materials (E4.10.1)

Monitoring Program(s)

- No specific monitoring program required

Risk Items

- Fuel or chemical spill into Darwin Harbour due to equipment failure and/or operator error during construction
- Fuel leak or spill due to failure of containment systems and/or inadequate bunding during operation

Contingency Options

- To be developed as required

ID 2	STORAGE, TRANSPORT AND HANDLING OF HAZARDOUS MATERIAL
ID 2.1	**Chemical/Hydrocarbon Spillage**
BHP Billiton Responsible Officer	
• tba	
Key Government Department(s)	
• NT WorkSafe (Department of Justice)	

ID 2	STORAGE, TRANSPORT AND HANDLING OF HAZARDOUS MATERIAL
ID 2.3	Transport of Radioactive Material

Scope

The Port of Darwin facilities are to receive and transfer copper concentrate containing recoverable quantities of uranium oxide, gold and silver (hereafter termed concentrate). Olympic Dam has been producing and exporting uranium oxide via Port Adelaide since 1988 and via the Port of Darwin since 2005 under strictly controlled conditions. Considerable knowledge and expertise has been accumulated, resulting in an ongoing, safe and environmentally competent operation. In addition, samples of radioactive materials are routinely sent to and from various laboratories and institutions for test work. Internal management systems which are externally audited and comply with all relevant requirements ensure that the transport of radioactive material from Olympic Dam is well controlled. These systems will extend to the transport, storage and export of additional uranium oxide and concentrate at the Port of Darwin

Legal and Other Guidance

- *Darwin Port Corporation Act*, Port By-Laws and Darwin Port (Handling and Transport of Dangerous Cargoes) By-Laws
- *Radiation (Safety Control) Act*
- *Radioactive Ores and Concentrates (Packaging and Transport) Act*
- *Radiation Protection Act 2004* (due to commence in 2009)
- Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (ARPANSA 2005)
- Code of Practice for the Safe Transport of Radioactive Materials (ARPANSA 2008)

Values

- Security of potentially hazardous material
- Clean, safe workplace and community

Objective(s)

- No adverse impacts to health of employees or the public from exposure to radiation as a result of BHP Billiton's expansion activities

Assessment Criteria

- Radiation doses to the public less than 1 mSv/y above natural background and 20 mSv/y above natural background for designated workers

Management Plans

Transport Plan for uranium oxide from Olympic Dam to Australian shipping ports (OD 43773)

- The transport plan describes the procedures and processes for safely storing and transporting uranium oxide, from packaging and delivery, including the emergency response to potential incidents along the routes. It also describes the roles and responsibilities of the various organisations involved. The plan is externally audited (E4.10.3)

Transport Plan for Concentrate (new)

- A transport plan is being developed in consultation with appropriate authorities for the transport of concentrate. The plan outlines the key information for shippers, including material hazardousness, stowage information, transport precautions, environmental considerations and emergency procedures

Uranium and Olympic Dam Development Crisis and Emergency Management Team Plan (OD 48958)

- This customer group plan has been established to manage issues that may have group wide consequences

ID 2	STORAGE, TRANSPORT AND HANDLING OF HAZARDOUS MATERIAL
ID 2.3	Transport of Radioactive Material

Controls/Management Actions

- A 'closed system' would be used to transport, store and convey concentrate from Olympic Dam to the ship's hold at the Port of Darwin (E4.2.3; E4.10.1). Specifically:
  - appropriate dedicated equipment would be constructed and used
  - rail wagons would be effectively sealed with suitable covers and fitted in such a manner that concentrate would not escape during transport (E4.2.3; E4.13)
  - the water used to wash the outside of the rail wagons would be collected and reused. Solids that settle from this water would be placed on the concentrate stockpile and when required, water would be returned to Olympic Dam for disposal (E4.2.3; E4.8.3; E4.13)
  - the concentrate storage system and conveying system would have a negatively pressured extraction ventilation system with automatic unloading and rail truck wash systems (E4.2.3; E4.8.1)
- BHP Billiton would collaborate with the Darwin Port Corporation and relevant regulatory authorities and agencies to develop and implement a site specific security management plan (E4.2.3)
- Compliance with appropriate transport requirements as detailed in the ARPANSA Code of Practice for the Safe Transport of Radioactive Material (2008) would be required (E4.10.3)
- The existing Olympic Dam Corporation Emergency Incident Response Plan would be modified to address aspects of the concentrate transport process (E4.10.3)
- Uranium oxide would continue to be sealed in 200 L drums and placed in sealed shipping containers for transport to the nominated export port (E4.2.2)

Monitoring Program(s)

Radiation Dose to Members of the Public

- Potential doses to members of the public from the transport of radioactive material would be assessed as necessary

Risk Items

- Spread of concentrate along rail line due to failure of washing and monitoring
- Spillage of concentrate into Darwin Harbour during ship loading due to failure of materials handling systems or dust control systems
- Loss of integrity of concentrate storage during cyclonic rain storm

Contingency Options

- To be developed as required

BHP Billiton Responsible Officer

- tba

Key Government Department(s)

- NT WorkSafe (Department of Justice)
- Department of Health and Families
- Australian Safeguards and Non-Proliferation Office (ASNO)
- Australian Maritime Safety Authority
- NT and Darwin Emergency Services

ID 3	OPERATION OF INDUSTRIAL SYSTEMS
ID 3.1	**Fugitive Particulate Emissions**

Scope

Fugitive particulate emissions would be generated during construction works and appropriate dust suppression and control measures would be implemented to reduce dust generation

The engineered systems for product transport, storage and transfer are closed systems. Hence, fugitive particulate emissions as a result of materials handling would not be an issue for operations. The facilities would be completely on hardstand and hence fugitive dust from trafficked areas is likely to be minimal, however controls, such as regular street sweeping, would be implemented to ensure dust was minimised for the operation

Legal and Other Guidance

- *Waste Management and Pollution Control Act* and Waste Management and Pollution Control (Administration) Regulations
- *Workplace Health and Safety Act 2007* and Workplace Health and Safety Regulations

Values

- Existing background air quality
- Clean, safe workplace and community

Objective(s)

- No adverse impacts to public health as a result of fugitive particulate emissions from BHP Billiton's expansion activities at Port of Darwin

Assessment Criteria

- Annual average operational contributed PM_{10} concentration of less than 30 µg/m^3 and 24 hour average of less than 50 µg/m^3 at sensitive receivers

Management Plans

HSEC Management Plan (new)

- HSEC Management Plans would be developed for construction activities by those undertaking the activities, in accordance with Environmental Objectives and Performance Criteria as part of contractual arrangements. HSEC Management Plans would be endorsed by BHP Billiton and would incorporate relevant controls/management actions, monitoring requirements and contingency measures as listed in this program for the management and control of dust and other fugitive emissions (E4.12.11)

Controls/Management Actions

- The concentrate handling facility at the Port of Darwin would be a closed system. This would include an enclosed concentrate storage and handling facility with a suitable ventilation system. Additional systems for spillage control that aim to control spills at source, contain them on-site and provide for clean-up equipment and procedures would be implemented (E4.2.3, E4.8.1, E4.13)
- Enclosed conveyors and transfer points for the transfer of concentrate from the concentrate shed to the ship hold (E4.2.3, E4.8.1)

Monitoring Program(s)

Dust monitoring program (new)

- Establish a particulate monitoring station at a suitable location adjacent to the site before construction commenced. Monitoring would continue through construction and operation of the port facility (E4.8.1)

Risk Items

- Spillage during movement of material to and from stockpile at Port of Darwin due to failure of conveyor system and/or product enclosure system
- High dusting of concentrate in the concentrate shed due to loss of moisture in concentrate stockpile

Contingency Options

- To be developed as required

BHP Billiton Responsible Officer

- tba

Key Government Department(s)

- Department of Natural Resources, Environment, The Arts and Sport
- NT WorkSafe (Department of Justice)

ID 3	OPERATION OF INDUSTRIAL SYSTEMS
ID 3.2	**Noise (and Vibration) Emissions**

Scope

Noise (and vibration) would be generated during construction activities with the operation of large equipment and the building of infrastructure for the facilities

Legal and Other Guidance

- *Waste Management and Pollution Control Act* and Waste Management and Pollution Control (Administration) Regulations
- *Workplace Health and Safety Act 2007* and Workplace Health and Safety Regulations
- World Health Organization Guidelines for Community Noise 1999

Values

- Existing noise levels, amenity

Objective(s)

- No adverse impacts to public health as a result of noise emissions from BHP Billiton's expanded operations

Assessment Criteria

- Maintain noise from the operations at Port of Darwin to less than 30dBL_{Aeq} (24 hour) within residential dwellings

Management Plans

HSEC Management Plan (new)

- HSEC Management Plans would be developed for construction activities by those undertaking the activities, in accordance with Environmental Objectives and Performance Criteria as part of contractual arrangements. HSEC Management Plans would be endorsed by BHP Billiton and would incorporate relevant controls/management actions, monitoring requirements and contingency measures as listed in this program (E4.12.11)

Controls/Management Actions

- Excessive noise generating activities from the operation of the concentrate handling facility (such as train shunting and unloading) would be undertaken within buildings and enclosures (E4.8.2)

Monitoring Program(s)

- No specific monitoring program required

Risk Items

- No key project risks identified for noise and vibration during the risk assessment process

Contingency Options

- To be developed as required

BHP Billiton Responsible Officer

- tba

Key Government Department(s)

- Department of Natural Resources, Environment, The Arts and Sport
- NT WorkSafe (Department of Justice)

ID 3	OPERATION OF INDUSTRIAL SYSTEMS
ID 3.5	**Radioactive Emissions**

Scope

The existing Olympic Dam operation holds a licence under the *Radioactive Ores and Concentrates (Packaging and Transport) Act* for the transport of uranium oxide to the Port of Darwin. The proposed expansion would transport, store and handle additional uranium oxide and the new concentrate product

Olympic Dam has controlled radioactive emissions from the operation to below occupational and member of the public dose limits as per national and international standards since the commencement of operations in 1988

Radiation protection is managed under the operation's health and safety systems

Legal and Other Guidance

- *Workplace Health and Safety Act 2007* and Workplace Health and Safety Regulations
- *Radioactive Ores and Concentrates (Packaging and Transport) Act*
- *Radiation (Safety Control) Act*
- *Radiation Protection Act 2004* (due to commence in 2009)
- Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (ARPANSA 2005)
- Recommendations of the International Commission on Radiological Protection (ICRP) (various publications)

Values

- Background radiation levels in the environment
- Clean, safe workplace and community

Objective(s)

- No adverse impacts to health of employees or members of the public from exposure to radiation from BHP Billiton's expansion activities

Assessment Criteria

- Radiation doses to members of the public less than 1 mSv/y above natural background and 20 mSv/y above natural background for designated workers

Management Plans

Radioactive Waste Management Plan (RWMP)

- There are specific requirements under the Mining Code and these are currently incorporated within the Olympic Dam EMS. These requirements are being reviewed and updated to incorporate any additional requirements of the expansion, including the NT Transport Option, if required.

Controls/Management Actions

- A closed transportation system would be implemented from Olympic Dam to the ship hold to effectively contain radioactive material and the potential for radiation exposure (E4.10.2)
- BHP Billiton would comply with internationally accepted radiation limits for workers and the public and would set a goal of maintaining doses at less than 50% of the internationally acceptable limits (E4.13)
- Member of the public radiation dose would be maintained below applicable limits (E4.10.2)
- Further reduce the potential for radiation exposure through an 'optimisation program' based on the ALARA principle (E4.10.2)

Monitoring Program(s)

Radiation Dose to Members of the Public (OD 2790)

- The Olympic Dam operation monitors the radiation dose to members of the public. This would continue with the expanded operation, with results continuing to be publicly reported in the annual Environmental Management and Monitoring Report

Airborne Emissions (OD 2788)

- The existing Airborne Emissions Monitoring Program currently includes a regime for radionuclides. The Program would incorporate the expanded operations

Risk Items

- Increased radiation levels due to inaccurate modelling of dust and radon patterns leading to increased area of influence

Contingency Options

- To be developed as required

BHP Billiton Responsible Officer

- tba

Key Government Department(s)

- NT WorkSafe (Department of Justice)
- Department of Health and Families

ID 3	OPERATION OF INDUSTRIAL SYSTEMS
ID 3.6	**Greenhouse Gas Emissions**

Scope

The operation proposed at the Port of Darwin would consume fossil fuels directly and indirectly as part of its activities. Major greenhouse generating sources include the use of electricity and gas as major energy sources and the combustion of diesel

The *Energy Efficiency Opportunities Act 2006* aims to improve identification and evaluation of energy efficiency opportunities by large energy using businesses and, as a result, to encourage implementation of cost effective energy efficiency opportunities. The Act requires organisations to submit five-year plans that set out proposals for assessing their energy usage and to identify efficiency projects

BHP Billiton's Climate Change Position is a multifaceted approach to tackling climate change. The Olympic Dam expansion is implementing the BHP Billiton-wide position goals as part of its Greenhouse Gas and Energy Management Plan

The predicted annual emissions for the NT Transport Option are 66,450 tonnes of CO_2-e. Nevertheless, the full expansion project is above 100,000 tonnes and a reduction plan that includes the NT component of the expansion is being prepared

Legal and Other Guidance

- *National Greenhouse and Energy Reporting Act 2007* (Commonwealth)
- *Energy Efficiency Opportunities Act 2006* (Commonwealth)
- BHP Billiton Climate Change Position
- NT Environmental Impact Assessment Guide: Greenhouse Gas Emissions and Climate Change

Values

- Global atmospheric greenhouse concentrations

Objective(s)

- Contribute to stabilising global atmospheric greenhouse gas concentrations to avoid environmental impacts associated with climate change

Assessment Criteria

- Apply a management goal of reducing 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

Management Plans

Greenhouse Gas and Energy Management Plan (new)

- A Greenhouse Gas and Energy Management Plan would be developed for the proposed expansion and would incorporate the activities at the Port of Darwin. The Plan would:
  - establish modelling to project the likely emissions from the expanded Olympic Dam operation from commencement to 2050
  - establish targets and timelines for greenhouse gas reduction
  - identify greenhouse gas reduction strategies and projects (EIS 13.2.5)
- The Greenhouse Gas and Energy Management Plan would be reviewed annually

Controls/Management Actions

- Greenhouse gas emissions would be addressed by:
  - applying a goal of reducing 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
  - constructing an on-site cogeneration power station (250 MW capacity) for recovering waste heat
  - sourcing renewable energy (35 MW capacity) via the national electricity market for the seawater desalination plant
  - producing an annual 'road map' that quantifies emission reduction opportunities and achievements (EIS 13.2.2)
- The BHP Billiton Group Climate Change Position aims to:
  - understand emissions from the full life cycle of the products the BHP Billiton Group produces
  - improve the management of energy and greenhouse gas emissions across BHP Billiton Group businesses
  - commit US$300m over five years to support the development of low emissions technology, energy excellence projects within the company and encourage emissions abatement by employees and local communities
  - use the technical capacity and experience of the BHP Billiton Group to assist governments and other stakeholders to design effective and equitable climate change policies, including market-based mechanisms such as emissions trading (EIS 13.2.2)

ID 3	OPERATION OF INDUSTRIAL SYSTEMS
ID 3.6	**Greenhouse Gas Emissions**

Monitoring Program(s)

Airborne Emissions (OD 2788)

- The existing Airborne Emissions Monitoring Program would be reviewed to incorporate the expanded operations and would include consideration of greenhouse gas emissions

Risk Items

- No key project risks identified for greenhouse gas emissions during the risk assessment process

Contingency Options

- To be developed as required

BHP Billiton Responsible Officer

- tba

Key Government Department(s)

- Department of Natural Resources, Environment, The Arts and Sport

ID 4	GENERATION OF INDUSTRIAL WASTES
ID 4.4	**Stormwater Discharge**

Scope

The Port of Darwin facilities requires the construction of new infrastructure on newly reclaimed land and would involve construction and operation activities adjacent to the marine environment. Management of stormwater and the prevention of stormwater pollution are necessary for both construction and operation so as to not impact the nearby marine environment

Legal and Other Guidance

- *Waste Management and Pollution Control Act* and Waste Management and Pollution Control (Administration) Regulations
- *Water Act*
- Port of Darwin Draft Stormwater Management Plan

Values

- Marine environmental values of the Port of Darwin and Darwin Harbour

Objective(s)

- No significant adverse impact to environmental receptors as a result of stormwater discharges to soil, surface water (freshwater and marine) or groundwater associated with BHP Billiton's expansion activities

Assessment Criteria

- All contact stormwater maintained within designated stormwater management areas

Management Plans

HSEC Management Plan (new)

- HSEC Management Plans would be developed for construction activities by those undertaking the activities, in accordance with Environmental Objectives and Performance Criteria as part of contractual arrangements. HSEC Management Plans would be endorsed by BHP Billiton and would incorporate relevant controls/management actions, monitoring requirements and contingency measures as listed in this program (E4.12.11)

Stormwater Management Plan (new)

- A Stormwater Management Plan would be developed for the NT Transport Option and would incorporate relevant controls, monitoring requirements and mitigation measures

Controls/Management Actions

- A 'closed system' would be used to transport, store and convey concentrate from Olympic Dam to the ship's hold at the Port of Darwin (E4.2.3; E4.10.1) (see ID 2.3 for details)
- First flush stormwater run-off from the site would be directed to on-site detention basin(s) for settling of sediments prior to discharge to the established Port of Darwin stormwater detention system (as per the Port of Darwin's Draft Stormwater Management Plan) (E4.8.3)
- No wagon wash-down water would be discharged to the natural environment; rather, washing would occur in an enclosed building, with the water collected, reused and ultimately transported back to Olympic Dam in a rail wagon (E4.2.3; E4.8.3; E4.13)
- The water used to wash the outside surfaces of the rail wagons would be collected and treated to recover concentrate particles that may have attached to the wagon during unloading (i.e. tippling). The treated water would be contained in on-site storage tanks for reuse in subsequent wash cycles, while any collected solids would be placed on the concentrate stockpile for export, resulting in a zero discharge decontamination system (E4.2.3; E4.13)
- From time to time (preliminary estimates suggest about every four to six months), a proportion of the wash-down water would be removed from the system and the system would be 'topped up' with replacement water. The removed water would be discharged into a holding tank or similar unit and railed back to Olympic Dam to be disposed of within the Olympic Dam tailings storage facility (E4.2.3; E4.8.3; E4.13)

Monitoring Program(s)

Stormwater Monitoring Program (new)

- As part of the Stormwater Management Plan, a Stormwater Monitoring Program would be developed for the Port of Darwin facilities to monitor controls and performance

Risk Items

- Stormwater comes into contact with concentrate due to failure to exclude stormwater from concentrate shed

Contingency Options

- To be developed as required

BHP Billiton Responsible Officer

- tba

Key Government Department(s)

- Department of Natural Resources, Environment, The Arts and Sport

ID 4	GENERATION OF INDUSTRIAL WASTES
ID 4.6	**General Waste Disposal**

Scope

Wastes would be generated by the construction and operation of the facilities at the Port of Darwin. Appropriate systems would be put in place to ensure the hierarchy of reduce, reuse, recycle was adopted and that wastes were managed in accordance with regulatory requirements

Legal and Other Guidance

- *Waste Management and Pollution Control Act* and Waste Management and Pollution Control (Administration) Regulations
- Code of Practice and Safety Guide for Radioactive Waste Management in Mining and Mineral Processing (2005)
- NEPM(s) Movement of Controlled Waste, Used Packaging, Materials, and Assessment of Site Contamination
- National Waste Minimisation and Recycling Strategy

Values

- Clean, safe workplace and community
- Marine environmental values of Darwin Harbour

Objective(s)

- Minimise general waste generated by BHP Billiton's expansion activities and maximise the reuse of general waste

Assessment Criteria

- Increase the proportion of general waste reuse/recycling

Management Plans

HSEC Management Plan (new)

- HSEC Management Plans would be developed for construction activities by those undertaking the activities, in accordance with Environmental Objectives and Performance Criteria as part of contractual arrangements. HSEC Management Plans would be endorsed by BHP Billiton and would incorporate relevant controls/management actions, monitoring requirements and contingency measures as listed in this program (E4.12.11)

Controls/Management Actions

- General office waste and putrescible wastes would be disposed of to local waste management facilities by licensed contractors (E4.8.8)

Monitoring Program(s)

Waste (OD 2791)

- The existing Waste Monitoring Program would incorporate the Port of Darwin facilities

Risk Items

- Inadequate waste management practices due to failure to contain construction wastes

Contingency Options

- To be developed as required

BHP Billiton Responsible Officer

- tba

Key Government Department(s)

- Department of Natural Resources, Environment, The Arts and Sport

ID 5	EMPLOYMENT AND ACCOMMODATION OF PEOPLE
ID 5.1	**Community Interactions**

Scope

Recognising that the workforce and the community are an important part of the operation, consideration and management of social interactions are necessary for BHP Billiton to be considered a valued citizen by the community

Legal and Other Guidance

- BHP Billiton Standard – Community

Values

- Acceptable working conditions
- Safe and content community and workforce

Objective(s)

- Communities in which BHP Billiton operates value our citizenship

Assessment Criteria

- Community concerns are tracked and all reasonable complaints are addressed

Management Plans

Security Management/Operations Plan (new)

- BHP Billiton would develop and implement a security management plan for the Port of Darwin operations (E4.2.3)

Risk management and cyclone response plan (new)

- BHP Billiton would develop and implement a risk management and cyclone response plan for their operations at the Port of Darwin

Industry Participation Plan (Port of Darwin)

- BHP Billiton would consult with the Larrakia Development Corporation to develop an Industry Participation Plan (E4.8.6)

Controls/Management Actions

- BHP Billiton would collaborate with the Darwin Port Corporation and relevant regulatory authorities and agencies to develop and implement a site specific security management plan (E4.2.3)
- Member of the public radiation dose would be maintained below applicable limits (E4.10.2)
- Develop and implement an education program providing details of the minimal impact of the proposed transport of uranium oxide and concentrate along the Adelaide to Darwin rail line (E4.10.5)

Monitoring Program(s)

Radiation Dose to Members of the Public (OD 2790)

- The Radiation Dose to Members of the Public Monitoring Program would be reviewed and updated to include expansion requirements, if any

Risk Items

- Public outcry over rail transport of uranium oxide and concentrate due to public failure to understand actual risks of such transport
- Collision between Olympic Dam supply train and a vehicle driven by a member of the public due to inadequate warning of oncoming train or inattention
- Vehicle accidents due to increase in number of contractor vehicles during construction and failure of road safety systems

Contingency Options

- To be developed as required

BHP Billiton Responsible Officer

- tba

Key Government Department(s)

- Department of Health and Families

ID 5	EMPLOYMENT AND ACCOMMODATION OF PEOPLE
ID 5.2	**Workplace Interactions**

Scope

Social well-being of employees and contractors is incorporated into the BHP Billiton HSEC standards, which are incorporated into site operational systems at Olympic Dam. The expansion would result in increased workforce numbers, increased career changes within the organisation and added pressure on the associated community to provide support

It is important that issues are recognised and that appropriate strategies are implemented to assist in meeting the needs of the community and workforce to maintain a healthy workplace and lifestyle, where BHP Billiton has the authority and capacity to do so

Legal and Other Guidance

- *Workplace Health and Safety Act 2007* and Workplace Health and Safety Regulations

Values

- Safe and content workforce

Objective(s)

- Olympic Dam (Port of Darwin facilities) is a safe and valued place of employment

Assessment Criteria

- Health, Safety, Environment and Community incidents are tracked and significant incidents are addressed

Management Plans

Other Operational HSEC Plans (eg. OD Doc. 67957 (Security), OD Doc.48958 (Incident Management Team Plan) and OD Doc. 60140 (Confirmed Fire, Surface))

- Security operations, emergency response, crisis management, fire control and other existing operational risk management plans would be updated to incorporate the expansion

HSEC Management Plans

- BHP Billiton would develop a comprehensive set of health, safety, environment and community (HSEC) design criteria documents for the project definition stage. These documents would collate details of design leading practice and specific requirements and outcome requirements that are to be used by the design, development and review teams (EIS 22.5.2)

Controls/Management Actions

- BHP Billiton would comply with internationally accepted radiation limits for workers and the public and would set a goal of maintaining doses at less than 50% of the internationally acceptable limits (E4.13)
- A 'safety case' for the current operation is being conducted and would incorporate all components of the proposed expansion, including the NT Transport Option. This includes:
  - identifying the hazards and risks of the proposed expansion
  - describing how the risks are to be controlled
  - outlining the safety management system and its implementation
  - monitoring and review of effectiveness (E4.13)
- All workers would be trained in radiation protection measures and a site wide safety culture promoted (E4.10.2)

Monitoring Program(s)

- tba

ID 5	EMPLOYMENT AND ACCOMMODATION OF PEOPLE
ID 5.2	**Workplace Interactions**
Risk Items	
• Unauthorised entry by construction workers into operations area due to failure of management and control procedures • Vehicle accidents due to increase in number of contractor vehicles during construction and failure of road safety systems • Collision or roll over of surface mobile equipment due to failure of safety systems and operating procedures • Worker buried while working in trench due to failure of safety systems and/or lack of adequate shoring or benching • Interaction between construction and operations work areas resulting in such events as falling objects due to construction workers working in vicinity of operations personnel with different safety systems • Accident to technicians while monitoring radioactivity levels of rail wagons due to failure of safety systems and operating procedures • Interaction between rail wagon tippler and worker due to operator failure to follow procedure or unauthorised entry • Accident during rail wagon lid fitting or removal due to failure to follow procedures or inadequate design • Contact/collision between operator and reclaimer in concentrate shed due to unauthorised entry or failure to follow procedures • Operator engulfed in concentrate due to slumping of stockpile • Entrapment in moving machinery (i.e. conveyors) due to failure to follow procedures or inadequate design • Transport accidents during removal of infrastructure during decommissioning due to increased number of trucks on the road • Ship collision or grounding due to loss of control of vessel or operator error	
Contingency Options	
• To be developed as required	
BHP Billiton Responsible Officer	
• tba	
Key Government Department(s)	
• NT WorkSafe (Department of Justice)	

APPENDIX E5

BHP Billiton Charter and sustainable development

BHP BILLITON CHARTER

WE ARE BHP BILLITON, A LEADING GLOBAL RESOURCES COMPANY.

Our purpose is to create long-term value through the discovery, development and conversion of natural resources, and the provision of innovative customer and market-focused solutions.

To prosper and achieve real growth, we must:

- actively manage and build our portfolio of high quality assets and services,
- continue the drive towards a high performance organisation in which every individual accepts responsibility and is rewarded for results,
- earn the trust of employees, customers, suppliers, communities and shareholders by being forthright in our communications and consistently delivering on commitments.

We value:

- **Safety and the Environment –** An overriding commitment to health, safety, environmental responsibility and sustainable development.
- **Integrity –** Including doing what we say we will do.
- **High Performance –** The excitement and fulfilment of achieving superior business results and stretching our capabilities.
- **Win-Win Relationships –** Having relationships which focus on the creation of value for all parties.
- **The Courage to Lead Change –** Accepting the responsibility to inspire and deliver positive change in the face of adversity.
- **Respect for Each Other –** The embracing of diversity, enriched by openness, sharing, trust, teamwork and involvement.

We are successful in creating value when:

- our shareholders are realising a superior return on their investment.
- our customers and suppliers are benefiting from our business relationships.
- the communities in which we operate value our citizenship.
- every employee starts each day with a sense of purpose and ends each day with a sense of accomplishment.

Marius Kloppers
Chief Executive Officer

October 2007

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resourcing the future

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POL.004 SUSTAINABLE DEVELOPMENT POLICY

Version:	**1.1**
Replaces:	**Sustainable Development Policy 1 October 2007**
Approved Date (GMC):	**11 November 2008**
Valid Until:	**11 November 2009**
Related Documents:	**N/A**
Key Contacts:	**Ian Wood**
Change Requests:	**Ian Wood**
Brief Description:	**Defines the aspirations and approach to all key elements of sustainable development across the Company.**

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SUSTAINABLE DEVELOPMENT POLICY

We aspire to Zero Harm to people, our host communities and the environment and strive to achieve leading industry practice. Sound principles to govern safety, business conduct, social, environmental and economic activities are integral to the way we do business.

Wherever we operate we will develop, implement and maintain management systems for sustainable development that drive continual improvement and ensure we:

- do not compromise our safety values, and seek ways to promote and improve the health of our workforce and the community;
- identify, assess and manage risks to employees, contractors, the environment and our host communities;
- uphold ethical business practices and meet or, where less stringent than our standards, exceed applicable legal and other requirements;
- understand, promote and uphold fundamental human rights within our sphere of influence, respecting the traditional rights of Indigenous peoples and valuing cultural heritage;
- encourage a diverse workforce and provide a work environment in which everyone is treated fairly, with respect and can realise their full potential;
- take action within our own businesses and work with governments, industry and other stakeholders to address the challenge of climate change;
- set and achieve targets, including energy efficiency and greenhouse gas intensity, that promote efficient use of resources and include reducing and preventing pollution;
- enhance biodiversity protection by assessing and considering ecological values and land-use aspects in investment, operational and closure activities;
- engage regularly, openly and honestly with our host governments and people affected by our operations, and take their views and concerns into account in our decision-making;
- develop partnerships that foster the sustainable development of our host communities, enhance economic benefits from our operations and contribute to poverty alleviation;
- work with those involved through the lifecycles of our products and by-products to enhance understanding of lifecycle emissions and develop technologies that facilitate responsible use and management;
- regularly review our performance and publicly report our progress.

In implementing this Policy, we will engage with and support our employees, contractors, suppliers, customers, business partners and host communities in sharing responsibility for meeting our requirements.

We will be successful when we achieve our targets towards Zero Harm, are valued by our host communities, and provide lasting social, environmental and economic benefits to society.