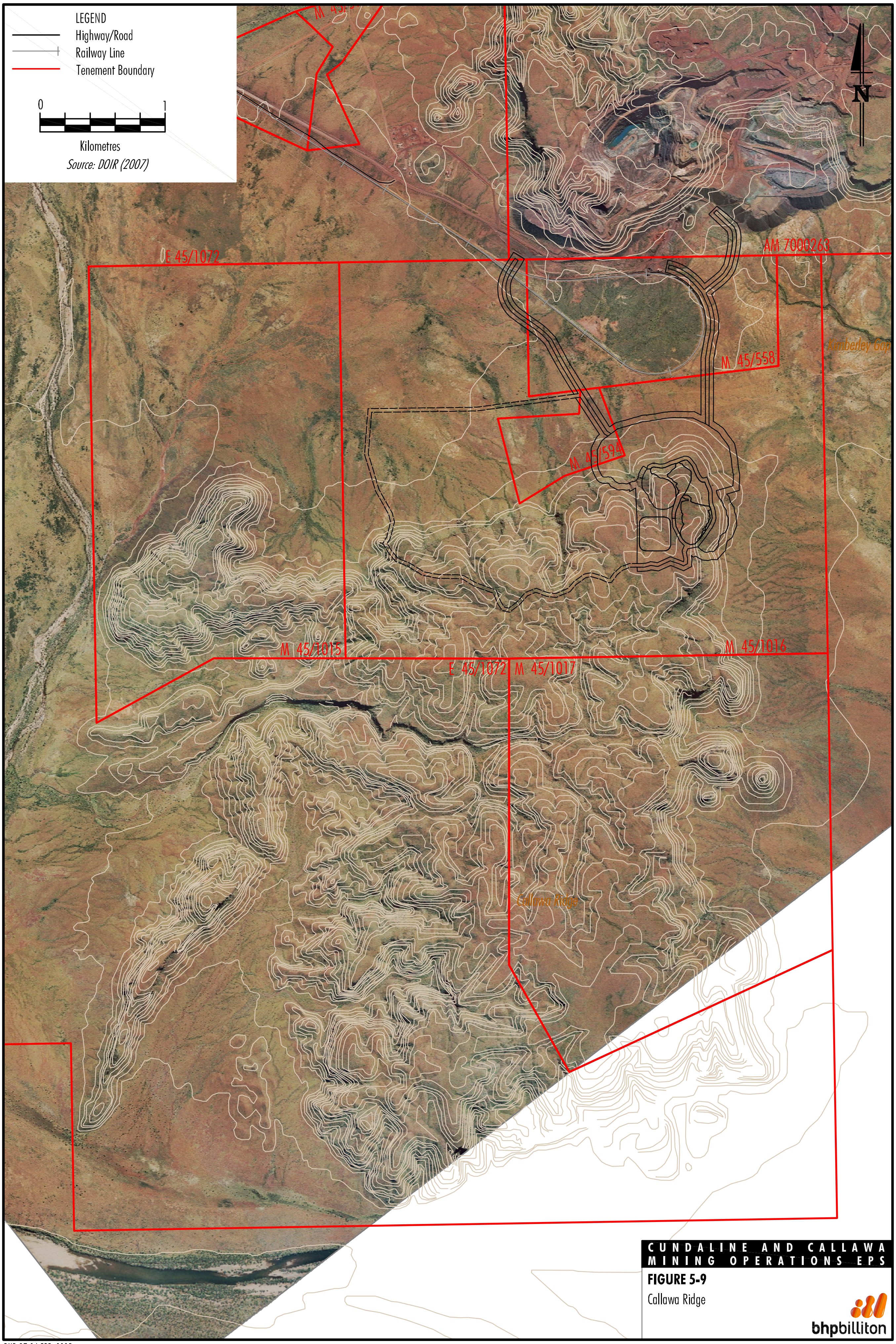

CUNDALINE AND CALLAWA MINING OPERATIONS EPS

FIGURE 5-9

Callawa Ridge

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The hard, rocky hilltops support only sparse vegetation, dominated by grasses, with fewer shrubs and small trees present. In turn, litter cover is low, ranging from 0 to 15%, consisting of leaves and twigs. Although some microhabitat is provided by the Spinifex hummocks and the crevices in the rocky soils, these areas have low microhabitat complexity. The lack of tall shrubs and trees in these habitats also limits habitat diversity on these landscapes (Appendix I).

Hilltops have a relatively low potential to support SRE species within the Cundaline and Callawa study areas. The exposed rocky nature of the hilltops would provide little shelter and the limited vegetation would provide limited sources for leaf litter accumulation. Additionally, hilltops are a relatively common habitat type in the areas surrounding the Cundaline and Callawa ridges so it is unlikely that any species would develop ranges restricted only to the hilltops within the study area (Appendix I).

Ridge

The Cundaline and Callawa ridges are distinctive features of the landscape even though they only make up a relatively small proportion of the overall study area. They consist of exposed rock and bare skeletal soils overlying large cliffs above vegetated slopes below. Vegetation generally consists of *Eucalyptus* sp., *Acacia* sp. and *Ficus* sp., with some *Triodia* sp., and the grasses *Themeda* sp. and *Eragrostis* sp. in more sheltered areas. Litter cover is variable, ranging from 5 to 60%, depending on the proximity of vegetation (Appendix I).

Ridges that face in a south-west to south-east direction are considered to have the highest potential to support SRE species as the ridges provide areas at their base which are shaded. This are supports vegetation dominated by grasses such as *Themeda* sp. and *Eragrostis* sp. along with ferns (*Cheilanthes* sp.) and *Ficus* sp (Appendix I). Ridge habitat is not restricted to the proposed Cundaline and Callawa mining operations areas.

Drainage Lines

Drainage lines on the Cundaline and Callawa ridges have a potential to support SRE species. The sheltered regions created by the steep to moderate rocky slopes provide a relatively moister and cooler environment compared to the surrounding exposed ridge tops and plains. Additionally, the moister conditions support vegetation which in turn provides opportunity for the accumulation of decomposing leaf litter which would be suitable food sources for detritivores such as millipedes and snails as well as predators such as mygalomorph spiders, pseudoscorpions, scorpions and centipedes (Appendix I). Drainage lines are not restricted to the proposed Cundaline and Callawa mining operations areas.

Slopes and Plains

Below both the Cundaline and Callawa Ridges, the scree slopes are made up of hard rocky soils and boulders accumulated from the ridgelines above. The rocky soil restricts vegetation to predominantly Spinifex grasslands, which provide little leaf litter and limited cover. The plains below are less rocky, and are comprised of sandier soils. Spinifex grasslands also dominate here, with some *Eucalyptus* spp. and *Acacia* spp. shrubs and trees also present. Although some microhabitat is provided by the Spinifex hummocks and the crevices in the rocky soils, these areas have low microhabitat complexity. The lack of tall shrubs and trees in these habitats also limits habitat diversity on these landscapes (Outback Ecology, 2008).

The slopes and plains on the Cundaline and Callawa Ridges provide a low potential for SRE invertebrate habitat. The slopes and plains provide little relief from the hot summers and this effect on vegetation results in little opportunity to support relictual species. Additionally, the slopes and particularly the plains are not a limited habitat type within the areas surrounding the Cundaline and Callawa study areas (Appendix I).

Survey Results

Overall, there were no known terrestrial short-range endemic invertebrate species identified as a result of the survey within the Cundaline and Callawa areas, though the WAM have stated that for some samples it is not possible, based on current knowledge, to determine whether or not they are SRE taxa (Appendix I).

The results of the surveys are as follows:

- *Mygalomorph Spiders* - eight mygalomorph spiders were collected during the surveys conducted in 2008 (Appendix I). No mygalomorph species collected within the Cundaline or Callawa areas were known to represent short-range endemic species.

  One mygalomorph spider was collected during the additional survey conducted in 2009. The spider was collected during targeted searching on the Cundaline Ridge approximately 1 km outside the proposed disturbance area to the south (20º34'37.6"S, 120º12'30.1"E WGS 84). The spider was identified as the same species recorded during the previous survey, namely *Conothele* sp. (Family Ctenizidae). The taxonomy of the genus *Conothele* is not well defined with all species of the genus unnamed.

- *Pseudoscorpions* - A total of 20 pseudoscorpions were collected during the surveys. The pseudoscorpions represented three genera from the family Olpiidae. From the current level of taxonomic knowledge, no pseudoscorpions collected within the Cundaline or Callawa areas were found to represent short-range endemic species.

- *Scorpions* - A total of 12 scorpions from two genera were collected during the surveys. From the current level of taxonomic knowledge, no scorpions collected within the Cundaline or Callawa areas were found to represent short-range endemic species.

- *Millipedes* - No millipedes were collected during the surveys, however a number of centipede specimens were collected. These specimens represented six species from three Orders. From the current level of taxonomic knowledge, no centipedes collected within the Cundaline or Callawa areas were found to represent short-range endemic species.

- *Terrestrial Molluscs* - A total of 78 terrestrial mollusc specimens were collected during the survey, 33 from the Cundaline area, and 45 specimens from the Callawa area. The mollusc specimens were collected in litter samples, soil samples and whilst actively searching. No terrestrial mollusc specimens collected within the Cundaline or Callawa areas were found to represent short-range endemic species.

5.9.2 Potential Impacts and Management Measures

No terrestrial SRE invertebrate species were identified during the surveys. For a number of samples, the WAM have stated that it is not possible, based on current knowledge, to determine whether or not they are SRE taxa. However, were these samples to represent SREs it is unlikely that the taxa would be restricted to the proposed disturbance areas given the wider occurrence of habitat along both ridges (Figures 5-8 and 5-9).

The mygalomorph spiders recorded on the ridge are not necessarily restricted to the ridge habitat. Male mygalomorph spiders and dispersing juveniles may move across the plains as these spiders would generally move at night in search for a mate, when shelter from desiccation (shelter which would be provided by the ridge habitat) is not required. Further, the Cundaline pits would not completely remove the slope habitat.

The results of the various SRE surveys conducted suggest that the area appears to be of low significance for mygalomorph spiders. There is a low likelihood that any SREs would be significantly impacted by the proposed Cundaline and Callawa mining operations.

5.9.3 Outcome

As described in Section 4, a risk assessment was completed for the proposed Cundaline and Callawa mining operations. The risk assessment findings for fauna (including terrestrial invertebrate fauna) are summarised in Section 5.8.3.

5.10 SUBTERRANEAN INVERTEBRATE FAUNA

5.10.1 Stygofauna

A stygofauna survey and assessment was prepared by Subterranean Ecology for the proposed Cundaline and Callawa mining areas and is provided in Appendix J.

Existing Environment and Background Information

Stygofauna are subterranean dwelling, aquatic fauna that are linked to geological periods when the Pilbara was covered with rainforest (Biota Environmental Sciences [Biota], 2001). They are therefore regarded as relict fauna that have survived in aquifers over geological timeframes (Biota, 2001).

Stygofauna in the Pilbara are largely represented by crustacean orders including Isopoda (an order which includes most common garden slaters), Copepoda and Amphipoda. Most species are in the order of a few millimetres in size (Biota, 2001).

Previous Stygofauna Surveys

A stygofauna survey was undertaken in the Goldsworthy Operations area as part of the BHP Billiton Iron Ore Regional stygofauna monitoring programme between 2005 and 2007 (Biota, 2008a). The stygofauna survey sampled bores at Nimingarra, Sunrise Hill, Shay Gap and Yarrie. During the survey, only one stygofauna group (Bathynellacea) was detected and only from two bores in the vicinity of the inactive Yarrie Pit (Biota, 2008a). The water parameters that were measured at each site were comparable and did not provide an explanation of the apparent absence of stygofauna in the north-western region of the Goldsworthy Operations mining area.

BHP Billiton Iron Ore is continuing its regional subterranean fauna sampling programme on its tenements in the Pilbara. The stygofauna results from the numerous BHP Billiton Iron Ore survey projects since the end of 2007 are variable. Little or no stygofauna have been detected in some areas (e.g. Jimblebar [Biota, 2008a], Mining Area C [Biota, 2008a; Subterranean Ecology, in preparation]) to relatively diverse stygal communities in other areas (e.g. Marillana, Orebody 23/25 and Ophthalmia Dam [Biota, 2008a], Quarry 8 [Subterranean Ecology, 2008c]).

Methodology

Appendix J reports on a stygofauna sampling programme undertaken within the Cundaline and Callawa areas by Subterranean Ecology during the following dates:

- Sampling Round 1 - December 2007;
- Sampling Round 2 - February 2008; and
- Sampling Round 3 - April 2008.

This sampling consisted of 89 sample events from 60 holes (Appendix J). The location of the stygofauna sampling sites in the Cundaline and Callawa areas is shown on Figure 5-10 in relation to the proposed groundwater drawdown.

Additional stygofauna sampling was undertaken 28 May – 4 June 2009 (Sampling Round 4) and 9 -15 June 2009 (Sampling Round 5) in response to consultation with the DEC (December 2008) (Subterranean Ecology, 2009a). During this sampling stygofauna were collected from bores in the wider area, outside of proposed disturbance areas.

BHP Billiton Iron Ore prepared a geological review document for the Cundaline and Callawa areas and it is provided in Attachment 1 of Appendix J. The Groundwater Assessment (Appendix G) has indicated that the proposed pits at the proposed Callawa mining operation would extend below the watertable, which would necessitate some mine dewatering to enable mining of the lower benches although the proposed Cundaline mining operation would not intercept the natural watertable and no dewatering would be required.

Results

The stygofauna sampling programme identified an apparent absence of stygofauna on the Cundaline Ridge. The apparent absence of stygofauna on the Cundaline Ridge is consistent with the apparent absence of stygofauna at the nearby Nimingarra and Sunrise Hill deposits which have been sampled repeatedly over several years from 2005 to 2007 (Biota, 2008a), and more recently in 2008 (Subterranean Ecology, in preparation). Although as described above the proposed Cundaline mining operation would not intercept the natural watertable and no dewatering would be required.

Appendix J reports that on the Callawa Ridge five morphospecies[5] of stygofauna were detected, including:

- one worm (Phreodrilidae SP01); and
- four crustaceans: Paramelitidae SP01, *Metacyclops* SP01, Bathynellidae SP01 and Parabathynellidae SP01.

[5] Morphospecies are defined as a group of organisms in which members sufficiently conform to certain fixed properties.

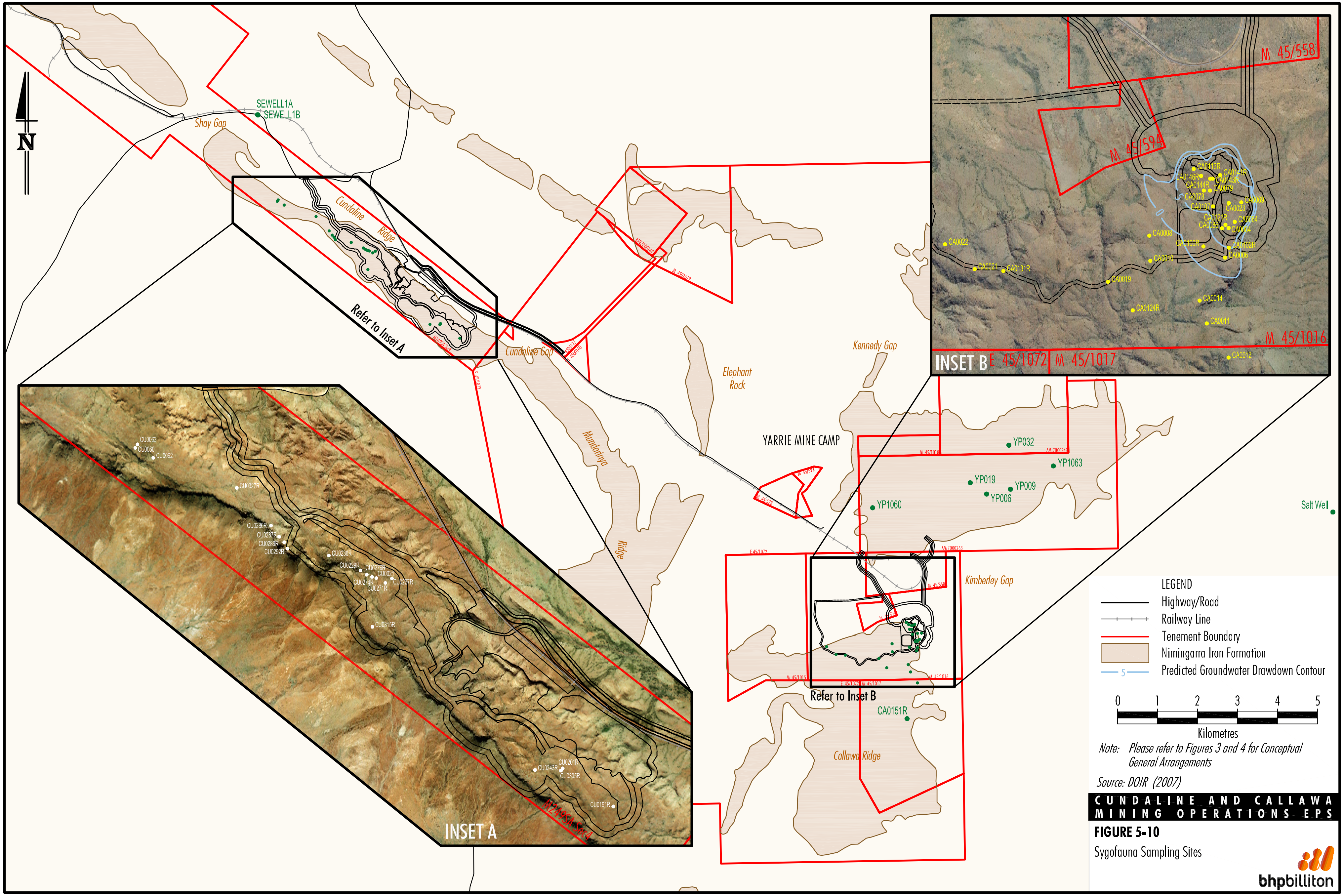

FIGURE 5-10
Sygofauna Sampling Sites

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The stygofauna sampling reported in Appendix J, indicates that all but one of these morphospecies, namely, the codepod *Metacyclops* SP01, had been recorded outside of the proposed Callawa pits during the survey, although *Metacyclops* SP01 has been recorded from Quarry 8, which is located approximately 215 km south-west of the proposed Callawa mining operation (Subterranean Ecology, 2008c).

Three of the above listed stygofauna morphospecies were also collected at the nearby Yarrie operations during the surveys reported in Appendix J.

As described above, additional stygofauna sampling was undertaken in May and June 2009 with the aim of collecting additional samples of the above stygofauna, from bores in the wider area, outside of proposed disturbance areas (Subterranean Ecology, 2009a). The first round of additional stygofauna sampling confirmed the occurrence of the copepod Metacyclops SP01 outside the pit and drawdown zone on the Callawa Ridge (Subterranean Ecology, 2009a).

Potential Impacts and Management Measures

As described in Section 3.7, water would be supplied to the proposed Cundaline and Callawa mining operations via new connecting pipelines constructed from the existing water supply network. Water would be sourced from the Shay Gap Wellfield and would not exceed the current licensed allocation.

As described above, the Groundwater Assessment (Appendix G) has indicated that the proposed pits at the proposed Callawa mining operation would extend below the watertable, which would necessitate some mine dewatering to enable mining of the lower benches.

The five stygofauna recorded in the proposed Callawa pits were also recorded outside of the proposed Callawa pits during the various surveys. As described in Appendix J, the potential impacts to the stygofauna community are likely to be minimal given:

- the probable wider distribution of the community throughout the Callawa ridge aquifer (Appendix J);
- the localised zone of dewatering influence (< 500 m) in relation to the wider extent of the Callawa ridge aquifer (Section 5.6.2; Appendix G; Figure 5-10);
- the short mine life with backfilling of pits to above the watertable, and predicted recovery of water levels and water quality after cessation of mining (Appendix G); and
- operational experience at Yarrie pit demonstrating localised zone of dewatering influence (Appendix G) and persistence of the stygofauna community in the Yarrie ridge aquifer after cessation of mining (Appendix J).

As stated in Section 5.6.2, groundwater levels and water quality would be monitored at Cundaline and Callawa. Groundwater would be managed to minimise adverse impacts outside the disturbance area.

No specific management measures or monitoring programmes are proposed for stygofauna at the proposed Cundaline and Callawa mining operations, as no stygofauna were recorded on the Cundaline ridge and dewatering is not required at the proposed Cundaline mining operation (Section 5.6.2; Appendix G), the stygofauna survey results (Appendix J and Biota [2008a]) and the Groundwater Assessment (Appendix G) indicate that the stygofauna recorded on the Callawa ridge are likely to occur more widely as indicated by the extent of the Nimingarra Iron Formation which forms the Callawa Ridge.

5.10.2 Troglofauna

A troglofauna survey and assessment was prepared by Subterranean Ecology for the proposed Cundaline and Callawa mining areas and is provided in Appendix K.

Existing Environment and Background Information

Troglofauna (or troglobites) are air-breathing terrestrial subterranean fauna which occur in air chambers in underground caves[6] or smaller voids[7] (EPA, 2003). Troglofauna are typically invertebrates (such as spiders, scorpions, millipedes, insects and crustaceans) (EPA, 2003).

Troglofauna Habitat Characterisation

A detailed geological habitat review was prepared by BHP Billiton Iron Ore and is provided as an attachment to the troglofauna assessment report prepared by Subterranean Ecology (Appendix K)

The iron ore mineralization associated with the Cundaline and Callawa ridges is hosted within the Nimingarra Iron Formation (Figures 5-11 and 5-12). The Nimingarra Formation forms a prominent, semi-continuous fault-offset and folded group of ridges extending from the Callawa Ridge in the south to Nimingarra Ridge in the north, a strike length of approximately 60 km. Interrogation of the drill hole database shows that cavities extend throughout the Nimingarra Iron Formation to downhole depths up to 160 m. These cavities are likely to provide habitat for troglofauna to varying degrees.

As shown on the Figure 5-11, the Nimingarra Iron Formation habitat would remain around the edges of the mined out voids on Cundaline Ridge providing a corridor for the movement of troglofauna.

Due to weathering processes the cavities are more prevalent at shallower depths associated with surficial weathering and development of hardcap and crustal deposits. From continuous weathering, the ‘hardcap’ zone forms a caraspace which is a semi-continuous horizon that hosts mineralisation across many of the ridges in the Goldsworthy area. This ‘hardcap’ zone can be extremely variable in texture and is known to contain more frequent voids and cavities, providing potential habitat for troglofauna. At the base of the hardcap zone there is often an extremely weathered, soft, saprolitic zone several metres thick.

The saprolitic zone often outcrops as an undercut where small caves and overhangs occur. While not common, large cavities on a scale of metres are occasionally observed during mining and drilling in this zone (Appendix K).

The Cundaline Deposit comprises a series of narrow lode-style orebodies over a strike length of approximately 9 km. Several localised faults are noted throughout the deposits with a variety of orientations which offset stratigraphy and associated mineralisation. Examination of bore logs and geological mapping suggests there are minor variations between the composition and structure of the strata along strike, due to depositional variations and faulting and folding. However, these differences are minor, with the main variation being the depth of mineralization and the extent of hardcap development. The hardcap zone reaches a depth of 30 m in the Cundaline Ridge. Interrogation of the drilling database indicates that vuggy cavities were identified to a depth of 160 m (Appendix K).

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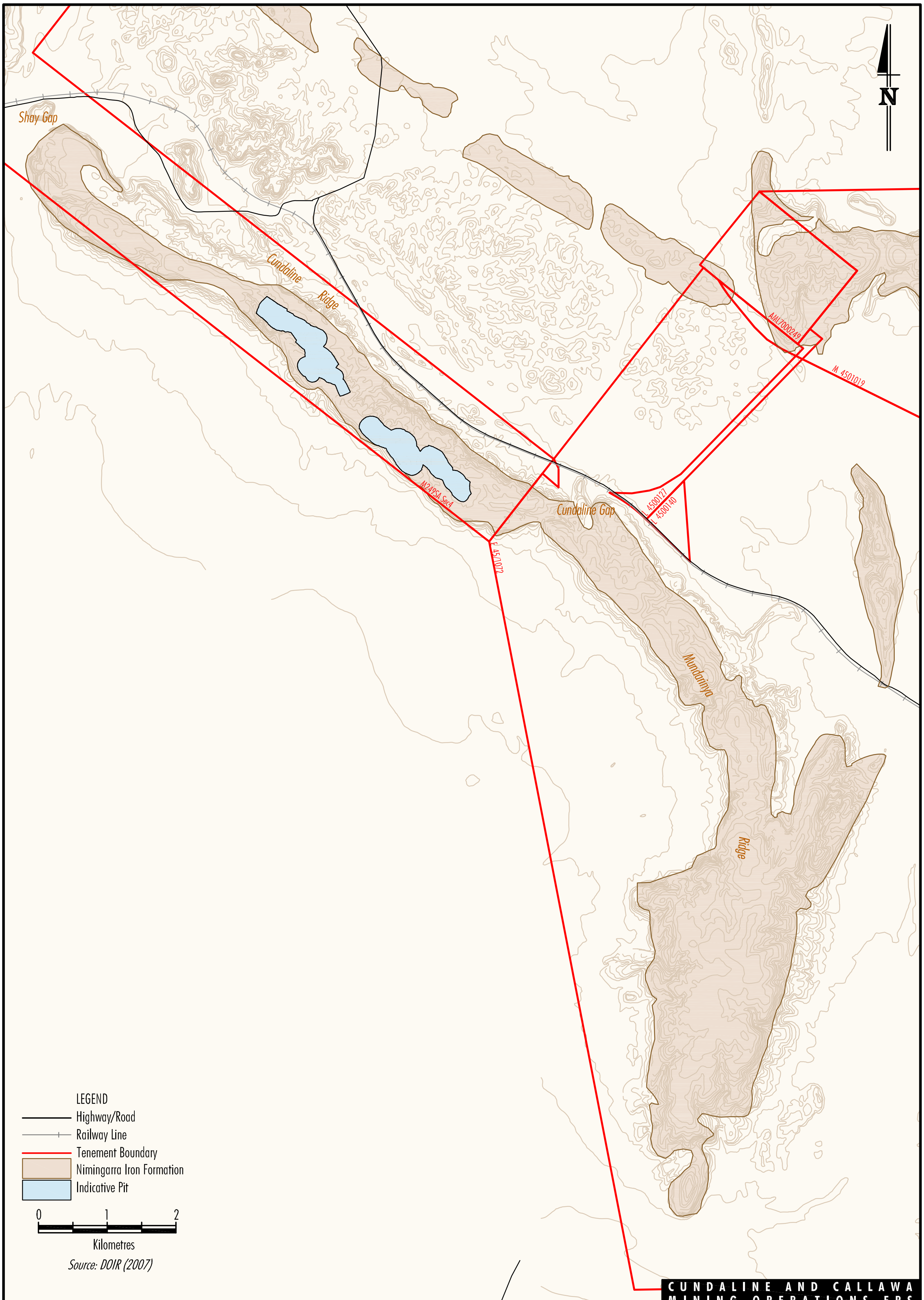
[6] A cave is a subterranean space, sufficiently large enough to admit a person (EPA, 2003).

[7] A void is a subterranean space of any size smaller than a cave (EPA, 2003).



CUNDALINE AND CALLAWA MINING OPERATIONS EPS

FIGURE 5-11
Extent of Mining in Relation to Potential Troglofauna Habitat on Cunadline Ridge

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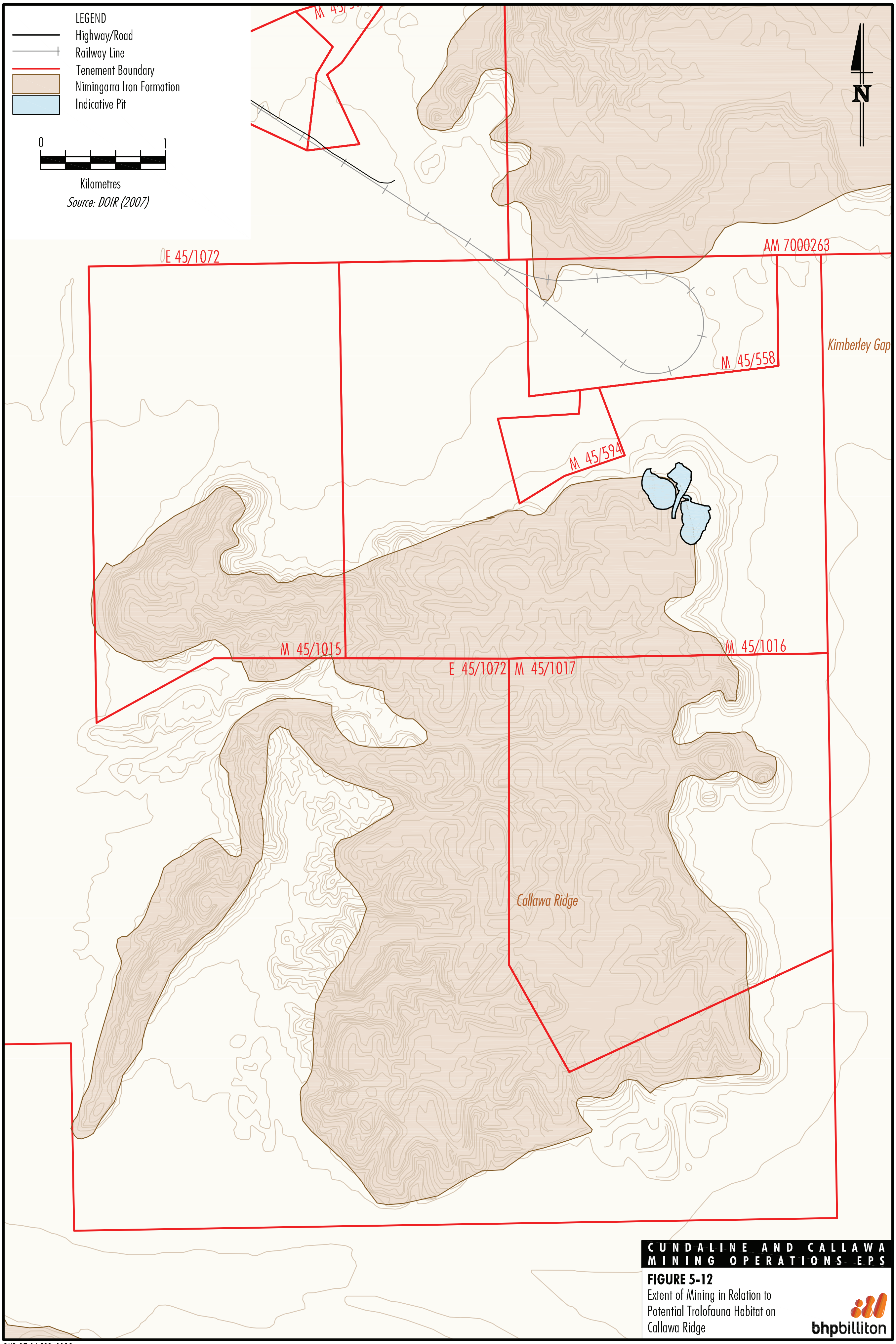

CUNDALINE AND CALLAWA MINING OPERATIONS EPS

FIGURE 5-12
Extent of Mining in Relation to Potential Trolofauna Habitat on Callawa Ridge

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The Callawa deposit contains only one identified lode ore deposit on the northeast corner. This deposit is situated in the Lower or Middle member of the Nimingarra Iron Formation which dips shallowly to the west. This deposit contains post-mineralisation dolerite dykes that cross-cut mineralisation but have little offset and there are no other structural disruptions throughout the deposit to indicate faulting. The hardcap zone reaches a depth of 30 m in the Callawa Ridge. Interrogation of the drilling database indicates that vuggy cavities were identified to a depth of 60 m (Appendix K).

Previous Troglofauna Surveys

BHP Billiton Iron Ore is conducting a regional troglofauna sampling program for its tenement areas in the Pilbara. The preliminary results of the regional troglofauna sampling program, combined with results of troglofauna surveys in the western Pilbara are showing:

- Troglofauna are widespread in outcropping mineralised habitat of the Pilbara.
- The species present include isopods, spiders, schizomids, pseudoscorpions, millipedes, centipedes, pauropods, bristletails, silverfish, cockroaches and beetles.

Biota conducted a stygofauna survey in the Goldsworthy Operations area as part of the BHP Billiton Iron Ore regional stygofauna monitoring between 2005 and 2007 (Biota, 2008a). Troglofauna collected as by-catch included Diplopoda (millipedes), Pseudoscorpionida (pseudoscorpions), and Chilopoda (centipedes) species.

Methodology

Appendix K reports on a troglofauna sampling programme undertaken within the Cundaline and Callawa areas by Subterranean Ecology during the following dates:

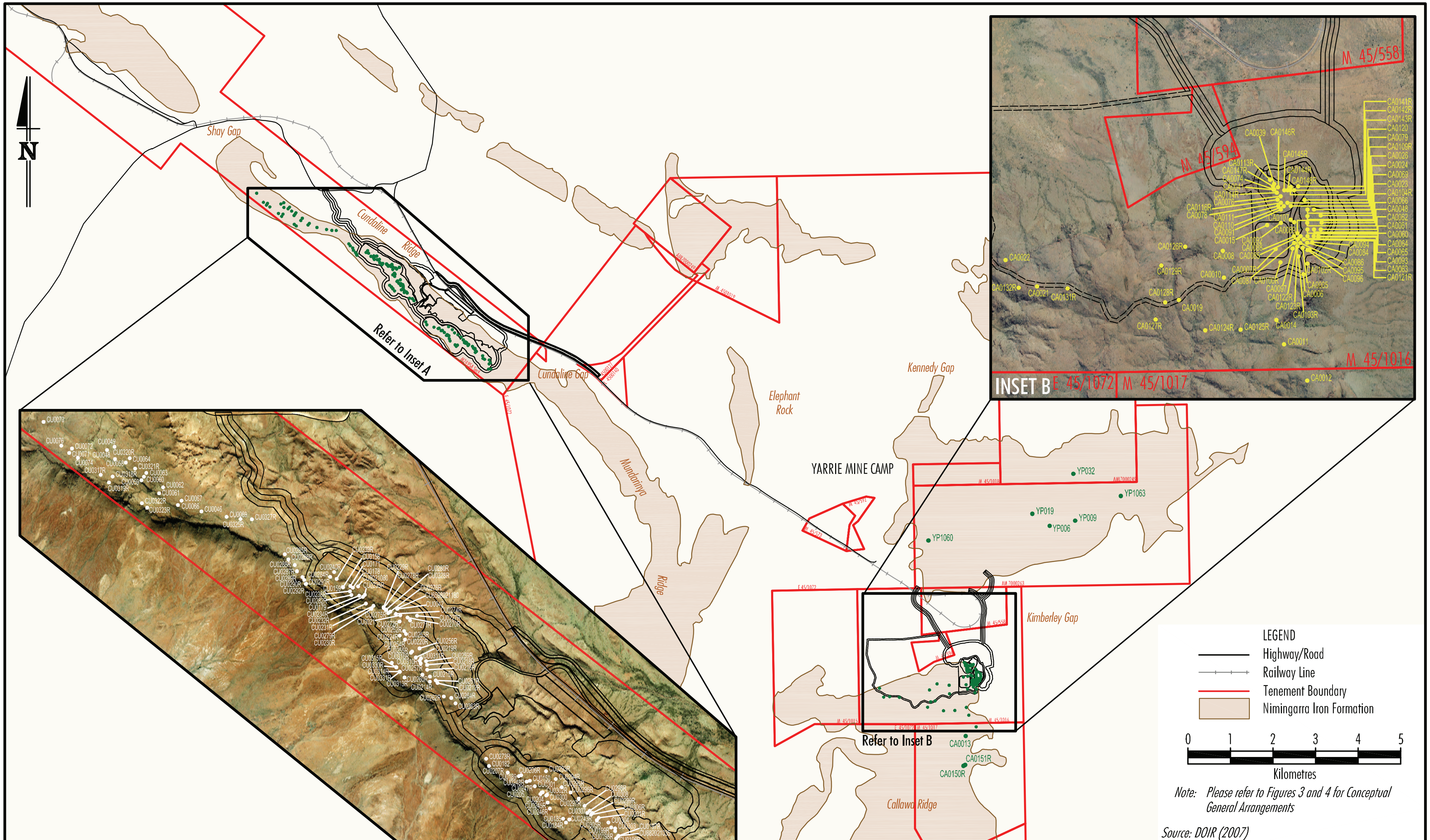
- Sampling Round 1 – 12 December 2007 – 28 February 2008; and
- Sampling Round 2 - February – April 2008.

The troglofauna sample plan adopted by Subterranean Ecology conforms with BHP Billiton Iron Ore's *Regional Subterranean Fauna Study - Troglofauna Sampling Program Methodology* (Biota, 2008b) for the Pilbara that was endorsed by the DEC. The location of the troglofauna sampling sites in the Cundaline and Callawa areas is shown on Figure 5-13.

Subterranean Ecology conducted additional survey work for troglofauna in response to a request by the DEC (16 December 2008) relating to the six tax that were only collected from drill holes located inside proposed pits at Cundaline and/or Callawa (Subterranean Ecology, 2009b). Additional troglofauna sampling on the Cundaline and Callawa ridges was conducted between the 28 May and 4 June and 10 to 16 June.

Results

Appendix K reports a total of 29 troglomorphic morphospecies were collected during the first two rounds of sampling from the following eleven orders, Diplopodea, Symphyla, Chilopoda, Isopoda, Pseudoscorpionida, Araneae, Opilionida, Diplura, Zygentoma, Blattodea, Hemiptera and Coleoptera.



CUNDALINE AND CALLAWA MINING OPERATIONS EPS

FIGURE 5-13

Troglofauna Sampling Sites

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During these sampling rounds, twenty-two troglofauna morphospecies were recorded at sampling sites on the Callawa ridge and 15 troglofauna morphospecies were recorded at sampling sites on the Cundaline ridge. Ten of the troglofauna morphospecies collected were recorded at both the Cundaline and Callawa ridges. These comprised of millipedes, isopods, psuedoscorpions, beetle and cockroach.

During the first two rounds of sampling, six low abundance species were collected only from inside the proposed mining operations areas, namely, Haplodesmidae SP02, Symphyla SP01, Geophilidae SP01, Diplura SP01, Meenoplidae SP02 and Phalangodidae SP01. The additional sampling found *Symphyla* SP01 outside of the pit on the Cundaline Ridge and *Meenoplidae* SP02 outside of the pit on the Callawa Ridge (Subterranean Ecology, 2009b). These results are considered to confirm the assessment findings by demonstrating that additional sampling outside of the pit area found additional records of the low abundant troglofauna.

Extra sampling in May and June emphasized that Callawa and Cundaline share the same troglofauna community, with 56% of the originally collected species now known from both ridges. It is considered likely, given the extent of Nimingarra Iron Formation (Figures 1-2, 5-11 and 5-12), these species occur more widely on their respective landform ridges, or on other ridges in the region.

No species represented by two or more animals is known only from within the pit(s) of a single deposit, at either Callawa or Cundaline. The only species with multiple occurrences known only from within pits (Diplura SP01) occurs in both deposits and almost certainly in the habitat between the deposits.

An interesting finding was the detection of troglofauna on the Yarrie ridge adjacent to the Yarrie mining operations, indicating that troglofauna populations either persisted during the mining activity, or recolonised from adjacent habitat after the mining had ceased.

Potential Impacts and Management Measures

It is considered probable, given the extent of the Nimingarra Iron Formation (Figures 5-11 and 5-12), that populations of each troglofauna species occur outside the pits (Appendix K).

Troglofauna are unlikely to be threatened by the proposed mining operations due to the large areas of contiguous habitat that will remain in the portions of each ridge that will not be impacted by proposed mining.

No specific management measures or monitoring programmes are proposed for troglofauna at the proposed Cundaline and Callawa mining operations, as the troglofauna survey results and geological review (Appendix K) indicate that the troglofauna, and their habitat, are likely to occur more widely.

5.10.3 Outcome

As described in Section 4, a risk assessment was completed for the proposed Cundaline and Callawa mining operations. Based on the implementation of the management measures described above, the risk assessment findings for subterranean invertebrate fauna (including stygofauna and troglofauna) are summarised below.

Environmental Objectives	Potential Impacts	Management Measures	Severity	Likelihood	Residual Risk*
To maintain the abundance, species diversity, geographic distribution and productivity of subterranean fauna at a species and ecosystems level through the avoidance or management of adverse impacts and improvements in knowledge.	Removal/modification of troglofauna, or their habitat, at the proposed Callawa mining operation.	Refer Section 5.10.2.	1	0.3	Minor (0.3)
	Removal/modification of stygofauna, or their habitat at the proposed Callawa mining operation.		1	1	Minor (1)
	Removal/modification of troglofauna, or their habitat, at the proposed Cundaline mining operation.		1	0.3	Minor (0.3)
	Removal/modification of stygofauna, or their habitat, at the proposed Cundaline mining operation.		1	0.1	Low (0.1)

* Low (0.03 to 0.1); Minor (0.3 to 3); Moderate (9 to 30); Major (90 to 1,000); Critical (3,000 to 10,000) (refer Section 4).

6 POLLUTION PREVENTION

6.1 AIR QUALITY

6.1.1 Existing Environment

The Cundaline and Callawa areas are located in a remote part of the Pilbara, approximately 85 km 2north-east of Marble Bar and some 11 km to the nearest non-BHP Billiton Iron Ore owned residence (Yarrie homestead). The area has sparse vegetation cover and experiences extended periods of low rainfall. The existing air quality in the vicinity of the proposed mining operations is typical of a rural arid environment. Windblown dust from exposed surfaces is likely to be the main contributor of particulate matter in the vicinity of the proposed Cundaline and Callawa mining operations.

Sensitive receptors that have been identified in the vicinity of the proposed Cundaline and Callawa mining operations include:

- Yarrie accommodation camp (located approximately 3 km north-west of the Callawa deposit);
- Yarrie homestead (located approximately 11 km south of Cundaline deposit); and
- Warralong Aboriginal Community (located approximately 60 km west south-west of the Cundaline deposit).

6.1.2 Potential Impacts and Management Measures

Potential Impacts

Activities associated with the proposed Cundaline and Callawa mining operations that are likely to generate dust would include the following:

- topsoil stripping;
- drilling and blasting;
- primary, secondary and tertiary crushing;
- loading operations;
- ore and overburden hauling;
- truck unloading;
- product/ore stockpiles;
- conveyor transfer points; and
- rail load-out.

An air quality assessment (Appendix L) has been conducted for the proposed Cundaline and Callawa mining operations. The study evaluated the potential air quality impacts of the proposed mining of the Cundaline and Callawa deposits in conjunction with the existing Goldsworthy Operations at Yarrie on potentially sensitive receptors (i.e. Yarrie accommodation camp, Yarrie homestead and Warralong Aboriginal Community).

In the absence of site-specific air quality data, the predicted incremental increase in dust levels and particulate concentrations were estimated, from which the predicted incremental impact from the proposed Cundaline and Callawa mining operations was calculated and assessed.

A combination of dispersion modelling and qualitative analysis was used to assess the construction and operational air quality impacts from the proposed mining operations.

The air quality assessment report is provided in Appendix L and was a summary of its findings are provided below:

- The total maximum incremental contribution of wheel-generated dust emissions from the proposed Cundaline and Callawa mining operations to the 24-hour average ground-level concentration at the location of the Yarrie accommodation camp is predicted to be 39.7 $\mu g/m^3$, which is below the NEPM standard of 50 $\mu g/m^3$.
- The proposed Cundaline and Callawa mining operations would not result in any significant impacts on any of the sensitive receptors (i.e. would not have a measurable impact on the Yarrie homestead or Warralong Aboriginal Community due to the distance from them).

Yarrie Processing Options

Two options for the processing of ore from the proposed Cundaline mining operations were considered:

- on-site mobile crushing and screening plant; and
- hauling of ore to the existing Yarrie ore processing facilities.

The results of the assessment indicated that the Cundaline processing option would have a more favourable air quality outcome when compared to processing all ore at the Yarrie processing facility. However, neither processing option is likely to result in a significant air quality impact on any sensitive receptor.

EPA Objective

- To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and landuses by meeting statutory requirements and acceptable standards.

Management Measures

The management measures summarised below and the specific dust management practices described in the EMP (Appendix A) would be used throughout the life of the proposed Cundaline and Callawa mining operations to minimise potential impacts on air quality.

The BHP Billiton Iron Ore Land Management Manual contains a dust management component that is used to guide the management of dust at all BHP Billiton Iron Ore mining operations. The dust management component of the BHP Billiton Iron Ore Land Management Manual aims to minimise and monitor the generation of dust from mining operations and identifies dust control methods that may be adopted at BHP Billiton Iron Ore mine sites, including:

- watering of haul roads;
- use of chemical suppressants on haul roads;

- water sprays at strategic points in the processing circuit (e.g. primary crusher bins and stackers); and
- rehabilitation of disturbed areas as they become available.

As described in the EMP (Appendix A), BHP Billiton Iron Ore would implement the following dust control measures at proposed Cundaline and Callawa mining operations:

- Transfer points would be enclosed and fitted with water sprays.
- Water tankers would be used to apply water to sites within areas of operation which have the potential to generate dust, including unsealed roads, haul roads and construction areas.
- Areas of exposed soil (land disturbance) would be minimised.
- Dust suppression equipment would be maintained in efficient operating condition.
- Disturbed areas would be rehabilitated as they become available.
- Mine regulations require that the area be cleared of all personnel during blasting operations and that re-entry is not permitted until safe work conditions (which includes a safe breathing atmosphere) exist.
- Routine maintenance and housekeeping practices would be employed to ensure that waste materials in or around the premises do not accumulate and lead to the generation of unacceptable airborne dust.
- Routine maintenance of dust control systems would be undertaken to ensure dust emissions are minimised.
- All employees and contractors would be informed of the importance of minimising ambient dust levels.
- A Low Frequency Microwave Moisture Analyser (LFMMA) would be used to monitor the moisture content of material on the conveyer system. In the event that moisture content is outside the accepted ore moisture range, the water supply would be adjusted to ensure adequate dust suppression.

6.1.3 Outcome

As described in Section 4, a risk assessment was completed for the proposed Cundaline and Callawa mining operations. Based on the implementation of the management measures described above, the risk assessment findings for air quality are summarised below.

Environmental Objectives	Potential Impacts	Management Measures	Severity	Likelihood	Residual Risk*
To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and landuses by meeting statutory requirements and acceptable standards.	Dust affects sensitive receptors.	Refer Section 6.1.2.	1	0.1	Low (0.1)
	Dust deposition on flora surrounding the mine disturbance area causes an adverse impact.		1	0.03	Low (0.03)

* Low (0.03 to 0.1); Minor (0.3 to 3); Moderate (9 to 30); Major (90 to 1,000); Critical (3,000 to 10,000) (refer Section 4).

6.2 NOISE AND BLASTING

6.2.1 Existing Environment

A noise assessment was conducted for the proposed Cundaline and Callawa mining operations by Heggies and is provided in Appendix L. The assessment was conducted in accordance with the requirements of the *Environmental Protection (Noise) Regulations 1997*, EPA *Guidance Statement No.8 – Environmental Noise* (2007a) and Australian Standard (AS) 2187.2:1993 *Explosives – Storage, Transport and Use* (Standards Australia, 1993).

6.2.2 Potential Impacts and Management Measures

Potential Impacts

Noise generated from the proposed Cundaline and Callawa mining operations would be primarily attributable to the following sources:

- drilling, blasting and mining activities;
- new primary, secondary and tertiary crushing and screening facility (Cundaline processing option);
- vehicle movement (including potential road train movements between the proposed Cundaline mining operation and the Yarrie processing facility); and
- ore stockpiling, reclaiming and rail loading activities (at the Yarrie processing facility and possibly at the proposed Cundaline mining operation).

The noise assessment (Appendix L) evaluated the potential cumulative noise and blasting impacts of mining the Cundaline and Callawa deposits in conjunction with the existing Goldsworthy Operations. The assessment concluded that there would be no significant impacts on the Yarrie homestead or Warralong Aboriginal Community due to the distance between these locations and the proposed mining activities. The assessment indicated that the greatest potential for noise impacts was at the Yarrie accommodation camp, and therefore the assessment focussed on this receptor location

A summary of the key findings of the assessment is provided below:

- Noise impacts at the Yarrie accommodation camp as a result of the proposed mining operations would not exceed the nominated criteria (assigned noise levels) for this location.
- The potential for sleep disturbance (awakening) was also used to assess the potential for disturbance. The internal noise levels were conservatively estimated to be well below the World Health Organisation criterion of 45 A-weighted decibels (dBA) maximum continuous noise level (L_{Amax}) internal.
- Airblast levels from blasting operations were predicted to achieve the most stringent criterion of 115 decibels (dB), as prescribed under the *Environmental Protection (Noise) Regulations, 1997*.

EPA Objective

- To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards.

Management Measures

Notwithstanding the predicted compliance with assigned noise limits at the nearest sensitive receptor, a number of measures would be implemented by BHP Billiton Iron Ore to minimise noise emissions at the proposed Cundaline and Callawa mining operations. The management measures summarised below and described in the EMP (Appendix A) would be used, where appropriate throughout the life of the proposed Cundaline and Callawa mining operations to minimise potential noise impacts.

The generic BHP Billiton Iron Ore Land Management Manual contains a noise management component that is used to guide the management of noise at all BHP Billiton Iron Ore mining operations. The noise management component of the BHP Billiton Iron Ore Land Management Manual aims to ensure that measures are undertaken to minimise the potential for environmental impact.

As described in the EMP (Appendix A), BHP Billiton Iron Ore would implement the following management measures to reduce noise levels and blasting-related impacts:

- Preferential purchase and use of low-noise equipment where practicable.
- Fitting silencers and exhaust mufflers, where necessary.
- Undertaking blasting during daylight hours only.
- Machinery would be regularly serviced.
- Where possible, generators would be located in enclosed areas and at a sufficient distance from personnel areas.

6.2.3 Outcome

As described in Section 4, a risk assessment was completed for the proposed Cundaline and Callawa mining operations. Based on the implementation of the management measures described above, the risk assessment findings for noise are summarised below.

Environmental Objectives	Potential Impacts	Management Measures	Severity	Likelihood	Residual Risk*
To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards.	Noise affects sensitive receptors.	Refer Section 6.2.2.	1	0.03	Low (0.03)
	Noise has an adverse impact on native fauna.		1	0.1	Low (0.1)
	Breach of noise regulations.		1	0.1	Low (0.1)

* Low (0.03 to 0.1); Minor (0.3 to 3); Moderate (9 to 30); Major (90 to 1,000); Critical (3,000 to 10,000) (refer Section 4).

6.3 GREENHOUSE GAS EMISSIONS

Background

The Kyoto Protocol is an international agreement which aims to manage human practices which contribute to the greenhouse effect and global warming. Gases covered specifically by the Kyoto Protocol include:

- carbon dioxide (CO_2);
- methane (CH_4);
- nitrous oxide (N_2O);
- hydroflurocarbons (HFCs);
- perflurocarbons (PFCs); and
- sulphur hexafluoride (SF_6).

EPA Guidance Statement for Minimising Greenhouse Gas Emissions

The EPA Guidance Statement No. 12, *Minimising Greenhouse Gas Emissions* (EPA, 2002) applies to significant new projects or expanding operations. The guidance statement describes the EPA objectives for the assessment and management of greenhouse gases, to ensure:

- on-going programmes are implemented to monitor and report emissions and periodically assess opportunities to further reduce greenhouse gas emissions over time;
- best available technologies and measures are applied to minimise emissions and maximise energy efficiency; and
- appropriate sink enhancement actions have been considered to offset emissions.

This EPS addresses the information requirements as required by the EPA guidance statement.

6.3.1 Existing Environment

The proposed Cundaline and Callawa mining operations have the potential to generate greenhouse gas emissions from a number of sources. These sources include the following:

- the combustion of fuel by diesel-powered generators, equipment and vehicles;
- use of explosives during blasting operations; and
- use of purchased electricity.

6.3.2 Potential Impacts and Management Measures

Potential Impacts

Electricity for the proposed Cundaline and Callawa mining operations would be supplied via the existing Goldsworthy Operations 66 kV ETL or diesel-fuelled generators that would be set up at the proposed Cundaline and Callawa mining areas. The expected electricity demand for the proposed Cundaline and Callawa mining operations would be approximately 7,500 MWh per annum if the Cundaline processing option is used, with a similar demand expected if the Yarrie processing option is used.

Predicted greenhouse gas emissions from the proposed Cundaline and Callawa mining operations were calculated as part of the air quality assessment (Appendix L). This analysis included consideration of Scope 1 (direct/point source emissions), Scope 2 (point source emissions from purchased electricity), and Scope 3 (indirect, fuel extraction and/or line loss emissions) emissions generated from the consumption of fuel in vehicles, power consumption and blasting.

The calculated annual greenhouse gas emissions for the proposed Cundaline and Callawa mining operations would be up to approximately 19,000 t of CO_2 equivalent (CO_2-e) per annum.

It should be noted that the tabulated greenhouse gas emission estimates are conservative, as maximum predicted increases have been used and current greenhouse gas reduction technologies used on-site have not been taken into consideration. Management measures that may reduce greenhouse gas emissions below the levels predicted are discussed below.

EPA Objective

- To minimise emissions to levels as low as practicable on an on-going basis and consider offsets to further reduce cumulative emissions.

Management Measures

BHP Billiton Iron Ore manages its greenhouse gas emissions for all its operations through its Climate Change Policy. BHP Billiton Iron Ore also implements site-specific greenhouse gas management measures at its operations and these are also described below.

General Greenhouse Gas Emission Management Measures

To address associated risks of climate change BHP Billiton's focus is on improving the management of greenhouse gas emissions. This focus is built into the decision-making processes, through:

- **Business targets** – BHP Billiton Iron Ore set greenhouse gas efficiency improvement target of 6 per cent over the period 2006 (baseline year) to 2012, cascaded into business planning.
- **Energy Excellence Programme** – BHP Billiton Iron Ore identifies initiatives and implements business processes that integrate energy source substitution opportunities into operational, engineering, contractual and investment business activities.
- **Eco-efficiency Identification** – each site has implemented the Eco-efficiency Identification and Implementation Procedure. Initiatives for the reduction of greenhouse gas emissions and energy saving are identified via site workshops, logged, prioritised and implemented.

- **Site based GHG Management Plans** – all sites have developed energy and greenhouse gas management plans, including targets, improvement project evaluation and associated monitoring and reporting. Management plans are mandated where emissions are greater than 50,000 tonne CO_2-e.
- **Carbon pricing** – BHP Billiton Iron Ore applies carbon pricing sensitivity analysis within investment evaluation decision making.

Greenhouse Gas Emission Management Measures

Greenhouse gas emissions at the proposed Cundaline and Callawa mining operations would be minimised by adopting the following management measures:

- restricting the amount of native vegetation that is cleared to a practical minimum;
- educating staff on energy efficiency;
- progressively rehabilitating mine landforms and disturbed areas as they become available;
- consideration of other transport options for supplies to the site (e.g. empty trains);
- considering greenhouse gas emissions when evaluating crushing and screening options at either Yarrie or Cundaline;
- regularly maintaining and replacing fixed and mobile equipment to minimise fuel consumption; and
- minimising haulage distances and grades.

6.3.3 Outcome

As described in Section 4, a risk assessment was completed for the proposed Cundaline and Callawa mining operations. Based on the implementation of the management measures described above, the risk assessment findings for greenhouse gas are summarised below.

Environmental Objectives	Potential Impacts	Management Measures	Severity	Likelihood	Residual Risk*
To minimise emissions to levels as low as practicable on an on-going basis and consider offsets to further reduce cumulative emissions.	Exceedance of the proposed Callawa/Cundaline mining operations forecast greenhouse gas emissions.	Refer Section 6.3.2.	1	0.1	Low (0.1)

* Low (0.03 to 0.1); Minor (0.3 to 3); Moderate (9 to 30); Major (90 to 1,000); Critical (3,000 to 10,000) (refer Section 4).

6.4 WASTE MATERIALS

6.4.1 Potential Impacts and Management Measures

Potential Impacts

The types of wastes that would be produced during the proposed Cundaline and Callawa mining operations include:

- equipment/vehicle washdown water;
- scrap metal;
- non-metal scrap (e.g. uncontaminated piping, plastic, fibreglass, wood or concrete rubble);
- general refuse;
- office and administrative wastes (e.g. paper, cardboard, etc.);
- domestic putrescible wastes;
- medical wastes (e.g. bandages, medicine, syringes etc. from first aid kits);
- sewage waste (i.e. sludge from sewage treatment unit);
- tyres and conveyor belts;
- explosives packaging;
- batteries;
- miscellaneous chemical packaging and chemical wastes; and
- hydrocarbon waste.

Wastes which may cause acute environmental impacts if inappropriately managed are listed as controlled wastes under the *Environmental Protection (Controlled Waste) Regulations, 2004.* Controlled wastes include tyres, batteries, electrical waste, hazardous waste and waste oils.

Waste materials, including controlled and non-controlled wastes, as defined by the *Environmental Protection (Controlled Waste) Regulations, 2004*, have the potential to adversely affect the environment (e.g. contamination of soil and water resources) if improper management/treatment procedures are applied.

EPA Objectives

- To ensure that the disposal of wastes does not adversely affect the integrity, ecological function and values of the environment, or the health, welfare and amenity of people and landuses.

Management Measures

General Waste Management Measures

Management measures to minimise potential impacts from wastes produced by the proposed Cundaline and Callawa mining operations are described in the EMP (Appendix A). The main aspects of waste management described in the EMP are provided below.

BHP Billiton Iron Ore would aim to minimise and monitor the generation of waste from mining operations and would adopt the following waste control objectives:

- To observe the waste management hierarchy of elimination, reduction, re-use, recycling, treatment and disposal.
- To manage all waste generated in such a manner that minimises any detrimental effects it may have to the environment.
- To ensure that BHP Billiton Iron Ore mining operations comply with applicable licence conditions and commitments at all times.

Site-specific Management Measures

Specific waste management practices that would be used at the proposed Cundaline and Callawa mining operations to minimise impacts from waste generation are presented below:

- Materials such as batteries and scrap metal would be recycled.
- Materials to be recycled would be neatly stored in a designated area until they are removed from the site.
- All waste collecting systems would be designed for ease of use and prevention or capture of spillage.
- Used containers, such as 205 L drums, would be collected by a licensed contractor for recycling.
- Oily wastes generated at site would be collected and disposed of in accordance with the *Environmental Protection (Controlled Waste) Regulations, 2004*.
- All soil contaminated by hydrocarbons would be removed to the bioremediation landfarm for treatment in accordance with *Oil Farming for Oily Wastes* (EPA, 1990).
- Controlled wastes transported off-site for disposal would be managed in accordance with the *Environmental Protection (Controlled Waste) Regulations, 2004.*
- Non-controlled solid wastes would be disposed of at the Yarrie Mine landfill in accordance with the licence conditions.

6.4.2 Outcome

As described in Section 4, a risk assessment was completed for the proposed Cundaline and Callawa mining operations. Based on the implementation of the management measures described above, the risk assessment findings for waste are summarised below.

Environmental Objectives	Potential Impacts	Management Measures	Severity	Likelihood	Residual Risk*
To ensure that the disposal of waste does not adversely affect the integrity, ecological function and values of the environment, or the health, welfare and amenity of people and landuses.	Site contamination impacting on the environment.	Refer Section 6.4.1.	3	0.3	Minor (0.9)

* Low (0.03 to 0.1); Minor (0.3 to 3); Moderate (9 to 30); Major (90 to 1,000); Critical (3,000 to 10,000) (refer Section 4).

6.5 DANGEROUS GOODS AND HAZARDOUS SUBSTANCES

6.5.1 Potential Impacts and Management Measures

Potential Impacts

Hazardous materials to be used at the proposed Cundaline and Callawa mining operations would include:

- hydrocarbons (e.g. fuels, lubricants and waste oils);
- detergents, glues and paints; and
- explosives.

The proposed Cundaline and Callawa mining operations would use the existing hazardous materials and explosive storage areas at the Yarrie processing facilities. No upgrades of these areas would be required for the Yarrie processing facilities. Fuel storage facilities would be constructed at the proposed Cundaline mining area. Consumables would be trucked to the proposed Cundaline and Callawa mining operations on a demand basis. Diesel would be transported to the proposed Cundaline and Callawa mining operations using road train fuel tankers.

Hazardous materials such as fuels, lubricants, detergents, explosives and paints have the potential to cause atmospheric, soil or water contamination.

EPA Objectives

- To ensure that the use of dangerous goods and hazardous materials does not adversely affect the integrity, ecological function and values of the environment, or the health, welfare and amenity of people and landuses.

Management Measures

The storage, transport, handling, use and disposal of dangerous goods and hazardous substances would be undertaken in a manner that complies with relevant local and State regulations and guidelines, and Australian Standards.

Regulatory Framework

The management of dangerous goods and hazardous substances will be conducted in accordance with all relevant legislation including:

- *Mine Safety and Inspection Act, 1994*;
- *Mine Safety and Inspection Regulations, 1995*;
- *Explosives and Dangerous Goods Act, 1961*;
- *Dangerous Goods (Transport) (Road and Rail) Regulations, 1999*; and
- *Traffic Act, 1974.*

- *Australian Code for the Transport of Dangerous Goods by Road and Rail, 1998*

  Volume 1 of the *Australian Code for the Transport of Dangerous Goods by Road and Rail* (ADG Code) classifies dangerous goods into Classes based on their various properties. Packaging requirements and standards, design and maintenance of bulk containers for transport, as well as marking and placarding of transport vessels and vehicles are also provided in detail in Volume 1 of the ADG Code. Volume 2 of the ADG Code lists the goods that are specified as "dangerous goods".

- *National Model Regulations for the Control of Workplace Hazardous Substances (National Occupational Health and Safety Committee [NOHSC]: 1005 [1994])*

  The National Model Regulations apply to all workplaces in which hazardous substances are used or produced, and to all persons with potential exposure to hazardous substances in those workplaces. The two principal components of the regulations are:

  – Information provisions - which address the delivery of specific information (e.g. labels and Materials Safety Data Sheets [MSDSs]) that the supplier of a workplace hazardous substance is required to provide through the employer to employees. These provisions ensure that employee representatives, relevant public authorities and emergency services are also provided with access to relevant information.

  – Assessment and control provisions - which require employers to identify hazardous substances in the workplace, make an assessment of those hazards, which arise out of the work activity and then take appropriate control action.

  The National Model Regulations require employers to obtain MSDSs for all substances from suppliers and ensure these are readily accessible to employees. Employers must also ensure all substances are labelled properly and keep and maintain a register for all hazardous substances used or produced in the workplace. The register must contain a list of all hazardous substances used or produced at the workplace and the MSDSs for all hazardous substances for which MSDSs are required by these national model regulations. The model regulations also require employers to provide induction and on-going training to all employees with the potential for exposure to hazardous substances in the workplace. It also provides for health surveillance, record keeping and employees duties to comply with the model regulations.

- *The National Code of Practice for the Control of Workplace Hazardous Substances [NOHSC: 2007 (1994)]*

  The National Code of Practice for the Control of Workplace Hazardous Substances provides a practical guide on how to comply with the National Model Regulations. It contains information on complying with requirements relating to consultation, classification, provision of information, training, assessment, monitoring and record keeping.

- *Approved Criteria for Classifying Hazardous Substances [NOHSC: 1008(2004)]*

  Approved Criteria for Classifying Hazardous Substances is a national standard for determining whether a substance is a hazardous substance, and to assist in preparing labels and MSDSs.

Australian Standards

The storage, transport, handling, use and disposal of dangerous goods and hazardous substances would be conducted in accordance with the relevant Australian Standards including, but not limited to:

- AS 1216 – *Class Labels for Dangerous Goods*;
- AS 1319 – *Safety Signs for the Occupational Environment*;
- AS 1345 – *Identification of the Contents of Pipes and Conduits and Ducts*;
- Australian and New Zealand Standard [AS/NZS] 1596 – *The Storage and Handling of LP Gas*;
- AS 1940 – *The Storage and Handling of Flammable and Combustible Liquids*;
- AS 2030.1 – *The verification, filling, inspection, testing and maintenance of cylinders for storage and transport of compressed gases - cylinders for compressed gases other than Acetylene*;
- AS 2187.1 – *Explosives – Storage, transport and use – Storage*;
- AS 3780 – *Storage and Handling of Corrosive Substances*;
- AS 4326 – *The Storage and Handling of Oxidising Agents*;
- AS/NZS 2906 – *Fuel Containers - Portable-Plastic and Metal*;
- AS/NZS 3833 – *The Storage and Handling of Mixed Classes of Dangerous Goods in Packages and Intermediate Bulk Containers*; and
- AS/NZS 4452 – *The Storage and Handling of Toxic Substances*.

Government Guidelines

Management of Hazardous Substances on Minesites

The *Management of Hazardous Substances on Minesites Guideline* (DoIR, 1997) was prepared to promote the implementation of effective hazardous substance management programmes on mines. The document includes guidance on the delivery, storage, use and disposal of hazardous substances, as well as the development of hazardous substances management procedures and registers, stock management, monitoring and surveillance, personal protective equipment, first aid procedures, emergency plans and audit procedures.

Water Quality Protection Guidelines for Mining and Mineral Processing – Above-ground Fuel and Chemical Storage

This guideline was prepared by Water and Rivers Commission [WRC] (2000) to reflect industry standards and incorporate best management practices for fuel and chemical storage facilities within the mining and mineral processing industry. It includes guidance on the design and sitting of tanks, bunded compound design and maintenance, vehicle refilling and mobile refuelling vehicles.

Proposed Cundaline and Callawa Mining Operations Dangerous Goods and Hazardous Substances Management Measures

The following hierarchy of control measures outlined in the *National Code of Practice for the Control of Workplace Hazardous Substances* would be applied at the proposed Cundaline and Callawa mining operations to minimise potential for exposure to hazardous substances:

- elimination;
- substitution;
- isolation;
- engineering controls;
- safe work practices; and
- personal protective equipment.

In accordance with the *Mines Safety and Inspection Regulations, 1995*, a register of hazardous substances will be maintained for the proposed Cundaline and Callawa mining operations. In accordance with the National Model Regulations, the hazardous substances register will contain MSDSs for all hazardous substances used on-site and include details of the duties or operations which have the potential for an employee to become exposed to a hazardous substance.

In order to ensure the safe handling of all hazardous materials used at the proposed Cundaline and Callawa mining operations, the BHP Billiton Iron Ore Hazardous Materials Management Programme (HMMP) would be adopted which incorporates the following elements:

- adoption of a formal policy statement;
- designation of responsibility for all elements of the programme;
- employee participation;
- training of personnel;
- dissemination of information;
- establishment of purchasing and inventory controls; and
- environmental monitoring.

On-site management of hazardous materials is required to be undertaken in accordance with the HMMP and BHP Billiton Fatal Risk Control Protocol No. 5 Hazardous Materials Management, and is the responsibility of the mining contractor.

The general management measures for minimising impacts from hazardous substances and dangerous goods at the proposed Cundaline and Callawa mining operations are described in the EMP (Appendix A) and are summarised below:

- Storage of bulk fuel in above ground tanks within impermeable, bunded enclosures and minor storage vessels in accordance with licence conditions and applicable Australian Standards (e.g. AS 1940).
- Storage of explosives in remote magazines.
- Storage of all toxic or hazardous mining or process materials within weatherproof enclosures, with impervious flooring and perimeter bunding.

- Transportation of all hazardous materials (including controlled wastes) is to comply with the provisions of a Licence to Transport Dangerous Goods.

6.5.2 Outcome

As described in Section 4, a risk assessment was completed for the proposed Cundaline and Callawa mining operations. Based on the implementation of the management measures described above, the risk assessment findings for dangerous goods and hazardous substances are summarised below.

Environmental Objectives	Potential Impacts	Management Measures	Severity	Likelihood	Residual Risk*
To ensure that the use of dangerous goods and hazardous materials does not adversely affect the integrity, ecological function and values of the environment, or the health, welfare and amenity of people and landuses.	Release of toxic or polluting gases to the atmosphere.	Refer Section 6.5.1.	1	0.1	Low (0.1)
	Surface water contamination.		3	0.1	Minor (0.3)
	Soil and groundwater contamination.		3	0.1	Minor (0.3)

* Low (0.03 to 0.1); Minor (0.3 to 3); Moderate (9 to 30); Major (90 to 1,000); Critical (3,000 to 10,000) (refer Section 4).

7 SOCIAL ENVIRONMENT

7.1 ABORIGINAL CULTURAL HERITAGE AND RELATIONSHIPS

7.1.1 Potential Impacts and Mitigation Measures

Potential Impacts

The potential impacts of the proposed Cundaline and Callawa mining operations on Aboriginal heritage sites are related primarily to direct disturbance of sites and include:

- damaging sites during mining operations and construction of mine infrastructure;
- collecting or excavating artefacts from heritage sites;
- damaging artefacts by off-road use of vehicles; and
- trespassing on sites by unauthorised personnel and culturally inappropriate behaviour (including defacing artefacts or artworks).

EPA Objectives

- To ensure that changes to the biophysical and physical environment resulting from the proposed Cundaline and Callawa mining operations do not adversely affect historical and cultural associations and complies with relevant heritage legislation.

Management Measures

BHP Billiton Iron Ore manages and protects Aboriginal heritage in compliance with the WA *Aboriginal Heritage Act, 1972.* Before any ground disturbing activities proceed, BHP Billiton Iron Ore conducts an internal PEAHR to ensure that all heritage sites within the disturbance area are identified. Sites are managed to either be excluded from disturbance, or if this is not practical, approval of the Minister for Indigenous Affairs is obtained under Section 18 of the *Aboriginal Heritage Act, 1972*.

The proposed Cundaline and Callawa mining operations are within the Njamal Native Title Claim. Comprehensive heritage surveys of the proposed Cundaline and Callawa mining operations areas have been conducted over a number of years in consultation with the Njamal people, with a number of Aboriginal heritage sites have been recorded. Out of respect for the wishes of Aboriginal people the location of the recorded Aboriginal heritage sites have not been shown.

Callawa ridge has been identified by the Njamal people as a site of particular importance. Consent pursuant to Section 18 of the *Aboriginal Heritage Act, 1972* to conduct drilling and exploration activities has been granted to BHP Billiton Iron Ore. Consultation with the Njamal people is progressing and before development proceeds BHP Billiton Iron Ore will seek consent pursuant to Section 18 of the *Aboriginal Heritage Act, 1972* to mine parts of the Callawa ridge.

Callawa ridge is also covered by a land access agreement (the Yarrie Continued Operations Agreement). In accordance with that agreement the Njamal Native Title Group have consented exploration and mining in the project area subject to conditions which include:

- a benefits package; and
- avoidance of areas identified in the agreement as not to be disturbed.

BHP Billiton Iron Ore will continue to work with the Njamal people to manage the heritage within the proposed Cundaline and Callawa mining operations areas as the work proceeds.

7.1.2 Outcome

As described in Section 4, a risk assessment was completed for the proposed Cundaline and Callawa mining operations. Based on the implementation of the management measures described above, the risk assessment findings for Aboriginal heritage are summarised below.

Environmental Objectives	Potential Impacts	Management Measures	Severity	Likelihood	Residual Risk*
To ensure that changes to the biophysical and physical environment resulting from the proposed Cundaline and Callawa mining operations do not adversely affect historical and cultural associations and complies with relevant heritage legislation.	Damage or destruction of heritage sites not covered by S18 approvals.	Refer Section 7.1.1.	3	0.3	Minor (0.9)

* Low (0.03 to 0.1); Minor (0.3 to 3); Moderate (9 to 30); Major (90 to 1,000); Critical (3,000 to 10,000) (refer Section 4).

7.2 ECONOMIC AND SOCIAL EFFECTS

The Goldsworthy Operations are located in a remote area with no significant public settlements or towns in the vicinity of the operations. Muccan and Yarrie stations are the closest privately owned properties. BHP Billiton Iron Ore regularly consults with the owner of these stations to minimise the impacts of the mining operations on their pastoral enterprises.

Due to the remote nature of the Goldsworthy Operations, the majority of the workforce operates on a fly-fly-out basis from Perth and the majority reside in the greater Perth area. In addition to the Perth workforce, BHP Billiton Iron Ore engages local contractors for work at the Goldsworthy Operations where available. The Goldsworthy Operations therefore contribute to the Perth and local economies through employee expenditure and provision of goods and services for the mine.

7.3 GOVERNANCE AND SUSTAINABILITY

7.3.1 Existing Environment

BHP Billiton Iron Ore has demonstrated a commitment to sustainable development over a long history of operational experience. BHP Billiton Iron Ore has recognised the benefits of successful management of environmental and social performance while delivering economic benefits. As an example of this commitment in May 2003, BHP Billiton Iron Ore was recognised, through the Banksia Environmental Foundation Award, for Leadership in Sustainability in the Minerals Industry as a result of its (HSEC Management Standards. The HSEC Management Standards are discussed further in the EMP (Appendix A).

BHP Billiton Iron Ore participates in a number of initiatives that relate to sustainable development and maintaining biodiversity.

These are summarised below:

- The Company is a signatory to the United Nations Global Compact, establishing aspirational principles addressing global issues such as human rights, labour standards and the environment.
- BHP Billiton Iron Ore was a founding member of the Global Mining Initiative and is a member of the World Business Council for Sustainable Development.
- BHP Billiton Iron Ore is a founding member for the International Council on Mining and Metals (ICMM).
- BHP Billiton Iron Ore, through the Minerals Council, is involved with a research project in conjunction with the World Wildlife Fund for Nature to evaluate the potential to certify mine sites on the basis of their Sustainable Development Performance.

7.3.2 Potential Impacts and Management Strategies

Potential Impacts

The proposed Cundaline and Callawa mining operations could potentially impact on the sustainability of the surrounding environment if appropriate mitigation measures were not implemented. BHP Billiton Iron Ore's Sustainability Framework aims to minimise these impacts.

No adverse or cumulative impacts on Port Hedland are anticipated as the overall production rate from the existing Goldsworthy Operations (which includes the Yarrie operations) would not change from the current 8.5 Mtpa (i.e. the number of trains and ship movements from the Goldsworthy Operations would remain the same).

EPA Objectives

- 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.

Management Strategies

BHP Billiton Iron Ore has developed and adopted a Company Charter, HSEC Policy and HSEC Management Standards in support of sustainable development, which exist as a hierarchy of systems and documents. These systems and documents, along with a commitment to the ICMM sustainable development principles, form the Sustainability Framework to which the company operates.

The ICMM principles are incorporated into BHP Billiton's Corporate Sustainability Framework. The key components of the Framework are:

- The Charter is the company's *overriding commitment to health, safety environment, community responsibility and sustainable development*. It presents BHP Billiton's purpose, which is *to create value through the discovery, development and conversion of natural resources, and the provision of innovative customer and market-focused solutions*. In doing so, BHP Billiton values an overriding commitment to health, safety, environmental responsibility and sustainable development.
- Supporting the Charter is the BHP Billiton HSEC Policy, which outlines a commitment to sustainable development and to continual improvement in performance, efficient use of natural resources and aspires to zero harm to people and the environment.
- The Charter is implemented via the HSEC Management Standards and guidelines.
- The implementation of the HSEC Management Standards and associated guidelines is measured through Assessment and Targets Reporting processes.

The principles of sustainable development are implemented across BHP Billiton Iron Ore's operations through the use of the BHP Billiton HSEC Management Standards. These Management Standards are discussed further in the EMP (Appendix A). The environmental management programmes and plans that would be implemented at the proposed Cundaline and Callawa mining operations within the Sustainable Development framework are discussed in Section 2.

7.4 ROAD TRANSPORT

7.4.1 Existing Environment

Vehicles currently using the access road to the existing Yarrie operations include light vehicles, freight trucks, road trains and fuel trucks. Consumables currently used at the Yarrie operations primarily come from Newman and Port Hedland.

7.4.2 Potential Impacts and Management Measures

Potential Impacts

The access road for the existing Yarrie operations would be used to provide access to the proposed Cundaline and Callawa mining areas. It is expected that vehicle use of the access road would remain similar to the current vehicle use, although additional road train trips would be required if the Cundaline processing option is implemented.

Potential impacts from road transport include the following:

- an increase in noise emissions due to vehicles travelling to and from the proposed Cundaline and Callawa mining operations; and
- additional heavy vehicles carrying hazardous materials using the access road.

EPA Objective

- To ensure that transport noise levels meet acceptable standards and that an adequate level of safety and public amenity is maintained on the access road.

Management Measures

Heavy vehicles transporting consumables to and from the proposed Cundaline and Callawa mining operations would comply with road safety and noise emission guidelines and the *Dangerous Goods (Transport) (Road and Rail) Regulations, 1999* and the ADG Code.

Management measures for the transportation of hazardous materials are discussed in Section 6.5.1 of this EPS and are provided in the EMP (Appendix A).

7.5 WORKFORCE INDUCTION AND TRAINING

Employee and contractor training would be conducted at the proposed Cundaline and Callawa mining operations to minimise potential impacts arising from a lack of knowledge regarding sensitivities of the environment or inadequate application of site management procedures.

BHP Billiton Iron Ore's HSEC Management Standard No. 5 sets a requirement for BHP Billiton Iron Ore to put in place a workforce induction and training programmes based upon risk assessment and management systems, which include:

- induction programmes for all employees, contractors which address relevant objectives, hazards, risks, controls and behaviours at the commencement of their employment or site visit;
- the establishment of systems to enable the identification, prioritisation, planning, documentation and monitoring of training needs so that employees and contractors are able to fulfil their responsibilities; and
- the management of periodic refresher courses using induction and environmental training records maintained on-site.

Additional general environmental induction and training of the workforce at the proposed Cundaline and Callawa mining operations would include, but not be limited to:

- vegetation clearing and disturbance protocols;
- identification of weed species, reporting of infestations and hygiene procedures to prevent the introduction and spread of weeds;
- protection of flora and fauna;
- waste management, storage and handling of hydrocarbons/chemicals; and
- spill response and clean-up procedures.

The above workforce training and induction practices would continue throughout the life of the proposed Cundaline and Callawa mining operations.

8 REHABILITATION

8.1 REGULATORY REQUIREMENTS

Rehabilitation criteria for mines in arid regions of WA are established on a site by site basis through consultation with the DMP. Broad recommendations for developing rehabilitation objectives and principles have been addressed in the *Leading Practice Sustainable Development Programme for the Mining Industry* series (WA Department of Industry, Tourism and Resources [DITR], 2006), and the *Mine Rehabilitation Handbook* (Minerals Council of Australia [MCA], 1998).

8.2 GUIDING CLOSURE PRINCIPLES

As part of the EPS approval for the Goldsworthy Operations in 2005, BHP Billiton Iron Ore consulted with stakeholders to develop Guiding Closure Principles for the Goldsworthy Operations which would be used to guide the design and revegetation of the proposed mine landforms throughout the life of the mining operations and in particular during the decommissioning and closure phase. These Guiding Closure Principles are included in the DRP (Appendix B) and are outlined below.

- *There will be no significant, physical off-site impacts.*
- *No significant impact on baseline surface water quality and flow regimes in Eel Creek and Egg Creek.*
- *The established vegetative cover will be self-sustaining and show progression towards the surrounding undisturbed vegetation in terms of species diversity and plant density.*
- *The post-mining landform will be designed to be stable and respond to erosive forces in a manner to suit the end landuse.*
- *There will be no unsafe areas where members of the general public could inadvertently gain access. Access to potentially unsafe areas will be impeded by safety bunds built to comply with the applicable DMP guidelines.*
- *The number and size of out of pit overburden storage areas in new mining areas will be minimised.*
- *Residual pit voids will be left as mined where geotechnically stable, and profiled as necessary to achieve long-term closure objectives.*
- *Final overburden storage areas will be sympathetic with regional landforms.*
- *A long-term systems based approach will be used to track the trajectory of rehabilitated areas towards self sustaining status.*
- *The end landuse for the area will be determined in consultation with stakeholders, and agreed with the administering authority ongoing during the life of the mine.*

BHP Billiton Iron Ore would adopt these Guiding Closure Principles for the proposed Cundaline and Callawa mining operations.

8.3 STANDARD REHABILITATION PROCEDURES

BHP Billiton Iron Ore has developed and implemented standard rehabilitation procedures for ‘Earthworks’, ‘Surface Treatments’ and ‘Revegetation’. A summary description of each is provided in the DRP (Appendix B).

The DRP (Appendix B) also describes the control measures that would be used to guide the management of mine landforms, revegetation and infrastructure and support facilities during decommissioning and closure of the proposed Cundaline and Callawa mining operations to satisfy the Guiding Closure Principles.

8.4 ADAPTIVE MANAGEMENT APPROACH

BHP Billiton Iron Ore's adaptive management approach to rehabilitation involves regularly assessing performance and adjusting its management practices to facilitate continuous improvement. This adaptive management approach takes into consideration the results of rehabilitation and trials from BHP Billiton Iron Ore's other Pilbara mines and best practice rehabilitation techniques used elsewhere in the mining industry. The adaptive management approach is described in the DRP (Appendix B).

8.5 REHABILITATION MONITORING

8.5.1 Ecosystem Function Analysis

Ecosystem Function Analysis (EFA) is a monitoring method developed by Commonwealth Scientific and Research Organisation that is used to provide indicators of rehabilitation performance and aims to measure the progression of rehabilitation towards self-sustaining ecosystems. It allows assessment of ecosystem sustainability through the plotting of ecosystem development trajectories and can identify areas of rehabilitation that require remedial action. EFA is comprised of the following three components:

- Landscape Function Analysis;
- Vegetation Dynamics; and
- Habitat Complexity.

EFA is described further in the DRP (Appendix B).

8.5.2 Fauna Monitoring

Fauna activity on rehabilitated sites would be monitored in accordance with the EMP (Appendix A). Results of the fauna monitoring would be documented in the Annual Environmental Report (AER).

8.5.3 Weed Monitoring

The WMP (Appendix D) describes the weed monitoring to be conducted and measures used to prevent the introduction and spread of weeds at the proposed Cundaline and Callawa mining operations. Weed monitoring and control would be conducted as part of the proposed Cundaline and Callawa mining operations rehabilitation programme and in accordance with the WMP.

8.6 POST-MINING LANDUSE

The proposed Cundaline and Callawa mining operations would be progressively rehabilitated in accordance with the Guiding Closure Principles presented in Section 8.2.

The post-mining landuse would be determined through on-going consultation with the administering authority and relevant stakeholders during the remaining life of the mining operations. Notwithstanding, the most likely final landuse for the lease areas would either be low intensity cattle grazing (which is the current landuse for areas not directly affected by mining activities) or inclusion in some form of natural conservation area.

9 PROPOSED ENVIRONMENTAL MANAGEMENT ACTIONS

The following sub-sections describe a number of key environmental management actions that BHP Billiton Iron Ore propose to be included in the Ministerial Statement for the proposed Cundaline and Callawa mining operations. Table 9-1 provides a summary of BHP Billiton Iron Ore's Environmental Management Actions for the proposed Cundaline and Callawa mining operations. These actions would be refined in consultation with the administering authority during the assessment of the proposed Cundaline and Callawa mining operations.

Table 9-1
Proposed Environmental Management Actions

Number	Topic	Objective	Action	Timing	Advice
1	Mining Below the Watertable	To minimise the long-term impact of the open pits on groundwater following mine closure.	• All mine voids at the proposed Cundaline and Callawa mining operations which progress below the watertable will be backfilled to above the pre-mining watertable level.	Prior to mine closure.	-
2	AER	Annually prepare reports on environmental management, monitoring and rehabilitation.	• BHP Billiton Iron Ore will prepare an AER that discusses environmental management actions, summarises monitoring results and describes rehabilitation activities at the Goldsworthy operations over the 12 month reporting period. • The AER will be distributed to key stakeholders and provide copies to other interested parties if requested.	Annually during operations.	DMP DEC
3	Mine Planning Process	Include consideration of key environmental aspects in mine planning process, and adjust designs where possible to minimise environmental impacts.	• BHP Billiton Iron Ore will implement the mine planning process described in Section 3.3 and illustrated on Figure 3-3 of this EPS.	During the life of the mine.	DMP DEC

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APPENDIX A

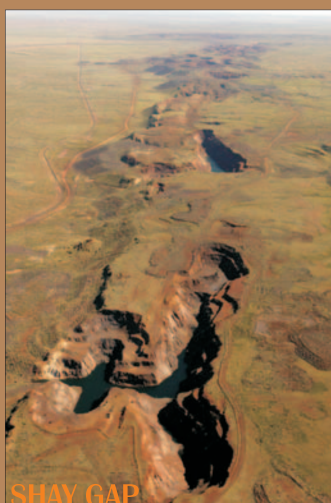
ENVIRONMENTAL MANAGEMENT PLAN
(BHP BILLITON IRON ORE, 2009a)


YARRIE

GOLDSWORTHY IRON ORE MINING OPERATIONS
ENVIRONMENTAL MANAGEMENT PLAN


CATTLE GORGE


NIMINGARRA


SHAY GAP


SUNRISE HILL

REVISION 4
May 2009

BHP Billiton Iron Ore

GOLDSWORTHY IRON ORE MINING OPERATIONS

ENVIRONMENTAL MANAGEMENT PLAN

REVISION 4

May 2009

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EXECUTIVE SUMMARY

BHP Billiton Iron Ore Pty Ltd's Goldsworthy Iron Ore Mining Operations are located approximately 200 kilometres (km) by road east-southeast of Port Hedland in the Pilbara region of Western Australia. Goldsworthy is owned by the Mt Goldsworthy Mining Associates Joint Venture. The Joint Venture participants are BHP Billiton Minerals Pty Ltd (85%), CI Minerals Australia Pty Ltd (8%) and Mitsui Iron Ore (7%). BHP Billiton Iron Ore manages Goldsworthy on behalf of the Joint Venture participants. The majority of mining activity is undertaken within mining lease M263SA.

The expansion of Goldsworthy has been conducted in phases. The first major phase involved the development of the Shay Gap and Sunrise Hill-Nimingarra mining areas, which are located approximately 50 to 70 km to the east of the Mount Goldsworthy mining area, between 1972 and 1992. In 1992, approval was obtained for the Yarrie operations, which are located a further 20 km to the east of Shay Gap. In 2005, approval was obtained for the Cattle Gorge mining operations (located between Yarrie and Sunrise Hill) plus extensions to the Nimingarra (Nim I) and Yarrie (Y10, Y7 and Y4B) mining areas.

Current mining operations are centred at Yarrie with some mining still taking place at the Nimingarra, Cattle Gorge and Sunrise Hill deposits. The Mount Goldsworthy and Shay Gap mining areas are no longer operational, with the majority of activities at these sites directed towards the monitoring and maintenance of rehabilitated landforms.

Goldsworthy is operated in accordance with the *Iron Ore (Goldsworthy) Agreement Act 1964,* and the *Iron Ore (Goldsworthy-Nimingarra) Agreement Act 1972*. Environmental operating requirements for the site are specified in the Goldsworthy Notice of Intent (GML, 1986), and the conditions of Ministerial Statement's. No. 000303 and No. 000682 issued by the Minister for the Environment, and Licences 5611 and 4412 issued under Parts IV and V of the *Environmental Protection Act, 1986* (EP Act), respectively.

This Environmental Management Plan (EMP) has been prepared to satisfy the relevant conditions of Ministerial Statement of Approval No. 000682 (issued in August 2005), and the relevant conditions included in Ministerial Statement of Approval No. 000303 (issued in February 1993). It replaces the EMP presented for public review in 2006 (Revision 3) (BHP Billiton Iron Ore, 2007).

Whilst the overall structure remains similar to the 2007 EMP, the content has been updated to include the site specific characteristics of the Cundaline and Callawa operations, and as supporting documentation to the Cundaline and Callawa Mining Operations EPS (BHP Billiton Iron Ore, 2008a).

This EMP describes the overall environmental management programme that will be used to manage potential impacts of Goldsworthy on environmental aspects relevant to the site. These include soil resources, landforms, surface water, groundwater, air quality, noise, flora, fauna and Aboriginal heritage. For each, the EMP identifies potential impacts, establishes management objectives, outlines relevant strategies/practices/procedures to minimise impacts, establishes performance indicators and sets out monitoring requirements.

The management of flora and fauna, weed species and stygofauna is managed in accordance with separately prepared management plans as required under Ministerial Statement No. 000682. References to these plans are made throughout the EMP where appropriate.

The EMP also contains an overview of how the site specific environmental management measures are linked to BHP Billiton's Environmental Management System, Health, Safety, Environment and Community (HSEC) Policy and Management Standards. The EMP includes a description of the main components of the Environmental Management System and its application to Goldsworthy, including employee and contractor responsibilities, training, auditing and reporting systems as well as the risk assessment and management system.

As per the conditions of Ministerial Statement of Approval No. 000682, this EMP will be reviewed and revised at intervals of no more than five years, or when significant changes occur at Goldsworthy.

1 INTRODUCTION

1.1 BACKGROUND

The Goldsworthy Iron Ore Mining Operations (Goldsworthy) are located approximately 200 kilometres (km) east-southeast of Port Hedland, in the northern Pilbara region of Western Australia (WA) (Figure 1-1). Goldsworthy is operated by BHP Billiton Iron Ore Pty Ltd (BHP Billiton Iron Ore).

BHP Billiton Iron Ore's activities at Goldsworthy are conducted under the *Iron Ore (Goldsworthy) Agreement Act, 1964,* and the *Iron Ore (Goldsworthy-Nimingarra) Agreement Act, 1972*. Environmental requirements are specified in the Goldsworthy Operations Notice of Intent (Goldsworthy Mining Limited, 1986), and the conditions of Ministerial Statement's No. 000303 and No. 000682 issued by the Minister for the Environment under Part IV of the WA *Environmental Protection Act, 1986* (EP Act), and Licences 5561 and 4412 issued under Part V of the EP Act.

The expansion of Goldsworthy has been conducted in phases. The first major phase involved the development of the Shay Gap and Sunrise Hill-Nimingarra mining areas, which are located approximately 50 to 70 km to the east of the Mount Goldsworthy mining area, between 1972 and 1992. In 1992, approval was obtained for the second major phase, which involved development of the Yarrie operations located a further 20 km to the east. In 2005, approval was obtained for the Cattle Gorge mining operations (located between Yarrie and Sunrise Hill) plus extensions to the Nimingarra mining areas (Nim I) and Yarrie (Y10, Y7 and Y4B). In 2009, approval was obtained for the mining of the Cundaline and Callawa deposits.

Current mining operations are centred at Yarrie with some mining still takes place at the Nimingarra, Cattle Gorge and Sunrise Hill deposits (Figure 1-2). The Mount Goldsworthy and Shay Gap mining areas are no longer operational, with the majority of activities at these sites directed towards the monitoring and maintenance of rehabilitated landforms.

Figure 1-2 shows the main deposits, mining areas, infrastructure facilities and BHP Billiton Iron Ore's mining tenements in the Goldsworthy area.

1.2 HISTORICAL DEVELOPMENT OF THE ENVIRONMENTAL MANAGEMENT PLAN

BHP Iron Ore (BHPIO) prepared and submitted an initial Environmental Management Plan (EMP) for the Yarrie-Nimingarra Iron Ore Project in 2000 (i.e. Revision 1).

BHP Billiton Iron Ore revised the initial EMP in 2005 (i.e. Revision 2) as supporting documentation to the Goldsworthy Environmental Protection Statement (EPS) (BHPBIO, 2005a).

In 2007 the EMP was revised to satisfy Proponent Commitment No. 1 in Schedule 2 of Ministerial Statement of Approval No. 000682 and the relevant conditions and Proponent Commitments included in Ministerial Statement of Approval No. 000303 (i.e. Revision 3).

1.3 PURPOSE OF THIS DOCUMENT

This revision of the EMP (i.e. Revision 4) has been prepared to satisfy the relevant conditions of Ministerial Statement of Approval No.'s 000682 and 000303. It replaces Revision 3 and has been revised to include the site specific characteristics of the Cundaline and Callawa mining operations, and as supporting documentation to the Cundaline and Callawa EPS (BHP Billiton Iron Ore, 2008a).

Ministerial Statement of Approval No. 000682

Proponent Commitment No. 1 in Schedule 2 of Ministerial Statement of Approval No. 000682 is outlined below, along with the corresponding sections of this EMP that address each component of the commitment.

	Proponent Commitment	Section
1.1	*Implement an Environmental Management Plan for the Project which includes the following:*	
	• *A description of key components of the Project (ie. mining method, overburden management, ore processing, ore loading and transportation, water and power supply, and service infrastructure).*	2
	• *A description of the Environmental Management System, and the Environmental Risk Assessment and Management systems which will be used at the Project. This section will include a description of the findings of the proponent's most recent Environmental Risk Assessment of the Goldsworthy Extension Project operations. It will also include a description of how best practicable environmental measures have been applied to risks which are identified (through the Risk Assessment Process) as requiring this level of management to reduce residual risk to an acceptable level.*	3
	• *A description of the environmental management procedures and practices to be used to minimise impacts on key environmental aspects. These aspects are to include: soil resources, landforms, surface water, groundwater, flora (including priority species and species of interest), fauna (including priority species and species of interest), air quality, noise, waste, dangerous goods and hazardous materials, and Aboriginal heritage.*	4
	• *For each environmental aspect, the Environmental Management Plan will describe the overall management objective, potential impacts, management measures and monitoring programme to track performance.*	4

Proponent Commitment No. 1 also contains two components which relate to the revision of this EMP and its distribution. These commitments (1.2 and 1.3) are repeated below:

1.2 *The Environmental Management Plan will be reviewed and revised at intervals of no more than five years, or when significant changes occur at the mine.*

1.3 *A copy of each new revision of the Environmental Management Plan will be provided to key Stakeholders, and to other interested parties if requested.*

Ministerial Statement of Approval No. 000303

Ministerial Statement of Approval No. 000303 relates to the Yarrie mining area of Goldsworthy. Conditions within the Statement which are relevant to this EMP are presented below, along with the corresponding sections of the EMP that address each condition.

	Ministerial Condition	Section
3-1	• *Water Management* *Prior to the commencement of productive mining, the proponent shall prepare a water management programme to the requirements of the Minister for the Environment on advice of the Water Authority of Western Australia and the Department of Minerals and Energy. This programme shall be based upon hydrogeological studies and shall include consideration of, but not be limited to:* *1) surface water monitoring and management procedures;* *2) groundwater dewatering impacts, monitoring and management procedures; and* *3) long term management of any water bodies which expose the water table to long term evaporation.*	4.4 Appendix B
3-2	*The proponent shall implement the water management programme required by condition 3-1.*	
4-1	• *Fauna Management* *Prior to the commencement of any clearing or construction activity on the mine site, excluding the railway, the proponent shall conduct a fauna survey and prepare a fauna management plan to the requirements of the Minster for the Environment on advice of the Department of Conservation and Land Management.*	4.9.4
4-2	*The proponent shall implement the fauna management plan required by condition 4-1.*	

Ministerial Condition		Section
5.0	• *Decommissioning* *The satisfactory decommissioning of the project, removal of the plant and installations and rehabilitation of the site and its environs is the responsibility of the proponent.*	
5-1	*At least six months prior to decommissioning, the proponent shall prepare a decommissioning and rehabilitation plan.*	1.4
5-2	*The proponent shall implement the plan required by condition 5-1.*	
8-1	• *Compliance Auditing* *In order to ensure that environmental conditions and commitments are met, and audit system is required.*	3.2.6
8-2	*The proponent shall prepare periodic "Progress and Compliance Reports" to help verify the environmental performance of this project, in consultation with the Environmental Protection Authority.*	

Ministerial Statement of Approval No. 000303 also contains a number of proponent commitments. Each proponent commitment is presented below, along with the corresponding sections of this EMP that address each commitment.

Proponent Commitment		Section
7-1	• *Clearing of Vegetation* *Only the minimum area required for construction and operation of the project will be disturbed. Where practicable, topsoil to a depth of about 15 cm will be stripped and stockpiled prior to any earthmoving and, once construction is completed, all disturbed areas no longer required for the operation of the facility will be contoured (where necessary), topsoiled (where available), ripped and seeded where necessary.*	4.2.4 4.3.4
7-2	• *Development Policy* *BHP will pursue a "minimum impact" development policy which will include minimum clearing and ground disturbance, minimum groundwater abstraction, minimum water discharge, careful monitoring and effective rehabilitation. Adherence to this policy will be a requirement written into the mining contracts.*	4.2.4 4.3.4
7-3	• *Railway Creek Crossings* *Care will be exercised at all stages of construction to minimise damage to drainage channels. Culverts will be utilised along the rail route to avoid interference with the natural surface drainage. Large culverts will be utilised to cross Eel Creek.*	4.4.4
7-4	• *Shadowing Effects of Railway Line* *BHP will establish a programme to monitor and evaluate the health of vegetation downslope of the railway embankment. If any adverse impacts are revealed by this monitoring, BHP will take steps as necessary to mitigate those impacts.*	4.8.1 4.8.2
7-5	• *Borrow Pits* *Borrow pits for all construction materials will be selected and operated to minimise erosion and land disturbance. Where possible, pits will be located where they are not visible from the village or access roads. The BHP-Newman Guidelines and Objectives for Borrow Pit Development and Rehabilitation will be applied.*	4.1.2 4.3.4
7-6	• *Water Supplies* *Water supplies will be preferentially obtained from bores drilled into the Yarrie plateau adjacent to the mine pit. Water will be abstracted from the Eel Creek aquifer only if supplies from the plateau are insufficient to meet project requirements.*	4.5.2
7-7	• *Monitoring of Drawdowns and Water Quality* *If water is abstracted from the Eel Creek aquifer, BHP will monitor the groundwater levels and water quality in the aquifer to detect excessive drawdown or water quality changes. If significant effects are observed, the health of vegetation in the creekbed will be monitored and steps taken to mitigate adverse impacts.*	4.5.2

	Proponent Commitment	Section
7-8	• *Surface Water Discharges* *Water produced from dewatering will be used, as much as possible, for domestic and mine uses. The minimum possible amount will be discharged to the natural surface drainage. BHP will monitor the quality of all water discharged to the environment from pit dewatering or other sources. Water discharged to natural drainage will comply Works Approvals and Licences issued under Part V of the Environmental Protection Act 1986.*	4.4.4 4.4.6
7-9	• *Hydrogeological Investigations* *Hydrogeological investigations will continue with the aims of better defining the aquifers of the Yarrie area, identifying sources of project water supply, predicting drawdown effects and modelling the effect of salinity buildup in the mined-out Y2 pit. The results of these investigations will be used to optimise the water abstraction and dewatering programmes and the long-term management of the mined-out pit.*	4.5.4
7-10	• *Erosion Control* *Erosion around roads and building areas will be controlled by minimisation of clearing, rehabilitation, proper drainage and bunding where necessary. Erosion at creek crossings and culverts will be minimised by the use of rock armouring and careful design. Regular inspections will be carried out to detect and repair any erosion damage which does occur.*	4.2.4 4.3.4
7-11	• *Overburden* *The overburden storage site will be designed to be stable and to resist erosion. At the completion of mining, the surface of the overburden will be rehabilitated.*	4.3.4
7-12	• *Hazardous Materials Storage* *The handling, use and disposal of hazardous materials will comply with all local and State regulations. Bulk fuel will be stored in above-ground tanks held in impermeable, bunded enclosures, in accordance with Department of Minerals and Energy (DOME) requirements. Explosives will be stored in a magazine remote from accommodation facilities, workshops, the mine site and any areas susceptible to flooding.*	4.13.2 4.13.3
7-13	• *Oily Wastes* *Used oils will be stored securely in drums or tanks and will be periodically removed by a licensed waste disposal contractor for recycling or disposal at a Shire Council-approved site.* *Runoff and wastewater from areas subject to hydrocarbon contamination, such as workshops and washdown bays, will be drained to evaporation ponds where sunlight and bacteria will decompose the hydrocarbons. Water contaminated with hydrocarbons will not be released to the environment.*	4.12.3 4.12.4
7-14	• *Landfills* *Landfills for the disposal of non-toxic (including domestic) wastes will be managed in accordance with relevant local health authority requirements.*	4.12.4
7-15	• *Fire Prevention* *BHP will maintain firefighting equipment at the mine site in case of accidental fires. The induction briefing given to all site personnel will include the prevention of accidental fires.*	4.8.4
7-16	• *Weeds* *Regular inspections of the vegetation adjacent to the railway line, roads and rehabilitated areas to ensure that weed infestation is not occurring. Any infestations discovered in the area will be dealt with by appropriate physical or chemical means.*	4.8.4
7-17	• *Pebble-mound Mouse Nests* *Disturbance of areas where Pebble-mound Mouse nests are located will be avoided wherever possible. BHP will undertake detailed surveys of Pebble-mound Mouse populations in the project area as described in Section 5.0 to provide data for their proper management.*	4.9.1
7-18	• *General Flora and Fauna Protection* *Pets (dogs and cats), firearms and indiscriminate use of off-road vehicles will be prohibited in the project area.*	4.8.4 4.9.4
7-19	• *Noise* *Blasting will be carried out at specified times during daylight hours to minimise noise impacts at the village. Occupational noise levels will be monitored and managed as required under Works Approvals and Licences issued under Part V of the Environmental Protection Act 1986.*	4.7.4

	Ministerial Condition	Section
7-20	• *Dust Control* *Normal means of dust suppression, including watering of roads, will be employed to minimise dust generation. Occupational dust levels will be monitored and managed as required under Works Approvals and Licences issued under Part V of the Environmental Protection Act 1986.*	4.6.4
7-21	• *Employment* *The mining contractor will be encouraged to source the operational workforce from the Pilbara, including Karratha and Wickham as well as Port Hedland and Newman. Former BHP employees accepting redundancy from Shay Gap will, if they indicate interest, be made known to the contractor and, if suitable, the contractor will be encouraged to employ them.*	2.5
7-22	• *Community Liaison* *BHP will continue to consult with Aboriginal custodians of the project area and the owners of the neighbouring pastoral leases. BHP will respect the "no-go" areas agreed to with the Aboriginal elders.*	4.14.3
7-23	• *Rehabilitation* *Procedures developed by BHP in the Pilbara will be applied to rehabilitation at Yarrie. The object of the rehabilitation will be to ensure that, at the end of the project, all disturbed surfaces (with the exception of the mine pits) are returned to a stable condition with a flora and fauna which approaches the natural condition of the site.*	4.3.4
7-24	• *Decommissioning* *Following the completion of the project, buildings and other structures will be removed. Concrete slabs will be broken up and buried. The rehabilitation of the overburden will be completed. Remaining borrow pits will be rehabilitated. All unwanted bare or compacted areas will be contoured (where necessary), ripped and seeded. Monitoring of the rehabilitated areas will be undertaken to gauge success. This monitoring will continue until the vegetation is seen to be progressing towards a condition similar to that which existed before mining.*	4.3.4 4.8.6
7-25	• *Yarrie Pit Long-term Salinity* *BHP will continue to monitor the salinity of water in the Goldsworthy pit for several years to determine the future likelihood of saline water seeping from the pit into the De Grey River aquifer. The results of this monitoring will be used to formulate management strategies for the Yarrie pit if necessary.*	4.5.4 4.5.6
7-26	• *Project Management* *The Yarrie project will be overseen by BHP environmental officers to ensure that the environmental management programme is adhered to. The commitments made to environmental protection in this CER will be written into the contracts for construction and mining. Regular internal audits will be carried out to ensure that the environmental management programme is being fulfilled and that no unacceptable environmental impacts are occurring.*	3.3.2 3.3.5

Obligations under this EMP

This EMP has been prepared to assist BHP Billiton Iron Ore and its contractors in the implementation of appropriate environmental management measures during the operation of Goldsworthy. Where there is any conflict between the provisions of this EMP and a contractor's obligation under the relevant contract, including the various statutory requirements (i.e. licences, permits, consent conditions and relevant laws), the contract and statutory requirements are to take precedence. In the case of any real or perceived ambiguity between elements of this EMP and the above statutory requirements the contractor shall first request clarification from BHP Billiton Iron Ore prior to implementing that element of this EMP over which the ambiguity is identified.

1.4 RELATIONSHIP BETWEEN THIS PLAN AND OTHER GOLDSWORTHY MANAGEMENT PLANS

This EMP is a broad document that describes the overall programme to be used to manage potential impacts of Goldsworthy on environmental values relevant to the site.

Figure 1-3 shows the relationship between this EMP and the other management plans required by Ministerial Statement of Approval No. 000682.

Table 1-1 is a summary of other management plans required by Ministerial Statement of Approval No. 000682.

Table 1-1
Environmental Management Plans Required by Ministerial Statement of Approval No. 000682

Relevant Ministerial Condition	Environmental Management Plan/Programme Required	Status
6	Significant Species Management Plan	Revision 3 prepared September 2008 (BHP Billiton Iron Ore, 2008b)
7	Weed Management Plan	Revision 2 prepared September 2008 (BHP Billiton Iron Ore, 2008c)
8	Subterranean Fauna Survey Plan	Prepared January 2006 (BHP Billiton Iron Ore, 2006)
9	Decommissioning and Rehabilitation Plan	Revision 2 prepared September 2008 (BHP Billiton Iron Ore, 2008d)

2 PROJECT DESCRIPTION

2.1 MINING METHOD

The mining method employed at Goldsworthy involves the selective removal of overburden and the mining of ore using conventional drill, blast and haul mining methods. Mining is undertaken in benches and following drilling and blasting, broken ore and waste rock is loaded by hydraulic excavators or front end loaders to off-highway dump trucks for transport to the crushing/screening facilities, temporary stockpiles or OSAs.

2.2 OVERBURDEN MANAGEMENT

Overburden generated at Goldsworthy is hauled to out-of-pit overburden storage areas (OSAs), or is used to backfill mined-out voids. The OSAs and infill areas are designed to be stable, and are rehabilitated using plant species from the local area. Closure objectives for OSAs are discussed in the Decommissioning and Rehabilitation Plan (DRP) (BHP Billiton Iron Ore, 2008d).

BHP Billiton Iron Ore will manage overburden in the new mining areas to maximise the infilling of pits and minimise the requirement to use out-of-pit OSAs. The Cattle Gorge, Nim I and Callawa pits will be backfilled to at least 5 m above the natural groundwater table in order to minimise potential long term impacts on groundwater resources. An overburden storage plan will be developed for each new OSA.

The depth of weathering encountered within the iron formations in the Goldsworthy area is typically some 80–100 m below the current surface. All rock types occurring above the weathering horizon are oxidised. Hence, this natural weathering process has leached any potential sulphide minerals. In the Goldsworthy area, potential sulphide bearing minerals only occur in the interbedded mudstone and chert horizons of the lower (basal) member of the Nimingarra Iron Formation. A relatively small proportion of potentially acid forming (PAF) material from these horizons has been encountered at Yarrie (Y2/3 pit) and at Sunrise Hill (SHW7). No PAF material is expected to be encountered at Cundaline or Callawa.

In order to manage the identified PAF material, BHP Iron Ore prepared and implemented a Net Acid Generating (NAG) Material Management Plan (BHPIO, 2000). In 2004, the Plan was updated to include mining operations at Nimingarra and Sunrise Hill, and was included as an attachment to the Nimingarra and Sunrise Hill Notice of Intent (NOI) (BHP Billiton Iron Ore, 2004a). The current NAG Material Management Plan covers the Nimingarra, Sunrise Hill and Yarrie mining areas and includes management procedures for the following:

- NAG material handling requirements during operations;
- investigation of sites for long term storage of NAG material;
- details of approved NAG storage locations during operations;
- monitoring requirements for approved NAG storage locations; and
- closure plans for approved NAG storage locations.

In the event that PAF material is found within any proposed mining areas in Goldsworthy, the management procedures outlined in the NAG Material Management Plan will be applied to that area. A copy of the NAG Material Management Plan is provided in Appendix A.

2.3 PROCESSING, LOADING AND TRANSPORTATION OF ORE

The primary crushing facilities at Yarrie and Nimingarra will continue to be used for ore extracted from the Yarrie, Nimingarra, Sunrise Hill, Sunrise Hill West, Cattle Gorge, Cundaline and Callawa mining operations. Crushed ore at Yarrie and Nimingarra/Sunrise Hill is loaded onto the ore trains after being reclaimed from the crushed ore stockpiles and conveyed to the train load out bins.

Ore is hauled from the Cattle Gorge pits directly to the Yarrie crusher via a haul road located to the south west of Elephant Rock. A fleet of six haul trucks are used to transport the ore and operate 24 hours per day. It is estimated that each round trip takes approximately 1 hour. A water cart is used for watering the haul road to Yarrie and for dust suppression on roads in the Cattle Gorge mine area.

Ore from Cundaline will be processed at new primary and secondary crushing facility located adjacent to the mining pits or at the existing Yarrie facilities. Ore from the Callawa deposit will be processed at Yarrie. The combined ore processing for Cundaline and Callawa will be up to a maximum rate of 5 Mtpa.

2.4 ANCILLARY INFRASTRUCTURE

Ancillary infrastructure at Goldsworthy includes:

- a fly-in-fly out accommodation village at Yarrie;
- airstrip;
- mine offices;
- workshops and laydown areas;
- fuel farm and fuelling facilities;
- electricity substations and reticulation;
- telecommunications;
- water supply; and
- explosives and hydrocarbon stores.

A description of these facilities is provided below.

Power Supply

The existing power supply system at Goldsworthy includes a 66 kilovolt (kV) line from Port Hedland to Shay Gap and 22 kV lines to Yarrie, Sunrise Hill, Nimingarra, and Cattle Gorge. Power will be supplied to Cundaline and Callawa by extending the existing 22 kV line from Yarrie or from on-site diesel fuelled generators. Night lighting will be powered by on-site diesel fuel generators.

Water Supply

Water supplies for each mining area are obtained from licensed dewatering operations and/or borefields. Water supply for Cundaline and Callawa will be provided by a pipeline extension from the Yarrie water supply system.

Offices, Workshops and Other Amenities

The existing offices, workshops and other general amenities located at Nimingarra and Yarrie will continue to be used for the Goldsworthy operations, including Cundaline and Callawa. The main office and workshop at Yarrie will continue to be the primary facilities at Goldsworthy.

Accommodation Village

Accommodation facilities at Goldsworthy are located at the Yarrie Accommodation Village. The village contains facilities to house up to approximately 400 mine personnel, and dry and wet mess areas.

Hydrocarbon Use and Storage

The existing fuel storage facilities are located at Nimingarra and Yarrie. These facilities are above ground, bunded and constructed and operated in accordance with applicable Australian Standards. Current fuel consumption is approximately 14 ML of diesel per annum (BHP Billiton Iron Ore, 2005b). Fuel storage facilities will be constructed at Cundaline.

Road Transport

The existing access road for Yarrie will be used to provide access to Cundaline and Callawa. Vehicles using this road for access will include light vehicles, freight trucks, road trains and fuel trucks. It is expected that vehicle use of the access road will remain similar to the current vehicle use, although additional road train trips will be required if a processing plant is located at Cundaline.

Airstrip

Fly-in/fly-out operations occur from the Shay Gap airstrip, which will remain unchanged for Cundaline and Callawa. The airstrip will be maintained and licensed to Civil Aviation Safety Authority (CASA) standards (including fencing, to minimise access by cattle and native fauna).

2.5 WORKFORCE

The current workforce at Goldsworthy is approximately 290 people. Approximately 140 to 150 of these employees will be used at Cundaline and Callawa. The majority of the workforce will continue to be sourced from within the Pilbara Region.

3 ENVIRONMENTAL MANAGEMENT SYSTEM AND RISK ASSESSMENT AND MANAGEMENT SYSTEMS

3.1 OVERVIEW

The following sub-sections provide an overview of how the environmental management measures contained in this EMP are linked to the BHP Billiton Sustainable Development Policy and Health, Safety, Environment and Community (HSEC) Management Standards. They provide an overview of the Environmental Management System (EMS) used by BHP Billiton Iron Ore, including employee and contractor responsibilities, training, auditing and reporting systems, as well as risk assessment and management system in place at all BHP Billiton operations.

3.2 ENVIRONMENTAL MANAGEMENT SYSTEM

3.2.1 Summary of the Environmental Management System

The principal components of the EMS include:

- environmental policy and standards;
- planning;
- implementation and operation;
- monitoring and corrective action; and
- management review.

Corporate Sustainability Framework

The BHP Billiton Corporate Sustainability Framework is discussed below.

- The framework is the Company's "overriding commitment to health, safety, environment, community responsibility and sustainable development". It presents BHP Billiton's purpose, which is "to create value through the discovery, development and conversion of natural resources, and the provision of innovative customer and market-focused solutions". In doing so, BHP Billiton values an overriding commitment to health, safety, environmental responsibility and sustainable development.
- Supporting the framework is the Sustainable Development Policy, which outlines a commitment to sustainable development and to continual improvement in performance, efficient use of natural resources and aspires to zero harm to people and the environment.
- The framework is implemented via the HSEC Management Standards and associated guidelines.
- The implementation of the HSEC Management Standards and associated guidelines is measured through BHP Billiton's Assessment and Targets Reporting processes.

Environmental Policy and Standards

The principles of sustainable development are implemented across all BHP Billiton Iron Ore operations through the use of the BHP Billiton HSEC Management Standards. These management standards have been developed to interpret and support the Sustainable Development Policy illustrated on Figure 3-1. The standards form the basis for the development and application of HSEC Management Systems at all levels of BHP Billiton's operations.

The objectives of the HSEC Management Standards are to:

- provide a risk-based management system framework, consistent with the BHP Billiton Enterprise-Wide Risk Management Policy, and with ISO 14001, OHSAS 18001, SA 8000 and other internationally recognised standards, that support the implementation of the BHP Billiton Charter, and the Sustainable Development Policy across all BHP Billiton operations;
- set out and formalise expectations for the progressive development and implementation of detailed HSEC Management Systems at all levels of BHP Billiton operations;
- provide benchmarking, against which HSEC Management Systems across all BHP Billiton operations can be measured; and
- provide a basis from which to drive continuous improvement towards leading industry practice and sustainable development.

The HSEC Management Standards are described in full within the *HSEC Management Standards* (BHP Billiton, 2002) under the following 15 headings:

1. *Leadership and Accountability;*
2. *Legal Requirements and Document Control;*
3. *Risk and Change Management;*
4. *Planning, Goals and Targets;*
5. *Awareness, Competence and Behaviour;*
6. *Health and Hygiene;*
7. *Communication, Consultation and Participation;*
8. *Business Conduct, Human Rights and Indigenous Affairs;*
9. *Design, Construction and Commissioning;*
10. *Operations and Maintenance;*
11. *Suppliers, Contractors and Partners;*
12. *Product Stewardship;*
13. *Incident Reporting and Investigation;*
14. *Crisis and Emergency Management; and*
15. *Monitoring, Audit and Review.*

Where appropriate, extracts of the HSEC Management Standards are summarised in the following sub-sections.

Planning

BHP Billiton's HSEC Management Standard No. 4 requires the development of plans and programmes that include allocation of responsibilities, resources and timeframes to facilitate the achievement of Sustainable Development goals and targets, with systems to monitor and report on progress. These plans and programmes are updated as changes, modifications or new developments occur.

This EMP is a planning document that establishes environmental management objectives and formalises the environmental management programme for Goldsworthy. The EMP also provides the control measures that employees and contractors must use to achieve the agreed environmental management objectives specified in the environmental approvals, along with the monitoring and performance indicators to be met by the operation.

Implementation and Operation

The implementation and operation component of the EMS involves the following:

- clearly defining the EMS structure and delegation of responsibility;
- implementing training and awareness programmes and improving competence;
- maintaining communication channels;
- maintaining the document control system; and
- refining emergency contingency procedures and response plans.

These components are addressed by BHP Billiton Management Standards and a series of procedures, protocols, guidelines and toolkits that have been developed by BHP Billiton. The hierarchical structure of BHP Billiton management documents is illustrated by Figure 3-2.

BHP Billiton Iron Ore's operation-based management documents are developed and implemented within the broader BHP Billiton standards and procedures (Figure 3-2).

Checking, Corrective Action and Management Review

The checking and corrective action component of the EMS involves regular review of environmental monitoring records and assessment of the performance in relation to environmental objectives. Monitoring records for the mine are collated and reported annually in BHP Billiton Iron Ore's combined Annual Environmental Report (AER) for all of its Pilbara Mining Operations.

Section 4 provides details of the specific environmental management measures that will be used at Goldsworthy to meet BHP Billiton Iron Ore's environmental management objectives, as well as the operating conditions and statutory requirements relevant to Goldsworthy. These programmes, procedures and management measures will continue to be reviewed and updated as necessary in accordance with the EMS continuous review and improvement process.

Where necessary, this EMP will be revised to incorporate these updates.

Environmental Approvals Dossier

BHP Billiton Iron Ore maintains a dossier that contains copies of all environmental approvals, licences and permits relevant to Goldsworthy. The dossier is updated as necessary to include new operating approvals and updated licences.

3.2.2 Responsibilities

Site Manager

Overall environmental management at Goldsworthy is the responsibility of the BHP Billiton Iron Ore Site Manager. The responsibilities of the Site Manager are as follows:

- implement BHP Billiton Sustainable Development Policy and HSEC Management Standards at the site;
- ensure that the management aims and monitoring responsibilities of the EMP are met;
- understand environmental requirements and ensure compliance;
- set environmental objectives and targets;
- assign an individual responsible for environmental management (e.g. Environmental Officer) who has direct access to the Site Manager;
- direct the activities of company employees, contractors and subcontractors on-site to ensure that environmental requirements are met;
- obtain goods and services that conform with relevant legal, permit and contract requirements, accepted standards and BHP Billiton Iron Ore specifications;
- provide information/training to employees and contractors regarding their environmental obligations; and
- liaise with the mining contractor, other BHP Billiton Iron Ore staff and government agencies, as required.

As described in Section 3.2.1, the EMP will be periodically reviewed and revised during the mine life to incorporate the results of environmental monitoring, regular auditing, improving industry practices or any major change to mining operations. An effective feedback system is an integral part of this improvement process. In order to provide this feedback, the Site Manager will be responsible for ensuring:

- scheduled and documented inspections of key aspects that are highlighted in the EMP are undertaken; and
- environmental events are reported and investigated (e.g. major hydrocarbon spills).

Contractors

The intent of BHP Billiton HSEC Management Standard No. 11 is that activities such as the contracting of services, the purchase, hire or lease of equipment and materials, and activities with partners, are carried out so as to minimise any adverse HSEC, consequences and, where possible, to enhance community development opportunities.

The contracting company undertaking the mining operation at Goldsworthy is required to designate an environmental representative. The main responsibilities of the environmental representative are to:

- maintain regular contact with the BHP Billiton Iron Ore Site Manager and registered Site Manager to ensure the integration of environmental objectives with the mining operation;
- provide regular reports to site management on environmental issues;
- maintain compliance with DEC licence conditions;
- conduct or co-ordinate regular environmental inspections/audits; and
- assess compliance with environmental operating conditions.

Minimum environmental standards and responsibilities will continue to be incorporated into all written contracts at Goldsworthy. These minimum standards include, but are not necessarily limited to, a requirement that contractors comply with this EMP and BHP Billiton's Sustainable Development Policy and HSEC Management Standards, as well as relevant legislative and licensing requirements.

Contracts include an environmental clause stating that contractors must comply with the environmental practices detailed in this EMP. This documentation is kept on file at the mine and a copy is also held by the BHP Billiton Iron Ore Site Manager.

In addition to contractual requirements, the following management measures will be implemented at Goldsworthy to ensure that contractors comply with the management practices outlined within this EMP:

- As part of BHP Billiton Iron Ore's commitment to ensure products removed from site are disposed of or recycled in an environmentally acceptable manner, contractors will be required to provide a copy of the licence if requested, which stipulates their authority to handle the material to be removed from the site.
- BHP Billiton Iron Ore considers the environmental performance of tenderers with reference to price, timing, experience and other criteria, including:
  - nature and number of environmental events (particularly repeat events) that the tenderer has had in last three years;
  - presence of an implemented EMS;
  - environmental management procedures that the tenderer has in place;
  - dust prevention measures that the tenderer will use on site; and
  - spill prevention and response procedures that the tenderer puts in place.
- Contractors will be required to apply appropriate environmental management practices in carrying out the contracted work to minimise environmental risks.
- Contractor employees will be required to undergo site induction that includes the environmental requirements of Goldsworthy.
- Monitoring of contractors activities will be carried out to ensure compliance with issues raised during the audit process and conditions specified in contracts.

3.2.3 Training

BHP Billiton HSEC Management Standard No. 5 requires employees, contractors and visitors to receive inductions that address relevant HSEC objectives, hazards, risks, controls and behaviours at the commencement of their employment or site visit. Management Standard No. 5 also requires the establishment of systems to enable the identification, prioritisation, planning, documentation and monitoring of training needs so that employees and contractors are able to fulfil their HSEC responsibilities. The identification, documentation and periodic review of HSEC competencies are also required for all positions.

Employee and contractor training will be conducted to minimise potential impacts arising from a lack of knowledge regarding sensitivities of the environment or inadequate application of site management procedures. In accordance with BHP Billiton Management Standard No. 5:

- Initial environmental training will be provided to all BHP Billiton Iron Ore personnel and contractors via the site induction process.
- Specific training on environmental management issues will be based on the outcomes of a needs analysis for each work area/employee.
- Induction and environmental training records will be maintained on-site to allow for management of periodic refresher courses.

General workforce environmental induction and training will include, but is not necessarily limited to:

- vegetation clearing and disturbance procedures;
- identification of weed species, reporting of infestations and hygiene procedures to prevent the introduction and spread of weeds;
- protection of flora and fauna; and
- waste management, storage and handling of hydrocarbons/chemicals and spill response and clean up procedures.

3.2.4 Communication, Consultation and Participation

BHP Billiton Management Standard No. 7 was established with the intention of facilitating the maintenance of effective communication with stakeholders associated with BHP Billiton activities, while encouraging stakeholder participation in, and commitment to Sustainable Development performance improvement initiatives. BHP Billiton Management Standard No. 7 establishes performance requirements for communication, consultation and participation across BHP Billiton operations. These performance requirements include the establishment of systems to identify and work with stakeholders, including participation in the development, implementation, review and improvement of Sustainable Development initiatives and programmes, regular dissemination of relevant policies and standards to employees, contractors and external stakeholders, and maintenance of open consultation and communication with government and other organisations in order to contribute to the development of public policy initiatives.

In accordance with BHP Billiton HSEC Management Standard No. 7, information is shared across all BHP Billiton operations. Provision is also made for the recording, acknowledgement, investigation and reporting of concerns, complaints and other communications related to Sustainable Development aspects of the BHP Billiton operations. Communication, consultation and participation processes are regularly reviewed in collaboration with stakeholders.

Communication and consultation with stakeholders at Goldsworthy is undertaken at a variety of levels and includes employees, contractors and regulatory authorities as well as other external parties. The dissemination of BHP Billiton's Sustainable Development Policy and objectives is an essential part of the employee and contractor training programme (Section 3.2.3). At the same time, participation of employees and contractors is an integral part of the review and verification of Sustainable Development performance at Goldsworthy.

Enviro Alerts

Environmental awareness notices and leaflets (known as 'Enviro Alerts') will be provided to contractors and employees to raise awareness of environmental management issues at Goldsworthy. Issues currently covered by Enviro Alerts include landfarms, weed management, flora and fauna species of conservation significance, and hazardous wastes and chemicals.

3.2.5 Auditing

BHP Billiton Management Standard No. 15 establishes a number of requirements in relation to auditing of compliance with BHP Billiton Management Standards and the management of HSEC risk. In particular BHP Billiton Management Standard No. 15 establishes a requirement for inspections and audits to be conducted at frequencies appropriate to the level of HSEC risk. Systems must also be in place to respond to and manage instances of non-conformance. Annual self-assessments are conducted at each site to assess the extent of compliance with BHP Billiton Management Standards.

The suitability, adequacy and effectiveness of HSEC management systems are assessed through documented annual management reviews. BHP Billiton Management Standard No. 15 requires that all sites and organisations be audited at a minimum frequency of once every three years (more frequent if warranted by HSEC risk profile and performance history) to establish the extent of compliance with the Management Standards. Non-conformances are addressed through the preparation and execution of performance improvement plans.

Both internal and external auditing provides a method for assessing whether BHP Billiton Iron Ore employees and contractors are fulfilling their environmental responsibilities in accordance with the Project EMP. Where the auditing process identifies sub-optimal performance or non-compliance, BHP Billiton Management Standard No. 15 requires the development of an action plan to rectify the problem.

The auditing and review processes that will be used at Goldsworthy are as follows:

- BHP Billiton Iron Ore will undertake internal audits and will facilitate audits by government agencies to assess compliance with licence requirements and environmental obligations. Management personnel from government agencies may audit the site on an annual or three yearly basis as a component of Annual or Triennial report reviews.

- BHP Billiton Iron Ore will conduct an annual compliance audit. This audit will include, but is not necessarily limited to:
  - all aspects of the operation that potentially result in pollution and processes that result in emissions;
  - effluent or wastes;
  - land rehabilitation;
  - site closure;
  - permits;
  - programmes to enhance community and government relations;
  - effects on natural systems;
  - effects on archaeological, palaeontologic or historic artefacts; and
  - management systems to identify, control and monitor environmental risks arising from operations.
- BHP Billiton Iron Ore and/or the auditing organisation will prepare environmental performance/compliance reports that describe the status of compliance with environmental conditions at the time of the audit. These environmental performance/compliance reports will be submitted to the relevant administering authority where required by the operating approvals for Goldsworthy.

3.2.6 Reporting

BHP Billiton HSEC Management Standard No. 15 requires HSEC performance to be regularly measured, monitored, recorded and analysed with results reported to stakeholders as appropriate. Systems are also required to be in place to respond to and manage non-conformances.

Reporting to Government

In accordance with the requirements of the State Agreement Act, EP Act operating licences and a proponent commitment in the EPS, an AER is provided to the Department of Environment and Conservation (DEC), Department of Industry and Resources (DoIR), and other relevant authorities. The AER provides results of the environmental monitoring programmes and assessment of compliance with licence requirements. Where appropriate, environmental monitoring data is summarised and/or submitted in full as an appendix to the AER.

Ministerial Statements of Approval Nos. 000682 and No. 000303 contain conditions relating to compliance audit and performance reviews. To satisfy these ministerial requirements, BHP Billiton Iron Ore will continue to include a progress and compliance report (PCR) table in the AER. The PCR table presents a summary description of the status of the mine with regard to the conditions and proponent commitments specified in Ministerial Statement of Approval Nos. 000682 and 000303.

Event Reporting

The following event reporting mechanisms are implemented at Goldsworthy:

- all employees and contractors are required to report environmental occurrences and hazards via their supervisor for notification and follow-up investigation assessment;
- non-compliance or emergency events are reported to regulatory authorities as per the requirements of relevant licences and approvals; and
- significant events are reported to BHP Billiton Iron Ore at a corporate level where appropriate.

Reporting to Non-Government Stakeholders

The AER is available to non-government stakeholders through the Department of Environment and Conservation (DEC - previously the Department of Environment [DoE]) or via the public library at Newman. BHP Billiton and BHP Billiton Iron Ore also undertake public annual environmental reporting at a corporate level, which is distributed to interested parties and made available on the BHP Billiton website.

3.3 RISK ASSESSMENT AND MANAGEMENT SYSTEM

3.3.1 Overview

BHP Billiton's HSEC Management Standard No. 3 requires the application of HSEC risk management system in order to prioritise and manage risks and to drive continuous improvement in Sustainable Development performance. People with relevant knowledge and experience, including employees, contractors and other stakeholders are involved in the HSEC risk assessment process. Evaluation of identified risks is undertaken by the level of management that is consistent with the significance of the risk. HSEC risks are reviewed annually (at a minimum) and are recorded and maintained in a risk register. Risk management decisions are also documented and resulting actions are tracked.

The primary objective of the BHP Billiton Iron Ore environmental risk assessment and management system is to minimise environmental risk in all aspects of its operations. The risk assessment process and the development of a risk profile are undertaken in accordance with BHP Billiton's Enterprise Wide Risk Management Policy, the BHP Billiton Iron Ore Risk Management Guidelines, and the BHP Billiton Sustainable Development Policy, HSEC Management Standards and Guidance Notes. The risk standards have been developed in accordance with AS/NZS 4360 and ISO 14001.

Risk management is recognised as an integral part of good management practice. It is an iterative process consisting of steps, which when undertaken in a sequence, enable continuous improvement in decision making. The main elements of the risk management process are as follows (AS/NZS 4360):

- establish the context;
- identify risks;
- analyse risks;
- evaluate risks;
- control risks;
- monitor and review; and
- communicate and consult.

BHP Billiton's HSEC Management Standards require systems to be in place to identify, assess and document actual and potential risks. A summary of the major components of this process is provided in the sub-sections 3.3.2 to 3.3.5.

3.3.2 Risk Identification

AS/NZS 4360 emphasises the importance of a comprehensive and well-structured risk identification step, since a potential risk not identified at this stage is excluded from further analysis. Where possible, the risk identification step should identify all risks whether or not they are under the control of the organisation, and each activity should have the identified risks separated into a set of elements (e.g. environmental, health and safety and business).

Identification of environmental risks at Goldsworthy is undertaken in collaboration between BHP Billiton Iron Ore site staff and mining contracting personnel from each different department on-site including operational staff within a scheduled session. This process involves a review of existing risks previously identified and identification of new risks based on new or amended processes, activities and new events reported.

A variety of different approaches to risk identification are suggested in AS/NZS 4360. These include the use of checklists, judgements based on experience and records, flow charts, brainstorming sessions, systems analysis, scenario analysis and systems engineering techniques. Once a list of risk events has been identified, consideration needs to be given to possible causes and scenarios for each event.

Environmental risks at BHP Billiton Iron Ore operations are evaluated using the standard BHP Billiton Iron Ore matrix to determine risk rating. A database has been developed in accordance with BHP Billiton Iron Ore's Risk Management Guideline to facilitate a consistent approach to risk assessment.

3.3.3 Risk Analysis and Evaluation

The overall objective of the risk analysis step is to separate the minor acceptable risks from the major risks, and provide data to assist in the evaluation and treatment of risks. Risk analysis typically involves consideration of the sources of risk, their consequences and the likelihood that those consequences may occur. The analysis may be qualitative, semi-quantitative or quantitative, or a combination of these depending on the circumstances.

The risk evaluation process at BHP Billiton Iron Ore operations typically involves comparing the level of risk found during the analysis process with previously established risk criteria. The output of the risk evaluation process is a prioritised list of risks that require further action.

Risk analysis at Goldsworthy is generally in the form of a Risk Register Review Workshop attended by BHP Billiton Iron Ore site staff and contractor representatives.

3.3.4 Risk Treatment and Management

AS/NZS 4360 defines the risk treatment step as 'identifying the range of options for treating risk, assessing those options, preparing risk treatment plans and implementing them'.

In establishing risk management methods, the principles of best practice management are adopted. Risk can be managed through the development and implementation of measures that aim to:

- minimise the likelihood and impact of an environmental hazard occurring; and
- minimise the impact of an environmental hazard should it occur.

The BHP Billiton Iron Ore risk assessment and management system is designed to:

- identify cost-effective controls and management strategies that minimise the risk of environmental hazards occurring;
- implement risk control measures that minimise the potential impact of a hazard should it occur;
- meet organisational environmental objectives and targets; and
- demonstrate a commitment to protection of the environment.

3.3.5 Communication, Consultation and Monitoring Review

The outputs of the BHP Billiton Iron Ore Risk Assessment process are used to generate a site Environmental Risk Register, which typically contains the following generic categories:

1. List/description of environmental aspects/hazards.
2. Description of potential environmental impacts (consequences).
3. Management measures in place (or proposed in the case of proposed activities).
4. Environmental consequence severity rating.
5. Likelihood/frequency rating.
6. Residual risk rating (residual risk left after applying management measures).

The Risk Register is an operational management tool that is used for communication, consultation and monitoring of risks, and is reviewed and updated regularly in accordance with BHP Billiton Management Standard No. 3.

The Goldsworthy Risk Register assesses potential risks against a range of environmental aspects and presents the measures that are in place or are to be adopted to treat and/or manage identified risks.

Table 3-1 presents the relevant sections of the EMP which address the practices currently in place or to be adopted to treat and/or manage identified risks.

Table 3-1
Environmental Aspects Addressed in the EMP

Environmental Aspect	Section of EMP
Soil Resources	4.2
Landforms	4.3
Surface Water	4.4
Groundwater	4.5
Air Quality	4.6
Greenhouse Gas	4.6
Noise	4.7
Vegetation and Flora	4.8
Terrestrial Vertebrate Fauna	4.9
Terrestrial Invertebrate Fauna	4.10
Stygofauna	4.11
Troglofauna	4.12
Waste Management	4.13
Dangerous Goods and Hazardous Materials	4.14
Aboriginal Heritage	4.15

3.3.6 Goldsworthy Operations Mine Closure Risk Assessment

BHP Billiton's Closure Standard (BHP Billiton Iron Ore, 2004b) requires Enterprise Wide Risk Management (EWRM) assessments to be conducted for all of its operations in order to prioritise and manage risks. The most recent mine closure EWRM assessment of Goldsworthy was carried out in September 2008.

The risk assessment process was used to identify and assess the potential closure-related risks associated with Goldsworthy. The risk assessment identified several risk issues which related to one or more of the following:

- groundwater management;
- surface water management;
- contaminated sites;
- revegetation performance;
- landform reconstruction; and
- public access.

The risk assessment was used to identify and evaluate the potential closure-related risks associated with Goldsworthy, with the findings being incorporated into this revision of the EMP and other environmental management plans where appropriate (e.g. DRP). For each issue a summary of the potential causes, impacts, existing control measures and risk assessment scores was completed. Where appropriate this EMP includes a description of how best practicable environmental measures have been applied to risks which have been identified (through the risk assessment process) as requiring this level of management to reduce residual risks to an acceptable level (e.g. preparation and implementation of the Management Plan for Bat Species – Section 4.9.5).

4 ENVIRONMENTAL MANAGEMENT PROGRAMME

4.1 OVERVIEW OF THE ENVIRONMENTAL MANAGEMENT PROGRAMME

BHP Billiton Iron Ore manages environmental issues at its mining operations within the BHP Billiton Sustainable Development framework (refer to Section 3.2).

This EMP has been prepared to describe the site-specific potential environmental impacts, management practices and monitoring programmes for the following environmental aspects:

- soil resources;
- landforms;
- surface water;
- groundwater;
- air quality;
- noise;
- flora;
- fauna (including stygofauna);
- waste management;
- dangerous goods and hazardous materials; and
- Aboriginal heritage.

BHP Billiton Iron Ore also implements Pilbara-wide environmental management programmes for 'land' and 'waste' which describe generic objectives and strategies to manage environmental aspects at its operations. The Land Management Programme and Waste Management Programme are described in Section 4.1.1.

In addition to the Pilbara-wide management programmes, BHP Billiton Iron Ore prepares and regularly revises technical environmental manuals for its Pilbara mining operations which cover specific environmental issues. Environmental management manuals, relevant to this EMP, are summarised in Section 4.1.2.

Principles from these environmental manuals are incorporated into the site-specific management measures and monitoring programmes developed for Goldsworthy where appropriate.

BHP Billiton Iron Ore has also developed a Project Environmental and Aboriginal Heritage Review (PEAHR) procedure to manage the implementation of its environmental, Aboriginal heritage, land tenure and legal commitments prior to and during land clearing. The PEAHR procedure is described in Section 4.1.3.

4.1.1 BHP Billiton Iron Ore Environmental Management Programmes

Land Management Programme

The BHP Billiton Iron Ore Mining Operations Land Management Programme (MOLMP) focuses on the management of land clearing, rehabilitation and mine closure. The objectives of the MOLMP are to:

- ensure all land clearing is proposed, including compliance with the PEAHR procedure (Section 4.1.3);
- ensure mine closure plans are developed and finances accounted for;
- ensure rehabilitation is progressive when land becomes available;
- establish and communicate the management structure, including defined roles and responsibilities, in relation to land management;
- establish a framework of continuous improvement in land management; and
- establish key performance Indicators and monitoring schedules to measure against targets.

The objectives of the MOLMP are implemented through two components: the BHP Billiton Iron Ore Land Management Manual and a site-specific management plan.

The BHP Billiton Iron Ore Land Management Manual outlines the management of clearing and rehabilitation across all of BHP Billiton Iron Ore's mining operations. The manual describes roles and responsibilities, management procedures and performance indicators.

The site-specific management plan is an operational document developed for the particular mine site and is either a stand-alone plan or this EMP (as is the case for Goldsworthy).

Waste Management Programme

As part of BHP Billiton Iron Ore waste management commitments, a Mining Operations Waste Management Programme has been developed. The objectives of the Waste Management Programme are:

- to observe the waste management hierarchy of elimination, reduction, reuse, recycling, treatment and disposal as the last resort;
- to manage all waste generated in such a manner that minimises any detrimental effects it may have to the environment; and
- to ensure that BHP Billiton Iron Ore mining operations comply with all applicable licence conditions and commitments, at all times.

The objectives of the Waste Management Programme are implemented through two components: the BHP Billiton Iron Ore Waste Management Manual and a site-specific management plan.

The BHP Billiton Iron Ore Waste Management Manual outlines objectives and strategies for the management of wastes at all BHP Billiton Iron Ore mining operations.

The site-specific management plan is an operational document developed for the particular mine site and is either a stand-alone plan or this EMP (as is the case for Goldsworthy).

4.1.2 Environmental Manuals

BHP Billiton Iron Ore has developed a series of manuals to provide environmental personnel and others, with easily accessible information regarding the management of specific environmental issues. These manuals are generally applicable to all of BHP Billiton Iron Ore's Pilbara operations and are intended to be used as guiding documents only.

BHP Billiton Iron Ore environmental manuals used at Goldsworthy include the following:

- Topsoil Management Manual;
- Hydrocarbon and Hazardous Chemical Management Manual;
- Land Management Manual;
- Borrow Pit Management Manual;
- Feral Animal Control Manual;
- Waste Management Manual; and
- Project Environmental and Aboriginal Heritage Review Procedure Manual.

Summaries of these manuals are provided below.

- *Topsoil Management Manual*. This manual describes the overall objectives and strategies relating to the four main components of soil management: baseline soil surveys, soil stripping, stockpiling and soil use.
- *Hydrocarbon and Hazardous Chemical Management Manual.* This manual outlines standards associated with hydrocarbon and hazardous chemical management. The manual includes details and references to the approval process for bringing new chemicals to site, the storage and handling of hydrocarbons and chemicals, spill management, disposal concerns and reporting requirements.
- *Land Management Manual.* This manual covers the various responsibilities of mining personnel and reference to all work instructions associated with land management. Key issues such as baseline data, closure, monitoring, heritage, land use, rehabilitation, waste management are described. The manual also provides direction to record and training requirements.
- *Borrow Pit Management Manual.* This manual outlines the principles and objectives for the planning, development and subsequent rehabilitation of borrow pits.
- *Feral Animal Control Manual.* This manual provides instructions for the safe control of wild dogs and feral cats.
- *Waste Management Manual.* This manual outlines roles and responsibilities for onsite waste management, legal and other requirements for onsite waste activities and the monitoring and reporting requirements for onsite waste activities.
- *Project Environmental and Aboriginal Heritage Review Procedure.* This manual outlines the procedures to fulfil the Environmental, Aboriginal Heritage and Legal requirements for activities that may cause a significant impact of the environment, result in land disturbance, change in land use, or result in changes to an area's environmental aspects (refer to Section 4.1.3).

4.1.3 Project Environmental and Aboriginal Heritage Review Procedure

BHP Billiton Iron Ore has developed a PEAHR procedure to manage the implementation of its environmental, Aboriginal heritage, land tenure and legal commitments prior to and during land clearing. Additionally, the PEAHR procedure provides a mechanism whereby technical and professional advice provided regarding environmental issues, land access and Aboriginal heritage planning and management issues is sought where necessary.

The objectives of the PEAHR procedure are to:

- Identify the significant environmental, Aboriginal heritage and legal aspects of BHP Billiton Iron Ore operations.
- Ensure that, through appropriate environmental Aboriginal heritage and land access planning and management, BHP Billiton Iron Ore Project activities comply with all legislative and regulatory requirements, BHP Billiton Sustainable Development Policy, industry standards and Codes of Practice.
- Minimise the number and nature of environmental, Aboriginal heritage and land tenure events and improve the environmental performance of BHP Billiton Iron Ore operations.
- Provide improved planning and management throughout a project, from the planning stage to completion.

A summary of the PEAHR procedure is presented in Figure 4-1 and it is described in detail in the BHP Billiton Iron Ore PEAHR Manual.

4.2 SOIL RESOURCES

4.2.1 Existing Environment

As a result of the sparse vegetation cover and the erosive force of the heavy summer rains, soil resources on the hills and ranges where the Goldsworthy ore bodies occur are generally limited to very thin, poorly developed skeletal soils in between rocky outcrops. Much of the soil on the hill slopes tends to be transported downwards, and hence, soils on the adjoining plains are generally deeper and show more pronounced development of horizons (*ecologia*, 2005).

Notwithstanding the generally limited depth of soil resources at Goldsworthy, operational experience has shown that where they have been stripped from disturbance areas and used in rehabilitation they provide valuable nutrient and seed resources. This proven success of topsoil, prompts the recovery of soil reserves wherever possible prior to disturbance by mining activities. Studies into the use of laterite subsoils at Goldsworthy have indicated that they are potentially valuable for use in rehabilitation (Outback Ecology, 2004) and are also recovered, where possible, to be used as an alternative growth medium to topsoil.

4.2.2 Potential Impacts

Potential impacts of Goldsworthy on soil resources include:

- clearing of established vegetation will increase the likelihood of soil erosion by both wind and water;
- inappropriate stockpiling of topsoil and other soil resources has the potential to reduce the viability of seeds, nutrients, organic matter and micro-organisms;
- alterations of soil structure and/or chemistry beneath infrastructure items, hardstand areas and roads (e.g. through compaction, spillage of hydrocarbons or chemicals); and
- alterations of soil structure and/or chemistry and changes to the natural soil evolution/forming process, caused by stripping and re-using soil from disturbed areas in rehabilitation.

4.2.3 EMP Objective

To conserve and re-use the soil resources which contain seeds, nutrients, organic matter and micro-organisms required for re-establishing vegetation on rehabilitated areas.

4.2.4 Management Practices

General Soil Management Practices

Minimising the impact of mine operations on the surrounding environment (i.e. flora and fauna habitats, landform and drainage systems) is accomplished at BHP Billiton Iron Ore's operations through the adoption of a policy of minimum disturbance. Where disturbance is unavoidable, it is undertaken in a manner which limits the area cleared to the minimum necessary, reduces the potential for erosion, and uses rehabilitation to promote the natural return of vegetation and fauna consistent with agreed closure criteria and commitments.

As discussed in Section 4.1.1, BHP Billiton Iron Ore has prepared a Land Management Manual for its Pilbara mining operations. The purpose of the manual is to outline the aspects relevant to the management of clearing and rehabilitation of land.

The BHP Billiton Iron Ore Land Management Manual contains a topsoil management section, which refers to BHP Billiton Iron Ore's Topsoil Management Manual for details. The BHP Billiton Iron Ore Topsoil Management Manual describes the overall objectives and strategies relating to the four main components of soil management at BHP Billiton Iron Ore's Pilbara operations. These components are centred on the following directives:

- baseline soil surveys should be undertaken prior to disturbance;
- stripping of soil resources should be to appropriate depths and conducted at appropriate times;
- stripped soils should be stockpiled in an appropriate manner; and
- appropriate planning should be undertaken so that stripped soil can be efficiently and effectively used during rehabilitation.

BHP Billiton Iron Ore's Topsoil Management Manual has been prepared to provide BHP Billiton Iron Ore's environmental personnel and others, with easily accessible information regarding the management of topsoil. The information provided relates to baseline topsoil assessment methodologies, consideration of topsoil resources during mine planning, generic topsoil stripping and stockpiling procedures, topsoil use in rehabilitated areas, and reporting requirements.

The general guiding principles for the management of borrow pits are also outlined in the Land Management Manual. These principles include:

- minimisation of environmental impacts; and
- tracking of all cleared areas to ensure that rehabilitation is satisfactory.

Specific management procedures for borrow pits are described in the BHP Billiton Iron Ore Borrow Pit Manual. The manual includes management procedures for the planning and construction of proposed borrow pits and rehabilitation of old borrow pits. These procedures will be followed throughout the life of the Project.

Site Specific Land Clearing and Soil Management Practices

Specific land clearing management practices that will be undertaken at Goldsworthy to minimise the effect of land disturbance on the environment include:

- All activities that require land clearance will be authorised by BHP Billiton Iron Ore via the PEAHR procedure (Figure 4-1). For each proposed clearing area the following must be provided in the PEAHR form: a summary of the proposed clearing operation (the Project), a plan showing the location of the proposed works, the anticipated environmental, land access and Aboriginal heritage impacts and specific management strategies where necessary. Land clearing cannot take place until the PEAHR form is authorised by BHP Billiton Iron Ore.
- Employees and contractors will be advised of the land clearing authorisation processes via the induction.
- Key BHP Billiton Iron Ore personnel undergo additional competency based training in the PEAHR land clearing procedure.

Once proposed land disturbance activities have been authorised, the following specific soil resource management practices will be used at Goldsworthy to minimise soil loss through erosion and to maximise the potential for re-using stripped materials in rehabilitation programmes:

- A plan will be prepared showing areas requiring topsoil removal before stripping occurs as part of the PEAHR procedure (Figure 4-1).
- Where practicable, topsoil and other identified suitable growth medium material (e.g. deeper alluvial and gravel material from drainage line areas) will be stripped prior to the commencement of mine operation activities.
- Where mine scheduling allows, stripped topsoil and other materials will be applied to areas being rehabilitated. Where this is not possible, stripped materials will be stored in separate stockpiles for later use. The stockpiles (both long and short-term) will be constructed and managed in a manner that encourages the continuation of the soil's biological activity.

- Topsoil details will be recorded on the Topsoil Stockpile Datasheet and stored into a central database or spreadsheet.
- Locations of topsoil storage stockpiles will be recorded on BHP Billiton Iron Ore's Spatial Mine Planning Programme (i.e. Vulcan or equivalent). The locations of soil stockpile will be proposed so that potential sites for future mine and infrastructure disturbance areas are taken into consideration.
- Stockpiles will be clearly identified on the relevant site plan and, where appropriate, signposted in the field. Plans indicating the location and volume of topsoil and other materials stockpiled will be updated as necessary.
- Regular inspections will be undertaken to assess erosion and sediment migration from topsoil stockpiles. Where unacceptable rates of erosion are identified, remedial works will be undertaken or the stockpile will be relocated.
- Regular inspections will be undertaken to assess for weed establishment or invasion on topsoil stockpiles. Where weeds are identified on topsoil stockpiles, weed control programmes will be implemented, as described in the WMP (BHP Billiton Iron Ore, 2008c), to avoid seed set.
- Mining contractors will be closely supervised and will be subject to periodic audits by BHP Billiton Iron Ore to assess conformance with these land, soil and rehabilitation management procedures.
- Investigate measures for improving the viability of seed, nutrients and organic matter and micro-organisms in topsoil.
- Topsoil movement will be proposed and tracked to ensure it is available for rehabilitation.
- A condition prohibiting unauthorised clearing will be included in all relevant contracts.

Soils that are contaminated by hydrocarbons will be excavated and either buried within an out-of-pit OSA, or bioremediated. The bioremediation process will be conducted in accordance with EP Act Licence No. 5611 and 4412 and include:

- maintaining a soil thickness at a depth of no more than 30 centimetres (cm);
- maintaining soil moisture content and nutrient levels within the soil to sustain biological activity; and
- monthly aeration of the soil.

Historical Goldsworthy Soil Management Issues

It is acknowledged that prior to the mid to late 1990's soil resource stripping, stockpiling and management at Goldsworthy was generally insufficient to meet current BHP Billiton Iron Ore standards (i.e. at many of the earlier pits and OSAs, no stripping or stockpiling of soils was undertaken). To address this issue, recent mining practice at Goldsworthy has included the recovery and separate storage of laterite subsoil material that overlies mined iron ore reserves in some areas (up to 10 m thick).

This laterite material has suitable characteristics for use as a growth medium during rehabilitation (Outback Ecology, 2004). As part of the Goldsworthy soil stripping and management practices, laterite material recovery will continue to be used in the rehabilitation of new landforms, as well as some designated existing landforms where success is considered sub-optimal.

4.2.5 Performance Indicators

Comparison between the information recorded in the topsoil database and the relevant PEAHR form to determine whether specific management measures, disturbance areas and stockpile locations nominated in the PEAHR form have been followed.

4.2.6 Monitoring

BHP Billiton Iron Ore will conduct regular inspections to confirm that soil resources are being removed and stockpiled in the appropriate locations and the relevant plans and databases are updated. Rehabilitation will be monitored using Ecosystem Function Analysis (EFA) (Section 4.2.1 of the DRP [BHP Billiton Iron Ore, 2008d]) and the results will used to adjust its soil management practices, where required, in accordance with BHP Billiton Iron Ore's adaptive management approach described in Section 4.1 of the DRP (BHP Billiton Iron Ore, 2008d).

4.3 LANDFORMS

4.3.1 Existing Environment

Existing Topography

The landforms of the Goldsworthy area are dominated by rocky ridges and plateaus, separated by the wide plains and floodplains of the De Grey River and its tributaries. To the north-east is the predominantly flat expanse of the Great Sandy Desert.

The ridges and plateaus of the Goldsworthy area typically rise sharply from the surrounding plains, and in many areas cliffs and steep escarpments that are up 100 m high have formed. Scree slopes typically form below the escarpments, and areas of the ridges and plateaus are heavily dissected with steep V-shaped valleys, gorges and dendritic drainage patterns. The wide plains to the south of the Goldsworthy area gently slope towards the De Grey River, which is situated some 10 to 20 km to the south.

The elevation of topographical features in the Goldsworthy area ranges from approximately 280 m AHD (Australian Height Datum) at the Yarrie Plateau, to approximately 80 m AHD at the De Grey River south of Nimingarra. The Yarrie accommodation village lies at approximately 130 m AHD as does the Shay Gap borefield to the north on the edge of the Sandy Desert. Coonieena Creek at Shay Gap is at an elevation of approximately 120 m AHD.

Elevations at Cattle Gorge range from approximately 250 m AHD on the plateau to approximately 130 m on the adjoining plain. Sunrise Hill and Nimingarra Ridges are lower than Yarrie and Cattle Gorge with elevations generally below 210 and 200 m AHD respectively.

The elevation of the Cundaline and Callawa ridges in the vicinity of the proposed mining operations are 250 m AHD and 270 m AHD, respectively. The elevation of the surrounding plains of both ridges is approximately 130 m AHD.

Existing Disturbance

The existing mining operations have altered the natural landforms at Nimingarra, Sunrise Hill, Shay Gap and Yarrie through the creation of mine voids and out-of-pit OSAs. The majority of the pits have been mined into the top surface of the ridges and plateaus (i.e. rather than coming in from the side). As a result, in most cases they are not visible from the surrounding plains, and can only be clearly seen when on the ridge itself or from the air. Some of the open pits have been mined below the watertable. In those areas where mining has ceased, permanent lakes have developed within the pits.

Several of the mined-out pits in the Yarrie area have been used to store overburden from adjoining pits. Once full, the final surfaces of these in filled pits have been re-contoured to be a close as possible to the pre-mining situation before being rehabilitated.

The existing out-of-pit OSAs at Goldsworthy have generally been constructed near to the pits by placing overburden over the edge of the natural escarpments. These OSAs are therefore much more visible than the pits. Notwithstanding, the OSAs have been designed and rehabilitated to have similar shapes to the naturally occurring scree slopes, and in most cases blend in with the pre-mining topography (particularly where revegetation of the area is advanced).

4.3.2 Potential Impacts

The natural topography will be affected by the mining operations at Nim I, Cattle Gorge, Yarrie pits Y4A, Y7 West and Y10 North, and Callawa and Cundaline. These effects will primarily be in the vicinity of the existing open pits and OSAs where areas of the ridges and plateaus will be locally reduced in elevation in the pits and the OSAs will extend existing escarpment faces. The open pits would create permanent excavations in the southern face of the Cundaline Ridge and north-eastern face of the Callawa Ridge, resulting in localised effects on visual amenity.

OSAs will be constructed to adjoin existing ridge and mesa landforms where practicable to minimise their contrast with existing landforms and will be designed to have final slopes and shapes that are similar to the surrounding naturally occurring landforms.

Changes to existing landforms have also occurred as a result of cut and fill works associated with the required service infrastructure (i.e. access and haul roads, Yarrie ore processing facilities and service infrastructure at Cattle Gorge). The additional hauls roads for Cundaline and Callawa, and the potential ore processing facilities at Cundaline, would not represent significant visual impacts as the relative area of these proposed landforms would be moderate and the intervening topography and/or natural vegetation would limit potential views. Once these areas are no longer required, all equipment and infrastructure will be decommissioned and removed (unless otherwise agreed with the administering authority) and the areas will be re-contoured to blend with the surrounding topography and then rehabilitated.

4.3.3 EMP Objectives

The Guiding Closure Principles for landforms and landuse at Goldsworthy are specified in the Decommissioning and Rehabilitation Plan (DRP) (BHP Billiton Iron Ore, 2008d). These principles represent the following broad management objectives for landforms at Goldsworthy:

- *Post-mining landforms will be designed to be stable and respond to erosive forces in a manner to suit the end landuse.*
- *Final OSAs will be sympathetic with regional landforms.*
- *The number and size of out-of-pit OSAs in new mining areas will be minimised.*
- *Residual pit voids will be left as run-of-mine (ROM) where geotechnically stable, and profiled as necessary to achieve long-term closure objectives.*
- *The end landuse for the area will be determined in consultation with stakeholders, and agreed with the administering authority during the life of the mine.*

4.3.4 Management Practices

Life-of-mine planning and progressive rehabilitation is used at Goldsworthy to minimise the effect of BHP Billiton Iron Ore's operations on landforms during operations and following mine closure. Details of the closure and rehabilitation concepts for the mine landforms at Goldsworthy are provided in the DRP (BHP Billiton Iron Ore, 2008d). A summary of the land management measures that are used at Goldsworthy are provided below.

Life-of-mine planning and progressive rehabilitation will be used at Goldsworthy to minimise the effect of BHP Billiton Iron Ore's operations on landforms during operations and following mine closure. Details of the closure and rehabilitation concepts for the mine landforms at Goldsworthy are provided in the DRP (BHP Billiton Iron Ore, 2008d). A summary of the management measures that will be used to minimise the effect on landforms during the life of the Goldsworthy mining activities are described below.

General Landform Management Practices

- Mine infrastructure areas (i.e. access tracks, borrow pits, topsoil stockpiles, buildings, etc.) that are no longer required will be decommissioned, and wherever possible, the disturbed area re-contoured to blend with the surrounding topography, topsoiled, contour ripped (or equivalent) in preparation for seeding with native species as necessary.
- Materials will be selected and drainage designed to minimise erosion of cuts and fills. Materials that have a low resistance to erosion will generally be not used in outer slope fill batters.
- Erosion within and around infrastructure areas will be managed through the minimisation of clearing, rehabilitation, and the installation of appropriate drainage controls, where necessary.
- Where necessary, drainage features such as cut-off drains and bunds will be incorporated onto the tops of cuts and dumps to prevent water filtering down the sides of drains/bunds and causing erosion.
- All employees and contractors involved in establishing and rehabilitating borrow pits will use BHP Billiton Iron Ore's Manual for Borrow Pit Management.

- The layout of infrastructure will be designed to take into account impacts on drainage lines.
- Where possible, the location and layout of infrastructure areas and mine landforms will be designed in a manner such that environmental impacts (including potential changes to existing landforms and drainage channels) are kept to a minimum.
- Residual batters in the pit voids will be left as ROM where geotechnically stable, and profiled as necessary to achieve long-term closure objectives.

Mine Planning

The layout of infrastructure and mine landforms will be designed so that environmental impacts (including potential changes to existing landforms and drainage channels) will be kept to a minimum. Figure 4-2 illustrates the decision-making steps and considerations mine planners follow during the planning and design process for major mine landforms, such as OSAs. BHP Billiton Iron Ore will implement this mine planning process during the life of the Goldsworthy mining activities.

As illustrated in Figure 4-2, once a preliminary design has been developed, BHP Billiton Iron Ore mine planners will then consider aspects such as:

- the coverage and results of baseline flora, fauna and heritage surveys;
- whether the preliminary design complies with tenure and operating conditions and commitments for the operations;
- whether investigations have been conducted to determine if the preliminary design is located at a safe distance from the pit walls;
- whether the preliminary design would sterilise economic resources or future infrastructure;
- potential for acid rock drainage (ARD) and management considerations for any material that has been characterised as potentially acid forming (PAF);
- the compatibility of the preliminary design with the Guiding Closure Principles contained in the DRP (e.g. shape consistent with regional landforms, impacts on surface drainage, effect on visual amenity) (BHP Billiton Iron Ore, 2008d); and
- whether infill and backfill alternatives have been considered.

The decision-making hierarchy presented in Figure 4-2 has been established so as to pose questions which may require long lead-time surveys or approvals, ahead of questions which can be evaluated more efficiently. Notwithstanding this, the mine planners must consider all of the decisions and questions posed on the left hand side of Figure 4-2 in equity. The flow diagram, though presented sequentially, is provided as a guideline to ensure all items are covered in the decision-making process for mine plans.

Management strategies that will be implemented at the Goldsworthy operations to minimise impacts on landforms from out-of-pit OSAs are described below.

Overburden Storage Areas

The following management practices will be employed at each of Goldsworthy out-of-pit OSAs:

- An overburden storage plan for new OSAs will be developed and incorporated into the life of mine plan prior to the commencement of out-of-pit dumping activities. All overburden placement in the new OSAs will be undertaken in accordance with this plan.
- The final rehabilitated designs of OSAs will be similar to the surrounding landforms and consistent with the relevant Guiding Closure Principles contained in the DRP (BHPBIO, 2008d).
- New OSAs will be located in existing valleys and as extensions to the existing ridgelines rather than new stand-alone emplacements on the valley floor.

4.3.5 Monitoring

- The BHP Billiton Iron Ore Site Manager or delegate to regularly inspect operational areas to ensure adherence to site plans.
- Routine audits to be undertaken as described in Section 3.2.5.

Monitoring of the rehabilitated areas will be undertaken until it can be demonstrated that the landscape and vegetation is progressing towards a self-sustaining state. Ecosystem Function Analysis (EFA) is used to monitor rehabilitation at Goldsworthy and is described in the DRP (BHP Billiton Iron Ore, 2008d).

4.4 SURFACE WATER

4.4.1 Existing Environment

The Goldsworthy operations are located in the De Grey River catchment. The De Grey River basin covers an area of 49,440 km^2 and extends nearly 410 km inland in the north-west region of Western Australia. The De Grey River is a major river system with an extensive sediment filled floodplain and numerous tributary rivers and creeks. The river is located some 10 to 20 km to the south of the mining areas.

Most rivers and creeks in the De Grey basin are intermittent and only flow following cyclonic activity over the summer months and can have several years of no flow, followed by flood events. Drainage channels in the Goldsworthy area collect and direct overland flow to the various tributary creeks of the De Grey River including Egg Creek, Eel Creek and Coonieena Creek.

These creeks are generally dry and sandy with broad channel beds in the order of 20 m to 100 m wide. Significant flows occur during sustained high intensity rainfall events associated with cyclones and rain depressions. On a regional scale, the local creeks at Goldsworthy are very minor tributaries of the De Grey River.

Runoff from the Cattle Gorge area either flows to the adjoining plains to the north and west, or flows into Cattle Gorge Creek to the east and south of the deposit. A narrow gorge has been formed where Cattle Gorge Creek flows through the main ridge/plateau. This gorge is well outside of the proposed mining area. Cattle Gorge Creek flows in a generally south easterly direction and is a tributary of Eel Creek.

BHP Billiton Iron Ore has current licences to discharge excess water generated by mine dewatering activities into the creeks adjacent to the Sunrise Hill - Nimingarra and Yarrie mining areas. The water is transferred to the approved discharge points from turkeys nest dams that act as stilling ponds to reduce sediment loads prior to discharge.

In 1993 BHP Billiton Iron Ore prepared and implemented a Water Management Plan for the Yarrie mining operations in order to satisfy Condition 3-1 of Ministerial Statement of Approval No. 000303. The 1993 Water Management Plan described the surface water and groundwater management and monitoring procedures for Yarrie, as well as potential impacts to groundwater resources and long-term management procedures for pit salinity development. Since mining activities at Yarrie are now substantially completed, a large proportion of the monitoring and management measures contained in the 1993 Water Management Plan are no longer relevant (e.g. construction water management, monitoring of pit dewatering). However, the Plan does contain relevant information regarding post closure water management (in particular, the management of pit lake water quality at Y2/3). As a result, a copy of the Water Management Plan is provided in Appendix B. References to the 1993 Water Management Plan are included in this EMP where relevant.

4.4.2 Potential Impacts

Mining operations at Goldsworthy have the potential to impact surface water resources by changing local surface water flow patterns (i.e. through the construction of the new open pits, OSAs, and the Cattle Gorge haul road), or by affecting surface water quality or quantity as a result the discharge of mine dewatering water, or erosion and sedimentation from new disturbance areas or contamination from chemicals/hydrocarbons.

The continuous discharge of surface water at a single location, as occurs during dewatering operations, has the potential to encourage the temporary establishment of vegetation communities that are dependent on a continuous supply of water. Once dewatering operations cease, the vegetation communities are likely to return to a pre-mining condition.

4.4.3 EMP Objectives

Surface water management objectives for Goldsworthy include ‘general objectives’ which primarily relate to operational management activities, and ‘closure objectives’ which relate to rehabilitation, decommissioning and mine closure. The ‘closure objectives have been formalised as Guiding Closure Principles in the DRP (BHP Billiton Iron Ore, 2008d).

General

- *To prevent or minimise impacts on the quality of surface water resulting from mining operations and contain any contaminated water on site.*
- *To ensure that the quality of water returned to local and regional surface water resources will not result in significant deterioration of those resources.*

Closure

- *Baseline surface water quality and flow regimes in Eel Creek and Egg Creek will be maintained.*

4.4.4 Management Practices

The water management practices that will be used to minimise impacts on local surface water resources are presented below:

- Erosion and sediment control measures and clean water diversions (e.g. culverts, bunds/windrows, diversion channels, sediment ponds etc) will be designed and installed as required, within drainage lines in the vicinity of active mine areas, around the OSAs, railway creek crossings, and other disturbance areas.
- Water control structures at borrow pits will be installed in accordance with the Borrow Pit Management Manual.
- Wherever practicable, water use will be minimised and recycling undertaken.
- Approvals will be obtained from the relevant government agencies prior to disturbance within any named watercourse (e.g. permit to interfere with bed and banks as required by the *Rights in Water and Irrigation Act, 1914* [RIWI Act]).
- Controlled wastes, as defined by the *Environmental Protection (Controlled Wastes) Regulation 2004,* will be properly handled prior to removal from the site.
- On-site solid waste disposal will be minimised and properly managed.
- Runoff and wastewater from areas where hydrocarbon contamination may occur, such as workshops and washdown bays, will be collected and re-used or transferred to the bioremediation landfarm in accordance with the relevant licences issued by the DEC (formerly DoE) under the *EP Act.*
- Water contaminated with hydrocarbons will not be released to the environment unless treated to acceptable levels.
- Emergency response procedures will be used to manage events involving hazardous substances.
- Hazardous substances will be stored in properly bunded sites to minimise the potential for land, surface water or groundwater contamination.
- Use of culverts and diversions to prevent ponding and manage surface water flows around burrow pits, where appropriate.

Where possible, mine dewatering water will be used for dust suppression, process water, and vehicle washdown water. Any excess dewatering water will be discharged at licensed discharge points. BHP Billiton Iron Ore will review the water balance for Goldsworthy and evaluate potential mechanisms to improve water use efficiency over time (i.e. maximise re-use of mine dewatering and minimise pumping from the Shay Gap borefield).

4.4.5 Performance Indicators

- Compliance with water management requirements of licences issued under the RIWI Act (i.e. Bed and Banks permits) and the EP Act Licence No. 5611 and 4412 .
- Monthly reports to be up to date and contain current water monitoring data.
- Regular comparison of monitoring data against nominated water quality trigger values and/or historical monitoring data.

- No breaches of environmental licence conditions.
- Management of controlled waste in accordance with the *Environmental Protection (Controlled Wastes) Regulation, 2004*.

4.4.6 Monitoring

Water samples are collected from discharge points to assess compliance with the requirements of the EP Act Licences and at locations upstream and downstream of the mining areas. Table 4-1 summarises the surface water monitoring programme for Goldsworthy.

A summary of the monitoring results will be reported in the AER.

Table 4-1
Surface Water Monitoring Programme

Area/Aspect to be Monitored	Parameter	Location	Frequency
Mine Dewatering Discharge[1,2]	Flow Rate	Sunrise Hill West 7 (SHW7) Nimingarra B (Nim B) Nimingarra I (Nim I) Nimingarra F East (Nim FE) (emergency discharge point) West Nimingarra B (emergency discharge point) Y2/3 Y10 W1 (contingency discharge point)	Continuous
	Water Quality[a]	Sunrise Hill West 7 (SHW7) Nimingarra B (Nim B) Nimingarra I (Nim I) Y2/3 Y10	Quarterly (Nov, Feb, May, Aug)
	Water Quality[a]	West Nimingarra B (emergency discharge point) Nimingarra F East (Nim FE) (emergency discharge point) W1 (contingency discharge point)	Monthly (during discharge periods)
Stormwater Discharge from Hydrocarbon Storage Area[1]	Total Petroleum Hydrocarbon (TPH) Concentration	Hydrocarbon storage areas	Event Basic (as required)
Surface Water at Egg Creek, Eel Creek, Yarrie OSA[3]	Water Quality[a]	Egg Creek (NMSW003 and NMSW004) and Eel Creek (YASW005 and YASW006), base of the Yarrie W1 OSA (YASW003) and Chinaman Springs (YASW001), Cattle Gorge Creek	Quarterly (when surface flow is present)
Water Use Efficiency[3]	Site Water Balance	Calculate	Annual
Erosion and Sediment Control	Integrity of mine landforms and water management structures	All active and rehabilitated mine landforms and disturbance areas.	After major rainfall events

1 Programme required as per EP Act Licence No. 4412.
2 Programme required as per EP Act Licence No. 5611.
3 Programme internally developed and implemented by BHP Billiton Iron Ore.
a Water Quality Suite: pH, Electricity Conductivity (EC), Total Dissolved Solids (TDS), Total Suspended Solids (TSS), As, Cr, Cd, Cu, Hg, Mn, Zn, Pb, Fe, Al, Ca, Mg, Na and K.

4.5 GROUNDWATER

4.5.1 Existing Environment

Local aquifers in the Goldsworthy region are associated with the hematite orebodies that have developed within the BIF horizons. Due to the linear nature of the mineralisation and the tendency for it to be bounded by lower permeability materials such as unmineralised BIF, granites and mudstones, the aquifers are generally of a strip type (along strike) with the main orebodies forming areas of higher permeability (Aquaterra, 2005).

Recharge into the BIF aquifers is primarily through direct infiltration at the points where the orebodies outcrop. Due to the limited hydraulic connection to the groundwater system on the surrounding plains, these aquifers tend to be significantly higher in elevation than the aquifers beneath the surrounding plains.

The topography to the south of the BIF ridges is dominated by the drainage system of the De Grey River, where a shallow aquifer associated with alluvial sediments within the De Grey River floodplain is located. The topography to the north of the BIF ridges is characterised by flat to gently undulating sand plains with occasional small rocky outcrops and stony hills. Aquifers in this area are associated with hydraulically isolated sedimentary sequences within a broad Jurassic to Cretaceous-aged Canning Basin. This aquifer system is recharged by infiltration of rainfall runoff at the margins of the basin.

Minor local, limited area fractured rock aquifers also occur in areas near the seasonal creeks and are recharged by the infiltration of wet season stream flow in the overlying alluvium or direct infiltration of runoff to the aquifer.

Groundwater monitoring results for the area show groundwater extracted from mine dewatering bores is typically at or near neutral (i.e. pH 6 to 8) and fresh TDS of 700 mg/L or less) with little variation recorded over time.

Process water is sourced from pit dewatering activities, and potable water is sourced from shallow wells at the Shay Gap Wellfield.

4.5.2 Potential Impacts

Potential impacts of Goldsworthy on groundwater resources include:

- drawdown of local watertables where mine dewatering and borefield pumping is undertaken;
- adverse impacts on groundwater quality as a result of potential contamination by hydrocarbons, chemicals or mine wastes (i.e. PAF overburden); and
- permanent modification of groundwater quality and/or groundwater levels as a result of the creation of long term pit lakes that operate as groundwater sinks.

These potential impacts are discussed further below.

Dewatering

Mining below the groundwater table has historically occurred at a number of the Goldsworthy pits and is proposed at Callawa. The potential impacts of mining below the groundwater table at Cattle Gorge and Nimingarra were assessed as part of the Goldsworthy EPS (BHP Billiton Iron Ore, 2005a) and at Callawa in the Cundaline and Callawa EPS (BHP Billiton Iron Ore, 2008a). A summary of the assessed impacts is discussed below.

Nim I

Two proposed pits were assessed at Nim I. The proposed south pit was to be mined down to 56 mRL and the north pit mined down to 80 mRL. Both proposed pits extend below the current watertable (confirmed by recent drilling at around 115 mRL) (Aquaterra, 2005). It is proposed to dewater the pits by in-pit sump pumping.

As the two proposed pits at Nim I are located off the main Nimingarra ridge, the watertable is some 20 to 25 m below ground level and below any surface alluvium and weathered basement. As such, the orebody aquifer remains confined by lower permeability basement rocks and there is no direct connection with aquifers outside the Nimingarra Iron Formation. Dewatering activities are not expected to have any impact beyond the immediate mine area (Aquaterra, 2005).

Cattle Gorge

One bench of the proposed pit at Cattle Gorge will be mined down to 126 mRL. The groundwater table at Cattle Gorge has been measured at 136 mRL (Aquaterra, 2005). Dewatering is by in-pit sumps.

Aquaterra (2005) assessed the impact of dewatering at Cattle Gorge and concluded that as only minor dewatering was proposed, minimal impact would be expected outside the immediate pit area.

Callawa

Mining at the Callawa pits will extend below the watertable and pit dewatering via in-pit sumps will be required. Aquaterra (2008) assessed the impact of dewatering at Callawa using an analytical model. The model indicated that the water would decline in the immediate area of each pit in response to dewatering during mining activities. The depth of drawdown was estimated by Aquaterra (2008) to be less than 5 m at a distance of 100 m from the edge of the pits, and would be less than 0.5 m at a distance of 250 m from the edge of the pits. All water abstracted from the pits will be used onsite and as such no discharge will be required.

Water Supply

All groundwater abstraction at Goldsworthy is conducted in accordance RIWI Act groundwater licences (GWLs); GWL107452, GWL153404, GWL107453, GWL107451 and GWL154184, and the GWL Operating Strategy for Goldsworthy. The GWL Operating Strategy is a requirement of the GWLs, and describes the management and monitoring procedures for groundwater at Goldsworthy.

Water supplies for Goldsworthy are currently obtained from the pit dewatering operations and/or licensed borefields. The water supply for Cattle Gorge is provided by a pipeline extension from the existing Yarrie water supply system. Water supply for mining operations at Yarrie is sourced from the Shay Gap Wellfield and the Y2/3 Pit sump. Raw water supplies for the Yarrie Accommodation Village are also provided from the Shay Gap Wellfield. Water supply for Cundaline and Callawa will be provided via a pipeline extension from the Yarrie water supply system.

Water supply for the Sunrise Hill and Nimingarra operations is currently sourced from pit dewatering. The Egg Creek Wellfield is used to supply make-up water when supply is insufficient at Sunrise Hill and Nimingarra. Where possible, water abstracted from all new operations that extend below the watertable (e.g. Cattle Gorge and Nim I) will also be used as make up raw water (ie. road watering and dust suppression in the crushing plants) in preference to water pumped from the Shay Gap Wellfield.

Groundwater abstraction no longer occurs at the Eel Creek aquifer. The Eel Creek licence was relinquished in 1997.

At the Cattle Gorge, Nim I and Callawa pits, BHP Billiton Iron Ore will backfill the mined pits with overburden to above the pre-mining watertable (approximately 5 m). This will eliminate evaporative losses from the post-mining water balance and the watertable will recover to near pre-mining levels, as such no potential impacts on groundwater flows or quality are expected (Aquaterra, 2005; 2008).

A number of management measures are used at Goldsworthy to minimise potential impacts to groundwater. These management measures are discussed in the sections below.

4.5.3 EMP Objectives

- *To minimise the short and long-term impacts on groundwater resources caused by mining operations and groundwater use.*
- *To ensure the maximum volume of water abstracted for mining operations does not exceed the relevant licences.*
- *To minimise impacts on groundwater levels and quality and to minimise potential impacts on the surrounding environment.*

4.5.4 Management Practices

Operational Groundwater Management

Management measures used to minimise impacts on groundwater resources are presented below.

- All groundwater abstraction will be managed in accordance with the relevant groundwater extraction and discharge licences under the RIWI Act, part V of the EP Act, and the GWL Operating Strategy for Goldsworthy. Any additional groundwater extraction or discharge licences, will be obtained, if required, for Cundaline and Callawa.
- Advanced dewatering will be achieved by installing and pumping from dewatering bores and/or from in-pit sumps. Where possible, the water produced will be used in dust suppression and site water requirements (e.g. mining and ore treatment) in preference to discharge.

- Approval will be obtained from the relevant administering authority prior to the construction of additional and replacement wells, and the modification of refurbished or existing wells.
- Excess water produced by the dewatering operations will only be released in accordance with licence requirements at the designated release locations.
- All storage areas for hazardous substances will be designed and operated in accordance with the relevant legislation and standards.
- Emergency response procedures will be used to contain spills and remediate affected areas, where necessary.
- Controlled wastes, as defined by the *Environmental Protection (Controlled Wastes) Regulation 2004,* will be properly handled and stored prior to removal from the site by licensed waste removal contractors.
- Non-controlled wastes will be either collected and temporarily stored prior to being removed for off-site disposal, or are disposed in an on-site landfill area.
- Additional hydrological investigations will be conducted where necessary, with the aim of better defining the aquifers of Goldsworthy area and surrounds, identifying sources of water supply, predicting drawdown effects and modelling the effect of salinity build-up in mined-out pits.
- Groundwater levels and water quality will be monitored (Section 4.5.6).

Post Closure Groundwater Management

As described in the Water Management Plan (Appendix B), the process of salinisation in mined-out pits is being studied by BHP Billiton Iron Ore at the abandoned Mt Goldsworthy pit and the knowledge gained at this site will be applied to other mined-out pits at Goldsworthy. Studies conducted to date on the Mt Goldsworthy pit include; AGC Woodward Clyde (1992a, 1992b), Graeme Campbell and Associates (1995), Golder Associates (1997), Waterhouse, J. Davidge, S. (1999) and BHP Billiton Iron Ore (2004c). Research is also being conducted elsewhere into various methods of reducing direct evaporation including membrane covers, floating covers, oil-film covers and wind diversion structures.

The Callawa pits will be backfilled with overburden to approximately 5 m above the pre-mining watertable upon completion of mining. This would eliminate evaporative losses from the post-mining water balance and the watertable is predicted to recover to near pre-mining levels (Aquaterra, 2008). As a result, no long-term impacts on groundwater levels or quality are expected.

4.5.5 Performance Indicators

- Monthly reports to be up to date and contain current monitoring data.
- Regular comparison of monitoring data against water quality trigger values and/or historical monitoring data.
- No breaches of environmental licence conditions.
- Relevant corporate water reduction targets achieved (i.e. reducing water use per tonne of production of ore).

4.5.6 Monitoring

Groundwater monitoring at Goldsworthy is conducted in accordance with the GWL Operating Strategy, and the abstraction licenses issued under the RIWI Act (i.e. GWL107452, GWL153404, GWL107453, GWL107451 and GWL154184).

Table 4-2 provides an overview of the parameters, monitoring sites and frequency of the groundwater monitoring programme. Specific detail of the groundwater monitoring programme is provided in the GWL Operating Strategy, which is updated as required in consultation with the administering authority.

Table 4-2
Groundwater Monitoring Programme

Area/Aspect to be Monitored	Parameter	Location	Frequency
Mine Dewatering[1,2]	Abstraction/Flow Rate	Shay Gap: PB1, PB2, PB3, PB4 Yarrie: Sump(s) Y10 Pit: Sump SHW7: S7B04, S7B05, Sump(s) Nim B: Sump(s) Nim F East: Sump(s) Nim I: WBNI01 Egg Creek: NBP1, NBP2, NBP3 Cundaline: WB24	Monthly with Annual Total
Water Use	Flow Rate	All flow meters – see GWL operating strategy for Goldsworthy	Monthly
Groundwater Drawdown[2]	Water Levels	Yarrie: Sump Y10: Sump and any in-pit observation bores SHW7: S7B04, S7B05, sumps and any in-pit observation bores SHW4: SHW4-WB1, SHW4-WB2 Nim B: Sumps and any in-pit observation bores Nim F East: Sump(s) and NFE1 Nim I: WBNI01, WPNI01, WPNI02s/d, WPNI03	Weekly
		Shay Gap: OB1 Yarrie: YRP04, YRP06, YRP15, YRP22, YRP24, YR1060, YR1063, YR1065, YR836, YP6, YP9, YP19, YP23, YP27, YP32 SHW7: S7B04, S7B05, S7P01, S7P05, S7P13, SHW7P11 SHW4: SHW4-WB1, SHW4-WB2* Area has no active dewatering; stopped monitoring in September 2006 Nim B:NBP16, NBP57, NBP58, NBP59, NBP168, Sump/Pit lake Nim F East: NFE1, Sump* Nim I: WBNI01, WPNI01, WPNI02s/d, WPNI03* Area has no active dewatering; stopped monitoring in September 2006 Nim A: NAPB4, NAPB7, OB5, OB22 Egg Creek: NBP1, NBP2, NBP3 Cundaline: WB24	Monthly

Table 4-2 (Continued)
Groundwater Monitoring Programme

Area/Aspect to be Monitored	Parameter	Location	Frequency
Groundwater Quality [2]	Salinity (EC) and pH	Shay Gap: PB1, PB2R, PB3, PB4 Yarrie: Sump(s) Y10 Pit: Sump SHW7: S7B04, S7B05, Sump(s) Nim B: NB01, Sump(s) Nim F East: Sump(s) Egg Creek: NBP1, NBP2, NBP3 Cundaline WB24	Monthly (if operational)
	Hydrochemistry*	Yarrie: Sump(s) Y10 Pit: Sump SHW7: S7B04, S7B05, Sump(s) Nim B: NB01, Sump(s) Nim F East: Sump(s) Nim I: WBNI01 Egg Creek: NBP1, NBP2, NBP3 Cundaline: WB24	Annually (if operational)
	Hydrochemistry*	Shay Gap: PB1, PB2R, PB3, PB4	Quarterly (if operational)
Rainfall	Rainfall	Yarrie Weather Station	Monthly

1 GWL107452, GWL153404, GWL107453, GWL107451 and GWL154184.
2 GWL Operating Strategy for Goldsworthy.
* pH, EC, TDS, Na, Ca, Mg, K, Cl, SO_4, HCO_3, NO_3, Pb, Cu, Mn, Zn and Fe.

As required by the relevant RIWI Act and EP Act licences, BHP Billiton Iron Ore will continue to conduct annual and triennial aquifer reviews. These will be used to report the results of groundwater monitoring undertaken at the Goldsworthy. The reviews will discuss the results of water quality and water level monitoring within each of the bores, and if required, describe any groundwater investigations (i.e. if investigation trigger levels are exceeded), new monitoring programmes and changes to production bore extraction rates and management measures.

4.6 AIR QUALITY

4.6.1 Existing Environment

Dust

Goldsworthy is located in a remote area, approximately 90 km from Marble Bar and some 11 km to the nearest non-BHP Billiton Iron Ore owned residence (Yarrie Homestead). The area has sparse vegetation cover and experiences extended periods of low rainfall. As a result, dust is naturally generated during dry windy conditions or dust storms.

The cumulative Goldsworthy Air Quality Assessment conducted for the Cundaline and Callawa EPS (Heggies, 2008) identified the Yarrie Accommodation Village, Yarrie Homestead, and Warralong Aboriginal Community as sensitive receptors in the vicinity of Goldsworthy.

As no data exists in relation to existing air quality in the vicinity of the Yarrie operations or the wider region, the incremental increase in dust levels and particulate concentrations was used to assess the predicted incremental impacts from Cundaline and Callawa.

Greenhouse Gases

The sources of greenhouse gas emissions at Goldsworthy are restricted to the burning of fuels in mining and haulage equipment, blasting fumes from explosives, organic decay emissions of cleared native vegetation from new disturbance areas and decay emissions from the putrescible landfill. Electricity for Goldsworthy is supplied via a 66 kV powerline from Port Hedland. Electricity requirements for Goldsworthy would be provided by either extending the electricity line from the Yarrie processing facilities, or by on-site diesel-fuelled generators.

4.6.2 Potential Impacts

Activities at Goldsworthy that have the potential to generate dust include:

- clearing of vegetation and stripping of topsoil;
- drilling and blasting;
- hauling ore and overburden to stockpiles and OSAs;
- operation of the Cattle Gorge and Sunrise Hill haul roads to transfer ore to the Yarrie and Nimingarra crushers;
- loading and unloading operations (loaders, trucks and conveyor transfer points);
- ore crushing and material handling;
- rail load out operations; and
- movement of light vehicles.

Dust deposition also has the potential to result in adverse impacts on surrounding flora, fauna and Aboriginal heritage values in the areas immediately adjacent to disturbance and operational areas.

Results of the air quality impact assessment conducted for Goldsworthy (Heggies, 2008) indicated that no significant impacts were predicted on the Yarrie Homestead or Warralong Aboriginal Community given the distance between these receptors and the operations. The assessment concluded that wheel-generated dust associated with the transport of ore had the greatest potential to impact on air quality at the location of the Yarrie accommodation camp, however no exceedances of air quality criteria were predicted from operations-only emissions.

Greenhouse Gases

Current sources of greenhouse gas emissions at Goldsworthy are restricted to the burning of fuels for mining and haulage equipment, use of purchased electricity, blasting fumes from explosives, organic decay emissions of cleared native vegetation from disturbance areas and decay emissions from the putrescible landfill.

Electricity for Cundaline and Callawa will be supplied via a 22 kV ETL or diesel-fuelled generators. The expected electricity demand for the Cundaline and Callawa mining operations would be approximately 7,500 megawatt hours (MWh) per annum if the Cundaline processing option is used, with a similar demand expected if the Yarrie processing option is used.

Predicted greenhouse gas emissions from the proposed Cundaline and Callawa mining operations were calculated as part of the air quality assessment (Appendix L of the EPS). This analysis included consideration of Scope 1 (direct/point source emissions), Scope 2 (point source emissions from purchased electricity), and Scope 3 (indirect, fuel extraction and/or line loss emissions) emissions generated from the consumption of fuel in vehicles, power consumption and blasting.

The calculated annual greenhouse gas emissions for the proposed Cundaline and Callawa mining operations would be up to approximately 18,846 tonnes (t) of CO_2-Equivalent per annum.

It should be noted that the tabulated greenhouse gas emission estimates are conservative, as maximum predicted increases have been used and current greenhouse gas reduction technologies used on-site have not been taken into consideration. Management measures that may reduce greenhouse gas emissions below the levels predicted are discussed below.

4.6.3 EMP Objectives

- *To take all reasonable and practicable measures to prevent or minimise the generation of dust from all handling operations, stockpiles, open areas and transport activities.*
- *To ensure that nuisance dust levels are not experienced by other land users.*
- *To minimise the generation of greenhouse gas emissions.*

4.6.4 Management Practices

General

The generic BHP Billiton Iron Ore Land Management Manual contains a dust management component that is used to guide the management of dust at all of BHP Billiton Iron Ore's mining operations. The dust management component of the BHP Billiton Iron Ore Land Management Manual aims to minimise and monitor the generation of dust from mining operations and identifies dust control methods that may be adopted at BHP Billiton Iron Ore mine sites, including:

- installation and operation of high volume dust monitoring stations;
- watering of haul roads;
- use of chemical suppressants on haul roads;
- water sprays at strategic points in the processing circuit (e.g. primary crusher bins and stackers); and
- rehabilitation of disturbed areas as they become available.

Goldsworthy Dust Management Practices

Dust management practices employed at Goldsworthy are as follows:

- Transfer points are enclosed and fitted with water sprays.
- Water tankers are used to apply water to sites within areas of operation which have the potential to generate dust, including unsealed roads, haul roads and construction areas.
- Areas of exposed soil (land disturbance) are minimised.
- Dust suppression equipment is maintained in efficient operating condition.
- Disturbed areas are rehabilitated as they become available.
- Mine regulations require that the area be cleared of all personnel during blasting operations and that re-entry is not permitted until safe work conditions (which includes a safe breathing atmosphere) exist.
- Routine maintenance and housekeeping practices are employed to ensure that waste materials in or around the premises do not accumulate and lead to the generation of unacceptable airborne dust.
- Routine maintenance of dust collection and dust control systems to ensure dust emissions are minimised.
- All employees and contractors are informed of the importance of minimising ambient dust levels.
- A Low Frequency Microwave Moisture Analyser (LFMMA) is used to monitor the moisture content of material on the conveyer system. In the event that moisture content is outside the accepted ore moisture range, the water supply will be adjusted to ensure adequate dust suppression.

Greenhouse Gas Management Practices

BHP Billiton Climate Change Policy

The idea behind the BHP Billiton philosophy, “what we measure we can improve”, is that measurements allow progress to be tracked, which indicates whether or not specific targets are being met. From a greenhouse gas perspective this philosophy has been in practice since 1993 when BHP started measuring, and publicly reporting greenhouse gas emissions from its facilities.

In July 2007 BHP Billiton finalised and adopted a new Climate Change Policy to replace their existing policy, which had been in place since 2002. BHP Billiton issues policy statements in order to publicly define its position on climate change and greenhouse gas emissions. The Climate Change Policy commits to a series of actions including new greenhouse gas and energy targets and measures, a major investment in research and development of low carbon emissions technologies, and participation in the design of effective national and international climate change policies. BHP Billiton has developed an action plan in order to implement its Climate Change Policy.

This action plan is summarised below:

- *Increase understanding of life cycle emissions of our products*

  BHP Billiton aims to understand the sources, scopes and extent of greenhouse gas emissions associated with its activities, by continuing transparent public reporting of its emission profile and working with experts to improve the understanding of the full life cycle of its products and strategies for effectively reducing greenhouse gas emissions from their production and use.

- *Improve management of energy and greenhouse gas emissions from production*

  BHP Billiton aims to build emission abatement and energy saving considerations into decision-making processes, through:

  – Business excellence – BHP Billiton's business excellence systems promote and share leading practice and innovation in energy and operational efficiency to deliver savings in emissions and costs.

  – Group targets – BHP Billiton aims to achieve an improvement in energy intensity and greenhouse gas intensity from all operations of no less than 13% and 6%, respectively, over the period 2006 to 2012.

  – Site based plans and target – Every site is subject to the BHP Billiton Iron Ore Energy Efficiency Opportunity Programme that is designed to reduce energy wastage.

  – Carbon pricing – Carbon pricing sensitivity analysis will be undertaken in capital decisions on assets of US$100 million or more, or those that emit greater than 100,000 t CO_2-e/annum.

  – Market trading – Emission reduction instruments will be traded as a means of managing our emissions exposure and assisting our customers to manage their exposure.

  – Project-based emissions reductions – BHP Billiton will continue to pursue external projects and other opportunities that deliver tangible reductions in greenhouse gas emissions and generate credits.

- *Work collaboratively with customers, communities and employees to reduce emissions and support internal emissions reduction projects.*

  BHP Billiton will commit US$300 million over the period 2008 to 2012 to support industry research, development and demonstration of low emission technologies, provide capital funding for internal energy projects with a greenhouse gas emission reduction component, and support the efforts of employees and local communities to reduce their emissions.

- *Progress climate change policy within BHP Billiton's sphere of influence*

  BHP Billiton will work with governments and other stakeholders on the development of policies that provide the necessary incentives and tools for effective, equitable abatement.

General Greenhouse Gas Emission Management Measures

General BHP Billiton Iron Ore greenhouse gas management measures include:

- Energy efficiency improvement target of 13 per cent over the period 2006 (baseline year) to 2012, cascaded into business planning.
- Identify initiatives and implement business processes that ensure energy efficiency opportunities are integrated into our operational, engineering, contractual and investment business activities.

- All sites have developed energy and greenhouse gas management plans, including targets, improvement project evaluation and associated monitoring and reporting. Management plans mandated where energy use greater than 0.25 petajoules

In addition, BHP Billiton Iron Ore has implemented an Energy Excellence Project to aid in achieving its Climate Change Policy targets. Each of BHP Billiton Iron Ore's Pilbara operations is tasked with identifying energy efficiency improvement opportunities towards the reduction targets. The Energy Excellence Project is also designed to ensure that BHP Billiton Iron Ore shares leading practice and innovation across its operations in order to deliver energy and emission savings.

Examples of how the above commitments will be incorporated into Goldsworthy are provided below.

- Mining equipment fuel consumption, explosives consumption and purchased electricity data would be collected monthly at Goldsworthy for inclusion into the BHP Billiton Iron Ore mining operations monthly environmental report. The data is used to make a comparative assessment of greenhouse gas emissions (total and per unit production) with BHP Billiton Iron Ore's other mining operations in the Pilbara.
- Energy consumption and emissions data would be collated and annually reported to the Department of the Environment, Water, Heritage and the Arts through the National Pollutant Inventory (NPI).
- BHP Billiton is a participating corporation in the Energy Efficiency Opportunities (EEO) programme. The Programme encourages large energy-using businesses to improve their energy efficiency. It does this by requiring businesses to identify, evaluate and report publicly on cost effective energy savings opportunities.

Goldsworthy Greenhouse Gas Emission Management Measures

Greenhouse gas emissions at Goldsworthy would be minimised by adopting the following management measures:

- restricting the amount of native vegetation that is cleared to a practical minimum;
- educating staff on energy efficiency;
- progressively rehabilitating mine landforms and disturbed areas as they become available;
- regularly maintaining and replacing fixed and mobile equipment to minimise fuel consumption; and
- minimising haulage distances and grades.

BHP Billiton Iron Ore would aim to reduce the amount of greenhouse gas emissions during the course of operations by adopting available technologies which may improve the efficiency of mining and ore processing equipment, resulting in a reduction in energy usage and consequently greenhouse gas emissions.

4.6.5 Performance Indicators

- No excessive dust emissions from haul roads.
- Dust deposition in areas adjoining disturbance areas does not significantly impact environmental values (e.g. flora, fauna and/or Aboriginal heritage sites).
- Sprays and water control mechanisms are functioning adequately.

4.6.6 Monitoring

- The moisture content of the ore will be monitored during processing. Dust control equipment will be inspected regularly to assess its effectiveness.
- Greenhouse gas emissions will be reported annually as a component of the HSEC annual report.
- Dust deposition in areas adjoining disturbance areas will be periodically assessed.

Greenhouse gas emissions will be reported annually as a component of the HSEC annual report.

4.7 NOISE

4.7.1 Existing Environment

Noise generated at Goldsworthy is primarily caused by blasting activities, operation of the mining mobile fleet and the ore crushing and screening equipment. Rail noise is also generated by the loading and transport of ore. Due to the remote location the potential impact of noise from these sources is primarily restricted to impacts on workers at the mine and the Yarrie accommodation camp.

Noise levels at Goldsworthy are currently managed to comply with occupational health and safety conditions (*Mine Safety and Inspection Regulations, 1995*).

The Noise Assessment conducted for the Cundaline and Callawa EPS (Heggies, 2008) identified the Yarrie Accommodation Village and Yarrie Homestead as sensitive receptors in the vicinity of Goldsworthy.

4.7.2 Potential Impacts

Mining at Goldsworthy generates noise emissions as a result of the following activities:

- drilling and blasting;
- hauling ore and overburden to stockpiles, OSAs and processing facilities;
- loading and unloading operations;
- ore crushing and material handling;
- rail load out operations; and
- movement of light vehicles.

Impacts associated with the above activities were assessed as part of the Noise Assessment conducted for the Cundaline and Callawa EPS (Heggies, 2008). The assessment concluded that no significant impacts on sensitive receptors would arise as a result of the mining activities at Goldsworthy.

4.7.3 EMP Objectives

- *To take all reasonable and practicable measures to prevent or minimise the generation of noise from the mining, processing and rail operations.*
- *To ensure that noise generated does not result in neighbourhood annoyance, consistent with noise regulations.*

4.7.4 Management Practices

General Noise Management Practices

The generic BHP Billiton Iron Ore Land Management Manual contains a noise management component that is used to guide the management of noise at BHP Billiton Iron Ore mining operations. The noise management component of the BHP Billiton Iron Ore Land Management Manual aims to ensure that measures are undertaken to minimise the potential for environmental impact.

Goldsworthy Noise Management Practices

The *Mine Safety and Inspection Regulations, 1995* set an action level for noise exposure of 85 dB(A) over an eight hour period in relation to occupational health and safety. The regulations require that noise levels above the action level associated with the construction and operation of the mine must be reduced as much as practicable by engineering noise controls. Based upon the requirements of these regulations the following measures will continue to be implemented at Goldsworthy to minimise impacts on acoustic amenity:

- Preferential purchase and use of low-noise equipment where practicable.
- Fitting silencers and exhaust mufflers, where necessary.
- Undertaking blasting during daylight hours only.
- Machinery will be regularly serviced.
- Generators will be located in enclosed areas and at a sufficient distance from personnel areas.
- Designing blasting operations at Cattle Gorge such that there will be no significant impacts on the natural gorge located to the east of the mining area.

4.7.5 Performance Indicators

- Blasting is conducted at specified times during daylight hours.
- Compliance with the provisions of the *Mine Safety and Inspection Regulations, 1995.*

4.7.6 Monitoring

Noise monitoring for employee protection will be undertaken as required to assess whether noise exposure levels of 85 dB(A) over an eight hour period are being exceeded.

4.8 FLORA

4.8.1 Existing Environment

A description of the existing flora and vegetation communities recorded at Goldsworthy, including significant flora species, is provided in the Significant Species Management Plan (SSMP) (BHP Billiton Iron Ore, 2008b).

4.8.2 Potential Impacts

Vegetation clearing and disturbance associated with Goldsworthy may reduce species abundance at a local level, but is expected to have negligible impact on a regional scale as the habitats in disturbance areas are well represented in the region.

Weed species have the potential to spread along areas of disturbance and though the use of mobile earth-moving machinery used onsite. Weed species are usually able to out-compete local native plant species for water and soil because they are mode prolific, have more vigorous growth, and lack predators.

Other potential impacts could arise from dust deposition on vegetation in adjoining undisturbed areas and potential changes to the frequency and/or intensity of bushfires.

Proponent Commitment No. 7-4 in Ministerial Statement of Approval No. 000303, states that:

> *BHP will establish a programme to monitor and evaluate the health of vegetation downslope of the railway embankment. If any adverse impacts are revealed by this monitoring, BHP will take steps as necessary to mitigate those impacts*.

As required by this commitment, BHP Billiton Iron Ore conducted surveys in 1995 and 1997 to assess the level of impact on vegetation downslope of the railway embankment. In 2001 BHP Billiton Iron Ore revisited the initial survey sites. Results confirmed that there was minimal impact on vegetation communities downslope of the railway embankment.

During the remaining operations at Goldsworthy, BHP Billiton Iron Ore will continue to periodically inspect railway embankments within Goldsworthy area to evaluate the health of downslope vegetation.

4.8.3 EMP Objectives

The flora and vegetation management objectives for Goldsworthy include 'general objectives' which primarily relate to operational management activities, and 'closure objectives' which relate to rehabilitation, decommissioning and mine closure. The 'closure objectives' have been formalised as Guiding Closure Principles for revegetation in the DRP (BHP Billiton Iron Ore, 2008d).

General

- *To ensure that the conservation status of all flora species is not threatened.*
- *To restrict clearing of vegetation to the practicable minimum.*

Closure

- *The established vegetative cover will be self-sustaining and show progression towards the surrounding undisturbed vegetation in terms of species diversity and plant density.*
- *A long-term systems-based monitoring approach will be used to track the trajectory of rehabilitated areas towards self-sustaining status.*

4.8.4 Flora Management Practices

Flora management measures for Goldsworthy are documented in the SSMP (BHP Billiton Iron Ore, 2008b). The SSMP contains 'general' management practices to be implemented to minimise the impact of the mining operations on flora and fauna, as well as 'specific' management measures for species of conservation significance.

The SSMP includes a three level management hierarchy that has been developed by BHP Billiton Iron Ore to broadly classify and assign the appropriate level of management response for significant species. A summary of the management hierarchy and species assigned to each is provided in Table 4-3.

Table 4-3
Management Hierarchy for Significant Species

	1	2	3
Summary of Category	Species likely to be impacted in the next five years (i.e. period covered by the SSMP).	Species unlikely to be impacted in the next five years (i.e. period covered by the SSMP).	Species not previously identified at Goldsworthy but suitable habitat is available and therefore could potentially occur.

The management measures assigned to significant species within each level of the management hierarchy are described in the SSMP (BHP Billiton Iron Ore, 2008b), and are summarised below.

'Level 1' Significant Species

Species classified as 'Level 1' require the highest degree of management, as they are known to occur in or near to proposed disturbance areas and are therefore more likely to be directly impacted. In order to minimise potential impacts on Level 1 significant species, mine planning, general, and species-specific management measures will be implemented as described in the SSMP.

'Level 2' Significant Species

Species classified as 'Level 2' require specific monitoring, but fewer management measures, as they are considered unlikely to be directly impacted over the next five years. However mine planning and general management measures will still be implemented to minimise potential impacts. In the event that monitoring indicates the presence of a Level 2 significant species within an existing or proposed disturbance area, species-specific management measures will be developed, included in the SSMP and implemented.

'Level 3' Significant Species

Species classified as 'Level 3' significant species have the potential to occur in Goldsworthy area and will be managed by implementing the general management measures described in the SSMP. In the event that a 'Level 3' significant species is recorded, the level of management response will be adjusted as necessary, and species-specific management measures developed, included in the SSMP and implemented.

Weed Management Practices

Weed management measures for Goldsworthy are documented in the Weed Management Plan (WMP) (BHP Billiton Iron Ore, 2008c). The WMP outlines the general and species-specific weed management, hygiene and monitoring measures which relate to weed species recorded at Goldsworthy and other weed species which have the potential to occur.

Management of Fire Regime

While fire is accepted to be a part of the natural Pilbara landscape, following control measures will be implemented to minimise the potential for significant anthropogenic changes to the local fire regime:

- Fire hazard awareness and management training will be provided to BHP Billiton Iron Ore personnel and contractors, which will include emergency response procedures.
- Vehicles access will be restricted to designated access roads where possible.
- Spark shields will be used where appropriate.
- Fire-fighting equipment will be provided in work areas according to fire hazard.
- Fire-fighting equipment will be regularly inspected and maintained.
- Fire restrictions will be in place, including smoking in designated areas only.
- A resource inventory will be maintained that details fire management staff, contacts and equipment lists.
- Where necessary, controlled burns will be conducted in consultation with relevant government agencies (i.e. the Fire and Emergencies Services Association of WA and the DEC) in order to reduce local fuel loads.

4.8.5 Performance Indicators

The following performance indictors will be used to assess compliance with relevant legislation and guidelines which relate to flora within Goldsworthy mining leases:

- Clearing complies with approved PEAHR plans.
- Operations conducted in accordance with the SSMP (BHP Billiton Iron Ore, 2008b).
- Operations conducted in accordance with the WMP (BHP Billiton Iron Ore, 2008c).
- Staff trained to an acceptable standard in bushfire management.
- Implementation of fire emergency response procedures if required.
- Completion of bushfire management actions.

4.8.6 Monitoring

Operational

Regular inspections are undertaken by the onsite environmental officer to ensure that vegetation is being cleared and stockpiled in the appropriate locations and that relevant plans are updated.

The BHP Billiton Iron Ore Site Manager or delegate regularly inspects operational areas to monitor adherence to PEAHR clearing plans. Specifically that:

- only authorised clearing is being undertaken;
- vegetation and topsoil is being removed and stockpiled in appropriate locations; and
- areas to be cleared comply with design specifications.

Rehabilitation

Rehabilitation monitoring at Goldsworthy is conducted in accordance with the BHP Billiton Iron Ore EFA monitoring programme described in the DRP (BHP Billiton Iron Ore, 2008d), which aims to measure the progression of rehabilitation towards self-sustaining ecosystems. EFA is a CSIRO developed method used to provide indicators of rehabilitation performance. This allows assessment of ecosystem sustainability through the plotting of ecosystem development trajectories and can identify areas of rehabilitation that require remedial action. The results of rehabilitation monitoring will be used to adjust and refine the rehabilitation methods in accordance with BHP Billiton Iron Ore's adaptive management approach, which involves regularly assessing performance and adjusting its management practices to facilitate continuous improvement.

4.9 TERRESTRIAL VERTEBRATE FAUNA

4.9.1 Existing Environment

A description of the existing fauna (including significant species) recorded at Goldsworthy is provided in the SSMP (BHP Billiton Iron Ore, 2008b).

Condition 4-1 of Ministerial Statement of Approval No. 000303 required the preparation of a Fauna Management Plan. The Fauna Management Plan was assessed and deemed to satisfy Condition 4-1 in 1993 and was implemented by BHPIO as per Condition 4-2. The Fauna Management Plan primarily contained procedures for the management and monitoring of the Pebble-mound Mouse in the Yarrie area. As required by the Fauna Management Plan and Proponent Commitment No. 7-17 of Ministerial Statement of Approval No. 000303, Numerous Pebble-mound Mouse monitoring studies have been carried out at Yarrie over the past decade (e.g. HGM, 1997a, 1997b, 1997c, 1997d, 1997e; 1998a).

Ongoing management of the Pebble-mound Mouse at Goldsworthy is now conducted in accordance with the SSMP (BHP Billiton Iron Ore, 2008b).

4.9.2 Potential Impacts

Goldsworthy has the potential to impact local fauna through direct impacts during land clearing (i.e. fauna mortalities) and through the loss of fauna habitat. More mobile species such as birds and macropods are likely to move away from disturbance areas to adjoining habitats, however there is potential for the temporary loss of local populations of less mobile species due to clearing activities (*ecologia*, 2005).

The potential impacts associated with vegetation clearance will generally be limited to the proposed new development areas. There may also be an increased risk of bush fire in these areas, which could also have a detrimental effect on native fauna populations.

There is the potential for feral animals to be attracted to Goldsworthy by the creation of new habitat opportunities (e.g. stockpiled timber and/or rocks from cleared mine and OSA areas), discarded food scraps and other rubbish. These factors could result in an increase in the population or the introduction of new feral species in and around Goldsworthy area.

4.9.3 EMP Objectives

- *To minimise the impact of mining operations on local fauna populations.*
- *To ensure the conservation status of all fauna species is not threatened.*

4.9.4 Fauna Management Practices

Fauna management measures for Goldsworthy are documented in the SSMP (BHP Billiton Iron Ore, 2008b). The SSMP applies to all areas of Goldsworthy, and therefore replaces the 1993 Fauna Management Plan specifically required for the Yarrie site by Condition 4-1 of Ministerial Statement of Approval No. 000303.

The SSMP contains 'general' management practices to be implemented to minimise the impact of the mining operations on flora and fauna, as well as 'specific' management measures for species of conservation significance.

The SSMP describes the three level management hierarchy that has been developed by BHP Billiton Iron Ore to broadly classify and assign the appropriate level of management response for significant species. A summary of the hierarchy is provided in Section 4.8.4.

Pets, firearms and indiscriminate use of off-road vehicles will be prohibited in Goldsworthy area, to minimise impacts on native fauna species.

4.9.5 Management of Significant Bat Species

Potential impacts on the Pilbara Lead-nosed Bat (*Rhinonicteris aurantius*) and Ghost Bat (*Macroderma gigas*) at Goldsworthy are regarded as significant in terms of Goldsworthy risk assessment process. They are managed in accordance with the Management Plan for Bat Species, which is provided as an appendix to the SSMP (BHP Billiton Iron Ore, 2008b). The Management Plan for Bat Species represents the development and implementation of best practicable environmental measures at Goldsworthy. It presents the management measures to minimise impacts on both bat species, and a bat monitoring programme to assess impacts to known roost caves and bat populations. Management measures for bat species include the use of buffer zones, restrictions on blasting activities and directional night lighting.

Known roost caves occupied by populations of the two bat species will be monitored on a quarterly basis for parameters such as bat use, condition of the cave entrance and mine-related noise in the vicinity of the cave entrance. In addition, records of blasting times and activities in areas adjacent to the buffer zones will be documented, and buffer zones and the position of night lights will be periodically checked (i.e. at least every three months).

The results of quarterly monitoring of known roost caves will be presented in a report, which will provide a status report of the implementation of each of the management measures contained in the Management Plan for Bat Species. A summary of the results of quarterly monitoring and reporting will be provided in the AER.

4.9.6 Management of Pest Species

Section 37 of the *Agriculture and Related Resources Protection Act, 1976* (ARRP Act) refers to a list of all fauna species classed as ‘declared animals’. Declared animals are considered to be pest species, and require control under the ARRP Act. No declared animals have been found within the Goldsworthy area to date.

Other introduced species, which are not declared species under the ARRP Act, have been recorded at Goldsworthy. These species are also considered to be potentially destructive to vegetation and native fauna species due to competition for resources and/or predation requirements. Potentially destructive introduced species recorded at Goldsworthy include the House Mouse (*Mus musculus*) and Feral Cat (*Felis catus*).

The following pest management practices will be implemented at Goldsworthy:

- The BHP Billiton Iron Ore Environmental Officer (or nominated delegate) will conduct pest inspections at least every six months in the active mining areas of the Goldsworthy mining leases, in order to monitor for the presence of pest species.
- The status/declaration of all new and previously recorded pest species will be regularly reviewed and updated, with all new pest species and status changes recorded in relevant databases and mine plans (when appropriate).
- Follow-up inspections will be conducted by a BHP Billiton Iron Ore Environmental Officer (or nominated delegate) where necessary, to assess the effectiveness of control measures implemented, and if any additional control measures are required.

- A clean, rubbish-free environment will be maintained, particularly around administration and contractor areas in order to discourage scavenging and reduce the potential for colonisation of non-endemic fauna.
- BHP Billiton Iron Ore will regularly consult with the DEC (formerly CALM) and the Department of Agriculture and Food (DAFWA) for updates on best-practice pest control strategies.
- BHP Billiton Iron Ore will inform relevant government agencies (e.g. DEC, DoIR and DAFWA) of any new pest species identified within the mining lease.
- The need for, and type of control strategies used to manage pest species will be determined in consultation with DEC and DAFWA. Possible control measures that may be implemented include, but are not necessarily limited to, the following:
  - destruction of pest habitat (i.e. rabbit burrows and rabbit harbour);
  - fencing of pest infested/habitat areas (e.g. for known rabbit infested areas use rabbit proof fences);
  - species-specific baiting; and
  - lure and capture strategies using smells and sounds.

The BHP Billiton Iron Ore Feral Animal Control Manual describes procedures for the control of Feral Cats and Wild Dogs. These procedures include: internal notification that a baiting/trapping programme will be undertaken in a particular area over a particular time period; erection of suitable warning signs in the baiting area; the siting and use of suitable poisoned baits and/or traps; daily inspection of the baits/traps; and euthanasia and disposal of any captured pest species.

In the event that a previously unrecorded pest species is observed, consultation with the DEC (formerly CALM) and DAFWA will be undertaken to determine appropriate control measures, if required.

A summary of pest management activities will be reported in the AER.

4.9.7 Performance Indicators

- Restriction of land clearing to approved site plans.
- Operations conducted in accordance with the SSMP (BHP Billiton Iron Ore, 2008b).
- Clearing conforms with relevant PEAHR procedure forms (Figure 4-1).
- Compliance with the provisions of the *Wildlife Conservation Act 1950* and the ARRP Act.
- Maintenance of records of impacted flora/fauna species, vegetation associations and/or habitat areas of conservation significance.
- Where targeted pest control programmes are implemented, subsequent inspections confirm that the targeted species and/or its core habitat is no longer present, or numbers are reduced to a level agreed with DAFWA and the DEC.

4.9.8 Monitoring

Monitoring of fauna activity on rehabilitation sites will be conducted and will consist of six monthly qualitative observations of the following:

- birds, reptiles and mammals (species and number, if possible);
- scats and tracks; and
- evidence of nesting.

Monitoring of significant species will be conducted in accordance with the SSMP (BHP Billiton Iron Ore, 2008b). Results of fauna monitoring will be documented in the AER.

4.10 TERRESTRIAL INVERTEBRATE FAUNA

4.10.1 Existing Environment

Endemism refers to the restriction of a species to a particular area, whether it is at the continental, national or local scale (Allen *et al.*, 2002). Short-range endemic species have restricted distributional ranges, usually less than 10,000 square kilometres (km^2) (Harvey, 2002).

A number of invertebrate groups have been identified as containing short-range endemic species, such as Mygalomorph Spiders (Mygalomorphae), Pseudoscorpions (Pseudoscorpionida), Scorpions (Scorpionida), Millipedes (Myriopods) and Terrestrial Molluscs (Pulmonata) (Harvey, 2002). SRE species are generally characterised by poor dispersal, heavy reliance on discontinuous habitats, low growth rates, and low fecundity (Harvey, 2002).

Methodology

The short-range endemic survey was undertaken following consultation between BHP Billiton Iron Ore/Resource Strategies and the DEC, Dr Mark Harvey (Western Australian Museum [WAM]) Shirley Slack-smith (WAM), Professor Barbara York-Main (University of Western Australia [UWA]) and Professor Mike Johnson (UWA).

Mygalomorph Spiders (Mygalomorphae), Pseudoscorpions (Pseudoscorpionida), Scorpions (Scorpionida), Millipedes (Myriopods) and Terrestrial Molluscs (Pulmonata) were targeted during the assessment.

Three separate surveys were undertaken. ENV Australia conducted the first two surveys from April to May 2008 focusing on the collection of mygalomorph spiders. The third was undertaken by Outback Ecology in July 2008 and focusing on the collection of all of the above listed invertebrate groups.

A total of 160 pitfall traps were set during the surveys (80 pitfalls on each ridge). Methodology also included systematic targeted searching, litter collection, soil sieving and ultraviolet light night searching.

Habitat Assessment

Habitat with the potential to support short-range endemic invertebrates was identified at both the Cundaline and Callawa ridges. These potential habitats were associated with the following:

- south-west facing ridges and slopes of the Cundaline ridge; and
- east facing ridges and slopes of the Callawa ridge.

The hilltops of the Cundaline and Callawa ridges and the surrounding slopes and plains have a relatively low potential to support short-range endemic species (Outback Ecology, 2008).

Survey Results

Overall, there were no known terrestrial short-range endemic invertebrate species identified as a result of the survey within the Cundaline and Callawa areas.

The results of the surveys are as follows.

- *Mygalomorph Spiders* - eight mygalomorph spiders were collected during the surveys. No mygalomorph species collected within the Cundaline or Callawa areas were known to represent short-range endemic species.
- *Pseudoscorpions* - A total of 20 pseudoscorpions were collected during the surveys. The pseudoscorpions represented three genera from the family Olpiidae. From the current level of taxonomic knowledge, no pseudoscorpions collected within the Cundaline or Callawa areas were found to represent short-range endemic species.
- *Scorpions* - A total of 12 scorpions from two genera were collected during the surveys. From the current level of taxonomic knowledge, no scorpions collected within the Cundaline or Callawa areas were found to represent short-range endemic species.
- *Millipedes* - No millipedes were collected during the surveys, however a number of centipede specimens were collected. These specimens represented six species from three Orders. From the current level of taxonomic knowledge, no centipedes collected within the Cundaline or Callawa areas were found to represent short-range endemic species.
- *Terrestrial Molluscs* - A total of 78 terrestrial mollusc specimens were collected during the survey, 33 from the Cundaline area, and 45 specimens from the Callawa area. The mollusc specimens were collected in litter samples, soil samples and whilst actively searching.

4.10.2 Potential Impacts

Given that no terrestrial short-range endemic invertebrate species were identified during the surveys, there is a low likelihood that any would be significantly impacted by the proposed Cundaline and Callawa mining operations. Further, were a terrestrial short-range endemic invertebrate species to occur it is unlikely to be restricted to the proposed disturbance areas given the wider occurrence of habitat along both ridges.

4.10.3 Management Measures

No specific management measures are proposed at Goldsworthy for terrestrial invertebrate fauna.

4.11 STYGOFAUNA

4.11.1 Existing Environment

Stygofauna are subterranean dwelling, aquatic fauna that are linked to geological periods when the Pilbara was covered with rainforest (Biota, 2001). They are therefore regarded as relict fauna that have survived in aquifers over geological timeframes (Biota, 2001).

Stygofauna in the Pilbara are largely represented by crustacean orders including Isopoda (an order which includes most common garden slaters), Copepoda and Amphipoda. Most species are in the order of a few millimetres in size (Biota, 2001).

Previous Stygofauna Surveys

A stygofauna survey was undertaken in the Goldsworthy Operations area as part of the BHP Regional stygofauna monitoring between 2005 and 2007 (Biota, 2008a). The stygofauna survey sampled bores at Nimingarra, Sunrise Hill, Shay Gap and Yarrie. During the survey, only one stygofauna group (Bathynellacea) was detected and only from two bores in the vicinity of the inactive Yarrie Pit (Biota, 2008a). The water parameters that were measured at each site were comparable did not provide an explanation of the apparent absence of stygofauna in the north-western region of the Goldsworthy mining area.

BHP Billiton Iron Ore is continuing a regional subterranean fauna sampling program on its tenements in the Pilbara. The stygofauna results from the numerous BHP Billiton Iron Ore survey projects are variable with little or no stygofauna detected in some areas (e.g. Jimblebar [Biota, 2008a], Mining Area C [Biota, 2008a; Subterranean Ecology, in preparation]) to relatively diverse stygal communities in other areas (e.g. Marillana, Orebody 23/25 and Ophthalmia Dam [Biota, 2008a], Quarry 8 [Subterranean Ecology, 2008a]).

Methodology

A sampling programme was undertaken within the Cundaline and Callawa areas by Subterranean Ecology between December 2007 and April 2008. The sampling programme consisted of 89 sample events from 60 holes, and involved three separate rounds of sampling.

Results

The sampling programme identified a moderate diversity of stygofauna on the Callawa ridge, and an apparent absence of stygofauna on the Cundaline ridge. The apparent absence of stygofauna at Cundaline is consistent with the apparent absence of stygofauna at the nearby Nimingarra and Sunrise Hill deposits which have been sampled repeatedly over several years from 2005 to 2007 (Biota, 2008a), and more recently in 2008 (Subterranean Ecology, in preparation).

On the Callawa ridge, five morphospecies of stygofauna were detected, including one worm (Phreodrilidae), and four crustaceans: Paramelitidae sp., *Metacyclops* sp. 1 (Copepoda), Bathynellidae sp. and Parabathynellidae sp. (Syncarida). On morphological evidence, four of these species have distributions recorded outside of the Callawa disturbance area, including three species collected at the nearby Yarrie operations. The fifth putative morphospecies, *Metacyclops* sp. 1 was only recorded within the proposed pit on the Callawa ridge, although the same morphospecies has been recorded from Quarry 8, which is located approximately 215 km south-west of the Callawa mining operation.

4.11.2 Potential Impacts

The EPA's *Guidance for the Assessment of Environmental Factors Statement No. 54 - Consideration of Subterranean Fauna in Groundwater and Caves during an Environmental Impact Assessment in Western Australia* (EPA, 2003) indicates the following could potentially have a significant impact on stygofauna and their habitats:

- lowering the watertable sufficiently to dry out the zone in which some species live, or otherwise artificially changing watertables;
- changing water quality (e.g. increasing salinity levels or altering haloclines, increasing nutrient levels or the availability of organic matter, or introducing other pollutants); or
- destroying or damaging caves (including changing their temperature and humidity).

Water supply and dewatering operations at Yarrie, Nimingarra, Sunrise Hill and Callawa have the potential to cause the impacts described above.

4.11.3 EMP Objectives

- *To maintain the abundance, diversity, geographic distribution and productivity of stygofauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.*

4.11.4 Management Measures

The Regional Subterranean Fauna Study (BHP Billiton Iron Ore, 2006) has recently been completed. BHP Billiton Iron Ore is currently reviewing the results of the Study and plan to develop an ongoing regional subterranean fauna monitoring programme that may include sites at Goldsworthy.

Groundwater would be managed to minimise adverse impacts outside the disturbance area. As discussed in Section 4.5.6, groundwater levels and water quality will be monitored at Goldsworthy.

4.12 TROGLOFAUNA

4.12.1 Existing Environment

Troglofauna (or troglobites) are air-breathing terrestrial subterranean fauna which occur in air chambers in underground caves[1] or smaller voids[2] (EPA, 2003). Troglofauna are typically invertebrates (such as spiders, scorpions, millipedes, insects and crustaceans) (EPA, 2003).

Previous Troglofauna Surveys

BHP Billiton Iron Ore is conducting a regional troglofauna sampling program for the Pilbara. The preliminary results of the regional troglofauna sampling program, combined with results of troglofauna surveys in the western Pilbara are showing:

- Troglofauna are widespread in outcropping mineralised habitat of the Pilbara.
- The species present include isopods, spiders, schizomids, pseudoscorpions, millipedes, centipedes, pauropods, bristletails, silverfish, cockroaches and beetles.

Biota Environmental Sciences conducted a stygofauna survey in the Goldsworthy Operations area as part of the BHP Billiton Iron Ore regional stygofauna monitoring between 2005 and 2007 (Biota 2008a). Troglofauna collected as by-catch included Diplopoda (millipedes), Pseudoscorpionida (pseudoscorpions), and Chilopoda (centipedes) species.

Methodology

In accordance with Section 3.4 of EPA Guidance Statement No. 54a, BHP Billiton Iron Ore has evaluated the geological information at Goldsworthy, in order to facilitate the assessment of the potential occurrence of troglofauna habitat. This geological information review is provided in Appendix K.

BHP Billiton Iron Ore commissioned Subterranean Ecology to undertake a troglofauna sampling programme for the proposed Cundaline and Callawa mining areas. The sample plan conforms with BHP Billiton Iron Ore's *Regional Subterranean Fauna Study - Troglofauna Sampling Program Methodology* (Biota, 2008b) for the Pilbara that was endorsed by the DEC.

Within each ridge the sampling effort was necessarily greater in proposed pit areas because less holes were available outside of proposed pit areas.

Results

A total of 29 troglomorphic morphospecies[3] were collected during the survey from the following eleven orders, Diplopodea, Symphyla, Chilopoda, Isopoda, Pseudoscorpionida, Araneae, Opilionida, Diplura, Zygentoma, Blattodea, Hemiptera and Coleoptera. Twenty-two troglofauna morphospecies were recorded at sampling sites on the Callawa ridge and 15 troglofauna morphospecies were recorded at sampling sites on the Cundaline ridge.

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1 A cave is a subterranean space, sufficiently large enough to admit a person (EPA, 2003).

2 A void is a subterranean space of any size smaller than a cave (EPA, 2003).

3 Morpho-species are defined as a group of organisms in which members sufficiently conform to certain fixed properties.

Ten of the troglofauna morphospecies collected were recorded at both the Callawa and Cundaline ridges. These comprised of millipedes, isopods, psuedoscorpions, beetle and cockroach.

Six of these species were collected only from inside the proposed mining operations areas, namely, Haplodesmidae SP02, Symphyla SP01, Geophilidae SP01, Diplura SP01, Meenoplidae SP02 and Phalangodidae SP01. A seventh morphospecies (*Indohya* SP01) was collected on both Cundaline and Callawa ridges, but was collected only from the in-pit area on the Cundaline ridge. It is considered likely, given the extent of Nimingarra Iron Formation, these species occur more widely on their respective landform ridges, or on other ridges in the region.

An interesting finding was the detection of troglofauna on the Yarrie ridge adjacent to the Yarrie mining operations, indicating that troglofauna populations either persisted during the mining activity, or recolonised from adjacent habitat after the mining had ceased.

Potential Impacts and Management Measures

The EPA's *Guidance for the Assessment of Environmental Factors: Consideration of Subterranean Fauna in Groundwater and Caves during an Environmental Impact Assessment in Western Australia* (EPA, 2003) indicates the following could potentially have a significant impact on troglofauna and their habitats:

- lowering the watertable sufficiently to dry out the zone in which some species live, or otherwise artificially changing watertables;
- changing water quality (e.g. increasing salinity levels or altering haloclines, increasing nutrient levels or the availability of organic matter, or introducing other pollutants); or
- destroying or damaging caves (including changing their temperature and humidity).

Mining operations at Goldsworthy have the potential to cause the impacts described above. It is considered probable, given the extent of the Nimingarra Iron Formation, that populations of each troglofauna species occur outside the pits. If any of the troglofauna species are restricted in distribution to either the Callawa or Cundaline ridge, they are unlikely to be threatened by the proposed mining operations due to the large areas of contiguous habitat that will remain in the portions of each ridge that will not be impacted by mining (BHP Billiton Iron Ore, 2008).

4.12.2 Potential Impacts and Management Measures

BHP Billiton Iron Ore is currently reviewing the results of the Study and plan to develop an ongoing regional subterranean fauna monitoring programme that may include sites at Goldsworthy.

4.13 WASTE MANAGEMENT

4.13.1 Existing Environment

Mining at Goldsworthy generates a range of waste materials which require disposal. These include:

- washdown water;
- sewage;
- scrap metal;
- non-metal scrap (e.g. uncontaminated piping, plastic, fibreglass or wood);
- general refuse;
- domestic putrescible wastes;
- tyres and conveyor belts;
- explosives and chemical packaging and wastes;
- batteries; and
- hydrocarbons (waste oil) and hydrocarbon contaminated waste.

Washdown water and water from bunded facilities is directed to bioremediation landfarms located at Yarrie and Nimingarra/Sunrise Hill. These landfarm areas are also used for treatment of hydrocarbon contaminated soils that are collected when hydrocarbon spills occur.

Domestic sewage generated at the accommodation camp, administration and workshop areas is managed at the Yarrie sewage treatment plant or by septic systems. When necessary, a licensed contractor removes sludge from the sewage treatment systems and transports it to Port Hedland sewage treatment plant for disposal.

Controlled wastes under the *Environmental Protection (Controlled Waste) Regulations, 2001* that are generated at Goldsworthy include tyres, batteries, electrical waste and waste oils. Discarded tyres are deposited in the on-site tyre dump in a mined out pit at Yarrie where they are buried in accordance with licence requirements. Other controlled wastes such as batteries and waste oil are removed from site by a contractor for recycling and/or disposal in accordance with the requirements of the *Environmental Protection (Controlled Waste) Regulations, 2001*.

Other solid wastes (i.e. non-controlled and non-toxic wastes) are disposed in an on-site landfill located at Yarrie in the W1 OSA. Solid wastes from Cundaline and Callawa will also be disposed of at the Yarrie landfill facility. Regular inspections of the landfill site and bioremediation landfarms are carried out to identify if any inappropriate waste materials are entering the waste stream.

4.13.2 Potential Impacts

Waste materials (including controlled and non-controlled wastes as defined by the *Environmental Protection (Controlled Waste) Regulations 2004)* have the potential to adversely affect the environment (e.g. contamination of soil and water resources) if inappropriate management/treatment procedures are applied.

Mining at Cundaline and Callawa will not involve the generation or use of any significant additional quantities or types of waste materials to those currently generated at Goldsworthy.

4.13.3 EMP Objectives

- *To minimise the generation of waste from the site by reducing waste streams and recycling material, wherever practicable.*
- *To dispose of waste in an environmentally acceptable manner and in compliance with all regulatory and BHP Billiton Iron Ore requirements.*
- *To dispose of non-recyclable solid waste in accordance with the Code of Practice for Country Landfill Management (Department of Environmental Protection, 1995).*
- *To ensure that hazardous wastes are properly collected, segregated, transported, treated and disposed at an approved site.*

4.13.4 Management Practices

General

The BHP Billiton Iron Ore Waste Management Manual contains a waste management section. The BHP Billiton Iron Ore Waste Management Manual establishes the following objectives for BHP Billiton Iron Ore mining operations:

- To observe the waste management hierarchy of elimination, reduction, reuse, recycling, treatment and disposal.
- To manage all waste generated in a manner that minimises potentially detrimental effects on the environment.
- To ensure that BHP Billiton Iron Ore mining operations comply with applicable licence conditions and commitments at all times.

The Waste Management Manual establishes that the active management of waste is the responsibility of each mining site and that the overriding management principles for all waste should be considered as follows:

- How can waste generation be avoided or reduced?
- Can the waste be reused or reconditioned to enable reuse?
- Can the waste contents be recovered or recycled?
- Disposal should only be considered as the last option.

The Waste Management Plan also contains guidance on the management of process and general waste.

Goldsworthy Waste Management Practices

Management practices that will be used at Goldsworthy to minimise impacts from waste generation are presented below:

- Materials to be recycled will be neatly stored in a designated area until they are removed from the site.
- Domestic sewage will be collected in underground septic tanks and/or treated in the sewage treatment plant.
- Materials such as batteries and scrap metal will be recycled.
- All waste collecting systems will be designed for ease of use and prevention or capture of spillage.
- Used containers, such as 205 L drums, would be collected by a licensed contractor for recycling.
- Oily wastes generated at site will be stored securely in drums or tanks until removed from site by a contractor for recycling and/or disposal at a Shire Council-approved site, in accordance with the requirements of the *Environmental Protection (Controlled Waste) Regulations, 2004*.
- All soil contaminated by hydrocarbons will be disposed of in a designated site for bioremediation in accordance with *Oil Farming for Oily Wastes* (EPA, 1990).
- Non-controlled and non-toxic solid wastes will be disposed of in the onsite landfill site, in accordance with EP Act Licence No.'s 5611 and 4412.
- Onsite landfills will be managed in accordance with relevant local health authority requirements and Landfill Management Guidelines (Department of Environmental Protection, 1995).

In accordance with the Solid Waste Control Conditions outlined in the EP Act Licence Nos. 5611 and 4412, the following management practices are implemented at Goldsworthy:

- Material buried within the onsite landfill facility will be limited to clean fill, inert wastes and putrescible wastes.
- All toxic and hazardous wastes will be disposed of by at a disposal facility approved by the DEC.
- No waste will placed closer than 35 m to the premises boundary.
- Waste will be disposed of in a defined trench or within an area enclosed by an earthen bund.
- The tipping area will be restricted to a maximum linear length of 30 m.
- The waste area will be no greater than two meters in height.
- There will be a fire break of at lease 3 m around the boundary of the site.
- Waste in the tipping area will be covered as frequently as possible (e.g. at least once a month).
- At lease two months buffer storage of waste cover material will be placed near all landfill sites.
- Waste cover material will include either soil or other dense, inert and incombustible materials (e.g. material from OSAs at Goldsworthy).
- Waste will be covered to ensure that no waste is left exposed.
- All waste material which has washed or blown outside the landfill area will be collected and returned as soon as possible (or at frequencies no less than a month) to the waste tipping area.

In accordance with Conditions A3 of the EP Act Licence Nos. 4412 and 5611, rubber, rubber products, plastic or plastic products will not be burnt at any time, except for the purpose of emergency response training or fire prevention purposes.

In accordance with Conditions W3 of EP Act Licence Nos. 4412 and 5611, protective bunding, skimmers, silt traps, fuel and oil traps, drains and sealed collection sumps around the maintenance workshops, vehicle washdown bays, refuelling depots, and laboratories to enable recovery of spillages and allow treatment to remove contaminants within impervious containment structures prior to discharge to drainage or soakage, or otherwise disposal to the landfarm will be installed and maintained, where appropriate.

Controlled wastes (e.g. waste lubricants, spent radiator coolant/inhibitors and hydraulic fuels) will be stored for recycling and/or disposal off-site in accordance with Conditions W3 of EP Act Licence Nos. 4412 and 5611 and the *Environmental Protection (Controlled Waste) Regulations 2001.*

The *Interim Guideline for the Controlled Waste Regulations* (DoE, 2003) provides the following advice for generators of controlled wastes:

> ***Waste generators:***
>
> - *Must contact a licensed controlled waste carrier to transport their waste to a DEC approved disposal site.*
> - *Must provide the carrier with sufficient information to enable categorisation of the waste by the carrier and selection of an appropriate disposal site.*
> - *Must ensure that the waste is suitable for transportation prior to collection by a carrier."*

4.13.5 Performance Indicators

- Records kept of all waste types generated and how they have been disposed of or recycled, including:
  - landfarm disposal maintenance register;
  - landfill disposal/maintenance register;
  - waste oil collection transcripts; and
  - scrap metal collection transcripts.
- Achieve site targets for waste consumption per unit of production.
- Compliance with relevant legislative and regulatory requirements.
- Treatment and disposal of wastes collected by the sewerage facilities that service the mine offices and amenities to be undertaken in accordance with the *Health Act 1911 - 1979* and to the satisfaction of the local authority.

4.13.6 Monitoring

- Monthly inspections of the landfill site will be undertaken to ensure the guidelines are being met and that inappropriate waste materials are not entering the waste stream.
- Details of quantities of waste material recycled (e.g. hydrocarbons) will be kept for reporting purposes.
- Monitoring results relevant to waste management will be tabulated monthly in a waste management spreadsheet.

4.14 DANGEROUS GOODS AND HAZARDOUS MATERIALS

4.14.1 Potential Impacts

Hazardous materials to be stored and used at Goldsworthy include:

- hydrocarbons (e.g. fuels, lubricants and waste oils);
- detergents, glues and paints; and
- explosives.

Hazardous materials, such as fuels, lubricants, detergents, explosives and paints have the potential to cause atmospheric, soil or water contamination.

4.14.2 EMP Objectives

- *To minimise the potential adverse effects, risk and liability associated with hazardous materials at Goldsworthy.*
- *To ensure that the transport, handling and storage of hazardous materials is in accordance with the Explosives and Dangerous Goods Act 1961, the Dangerous Goods Regulations, 1992 and the associated applicable codes, guidelines and Australian Standards.*

4.14.3 Management Practices

The storage, transport, handling, use and disposal of dangerous goods and hazardous substances will be undertaken in a manner that complies with relevant local and state regulations and guidelines, and Australian Standards.

Regulatory Framework

The management of dangerous goods and hazardous substances will be conducted in accordance with all relevant legislation including:

- *Mine Safety and Inspection Act, 1994*;
- *Mine Safety and Inspection Regulations, 1995*;
- *Explosives and Dangerous Goods Act, 1961*;

- *Dangerous Goods (Transport) (Road and Rail) Regulations, 1999*; and
- *Traffic Act, 1974*.
- *Australian Code for the Transport of Dangerous Goods by Road and Rail* (ADG Code)*, 1998*

  Volume 1 of the ADG Code classifies dangerous goods into Classes based on their various properties. Packaging requirements and standards, design and maintenance of bulk containers for transport, as well as marking and placarding of transport vessels and vehicles are also provided in detail in Volume 1 of the ADG Code. Volume 2 of the ADG Code lists the goods that are specified as "dangerous goods".
- *National Model Regulations for the Control of Workplace Hazardous Substances (NOHSC: 1005 [1994])*

  The National Model Regulations apply to all workplaces in which hazardous substances are used or produced, and to all persons with potential exposure to hazardous substances in those workplaces. The two principal components of the regulations are:

  – Information provisions - which address the delivery of specific information (e.g. labels and MSDSs) that the supplier of a workplace hazardous substance is required to provide through the employer to employees. These provisions ensure that employee representatives, relevant public authorities and emergency services are also provided with access to relevant information.
  – Assessment and control provisions - which require employers to identify hazardous substances in the workplace, make an assessment of those hazards, which arise out of the work activity and then take appropriate control action.

  The National Model Regulations require employers to obtain MSDSs for all substances from suppliers and ensure these are readily accessible to employees. Employers must also ensure all substances are labelled properly and keep and maintain a register for all hazardous substances used or produced in the workplace. The register must contain a list of all hazardous substances used or produced at the workplace and the MSDSs for all hazardous substances for which MSDSs are required by these national model regulations. The model regulations also require employers to provide induction and on-going training to all employees with the potential for exposure to hazardous substances in the workplace. It also provides for health surveillance, record keeping and employees duties to comply with the model regulations.
- *The National Code of Practice for the Control of Workplace Hazardous Substances [NOHSC: 2007 (1994)]*

  The National Code of Practice for the Control of Workplace Hazardous Substances provides a practical guide on how to comply with the National Model Regulations. It contains information on complying with requirements relating to consultation, classification, provision of information, training, assessment, monitoring and record keeping.
- *Approved Criteria for Classifying Hazardous Substances [NOHSC: 1008(2004)]*

  Approved Criteria for Classifying Hazardous Substances is a national standard for determining whether a substance is a hazardous substance, and to assist in preparing labels and material safety data sheets (MSDSs).

Australian Standards

The storage, transport, handling, use and disposal of dangerous goods and hazardous substances will be conducted in accordance with the relevant Australian Standards including, but not limited to:

- AS 1216 – *Class Labels for Dangerous Goods*;
- AS 1319 – *Safety Signs for the Occupational Environment*;
- AS 1345 – *Identification of the Contents of Pipes and Conduits and Ducts*;
- AS/NZS 1596 – *The Storage and Handling of LP Gas*;
- AS 1940 – *The Storage and Handling of Flammable and Combustible Liquids*;
- AS 2030.1 – *The verification, filling, inspection, testing and maintenance of cylinders for storage and transport of compressed gases - cylinders for compressed gases other than Acetylene*;
- AS 2187.1 – *Explosives – Storage, transport and use – Storage*;
- AS 3780 – *Storage and Handling of Corrosive Substances*;
- AS 4326 – *The Storage and Handling of Oxidising Agents*;
- AS/NZS 2906 – *Fuel Containers - Portable-Plastic and Metal*;
- AS/NZS 3833 – *The Storage and Handling of Mixed Classes of Dangerous Goods in Packages and Intermediate Bulk Containers*; and
- AS/NZS 4452 – *The Storage and Handling of Toxic Substances*.

Government Guidelines

Management of Hazardous Substances on Minesites

The *Management of Hazardous Substances on Minesites Guideline* (DoIR, 1997) was prepared to promote the implementation of effective hazardous substance management programmes on mines. The document includes guidance on the delivery, storage, use and disposal of hazardous substances, as well as the development of hazardous substances management procedures and registers, stock management, monitoring and surveillance, personal protective equipment, first aid procedures, emergency plans and audit procedures.

Water Quality Protection Guidelines for Mining and Mineral Processing – Above-ground Fuel and Chemical Storage

This guideline was prepared by Water and Rivers Commission [WRC] (2000) to reflect industry standards and incorporate best management practices for fuel and chemical storage facilities within the mining and mineral processing industry. It includes guidance on the design and siting of tanks, bunded compound design and maintenance, vehicle refilling and mobile refuelling vehicles.

Project Dangerous Goods and Hazardous Substances Management Measures

The following hierarchy of control measures outlined in the *National Code of Practice for the Control of Workplace Hazardous Substances* will be applied at Goldsworthy to minimise potential for exposure to hazardous substances:

- elimination;
- substitution;
- isolation;
- engineering controls;
- safe work practices; and
- personal protective equipment.

In accordance with the *Mines Safety and Inspection Regulations, 1995*, a register of hazardous substances will be maintained for Goldsworthy. In accordance with the National Model Regulations, the hazardous substances register will contain MSDSs for all hazardous substances used on-site and include details of the duties or operations which have the potential for an employee to become exposed to a hazardous substance.

In order to ensure the safe handling of all hazardous materials used at Goldsworthy, the BHP Billiton Iron Ore Hazardous Materials Management Programme (HMMP) will be adopted which incorporates the following elements:

- adoption of a formal policy statement;
- designation of responsibility for all elements of the programme;
- employee participation;
- training of personnel;
- dissemination of information;
- establishment of purchasing and inventory controls; and
- environmental monitoring.

On-site management of hazardous materials is required to be undertaken in accordance with the HMMP and BHP Billiton Fatal Risk Control Protocol No. 5 Hazardous Materials Management, and is the responsibility of the mining contractor.

All major consumables will be trucked to Goldsworthy. Fuel will be transported from the Mt Whaleback bulk holding tank facility using heavy vehicles. All hazardous chemical reagents and explosives will be transported in accordance with the *Dangerous Goods (Transport) (Road and Rail) Regulations, 1999* and the ADG Code.

Hydrocarbons that will be used on site include oils, greases, fuels (petroleum and diesel), degreaser and kerosene. Bulk fuel and other environmentally hazardous chemicals will be stored in above-ground tanks located within impermeable, bunded enclosures in accordance with the applicable conditions in licences issued under the EP Act, Department of Consumer and Employment Protection (DoCEP) requirements and AS 1940. Bulk fuel diesel will be stored at Yarrie and Cundaline.

In accordance with AS 1940 and Water Quality Protection Guidelines for Mining and Mineral Processing – Above-ground Fuel and Chemical Storage (WRC, 2000), environmentally hazardous chemicals will be stored within low permeability, bunded compounds designed to contain no less than 110% of the volume of the largest storage vessel and at least 25% of the total volume of the substances stored in the compound. The bunded compounds will:

- be graded or include a sump to allow recovery of liquid;
- be chemically resistant to the substances stored;
- include values, pumps and meters associated with transfer operations wherever practical, otherwise the equipment shall be adequately protected and contained in an area designed to permit recovery of chemicals released following accidents or vandalism;
- be designed to capture any jetting from any storage vessel or fitting within the bunded area;
- store chemicals which will react dangerously if they come into contact in separate bunds within the same compound or in different storage bunds; and
- be controlled to maintain sufficient capacity of the bund at all times.

The fuel dispensing facilities will be situated on a concrete hardstand enabling any hydrocarbon releases to be contained and collected within a sump, it is then evacuated and either treated through an oily water separator or transferred to the waste oil tank. Lubricant dispensing facilities will be situated on a concrete hardstand in the vehicle maintenance bay.

Any spill or leaks of chemicals, whether inside or outside the low permeability compounds, will be removed and disposed as appropriate.

Explosives will be stored in dedicated magazine areas which are remote from workshops, administration and active work areas and above flood level. Ammonium nitrate will be transported to Goldsworthy from Newman when required. Access to the magazine areas will be restricted to authorised personnel. The manufacture of ammonium nitrate fuel oil will be conducted in a dedicated explosives truck.

All domestic and industrial solid wastes, excluding toxic and hazardous solids, will be collected and transported to an on-site landfill facility (i.e. Yarrie landfill). All toxic and hazardous substances will be disposed of at an approved disposal facility.

4.14.4 Performance Indicators

- Compliance with all local and State regulations that relate to the storage, handling, use and disposal of hazardous materials.
- Transportation of all hazardous materials (including controlled wastes) complies with the provisions of the Licence to Transport Dangerous Goods.
- Storage of bulk fuel in above ground tanks held in impermeable, bunded enclosures, in accordance with DOCEP requirements and AS 1940.
- Storage and handling compliance of hazardous materials with BHP Billiton Fatal Risk Control Protocol No. 5 Hazardous Materials Management.
- Storage of explosives in a magazine remote from workshops, the mine site and areas susceptible to flooding.

- Location of all fuel storage tanks (exceeding 200 L capacity), including associated pipework, valving and fuelling installations, aboveground and within impervious bunding designed to fully contain, at a minimum, the contents of the largest tank in the event of equipment failure or accidental spillage.

4.14.5 Monitoring

Regular inspections are carried out monthly by BHP Billiton Iron Ore to ensure that hazardous material management systems are effective and in compliance with relevant regulations and BHP Billiton Standards. This includes inspecting storage areas for leaking bunds, drums or containers and inventories of spill response equipment and materials.

4.15 ABORIGINAL HERITAGE

4.15.1 Existing Environment

Goldsworthy is situated within the traditional lands of the Njamal speaking people, whose territory was centred on the Oakover, lower Nullagine and central De Grey Rivers (BHPIO, 1992).

BHP Billiton Iron Ore commissioned a number of archaeological and ethnographic Aboriginal heritage surveys and consulted widely with principle Njamal heritage custodians (and others from the neighbouring language groups such as the Nyangumarta) during the planning and development for earlier mining activities associated with Goldsworthy (O'Connor and Quartermaine 1988; O'Connor *et al.,* 1991; O'Connor and Quartermaine, 1992a; O'Connor and Quartermaine, 1992b).

There are five Aboriginal heritage sites registered with the Department of Indigenous Affairs (DIA) located within or near the proposed Cundaline and Callawa mining areas, which are listed in Table 4-4.

Table 4-4
Known Aboriginal Heritage Sites Recorded within the Cundaline and Callawa Mining Areas and Surrounds[1]

DIA No.	Site Name	Site Type	Section 18 Approved (Y/N)
6286	Shay Gap 3	Artefact Scatter/Rockshelter	N
6287	Shay Gap 4	Artefact Scatter/Rockshelter	N
21381	Cundaline Ridge	Mythological	N
6970	Kimberly Gap	Artefact Scatter	N
21380	Callawa Ridge	Ceremonial/Mythological	Y*
12140	Yarrie Birmal	Repository/cache/Artefact Scatter	N

1 Within 1km of Maximum Disturbance Area Boundary
* Exploration drilling activities only.

4.15.2 Potential Impacts

The potential impacts of Goldsworthy on Aboriginal heritage sites include:

- direct structural damage to heritage sites (e.g. clearing of land for projects such as drilling, the construction of infrastructure and mining operations, damage caused by off-road use of vehicles);
- indirect structural damage (e.g. intrusive debris such as fly-rock from blasting activities, or blasting activities effecting the integrity of heritage sites such as rockshelters);
- inappropriate behaviour concerning heritage sites (e.g. the collection of artefacts, vandalising heritage sites); and
- trespass by unauthorised personnel

4.15.3 EMP Objectives

- *To minimise disturbance to Aboriginal sites.*
- *To establish appropriate management and protective measures for Aboriginal sites.*
- *To ensure that the disturbance of any site is properly approved consistent with the Aboriginal Heritage Act, 1972 and the wishes of the appropriate Aboriginal heritage custodians and spokespeople.*

4.15.4 Management Practices

General Aboriginal Heritage Management Practices

The objectives of BHP Billiton Iron Ore Aboriginal Heritage management are:

- To minimise the possibility of disturbance to Aboriginal heritage sites.
- To establish appropriate management and protective measures for Aboriginal heritage sites.
- To ensure that in the event that a heritage site will be impacted upon by a project, the correct approvals have been obtained and any conditions outlined in these have been met prior to disturbance taking place.

BHP Billiton Iron Ore currently has permits under Section 18 of the *Aboriginal Heritage Act, 1972* to o use the north and north-eastern portion of land of one of the Aboriginal heritage sites (Site ID 21380) for exploration drilling.

BHP Billiton Iron Ore would submit Section 18 applications under the *Aboriginal Heritage Act, 1972* and conduct appropriate consultation to obtain consent to disturb other sites within the proposed disturbance areas. Applications under Section 18 of the *Aboriginal Heritage Act, 1972* would only be lodged if a site is under direct threat of impact from development (i.e. mining or associated activities).

BHP Billiton Iron Ore Aboriginal Heritage Management Plan Guidelines and Cultural Heritage Management Plans

BHP Billiton Iron Ore has developed Aboriginal Heritage Management Plan Guidelines (AHMPG) and Cultural Heritage Management Plans (CHMP) for each of its Pilbara operations. The aims of the AHMP and CHMPs include:

- To minimise disturbance to Aboriginal sites.
- To manage land clearance activities through the PEAHR land clearing procedure (project summary, location of works and anticipated environmental, land access and Aboriginal heritage impact).
- To establish appropriate management and protective measures for Aboriginal sites and places of significance in consultation with the Aboriginal heritage custodians and in accordance with the *Aboriginal Heritage Act, 1972.*
- To avoid Aboriginal heritage sites where possible and revise the mine plan if significant Aboriginal heritage sites are identified.
- To ensure all personnel and contractors are aware it is a requirement to report any potential, previously unknown Aboriginal sites in the vicinity of operations.
- To ensure that any proposals to disturb an Aboriginal site for the purposes of mining and related activities are subject to the provisions of the *Aboriginal Heritage Act 1972*, other relevant legislation and the wishes of the appropriate Njamal custodians and spokespeople.
- To ensure that all areas to be disturbed have been subject to adequate ethnographic and archaeological Aboriginal site surveys and consultation with the Njamal cultural heritage custodians and spokespeople.
- To ensure that all personnel and contractors are made aware of their requirements under the *Aboriginal Heritage Act, 1972* and of the location of sites subject to management measures.
- To implement the procedures and protocols developed by the Department of Indigenous Affairs in the event that Human Skeletal remains be uncovered.

BHP Billiton Iron Ore Aboriginal Heritage Management Plan Guidelines

BHP Billiton Iron Ore has developed Aboriginal heritage management standards and guidelines to manage and protect heritage resources within its Pilbara-based operations in WA. The protocols and procedures outlined in BHP Billiton Iron Ore's AHMPGs for Contractor Annexure Purposes are applicable to all people, activities and operational aspects throughout the BHP Billiton Iron Ore. The Standards also apply to contractors, staff and all personnel working at BHP Billiton Iron Ore's Pilbara operations. The Standards are based primarily upon BHP Billiton's Sustainable Development Policy (Figure 3-1).

One of the key commitments identified in BHP Billiton's Sustainable Development Policy is:

> *Understand, promote and uphold fundamental human rights within our sphere of influence, respecting the traditional rights of Indigenous peoples and valuing cultural heritage.*

BHP Billiton Iron Ore Cultural Heritage Management Plans

CHMPs are available for all of BHP Billiton Iron Ore's operations throughout the Pilbara. The purpose of the CHMP is to outline the number and location of heritage sites within each of BHP Billiton Iron Ore's operations, and to provide management recommendations regarding these heritage sites to company personnel and in accordance with the *Aboriginal Heritage Act, 1972*, other legislative requirements, and the wishes of the native title claimants.

Goldsworthy Aboriginal Heritage Management Practices

In addition to the two documents briefly described above, and to further ensure compliance with provisions of the *Aboriginal Heritage Act, 1972*, BHP Billiton Iron Ore also addresses the identified Aboriginal heritage considerations specifically for Goldsworthy as part of an Aboriginal Heritage Management Plan (AHMP). This plan will be reviewed and revised to consider the Aboriginal Heritage values specific to the Cundaline and Callawa deposit areas. Contractors must create and implement their own AHMPs which are provided to BHP Billiton Iron Ore. These AHMPs are reviewed annually by BHP Billiton Iron Ore Cultural Heritage Advisors to ensure they comply with BHP Billiton Iron Ore's AHMPG and CHMP.

4.15.5 Performance Indicators

- Impact to Aboriginal sites to be avoided wherever possible.
- No Aboriginal sites to be disturbed without prior approval under the provisions of Section 18 of the *Aboriginal Heritage Act 1972*.
- All personnel and contractors to undergo an Aboriginal heritage and culture induction process for the Goldsworthy region.
- Compliance with the provisions of the *Aboriginal Heritage Act, 1972*.

4.15.6 Monitoring

During construction and earthworks BHP Billiton Iron Ore Aboriginal Affairs Department personnel (or a nominated delegate) will monitor the boundaries of sites in the area of activity to ensure compliance with management measures and commitments.

5 TIMEFRAME FOR IMPLEMENTATION OF THE PLAN

This revision of the EMP will be implemented by BHP Billiton Iron Ore once it has been approved by the relevant Government administering authorities. In accordance with the conditions of Ministerial Statement of Approval No. 000682, this EMP will be reviewed and revised at intervals of no more than five years, or when significant changes occur at Goldsworthy. Any further revisions of this EMP will be submitted to DEC, DoIR and DIA required by Proponent Commitment 1 of Ministerial Statement of Approval No.000682.

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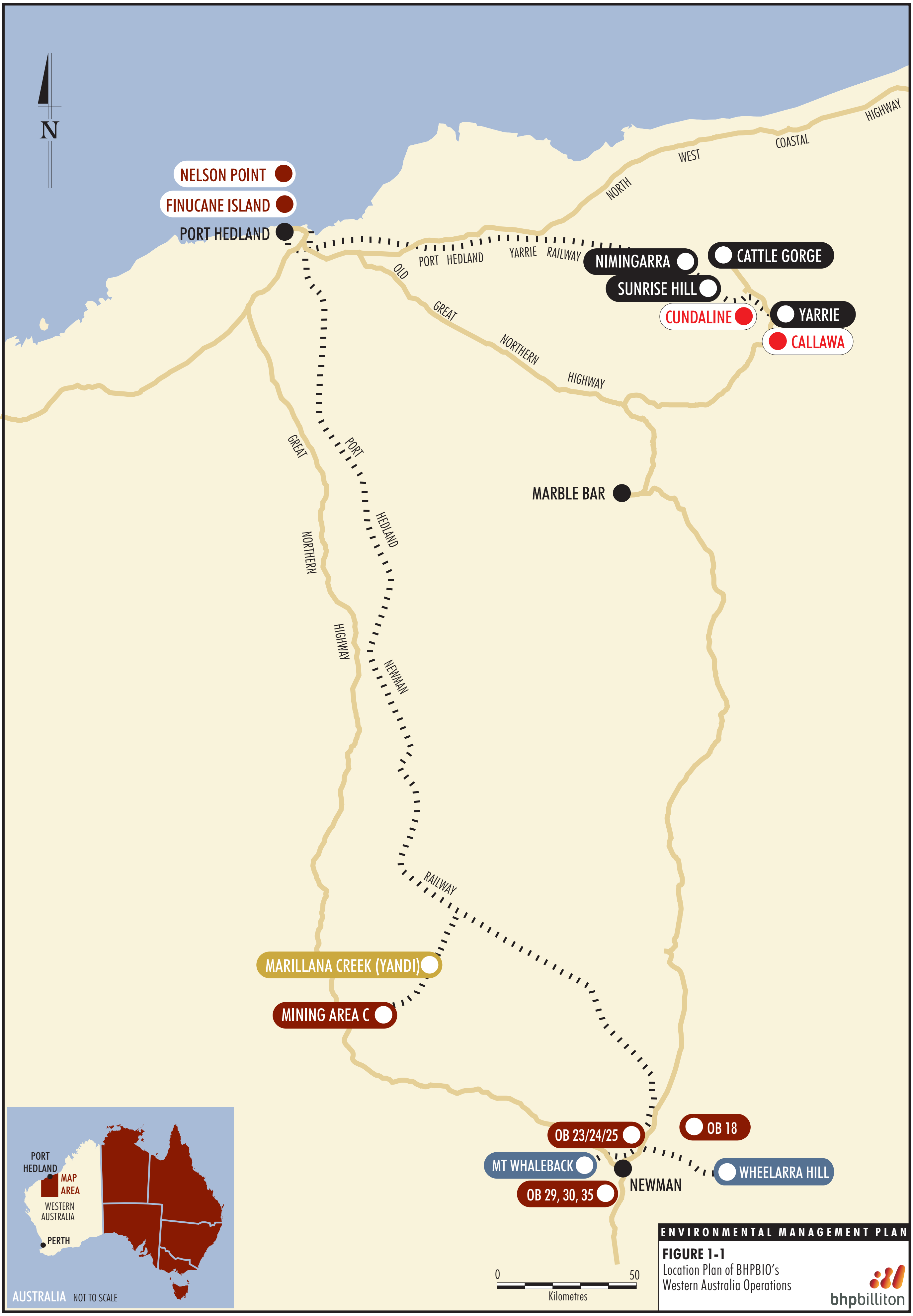
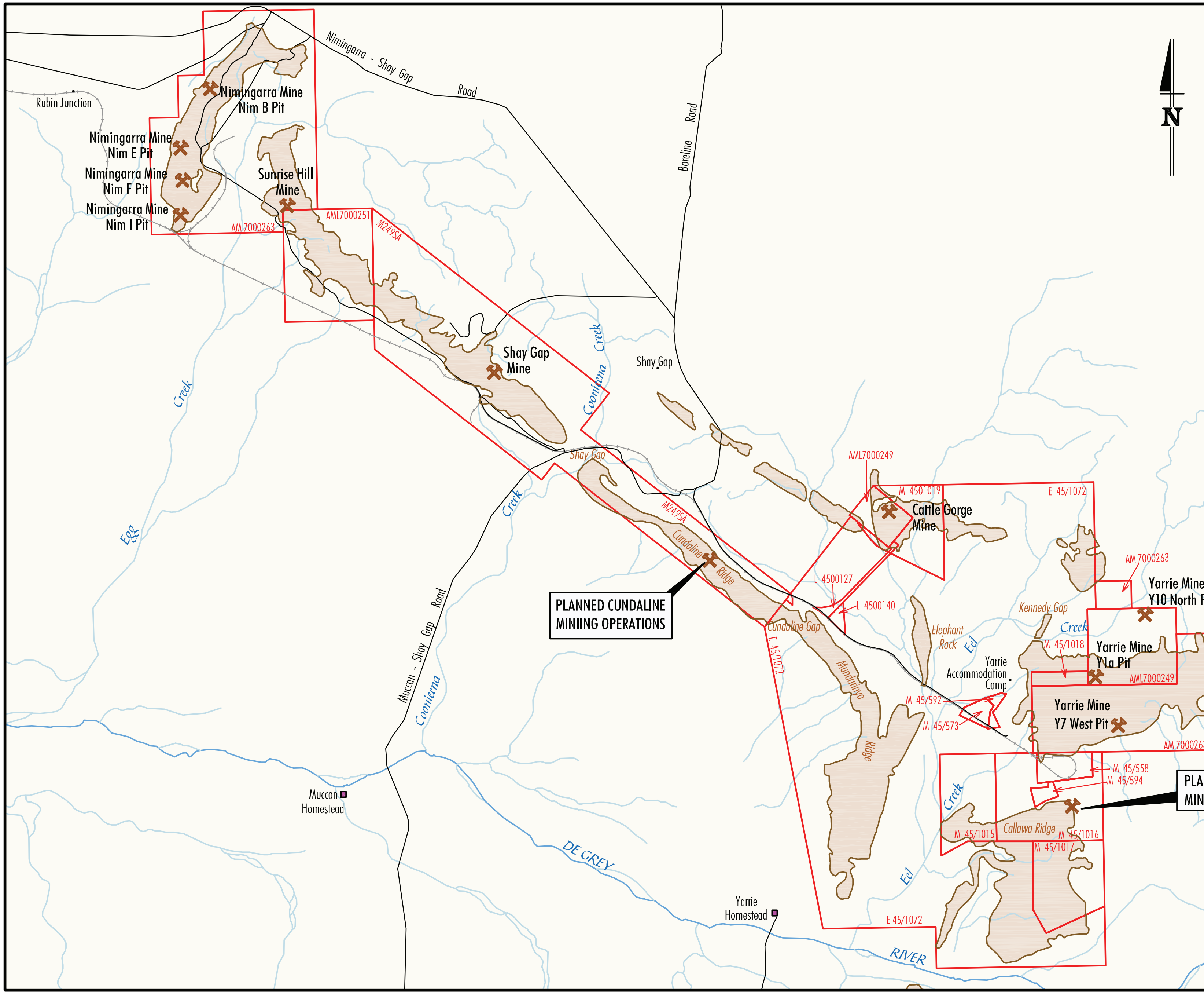
FIGURES



ENVIRONMENTAL MANAGEMENT PLAN

FIGURE 1-1
Location Plan of BHPBIO's
Western Australia Operations

BHP-07-16 GEMP_001B



Source: DOIR (2007)

ENVIRONMENTAL MANAGEMENT PLAN

FIGURE 1-2
Goldsworthy Iron Ore Mining Operations

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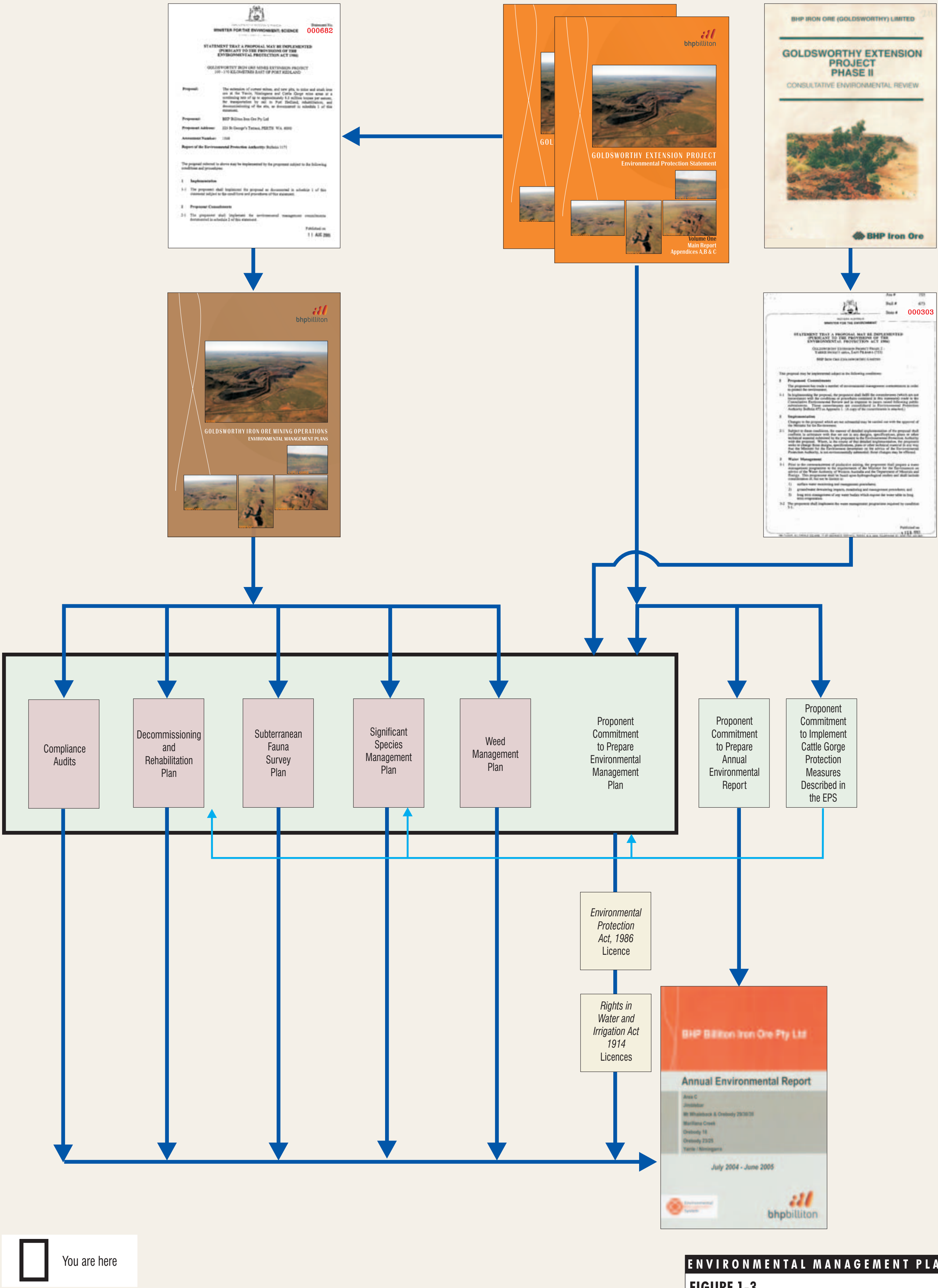
BHP-07-16 EMP_101B



ENVIRONMENTAL MANAGEMENT PLAN

FIGURE 1-3
Relationship between Environmental Management Plans

BHP-07-16 GEMP_002B

OUR APPROACH TO HEALTH, SAFETY, ENVIRONMENT AND THE COMMUNITY

BHP BILLITON'S SUSTAINABLE DEVELOPMENT POLICY

At BHP Billiton our objective is to be the company of choice – creating sustainable value for our shareholders, employees, contractors, suppliers, customers, business partners and host communities.

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
- set and achieve targets 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 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 promote their 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.

Marius Kloppers

Marius Kloppers
Chief Executive Officer

1 October 2007

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ENVIRONMENTAL MANAGEMENT PLAN
FIGURE 3-1
BHP Billiton's Sustainable Development Policy

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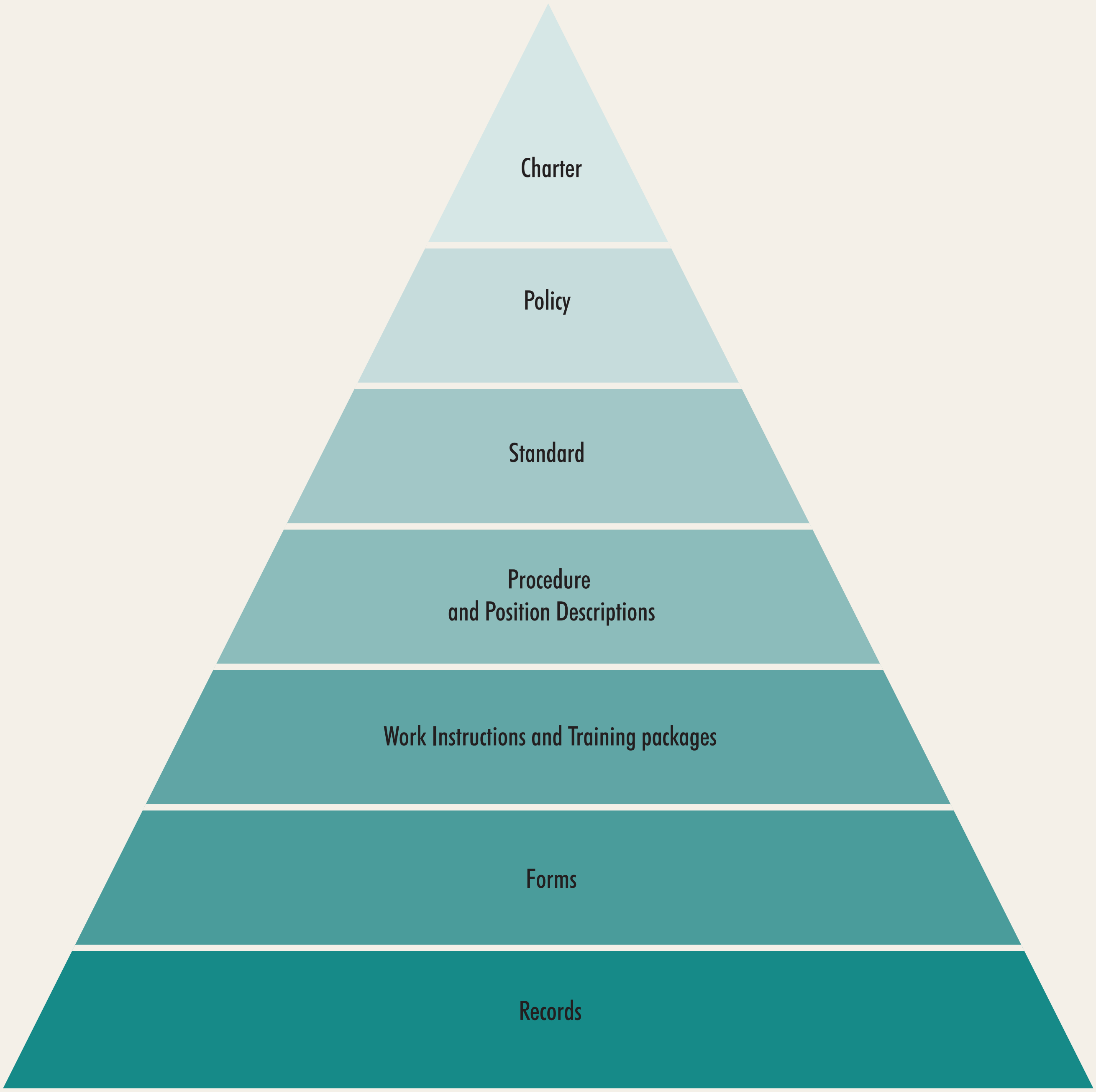

ENVIRONMENTAL MANAGEMENT PLAN

FIGURE 3-2
Health, Safety, Environment and Community Management System Manual - Document Hierarchy

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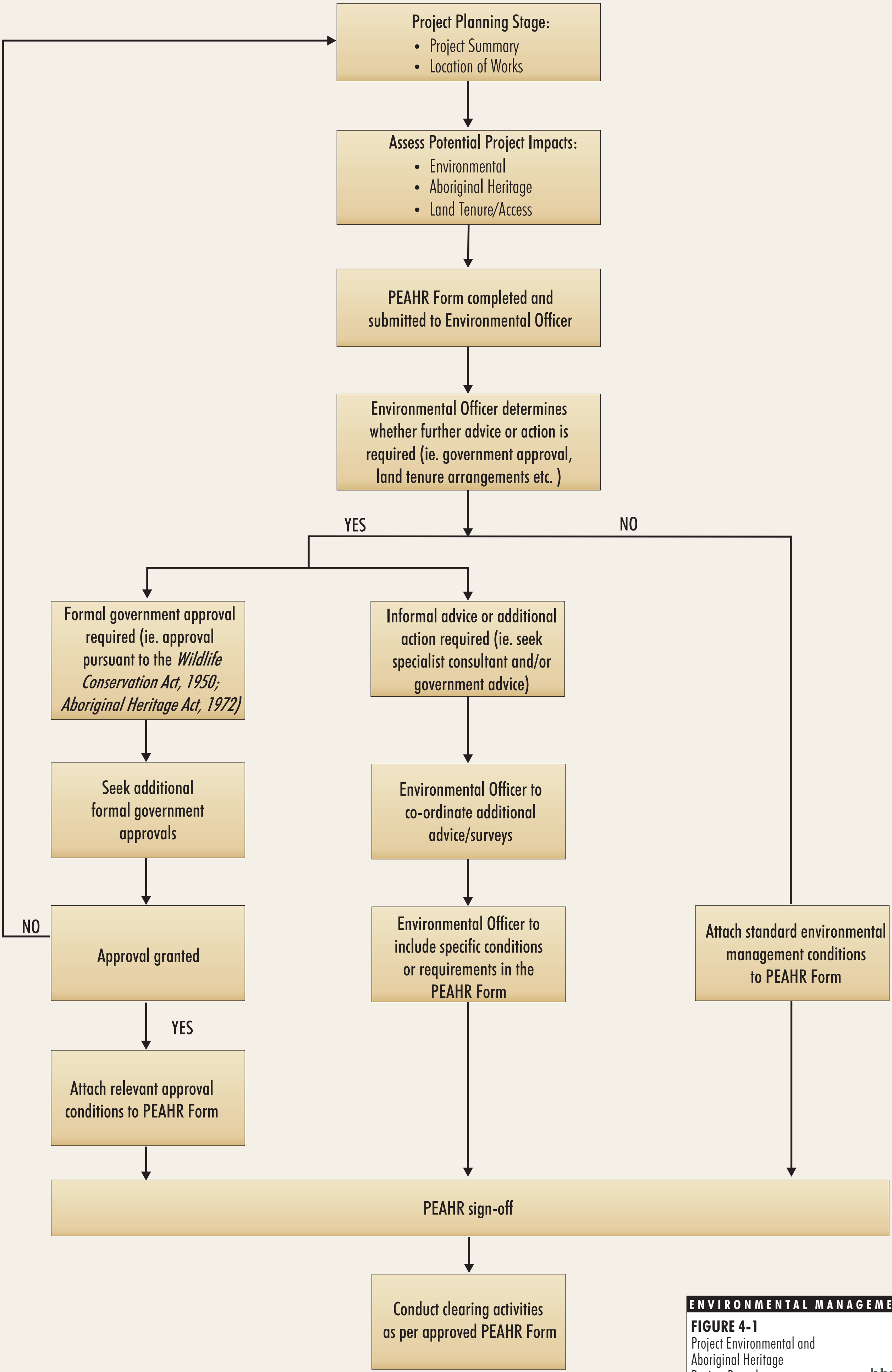
BHP-07-16 GEMP_005C



ENVIRONMENTAL MANAGEMENT PLAN

FIGURE 4-1
Project Environmental and Aboriginal Heritage Review Procedure

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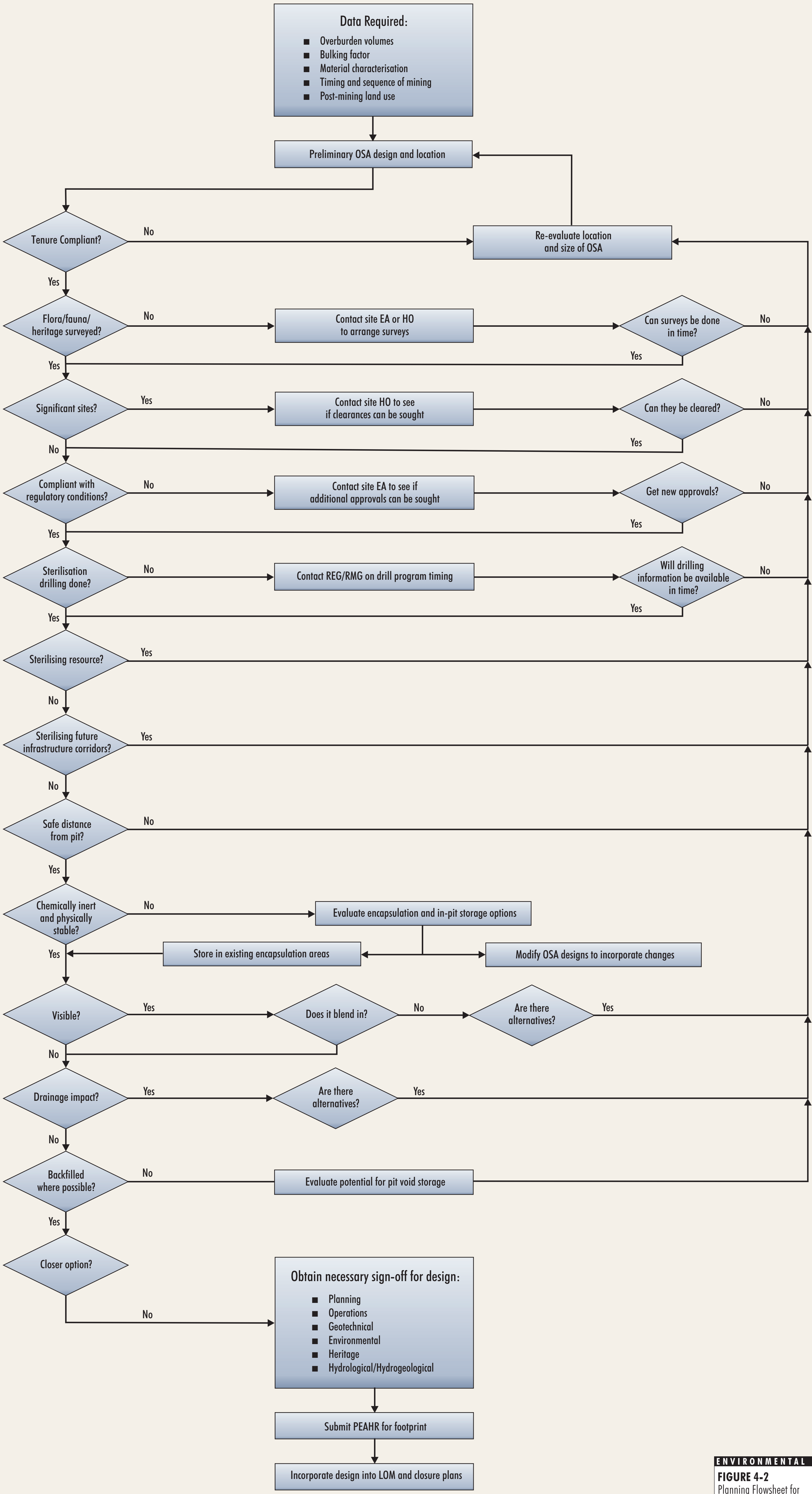
BHP-07-16 GEMP_006B



ENVIRONMENTAL MANAGEMENT PLAN

FIGURE 4-2
Planning Flowsheet for Major Mine Landforms

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APPENDIX A

NIMINGARRA, SUNRISE HILL AND YARRIE NET ACID GENERATING MATERIAL MANAGEMENT PLAN

Nimingarra, Sunrise Hill and Yarrie

Net Acid Generating Material Management Strategy

July 2004

BHPBilliton Iron Ore

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    - 5.4 General NAG Material Management at BHPBIO

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    - 5.1 NAG Material Stratigraphy and Volumes at Yarrie
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3. NAG MATERIAL HANDLING STANDARD WORK PROCEDURES

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Table 1 – BHPBIO ARD Management Strategy

Figure 1 Location Map

Figure 2 Meteorological Data

Figure 3 Schematic Cross Section of NAG geological setting

Figure 4 Schematic Cross Section of NAG in-pit storage

1 INTRODUCTION

1.1 Location

The BHPBilliton Iron Ore (BHPBIO) Northern Pilbara operations (Nimingarra, Sunrise Hill and Yarrie areas) are approximately 200 km east of Port Hedland (Figure 1).

The operation produces approximately 7 Mtpa of high grade lump and fines iron ore product using conventional open-cut mining, crushing and train-loading methods. In order to access the resource, approximately 20 Mtpa of overburden is mined and placed into Overburden Storage Areas (OSA).

Mining has commenced variously at deposits over the last 30 years;

- Shay Gap operations in 1972
- Sunrise Hill deposits in 1978
- Sunrise Hill west and Nimingarra deposits in 1987
- Yarrie deposits in 1993

Of the above, only the Shay Gap operations can be considered mined out.

1.2 Climate

The Pilbara region of Western Australia is situated in the arid-tropical zone and generally experiences two distinct seasons; a hot wet summer from October to April and a mild winter from May to September. The region experiences high temperatures and high diurnal temperature variations. The mean summer temperature for Marble Bar (approx. 50 km southwest of the Yarrie Mine) is 39^0C, while the mean winter temperature is 23^0C.

Rainfall is seasonally low and unreliable. Most rainfall occurs in summer, with the majority of the total annual precipitation occurring between December through to March. This rainfall results from moist tropical storms and cyclones, producing sporadic, heavy rains. The average annual rainfall for Marble Bar is 346mm. Annual evaporation exceeds rainfall by 3000 mm per year.

1.3 Net Acid Generating Materials

Net Acid Generating (NAG) materials have been known to occur in the Pilbara iron ore geological province for many years. These materials outcrop in many places and have being weathering into the environment for long periods of time. Since the 1980's, issues relating to sulphur dioxide (SO_2) emissions from shale deposits and spontaneous combustion of the graphitic and pyritic materials have caused a variety of management issues at some Pilbara mine sites.

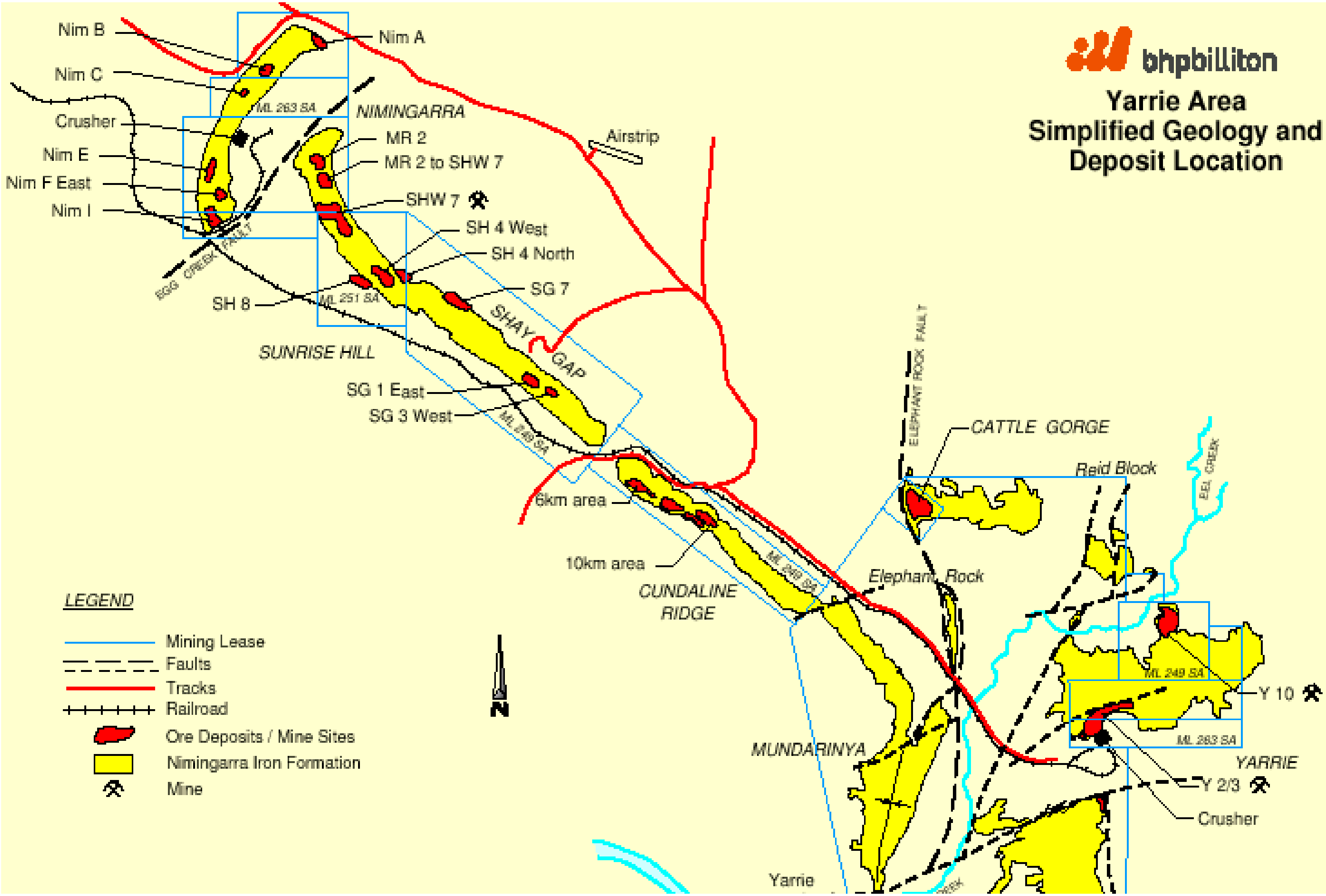

Figure 1 – Location Map

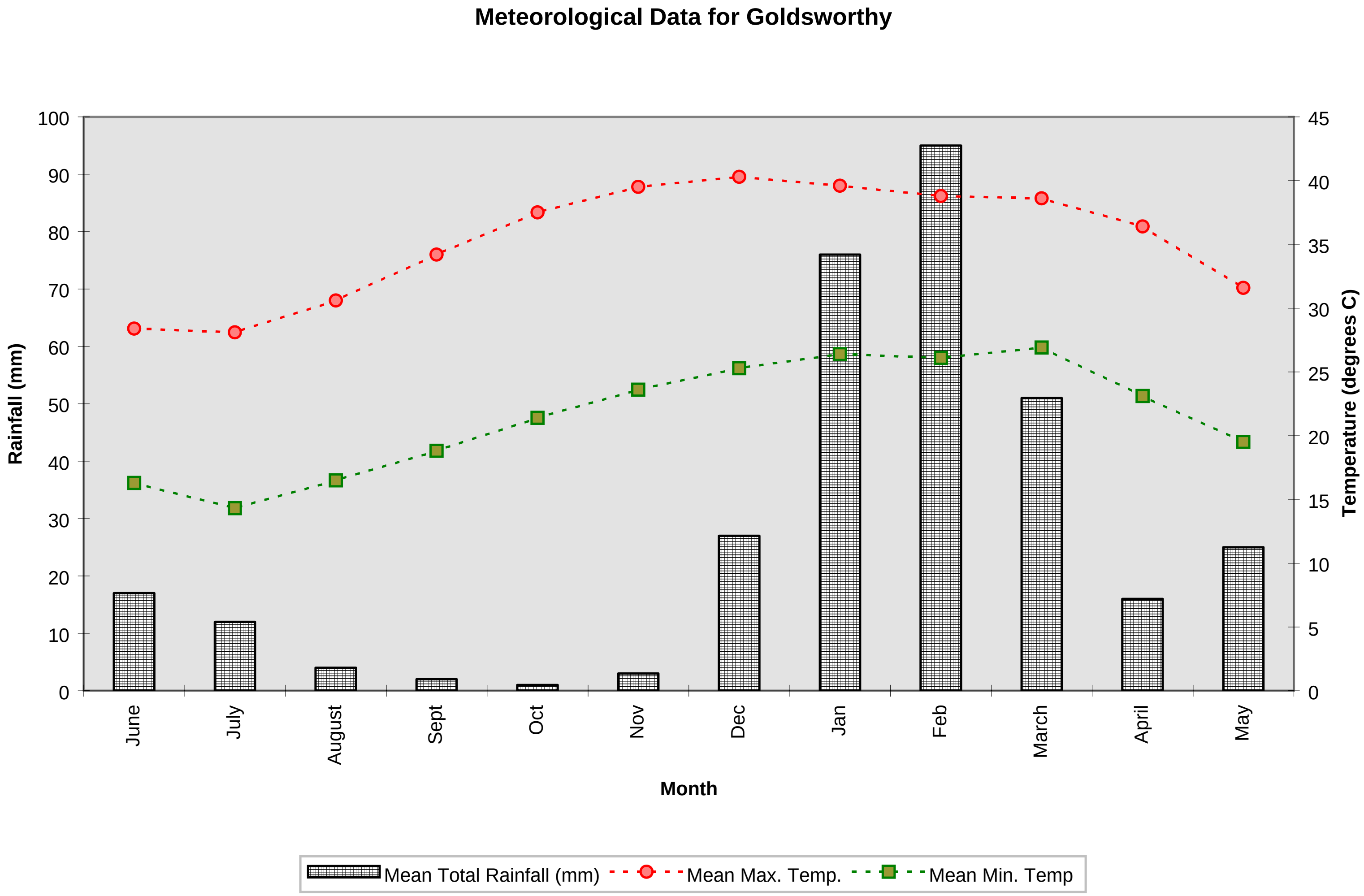

Figure 2 – Meteorological Data for Goldsworthy

It was not until the mid 1990's, when regular cyclonic events and associated heavy rainfalls returned to the region after a prolonged dry period, that Acid Rock Drainage (ARD) was identified as an issue in the Pilbara. Several management options have been taken to minimise the potential effects of these materials on the environment. Current research being undertaken will determine the most appropriate management practices.

1.4 General NAG Material Management at BHPBIO

Ongoing research designed to improve the management of NAG material is being coordinated from BHPBIO's Mt Whaleback operations at Newman (refer to Mt Whaleback Mine NAG Generating Material Management Strategy – 1998).

The identification of NAG materials initiated the requirement to research and develop appropriate management strategies to mitigate potential impacts.

These strategies can be prioritised into short-, medium- and long- term strategies (Table 1). Although much of this work is being completed at BHPBIO's Mt Whaleback operation, the information and experience gained is being used to assist with the management of NAG materials in the Nimingarra, Sunrise Hill and Yarrie areas. Information from these research programmes continues to be used to assist with the management of NAG material and the development of closure plans for the northern Pilbara operations.

.

Short Term
• Initiation of research on potential control options • Identify expertise to assist with technical solutions • Identify and characterise waste materials • Establish NAG Material Handling Standard Work Procedures. • Investigate sites for long term storage of the NAG materials once they are mined. • Initiate rehabilitation research • Communication
Medium Term
• Implement field research • Investigate water management options • Create long term mine plans and block models • Measure short term strategies • Continue to evaluate options
Long Term
• Confirm effectiveness of all strategies • Implement rehabilitation strategies • Start implementing "Walk Away" solutions

Table 1 – BHPBIO ARD Management Strategy

2 DELINEATION OF NAG MATERIAL

2.1 NAG Material Stratigraphy and Volumes at Yarrie

NAG materials were detected at Yarrie during development drilling of the Y2/3 deposit in 1992.

In 1996 NAG material was exposed by mining in the Y2/3 deposit. The NAG material was confined to a small volume within a thin shale band that has been extensively folded in the central portion of the Y2 deposit. This part of the deposit is referred to as Pit A.

The pyritic shale in Pit A extends over a maximum vertical distance of 104 m and a maximum horizontal distance of 90 m. However, it appears from pit wall mapping that the NAG materials were once more extensive but have oxidised over time and now only remnants remain.

Modelling indicates that a total of approximately 100 Mt of overburden is to be mined from the Yarrie Y2/3 deposit (BHPIO 1992). Additional modelling has been completed and is estimated that a volume of 500 cubic metres of NAG material will be mined from June 2000 to the end of the mine life (with a sulphur content greater than 0.02%). The NAG material will be a dilution of BIF and mudstone also, as the thin banding (<1m) of the shale does not allow for the separation of other material during blasting and mining. This material generated from the Y2/3 pit is stored and encapsulated in the adjacent mined out C and B pits (refer Section 4.1).

2.2 NAG Material Stratigraphy and Volumes at Sunrise Hill West 7

NAG materials were detected at Sunrise Hill West 7 (SHW7) during development drilling in 2002.

In 2004, it is expected that NAG material will be exposed by mining activities at SHW7 pit. NAG material is confined to a small volume within a thin shale band. Unlike Yarrie, the units have not been folded; hence the overall exposure of NAG material is limited and only expected to be encountered in two of the lower benches of the ultimate SHW7 pit (refer Figure 3).

Modelling indicates a total of approximately 3 Mt of overburden remains to be mined from the SHW7 deposit. Current conservative estimates indicate that approximately 50 kT of NAG material (representing 1.5% of remaining overburden to be mined) will be mined to the end of the mine life. The NAG material will be a dilution of BIF and mudstone also, as the thin banding (<1m) of the shale does not allow for the separation of other material during blasting and mining. This material generated from the SHW7 pit will be stored and encapsulated in the adjacent mined out SHW5 pit (refer Section 4.2).

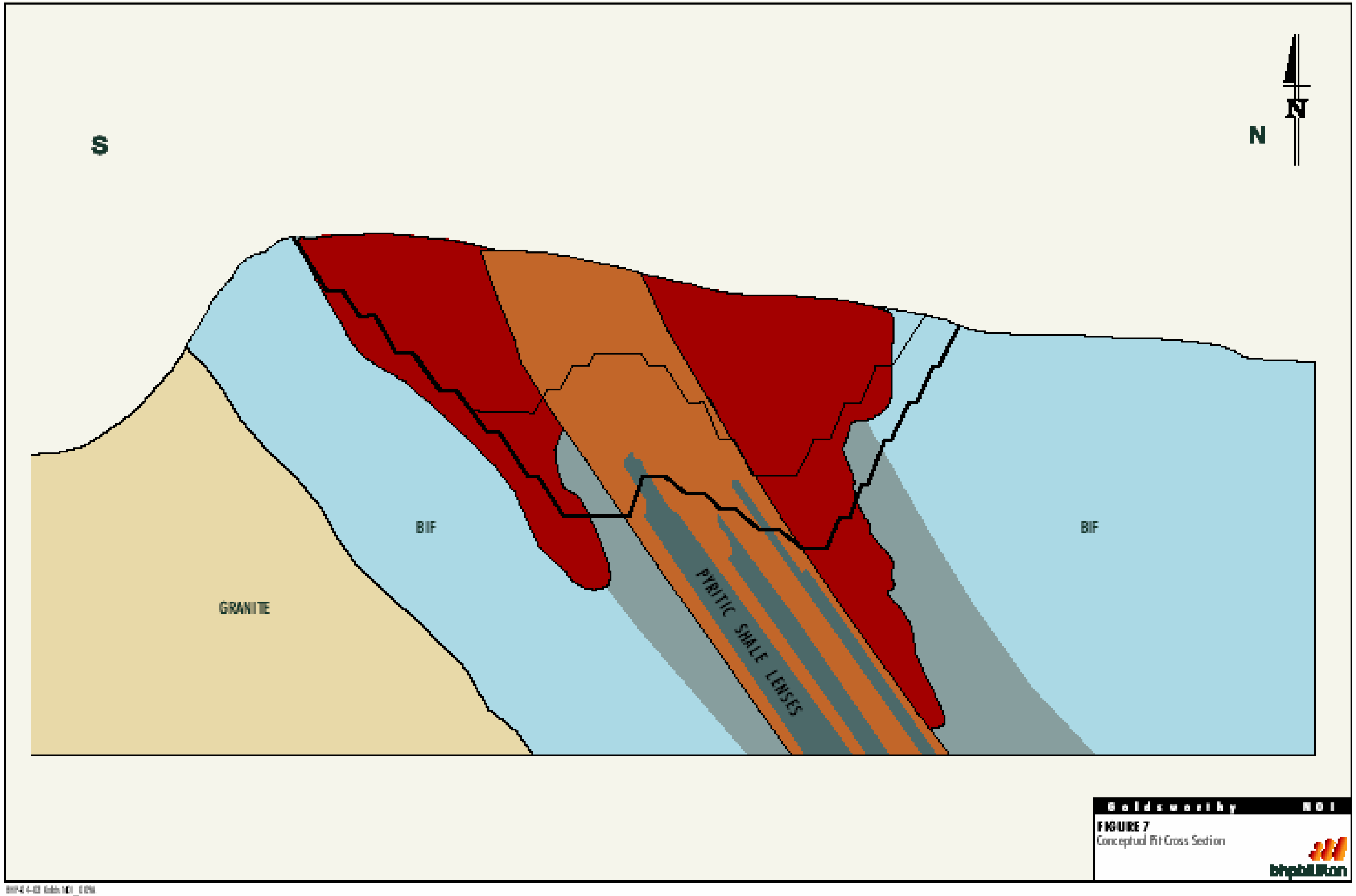

Figure 3 – Schematic Cross Section of NAG geological setting

2.3 Characterisation of NAG Material

Characterisation of overburden at Yarrie has shown that the vast majority of material is non-acid forming (Graeme Campbell & Associates, 1996). The small percentage of pyritic material, which is potentially acid forming, has the following characteristics:

- a mildly acidic pH between 3.2-4.7;
- low to moderate contents of soluble salts (EC 0.17-0.56 mS/cm^2);
- moderate-to-high contents of pyrite, corresponding to sulphide-S concentrations of 1.8 - 9.4%;
- negative acid neutralisation capacity (ANC) values that ranged from -1.8 to 0.2 kg H_2SO_4/tonne; and,
- net acid producing potential (NAPP) values within the range 120 to 290 kg H_2SO_4/tonne, indicating that the pyrite is Potentially Acid Forming (PAF).

As the geological setting of potentially acid forming material at SHW7 is identical to that at Yarrie, the same geochemical values and assumptions can be applied.

3 NAG MATERIAL HANDLING STANDARD WORK PROCEDURES

In order to mine NAG materials in line with this management plan, BHPBIO and the mining contractor have developed operational procedures which deal with the identification and selective handling of NAG material.

Any material mined from pits is drilled and blasted prior to excavation. BHPBIO personnel are responsible for logging the cone cuttings from every blasthole in all pits. This is done for two reasons:

- classification of ore quality, and
- identification of sulphide content

The latter is required because pyrite material may react and cause instability with the blasting agents and if not properly handled, may result in the formation of ARD.

The procedure confirms the need for and type of detailed sampling of the blasthole cone and subsequent analysis for sulphide.

Following sampling of the material from blasthole cones, material classified as NAG is identified in mining blocks for excavation.

Haul trucks carrying pyritic shale are given their destination from the shovel or front-end loader operator. A spotter often assists the operator (ie. BHPBIO geologist), in determining which loads contain NAG material.

The number of loads of NAG material sent to the designated NAG approved storage location (refer Section 4) are recorded and reported monthly.

4 INVESTIGATION OF SITES FOR LONG TERM STORAGE OF NAG MATERIALS

4.1 Yarrie

In 1997, an evaluation was conducted to determine potential suitable sites for the long term storage and encapsulation of NAG materials. The results of this evaluation identified B and C pits within the eastern section of the Y2/3 deposit as the best location.

A hydrogeological assessment by Woodward-Clyde (1997) revealed that C pit is bounded on all sides by low permeability rocks, which are above the regional groundwater table. Consequently, there is very little potential for leachates (if generated) to impact on the groundwater. Further evaluation of the area also has indicated that B pit (immediately adjacent) possesses similar characteristics, however this pit is on the hydrologic divide with the main pit.

Other important determining factors for B and C pit included:
- The pits will be mined-out before NAG materials were to be encountered.
- The pits have the volume for storage capacity for all NAG materials.
- The majority of the natural topography around these pits slopes away from the void and therefore this enable surface water management, during infilling operations and upon closure.

There is also a basin of lower member ore located below B and C pit, and any seepage arising from the NAG materials would be expected to collect and remain in the basin located below the pit. However, current indications are that encapsulation of NAG materials with inert overburden materials to a depth of approximately 5 metres is sufficient to effectively eliminate water movement through the profile.

4.2 SHW7

Based on current best practice for NAG storage, the success of in-pit storage at Yarrie and the small volumes of NAG material expected at SHW, a location for in-pit storage of NAG material near the SHW7 pit was sought.

A number of mined out pits are located on top of the Sunrise Hill – Shay Gap ridge east of SHW7. Any prospective location had to address the following selection criteria;
- Enough volume to accommodate all potential NAG material, including allowance for 100% dilution and inert surroundings,
- No resource potential (ie. Pit considered “mined out”),
- No new land disturbance required (including haul route),
- Topography generally draining away from the location,
- Economic haul distance from SHW7 pit,
- Knowledge / proximity to water table.

Pit SH5A, located within 3 km of SHW7, is the nearest pit void which satisfies all the listed criteria. As such, the mined out void has been designated the NAG approved storage location for NAG material mined from the SHW7 pit.

5 MANAGEMENT OF NAG APPROVED STORAGE LOCATIONS DURING OPERATION

The concept for storage of NAG material in a mined out pit void is illustrated in Figure 4.

5.1 Operational Management at Yarrie

Prior to placing NAG material into C Pit, the floor was covered with a 1 m layer of compacted gravel to create an inert compacted barrier and capillary break between the NAG material and the base of C pit.

As it is encountered, NAG material is progressively placed into B and C Pit. To minimise exposure of the materials to significant rainfall events, inert overburden is placed over the NAG material to progressively encapsulate it.

Dumping of NAG material into B and C pit will be such that sufficient volume will be left for the placement of an inert cover (greater than 5m) over the NAG material.

To minimise potential water flow into B and C Pit from other areas, a permanent windrow has been built around the pit perimeter.

With management practices currently in place, it is expected that, in line with the stability of the B and C pits, potential NAG impacts on the surrounding environment in the long and short term within the area will be minimal.

5.2 Operational Management at SHW7

Storage of NAG material from SHW7 into SH5A pit void will be similar to that undertaken at Yarrie (Figure 4).

NAG material will be progressively placed into the SH5A mined out pit void. To minimise exposure of the materials to significant rainfall events, inert overburden is placed over the NAG material to progressively encapsulate it.

Dumping of NAG material into SH5A pit will be such that sufficient volume will be left for the placement of an inert cover (greater than 5m) over the NAG material.

To minimise potential water flow into SH5A pit from other areas, a permanent windrow has been built around the SH5A pit perimeter.

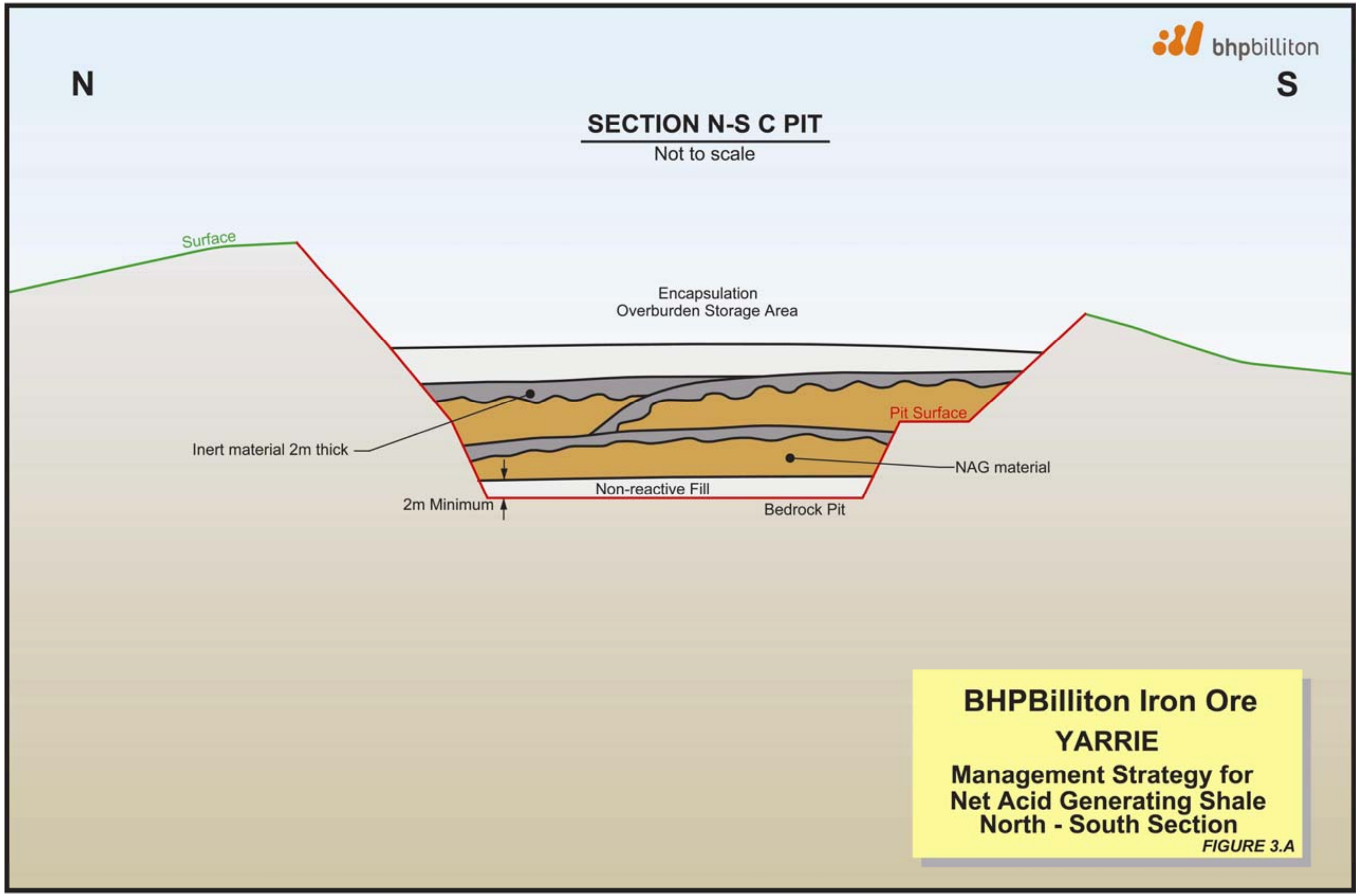

Figure 4 Schematic Cross Section of NAG in-pit storage

5.3 Auditing

Procedures have been developed to ensure that the NAG material is dumped in the specified area. They incorporate calculations of estimated volumes of NAG material present in the area. The calculations can then be accurately compared to actual volume of NAG material sent to the specified areas. Reconciliation can then occur between actual and predicted NAG material.

Annually, these procedures and reconciliations will be audited to ensure that they are effectively implemented and any improvements are incorporated into the management plans.

5.4 Contingency plans

Areas of exposed NAG material will be minimised during mining operations, to prevent contact with water / open air by means of regular capping with inert material. This will also allow for minimal work to be done prior to the wet season commencing.

Prior to the onset of expected rainfall, all exposed NAG material within the NAG approved storage locations will be capped (paddock dumping) with a minimum of 2 metres of low permeability granitic or lateritic materials.

Routine stockpiling and waste dump checks by BHPBIO personnel allow for the identification of any misappropriated loads containing NAG material and will be marked out immediately and relocated at the first available opportunity to NAG approved storage location for correct storage.

6 MONITORING

Water quality monitoring of NAG approved storage locations is included within the Site Water Monitoring Programme.

The water monitoring program associated with NAG management at Yarrie includes:

- A series of (shallow and deep) piezometers have been established around B and C pit to monitor groundwater quality. These piezometers are marked on the geological map located on Appendix B and are monitored on a quarterly basis.
- Surface drainage / ponding potentially flowing from C pit to B pit during operations.
- Quarterly production bore dewatering A pit of the Y2/3 pit during operations
- Quarterly monitoring of the dewatering discharge (when present)

Results collected from these sampling areas are supplemented with data collected from other routine water monitoring locations included in the Yarrie Water

Monitoring Programme. Collectively, the monitoring programme enable close scrutiny of the water quality in the Y2/3 mining area and surrounds.

A similar monitoring regime is proposed for SHW7 and SH5A

7 CLOSURE OF NAG APPROVED STORAGE LOCATIONS

7.1 Research

Ongoing research designed to improve the management of NAG material is being co-ordinated from BHPBilliton Iron Ore Mt Whaleback operation at Newman (refer to *Mt Whaleback Mine Acid Rock Drainage and Net Acid Generating Material Management Strategy, March 1998*).

Information from these research programmes will be used to assist with the management of NAG material and the development of final closure plans for the Northern Pilbara region.

7.2 Closure

Research (O'Kane et al 1997, 2000) conducted in the Pilbara indicates that infiltration into the NAG materials by surface water does not occur. Instead, these encapsulated covers form a "store and release" system to minimise contact with the underlying NAG material, thus preventing the generation of ARD. With management practices currently in place, it is expected that, in line with the stability of the NAG approved storage lcoations, potential NAG impacts on the surrounding environment in the long and short term within the area will be minimal.

Currently, the long-term management strategy is to infill the pit voids (C pit and SH5A) from the east to the west to a height approximately 10m below the crest of the pit void. The rest of the pit will then be infilled with Banded Iron Formation (BIF) material to a height of 4 -5m, backsloping to the east of the pit. This will ensure that any surface water flows will drain to the back of the pit, rather than down the face of the in-pit slope.

The in-pit slope resulting from the infilling operation will be covered with a minimum of 4 m of BIF. The surface will be stabilised using appropriate earthworks. Pending the final earthwork design of the cover system, topsoil may be spread over the cover system surfaces to assist with the re-establishment of native vegetation.

8 TRAINING

All production supervision and planners will be made aware of the modified Standard Work Procedures through distribution and meetings. Crews will be notified via regularly scheduled toolbox meetings that routinely discuss changes in procedure and work activities.

9 REFERENCES

BHP (1992) *Goldsworthy Extension Project – Phase II. Consultative Environmental Review*. Prepared by Dames and Moore.

BHP (1998) *Mt Whaleback Mine Net Acid Generating Material Management Strategy*. Internal Report.

Campbell, G (1995) *Yarrie Operation Acid-Forming Characteristics of Pyritic Shale Rock. Implications for Waste Rock Management*. Internal report to BHPIO.

Woodward-Clyde (1997) *Yarrie Pit C Hydrogeological Assessment*. Internal report for BHPIO.

APPENDIX B

YARRIE WATER MANAGEMENT PLAN

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1 INTRODUCTION

The Consultative Environmental Review document submitted for the Goldsworthy Extension Project Phase 2 (753) Yarrie Project identified water supply being obtained from local groundwater sources. The preferred source was to be bores drilled into the Yarrie orebody, supplemented as necessary from bores installed in the Eel Creek drainage. Subsequent groundwater investigations have indicated that these sources may not be adequate to meet the needs of the Project.

The water supply for the Yarrie Project will now be sourced from the existing borefield which provides water to the Shay Gap townsite and several nearby mining operations. This borefield has been supplying in excess of 3 000 kL/d for some twenty years and has established a state of dynamic equilibrium in the aquifer. The borefield as constructed is capable of supplying approximately 4 000 kL/d and the aquifer capable of much more if further bores were to be installed. The programmed decommissioning of Shay Gap town in 1993 makes it possible to use this source of water supply for the Yarrie Project. A buried pipeline will be constructed from Shay Gap to Yarrie along the same easement as the planned overhead powerlines.

The approval for the Project by the Minister for the Environment (EPA) required that a water management plan be prepared to the requirements of the Minister, the Water Authority of Western Australia (WAWA) and the Department of Minerals and Energy (DME) (Condition 3.1). The water management plan herein takes into consideration the new water supply strategy and addresses Condition 3.1 in terms of the current plans.

2 WATER SUPPLY

2.1 Water Demand

The initial Project water requirement occurs during the construction period when potable water is required for the construction camps and raw water is required for dust suppression, earthworks and concrete batching. Subsequently, the water requirements are for potable water at the accommodation village, and raw water for mine dust suppression and ore processing. The water requirement peaks during the construction of the railway line from Shay Gap to Yarrie.

The water demand and time distribution are given in Table 1.

TABLE 1

ANTICIPATED WATER DEMAND
(kL/d)

	Apr '93	May	June	July	Aug	Sept	Oct	Nov	Dec+
Rail Construction	2 000	3 500	3 500	3 000					
Village Camp	100	100	100	100	100	150	150	200	200
Mine Prestrip	500	1 000	1 000	1 500	1 500	1 500	1 500	1 000	
Mining								500	2 000
Ore Processing									100
Total	**2 600**	**4 600**	**4 600**	**4 600**	**1 600**	**1 650**	**1 650**	**1 700**	**2 300**

2.2 Water Sources

2.2.1 Construction Phase

The primary source of water supply during the construction phase will be the pipeline from Shay Gap connected into the pipeline system from the Shay Gap Borefield. The pipeline to Yarrie is designed to deliver up to 2 500 kL/d operating under gravity flow, and up to 3 500 kL/d with the installation of a booster pump.

During times of maximum demand, the pipeline capacity will be insufficient to meet the total requirement. The shortfall in the pipeline supply will be pumped from bores installed in the Eel Creek area during the recent groundwater investigation.

2.2.2 Mining Phase

The initial source of water supply will be the pipeline from the existing Shay Gap Borefield.

As the Yarrie Mine advances to depth, the pit will eventually reach and then proceed below the local water table. At that time, pit dewatering will be required to allow mining on dry benches. The water discharged from the pit will be used for industrial water supply in preference to the water available from the pipeline.

2.3 Water Supply Monitoring

Abstractions from the Shay Gap Borefield are not expected to increase. The supply to Yarrie will be roughly equivalent to reductions in existing usage from this source as Shay Gap town and mining operations wind down.

The existing groundwater licence (GWL 33614) authorises abstractions up to 1 460 000 kL/annum (4 000 kL/d). The licence conditions require that the aquifer and borefield be monitored and that annual review reports be prepared and submitted to WAWA. The monitoring includes water levels, abstraction and water quality. This existing programme of monitoring, review and reporting will be continued in accordance with the conditions of the licence.

If the borefield monitoring data indicates that the abstractions cannot be sustained or that unacceptable impacts are occurring, corrective actions will be taken. These actions may include reducing the demand on the borefield, increasing the number of production bores so that drawdowns are lessened or moving the borefield. However, the existing long history of monitoring data indicates that the borefield will continue to operate satisfactorily.

During the construction phase, some groundwater is expected to be pumped from bores in the Eel Creek area. These bores are installed into fracture-controlled strip aquifers of finite areal extent and therefore any impacts due to groundwater abstractions should be localised. Observation bores and drillholes will be monitored to measure groundwater levels in the immediate area of the abstractions and near Eel Creek.

Because of the short period of planned abstractions (May to July 1993) from this area, it is not expected that any adverse impacts will be noted. However, if unacceptable impacts are noted, the groundwater abstractions will be reduced or halted.

3. PIT DEWATERING

3.1 Dewatering Requirement

The Yarrie pit is expected to reach the local water table during Year 3 of mining (1996). At that time, dewatering will be minimised so that only that abstraction which is necessary to maintain safe and efficient mining operations will be sustained. The groundwater investigations completed to date indicate that the total discharge will gradually increase to the order of 2 000 kL/d.

The volume and strategy of dewatering will be determined by the actual conditions encountered during mining. The strategy will be continually reviewed and up-dated in light of the operating experience and refinement of the hydrogeological model.

3.2 Disposal of Dewatering Discharge

The water removed from the pit will be used for dust suppression and ore processing in preference to the water available from the Shay Gap pipeline. If the volume of dewatering exceeds the demand for water, the excess will be discharged into settling ponds to remove fines and then into an existing surface drainage in a controlled manner. The approximate point of discharge is shown on Figure 1.

3.3 Monitoring of Dewatering Progress and Effects

The rate and cumulative total of dewatering will be monitored by the installation of flowmeters in the discharge pipework. The rate and volume of dewatering will be recorded monthly. The volume of water used in processing and the amount discharged will be recorded.

The quality of the orebody groundwater is excellent, generally less than 300 mg/L TDS. The surface discharge of such water will not adversely impact the local environment due to water quality. The surface discharge outfall will be sampled every six months and analysed for the parameters listed in Table 2. On a monthly basis, water discharged will be analysed for pH, electrical conductivity (EC) and total suspended solids (TSS).

The final depth of mining is scheduled to be 46 m AHD, compared with a water table elevation of about 270 m AHD in the mine area and approximately 110 m AHD in the surrounding low-lying areas of Eel Creek and Kimberley Gap. The effects of dewatering will therefore be monitored in the mine area and the surrounding low-lying areas.

Groundwater levels will be monitored regularly in permanently established monitor bores, prior to any dewatering. The outlying areas will include the vicinity of Eel Creek, the flats of Kimberley Gap and the area between the mine and Chinaman Springs. Indicative monitor bore locations are shown on Figure 1.

All monitoring data collected in the region will be presented in an annual report to the EPA through the Minister of Resource Development. A review of this total programme will occur tri-annually in consultation with the EPA and other authorities.

TABLE 2

WATER QUALITY MONITORING PARAMETERS

Major Parameters	Detection Limits
pH	0.1
Electrical Conductivity (EC)	1
Total Dissolved Solids (TDS)	1
Total Suspended Solids (TSS)	1
Sodium, as Na	1
Potassium, as K	1
Magnesium, as Mg	1
Calcium, as Ca	1
Chloride, as Cl	1
Sulphate, as SO_4	1
Bicarbonate, as $CaCO_3$	1
Carbonate, as $CaCO_3$	1
Nutrients	
Nitrate Nitrogen, as N	0.01
Orthophosphate Phosphorus, as P	0.01
Heavy Metals	
Iron, as Fe	0.01
Manganese, as Mn	0.001
Copper, as Cu	0.001
Zinc, as Zn	0.001
Nickel, as Ni	0.001
Chromium, as Cr	0.001
Mercury, as Hg	0.0001
Selenium, as Se	0.001
Arsenic, as As	0.01
Barium, as Ba	0.01
Cadmium, as Cd	0.01
Lead, as Pb	0.001
Organic Parameters	
Total Oil and Grease	0.01
Total Petroleum Hydrocarbons	0.2
Total Phenols, as phenol	0.0002

Note: all values are mg/L except pH (no units) and EC (µS/cm).

If this programme of monitoring shows that the drawdowns will affect Chinaman Springs, the Springs will be artificially supported by piping a portion of the dewatering discharge to the Springs.

If the monitoring in the Eel Creek and Kimberley Gap areas indicates that the dewatering is lowering the water levels in those areas, then a programme of vegetation monitoring will be instigated. If the vegetation monitoring shows that deaths are occurring due to excessive groundwater level drawdown, action as agreed with the relevant authorities will be instigated in order to ameliorate the impacts.

4 WASTEWATER AND SURFACE WATER RUNOFF

Runoff and wastewater from washdown bays and workshop areas will be directed into holding ponds. The volume of water generated will be relatively small and the ponds designed so that the water will be evaporated. The ponds will be in an open area so that any hydrocarbons possibly contained in the wastewater will decompose due to sunlight and bacteriological processes.

The holding ponds will be regularly sampled and analysed for the presence of hydrocarbons. Surface runoff generated during major rainfall events will be sampled and analysed for hydrocarbons to ensure that hydrocarbon contamination does not enter the environment. The ponds will be regularly inspected for signs of leaks or overtopping. Corrective action will be taken as necessary.

The control of siltation due to surface runoff from disturbed areas, and the sealing of bunded holding areas are conditions of the Works Approval and will be licence conditions issued by the Environmental Protection Authority.

5 MINE CLOSURE

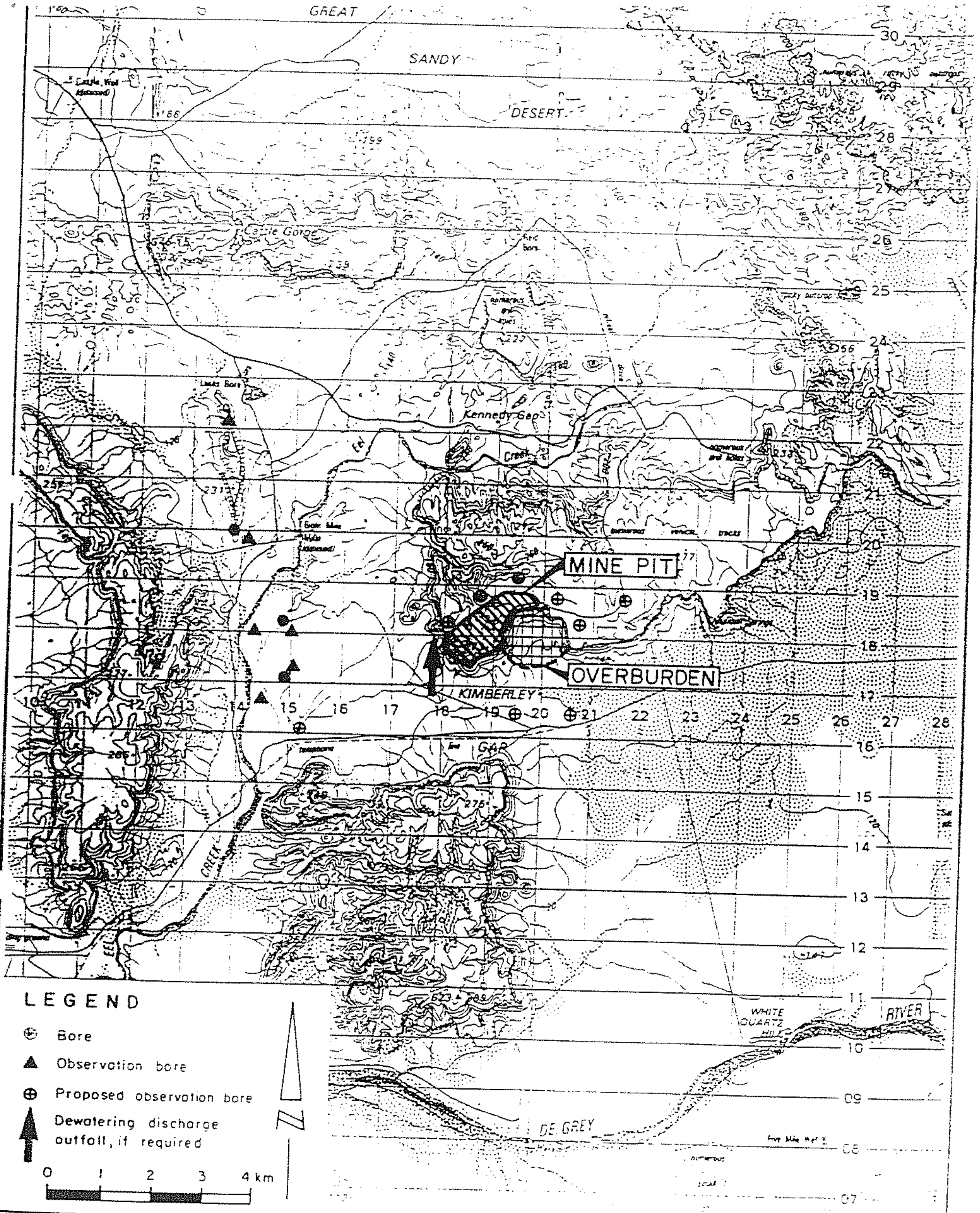
The local water table will be lowered during mining by the on-going dewatering programme. When the mine is decommissioned, the dewatering will cease and the water table will gradually rise, filling the pit until an equilibrium level is established. The water body in the pit will be exposed to the atmosphere and subsequent evaporation may cause an increase in the salinity of the water in the pit compared with existing groundwater.

The possible degree of salinisation and resulting impacts cannot be accurately addressed at this time. The processes of salinisation in mined out pits is being studied by BHP Iron Ore at the nearby abandoned Goldsworthy pit and the knowledge gained there will be applied to Yarrie. Research is also being conducted elsewhere by others into various methods of reducing direct evaporation including membrane covers, floating covers, oil-film covers and wind diversion structures.

During the life of the mine, methods will be investigated to reduce the surface area of open water left by the mine and where practicable mine planning adjustments will be made to minimise evaporation.

After closure of the mine, groundwater levels and quality will be monitored indefinitely or as may be required by the regulatory authorities.

A salinisation management plan will be prepared and submitted to EPA/WAWA/DME prior to mine closure.



REVISIONS

AGC Woodward-Clyde

YARRIE PROJECT
OBSERVATION BORE LOCATIONS

APPENDIX B

DECOMMISSIONING AND REHABILITATION PLAN (BHP BILLITON IRON ORE, 2008B)

bhpbilliton


YARRIE

GOLDSWORTHY IRON ORE MINING OPERATIONS
DECOMMISSIONING AND REHABILITATION PLAN


CATTLE GORGE


NIMINGARRA


SHAY GAP


SUNRISE HILL

REVISION 2

May 2009

BHP Billiton Iron Ore

GOLDSWORTHY IRON ORE MINING OPERATIONS

Decommissioning and Rehabilitation Plan

Revision 2

May 2009

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EXECUTIVE SUMMARY

The Goldsworthy Iron Ore Mining Operations (Goldsworthy) are located approximately 200 kilometres east of Port Hedland, in the north of the Pilbara region of Western Australia.

Goldsworthy is situated within mining tenements AML7000249, AML7000263, AML7000251, ML45/594, ML 45/558, ML45/573, ML592 and ML45/1016, and is operated in accordance with the *Iron Ore (Goldsworthy) Agreement Act, 1964*, the *Iron Ore (Goldsworthy-Nimingarra) Agreement Act, 1972* and Notice of Intent approval conditions.

Environmental management commitments for Goldsworthy are specified in Ministerial Statements of Approval No. 000682 and No. 000303. This revision of the Decommissioning and Rehabilitation Plan (DRP) (i.e. Revision 2) has been prepared to satisfy Condition 9 of Ministerial Statement of Approval No. 000682 and Condition 5 of Ministerial Statement of Approval No. 000303. It replaces Revision 1 and has been revised to include the site specific characteristics of the Cundaline and Callawa mining operations, and as supporting documentation to the Cundaline and Callawa Environmental Protection Statement (BHP Billiton Iron Ore, 2008a).

This DRP describes how BHP Billiton Iron Ore Pty Ltd's Guiding Closure Principles for the proposed operations will be achieved. It also describes the control measures that will be used to guide the management of mine landforms, revegetation and infrastructure and support facilities during decommissioning and closure of Goldsworthy.

The DRP is designed to be periodically reviewed and revised as necessary during the remaining life of the operations and following closure. In line with its Health, Safety, Environment and Community Policy and Management Standards, BHP Billiton Iron Ore would also regularly review its rehabilitation and mine closure plans for Goldsworthy to keep abreast of best practice in the mining industry.

1 INTRODUCTION

1.1 PROJECT BACKGROUND AND HISTORY

The Goldsworthy Iron Ore Mining Operations (Goldsworthy) are located approximately 200 kilometres (km) east of Port Hedland, in the north of the Pilbara region of Western Australia (WA) (Figure 1-1). BHP Billiton Iron Ore Pty Ltd (BHP Billiton Iron Ore) operates Goldsworthy on behalf of the Goldsworthy Joint Venture participants.

Goldsworthy is situated within mining tenements AML7000249, AML7000263, AML7000251, ML45/594, ML 45/558, ML45/573, ML592 and ML45/1016 (Figure 1-2), and is operated in accordance with the *Iron Ore (Goldsworthy) Agreement Act, 1964*, the *Iron Ore (Goldsworthy-Nimingarra) Agreement Act, 1972* and Notice of Intent (NOI) approval conditions.

Environmental management commitments for Goldsworthy are specified in Ministerial Statements of Approval No. 000682 and No. 000303 issued under Part IV of the *Environmental Protection Act, 1986* (EP Act).

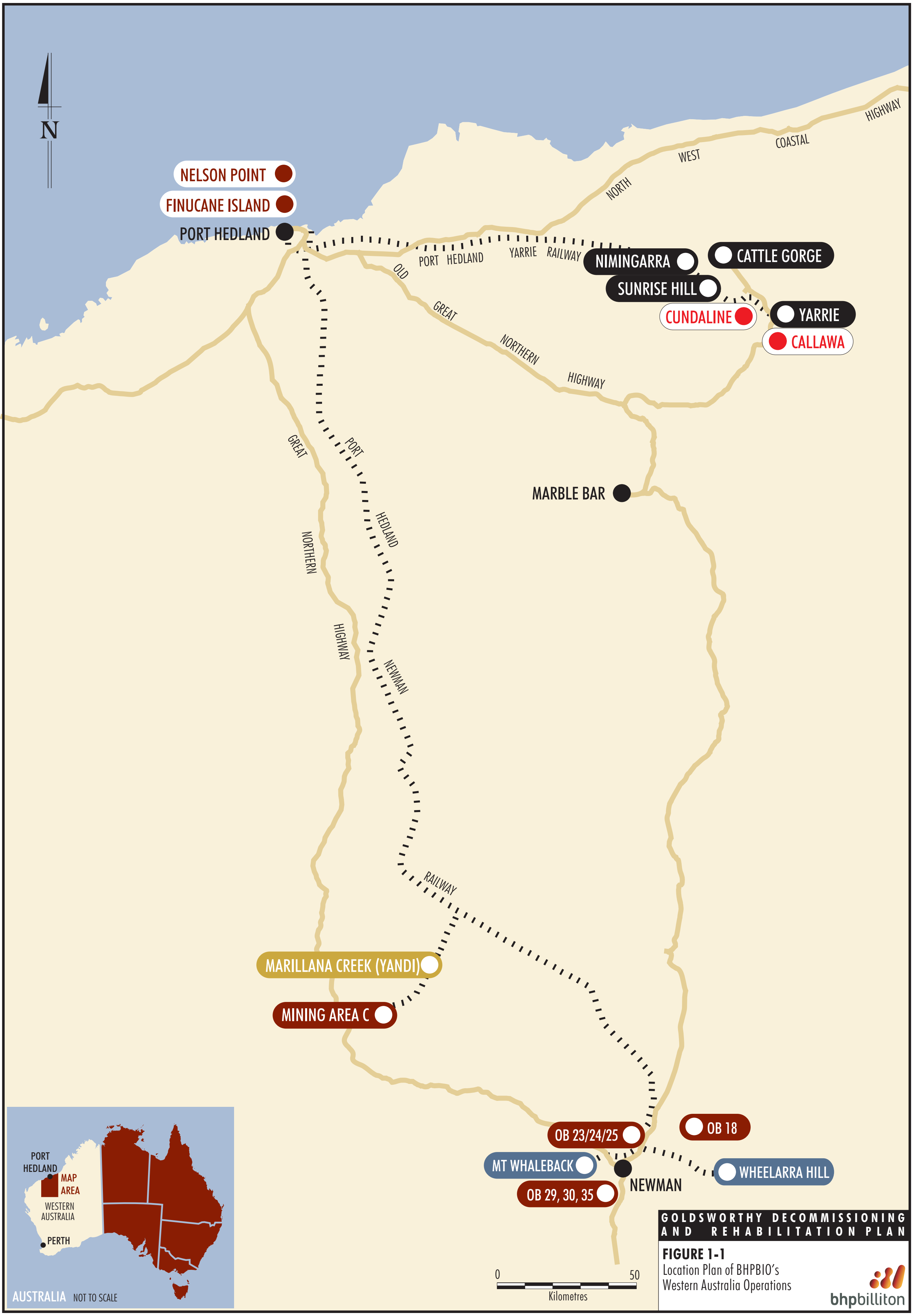
Goldsworthy processes up to 8.5 million tonnes of ore per annum (Mtpa). Ore is produced from Goldsworthy using conventional open pit hard rock mining methods. The ore is transported from Goldsworthy via rail to Port Hedland. Based on the proposed mining rate and current mine plan, mining is expected to continue at Goldsworthy until approximately 2016.

The development of the Goldsworthy operations has been conducted in phases over the past 50 years. The first major phase involved the development of the Shay Gap and Sunrise Hill Nimingarra mining areas, which are located approximately 50 to 70 km to the east of Mount Goldsworthy, between 1972 and 1992. In 1992, approval was obtained for the second major phase of development, which involved development of the Yarrie operations, located a further 20 km to the east. In 2005, approval was obtained for the Cattle Gorge operations (located between Yarrie and Sunrise Hill) plus extensions to the Nimingarra mining areas (Nim I) and Yarrie (Y10, Y7 and Y4B)..

BHP Billiton Iron Ore's current Goldsworthy operations are centred at Yarrie with some mining still taking place at the Nimingarra, Cattle Gorge and Sunrise Hill deposits. The Mount Goldsworthy and Shay Gap mining areas are no longer operational, with the majority of activities at these sites directed towards the monitoring and maintenance of rehabilitated landforms.

The next proposed phase of development for the Goldsworthy operations will be the development of the iron ore deposits at the Cundaline and Callawa ridges (Figure 1-2). BHP Billiton Iron Ore has prepared an Environmental Protection Statement (EPS), which describes these proposed operations, and the environmental management measures that will be used to minimise their impact (BHP Billiton Iron Ore, 2008a).

Current predictions are that BHP Billiton Iron Ore's mining operations in the Goldsworthy area (i.e. residual mining plus the new Cundaline and Callawa deposits) will occur until approximately 2016, after which the remaining disturbance areas will be rehabilitated and the site closed. Notwithstanding, BHP Billiton Iron Ore is continuing to explore in the Goldsworthy area and it is therefore possible that additional resources may be identified that would extend the mine life beyond the current predictions.



GOLDSWORTHY DECOMMISSIONING AND REHABILITATION PLAN

FIGURE 1-1
Location Plan of BHPBIO's Western Australia Operations

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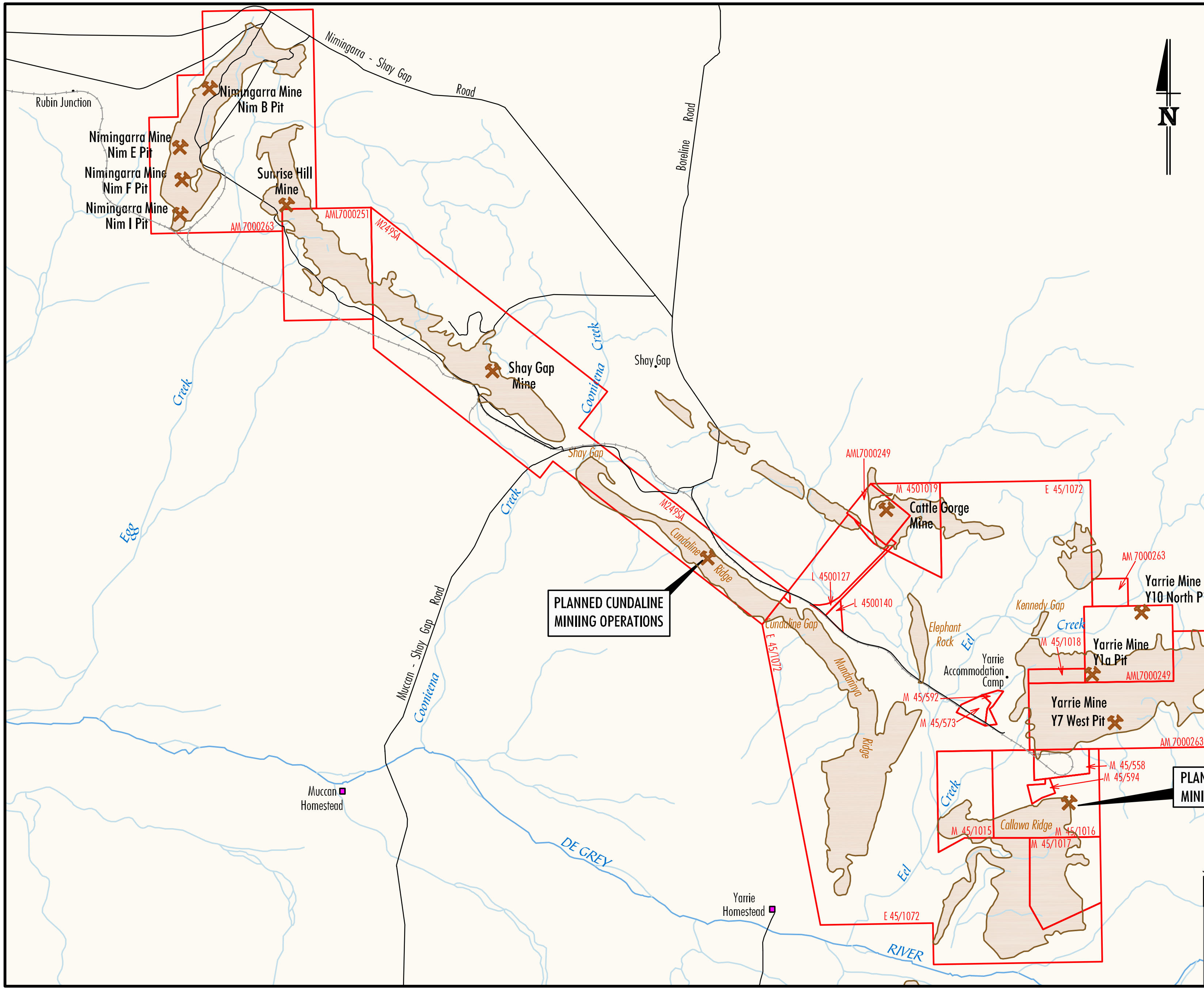

GOLDSWORTHY DECOMMISSIONING AND REHABILITATION PLAN

FIGURE 1-2
Goldsworthy Iron Ore Mining Operations

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1.2 SCOPE OF DOCUMENT

This DRP covers the existing and proposed mine landforms and infrastructure at the Cundaline, Callawa, Shay Gap, Sunrise Hill, Nimingarra, Yarrie and Cattle Gorge areas. The Mount Goldsworthy operations have not been included in this document as the area has been extensively rehabilitated and no other mining operations (except remediation works) are expected to occur.

It is intended that this DRP will be periodically reviewed and revised as necessary during the remaining life of Goldsworthy and following closure. Each revision will incorporate, where appropriate, operational experience gained at Goldsworthy and BHP Billiton Iron Ore's other Pilbara operations. In line with its Health, Safety, Environment and Community (HSEC) Policy and Management Standards, BHP Billiton Iron Ore would also regularly review its rehabilitation and mine closure plans for Goldsworthy to keep abreast of best practice in the mining industry.

1.3 PURPOSE OF THIS DOCUMENT

This DRP has been prepared to provide the following:

- A description of the current rehabilitation status of the areas disturbed by previous and current mining activities at Goldsworthy.
- A description of the rehabilitation and decommissioning standards that will be applied to the previous, current and proposed mining activities at Goldsworthy. These concepts are based on Guiding Closure Principles that have been developed to define the overall objectives for the development and closure of the operations. These Guiding Closure Principles are presented in Section 1.5.
- A summary of the risk assessment that has been conducted by BHP Billiton Iron Ore for closure-related aspects at Goldsworthy.
- Indicative timing of rehabilitation works during the remaining life of Goldsworthy, a description of proposed revegetation trials, ongoing research activities, and the mine rehabilitation and closure monitoring programme.

This revision of the DRP (i.e. Revision 2) has been prepared to satisfy Condition 9 of Ministerial Statement of Approval No. 000682 and Condition 5 of Ministerial Statement of Approval No. 000303. It replaces Revision 1, which was prepared in 2005, and has been revised to include the site specific characteristics of the Cundaline and Callawa mining operations, and as supporting documentation to the Cundaline and Callawa EPS (BHP Billiton Iron Ore, 2008a).

Ministerial Statement of Approval No. 000682

Condition 9 of Ministerial Statement of Approval No. 000682 is repeated below, along with the corresponding sections of this DRP that address each component of the commitment.

	Ministerial Condition	Section
9-1	*The proponent shall rehabilitate and decommission the new project areas in accordance with the Decommissioning and Rehabilitation Plan included in the Environmental Protection Statement (May 2005), or subsequent revisions of the Plan, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority, the Water and Rivers Commission, the Department of Industry and Resources and the Department of Conservation and Land Management.*	
9-2	*The proponent shall review and revise the Decommissioning and Rehabilitation Plan at intervals not exceeding five years, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority, the Waters and Rivers Commission, the Department of Industry and Resources and the Department of Conservation and Land Management.*	7
	The objective of this plan is to ensure that closure planning and rehabilitation are carried out in a coordinated, progressive manner and are integrated with development planning, consistent with the Australian and New Zealand Minerals and Energy Council / Minerals Council of Australia <u>Strategic Framework for Mine Closure (2000)</u>, current best practice, and the agree land uses.	
	Each revision of the Decommissioning and Rehabilitation Plan shall set out procedures and measures to:	
	1. manage over the long tem ground and surface water systems affected by the open pits and waste rock dumps;	3.3
	2. rehabilitate all disturbed areas to a standard suitable for the agreed end land use(s);	3.2 and 6
	3. backfill the Nim I and Cattle Gorge pits, to at least five metres above the pre-mining groundwater table so as to minimise impacts to groundwater quality and subterranean fauna;	3.2.3 and 3.3.2
	4. identify contaminated areas, including provision of evidence of notification and propose management measures to relevant statutory authorities; and	3.2.8
	5. develop management strategies and/or contingency measures in the event that operational experience and/or monitoring indicate that a closure objective is unlikely to be achieved.	4.2 and 7
9-3	*The proponent shall make revisions of the Decommissioning and Rehabilitation Plan required by condition 9-2 publicly available.*	

Ministerial Statement of Approval No. 000303

Ministerial Statement of Approval No. 000303 relates to Yarrie. Conditions within the Statement which are relevant to this DRP are repeated below, along with the corresponding sections of the DRP that address each condition.

	Ministerial Condition	Section
5.0	• *Decommissioning*	
	The satisfactory decommissioning of the project, removal of the plant and installations and rehabilitation of the site and its environs is the responsibility of the proponent.	3.2
5-1	*At least six months prior to decommissioning, the proponent shall prepare a decommissioning and rehabilitation plan.*	
5-2	*The proponent shall implement the plan required by condition 5-1.*	

Ministerial Statement of Approval No. 000303 also contains a number of proponent commitments. Each proponent commitment is repeated below, along with the corresponding sections of this DRP that address each commitment.

Ministerial Condition		Section
7-23	• *Rehabilitation* *Procedures developed by BHP in the Pilbara will be applied to rehabilitation at Yarrie. The object of the rehabilitation will be to ensure that, at the end of the project, all disturbed surfaces (with the exception of the mine pits) are returned to a stable condition with a flora and fauna which approaches the natural condition of the site.*	2.4
7-24	• *Decommissioning* *Following the completion of the project, buildings and other structures will be removed. Concrete slabs will be broken up and buried. The rehabilitation of the overburden will be completed. Remaining borrow pits will be rehabilitated. All unwanted bare or compacted areas will be contoured (where necessary), ripped and seeded. Monitoring of the rehabilitated areas will be undertaken to gauge success. This monitoring will continue until the vegetation is seen to be progressing towards a condition similar to that which existed before mining.*	3.2 and 4.1
7-25	• *Yarrie Pit Long-term Salinity* *BHP will continue to monitor the salinity of water in the Goldsworthy pit for several years to determine the future likelihood of saline water seeping from the pit into the De Grey River aquifer. The results of this monitoring will be used to formulate management strategies for the Yarrie pit if necessary.*	4.2.4

Obligations under this DRP

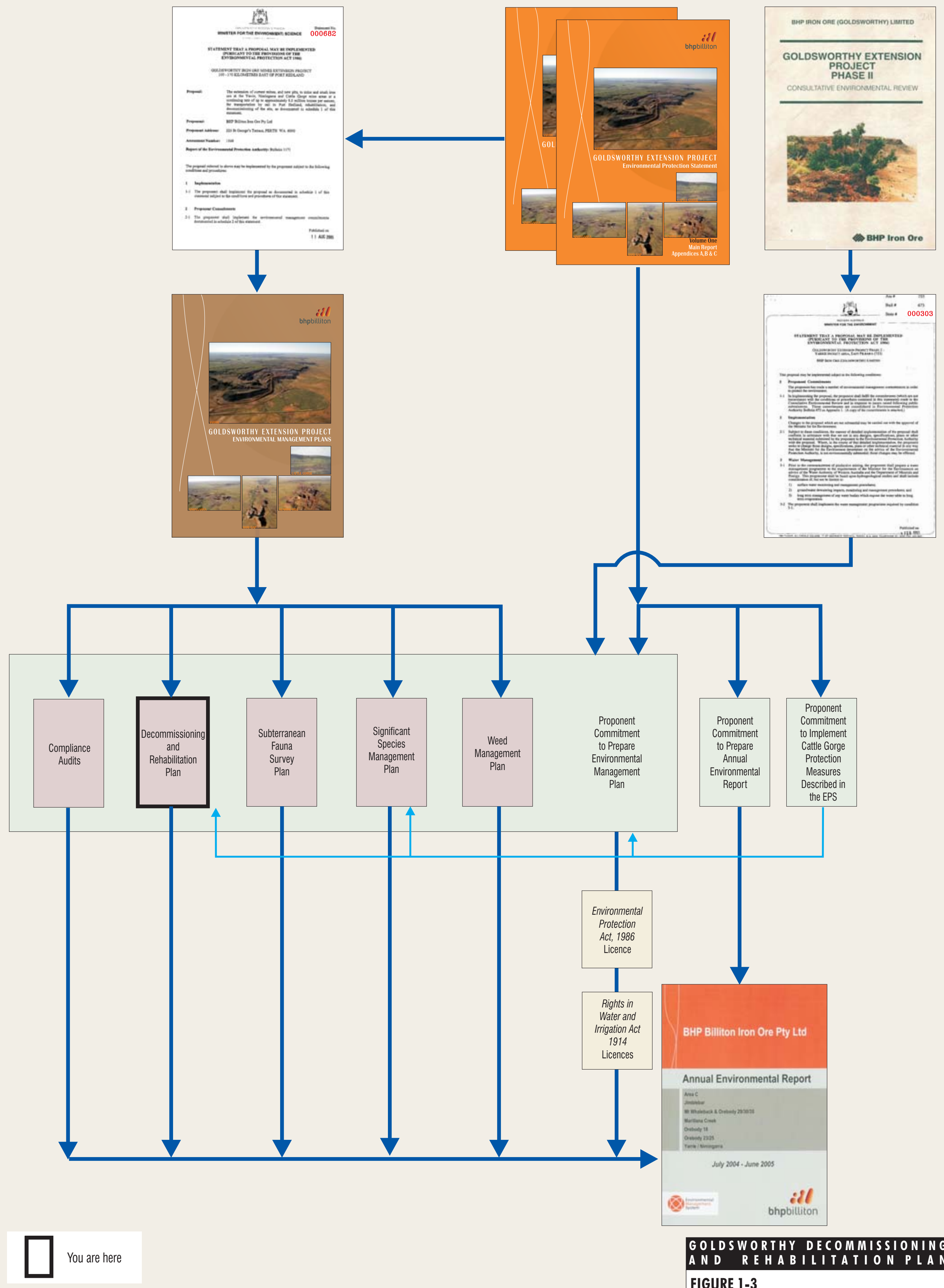
This DRP has been prepared to assist BHP Billiton Iron Ore and its contractors in the implementation of appropriate rehabilitation and mine closure strategies at Goldsworthy. Where there is any conflict between the provisions of this DRP and a contractor's obligation under the relevant contract, including the various statutory requirements (i.e. licences, permits, consent conditions and relevant laws), the contract and statutory requirements are to take precedence. In the case of any real or perceived ambiguity between elements of this DRP and the above statutory requirements the contractor shall first request clarification from BHP Billiton Iron Ore prior to implementing that element of this DRP over which the ambiguity is identified.

1.4 RELATIONSHIP BETWEEN THIS PLAN AND OTHER GOLDSWORTHY MANAGEMENT PLANS

BHP Billiton Iron Ore has developed an Environmental Management Plan (EMP) for Goldsworthy in accordance with the conditions of Ministerial Statement of Approval No.'s 000682 and 000303 (BHP Billiton Iron Ore, 2006a). The latest revision of the EMP (i.e. Revision 4) was updated to include the site specific characteristics of Cundaline and Callawa, and was prepared as supporting documentation to the Cundaline and Callawa EPS (BHP Billiton Iron Ore, 2008). The EMP is a broader document than this DRP in that it describes the overall programme to be used to manage potential impacts of Goldsworthy on all environmental values relevant to the site. The EMP contains an overview of rehabilitation and decommissioning at Goldsworthy, as well as referring to this DRP for specific detail (Figure 1-3).

1.5 CLOSURE GUIDELINES AND INDUSTRY STANDARDS

BHP Billiton's *Closure Standard* was issued in July 2004 (BHPB, 2004a). The *Closure Standard* describes the objectives, application, planning, execution and review processes involved in the closure of BHP Billiton's mines. The *Closure Standard* requires the preparation of closure plans for all operations and investment opportunities, the identification of risks and potential outcomes, estimation of closure costs, execution of timely and efficient closure plans, reporting, auditing and governance of procedures, and the application of project management practices.



GOLDSWORTHY DECOMMISSIONING AND REHABILITATION PLAN

FIGURE 1-3
Relationship between Environmental Management Plans

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This DRP has been prepared to satisfy the relevant components of BHP Billiton's *Closure Standard.* In addition, this DRP incorporates relevant aspects from other closure guidelines and industry standards. A list of relevant publications and a brief summary of their content is provided below:

- *Strategic Framework for Mine Closure.* This handbook was prepared by the Minerals Council of Australia, and the Australian and New Zealand Minerals and Energy Council (ANZMEC) in 2000. It outlines strategic framework concepts associated with stakeholder involvement, planning, financial provision, implementation, standards, and relinquishment. Examples of best practice are included (Minerals Council of Australia and ANZMEC, 2000).
- *Mine Closure and Completion.* This document was prepared by the Department of Industry, Tourism and Resources in October 2006 as part of an Australian Government initiative called Leading Practice Sustainable Development Program for the Mining Industry. The publication addresses sustainable development and closure, mine life phases, planning during the operational phase and mine completion and relinquishment, including case studies (Department of Industry, Tourism and Resources, 2006a).
- *Mine Rehabilitation.* This handbook was published in October 2006 within the Leading Practice Sustainable Development in Mining Series by the Department of Industry, Tourism and Resources. It outlines sustainable development and mine rehabilitation, planning, operations, and closure, and includes case studies addressing these aspects of mine rehabilitation (Department of Industry, Tourism and Resources, 2006b).

1.6 GUIDING CLOSURE PRINCIPLES

The overall guiding closure principles for the Goldsworthy mining operations are proposed as follows:

- *There will be no significant, physical off-site impacts.*
- *No significant impact on baseline surface water quality and flow regimes in Eel Creek and Egg Creek.*
- *The established vegetative cover will be self-sustaining and show progression towards the surrounding undisturbed vegetation in terms of species diversity and plant density.*
- *The post-mining landform will be designed to be stable and respond to erosive forces in a manner to suit the end land use.*
- *There will be no unsafe areas where members of the general public could inadvertently gain access. Access to potentially unsafe areas will be impeded by safety bunds built to comply with the applicable DOIR guidelines.*
- *The number and size of out of pit overburden storage areas in new mining areas will be minimised.*
- *Residual pit voids will be left as mined where geotechnically stable, and profiled as necessary to achieve long-term closure objectives.*
- *Final overburden storage areas will be sympathetic with regional landforms.*
- *A long-term systems based approach will be used to track the trajectory of rehabilitated areas towards self sustaining status.*
- *The end landuse for the area will be determined in consultation with stakeholders, and agreed with the administering authority ongoing during the life of the mine.*

1.7 CONSULTATION

BHP Billiton's Health, Safety, Environment and Community (HSEC) Policy (BHPB, 2004b) states that wherever the Company operates it will:

communicate with, and engage employees, contractors, business partners, suppliers, customers, visitors and communities to:

- *build relationships based on honesty, openness, mutual trust and involvement; and*
- *share responsibility for meeting the requirements of this policy.*

During the preparation of the DRP, BHP Billiton Iron Ore has consulted with government agencies (both state and local), non-government organisations, and land-users that have expressed interest in, or are directly impacted by, Goldsworthy. The main objectives of the mine closure consultation programme are to:

- provide information and the opportunity to comment to other groups or individuals who may potentially be interested in Goldsworthy;
- discuss with stakeholders, the key long term guiding principles for development of the mine and ultimate relinquishment of Goldsworthy;
- periodically provide updated information and results of the life-of-mine development and closure planning process to stakeholders as more information comes to hand; and
- where possible, allow for adjustments to closure designs and/or management programmes to accommodate concerns or issues raised by stakeholders following review of this document, as well as aspects raised during meetings, presentations and site visits.

1.8 MINING AREAS

The following subsections provide an overview of each mining area at Goldsworthy. Figures 1-4 to 1-10 show the general layout of each mining area at Goldsworthy.

1.8.1 Shay Gap

The Shay Gap townsite has been decommissioned and rehabilitated. Nearly all pits mined in the past still have remnant ore and as such have not been backfilled. Extensive rehabilitation works have been carried out on the OSAs, the vast majority of which were moonscaped in 1993. Some of the pits were mined below the watertable and have pit lakes; these pits are SG1 and 2, SG 3 and 4, SG7 and Hematite Hill. Pyritic shale has not been recorded at these operations (Figure 1-4).

1.8.2 Sunrise Hill

The Sunrise Hill pits, SH1, SH2, SH3, SH4, SH6, SH8 and SHW5 have all been mined in the past and their associated OSAs were rehabilitated in 1993. Nearly all pits still have remnant ore and as such have not been backfilled. Of these pits only SH8 has been mined below the watertable (Figure 1-5).

SHW3 was completed in 2005 and has been partially backfilled. It has been designated as the pyritic shale storage for the SH pits.

GOLDSWORTHY DECOMMISSIONING AND REHABILITATION PLAN

FIGURE 1-4
Shay Gap Operations

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LEGEND

- Screenable Material/laterite
- Ex-pit Osa
- Infrastructure
- Rehabilitation Complete
- Backfilled Pit
- Pit Void
- Pyritic Shale Dump
- Post Closure Access Roads
- Rehabilitation Monitoring

0 200 1000
Metres

GOLDSWORTHY DECOMMISSIONING AND REHABILITATION PLAN

FIGURE 1-5
Sunrise Hill Operations

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BHP-07-16 GDRP_004B

LEGEND

- Screenable Material/laterite
- Ex-pit Osa
- Infrastructure
- Rehabilitation Complete
- Backfilled Pit
- Pit Void
- Post Closure Access Roads
- Rehabilitation Monitoring

0 200 1000
Metres

GOLDSWORTHY DECOMMISSIONING AND REHABILITATION PLAN

FIGURE 1-6
Nimingarra Operations

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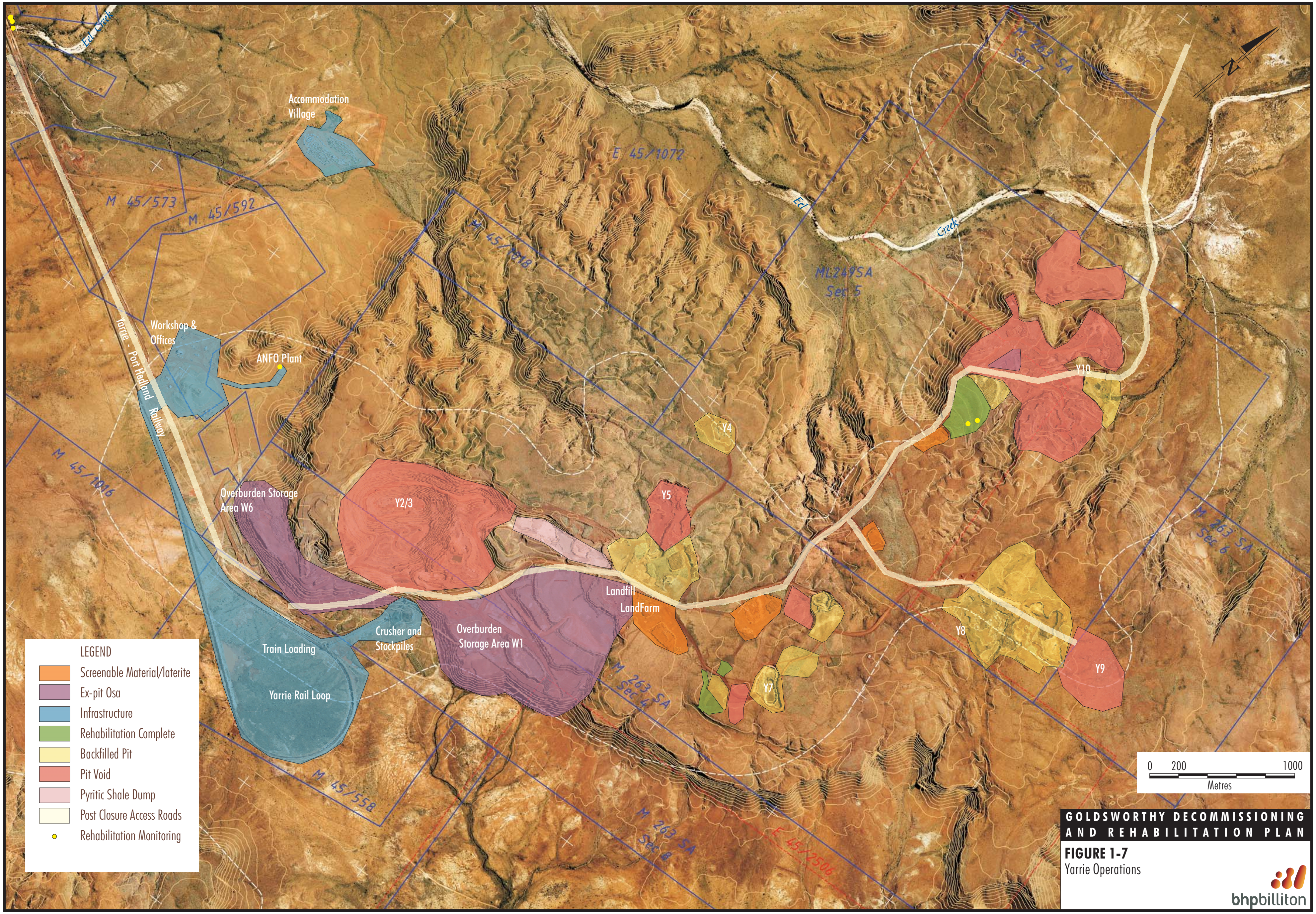

GOLDSWORTHY DECOMMISSIONING AND REHABILITATION PLAN

FIGURE 1-7
Yarrie Operations

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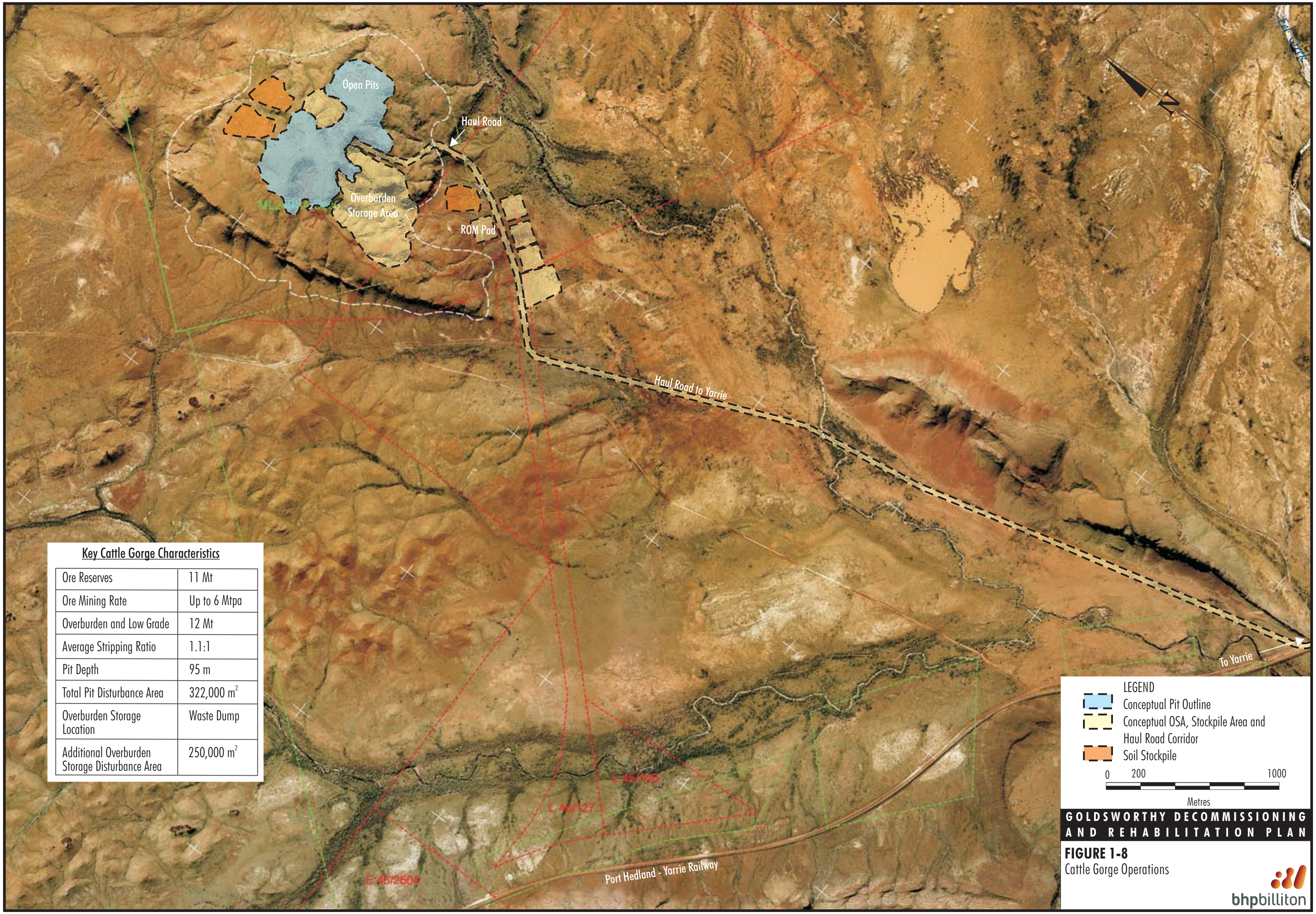

Key Cattle Gorge Characteristics

Ore Reserves	11 Mt
Ore Mining Rate	Up to 6 Mtpa
Overburden and Low Grade	12 Mt
Average Stripping Ratio	1.1:1
Pit Depth	95 m
Total Pit Disturbance Area	322,000 m^2
Overburden Storage Location	Waste Dump
Additional Overburden Storage Disturbance Area	250,000 m^2

GOLDSWORTHY DECOMMISSIONING AND REHABILITATION PLAN

FIGURE 1-8
Cattle Gorge Operations

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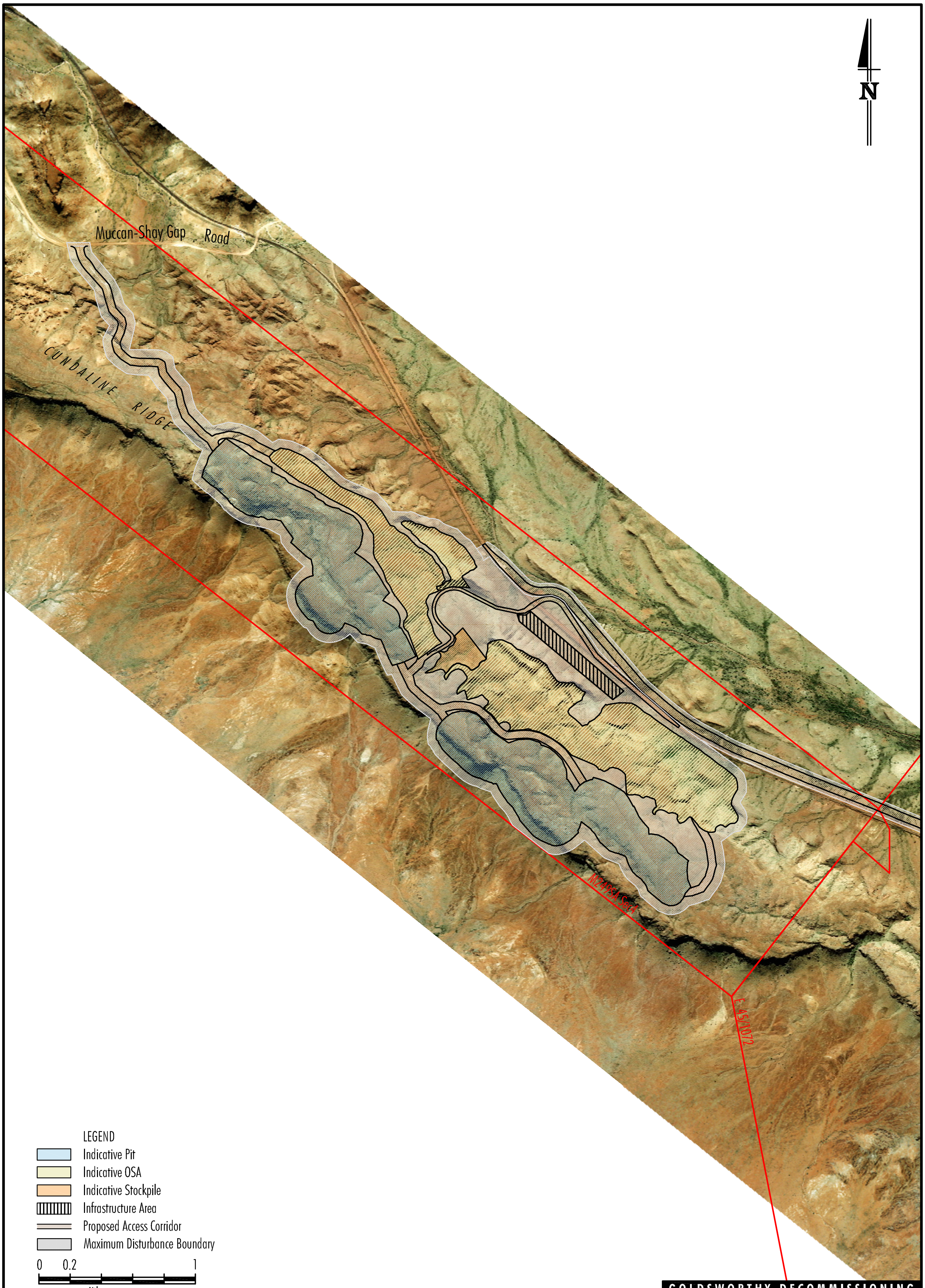

GOLDSWORTHY DECOMMISSIONING AND REHABILITATION PLAN

FIGURE 1-9

Cundaline Mining Operations

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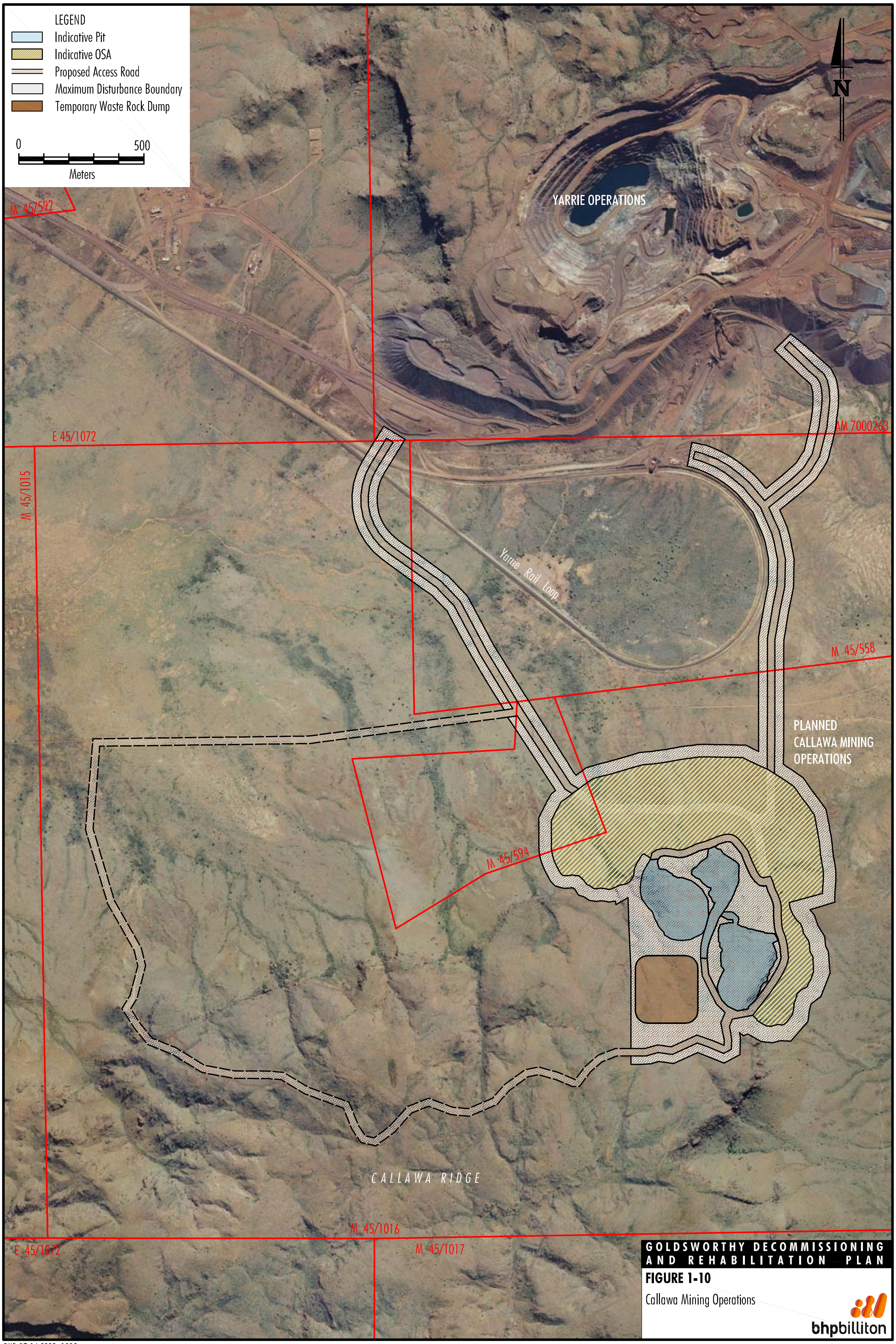

GOLDSWORTHY DECOMMISSIONING AND REHABILITATION PLAN

FIGURE 1-10

Callawa Mining Operations

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The SHW4, SH6W, SHW7 have all been mined in the past, but operations have currently ceased. SHW4 and SHW7 were mined below the watertable. These pits still have remnant ore and as such have not been backfilled. Their associated OSAs are currently undergoing rehabilitation.

1.8.3 Nimingarra

All mining at Nimingarra has currently ceased including Nim A, Nim B North, Nim C, Nim E, Nim F, Nim F East and Nim I. Of these pits Nim A, Nim B, Nim F East and Nim I have been mined below the watertable (Figure 1-6). All pits mined, except for Nim B North, still have remnant ore and as such have not been backfilled. Nim B is currently available for backfilling.

Rehabilitation on the associated OSAs commenced in 1993 and is currently continuing. Laterite and topsoil from the stripping of the push back has been directly placed on the top of the OSA to assist in rehabilitation of the OSAs.

1.8.4 Yarrie

The Y2/3 pit was mined below the watertable and was completed in 2005. Pyritic shale was encountered in this pit and all associated material has been selectively placed and encapsulated in the C-pit in-pit OSA in accordance with the site's Net Acid Generating Material Management Plan, (BHP Billiton Iron Ore, 2004).

The crustal Y7 pits have been mined out and are currently at various stages of backfilling. The crustal Y7D, Y6A and Y6B pits have been mined out and backfilled.

Mining at Yarrie is currently taking place at the Y4 and Y10 and Y6 is proposed to be developed in the next year. The Y10 deposit has been mined below the watertable but will be backfilled to the watertable once completed.

At present all waste from Y10 is taken to the in-pit Y10 OSA, which is being progressively rehabilitated.

1.8.5 Cattle Gorge

Cattle Gorge will be mined approximately 20 m below the watertable, but the pit will be backfilled to at least 5 m above the pre mining watertable level once mining is complete. There are no previously mined pits in the Cattle Gorge vicinity.

1.8.6 Cundaline

Mining of the Cundaline deposit is expected to commence in 2009 and will continue up until 2015. Mining operations will involve development of the Cundaline deposit from two pits. Overburden generated during mining operations will be hauled to mined-out voids for use as infill, or placed in out-of-pit OSAs. Cundaline mining operations may require up to three OSAs.

1.8.7 Callawa

Mining of the Callawa deposit is expected to commence in 2009 and will continue up until 2016. Mining operations will involve development of the Callawa deposit from three pits. Mining is proposed to occur below the watertable. Overburden generated during mining operations will be hauled to mined-out voids for use as infill, or placed in out-of-pit OSAs. Callawa mining operations may require up to two OSAs.

2 LIFE OF MINE PLAN

BHP Billiton Iron Ore plans to use the same open cut mining techniques, ore processing methods and predominantly the same supporting mine infrastructure (with allowance for ongoing maintenance and replacement of worn-out components) over the remaining life of the Goldsworthy operations. The main components of Goldsworthy are as follows:

- open pit mining of overburden and ore;
- dewatering of the orebodies during mining operations, as required;
- placement of overburden in mined out voids and out of pit OSAs;
- processing, loading and rail transportation of ore;
- supply and distribution of power and raw water to meet operational demands; and
- provision of surface infrastructure (e.g. access roads, workshops, administration areas, accommodation village, airstrip).

The life of mine plan presented in the Goldsworthy Extension Project EPS (BHP Billiton Iron Ore, 2005a) and the Cundaline and Callawa EPS (BHP Billiton Iron Ore, 2008a) have been used as the basis for establishing the potential sequence of rehabilitation and decommissioning activities. Planning for mine closure will be undertaken progressively throughout the life of Goldsworthy.

Closure planning for Goldsworthy has been segregated into the following geographical domains:

- Shay Gap open pits, OSAs, stockpiles and associated infrastructure;
- Sunrise Hill open pits, OSAs, stockpiles and associated infrastructure;
- Nimingarra open pits, OSAs, stockpiles and associated infrastructure;
- Yarrie open pits, OSAs, stockpiles and associated infrastructure;
- Cattle Gorge open pits, OSAs, stockpiles and associated infrastructure;
- Cundaline open pits, OSAs, stockpiles and associated infrastructure;
- Callawa open pits, OSAs, stockpiles and associated infrastructure; and
- ore processing infrastructure.

Sections 2.1 to 2.7 describe the current rehabilitation plans for these domains. The level of closure planning varies between the domains due to their development status and proposed decommissioning.

2.1 SHAY GAP

Existing Approvals

Approval for Shay Gap was granted under the *Iron Ore (Goldsworthy-Nimingarra) Agreement Act, 1972*. This pre-dates the enactment of the EP Act in 1986, consequently there are currently no site-specific conditions of approval (including rehabilitation standards) attached to the Shay Gap site that have been issued by the Minister for the Environment.

Disturbed and Rehabilitated Areas

Shay Gap has been rehabilitated to an assessable level.

The Shay Gap townsite and mine infrastructure areas underwent extensive rehabilitation in 1993. Revegetation is flourishing and cattle regularly graze the area.

Open pit mining at Shay Gap ceased in the 1980s. None of the seven pits have been backfilled, as some mineralisation remains in the pit walls/floor and it may become economically viable to mine this material in the future. Due to the substantial distances between the Shay Gap pits and the residual mining activities at the other Goldsworthy deposits (i.e. Nimingarra, Sunrise Hill and Yarrie), BHP Billiton Iron Ore is not proposing to use overburden mined from these areas to backfill the Shay Gap pits in the remaining few years of operation.

All of the pits except SG 5 and 6 were mined below the watertable. The groundwater levels in the pits have now recovered to a point where permanent lakes have developed.

Earthen bunds were erected around the Shay Gap pits in 1993 in order to restrict access and satisfy post-closure safety requirements. No additional rehabilitation works are proposed for these pits, with ongoing activities expected to be restricted to water monitoring in the pit lakes and maintenance of the pit bunds (refer to Section 4).

The Shay Gap OSAs were rehabilitated in a period over 1993 to 1995 as part of a Goldsworthy-wide moonscaping and revegetation programme. The majority of the rehabilitated OSAs appear to be stable, with only minor gullying occurring over the past 10 years. Notwithstanding, there are some parts of the OSAs that require minor remedial work; this is discussed further in Section 5.

The Shay Gap airstrip is located north of the Pardoo/Shay Gap Road near the now rehabilitated village of Shay Gap. The airstrip comprises an all weather airstrip conforming to current regulatory standards. The airstrip will remain in regular use by the fly in–fly out workforce for the duration of the mining operations.

The Shay Gap borefield is located approximately 20 km north of the old Shay Gap village site. The borefield comprises four non-artesian production bores and one monitoring bore in a Wallal sandstone aquifer. Pumping equipment and an electricity substation are also located at the borefield. Water is pumped from this borefield to the Yarrie accommodation village and mine. Again, this will remain in operation for the duration of the mining operations.

2.2 SUNRISE HILL

Existing Approvals

Like Shay Gap, approval for the initial mining of the Sunrise Hill deposits was granted under the *Iron Ore (Goldsworthy-Nimingarra) Agreement Act, 1972*, and pre-dated the EP Act. The mine closure and rehabilitation requirements for Sunrise Hill specified under the *Iron Ore (Goldsworthy-Nimingarra) Agreement Act, 1972* are the same as those described in Section 2.1.

In 1986 a NOI prepared by Goldsworthy Mining Limited (GML) was approved by the Minister for Minerals and Energy. In November 2004 the Minister for State Development approved a variation to the NOI. The NOI and subsequent variation covered the management of environmental aspects associated with a proposed extension of the Goldsworthy mining operations, in particular mining of the Sunrise Hill West and Nimingarra deposits. The NOI (and subsequent variation) did not include any new mine closure or rehabilitation commitments (i.e. in addition to the requirements of the *Iron Ore (Goldsworthy-Nimingarra) Agreement Act, 1972)*.

Disturbed and Rehabilitated Areas

There are thirteen open pits within the Sunrise Hill and Sunrise Hill West mining area. No additional rehabilitation works are proposed for the mined-out pits, with ongoing activities expected to be restricted to water monitoring in the pit lakes and maintenance of the pit bunds (refer to Section 4). Mining of remnant ore is ongoing at the following pits: SHW3, SHW4, SHW7, SH6W and SH4.

The SHW7 pit is currently the largest operating pit at Goldsworthy and mining is expected to continue through 2006. Mining of the SHW3 pit will be completed early in 2005. The majority of the waste rock hauled from this pit is taken to the W4 OSA. Weathered near-surface lateritic material is stockpiled separately for possible later use as a topsoil substitute. Section 4 discusses the proposed use of this material in rehabilitation of mine landforms at the Goldsworthy mining operations.

Bunds have been constructed around all of the mined-out pits at Sunrise Hill and Sunrise Hill West. BHP Billiton Iron Ore will construct additional bunds around the pits that are still active (i.e. SHW7, SHW4 SH1 and SH2) once mining activities cease in these areas. The bunds will be constructed in accordance with the relevant Department of Industry and Resources (DoIR, 1997) guidelines.

Of the mined out pits, only SH8 extended below the watertable. The groundwater levels in this pit have now recovered to a point where a permanent lake has developed. As described in Section 3.4.2, Aquaterra has prepared a groundwater assessment report as part of the Goldsworthy Extension Project EPS (Aquaterra, 2004).

The majority of the available OSAs in the Sunrise Hill and Sunrise Hill West area were rehabilitated in 1993. Like Shay Gap, the moonscaped OSAs appear to be stable with few gullies having developed over the past decade. However, as discussed in Section 2.1, there are differences in the revegetation of the moonscaped OSAs. The ongoing EFA monitoring programme will be used to assess this aspect (refer to Section 4.2).

Once mining is completed there will be a total of six OSAs to be rehabilitated at Sunrise Hill, these being:

- SHW7 W4 OSA;
- SHW4 OSA;
- SHW7 W3 OSA;
- SH6W OSA;
- SHW7 North OSA; and
- SHW5A.

Of these OSAs only the SHW7 W3 and the SHW5A OSAs contain pyritic material, which has been mined out from below the watertable in the SHW7 pit. The location of this material is known, and will be encapsulated within the dumps in a method that will promote successful rehabilitation of the OSAs. This method is described in the Net Acid Generating (NAG) Material Management Plan, (BHP Billiton Iron Ore, 2004) and in Section 3.2.5.

There are also numerous low grade stockpiles in the area. Those that are not reclaimed in the future will also be rehabilitated using the same methods as for OSA rehabilitation. Also requiring rehabilitation in the Sunrise Hill area is the explosives magazine, crib hut and hardstand area, along with a network of haul roads.

2.3 NIMINGARRA

Existing Approvals

Approval for the initial mining of the Nimingarra deposits was granted under the *Iron Ore (Goldsworthy-Nimingarra) Agreement Act, 1972*, and pre-dated the EPA Act. The mine closure and rehabilitation requirements for Nimingarra specified under the *Iron Ore (Goldsworthy-Nimingarra) Agreement Act, 1972* are the same as those described in Section 2.1.

As described in Section 2.2, a NOI for the Nimingarra mine site was approved in 1986. The NOI and subsequent variation in 2004 covered the management of environmental aspects associated with mining the Sunrise Hill West and Nimingarra deposits. The NOI (and subsequent variation) did not include any new mine closure or rehabilitation commitments (ie. in addition to the requirements of the *Iron Ore (Goldsworthy-Nimingarra) Agreement Act, 1972)*, other than that a Decommissioning and Rehabilitation Plan would be presented as a key supporting document to the GEP EPS.

Disturbed and Rehabilitated Areas

Nimingarra has been split into 3 areas:

- Nimingarra Ridge – Mining of a pushback at the Nim B pit is currently taking place and is expected to be complete in 2007. Mining has occurred below the watertable, with waste being taken to the Nim B OSA. Laterite and topsoil from the stripping of the pushback have been directly placed on the top of the Nim B OSA and will be used to assist with rehabilitation. The Nim F-East pit is also currently being mined below the watertable and is scheduled to be complete in 2005. Waste from this pit is being taken to the Nim F-East OSA.

  Aquaterra (2004) discuss the predicted long-term characteristics of the permanent pit lakes that are expected to develop at the Nim B and Nim F-East pits once mining ceases.

  BHP Billiton Iron Ore will construct additional bunds around the Nim B and Nim F-east pits once mining activities cease in these areas. The bunds will be constructed in accordance with the relevant DOIR guidelines.
- Nim A – still has ore remnant ore and as such has not been backfilled. The pit extends below the watertable. The Nim A OSAs were also rehabilitated as part of the 1993 programme.

- Nimingarra Infrastructure - the Nimingarra area comprises the fuel and workshop facilities, offices, haul roads, crusher and train load-out. Again there are several low-grade stockpiles which will also require rehabilitation should they not be reclaimed in the future. A landfill facility and a bioremediation facility also exist at the Nimingarra operations, which will both require rehabilitation.

Like Shay Gap and Sunrise Hill, the majority of the available OSAs in the Nimingarra area were rehabilitated in 1993. The rehabilitated OSAs appear to be stable. On the whole, wherever rehabilitation was undertaken the results were satisfactory, this subjective view has been further confirmed by the quantitative methods recently employed during the recent EFA surveys (see Section 4).

A detailed rehabilitation status report for the Nimingarra area was undertaken in 1998 by BHPIO staff, some 5 years after the completion of rehabilitation works (BHPIO, 1998). This report will be reviewed as per Section 7. The report covered the initial success of the moonscaping operations, in that little erosion was observed. There were also several areas where further rehabilitation works were required such as the old infrastructure area near Nim A.

2.4 YARRIE

Existing Approvals

BHPIO submitted a Consultative Environmental Review (CER) for development of the Yarrie Y2/Y3 deposits under Part IV of the EP Act in 1992 (BHPIO, 1992). Approval was granted by the Minister for the Environment in 1993 subject to the conditions contained in Ministerial Statement of Approval No. 303 (Assessment No. 753). Approval for the proposal was also granted by the Minister for State Development pursuant to Clause 8 of the *Iron Ore (Goldsworthy-Nimingarra) Agreement Act, 1972*.

Subsequent approvals to mine the Y10 deposit in 1995 and the Yarrie crustals (i.e. Y1, Y3N, Y4, Y5, Y6, Y7, Y8W, Y8 and Y9) in 1998 were assessed and approved by the Department of Environmental Protection (DEP) at the level of 'Informal Review with Public Advice', subject to BHPIO adhering to the existing conditions of Ministerial Statement of Approval No. 303, which was issued for the Y2/Y3 mining area.

The overall Proponent Commitments made by BHP Billiton Iron Ore in the CER (BHPIO, 1992) with regard to decommissioning and rehabilitation at the Yarrie operations are presented below.

> *Rehabilitation*
>
> *Procedures developed by BHP in the Pilbara will be applied to rehabilitation at Yarrie. The object of the rehabilitation will be to ensure that, at the end of the Project, all disturbed surfaces (with the exception of the mine pits) are returned to a stable condition with a flora and fauna which approaches the natural condition of the site.*
>
> *Decommissioning*
>
> *Following completion of the project, buildings and other structures will be removed. Concrete slabs will be broken up and buried. The rehabilitation of the overburden will be completed. Remaining borrow pits will be rehabilitated. All unwanted bare or compacted areas will be contoured (where necessary), ripped and seeded. Monitoring of the rehabilitated areas will be undertaken to gauge success. This monitoring will continue until the vegetation is seen to be progressing towards a condition similar to which existed before mining.*

Yarrie Pit Long-Term Salinity

BHP will continue to monitor the salinity of water in the Goldsworthy pit for several years to determine the future likelihood of saline water seeping from the pit into the De Grey River aquifer. The results of this monitoring will be used to formulate management strategies for the Yarrie pit if necessary.

Disturbed and Rehabilitated Areas

Yarrie has been split into three areas:

- Y2/3 Pit Area and OSAs – mining commenced in 1993 and was completed in 2004. The pit void will be rehabilitated to the standards described in Section 3.2.3. There are two out-of-pit OSA' that require rehabilitation; the W1 and W6 OSAs. However, since reshaping of these OSAs to the standards specified in Section 3.2.4 will require the removal of infrastructure that is still required. As a result neither of these can be completely rehabilitated until all mining operations in the Yarrie area cease.

  Some pyritic shale was encountered in the Y2/3 pit during operations and was selectively placed and encapsulated in the C-pit in-pit OSA in accordance with the site's Net Acid Generation (NAG) Material Management Plan (BHP Billiton Iron Ore, 2004a). A description of how the material has been capped and the final rehabilitation concept for this in-filled pit is presented in Section 3.2.5.

- Crustal pits and Y10 - Crustal pits at Yarrie that have been mined-out and backfilled with overburden include the Y7D, Y6A and Y6B pits. Most of these pits have not yet been topsoiled and revegetated as they are being used as storage areas for lateritic material, which has the potential to be used as a growth medium in the future.

  Mining at Yarrie is currently taking place in several crustal ore pits (i.e. Y7B, Y8A, Y8B and Y8C) and the Y10 conglomerate ore pit. Mining of these deposits is expected to be completed in 2006, with all waste being used to backfill mined-out crustal pits. Mining at Y10 is scheduled to continue into 2006, and a small portion of the Y10 deposit will be mined below the watertable. This part of the Y10 pit will be backfilled with waste rock so that the base of the final void is above the pre-mining watertable (i.e. a pit lake will not develop). At present all waste from the Y10 pit is taken to the in-pit Y10 OSA, which is being progressively rehabilitated.

  Residual mining at Yarrie will comprise extraction of the remaining ore at the approved Y7, Y8 and Y9 crustal pits. These, along with the Y10 conglomerate pit are scheduled to be productive until 2006. An extension to the existing Y4 pit outside the ML249SA lease boundary is also proposed, subject to BHP Billiton Iron Ore obtaining a new mining lease and the necessary environmental approval under Part IV of the EP Act. Section 3.2.3 describes the conceptual closure plan for this area.

  The scheduling of the residual mining at Yarrie is such that the majority of pits will be backfilled, however it is expected that final voids will remain at Y4, Y7 and Y9 at mine closure. Parts of the Y10 pit will continue to be used for in-fill dumping, however it is expected that it will not be completely in-filled and a void will remain following mine closure. Where practicable, these final voids will be re-profiled by pushing down the upper batter(s) to form a more-rounded landform. The pit voids and backfilled pits will be rehabilitated to the standards described in Sections 3.2.2 and 3.2.3.

  EFA monitoring sites have been established at Yarrie and will be used to evaluate the revegetated landforms (refer to Section 4).

- Yarrie Infrastructure - the infrastructure at Yarrie includes a crusher and train load out facility, workshop, hardstand and fuel facilities, an explosives magazine and yard, offices and the accommodation village. Other zones at Yarrie that will require rehabilitation are the tyre dump, landfill facility and bioremediation facility.

2.5 CATTLE GORGE

Existing Approvals

BHP Billiton Iron Ore submitted an EPS for the Goldsworthy Extension Project in 2005 (BHP Billiton Iron Ore, 2005a), which included the proposal to develop Cattle Gorge. The proposal was subsequently approved and Ministerial Statement of Approval No. 000682 was granted on 11 August 2005.

Disturbed and Rehabilitated Areas

Mining operations at Cattle Gorge commenced in 2005 and are currently still operational. Cattle Gorge will be mined to approximately 20 m below the watertable, but the pit will be backfilled to the pre-mining watertable level once mining is complete. Rehabilitation of the resulting pit void and OSA will be consistent with the principles presented in Sections 3.2.2, 3.2.3 and 3.2.5.

2.6 CUNDALINE AND CALLAWA

Existing Approvals

An EPS was submitted for the proposal to develop the Cundaline and Callawa deposits in 2008 (BHP Billiton Iron Ore, 2008a). At the time of preparing this DRP, the EPS was currently under stakeholder review.

Disturbed and Rehabilitated Areas

Mining is scheduled to commence in late 2009 and be completed by the end of 2015 at Cundaline, and commence in late 2009 and be completed by the end of 2016 at Callawa.

2.7 ORE PROCESSING INFRASTRUCTURE

The existing ore processing and rail facilities at Goldsworthy may remain operational after mining activities at existing approved Goldsworthy areas have ceased, in order to handle ore from other deposits within the region. Planning for the closure and decommissioning of these facilities will be undertaken throughout the life of the facilities in consultation with Department of Environment and Conservation (DEC) and Department of Industry and Resources (DoIR), and in accordance with the requirements of the relevant approvals. Methods and procedures for the rehabilitation of these facilities are described in Section 3.

3 REHABILITATION AND SUCCESS CRITERIA

3.1 RISK ASSESSMENT

BHP Billiton Management Standard 3 requires the application of Health, Safety, Environment and Community (HSEC) Management Standards risk management processes in order to prioritise and manage risks and to drive continuous improvement in HSEC performance. People with relevant knowledge and experience, including employees, contractors and other stakeholders are involved in the HSEC risk assessment process. Evaluation of identified risks is undertaken by the level of management that is consistent with the significance of the risk. HSEC risks are reviewed annually (at a minimum) and are recorded and maintained in a risk register.

The primary objective of the BHP Billiton Iron Ore environmental risk assessment and management system is to minimise environmental risk in all aspects of its operations. The risk assessment process and the development of a risk profile are undertaken in accordance with BHP Billiton's Enterprise Wide Risk Management (EWRM) Policy, the BHP Billiton Iron Ore Risk Management Guidelines, and the BHP Billiton Sustainable Development Policy, HSEC Management Standards and Guidance Notes. The risk standards have been developed in accordance with Australian and New Zealand Standards (AS/NZS) 4360 and International Standards Organisation (ISO) 14001.

Risk management is recognised as an integral part of good management practice. It is an iterative process consisting of steps, which when undertaken in a sequence, enable continuous improvement in decision making. The main elements of the risk management process are as follows:

- establish the context;
- identify risks;
- analyse risks;
- evaluate risks;
- control risks;
- monitor and review; and
- communicate and consult.

BHP Billiton's Closure Standard (BHP Billiton, 2004a) requires risk assessments to be conducted for all of its operations in order to prioritise and manage risks. The most recent mine closure EWRM assessment of Goldsworthy was carried out in September 2008.

The risk assessment process was used to identify and assess the potential closure-related risks associated with Goldsworthy. The risk assessment identified several risk issues which related to one or more of the following:

- groundwater management;
- surface water management;
- contaminated sites;
- revegetation performance;
- landform reconstruction; and
- public access.

The risk assessment was used to identify and evaluate the potential closure-related risks associated with Goldsworthy, with the findings being incorporated into this revision of the DRP, where appropriate. For each issue a summary of the potential causes, impacts, existing control measures and risk assessment scores was completed.

Where appropriate this DRP includes a description of how these aspects would be subject to ongoing control as part of the Goldsworthy environmental and closure management system.

3.2 STANDARD REHABILITATION PROCEDURES

BHP Billiton Iron Ore has developed and implemented standard rehabilitation procedures for 'Earthworks', 'Surface Treatment' and 'Revegetation', which it uses across its Pilbara mine sites and other areas where appropriate. Rehabilitation and revegetation of the final mine landforms, infrastructure and support facilities will be conducted in accordance with these procedures. A description of each is provided in Sections 3.2.1 to 3.2.3.

3.2.1 Earthworks

The BHP Billiton Iron Ore Mining Operations OSA Rehabilitation Manual describes the rehabilitation earthworks required for OSAs across BHP Billiton Iron Ore's Pilbara mining operations. It has been prepared to provide a consistent methodology based on previous rehabilitation success and identified issues. The results of rehabilitation monitoring are assessed for performance and are used to adjust and refine this methodology in accordance with BHP Billiton Iron Ore's adaptive management approach.

Rehabilitation earthworks aim to re-profile the land surface to be similar to existing regional landforms, within the constraints imposed by the physical nature of the materials, in accordance with the Guiding Closure Principles.

Earthworks consist of reshaping the slope. Ideally this will be 15° to 18°, however, the type of material used ultimately determines slope stability and therefore final gradient. Finer materials will generally be used at lower gradients (ie. 15°) and rockier material may be used at gradients greater than 20°.

OSAs typically require the creation of a compacted bund approximately 1 m high and 5 m wide along the crest of the OSA to prevent surface water runoff down the slopes of the OSA. This reduces erosion and the likelihood of OSA slope failure.

Earthworks for the construction and rehabilitation of borrow pits will be conducted in accordance with the BHP Billiton Iron Ore Borrow Pit Management Manual.

Experience gained from the performance of rehabilitation at BHP Billiton Iron Ore's other operations has shown that operator ability is a key determinant of successful rehabilitation across a range of rehabilitation techniques (Section 4.1). As a result, one of the selection criteria for rehabilitation operators will be their understanding and interest in environmental requirements.

3.2.2 Surface Treatment

A number of surface treatments may be used, depending on the size and nature of the rehabilitated area. For example, large areas with a rocky surface typically require a greater amount of surface treatment (eg. OSAs) than a small area with residual topsoil on the surface (eg. the Office and Workshop Area). The surface treatments used for rehabilitation areas at the Project have been developed to satisfy the Guiding Closure Principles and may consist of one or more of the following:

- deep ripping of compacted surfaces;
- selective application of topsoil material (or alternative media) to provide a medium for plant growth and to provide a natural seed source;
- surveyed contour ripping of surfaces following the application of soils to maximise water infiltration and enhance revegetation success;
- scalloping (moonscaping) of surfaces following the application of soils to maximise water infiltration and enhance revegetation success; and
- selective placement of timber (if available) and/or boulders across the re-profiled surface and/or constructing rocky cliff features to provide additional habitat areas for fauna species recorded prior to mining.

Surface treatment procedures for the rehabilitation of borrow pits are provided in the BHP Billiton Iron Ore Borrow Pit Management Manual.

A key component of surface treatment is the selective application of topsoil material. Prior to use in rehabilitation, topsoil is stripped and stored (if required) in accordance with the procedures outlined in the BHP Billiton Iron Ore Topsoil Management Manual. Topsoil stripping will be incorporated into mine planning to ensure that topsoil is removed and stored in appropriate locations. The Manual provides general information on soils of the Pilbara region and methods for soil stripping, soil stockpiling and topsoil use in rehabilitation.

Direct placement of topsoil onto rehabilitation areas is preferable. If direct placement is not possible, soil will be stockpiled in low mounds, ideally no more than 2 m high to maintain biological activity. Compaction of the topsoil stockpiles will be minimised by building from the edge (rather than the top of the stockpile), deep ripping and spreading stripped plant material to encourage revegetation. Revegetating the stockpiles will also minimise dust, erosion and weed establishment.

3.2.3 Revegetation

The BHP Billiton Iron Ore Purchase of Seed and Formulation of Seed Mixes for Rehabilitation across BHP Billiton Operations Manual describes the types of seed species mixes and seeding rates that BHP Billiton Iron Ore uses at its Pilbara mining operations. This mix can be adapted to suit the particular characteristics of the site through BHP Billiton Iron Ore's adaptive management approach. The manual also lists appropriate seed vendors which collect seed from the Pilbara region and requires the Environmental Advisor to plan for the purchase of seed well in advance of use in rehabilitation activities.

Revegetation at Project will use local provenance native seed (ie. ideally from the local area, then from the relevant IBRA subregions, but as a minimum from the relevant IBRA regions) consistent with vegetation associations and native species recorded in the Project area prior to mining. Where it is not possible to source seed from the relevant IBRA subregions, consultation with DEC will be conducted to determine the most appropriate seed sources for the Project within the relevant IBRA regions.

To promote vegetation density, species diversity and plant age heterogeneity, additional seeding (or planting) in subsequent years will be conducted following initial seeding of rehabilitation areas.

Two rainfall periods occur in the Project area, one from January to March and the other from May to August. The most reliable rainfall period occurs from January to March. Accordingly, revegetation activities will be completed during November and December, where practicable.

Revegetation Strategies

The vegetation associations of the Project area are described in the Significant Species Management Plan (SSMP). The objective of the rehabilitation programme will be to develop similar vegetation on the post-mining landforms where practicable. Research will be required to determine the most successful, efficient and cost effective method of undertaking this task.

The majority of the landform development will be carried out as a normal part of overburden removal and placement during the mining operations. Some final shaping of landforms will be needed to establish drainage lines and place selected materials in the required positions to protect those drainage lines against erosion. Topsoil recovered during mine development will then be placed on the final landform.

The revegetation programme will aim to re-establish local native vegetation that is appropriate to the environmental characteristics of the final mine landforms and the agreed final landuse in accordance with the Guiding Closure Principles.

The main components of the revegetation programme are:

- re-profiling of the land surface to blend in with surrounding landforms;
- deep ripping of compacted surfaces;
- selective application of topsoil material (where available) to provide a medium for plant growth and to provide a natural seed source;
- ripping of surfaces following the application of soils to maximise rainfall infiltration and enhance revegetation success;
- application of local provenance native seed (ie. ideally from the local area, but at a minimum from the relevant IBRA regions) consistent with vegetation associations and native species recorded in the Project area prior to mining; and
- selective placement of timber (if available) and/or boulders across the reprofiled surface to provide additional habitat areas.

A washdown/quarantine procedure for all machinery operating on-site will be used in order to minimise the introduction and spread of weed species whilst rehabilitation activities are undertaken.

A large proportion of the final surfaces of the mine voids and OSAs will have slope profiles and soil characteristics that are equivalent to the naturally occurring landforms found in the area. These areas will include the top surfaces of the OSAs and the flat to gently undulating 'benches' within the mine voids. The revegetation objective for these areas will therefore be to re-establish communities that are generally comparable with their vegetation associations (described in the SSMP). Selection of suitable species for revegetation programmes will be undertaken in consultation with DEC.

In addition to the above general revegetation strategies, consideration will be given to the use of species of conservation significance within the revegetation programme in the event that proposed disturbance areas will affect known populations of significant plant species (i.e. where the disturbance can't otherwise be avoided). The practicalities of propagation and revegetation techniques for these species will be investigated where appropriate in consultation with DEC.

Revegetation areas will be monitored on a regular basis to assess the performance of a particular revegetation technique, with the results used to further refine the rehabilitation programme. Monitoring of rehabilitation is summarised in Section 4.2.1.

Where practicable, the return of wildlife into rehabilitated areas will be encouraged through the incorporation of habitat features. These may include, but are not necessarily limited to the following:

- creation of rock piles in OSAs and/or mine void areas to provide potential habitat opportunities for reptiles and mammals;
- creation of rocky cliff features, which may include small hollows and cracks suitable for reptiles and mammals; and
- return of vegetation debris, logs and rocks to areas which have been disturbed to provide microhabitats for recolonising fauna.

3.3 DISTURBED AND REHABILITATED AREAS

All occurrences of landform disturbance at Goldsworthy have been designated to a particular category of disturbance which require different rehabilitation methods, these are:

- growth media stockpiles;
- final pit voids;
- backfilled pits;
- OSAs;
- pyritic shale dumps;
- low grade stockpiles;
- existing rehabilitation areas;
- heavy infrastructure areas (eg. workshops, ore processing);
- light infrastructure areas (eg. carparks, offices, crib rooms);
- haul roads; and
- exploration areas (eg. drill pads, tracks).

General methods of rehabilitation for each landform type are presented in Section 3.3.1 to 3.3.9.

3.3.1 Growth Media Stockpiles

Prior to ground disturbance works, all topsoil is recovered and stored in accordance with the Topsoil Management Manual (BHP Billiton Iron Ore, 2003). Where practicable, topsoil will be used immediately in the rehabilitation programme, however direct use may be limited due to the shortage of areas that are expected to become available for progressive rehabilitation (as a result of the rehandling of OSAs to facilitate the backfilling of the pit voids). Where required, the temporary topsoil stockpiles would be located adjacent to the disturbance areas and would be separated into the main soil types. Section 4.2.4 of the Cundaline and Callawa EPS (BHP Billiton Iron Ore, 2008a) describes the management measures that would be used to manage the stripping and re-use of topsoil.

Once topsoil or growth media stockpiles have been reclaimed, the underlying disturbance footprint will be rehabilitated in accordance with the Guiding Closure Principles.

There is a recognised shortage of topsoil resources at the operations, due to sub-optimal topsoil management practises occurring in the past. This shortfall is being addressed through the identification and recovery of other suitable growth media.

Several of the current mining areas have screenable material and or laterite stockpiles. This material has potential to be used as a topsoil substitute. This is discussed further in Section 4.1.

The topsoil resource will be deployed such that the higher risk areas (such as OSA slopes) will receive topsoil in preference to the lower risk flat areas, which will instead receive other types of growth media where possible.

3.3.2 Final Pit Voids

Most of the overburden mined is taken to OSAs, as the steeply dipping nature of the orebodies, does not allow for simultaneous backfilling of the pits. As a result of this final pit voids will remain when mining is complete.

In accordance with the Guiding Closure Principles, residual pit voids will be left as mined where geotechnically stable, and profiled as necessary to achieve long-term closure objectives. Mine batters will be retained as rocky walls within the mine voids at the angle created during the mining process (i.e. sub vertical). These features within the void generally range in height from 1 to 2 m up to 36 m and would be comparable to natural cliffs and rocky slopes widely found in the Pilbara. The overall final landform concept for the mine voids is for a stepped landform which contains a combination of flat/undulating surfaces with connecting sloped ramps interspersed with elongated rocky scarps. The final design may include ramps and sloped areas so as to facilitate safe entry to the pit voids (eg. for post-closure monitoring). In areas where the pit crest is highly visible from the plain level, the crest of the pit may be re-contoured to provide a softer profile. In some areas of the final mine voids 'pit lakes' will develop where the post closure equilibrium level of the aquifer is higher than the base of the pit. Section 3.4 discusses the pit lakes in more detail.

Final mine voids will also occur at some crustal pits. These voids will typically have a maximum depth of 30m and will not extend below the watertable. It is intended that the batters of the crustal pit voids will be reprofiled where possible. This will result in the pit becoming a local depression, which when rehabilitated will be relatively unnoticeable from the natural topography. It also has the advantage of removing the safety hazards associated with pit voids. The resulting landform will then have topsoil applied where available and be deep ripped prior to seeding. Figure 3-1 shows a simulation of the landforms that will be created in the crustal pit voids.

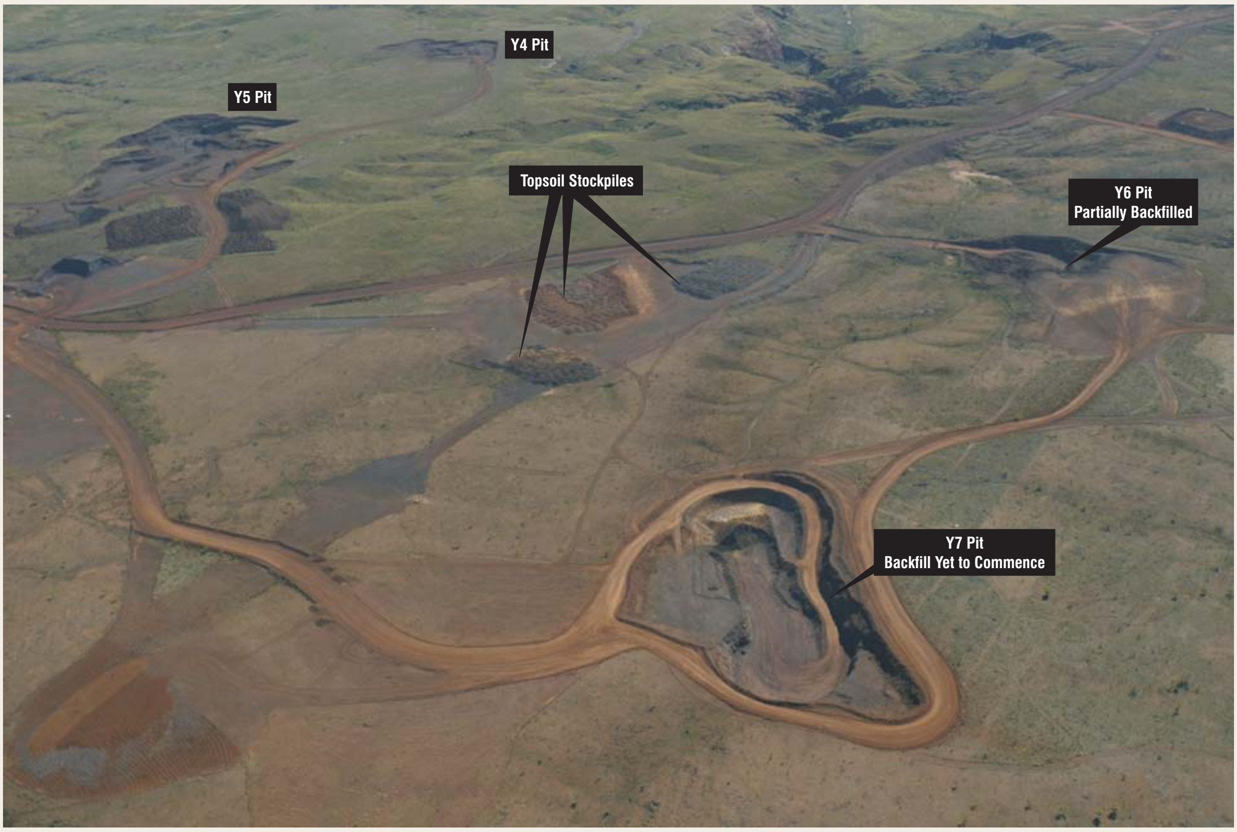
In accordance with Section 3.5.2 of *Mine Rehabilitation* (Department of Industry Tourism and Resources, 2006b), all open pits will be made safe prior to decommissioning. Safety bunds will be established around the final pit walls. The bunds will be a minimum 2 m high with a base width of minimum 5 m and constructed at least 10 m away from the edge of the area known to contain potentially unstable rock mass as per DoIR recommended practice (DoIR, 1997).

3.3.3 Backfilled Pits

Pits have been backfilled where operationally feasible; in particular this has and will continue to occur in the crustal pits. These pits have been backfilled to create a topography similar to the original topography of the area. Figure 3-1 is a photo taken in June 2004 of the backfilled Y6A pit, partially backfilled Y6B pit and yet to be backfilled Y7A pit. Also shown is a post-closure visual simulation of the same area following the completion of backfilling and revegetation of the site. As depicted in the simulation, some of the existing roads would be retained to provide ongoing access for monitoring and maintenance purposes.

The Y10 OSA is a backfill OSA within the Y10 pit. Parts of the Y10 OSA have been progressively rehabilitated as they have become available. The upper batter of the dump was re-profiled to a final slope of approximately 9^{o}, seeded, but not ripped in 1998. The mid batter slope of the OSA has an overall slope of approximately 13^{o} and was contour-ripped and seeded in 2003. The rest of the Y10 OSA will be rehabilitated progressively during the remaining mine life and/or following closure to the standards described in Section 3.3.4.

Figures 3-2 and 3-3 are photographs of rehabilitated parts of the Y10 OSA in 2004 and in 2008, respectively. EFA monitoring sites have been established at Yarrie and will be used to evaluate the revegetated landforms (Refer to Section 4.2). Other areas that will have backfilled pits on closure are Nim I, Nim B North and Nim C. Again, these will be profiled such that they blend in with the original topography of the area.



Aerial Photograph of Active and Partially Backfilled Yarrie Crustal Pits (June 2004)

Visual Simulation of Yarrie Crustal Pits
Showing Backfilled and Rehabilitated Pits

GOLDSWORTHY DECOMMISSIONING AND REHABILITATION PLAN

FIGURE 3-1
Crustal Pit Void Simulation

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Figure 3-2: Y10 OSA Rehabilitation 2008

Figure 3-3: Y10 OSA Rehabilitation 2004

Growth media will be applied where available, prior to deep ripping of the compacted top of the backfill. Seeding with a native vegetation mix will occur once all earthworks are complete.

BHP Billiton Iron Ore will monitor the stability and revegetation success of the rehabilitation beyond the closure of the Goldsworthy operations, incorporating new rehabilitation into the existing EFA programme.

3.3.4 Overburden Storage Areas

General design concepts for the out-of-pit OSAs are as follows:

- Drainage on the tops of the ridge will be diverted such that the major flow is towards a natural drainage feature rather than the top of the OSA.
- The tops of the dumps will be constructed such that they will harvest water and have perimeter bunds to minimise the flow of water onto the OSA slopes and prevent the ponding of water on the edge of the OSAs.
- The slopes of OSAs will be reshaped from an angle of repose to approximately 15 degrees (where possible).
- The outer slopes of the OSAs will be treated to increase the surface roughness to minimise erosion and provide microenvironments for vegetation.
- Slopes that have vertical heights of over 40 m may require mid slope berms to be constructed to reduce the flow of any surface run-off.
- The berms created in the above process will be constructed such that they slope back away from the slope crest.
- Where necessary drainage features such as cut-off drains will be incorporated onto the tops of berms to stop water running down the slopes and causing erosion.
- Where there is potential for sediment discharge, sediment traps will be constructed downstream of mining activities.

Moonscaping has been extensively employed on the OSAs rehabilitated to date, throughout the Shay Gap, Sunrise Hill and Nimingarra areas. The results achieved have been successful, in that little erosion has been observed and that vegetation is growing on the slopes. However, the success of moonscaping operations is highly dependant upon the accurate construction of the interlocking scallops. Therefore, before further large scale OSA rehabilitation is undertaken, different un-tested methods should be trialled, which lend themselves to the blocky material present within the Goldsworthy operations.

A trial commenced during the 2004/2005 wet season to assess the effectiveness of different surface treatments on the materials commonly found in all of the domains at the Goldsworthy operations.

BHP Billiton Iron Ore will monitor the stability and revegetation success of the existing rehabilitated OSAs and all rehabilitation trials during the remaining life of Goldsworthy. The design of any future OSAs will also take into consideration the success of design features and overall performance of these existing dumps and trials over time.

The future pits that are part of the Cundaline and Callawa mining operations will incorporate backfilling where economically viable; this may involve the creation of temporary OSAs.

3.3.5 Pyritic Shale Dumps

Pyritic shales have been encountered below the watertable in the Yarrie Y2/3 pit and the SHW7 pit. Pyritic shales are not expected to be encountered elsewhere. The management of these materials during operations and post closure is described below.

Yarrie

In 1997, an evaluation was conducted to determine suitable sites for the long term storage and encapsulation of Net Acid Generating (NAG) materials. The results of this evaluation identified B and C pits within the eastern section of the Y2/3 deposit as the best location.

A hydrogeological assessment by Woodward-Clyde (1997) revealed that C pit is bounded on all sides by low permeability rocks, which are above the regional groundwater table. Consequently, there is very little potential for leachates (if generated) to impact on the groundwater. Further evaluation of the area also has indicated that B pit (immediately adjacent) possesses similar characteristics, however this pit is on the hydrologic divide with the main pit.

Prior to placing NAG material into C Pit, the floor was covered with a 1 m layer of compacted gravel to create an inert compacted barrier and capillary break between the NAG material and the base of C pit. When backfilling commenced at the C-pit the area became known as the W9 OSA. NAG material was then progressively placed into B and C Pits as it was mined from the pit. To minimise exposure of the materials to significant rainfall events, inert overburden was periodically placed over the NAG material to progressively encapsulate it.

Dumping of NAG material into B and C pit was completed such that sufficient volume was left for the placement of an inert cover (greater than 5m) over the NAG material (Figures 3-4 and 3-5). To minimise potential water flow into B and C Pit from other areas, a permanent windrow has been built around the pit perimeter.

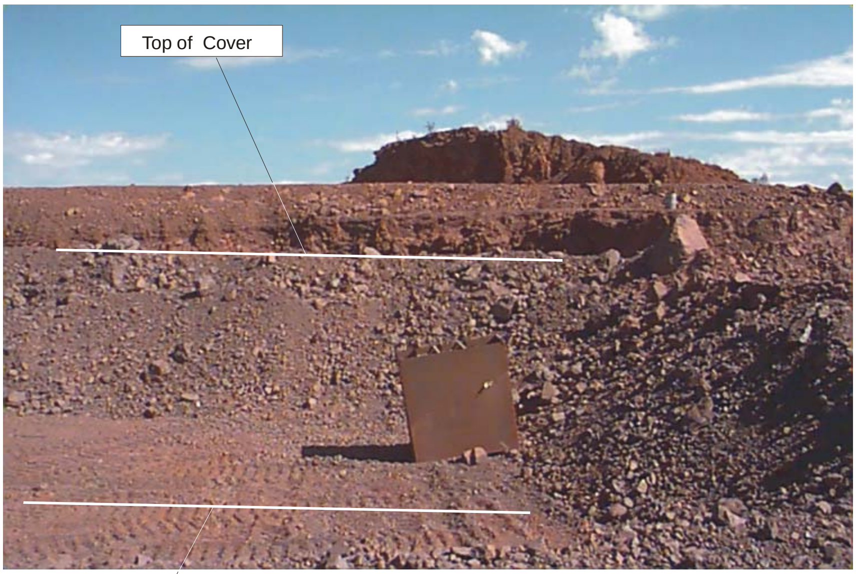
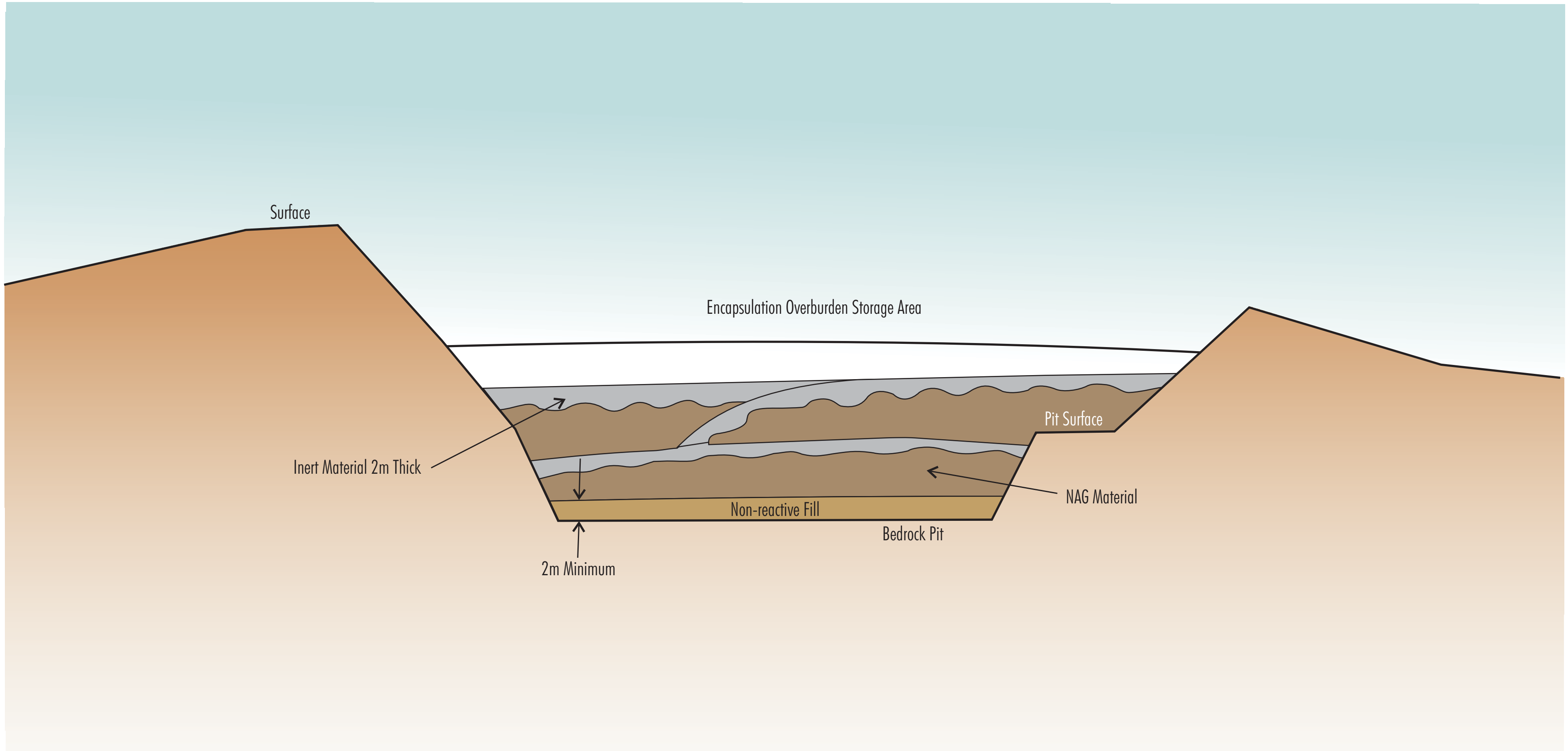


Figure 3-4: NAG Material Management Strategy (Profile of the C-pit NAG dump – showing the application of the 10 metre thick inert store and release cover).



Not to Scale

GOLDSWORTHY DECOMMISSIONING AND REHABILITATION PLAN

FIGURE 3-5
Profile of C-Pit NAG Dump

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With the management practices currently in place, in combination with the high stability of the B and C pits, it is expected that the potential NAG impacts on the surrounding environment will be minimal in both the short and long term.

SHW7

Based on current industry best practice for NAG storage, the success of in-pit storage at Yarrie and the small volumes of NAG material expected at SHW, a location for in-pit storage of NAG material near the SHW7 pit was selected in 2004.

A number of mined out pits located on top of the Sunrise Hill – Shay Gap ridge east of SHW7 were evaluated against the following selection criteria:

- enough volume to accommodate all potential NAG material, including allowance for 100% dilution and inert surroundings;
- no resource potential (i.e. Pit considered “mined out”);
- no new land disturbance required (including haul route);
- topography generally draining away from the location;
- economic haul distance from SHW7 pit; and
- knowledge of proximity to watertable.

Pit SH5A, located within 3 km of SHW7, was the nearest pit void that satisfied the above criteria. As such, Pit SH5A was designated the approved storage location for NAG material mined from the SHW7 pit.

NAG material is progressively placed into the SH5A mined out pit void. To minimise exposure of the materials to significant rainfall events, inert overburden is periodically placed over the NAG material to progressively encapsulate it. Dumping of NAG material into SH5A pit will be such that sufficient volume will be left for the placement of an inert cover (greater than 5m) over the NAG material.

To minimise potential water flow into SH5A pit from other areas, a permanent windrow has been built around the SH5A pit perimeter.

Management Strategy

Research (O’Kane *et al*., 1998, 2000) conducted in the Pilbara indicates that infiltration into the NAG materials by surface water does not occur. Instead, these encapsulated covers form a “store and release” system to minimise contact with the underlying NAG material, thus preventing the generation of ARD. With management practices currently in place, it is expected that, in line with the stability of the NAG approved storage locations, potential NAG impacts on the surrounding environment in the long and short term within the area will be minimal.

Currently, the long-term management strategy is to infill the pit voids (C pit and SH5A) from the east to the west to a height approximately 10m below the crest of the pit void. The rest of the pit will then be in filled with Banded Iron Formation (BIF) material to a height of 4 -5m, back sloping to the east of the pit (Figures 3-3 and 3-4). This will ensure that any surface water flows will drain to the back of the pit, rather than down the face of the in-pit slope.

The in-pit slope resulting from the infilling operation will be covered with a minimum of 4 m of BIF. The surface will be stabilised using appropriate earthworks. Standard topsoiling and seeding programmes will then be implemented over the cover surfaces to assist with the re-establishment of native vegetation.

3.3.6 Low Grade Stockpiles

Mining associated with Goldsworthy has resulted in the generation of a number of low grade ore stockpiles. These stockpiles will be active throughout the mine life, as it is likely that low-grade ore will be both added and removed depending on ore blending requirements. Market demand will determine how much, and when, it is viable to process the low grade material. BHP Billiton Iron Ore will endeavour to sell and remove all material in the low grade stockpiles prior to, or at the end of the mine life. In the event that this material is not able to be sold, BHP Billiton Iron Ore will re-profile the stockpiles (using a landform design similar to the out-of-pit OSAs) and rehabilitate them in accordance with the Guiding Closure Principles.

If the stockpiles are processed, the footprint of the stockpile will be rehabilitated in accordance with the Guiding Closure Principles.

3.3.7 Existing Rehabilitated Areas

Significant rehabilitation works were carried out at Nimingarra, Sunrise Hill and Shay Gap in between 1993 and 1995. All OSAs (that existed at the time) were rehabilitated using a moonscaping technique. The rehabilitation of these areas is considered to be generally successful, as supported by recent EFA monitoring, which has shown that the vegetation is steadily recovering.

Rehabilitation (moonscaping) was also undertaken in the partially backfilled areas of some mined out pits and of the infrastructure areas for the Shay Gap Crusher and townsite.

Rehabilitation activities limited to backfilled crustal pits at Yarrie, the Y10 OSA (Figure 3-2) and minor works on old access roads.

All of the above mentioned areas are part of the current EFA programme and will continue to be monitored beyond closure of the Goldsworthy operations.

3.3.8 Infrastructure Areas and Haul Roads

The decommissioning process will typically involve the removal of infrastructure for off-site reuse, recycling, or where possible resale, in agreement with the State Agreement Acts and stakeholders. Once the infrastructure is removed, the land surface will be reprofiled where necessary to integrate with the surrounding topography, prior to topsoiling and revegetation.

Prior to decommissioning, land contamination assessments will be undertaken in accordance with the requirements of the DEC and relevant technical guidelines. In areas where the potential for soil contamination is identified (e.g. areas where the use and storage of process chemicals, explosives, fuels and/or lubricants took place) soil samples will be taken and analysed. Any potentially contaminated soils identified by this assessment will be managed in accordance with DEC requirements. Sampling and analysis will then be undertaken to confirm the performance of the contaminated soil management measures.

Haul Roads

Haul roads that have not been progressively rehabilitated during the mine life will be re-profiled (including removal of portions of haul road embankment where necessary) to blend in with surrounding topography. Where necessary, road surfaces will be re-profiled to allow free drainage and minimise interference with surface flows. Surface treatment and revegetation will be implemented to achieve the Guiding Closure Principles.

Infrastructure Areas

Following the removal of infrastructure, re-profiling of the land surface and land remediation (if necessary), the following surface treatment works will be implemented:

- deep ripping of hard surfaces that do not require re-profiling;
- application of soils (topsoil or otherwise) to a depth of up to 100 mm (depending on available soil resources) to provide a growth medium;
- light ripping, as appropriate, of surfaces to maximise rainfall infiltration, reduce erosion potential and enhance revegetation establishment;
- application of native seed; and
- erection of sediment traps (or equivalent) where required to reduce the potential for the migration of sediments.

Rail Infrastructure

At the completion of mining operations at the Project, rail infrastructure (including rail loops and spur lines) that are not required for adjacent mining operations will be decommissioned in the following manner:

- rail infrastructure will be removed, including lines and sleepers;
- where concrete sleepers have been used these will be broken up and placed within areas of general backfill or buried *in-situ* to a minimum depth of 1.5 m below the rehabilitated surface; and
- rail corridors (including removal of portions of rail embankments where necessary) will be reprofiled to blend in with surrounding topography.

The decommissioning of rail corridors will involve consideration of the design discharge, durability and long-term stability of culverts and other surface water management measures. Rail embankments will be removed or surface water management measures enhanced if the existing embankment would result in significant adverse impacts on surface water drainage or quality in the long-term.

3.3.9 Exploration Activities

Exploration areas which will not be subsequently mined within five years will be rehabilitated by breaking up any compaction, re-applying topsoil as required, and ripping and seeding. Areas in which a substantial amount of regrowth is evident will be individually assessed to determine if there would be any additional benefit from remediation.

Remaining drill holes will be capped to prevent fauna deaths and residual rubbish in the area will be removed.

3.4 WATER RESOURCES

3.4.1 Surface Water

The Goldsworthy area is located in a hot, persistently dry desert climate. Rainfall is low and variable, and evaporation is very high. The extreme climate imposes severe stresses on vegetation growth, to the extent that the achievable level of vegetation cover can be expected to have only a relatively small effect on runoff-induced erosion rates from the post-mining landform.

Runoff in the Goldsworthy area, even from hard, rocky, hillside catchments, typically occurs only sporadically, and in response to occasional high intensity rainfall events, or in response to rare, extended sequences of wet days.

Surface Drainage and Runoff

Surface drainage issues as they affect mine closure at Goldsworthy are mostly related to the OSAs that are designed as flat-topped, steep-sided landforms for economic reasons. Even where deliberate placement control or reshaping is invoked to produce more rounded shapes, there will generally be separate “top” and “face” areas on the final landform, with quite different hydrological characteristics.

Top Surfaces

Trials of top surface OSA treatments at Goldsworthy and other BHP Billiton Iron Ore Pilbara mines have successfully produced stable, erosion resistant landforms conducive to revegetation of native species. Key features of these designs are:

- bunding around the perimeter and shaping of the outer top surface to contain all water on top of the OSA;
- creation of internal bund walls (“cells”) to further restrict the movement of water on the top surface; and
- light ripping, topsoiling and seeding.

Where appropriate, the OSAs at Goldsworthy will adopt these features in the rehabilitation programme.

Sloping Surfaces

BHP Billiton Iron Ore’s experience at Goldsworthy and its other Pilbara mines has indicated that attempts to prevent runoff from OSA faces by large-amplitude surface roughness features (eg. interlocking contour banks or moonscaping) can fail in high rainfall events where there is not a high proportion of coarse, cobble sized material on the outer face. Runoff from OSA faces needs to be accepted and controlled but runoff from surfaces behind the OSA faces should not be permitted to flow onto the face in an uncontrolled manner.

OSA face drainage issues can be subdivided into:

- Immediate, unchannelised runoff from the OSA slope, governed by appropriate selection of slope length versus slope angle for a given waste/soil type, vegetation cover and climate. Experience with existing revegetated slopes at other BHP Billiton Iron Ore Pilbara mines indicates that at low angles (approximately 15°-18°), long slopes (ie. greater than 100 m) can be successful in the rocky waste.
- Beyond an acceptable slope length for immediate runoff, flow will need to be channelised in a controlled fashion. Most practitioners now accept that narrow, horizontal or low-gradient berms (as recommended in Guidelines) are of negligible long term benefit for breaking up a slope length. They actually exacerbate erosion, because they concentrate downslope flow at overtopping points, leading to rapid gully development.

Figure 3-6 provides a cross-section of the preferred final slope design for OSAs at Goldsworthy. As outlined above, ultimate designs for OSAs will maximise horizontal surface areas and minimise sloping surface areas where possible. Key to the successful control of water is adequate bunding to restrict water movement, both on top of the OSA and across the face.

3.4.2 Groundwater

Advanced dewatering of some of the Goldsworthy pits is required where mining operations are proposed to extend below the watertable. This results in a lowering of the local watertable. The currently available groundwater information indicates that there are no groundwater dependent ecosystems or users in the vicinity of the Goldsworthy. In addition, dewatering operations to date have had little impact on groundwater levels other than in the immediate pit areas and along strike within the ore body aquifer host rocks. The restriction of the groundwater drawdown effect to the immediate vicinity of the pit is a reflection of local hydrogeological conditions. In particular the ore body aquifers are enveloped by low permeability footwall and hanging wall sequences and lower permeability unmineralised Banded Iron Formation (BIF) along strike of the orebodies.

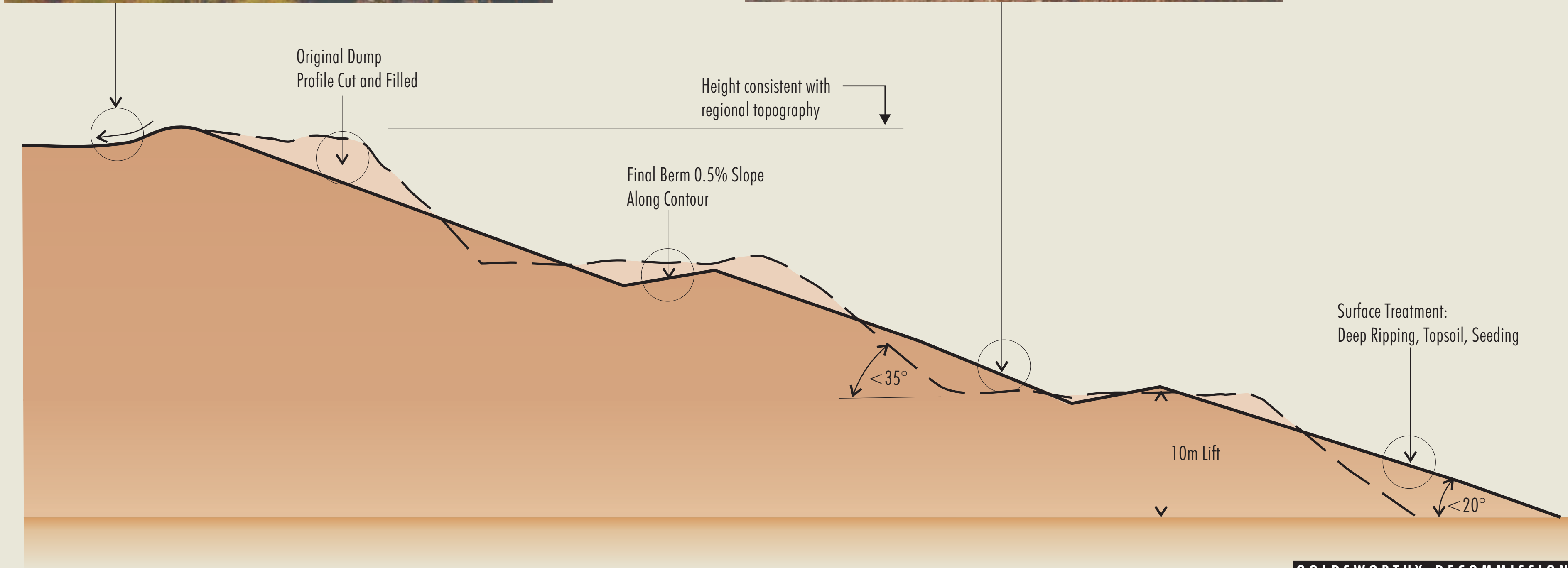
Recharge to the local aquifers is primarily through direct infiltration at the points where the orebodies outcrop. Groundwater modelling and water level monitoring results indicate that there is no significant hydraulic connection between the ore body aquifers and the shallow alluvial aquifers and fractured rock aquifers that occur in the sandy plains and drainage channels that surround the Nimingarra, Shay Gap and Yarrie ridges.

It is intended that upon closure the remaining pit voids will be left open. A report by Aquaterra (Aquaterra, 2004) for BHP Billiton Iron Ore details the expected outcomes resulting from the pit voids. Briefly, the findings of this report with relation to closure are as follows:

- It is expected that all final pit voids (other than Y10, Cattle Gorge and Nim I which are to be backfilled to the pre-mining watertable) will become groundwater sinks, with pit lake levels remaining below pre-mining watertable levels in the long term.
- The pit lakes that will develop in the final voids are expected to become saline in the longer term as a result of evaporative concentration. However, the saline water quality will be confined to the pits and there will be no impacts on local/regional groundwater quality.

Internally Draining Dump Surface

Final Batter Not Greater than 20°



GOLDSWORTHY DECOMMISSIONING AND REHABILITATION PLAN

FIGURE 3-6
Basic Slope Profile for Rehabilitated Overburden Storage Areas

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4 CURRENT AND PROPOSED REHABILITATION ACTIVITIES

4.1 REHABILITATION ACTIVITIES TO DATE

BHP Billiton Iron Ore's adaptive management approach to rehabilitation involves regularly assessing performance and adjusting its management practices to facilitate continuous improvement. This adaptive management approach takes into consideration the results of rehabilitation and trials at Goldsworthy and other BHP Billiton Iron Ore mines in the Pilbara, and best practice rehabilitation techniques used elsewhere in the mining industry. Rehabilitation performance at Goldsworthy and the results of rehabilitation trials at Goldsworthy and other BHP Billiton Iron Ore Pilbara operations is described in the following subsections.

4.2.1 Rehabilitation Performance at Goldsworthy

Rehabilitation is now a key focus at some of Goldsworthy's mining areas. Rehabilitation in the Shay Gap area commenced in 1993 and continued through into the Nimingarra area through to 1995.

Table 4-1 provides a breakdown of rehabilitation activities conducted within the Operations to date.

Table 4-1
Summary of Rehabilitation Activities to Date

Original Land Disturbance	Area Rehabilitated (ha)
Mine landforms	415
Infrastructure areas (incl. Haul roads, industrial areas)	12
Support facilities (i.e. borrow pits, old townsite)	45
Total	**472**

The historical rehabilitation of mine landforms has to date focussed on the ex-pit OSAs at Shay Gap, Sunrise Hill and Nimingarra. However, in the recent years rehabilitation has mainly occurred within the Yarrie area, with several trials being undertaken.

Rehabilitation efforts in the immediate future will focus on the Yarrie crustal areas, the Yarrie W1 OSA. Rehabilitation activities are proposed to then move on to Cattle Gorge and Mount Goldsworthy, followed by returning to Yarrie. Section 5 describes the proposed rehabilitation activities for the next five years (i.e. 2009 to 2013).

The rehabilitation of support facilities, i.e. borrow pits, exploration tracks and pads, was undertaken in the Shay Gap, Sunrise Hill and Nimingarra areas between 1993 and 1995. BHP Billiton Iron Ore uses internal guidelines to manage the development and rehabilitation of borrow-pits. These guidelines restrict the size and depth of individual pits. In addition, borrow pits are also generally rehabilitated as the borrow material is being removed in order to take advantage of the proximity of earthmoving equipment and because of the one-off nature of most borrow operations. The rehabilitated borrow pits are included in BHP Billiton Iron Ore's overall site-based rehabilitation-monitoring programme. Because they tend to be relatively small in area, limited in depth and progressively rehabilitated, the borrow pits at Goldsworthy have proved to be some of the most successful rehabilitation on the Goldsworthy Leases.

Rehabilitation Design Considerations for OSAs

Drainage on Top of OSAs

A significant cause of destructive erosion on rehabilitated landforms in the Pilbara is the runoff of concentrated water flows from the top surface of OSAs to their batters during extreme rainfall events. Erosion has been observed on some of the rehabilitated OSAs in the Shay Gap area, generally occurring in areas where the surface treatment employed (moonscaping) was not able to withstand the erosive forces generated when the water on top of the OSA has not been sufficiently controlled.

Drainage on top of dumps should be such that the flow of water will be away from the face of the OSA slope. Where this is not possible, barriers should be constructed on the edge of the OSA to prevent water from flowing down the slope, irrespective of the rehabilitation method employed.

Learning's from the recent trial conducted on the W1 OSA is that the barrier at the top of the OSA slope should be as close to the edge as possible. The windrow constructed in the W1 trial was 15m from the crest of the slope. This proved to be an adequate distance to create a catchment for water to pond on the edge of the crest, resulting in a concentrated flow in severe rainfall events.

Erosion on Moonscaped OSA slopes

Moonscaping was used extensively throughout the rehabilitation undertaken in the 1993 to 1995 period; the results of which have been variable. On the whole, moonscaping appears to create a stable landform, as previously mentioned the majority of erosion has occurred where the water on top of the OSA has not been controlled. Where failures have occurred they have tended to propagate across the slope, overtopping at the low points created by the edge of the dozer blade during construction.

The recent trial at W1 incorporated a column moonscaped section. Results of the trial indicated that the initial columns of moonscaped scallops running downslope did not interlock. However, a bridge had developed between the columns and there was no obvious areas where overtopping had or may occur. As a result, it was concluded that these areas had no visible signed of erosion when compared with the conventional method of interlocking moonscaped scallops.

Angle of OSA Slopes

Previous moonscaping efforts within the Shay Gap, Sunrise Hill and Nimingarra operations were carried out using various slope angles ranging from 23 degrees to 14 degrees.

Recent EFA monitoring results determined that the moonscaped slopes with lower angles were more successful than steeper slopes. As a result the recent trial at W1 was undertaken on a slope reshaped to 15 degrees, instead of the previously preferred 20 degrees. It is intended to adopt a 15 degree final slope for all OSAs, where possible.

Surface Material Type for Rehabilitated Areas

The majority of OSAs and backfilled crustal pits are constructed from blocky, fresh, BIF material. Rehabilitation efforts in these areas have not typically incorporated topsoil into the rehabilitation method.

EFA monitoring in these areas have shown that whilst the areas do exhibit some revegetation and stability qualities, they are not as advanced as those areas where the surface material consists of more weathered material and/or growth media. In recognition of this, topsoil was incorporated into all of the trial areas of the W1 rehabilitation.

Erosion on Contour Ripped Slopes

Contour ripping has been employed as a rehabilitation method on both the W1 trial slope and also on the slopes of the in-pit OSA at Y10. The slopes at Y10 have not exhibited any major signs of erosion and are revegetating well, despite the fact that no topsoil was applied. Conversely, the contour ripped area at W1 has several major erosion gullies present. The depth of the rip lines on the Y10 OSA were deeper than those at W1, due to the applied topsoil at W1 rilling back into the rip line.

Additionally, a W1 trial area had topsoil applied but was not ripped. The performance of this slope was comparable to the ripped W1 slope indicating that the rip lines had little impact on erosion resistance.

A tripe tyne will be trialled in upcoming rehabilitation sites within WAIO to assess the effect of lower amplitude, more dense rip line spacing.

Applied Topsoil Washing Away

The W1 trials demonstrated that if the topsoil was not sufficiently mixed in with the underlying waste profile, it would wash away down the slope during extreme rainfall events.

The fine topsoil must be anchored into the underlying profile. Further investigation is required to see if this could be achieved through extensive cross ripping of the slopes, prior to the final surface treatment.

Timing of Rehabilitation

The weather conditions experienced after the earthworks for the trial were completed consisted of one minor storm, followed by an extreme rainfall event within weeks of the completion date. This short period, without the occurrence of minor rainfall events did not allow the slope profile to self-armour.

All of the earthworks should be completed prior to the onset of the wet season. The potential to artificially water the slopes, to allow for a degree of self-armouring prior to the onset of heavy rain should be investigated further.

Additionally, initial research undertaken with Kings Park and Botanic Gardens, has indicated that the successful germination of *Triodia* sp. increases with higher temperatures. As a result, future seeding will be timed to coincide with the onset of hotter days and, where possible, take advantage of the summer rains.

Rehabilitation Trials

BHP Billiton Iron Ore have embarked upon rehabilitation trials at Goldsworthy as part of addressing the requirements of the guiding closure principles in Section 1.5. The Risk Assessment detailed in Section 3.1 highlighted that two aspects at the Goldsworthy operations needed addressing within a one-year time frame; potential failure of vegetation and management of ARD.

ARD is currently managed as described in Section 3.3.5 and further research is continuing at the Mt Whaleback operations along with regular monitoring at Yarrie.

The occurrence of vegetation failure or success can have many contributing factors. BHP Billiton Iron Ore is currently undergoing trials to determine the effects of utilising alternative forms of growth media and also the effect of different surface treatments on slopes.

Monitoring of these trials will be incorporated into the existing monitoring programme that takes in the Shay Gap, Nimingarra and Yarrie areas, the details of which are described below. Where relevant, the findings of current and future trials within all BHP Billiton Iron Ore operations will be used to develop and improve rehabilitation procedures at other BHP Billiton Iron Ore sites.

Topsoil Substitute Trial

All clearing operations must recover the topsoil resource in line with BHP Billiton Iron Ore's procedures. Topsoil recovered is directly placed for use in rehabilitation where possible or is stockpiled for future use during closure. In the case of Nimingarra, Sunrise Hill and Shay Gap, any topsoil available in 1993 was utilised during the rehabilitation works undertaken at this time.

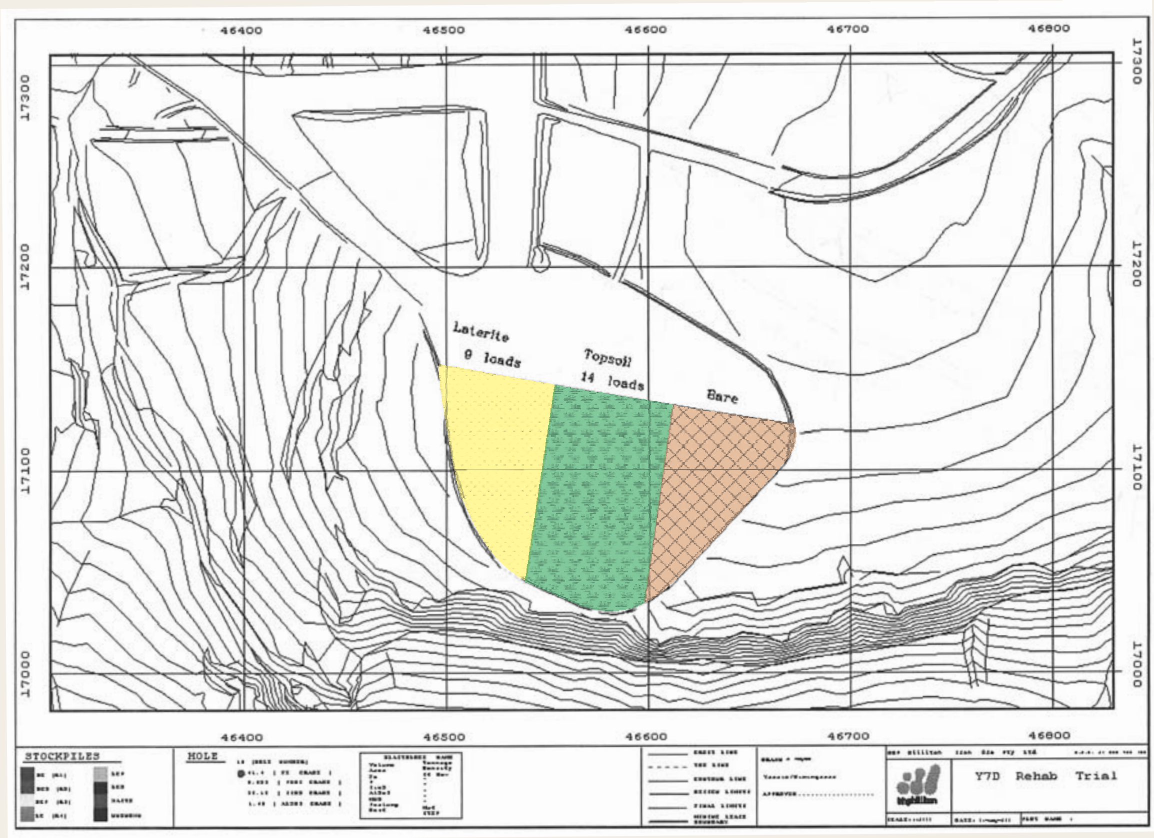
It is recognised that prior to the implementation of these procedures the topsoil resource was not optimised. As a result, the topsoil resource available for rehabilitation to meet closure objectives is acknowledged as being deficient. In recognition of this, the opportunity to recover near surface 'lateritic' material and use it as growth medium has been taken. At present this material is being stockpiled separately to clean waste pending the results of a trial.

The trial has been set up in the Yarrie Y7 area. The Y7D pit has been backfilled back to the original surface contours; the area was then split into three areas. One section had topsoil applied, another the 'lateritic' material and the final section was left bare (Figure 4-1). Each section was then contour ripped and seeded. Once the results of the trial are known, the decision on whether it is feasible to use the laterite, as a topsoil substitute will be made. EFA transects are proposed to be installed during YEJ09.

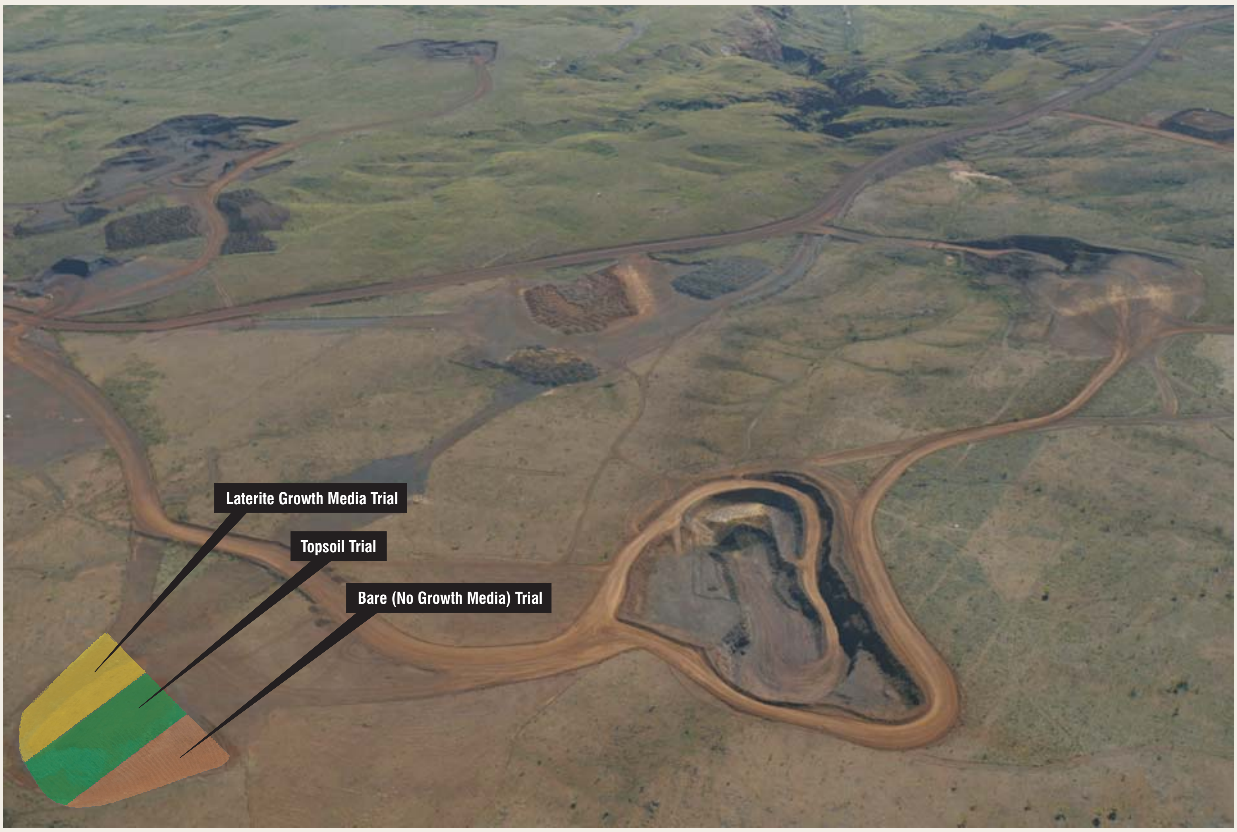
Also, at both the Yarrie and Nimingarra sites, a low-grade crustal resource known as B1 and S1 has been stockpiled. This material is essentially a crustal-type ore, which contains economic iron product in the lump component, but the fines component is considered waste. This resource has been stockpiled with the intention of screening the lump portion for use in the ore blends. The remaining fines portion, which is of a lateritic nature, is considered suitable as a growth medium. Screening of this material has commenced and will be utilised in a trial during YEJ09 with the aim of reducing the topsoil deficit at Yarrie, Nimingarra and Sunrise Hill.

OSA Slope Surface Treatment Trial

The majority of surface treatments on rehabilitated OSA slopes at Goldsworthy that has been carried out to date has all consisted of moonscaping. Previous moonscaping ventures have encountered operational difficulties, as the creation of moonscaped landforms requires a skilled operator. The process of moonscaping creates a series of scallops followed by angle of repose outer slopes. as the W1 trial was undertaken to assess the stability and vegetation success of alternative surface treatments.



Plan of Growth Media Trial



Aerial Photograph Showing Growth Media Trial

GOLDSWORTHY DECOMMISSIONING AND REHABILITATION PLAN

FIGURE 4-1
Growth Media Trial

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BHP-07-16 GDRP_012B

The top level (255mRL) of the W1 OSA was selected as the preferred location for the trial to take place, as waste placement is complete. The trial comprised four different treatments; moonscaping, contour ripping, a terraced landform and also a control site, leaving the surface as a battered down face (Figure 4-2).

The trial will serve to assess the effectiveness of the surface treatment against erosion, vegetation success and operational factors. Topsoil was applied to each of the trial areas, prior to surface treatments being carried out. Hand seeding of a local seed mix occurred at the completion of the surface treatments. A significant rainfall event (>75mm in one hour) occurred within a few weeks of seeding.

EFA transects were subsequently set up within each trial area. The results of which are presented in Section 4.2.1.3.

4.2.2 Rehabilitation at Other BHP Billiton Iron Ore Pilbara Mines

A summary of the performance of previously rehabilitated areas at BHP Billiton Iron Ore's other operations in the Pilbara is provided in Table 4-2 below.

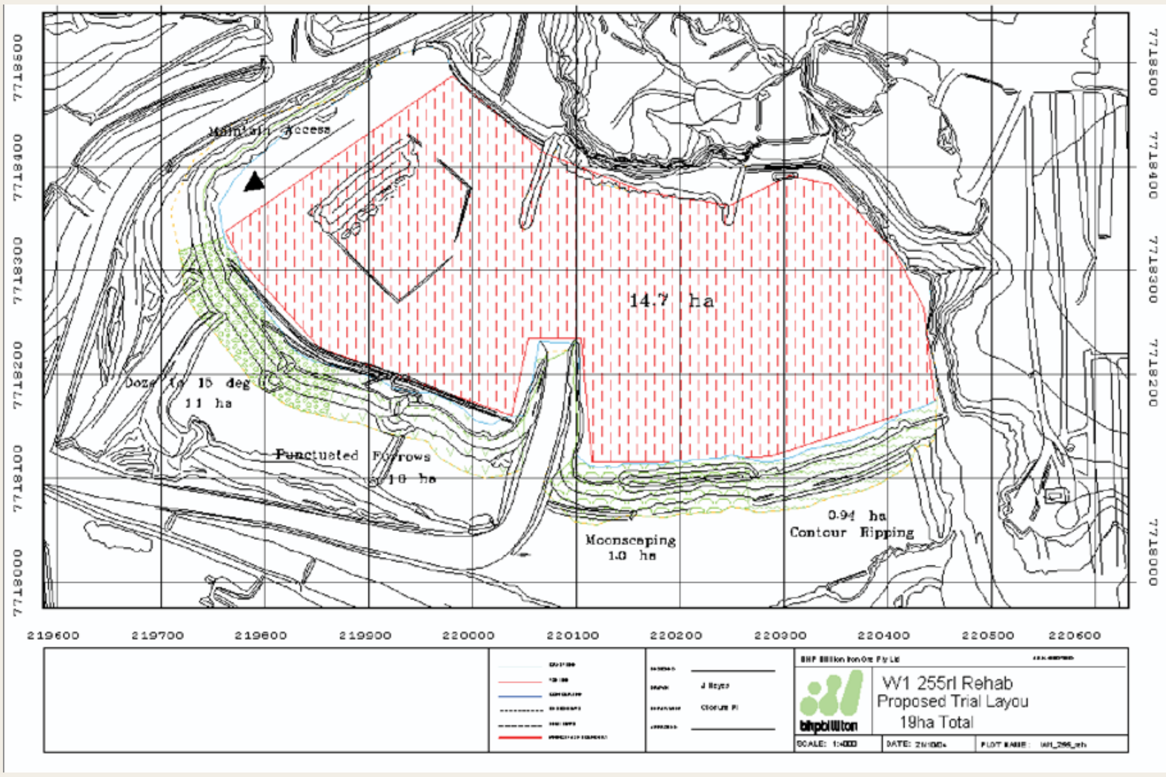
Table 4-2
Summary of Findings from Rehabilitation Performance at BHP Billiton Iron Ore's other Operations in the Pilbara

Site	Description of Findings from Rehabilitation Performance
General	• Scalloping (moonscaping) has been effective at slopes below 20^{o}, at slopes higher than 20^{o} erosion appears to be more pronounced. • When using scalloping as a rehabilitation technique, the scallops should be 'interlocked' to minimise erosion and optimise the success of revegetation. • The construction of bunds on the top of OSAs, around the perimeter, prevents water from flowing down the slopes and minimises erosion. • Material that has a higher sulphidic content can impact on the success of revegetation. It has been found that using inert waste material as a cover can minimise the impact of sulphidic material. It is estimated that the thickness of the inert material would need to be approximately 5 m to minimise the potential for deeper rooted vegetation penetrating into the sulphidic material. The overburden at the Wheelarra Hill Mine consists of unmineralised Banded Iron Formation and has inert geochemical characteristics. Acid forming overburden is not expected to be a significant issue at the Wheelarra Hill Mine. • When applying topsoil it is preferable that it be incorporated (keyed-in) into the subsurface material to minimise erosion. • Contour ripping has been effective at slopes below 20^{o}, however the contours should be surveyed accurately to minimise failure of rip lines. • Backfilling pits with waste material minimises visual impacts of the operations and prevents the need to disturb land for new out-of-pit OSA areas. • More successful revegetation has been found when seeding has taken place just prior to the main wet season (ie. before January).

Table 4-2 (Continued)
Summary of Findings from Rehabilitation Performance at BHP Billiton Iron Ore's other Operations in the Pilbara

Site	Description of Findings from Rehabilitation Performance
Jimblebar - Wheelarra Hill	• Prior to 2004, qualitative rehabilitation monitoring at the Wheelarra Hill Mine showed some areas encountered problems due to plants being of the same age. By adjusting the rehabilitation method used, BHP Billiton Iron Ore has demonstrated that this issue can be overcome by undertaking additional seeding (or planting) in subsequent years. • Operational experience has indicated that due to the unpredictable rainfall in the Newman area, seed application at the Wheelarra Hill Mine should, where practicable, be timed to coincide with major rainfall events. • Preliminary EFA monitoring results indicate that rehabilitated stockpiled fines are capable of supporting local native species and are exhibiting growth on a trajectory that would suggest that a sustainable ecosystem will develop over time. • The batters of the rehabilitated stockpiled fines have not performed well in terms of stability. These batters were generally profiled to a final slope of 20^{o}, and were directly seeded and contour ripped. • High litter development appears to be associated with higher densities of *Triodia* sp. on the rehabilitated stockpiled fines. Higher infiltration and nutrient cycling values recorded in the EFA monitoring programme also appear to be correlated with the high litter content. • BHP Billiton Iron Ore is investigating fire ecology (ie. response of ecosystems following fire) at the Wheelarra Hill Mine by monitoring areas which have been burnt. Findings from this investigation will be used to determine the possibility of using fire as a rehabilitation tool and to better manage fire affected areas. • Topsoil deficit has been recognised as a potential issue for future rehabilitation works at the Wheelarra Hill Mine. As a result, BHP Billiton Iron Ore is investigating blending waste fines and topsoil for future use as growth media on rehabilitated landforms. • Contour ripping at the Jimblebar operations has shown that the contour rip spacing should be as close together as possible to reduce surface water flow volume and the transport of sediments.
Marillana Creek (Yandi)	• Monitoring of OSA surfaces confirmed significantly advanced rates of recovery in rehabilitated areas with topsoil (ie. greater than 25% foliar cover) when compared with rehabilitated areas without topsoil (ie. less than 10% foliar cover). It was also determined that topsoil should be spread at a depth of 50 mm to 60 mm to achieve optimum use of available topsoil resources. • Promotion of soil harvesting and progressive rehabilitation has led to high success rates for rehabilitation. As a result of Yandi's soil harvesting, it has been possible for all rehabilitation areas to date to have topsoil applied. • Operator ability has been identified as a key factor in successful rehabilitation. Rehabilitation operators are selected based on their understanding and interest in environmental requirements to generate optimal rehabilitation results. • BHP Billiton Iron Ore is investigating fire ecology (ie. response of ecosystems following fire) at Yandi by monitoring areas which have been burnt. Findings from this investigation will be used to determine the possibility of using fire as a rehabilitation tool and to better manage fire affected areas.
Mt Whaleback and Orebody 29/30/35	• Previous trials have found that revegetation performance generally increases with greater depth of topsoil application (ie. there would be an ideal topsoil depth which would be dependent on the species). • OSAs with high pyritic content have been recognised as an issue for rehabilitation. As a result, trials are being conducted into appropriate surface treatments, species and seeding rates. The results will be used to improve OSA rehabilitation methodologies. • Trials have found that drainage on top of dumps should be such that the flow of water will be away from the face of the OSA slope. Where this is not possible, barriers should be constructed on the edge of the OSA to prevent water from flowing down the slope, irrespective of the rehabilitation method employed.

Sources: *Wheelarra Hill Extension Project Environmental Protection Statement* (BHP Billiton Iron Ore, 2005b).
Annual Environmental Report – July 2006 to June 2007 (BHP Billiton Iron Ore, 2007).
Pilbara Mining Operations - Rehabilitation Guide (BHP Billiton Iron Ore, 2006).



Plan of the Proposed W1 Trial Area

Aerial Photograph of the Proposed W1 Trial Area

GOLDSWORTHY DECOMMISSIONING AND REHABILITATION PLAN

FIGURE 4-2
Slope Surface Treatment Trial

bhpbilliton

The findings presented in Table 4-2 are examples of BHP Billiton Iron Ore's adaptive management approach to rehabilitation which involves regularly assessing performance and adjusting its management practices to facilitate continuous improvement. The adaptive management approach will also take into consideration the results of rehabilitation monitoring at Goldsworthy and at other BHP Billiton Iron Ore mines in the Pilbara.

Rehabilitation areas and trials will be monitored using EFA (Section 4.2.1) on a regular basis to assess the success or otherwise of a particular rehabilitation technique, with the results used to refine the Project rehabilitation programme.

4.2 MAINTENANCE AND MONITORING PROGRAMME

Across its Pilbara mining operations, BHP Billiton Iron Ore has implemented monitoring programmes to evaluate the performance of rehabilitated mine landforms and assess whether they have met the Guiding Closure Principles, or are showing satisfactory progress towards meeting these principles. These programmes will be expanded as new areas of the mine are rehabilitated, and will be refined based on monitoring results and rehabilitation success.

BHP Billiton Iron Ore's adaptive management approach to rehabilitation involves regularly assessing performance by taking into consideration results of rehabilitation and trials from BHP Billiton Iron Ore's operations in the region and adjusting its management practices to facilitate continuous improvement. Rehabilitation areas and trials will be monitored using EFA (Section 4.2.1) and other monitoring programmes (Section 4.2.2 to Section 4.2.7) on a regular basis to assess the success or otherwise of a particular rehabilitation technique, with the results used to further refine the Project rehabilitation programme.

During the remaining life of mine at the Goldsworthy operations, following will be monitored:

- rehabilitation monitoring (EFA);
- surface water quality within adjoining creeks (i.e. Egg Creek, Eel Creek and Cattle Gorge Creek);
- groundwater levels and quality in the aquifer;
- public access and safety;
- off-site impacts; and
- stability of mine landforms.

4.2.1 Rehabilitation Monitoring

4.2.1.1 Ecosystem Function Analysis

In 2004, an EFA monitoring programme was designed and implemented for BHP Billiton Iron Ore's Pilbara operations. EFA aims to measure the progression of rehabilitation towards self-sustaining ecosystems. EFA has been incorporated into the overall Goldsworthy rehabilitation monitoring programme to provide an assessment of ecosystem functionality. EFA is a CSIRO developed method used to provide indicators of rehabilitation performance which allows assessment of ecosystem self-sustainability through the plotting of ecosystem development trajectories. In addition, EFA identifies areas of rehabilitation that require remedial action.

EFA is comprised of the following three components:

- Landscape Function Analysis (LFA);
- Vegetation Dynamics; and
- Habitat Complexity.

The following is a summary of EFA components derived from *Assessing Rehabilitation Success Version 1.1* (Tongway, 2001) and *Landscape Function Analysis for Monitoring and Assessing Landscapes with Special Reference to Minesites and Rangelands Version 3.1* (Tongway and Hindley, 2004).

Landscape Function Analysis (LFA)

LFA provides a quantitative tool for management and monitoring. Data recorded as part of LFA monitoring is based on landscape processes and focuses on the dynamics of resource mobilisation, transport, deposition, utilisation and soil condition.

The first step of LFA is to characterise the "landscape organisation" of each transect. This is done by identifying the "patch" and "interpatch" zones along each transect. A "patch" is an area (on the ground) which collects or restricts the flow of resources (eg. water, topsoil or organic matter) and an "interpatch" area (also on the ground) generally loses resources. Typical patches include areas of vegetative ground cover, fallen logs or debris and troughs (in the case of an area that has been recently ripped). Typical interpatches include areas of bare soil and banks (areas of raised ground such as those found in areas recently ripped).

Once the types and positions of patches and interpatches along a transect have been identified, various parameters are assessed. These include:

- soil cover;
- perennial grass basal and tree and shrub foliage cover;
- litter cover, origin and degree of decomposition;
- cryptogam cover;
- crust brokenness;
- erosion type and severity;
- deposited materials;
- surface roughness;
- surface resistance to disturbance;
- soil slake test; and
- soil texture.

Each of the above parameters is assessed on a predetermined scale in accordance with the EFA field manual (Tongway and Hindley, 1995). Values for each parameter are entered into an Excel spreadsheet where set algorithms generate the three LFA indices, *viz.* stability, infiltration/runoff and nutrient cycling. Indices range from 1 to 100 and can be compared against indices from an appropriate analogue transect to assist in determining (over time) the progression of rehabilitation areas towards analogue areas considered to represent self-sustaining ecosystems.

Table 4-3 indicates which of the above parameters are used by the set algorithms to generate each of the three LFA indices.

Table 4-3
Landscape Function Index Contribution

Parameter	LFA Indices		
	Stability	Infiltration/Runoff	Nutrient Cycling
Soil Cover	•		
Perennial Basal Cover		•	•
Litter Cover (simple)	•		
Litter Cover (complex)		•	•
Cryptogam Cover	•		•
Crust Condition	•		
Erosion Features	•		
Deposited Materials	•		
Microtopography		•	•
Surface Nature	•	•	
Slake Test	•	•	
Soil Texture		•	

After Tongway and Hindley (2004).

Rill Assessment

In addition to the standard landscape organisation, slopes which show signs of erosion can be monitored using EFA's 'rill assessment'. At Goldsworthy, rill assessments will be conducted on the upper and lower sections of the rehabilitation slopes on the waste landforms. Rill assessment transects are established at right angles to the main transect. The total length of the rill assessment transect is 50 m (25 m either side of the main transect). The rill assessment transect for the upper slope is located at 10 m on the main transect and the lower slope is usually assessed at 25 m or 30 m, depending on the total length of the slope.

The crest of the bank immediately above the fixed positions for the upper and lower slopes is assessed. The number of rills (0.3 m deep) and gullies (greater than 0.3 m deep) are counted and their width and depth are measured (McDonald *et al.*, 1998).

The results of the rill assessment (i.e. number and size) can be analysed over time. If the rills continue to degrade, remedial action is generally required. If the results improve, it represents improved landscape and ecosystem function.

Vegetation Dynamics

Monitoring of vegetation dynamics provides a quantitative assessment of species composition (i.e. biodiversity), density and cover. Standard vegetation dynamics is measured using the wandering quarter method or the point centred quarter method. Goldsworthy also uses a modified method (Line Intercept Method) described below.

Wandering Quarter Method

The wandering quarter method records information on the different structural layers present (eg. grasses, shrubs and trees) along each transect and includes (for each structural layer present) the following general steps:

- From the start (ie. upslope end) of the transect and using its compass bearing, record the distance to base of the nearest plant which is within a 90 degree arc centered on the compass bearing.
- Record the species, canopy dimensions and canopy density (ie. a percentage value indicating the ability of the canopy to trap airborne resources).
- From that plant and within a 90 degree arc centered on the same compass bearing, find and record the distance, species, canopy dimensions and canopy density of the next plant.
- Continue to do this until at least 25 plants are recorded or the end of the transect is reached. If practical, more lines parallel to the original can be used to record the required 25 plants should insufficient plants be present on the first line. The same plant cannot be measured twice even on adjacent lines.
- Repeat the above for each structural layer present along each transect.

The above information is entered into an Excel spreadsheet where set algorithms generate the three vegetation dynamics indices for each structural layer present, *viz.* plants per hectare, distance between plants and canopy volume per hectare. These indices are compared against indices from an appropriate analogue transect to assist in determining (over time) the progression of rehabilitation areas towards analogue areas considered to represent self-sustaining ecosystems.

Point Centred Quarter Method

The point centred quarter method also records information on the different structural layers present (eg. grasses, shrubs and trees) along each transect. The point centred quarter technique includes (for each structural layer present) the following general steps:

- Sampling points are established on the EFA transect line at regular intervals (eg. every 5 m).
- At each point, a conceptual cross (ie. +) is drawn in the landscape. The distance to the nearest plant in each of the four "quarters" of the conceptual cross is measured.
- Record the species, canopy dimensions and canopy density (ie. a percentage value indicating the ability of the canopy to trap airborne resources).
- The details of a minimum of 20 points (ie. 20 points x 4 plants = 80 plants) along the transect should be recorded, where possible (ie. you may not be able to fit 20 points if the rehabilitation area is small).
- The same plant cannot be sampled twice.
- Repeat the above for each structural layer present along each transect (ie. grasses, shrubs, trees).

The above information is entered into an Excel spreadsheet where set algorithms generate the three vegetation dynamics indices for each structural layer present, *viz.* plants per hectare, distance between plants and canopy volume per hectare. These indices are compared against indices from an appropriate analogue transect to assist in determining (over time) the progression of rehabilitation areas towards analogue areas considered to represent self-sustaining ecosystems.

Line Intercept Method

Following analysis of the data, the level of plant cover had been exaggerated at analogue sites containing large, irregular *Triodia* hummocks. These sites contained bare, rocky soil in small, disconnected patches. It was determined that the point centred quarter or wandering quarter methods were not appropriate for assessing such vegetation and the line intercept method was developed for these sites in conjunction with David Tongway (a key contributor in the development of EFA).

The line intercept method is undertaken on analogue sites (or advanced rehabilitated sites) where mature *Triodia* plants no longer have easily identifiable, individual canopies. In such vegetation, the level of plant cover becomes the most important parameter as density values become difficult to determine.

Five transects are assessed at each analogue monitoring site (or advanced rehabilitated sites), by placing four transects parallel to the EFA transect at approximately 3 m intervals. The length of each transect is traversed and the points of intercept (beginning and end) of the understorey vegetation are recorded. From this data, the proportion of the transect covered by understorey vegetation is calculated. The mean level of understorey plant cover of the five transects is then determined. The vegetation species that intercept the transect line are recorded to give a measure of species diversity for each site. The line intercept method does not provide a measure of density.

Habitat Complexity

The “habitat complexity” index assesses the extent to which habitat resources (ie. shelter and foraging resources for vertebrate fauna) are developing.

The standard habitat complexity criteria used for EFA was considered by BHP Billiton Iron Ore to be inappropriate for the fauna habitats of the Goldsworthy area. As a result, a trial was implemented using modified habitat complexity criteria in response to a greater understanding of fauna habitats at other BHP Billiton Iron Ore Pilbara mines. The modified criteria were adapted from Newsome and Catling (1979) and are presented in Table 4-4.

Each vegetative storey is assigned a value relative to its worth as habitat. Zero is included for areas which lack any form of vegetation, for example areas of new rehabilitation and those areas which score 1 for ‘cryptogam cover’ in LFA. The value of each of the vegetative storeys present on the survey area is accumulated to give a score out of a maximum of 15.

Each available fauna niche is assigned a value according to its perceived value as habitat for vertebrate fauna. The value of each of the fauna niches on the survey area is accumulated to give a score out of a maximum of 10.

Table 4-4
Indicators of Habitat Complexity

Component	Score					
	0	1	2	3	4	5
Vegetative Storeys (0-15 cumulative)	Nil	Groundcover – vines, creeper, cryptogams	Understorey – grasses, herbs, 0-0.1 m	Midstorey – small shrubs, 0.5-1.5 m	Upperstorey – tall shrubs, 1.5-3.0 m	Overstorey >3.0 m
Available Faunal Niches (0-10 cumulative)	Nil	Leaf litter, or perennial grasses, or stocks <5 centimetres (cm), or rocky scree >2 cm <15 cm diameter	Logs, or rocks >25 cm diameter	Immature trees, or shrubs	Mature trees, or mature shrubs	
Ants	Nil	1 species, sparse	1 species, abundant	2 or more species, sparse	2 or more species, abundant	
Scats*	Nil	1 species, sparse	1 species, abundant	2 or more species, sparse	2 or more species, abundant	*try and identify source animal
Water Availability**	Nil	Waterbody <1 m diameter – present or evidence	Waterbody >1 m diameter – present or evidence			**within 25 m either side of transect and within 10 m of top/bottom markers

Ants are widely used as bio-indicators in terrestrial ecosystems as they are sensitive to disturbance and climatic variability (Thoday, 1998; Davison and Broese van Groenou, 1986). As a result, the presence or absence of ants is evaluated in terms of the number of species and the total abundance of ants within the survey area.

The assessment of scats is considered important in recognising present use of the rehabilitated areas by vertebrate fauna, and in identifying vertebrate species that inhabit or frequent analogue sites. The presence or absence of scats is evaluated in terms of the number of species of origin and the total abundance of the number of scats in the survey area.

Water availability is assessed to determine the amount of free water obtainable by vertebrate fauna on the survey area. Waterbodies can be either temporal or permanent, and must be within 25 m either side of the transect or within 10 m of the upper and lower end points of the transect.

Each component of habitat complexity carries a weighting depending on its relative importance to fauna habitat. The 'vegetative storeys' component carries the greatest weighting (~40%), followed by the 'available faunal niches' (~27%). 'Ants' and 'scats' both carry a weighting of ~11% and 'water availability' receives the lowest weighting of ~9%.

The overall index can then be compared against the index from an appropriate analogue transect to assist in determining (over time) the progression of rehabilitation areas towards analogue areas considered to represent self-sustaining ecosystems.

4.2.1.2 EFA Data Analysis

The EFA monitoring programme will be used to calculate average values across all BHP Billiton Iron Ore's Pilbara operations for the EFA parameters (ie. LFA, Vegetation Dynamics and Habitat Complexity) in rehabilitation sites and analogue (ie. unmined) sites.

The average values will be calculated over a number of years to minimise bias in the data. This will allow quantitative values to be assigned for satisfactory and unsatisfactory rehabilitation performance. It is expected that at least three years of EFA monitoring will be required to calculate average EFA values to minimise bias in the data.

The average values of EFA parameters for rehabilitation sites will be calculated for different ages, slope and aspect of rehabilitation areas. This will allow rehabilitation of similar ages to be compared and enable early detection of unsatisfactory rehabilitation performance. Remediation of areas which show signs of unsatisfactory performance can then be conducted.

The average values of EFA parameters for analogue sites will be calculated according to slope, aspect and vegetation community. These average values will be used as target values for rehabilitation sites to become the quantitative completion criteria.

4.2.1.3 EFA Monitoring Transects

The EFA rehabilitation monitoring programme commenced at Goldsworthy in 1995. Fourteen EFA monitoring transects have been established between the Yarrie and Shay Gap operations areas. The transects comprise seven analogue transects (designed to represent baseline, undisturbed conditions), and seven rehabilitation monitoring transects. Rehabilitated areas are predominantly located on waste landforms. The EFA monitoring programme will be progressively expanded to include sites at the Cundaline and Callawa areas as disturbance areas commence rehabilitation.

The location of existing rehabilitation areas and Ecosystem Function Analysis (EFA) rehabilitation monitoring sites are shown on Figure 4-3 and a summary is provided below in Table 4-5 (Outback Ecology, 2008).

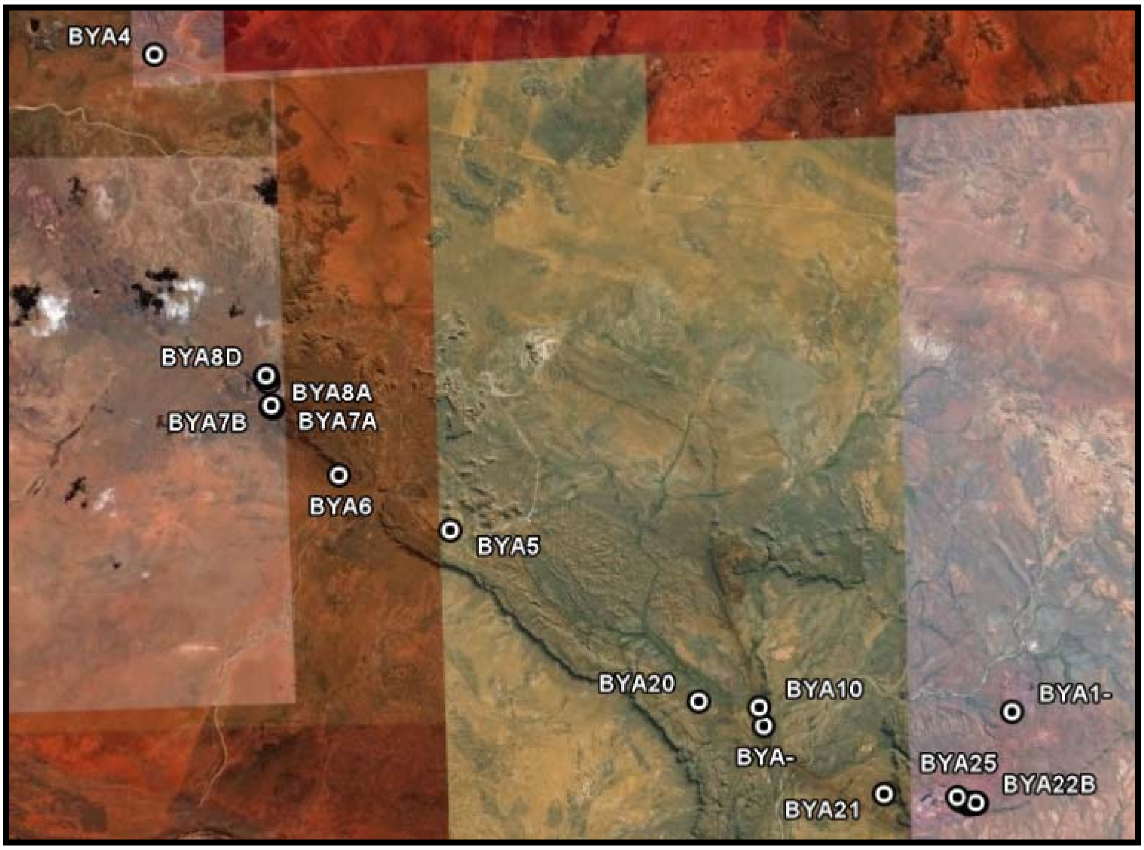


Figure 4-3: Existing Rehabilitation Areas and EFA Monitoring Sites

Table 4-5
EFA Rehabilitation Monitoring Transect Locations

Location	Date Rehabilitated	Type of Landform	Surface Treatment	EFA Monitoring Transect
Yarrie Y10	2003	Sloping Surface	Contour Ripped	BYA1
Shay Gap Ridge	1995	Flat Surface	Ripped	BYA7
Flying Circus	1995	Flat Surface	Ripped	BYA8
Yarrie Waste Landform W1	2004/2005	Waste Landform	Moonscaped	BYA22
Yarrie Waste Landform W1	2004/2005	Waste Landform	Terraced	BYA23
Yarrie Waste Landform W1	2004/2005	Waste Landform	Contour Ripped	BYA24
Yarrie Waste Landform W1	2004/2005	Waste Landform	Natural Slope	BYA25

A summary of the EFA rehabilitation monitoring sites is provided below:

- *Sloping Rehabilitation Transects*
  - Transect BYA1 was rehabilitated in 2003. The site had recently been burnt and is dominated by lower storey *Triodia* sp. and overstorey *Acacia* sp.
  - Transects BYA22, 23, 24 and 25, located on the top lift of the W1 waste landform at Yarrie, was rehabilitated in 2004/2005. The sites consisted of four trial transects comprising moonscaped, contour ripped, terraced and natural slope treatments.
- *Flat Rehabilitation Transects*
  - Transect BYA7, located on upper flat surfaces of the Shay Gap Ridge, was rehabilitated in 1995 and is dominated by lower storey Triodia sp.
  - Transect BYA8, located on the upper flat surfaces of the Shay Gap Ridge, was rehabilitated in 1995 and is dominated by lower storey *Triodia* sp.

The locations of the analogue transects considered the topography of the rehabilitation transects (i.e. sloping or flat) to enable direct comparison of results. A summary description of the environment of the sloping and flat analogue monitoring transects is provided below:

- *Sloping Analogue Transects*
  - Transect BYA4 is located at Nimingarra. The site is dominated by Triodia pungens and showed evidence of a recent fire.
  - Transect BYA5 is located on Shay Gap Ridge Sedimentary Mesa. The site is dominated by Triodia wiseana.
  - Transect BYA6 is located on Shay Gap Ridge Mesa, with Indigofera monophylla in the understory.
  - Transect BYA10 is located adjacent to Elephant Ridge, with Triodia wiseana understorey and mixed Acacia and Grevillea overstorey.
  - Transect BYA21 is located on Yarrie Mesa, with a mixed *Triodia wiseana* and *Cymbopogon ambiguous* understorey, and *Grevillea pyramidalis* dominated overstorey.
- *Flat Analogue Transects*
  - Transect BYA19 is located on Shay Gap Ridge, with an understorey of *Triodia wiseana* and *Grevillea wickhamii*.
  - Transect BYA20 is located on a sandplain at Yarrie, and shows improved *Triodia wiseana* cover after a fire in early 2007.

4.2.2 Fauna Monitoring of Rehabilitation Areas

Fauna monitoring on rehabilitation areas during the next five years will include six monthly qualitative observations of the following:

- birds, reptiles and mammals (species and number, if possible);
- scats and tracks; and
- evidence of nesting.

Fauna monitoring will also include observations of feral animals in rehabilitation areas. Where monitoring indicates an increase in feral animal populations, the need for, and type of control strategies used to manage pest species will be determined in consultation with DEC and the Department of Agriculture and Food Western Australia (DAFWA).

Results of the fauna monitoring on rehabilitation areas will be documented in the AER. Fauna monitoring will be reviewed in five years and further monitoring surveys will be considered depending on the performance of rehabilitation areas.

4.2.3 Surface Water Monitoring

A surface water monitoring programme has been established to investigate the on site and downstream effects of the Goldsworthy operations. Future additional monitoring will also be undertaken to assess the success of rehabilitation (i.e. long term stability) of mine landforms, such as the OSAs, infill areas and pit lakes (post-mining), with a focus on suspended solids and salinity. The monitoring programme will continue to be operated during the operational phase so that relevant baseline data can be collected, taking into account the variability of rainfall and stream flow events.

Inspections of drainage surfaces and erosion control measures will be carried out as soon as possible after periods of heavy rainfall to assess structural integrity of surface hydrological features such as rehabilitated OSAs.

4.2.4 Groundwater Monitoring

A groundwater monitoring programme has been developed to verify that the Guiding Closure Principles for groundwater will be achieved. The groundwater monitoring programme currently includes:

- monthly abstraction rates in production bores;
- monthly water level sampling in production and nominated observation bores;
- water use on a monthly basis; and
- analysis of water samples for the analytes specified in the Groundwater Well Licence (GWL) Operating Strategy (BHP Billiton Iron Ore, 2008b).

The existing groundwater-monitoring programme will be reviewed and revised as necessary to facilitate the assessment of groundwater functions against the guiding closure principles. In particular the function of the aquifers will be monitored, with a focus on the post closure performance (including salinity). Any changes to the programme will be reported in the AER and included in any revisions of the EMP.

The post mining groundwater monitoring programme will be developed in consultation with the relevant authorities prior to completion of mining.

4.2.5 Weed Monitoring

A Weed Management Plan (WMP) has been prepared for Goldsworthy which describes the weed monitoring to be conducted and measures used to prevent the introduction and spread of weeds.

Weed monitoring and control will be conducted as part of the rehabilitation programme in accordance with the WMP. Post-mining control measures and monitoring programmes (and completion criteria) will be developed and/or refined during the mine life in consideration of the performance of the rehabilitation (ie. results of EFA monitoring over time), the final landuse and in consultation with the relevant authorities. Approved changes to the monitoring programmes and completion criteria will be documented in the AER and revisions of the WMP.

4.2.6 Public Safety Monitoring

During operations and after mine closure, periodic inspections will be conducted to determine the condition of the safety bunds erected around the open pits and a record kept of those inspections. Where the integrity of the bunds has been compromised to the extent that inadvertent public access could occur, maintenance will be conducted.

4.2.7 Off-site Impacts and Landform Stability Monitoring

As part of the general monitoring of the site, visual inspections will be conducted to identify obvious off-site impacts. Visual inspections will be undertaken in conjunction with the public safety inspections.

Rehabilitated landforms will be inspected after significant rainfall to assess stability and to monitor for areas where unacceptable erosion has occurred. Where necessary, maintenance works will be undertaken to improve performance.

4.3 REHABILITATION REPORTING

The progress and performance of EFA monitoring sites and any new rehabilitation activities conducted at the Project will continue to be reported on an annual basis through both the AER, which covers all of BHP Billiton Iron Ore’s Pilbara operations, and the annual EFA report. Rehabilitation details reported in the AER will include a summary of the EFA results for the reporting period and the area and nature of any new rehabilitation that has been undertaken on-site. Any rehabilitation activities proposed for the future reporting period will continue to be reported as environmental initiatives on an annual basis. Reporting results will also be made available to the relevant authorities on request.

4.4 OTHER ACTIVITIES

A growth media resource database is currently being updated and will be recorded in Biodata in 2009. This records all existing growth media stockpiles' volumes and locations. This data will then be used in combination with the mining plan to ascertain the optimum locations for sourcing of additional material for rehabilitation. This data will be presented in future versions of the DRP. Topsoil will be preferentially used on slopes, with other growth media being utilised on flat areas.

Once the sequencing is established, any lateritic stockpiles that will not be recovered in the current year will be seeded, to encourage vegetation and hence the organic content of the lateritic material.

Further to this, Outback Ecology (2004) have recently produced a report on the physical and chemical characteristics of topsoil, laterite and the 'screenable' laterite fines, along with the materials present in the rehabilitated OSA slopes at Shay Gap and Nim A. The report focuses on their application as growth media.

5 UPCOMING REHABILITATION ACTIVITIES

The scheduling of rehabilitation works will include both rehabilitation of newly disturbed areas and also remediation of existing rehabilitated areas. A detailed review of each of the domains will be undertaken to ascertain the final rehabilitation requirements. The following provides a summary of the areas that will be targeted for rehabilitation over the next five years (i.e. year ending June (YEJ) 2009 to YEJ 2013), based on the "5 Year Progressive Rehabilitation Plan" being developed at the time of preparing this DRP.

YEJ 2009

Rehabilitation activities during YEJ09 are proposed for the Yarrie W1 OSA top level (i.e. 255 Berm), middle lift (i.e. 238 Berm and Batter). The area proposed for rehabilitation activities on the Yarrie WI OSA will total approximately 11 ha.

Rehabilitation activities are also proposed for the Y7 Pit and C-Pit areas, which will total approximately 11 ha.

YEJ 2010

Rehabilitation activities during YEJ10 are proposed for the Cattle Gorge OSA top lift and top lift berm. The area proposed for rehabilitation activities on the Cattle Gorge OSA will total approximately 5.5 ha.

Rehabilitation activities are also proposed for the Y3 and Y7 pits, which will total approximately 23.5 ha.

The Y7 core shed and road is also proposed for rehabilitation and will total approximately 1.5 ha.

YEJ 2011

Rehabilitation activities during YEJ11 are proposed for large areas across the Cattle Gorge and Mount Goldsworthy sites. The total area proposed for rehabilitation at Cattle Gorge and Mount Goldsworthy will be approximately 114 ha and 136 ha respectively.

YEJ 2012

Rehabilitation activities during YEJ12 are proposed for Hawks Head (i.e. approximately 12 ha), the Y7 B1 Stockpiles (i.e. approximately 9 ha) and the Y5 and Y6 pits (i.e. total of approximately 45.5 ha).

YEJ 2013

Rehabilitation activities during YEJ13 are proposed for large areas at the Y10 pit (i.e. approximately 98 ha) and the Y8 pit (i.e. approximately 65 ha).

6 FINAL LANDUSE

The post-mining landuse will be determined through ongoing consultation with the administering authority and relevant stakeholders during the remaining life of the mine. Notwithstanding, the most likely final landuse for the lease area will be either low intensity cattle grazing (which is the current landuse for areas not directly affected by mining activities) or inclusion in some form of natural conservation area.

Other possible final landuses for the Goldsworthy lease will be given due consideration during the consultation process. To date, the following stakeholders have indicated that they wish to be included in the process.

Government Organisations

- DoIR
- DEC
- DoW

Non-Government Organisations

- Local pastoralist (Yarrie Station)
- Nyamal Aboriginal Organisation (claimant group covering the entire area)
- Birramaya Aboriginal Organisation (claimant group covering the Yarrie portion only).
- East Pilbara Shire

7 REVISION OF THE DECOMMISSIONING AND REHABILITATION PLAN

The DRP will be revised at intervals of not more than five years. This revision timeline is consistent with the Strategic Framework for Mine Closure (Minerals Council of Australia and ANZMEC, 2000).

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APPENDIX C

SIGNIFICANT SPECIES MANAGEMENT PLAN
(BHP BILLITON IRON ORE, 2009c)

bhpbilliton

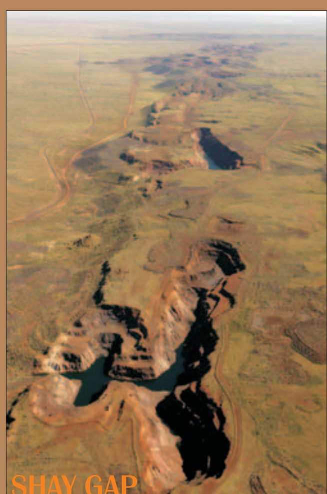

YARRIE

GOLDSWORTHY IRON ORE MINING OPERATIONS

Significant Species Management Plan


CATTLE GORGE


NIMINGARRA


SHAY GAP


SUNRISE HILL

REVISION 3

May 2009

bhpbilliton

BHP Billiton Iron Ore

GOLDSWORTHY IRON ORE MINING OPERATIONS

SIGNIFICANT SPECIES MANAGEMENT PLAN

Revision 3

May 2009

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EXECUTIVE SUMMARY

The Goldsworthy Iron Ore Mining Operations (Goldsworthy) is located approximately 200 kilometres east of Port Hedland, in the north of the Pilbara region of Western Australia. Goldsworthy is situated within mining tenements AML7000249, AML7000263, AML7000251, ML45/594, ML45/558 and ML45/1016 and is operated by BHP Billiton Iron Ore Pty Ltd.

This revision of the Significant Species Management Plan (SSMP) (i.e. Revision 3) has been prepared to satisfy Condition 6-3 of Ministerial Statement of Approval No. 000682. It replaces Revision 2 and has been revised to include the site specific characteristics of the Cundaline and Callawa mining operations, and as supporting documentation to the Cundaline and Callawa Environmental Protection Statement (EPS) (BHP Billiton Iron Ore, 2008a).

Numerous baseline flora and fauna surveys, impact assessments and monitoring programmes have been conducted at Goldsworthy since the 1980s. To date, four flora and eighteen fauna species have been recorded which are listed as being of conservation significance on a Federal and/or State level. There are also several other flora and fauna species which have not be recorded in surveys to date but may occur at Goldsworthy (i.e. they have been recorded in nearby areas and/or suitable habitat exists).

Management measures have been developed by BHP Billiton Iron Ore to reduce the potential impacts of its Pilbara operations on significant species. These measures are described in this document and include the following:

- The location of significant species, their habitat and significant vegetation types is recorded on the relevant databases and mine plans, and awareness of these records is promoted at mine planning and operational levels.
- PROPOSED clearing boundaries are adjusted where possible, to avoid disturbance to significant species, habitat, and vegetation types.
- Species-specific management plans have been developed for all significant species recorded at Goldsworthy and are used to minimise potential impacts on these species. These plans describe the general and specific control measures that are relevant to the particular species.

BHP Billiton Iron Ore recognises that there is a possibility that the conservation status of flora/fauna species may change, and/or new populations of previously recorded species (or other species of conservation significance) may be found at Goldsworthy during the remaining mine life. In the event that this occurs, BHP Billiton Iron Ore will, if possible, avoid disturbance in the area in the first instance. If disturbance is unavoidable, BHP Billiton Iron Ore will implement the flora/fauna management strategies described below:

- Where it is not practicable to avoid known significant flora/fauna species, vegetation associations and/or habitat areas, BHP Billiton Iron Ore will consult with the Department of Environment and Conservation (DEC) regarding the proposed land disturbance.
- Additional targeted pre-clearance surveys will be undertaken where necessary to improve BHP Billiton Iron Ore's knowledge of the distribution of flora species of conservation significance identified during the baseline flora surveys of the Goldsworthy area.

- Where required, species-specific management plans for known locations of significant flora/fauna species, vegetation associations and/or habitat areas that cannot be avoided will be developed in consultation with the DEC prior to the commencement of clearing activities in these areas. These Plans will be documented in a new revision of this SSMP, and the relevant control measures will be included as operational requirements in the Project Environment and Aboriginal Heritage Review (PEAHR) authorisation form for the relevant proposed disturbance area.
- No Declared Rare Flora (DRF) have been recorded within the Goldsworthy area to date, however if future surveys identify DRF, and they cannot be avoided by adjusting the proposed disturbance areas, BHP Billiton Iron Ore will prepare and submit an application(s) to take DRF pursuant to the *Wildlife Conservation Act, 1950*. Any land disturbance in these areas will be subject to Ministerial approval.
- BHP Billiton Iron Ore will maintain appropriate records of impacted flora/fauna species, vegetation associations and/or habitat areas of conservation significance.
- BHP Billiton Iron Ore will report on significant species management activities in its Annual Environmental Report.

The management measures, ongoing monitoring programmes and reporting procedures contained in this SSMP have been developed to minimise or avoid the impacts of Goldsworthy on all known populations of significant species, as well as those species that haven't been recorded to date but could potentially occur.

1 INTRODUCTION

1.1 BACKGROUND

The Goldsworthy Iron Ore Mining Operations (Goldsworthy) are located approximately 200 kilometres (km) east of Port Hedland, in the north of the Pilbara region of Western Australia (WA) (Figure 1-1). Goldsworthy is situated within mining tenements AML7000249, AML7000263, AML7000251, ML45/594, ML45/558 and ML45/1016 and is operated by BHP Billiton Iron Ore Pty Ltd.

Figure 1-2 shows the main deposits, mining areas, infrastructure facilities and BHP Billiton Iron Ore's mining tenements at Goldsworthy.

1.2 PURPOSE OF THIS PLAN

This revision of the Significant Species Management Plan (SSMP) (i.e. Revision 3) has been prepared to satisfy Condition 6-3 of Ministerial Statement of Approval No. 000682. It replaces Revision 2 and has been revised to include the site specific characteristics of the Cundaline and Callawa mining operations, and as supporting documentation to the Cundaline and Callawa Environmental Protection Statement (EPS) (BHP Billiton Iron Ore, 2008a). The relevant conditions within the Statement which are relevant to this SSMP are presented below, along with the corresponding sections of the SSMP that address each condition.

	Ministerial Condition	Section
6-3	• Within six months following the formal authority issued to the decision-making authorities under section 45(7) of the *Environmental Protection Act 1986*, the proponent shall prepare and submit Significant Species Management Plans for the Pilbara Leaf-nosed Bat (*Rhinonicteris aurantius*), the Ghost Bat (*Macroderma gigas*) and any other priority flora or significant fauna species recorded during the surveys required by condition 6-1, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority and the Department of Conservation and Land Management.	
	• The objective of these plans is to maintain the abundance, diversity, geographic distribution, conservation status and productivity of flora and fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	
	• These plans shall describe the significant identified species of flora and fauna and significant vegetation associations and habitat areas, and shall set out procedures and measures to:	2
	– delineate the identified populations and/or individuals of conservation-significant identified species of flora and fauna, and map the extent of conservation-significant vegetation associations and habitat areas;	2, 3
	– modify land clearing plans and evaluate alternative mine plans to minimise or avoid impacts on the conservation-significant identified species of flora and fauna, vegetation associations and habitat areas;	4
	– minimise impacts where proposed mining activities, changes to water flow patterns, or groundwater drawdown are likely to impact on conservation-significant identified species of flora and fauna, vegetation associations and habitat areas;	4
	– monitor and record impacts on identified conservation-significant species of flora and fauna, vegetation associations and habitat areas; and	4, 5
	– implement appropriate contingency plans where impacts on conservation-significant species of flora and fauna, vegetation associations and habitat areas are identified.	4, 5

Obligations under this SSMP

The purpose of this SSMP is to assist BHP Billiton Iron Ore and its contractors in the implementation of appropriate flora and fauna management measures, ongoing monitoring programmes, and reporting procedures for significant flora and fauna species during the operation of Goldsworthy. Where there is any conflict between the provisions of this SSMP and a contractor's obligations under the relevant contract, including the various statutory requirements (i.e. licences, permits, consent conditions and relevant laws), the contract and statutory requirements are to take precedence. In the case of any real or perceived ambiguity between elements of this SSMP and the above statutory requirements the contractor shall first request clarification from BHP Billiton Iron Ore prior to implementing that element of this SSMP over which the ambiguity is identified.

1.3 STRUCTURE AND CONTENT OF THIS PLAN

The structure of this SSMP is as follows:

Section 1	Introduction – describes the background of Goldsworthy and outlines the purpose and structure of this Plan, lists the relevant legislations, describes the relationship between this Plan and other Goldsworthy management plans, and summarises key issues addressed in this SSMP.
Section 2	Summary of Existing Survey Information – provides a summary of past survey information.
Section 3	Recorded and Potential Significant Species – identifies the location, approximate number and type of each significant species recorded in previous surveys and a list of significant species with the potential to occur.
Section 4	General Management Measures for Flora and Fauna – describes general management measures relevant to all flora and fauna species.
Section 5	Specific Management Measures for Species of Conservation Significance – describes specific management measures for species of conservation significance which have been recorded or have the potential to occur within the Goldsworthy area.
Section 6	Reporting Procedures – details the reporting to be undertaken as part of this SSMP.
Section 7	Timeframe for Implementation of this Plan – describes the timeframe for implementation and revision of this SSMP.
Section 8	Lists the references cited in this SSMP.

1.4 RELEVANT LEGISLATION

The management measures contained within this SSMP have been developed in accordance with the relevant provisions of the WA *Environmental Protection Act*, *1986* (EP Act), the WA *Wildlife Conservation Act, 1950* (WC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act). The WA DEC and the Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA) are the relevant administering authorities of these Acts. An overview of the provisions of these Acts which are relevant to Goldsworthy is provided below. It should be noted that the information presented is intended only to provide a summary of the subject matter covered. It does not purport to be comprehensive or to render legal advice.

WA Environmental Protection Act, 1986

The EP Act provides for the establishment of the EPA, which has the objective of overseeing the prevention, control and abatement of pollution and environmental harm, and the conservation, preservation, protection, enhancement and management of the environment. The EPA has developed policies to assist with achieving its objective. These include policies on the use of the precautionary principle, consideration of intergenerational equity, the conservation of biological diversity and ecological integrity, and waste minimisation.

Part IV of the EP Act establishes provisions for the EPA to carry out Environmental Impact Assessments (EIA) in WA. Where relevant, the EPA issues and directs proponents to comply with Guidance Statements that contain the EPA's minimum requirements for the protection of elements of the environment such as flora and fauna. *Guidance Statement 51 – Terrestrial flora and vegetation surveys for Environmental Impact Assessment in Western Australia* and *Guidance Statement 56 – Terrestrial fauna surveys for environmental impact assessment in Western Australia* require proponents to assess flora and fauna of conservation significance in their EIA.

The Goldsworthy Extension Project EPS and Goldsworthy – Callawa and Cundaline Mining Operations EPS (BHP Billiton Iron Ore, 2008a) assessed the impacts of Goldsworthy on flora and fauna in accordance with EPA Guidance Statements 51 and 56.

Wildlife Conservation Act, 1950

The WC Act provides for the protection of flora and fauna species of conservation significance. Protected species are identified as either Declared Rare Flora (DRF) or Scheduled Fauna.

DRF are plant species that are extant and considered likely to become extinct or rare and therefore in need of special protection. They are listed in the *Wildlife Conservation (Rare Flora) Notice, 2008.*

Scheduled Fauna are listed in the *Wildlife Conservation (Specially Protected Fauna) Notice, 2008.* There are four levels of Scheduled Fauna (i.e. 1 to 4). A description of each of the conservation levels is provided in Attachment A.

DEC also maintains a list of four Priority codes for flora, and five Priority codes for fauna. Priority flora and fauna are either poorly known, believed to be uncommon, rare or under threat, but have not be designated DRF or Scheduled Fauna under the WC Act. The WC Act does not provide specific protection for Priority species, however the potential impacts of new proposals on Priority species is generally considered as part of the EIA process under the EP Act (see above).

Environment Protection and Biodiversity Conservation Act, 1999

The Commonwealth EPBC Act contains a list of flora and fauna species that are nominated as being of 'National Environmental Significance'. The list is divided into groups according to conservation status (Attachment A). The EPBC Act also provides for the protection of migratory bird species listed in the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals), the Agreement between the Government of Australia and the Government of the Peoples Republic of China for the Protection of Migratory Birds and their Environment (CAMBA) and the Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA).

BHP Billiton Iron Ore referred the Goldsworthy Mining Operations to the DEWHA for assessment under the EPBC Act in October 2005 and July 2008. The DEWHA determined on both occasions that the Goldsworthy mining operations was not a 'Controlled Action'.

1.5 RELATIONSHIP BETWEEN THIS PLAN AND OTHER GOLDSWORTHY MANAGEMENT PLANS

BHP Billiton Iron Ore has developed an Environmental Management Plan (EMP) for Goldsworthy in accordance with the conditions of Ministerial Statement of Approval No.'s 000682 and 000303 (BHP Billiton Iron Ore, 2006a). The latest revision of the EMP (i.e. Revision 4) was updated to include the site specific characteristics of Cundaline and Callawa, and was prepared as supporting documentation to the Cundaline and Callawa EPS (BHP Billiton Iron Ore, 2008a). The EMP is a broader document than this SSMP in that it describes the overall programme to be used to manage potential impacts of Goldsworthy on all environmental values relevant to the site. The EMP contains an overview of significant species management measures used at Goldsworthy, as well as referring to this SSMP for specific detail (Figure 1-3).

1.6 SUMMARY OF KEY ISSUES COVERED BY THIS PLAN

There have been 28 significant species (eight plants, 10 birds, one reptile, nine mammals) found at Goldsworthy to date and another five significant species that could potentially occur.

A three level management hierarchy (shown below) has been developed by BHP Billiton Iron Ore to broadly classify and assign the appropriate level of management response for significant flora and fauna at Goldsworthy. This SSMP describes how the management hierarchy is to be implemented.

	BHP Billiton Iron Ore's Management Hierarchy for Significant Species at GEP		
	1	**2**	**3**
Summary of Category	Species likely to be impacted in the next five years (i.e. 2008 – 2012).	Species unlikely to be impacted in the next five years (i.e. 2008 – 2012).	Species not previously identified at Goldsworthy but suitable habitat is available and therefore could potentially occur.
Summary of Level of Management Required	Implement higher level specific management plans and monitoring (Section 5.1), plus general environmental management measures and monitoring (Section 4).	Implementation of specific monitoring required (Section 5.2), plus general environmental management measures and monitoring (Section 4).	Implementation of general environmental management measures and monitoring (Section 4).
Species currently in Category	*Goodenia hartiana* *Acacia glaucocaesia* Ghost Bat Mulgara Northern Quoll Pilbara leaf-nosed Bat Pilbara Olive Python Western Pebble-mound Mouse	*Euphorbia clementii* *Euphorbia inappendiculata* *Goodenia nuda* Australian Bustard Bilby Bush Stone-curlew Common Sandpiper Fork-tailed Swift Great Egret Greenshank Lakeland Downs Short-tailed Mouse Marsh Sandpiper Pictorella Mannikin (Western) Star Finch Wood Sandpiper Peregrine Falcon	*Fimbristylis* sp. Shay Gap *Ptilotus mollis* *Bulbostylis burbidgeae* Spectacled Hare Wallaby Long-tailed Dunnart

The following sections provide an overview of the previous flora and fauna surveys at Goldsworthy (Section 2), locations of recorded significant species (Section 3), general environmental management measures to be implemented at Goldsworthy (Section 4), and the specific management measures that are to be used for species of conservation significance (Section 5).

It should be noted that the management hierarchy shown above is intended for internal use by BHP Billiton Iron Ore and its contractors at Goldsworthy. The category assigned to each species is not necessarily fixed, as changes in the conservation significance (as listed by the WC Act or EPBC Act) or BHP Billiton Iron Ore's proposed activities at Goldsworthy may require a change to the level of management response.

This SSMP is to be reviewed and revised at intervals not exceeding five years. The level of management response assigned to species of conservation significance will be reviewed as part of this process. In addition, and where one or more of the management measures described in this SSMP are found to be inadequate, a review of the measure(s) will be conducted and alternative (i.e. contingency) management measures will be implemented where necessary. Any new measures will be developed in consultation with the DEC and will be documented in a new revision of this SSMP where appropriate.

2 SUMMARY OF EXISTING SURVEY INFORMATION

Several baseline surveys and impact assessments have been conducted at Goldsworthy to document and monitor the vegetation associations, flora and fauna in the Goldsworthy area. These studies have covered the Cattle Gorge, Nimingarra, Yarrie, Sunrise Hill, Shay Gap, Cundaline and Callawa areas. Attachment B lists the reports that have been conducted to date.

2.1 FLORA

In a regional context, Goldsworthy is situated in the Fortescue Botanical District within the Eremaean Botanical Province (*ecologia*, 2005a). The Fortescue Botanical District is characterised by tree and shrub steppe with some short grass savannah on the coast, and is divided into eight subdistricts. The relevant subdistrict to Goldsworthy area is Gorge Range. This subdistrict has been described as isolated sections of ranges of highly metamorphosed Archaean and lower Proterozoic rocks of sedimentary and volcanic origin, with tree steppe on rocky grounds of ranges, replaced by shrub steppe in the valleys and lower slopes (Beard, 1975).

The Shay Gap borefield (used to meet mine water requirements) is located in the Canning Botanical District, which is located immediately to the north of the Fortescue Botanical District and is largely coincident with the Great Sandy Desert. The Great Sandy Desert is characterised by Quaternary red longitudinal sand dune fields overlaying Jurassic and Cretaceous sandstones of the Canning Basin, with some areas of gently undulating laterised uplands that support a shrub steppe.

Early flora survey work in the wider Pilbara region was carried out by Royce (1948) and Burbidge (1959) while broad scale vegetation mapping was first carried out by Burbidge (1945) and later refined by Beard (1975; 1979). However it was not until the increased development of mineral resources in the region during the last twenty years that any site-specific detailed flora surveys have been conducted in the Pilbara region. A summary of the findings of surveys conducted in Goldsworthy area is provided below.

Yarrie

Some 209 flora species from 47 families and 105 genera have been recorded at Yarrie (*ecologia*, 2005a). The most common families recorded were Poaceae, Papilionaceae, Mimosaceae, Malvaceae and Myrtaceae. The most commonly recorded species were *Acacia*, *Eucalyptus*, *Ptilotus* and *Eriachne*. The 12 vegetation communities identified as occurring within the Yarrie area are shown on Figure 2-1a to 2-1d and the key characteristics of each are provided in Table 2-1.

Table 2-1
Vegetation Communities - Yarrie Area

Community	Community Description
01	Scattered *Corymbia hamersley*ana over sparse *Acacia inaequilatera*/*Grevillea pyramidalis* and sparse to moderately dense *Triodia wiseana* on calcrete base plains
02	*Triodia wiseana* steppes
03	Sparse emergents over open *Triodia pungens/T. wiseana* on steep rocky slopes
04	*Triodia pungens* dominated steppes
05	Open density emergents over moderately dense *Triodia pungens*
06	*Triodia basedowii* steppes
07	Sparse mixed shrubs over sparse *Triodia pungens* on low rocky slopes
08	Sparse *Eucalyptus leucophloia* and other Eucalypts over *Acacia tumida*, mixed soft grasses and *Triodia pungens* on gullies
09	Open to dense *Acacia tumida* over *Triodia pungens* on major drainage lines
10	*Eucalyptus camaldulensis/E. victrix* over sparse to moderately dense tall shrubs and mixed soft grasses and spinifex
11	Dense *Sesbania formosa* over dense *Cyperus vaginatus* on minor spring
12	Sparse *Corymbia hamersleyana/Eucalyptus candida* over *Indigofera monophylla* and mixed shrubs and *Ipomoea muelleri* on sandplains

Cattle Gorge Mining Area and Haul Road

A total of 126 flora species from 23 families and 33 genera have been recorded in the Cattle Gorge area (*ecologia*, 2005a). The most common families recorded were Poaceae, Papilionaceae, Mimosaceae, Malvaceae and Tiliaceae. The seven vegetation communities identified as occurring at Cattle Gorge are shown on Figure 2-2 and the key characteristics of each are provided in Table 2-2.

Table 2-2
Vegetation Communities - Cattle Gorge

Community	Community Description
01	Open to scattered *Grevillea wickhamii* tall shrubland, over *Acacia tumida* var. *pilbarensis/Tephrosia spechtii* medium shrubs, over moderately dense *Triodia epactia* hummock steppe on hill crests and gentle slopes.
02	Moderately dense *Grevillea wickhamii* tall shrubland, over *Acacia tumida* var. *pilbarensis,* often with scattered *Corymbia hamersleyana* low trees*,* over moderately dense *Triodia epactia* hummock steppe along moderate to gentle gullies and hill slopes.
03	Scattered *Grevillea pyramidalis* subsp. *pyramidalis/Acacia pyrifolia/Senna glutinosa* subsp. *glutinosa* tall to medium shrubs, over sparse medium to low shrubs, over *Acacia ptychophylla* dwarf shrubs, over open to moderately dense *Triodia wiseana* hummock steppe on steep scarp slopes.
04	Moderately dense to dense *Acacia tumida* var. *pilbarensis* tall shrubland, over sparse to scattered medium/low shrubs, over soft grasses such as *Cymbopogon ambiguus,* over open to sparse *Triodia epactia* hummock grassland at rocky outcrops on steep upper scarp slopes.
05	Scattered *Eucalyptus leucophloia* with scattered *Corymbia hamersleyana* or *Grevillea wickhamii* subsp. *aprica*, over *Acacia spondylophylla* with open to moderately dense *Triodia epactia/Triodia wiseana* on moderately steep hill slopes.
06	Scattered *Acacia inaequilatera/Grevillea pyramidalis* low trees, sometimes with *Corymbia hamersleyana* low trees, over scattered *Grevillea wickhamii* subsp. *aprica/Acacia ptychophylla*, and other medium to low shrubs, over moderately dense *Triodia wiseana/Triodia wiseana* hummock steppe.
07	Scattered *Acacia inaequilatera,* sometimes with *Corymbia hamersleyana* or *Corymbia flavescens* low trees, over scattered mixed *Acacia* species as medium to low shrubs, over moderately dense *Triodia wiseana* hummock steppe on gentle lower hill slopes.

Nimingarra and Sunrise Hill

A total of 183 flora species have been recorded at Nimingarra from 41 families and 149 genera (*ecologia*, 2005a). The most common families recorded were Poaceae, Papilionaceae, Mimosaceae, Malvaceae and Amaranthaceae. The most commonly recorded species were *Acacia*, *Sida*, *Ptilotus, Tephrosia, Eriachne* and *Solanum*.

A total of 201 flora species were recorded in the Sunrise Hill area from 45 families and 10 genera (*ecologia*, 2005a). The most common families recorded were Poaceae, Mimosaceae, Papilionaceae, Amaranthaceae, Asteraceae, Myrtaceae and Tiliaceae. The most commonly recorded species were *Acacia, Ptilotus*, *Eriachne Triodia, Senna, Triumfetta* and *Sida.*

Ecologia (2004a) classified the vegetation communities at Nimingarra along with those of Sunrise Hill area due to their close proximity and because they have very similar landform types. A total of 26 vegetation communities were identified as occurring in the Nimingarra and Sunrise Hill areas. The vegetation communities were categorised as forest, woodland, scattered trees over shrubland and various shrubland types over grasses and spinifex (*Triodia* spp). The vegetation communities are shown on Figures 2-3, 2-4a and 2-4b. Figure 2-5 provides the legend for the Nimingarra and Sunrise Hill vegetation maps. The key characteristics of each community are provided in Table 2-3.

Table 2-3
Vegetation Communities - Nimingarra and Sunrise Hill

Category	Community	Community Description
Forest	A1	*Melaleuca argentea/Eucalyptus victrix* dense to moderately dense tall to medium forest, over *Atalaya hemiglauca/Ficus brachypoda/Ficus opposita* var. *indecora* low trees, over *Typha domingensis* rushes, over *Cyperus vaginatus* sedgeland on peaty sand in shaded/sheltered locations near cliffs/gorge bases.
	A2	*Corymbia hamersleyana* and/or *Corymbia flavescens* and/or *Eucalyptus victrix* moderately dense to scattered medium forest to woodland, sometimes with *Melaleuca argentea,* over *Acacia tumida* var. *pilbarensis*/*Acacia colei* var. *colei* tall to low shrubland, often over *Bonamia pannosa, Trachymene oleracea, Waltheria indica* herbs, sometimes with *Cyperus* spp. sedges, on sand to sandy clay creek beds and gully confluences that may be degraded or disturbed by cattle grazing or hydrology change from roads.
	A3	*Ficus virens* dense medium forest over *Ficus brachypoda* over *Atalaya hemiglauca/ Corymbia flavescens* open low trees over *Ficus opposita* var. *indecora/Grevillea pyramidalis* subsp. *pyramidalis* over *Tinospora smilacina* lianas, at base of sheltered gorge/cliff, with *Stemodia* sp. Shay Gap and *Corymbia* sp.
Woodland	B1	*Eucalyptus leucophloia* medium woodland, over mixed shrubs such as *Senna glutinosa* subsp. *glutinosa*/*Acacia inaequilatera*/*Acacia adoxa* var. *adoxa/Indigofera monophylla* (small calyx form), over *Triodia epactia* hummock.
	B2	*Acacia ampliceps/Sesbania formosa/Corymbia hamersleyana* open medium trees over *Ficus opposita* var. *indecora,* over *Typha domingensis* rushes, over *Cyperus vaginatus sedges* in areas disturbed by cattle.
	B3	*Corymbia hamersleyana* scattered low woodland over *Grevillea wickhamii* subsp. *aprica* medium shrubs over *Corchorus* aff. *parviflorus* (2) sparse low shrubs over *Acacia hilliana* dwarf shrubs over *Triodia epactia* open hummock grassland on cream/brown/pale yellow sandy clay with gravel on undulating plains.
	B4	*Corymbia hamersleyana/Corymbia flavescens* low trees over mixed *Acacia* spp. and other shrubs over *Acacia adoxa* var. *adoxa/Indigofera monophylla* (small calyx form)*/Bonamia rosea/Tephrosia* sp. Bungaroo Creek (M.E. Trudgen 11601)/*Bonamia linearis/Isotropis atropurpurea,* over *Triodia epactia* hummock grassland on sand to clayey sand plain.
	B5	*Corymbia hamersleyana* scattered low trees, often found with *Eucalyptus odontocarpa* mallee, over *Acacia tumida* var. *pilbarensis* open tall shrubland, over *Templetonia hookeri,* over *Pterocaulon sphaeranthoides, Acacia adoxa* var. *adoxa,* over *Triodia epactia* hummock grass on broad gullies and minor channels.

Table 2-3 (Continued)
Vegetation Communities - Nimingarra and Sunrise Hill

Category	Community	Community Description
Woodland (Cont.)	B6	*Eucalyptus leucophloia/Grevillea pyramidalis* subsp. *pyramidalis* scattered low trees/medium shrubs over *Acacia colei* var. *colei* and *Solanum horridum* medium/low shrubs over *Triodia epactia* hummock grassland on hilltops that are sometimes dust and rock blast affected.
	B7	*Acacia inaequilatera* scattered low trees with or without *Corymbia hamersleyana*, over *Grevillea* subsp. *aprica,* over *Acacia hilliana/Acacia adoxa* var. *adoxa* dwarf shrubs, over *Triodia epactia* open to moderately dense hummock grassland.
	B8	*Acacia inaequilatera* low trees over *Grevillea wickhamii* subsp. *aprica* medium shrubs over *Acacia ptychophylla* over *Triodia epactia* hummock grassland on scarp plateaux.
	B9	*Acacia inaequilatera* scattered low trees, over *Acacia* sp. Ruddall River (B.R. Maslin 2046A) scattered medium shrubland, over *Triodia epactia* moderately dense hummock grassland steppe, with *Acacia pyrifolia* and *Eucalyptus leucophloia* on gentle slopes to gravel plains.
	B10	*Acacia inaequilatera* scattered low trees, over *Grevillea wickhamii* var. *aprica/Acacia tumida* var. *pilbarensis/Grevillea pyramidalis* subsp. *pyramidalis/Dodonaea coriacea/Ptilotus calostachyus,* over *Acacia hilliana* sparse dwarf shrubland, over *Bonamia media* var. *villosa/ Goodenia stobbsiana/Fimbristylis simulans* over *Triodia epactia* moderately dense hummock grassland on gentle hillcrest/scarp plateaux.
	B11	*Ficus brachypoda* or *Ficus virens* low trees, over *Atalaya hemiglauca* over *Jasminum didymum* over *Triumfetta maconochieana* over *Nicotiana benthamiana*, *Pterocaulon sphaeranthoides* herbs in shallow gorges with *Stemodia* sp. Shay Gap.
Shrublands	C1	*Acacia tumida* var. *pilbarensis* scattered to sparse tall to low shrubland with or without *Corymbia hamersleyana/Grevillea wickhamii* subsp. *aprica,* over *Acacia hilliana/Acacia adoxa* dwarf shrubs over *Triodia epactia* open to moderately dense hummock grassland.
	C2	*Acacia orthocarpa* sparse to scattered tall/medium shrubland with *Acacia inaequilatera* over sparse to scattered *Acacia adoxa* var. *adoxa/Acacia hilliana* dwarf shrubs over *Triodia epactia* open to moderately dense hummock grassland.
	C3	*Acacia tumida* var. *pilbarensis/Acacia colei* var. *colei* tall to low shrubland, over *Acacia inaequilatera/Acacia pyrifolia* over *Ptilotus calostachyus* often over *Salsola tragus* over *Aristida contorta, Aristida holathera/Cymbopogon ambiguus* grasses over *Ipomoea muelleri/Mukia maderaspatana* lianas over *Triodia epactia/Triodia lanigera/Triodia wiseana* hummock grass on rehabilitated soil or waste rock dumps.
	C4	Mixed medium to tall shrubland including *Tephrosia spechtii* over *Acacia adoxa* var. *adoxa/ Acacia hilliana* sparse to moderately dense dwarf shrubland over sparse to open *Triodia epactia* hummock grassland on hillcrests, slopes / breakaways and gullies.
	C5	Mixed medium shrubs over *Acacia inaequilatera* low shrubs or *Acacia adoxa* var *adoxa* dwarf shrubs, over *Indigofera monophylla* (small calyx form)/*Corchorus* aff. *parviflorus/Bonamia media* var. *villosa* over *Triodia epactia* or *Triodia wiseana* hummock grassland on steep slopes and breakaways.
	C6	*Grevillea wickhamii* subsp. *aprica* open to scattered medium – low shrubland usually with *Corymbia hamersleyana* low trees, over *Acacia adoxa* var. *adoxa* dwarf shrubland over *Triodia epactia* open hummock grassland along drainage lines.
	C7	*Acacia inaequilatera* scattered medium shrubland over *Acacia stellaticeps/Acacia hilliana/ Acacia adoxa* var. *adoxa*, *Acacia* sp. Ruddall River (B.R. Maslin)/*Acacia tumida* var. *pilbarensis*/*Ptilotus calostachyus,* over *Triodia epactia* moderately dense hummock grassland on low undulating slopes to plains and spurs.
	C8	*Acacia ptychophylla, Acacia ancistrocarpa, Acacia pyrifolia, Grevillea wickhamii* subsp. *aprica* scattered low shrubland over *Dodonaea coriacea*, *Acacia colei* var. *colei* dwarf shrubs over *Triumfetta maconochieana* over *Triodia wiseana* moderately dense hummock grassland on steep south-facing scarp slopes.
	C9	*Melaleuca glomerata* sparse medium shrubland with *Ficus opposita* var. *indecora*, over *Typha domingensis* rushes over *Cyperus vaginatus* sedges, over *Flaveria australasica* herbs on clay loam to peat soil in swampy channels.
	C10	Mixed shrubs including *Triumfetta* spp. over *Trachymene oleracea* over *Evolvulus alsinoides* var. *villosicalyx* over *Bulbostylis barbata* over *Triodia epactia/Triodia wiseana* hummock spinifex steppe on moderate slopes, minor channels and granite plains.

Along the south-western side and south-eastern end of the Sunrise Hill ridgeline, there are a number of pockets of vegetation associated with accumulated water and shaded environments at the base of cliff/gorge systems. These areas have been mapped by *ecologia* (2005a) as two vegetation communities which are dominated by *Melaleuca argentea, Eucalyptus victrix*, and/or *Ficus brachypoda*. The two communities were recorded at survey sites 41, 47, 65 and 71 (Figure 2-4a and 2-4b) and appear to be very restricted in local distribution. They are therefore considered by *ecologia* (2005a) to have local conservation significance. Mining activities are not proposed in these two vegetation community types.

Flora species of conservation significance that have been recorded at Goldsworthy to date are listed in Section 3.

Cundaline and Callawa

A total of 20 vegetation communities were identified along the Cundaline Ridge and surrounding plains (ENV Australia, 2008; *ecologia,* 2005d) (Figure 2-6a). Descriptions of these vegetation communities are provided on Figure 2-6b. A total of 14 vegetation communities were identified in the Callawa area and surrounds (ENV Australia, 2008; *ecologia,* 2005e) (Figure 2-7a). Descriptions of these vegetation communities are provided on Figure 2-7b. During recent surveys, 147 flora taxa were recorded in a study area encompassing the Callawa mining area and 193 taxa were recorded in a study area encompassing the Cundaline mining area. The most abundant plant families represented were Poaceae, Papilionaceae, Mimosaceae and Malvaceae.

2.2 FAUNA

The Interim Biogeographic Regionalisation of Australia (IBRA) divides the Australian continent into 85 biogeographic regions based on their climatic, faunal, vegetation, landform and geological features (Environment Australia, 2004). Goldsworthy falls within the Pilbara Region, which is further subdivided into the Hamersley, Fortescue Plains, Chichester and Roebourne sub-regions. Goldsworthy is located within the Roebourne sub-region.

The Roebourne sub-region is characterised by Quaternary alluvial plains with a grass savanna of mixed bunch and hummock grasses, and dwarf shrub steppe of *Acacia translucens* over *Triodia pungens*. Samphire, *Sporobolus* and Mangal occur on marine alluvial flats.

Yarrie

Systematic sampling and opportunistic collecting conducted by *ecologia* (2005a) found 88 vertebrate species, including 14 native and three introduced mammal species, 43 birds, 24 reptiles, three amphibians and one fish.

Five habitat types, ranging from mesa top to creek bed have been identified as occurring within the Yarrie area (*ecologia*, 1999).

(1) Riverine – Eucalypt species on stony to sandy substrate in channel and *Acacia* thicket on sandy soils on banks;

(2) Gorge – steep-sided gorge with scattered *Eucalyptus leucophloia* over *Triodia* species. Skeletal, sandy or stony soils. Pools in base;

(3) Shrubland – *Grevillea pyramidalis* shrubland over *Triodia* species;

(4) Scree slope – Scattered mixed shrubs over *Triodia* species. Substrate stony to rocky. Thick shrubs in minor drainage lines; and

(5) Plateau/hilltop – Scattered mixed shrubs over *Triodia* species on skeletal soils.

Fauna species of conservation significance that have been identified at Yarrie include:

- Northern Quoll (*Dasyurus hallucatus*);
- Western Pebble-mound Mouse (*Pseudomys chapmani*); and the
- Lakeland Downs Short-tailed Mouse (*Leggadina lakedownensis*).

Cattle Gorge

The combination of a systematic and an opportunistic survey conducted by *ecologia* (2005a) identified 15 mammal species, 77 bird species, three species of amphibian, one species of fish and 28 species of reptile.

Four of the habitat types identified at Yarrie were also recorded by *ecologia* (2005a) as also occurring in the Cattle Gorge area (i.e. gorge, shrubland, scree slope and plateau/hilltop). The riverine habitat type found at Yarrie in the vicinity of Eel Creek was not recorded at Cattle Gorge study area; however it does occur immediately to the east in Cattle Gorge itself.

Fauna species of conservation significance that have been identified at Cattle Gorge include:

- Pilbara Olive Python (*Liasis olivaceus barroni*);
- Pilbara Leaf-nosed Bat (*Rhinonicterus aurantia*);
- Mulgara (*Dasycercus cristicauda*); and the
- Northern Quoll (*Dasyurus hallucatus*).

Nimingarra

During the Nimingarra survey (*ecologia*, 2005a) approximately 103 vertebrate fauna species were identified, comprising three introduced and 14 native mammal species, 52 bird species, 34 reptile species and one amphibian species.

Four habitat types were recognised and surveyed by *ecologia* (2005a) at Nimingarra.

(1) Sandplain/Alluvial Outwash Plain - typically patchy stands of *Acacia tumida* var. *pilbarensis/ A. colei* var. *colei* tall/medium shrubs over dense to moderately dense *Triodia epactia* hummock grassland.

(2) Gullies/Major Drainage Lines - typically vegetated with *Corymbia hamersleyana* trees over mixed mid level shrubs, mainly *Acacia tumida* var. *pilbarensis, A. colei* var. *colei, Grevillea wickhamii* subsp. *aprica* and *Petalostylis labicheoides*. The slopes of these drainage lines are dominated by *Triodia epactia*. A number of these drainage lines also have large stands of *Ficus* spp. which provide an additional specific sheltered microhabitat.

(3) Slopes/*Triodia* Steppe - these slopes are typically with rocky substrate, mainly vegetated with *Triodia epactia* hummock grass.

(4) Riverine: The substrate ranges from sand through to loose stones and rocks. Vegetated by very sparse *Corymbia hamersleyana* trees, with open *Melaleuca argentea* woodland, that is quite dense in places, with disjunct beds of *Typha domingensis* rushes

Fauna species of conservation significance that have been identified at Nimingarra include:

- Pilbara Leaf-nosed Bat (*Rhinonicterus aurantia*); and the
- Northern Quoll (*Dasyurus hallucatus*).

In May 2006, CALM (now DEC) issued at letter in regards to the draft version of Goldsworthy SSMP, which explained that there were records of Bilby specimens that had been lodged from Goldsworthy area. BHP Billiton Iron Ore requested clarification of these records from the WA Museum in June 2006. The WA Museum advised that dead Bilby specimen donations had been received from approximately 700 m North of Nimingarra A in March and April 1990, and from Mt Goldsworthy (approximately 50 km east of Goldsworthy) in May 1991. Although not directly within the Goldsworthy mining leases, the 1990 records were within the vicinity of the pubic road that is used to access Goldsworthy.

Sunrise Hill

During the Sunrise Hill survey (*ecologia*, 2005a) approximately 92 vertebrate fauna species were identified, comprising two introduced and 10 native mammal species, 45 bird species, 30 reptile species, two amphibian species and three fish species.

Due to the close proximity of Sunrise Hill to Nimingarra, there is considerable similarity and overlap of habitat types, although some distinct differences were noted by *ecologia* (2005a). The six habitat types identified as occurring in the area were:

(1) Sandplain/Alluvial Outwash Plain: vegetation is typically patchy stands of *Acacia tumida*/ *A. colei* over dense to moderately dense *Triodia epactia* hummock grassland.

(2) Gullies/Major Drainage Lines: typically vegetated with *Corymbia hamersleyana* over mixed mid level shrubs, mainly *Acacia tumida*, *A. colei, Grevillea wickhamii* and *Petalostylis labicheoides.* The slopes of these drainage lines are dominated by *Triodia epactia*. A number of these drainage lines also have large stands of *Ficus* spp. which provide an additional specific sheltered microhabitat.

(3) Slopes/*Triodia* Steppe: these slopes are typically with rocky substrate, mainly vegetated with *Triodia epactia*.

(4) Riverine: The substrate ranges from sand through to loose stones and rocks. Vegetated by very sparse *Corymbia hamersleyana*, with open *Melaleuca* sp., which in places becomes quite dense, with disjunct beds of *Typha domingensis*.

(5) Gorges: Often vegetated similarly to the riverine habitat, the gorge systems in the Sunrise Hill area were defined by being much deeper, with high rock walls, and often containing pools of water.

(6) Melaleuca Woodland: situated at the base of gorges, this habitat was often inundated by water at ground level, either through runoff, or from permanent seeps out of the rocks.

Fauna species of conservation significance that have been identified at Sunrise Hill include the Bush Stone-curlew (*Burhinus* grallarius) and the Northern Quoll (*Dasyurus hallucatus*).

Cundaline and Callawa

Outback Ecology (2008) recorded the following broad fauna habitat types within the Cundaline and Callawa areas:

- *Drainage lines* – consists of steep to moderately rocky slopes, descending down to stony soils and silty to gritty alluvium. Shrubs and grasses dominate, such as *Themeda* species, *Eragrostis* species and *Triodia* species. This habitat type supports a number of bird, reptile and mammal species that utilise the embankments, litter layer and caves and rock pools that may be associated with the drainage lines.
- *Hilltops* – generally consist of large rock outcrops and stony skeletal soils, supporting only sparse vegetation, dominated by grasses, such as *Triodia* species. These habitats support a limited number of fauna species due to the lack of shelter in the form of leaf litter, bark and woody debris.
- *Ridges* - consists of exposed rock and bare skeletal soils overlying large cliffs above vegetated slopes below. Vegetation is generally comprised of *Eucalyptus* sp., *Acacia* sp. and *Ficus* sp. This habitat type supports a number of vertebrate fauna and invertebrate short-range endemic species that utilise caves and crevices in the cliff face and the sheltered vegetation below the ridge. Ridges also provide the highest potential for bat habitat in the region.
- *Slopes and plains* - consists of sparse *Corymbia* and *Eucalyptus* species and fairly dense spinifex (*Triodia* species), and generally supports only a moderate number of bird species.

A total of 12 mammal species (11 native), 40 birds, 18 reptiles and one amphibian was identified during the Cundaline field survey (*ecologia*, 2005d). The Callawa field survey yielded 13 native mammal species, 42 birds, 18 reptiles and one amphibian (*ecologia*, 2005e).

Fauna species of conservation significance that have been identified at Cundaline and Callawa include (Figures 2-8 and 2-9):

- Northern Quoll (*Dasyurus hallucatus*);
- Pilbara Leaf-nosed Bat (*Rhinonicterus aurantia*);
- Mulgara (*Dasycercus cristicauda*);
- Peregrine Falcon (*Falco peregrinus*); and
- Pilbara Olive Python (*Liasus olivaceus barroni*).

Genetic Studies on the Pilbara Leaf-nosed Bat (Rhinonicteris aurantia)

BHP Billiton Iron Ore commissioned Mohlar Pty Ltd (company of which Dr Armstrong is a collaborative partner), to conduct genetic studies on the Pilbara Leaf-nosed Bat to increase the understanding of the Pilbara Leaf-nosed Bat at a State and National level through building a genetic database spanning different bat populations. The initial study results are indicating an emerging pattern of population connection between Pilbara Leaf-nosed Bats from Goldsworthy and Bamboo Creek (located 30 km south of the Yarrie Ridge) (Mohlar, 2008).

3 LOCATION OF SIGNIFICANT SPECIES

Significant species identified at Goldsworthy are listed in Table 3-1.

Table 3-1
Location of Species of Conservation Significance

Species	Conservation Classification (November 2008) (Attachment A)	Significant Species Level[5]	Reference (see Attachment B)
Flora			
Acacia glaucocaesia	Priority 3[1]	Level 1	*ecologia*, 2005a
Euphorbia clementii	Priority 2[1]	Level 1	*ecologia*, 1999, 2004a ENV, 2008
Euphorbia inappendiculata	Priority 3[1]	Level 2	*ecologia*, 1999
Goodenia hartiana	Priority 2[1]	Level 1	*ecologia*, 2004a
Goodenia nuda	Priority 3[1]	Level 2	ENV, 2008
Fauna			
Australian Bustard (*Ardeotis australis*)	Priority 4[2]	Level 2	*ecologia*, 2004b, 2004c
Bilby (*Macrotis lagotis*)	Vulnerable[4] Schedule 13	Level 2	WA Museum
Bush Stone-curlew (*Burhinus grallarius)*	Priority 4[2]	Level 2	*ecologia*, 2004b, 2005a
Common Sandpiper (*Actitis hypoleucos)*	Migratory[4]	Level 2	*ecologia*, 2005a
Fork-tailed Swift (*Apus pacificus)*	Migratory[4]	Level 2	*ecologia*, 2005a
Ghost Bat (*Macroderma gigas)*	Priority 4[2]	Level 1	Dames and Moore, 1992 *ecologia*, 2005a, 2005c, 2005d, 2005e
Great Egret (*Ardea alba)*	Migratory[4]	Level 2	*ecologia*, 2005a
Greenshank (*Tringa nebularia)*	Migratory[4]	Level 2	*ecologia*, 2005a
Lakeland Downs Short-tailed Mouse (*Leggadina lakedownensis)*	Priority 4[2]	Level 2	*ecologia*, 1999
Marsh Sandpiper (*Tringa stagnatilits)*	Migratory[4]	Level 2	*ecologia*, 2005a
Mulgara (*Dasycercs cristicauda)*	Vulnerable[4] Schedule 1[3]	Level 1	*ecologia*, 2005a
Northern Quoll (*Dasyurus hallucatus)*	Endangered[4]	Level 1	Dames and Moore, 1992, *ecologia*, 2004b, 2005a, 2005d, 2005e
Peregrine Falcon (*Falco peregrinus*)	Schedule 4[3]	Level 3	*ecologia*, 2005e
Pilbara leaf-nosed Bat (*Rhinonicteris aurantia)*	Vulnerable[4] Schedule 1[3]	Level 1	*ecologia*, 2005a, 2005c, 2005d, 2005e
Pictorella Mannikin (*Heteromunia pectoralis)*	Priority 4[2]	Level 2	*ecologia*, 2005a
Pilbara Olive Python (*Liasis olivaceas barroni)*	Vulnerable[4] Schedule 1[3]	Level 1	Dames and Moore, 1992 *ecologia*, 2004b

Table 3-1 (Continued)
Location of Species of Conservation Significance

Species	Conservation Classification (November 2005) (Attachment A)	Significant Species Level[5]	Reference (see Attachment B)
Fauna (Continued)			
(Western) Star Finch (*Neochmia ruficauda subclarescens)*	Priority 4[2]	Level 1	*ecologia*, 2005a
Western Pebble-mound Mouse (*Pseudomys chapmani*)	Priority 4[2]	Level 1	*ecologia*, 2005a, 2005d, 2005e
Wood Sandpiper (*Tringa glareola)*	Migratory[4]	Level 2	*ecologia*, 2005a

1 Listed in DEC *Priority Flora List.*
2 Listed in DEC *Priority Fauna List.*
3 Listed in *Wildlife Conservation (Specially Protected Fauna) Notice 2005.*
4 Listed in *Environmental Protection and Biodiversity Conservation Act 1999.*
5 As defined in Section 1.6.

3.1 SIGNIFICANT SPECIES WITH THE POTENTIAL TO OCCUR

The significant species with the potential to occur at Goldsworthy are all categorised as requiring a Level 3 management response as defined in Section 1.6. These species are:

- *Fimbristylis* sp. Shay Gap (DEC – Priority 1);
- *Ptilotus mollis* (DEC – Priority 2);
- *Bulbostylis burbidgeae* (DEC – Priority 3).
- Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*) (Priority 3); and
- Long-tailed Dunnart (*Sminthopsi longicaudata*) (Priority 4).

None of these significant species have been recorded at Goldsworthy to date, however they all have the potential to occur as they are known to occur in the wider area and/or where suitable habitat exists at Goldsworthy (*ecologia*, 2005a).

4 GENERAL MANAGEMENT MEASURES FOR FLORA AND FAUNA

General management measures to minimise the potential impacts of Goldsworthy on all flora and fauna (i.e. not just significant species) can be broadly sub-divided into the following two categories:

- mine planning; and
- operational.

4.1 MINE PLANNING

The layout of new infrastructure and mine landforms at Goldsworthy will be designed so that overall environmental impacts (including impacts on flora and fauna) are kept to a minimum. Figure 4-1 illustrates the decision-making steps and considerations that BHP Billiton Iron Ore's mine planners will follow during the planning and design process.

Once a preliminary design has been developed, BHP Billiton Iron Ore mine planners will consider aspects such as:

- The coverage and results of baseline flora, fauna and heritage surveys, including avoiding species of conservation significance where possible.
- Whether the preliminary design complies with tenure and operating conditions and commitments for Goldsworthy.
- Whether investigations have been conducted to determine if the preliminary design is located a safe distance from the pit walls.
- Whether species of conservation significance are sensitive to removal and relocation.
- Whether the preliminary design would sterilise economic resources or future infrastructure.
- The potential for acid rock drainage (ARD) and management considerations for any material that has been characterised as potential acid forming (PAF).
- The compatibility of the preliminary design with the agreed 'Guiding Closure Principles' for the mine (e.g. shape consistent with regional landforms, impacts on surface drainage, effect on visual amenity).
- Whether infill and backfill alternatives have been considered.

Mine planners must consider all of the plan-related decisions and questions sequentially and in equity, to ensure all items are covered in the decision-making process for mine plans.

4.2 GENERAL OPERATIONAL CONTROL MEASURES FOR FLORA AND FAUNA

The following control measures will be used at an operational level to minimise the potential impacts of Goldsworthy on flora and fauna:

- The area of land disturbance at Goldsworthy will be kept to the practicable minimum and rehabilitation will be conducted progressively where mine scheduling allows.

- The location of significant flora and fauna species, their habitat and significant vegetation types will be recorded on the relevant environmental management databases and mine plans (where possible). These records will be updated as necessary, and awareness of these records will be promoted at mine planning and operational levels.
- The BHP Billiton Iron Ore Environmental Advisor for Goldsworthy (or nominated delegate) will retain all records of areas that have been disturbed by mining operations in the vicinity of Goldsworthy, and where possible, record all significant flora populations that have been impacted within these disturbed areas. These records will be used to update the SSMP each time it is revised, so that a summary of the impacted populations of each significant flora species is included.
- Where clearing of new areas is necessary, prior approval by BHP Billiton Iron Ore via the Project Environment and Aboriginal Heritage Review (PEAHR) land clearing procedure is required before works commence. The PEAHR procedure includes an assessment of the presence or absence of significant species in the area to be cleared based on the baseline survey results of the Goldsworthy area (Attachment B).
- The BHP Billiton Iron Ore Environmental Advisor for Goldsworthy (or nominated delegate) will determine whether the coverage of the baseline surveys in the proposed clearing area (i.e. the subject of the PEAHR) is adequate (in consultation with the DEC where appropriate), and will co-ordinate the undertaking of additional targeted pre-clearance surveys to improve BHP Billiton Iron Ore's knowledge of the distribution of flora and/or fauna species of conservation significance if required.
- The BHP Billiton Iron Ore Environmental Advisor for Goldsworthy (or nominated delegate) will include any operational flora and fauna management requirements in the PEAHR authorisation form for the relevant proposed clearing area. These management requirements will be determined on a case by case basis and may include, but are not necessarily restricted to, the following:
  - demarcation and retention of particular mature trees which can reasonably be avoided and may provide ongoing habitat during operations and post closure;
  - specific timing requirements or clearing methods to be used in order to minimise potential harm to fauna species (i.e. staged clearing to maximise the potential for mobile species to move to adjoining areas);
  - requirements to salvage and temporarily stockpile particular vegetation types or habitat features (i.e. leafy material, stumps, logs, boulders) for use in rehabilitation programmes; and
  - based in Section 5 of this SSMP, specific management measures to minimise impacts on species of conservation significance that may occur within or near the proposed clearing area (i.e. identification of a particular species, protocol for reporting, requirements to avoid/collect/record).
- Clearance plans will be prepared prior to clearing taking place to identify the extent of the area authorised to be cleared. The area to be cleared will be identified on the ground (e.g. with pegs and/or flagging tape). The BHP Billiton Iron Ore Environmental Advisor for Goldsworthy (or nominated delegate) will check the ground markings and regularly monitor clearing operations to assess whether the plans are being adhered to.
- A condition prohibiting unauthorised clearing will be included in all contracts.

- Vehicles and machinery will be parked only in designated locations and off-road recreational activities will be prohibited.
- Dust control measures such as road watering, use of sprays on the main ore transfer points, and progressive rehabilitation of disturbed areas will be used to minimise dust from the site adversely affecting flora and fauna.
- Weed management measures will be implemented in accordance with the Goldsworthy Weed Management Plan.
- Pest control measures will be implemented in accordance with the Goldsworthy EMP.
- The return of fauna to rehabilitated areas will be promoted.
- Where controlled burns of adjoining native vegetation is required to reduce local fuel loads, approval will be sort from the relevant Government administering authorities. The methods used for fire hazard reduction burning will be developed in consultation with the relevant Government administering authorities (including DEC) and in accordance with the control measures documented in the Goldsworthy EMP.
- Necessary precautions will be made by mining personnel to prevent unwanted fires during mining operations. These precautions will be stated at induction and awareness programmes held by BHP Billiton Iron Ore.
- The BHP Billiton Iron Ore Environmental Advisor for Goldsworthy (or nominated delegate) will regularly review the conservation status of flora and fauna species (i.e. DRF, Scheduled, Priority or other), and the development of State and Commonwealth flora and fauna management strategies and action plans.
- The BHP Billiton Iron Ore Environmental Advisor for Goldsworthy (or nominated delegate) will regularly consult with DEC to determine the latest developments in flora and fauna management measures in the mining industry.
- No DRF have been recorded within the Goldsworthy area to date, however if future surveys identify DRF, and they cannot be avoided by adjusting the proposed disturbance areas, BHP Billiton Iron Ore will prepare and submit an application(s) to take DRF pursuant to the WC Act. Any land disturbance in these areas will be subject to Ministerial approval.
- The Goldsworthy induction programme will be used to promote awareness of flora and fauna management measures (including significant species) that are to be used.
- Specific training in flora and fauna management measures (including significant species) will be provided to relevant BHP Billiton Iron Ore personnel and contractors.
- BHP Billiton Iron Ore document controlled ‘Enviro Alert’ information sheets for flora and fauna aspects of particular relevance to Goldsworthy (e.g. management of particular significant species, weeds, or pests) will be prepared and distributed to increase awareness amongst employees and contractors as necessary.
- All dead significant fauna species found within the Goldsworthy area will be retained and will be delivered in a frozen state to the WA Museum as voucher specimens.
- Injured fauna species found within the Goldsworthy area will be handled and transported in accordance with the procedures outlined in the BHP Billiton Iron Ore Fauna Rescue Manual.

5 SPECIFIC MANAGEMENT MEASURES FOR SPECIES OF CONSERVATION SIGNIFICANCE

The level of management response for significant species will vary depending on their ranking in the impact hierarchy as defined in Section 1.6.

'Level 1' Significant Species

Species classified as 'Level 1' require the highest degree of management, as they are known to occur in or near to proposed disturbance areas and are therefore more likely to be directly impacted. In order to minimise potential impacts on Level 1 significant species the following will occur:

- The mine planning process outlined in Section 4.1 and illustrated in Figure 4-1 will be implemented.
- The general flora and fauna management measures outlined in Section 4.2 will be implemented.
- The species-specific management measures contained in each of the significant species management plans in Section 5.1 and Attachment C will be implemented.

'Level 2' Significant Species

Species classified as 'Level 2' require specific monitoring, but fewer management measures, as they are considered unlikely to be directly impacted over the next five years. In order to minimise potential impacts on Level 2 significant species the following will occur:

- The general flora and fauna management measures outlined in Section 4.2 will be implemented.
- The BHP Billiton Iron Ore Environmental Advisor for Goldsworthy (or nominated delegate) will monitor for the presence of these species in existing and proposed mine disturbance areas as described in the each of the significant species management plans in Section 5.2.
- In the event that a new record of a Level 2 species is made in an existing or proposed disturbance area, species-specific management measures will be developed, included in the relevant significant species management plan (Section 5.2) and implemented.

'Level 3' Significant Species

Level 3 significant species will be managed by implementing the general flora and fauna management measures outlined in Section 4.2.

BHP Billiton Iron Ore recognises that there is a small possibility that some of the Level 3 species may be recorded at Goldsworthy during future baseline or targeted surveys. In order to manage this possibility, the following will occur:

- The BHP Billiton Iron Ore Environmental Advisor for Goldsworthy (or nominated delegate) will review the results of any additional baseline or targeted surveys conducted within the Goldsworthy area to determine whether any of the species regarded as 'potential occurrences', have been recorded.
- In the event that a record of a Level 3 species is made within the Goldsworthy area, the BHP Billiton Iron Ore Environmental Advisor for Goldsworthy (or nominated delegate) will determine whether the species category should be changed to Level 1 or Level 2, and if necessary species-specific management measures will be developed, included in the relevant significant species management plan (Section 5.3) and implemented.

5.1 LEVEL 1 SIGNIFICANT SPECIES MANAGEMENT PLANS

5.1.1 *Acacia glaucocaesia*

Acacia glaucocaesia

BHP Billiton Iron Ore Management Hierarchy: LEVEL 1

Description:	Dense, glabrous shrub or tree. Grows 1.8 to 6 m high.
Flowers:	Yellow flowers in July to September.
Fruit:	Nil.
Habitat:	Red loam, sandy loam, clay and floodplains.
Status:	Priority 3 (DEC) – Poorly Known Taxa. Taxa which are known from several populations and the taxa are not believed to be under immediate threat.

Known Locations at Goldsworthy:

- *Acacia glaucocaesia* has been recorded at two locations along the Cattle Gorge access road (Section 3).

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- The BHP Billiton Iron Ore Goldsworthy Environmental Advisor (or nominated delegate) is responsible for incorporating the following actions/restrictions into the PEAHR process for the areas surrounding the known locations of *Acacia glaucocaesia*:
  - Prior to any clearance a targeted survey for *Acacia glaucocaesia* should be conducted to identify any populations and determine the level of impact on *Acacia glaucocaesia.*
  - Provide information regarding the significance of *Acacia glaucocaesia* to land disturbance project owners (i.e. managers responsible for any clearing or construction activities) prior to the commencement of clearing/construction.
  - Clearance plans will be modified, where possible to minimise or avoid impacts on *Acacia glaucocaesia.*
- During clearing/construction in the areas surrounding the known locations of *Acacia glaucocaesia,* the BHP Billiton Iron Ore Goldsworthy Environmental Advisor (or nominated delegate) will:
  - Work alongside operations personnel to assist in minimising impact on *Acacia glaucocaesia* during clearing/construction operations.
  - Clearly demarcate identified populations of *Acacia glaucocaesia* located in the vicinity of disturbance areas.
  - Maintain appropriate records of impacted populations.

Further Information:	BHP Billiton Iron Ore Goldsworthy Environmental Advisor.
Further Reading:	DEC (2008) *Florabase – The Western Australian Flora*. Website: http://florabase.calm.wa.gov.au

5.1.2 *Goodenia hartiana*

Goodenia hartiana

BHP Billiton Iron Ore Management Hierarchy: LEVEL 1

Description: Small, multi-stemmed, viscid shrub.

Flowers: Blue flowers in August.

Fruit: Nil.

Habitat: Base of small sand hills.

Status: Priority 2 (DEC) – Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under threat.

Known Locations at Goldsworthy:

- *Goodenia hartiana* has only been identified north east of the existing Nimingarra mining area (Section 3 and Figure 2-3).

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- The BHP Billiton Iron Ore Goldsworthy Environmental Advisor (or nominated delegate) is responsible for incorporating the following actions/restrictions into the PEAHR process for the area surrounding the known locations of *Goodenia hartiana*:
  - Prior to any clearance a targeted survey for *Goodenia hartiana* should be conducted to identify any populations and determine the level of impact on *Goodenia hartiana*.
  - Provide information regarding the significance of *Goodenia hartiana* to land disturbance project owners (i.e. managers responsible for any clearing or construction activities) prior to the commencement of clearing/construction.
  - Clearance plans will be modified, where possible to minimise or avoid impacts on *Goodenia hartiana.*
- During clearing/construction in the area surrounding the known locations of *Goodenia hartiana,* the BHP Billiton Iron Ore Goldsworthy Environmental Advisor (or nominated delegate) will:
  - Work alongside operations personnel to assist in minimising impact on *Goodenia hartiana* during clearing/construction operations.
  - Clearly demarcate identified populations of *Goodenia hartiana* located in the vicinity of disturbance areas.
  - Maintain appropriate records of impacted populations.

Further Information: BHP Billiton Iron Ore Goldsworthy Environmental Advisor.

Further Reading: DEC (2008) *Florabase – The Western Australian Flora*.
Website: http://florabase.calm.wa.gov.au

5.1.3 Ghost Bat (*Macroderma gigas*)

Ghost Bat (*Macroderma gigas*)

BHP Billiton Iron Ore Management Hierarchy: LEVEL 1

Description: Light to dark grey upper body and paler below. Long ears joined together, large eyes, simple nose lead and no tail. Largest micro-chiropteran bat in Australia.

Habitat: Rests in large caves, mines or deep rock fixtures.

Feeding: Australia's only carnivorous bat. A predator on large insects, frogs, lizards, birds, small mammals and even other bats (including bentwinged, horseshoe, leafnosed, heathtailed, and the little cave bat).

Status: Priority 4 (DEC) - Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could if present circumstances change. These taxa are usually represented on conservation lands.

Known Locations at Goldsworthy:

- The Ghost Bat has been identified near the Yarrie rail loop, at Nimingarra, Cattle Gorge, Cundaline and Callawa (Section 3 and Attachment C).

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- A separate document ('Management Plan for Bat Species') which provides details of the specific management and monitoring measures to be implemented for this species has been prepared and is attached to this SSMP as Attachment C.
- A brief summary of the specific management measures contained in the 'Management Plan for Bat Species' is provided below: Please refer to Attachment C for specific details.
  - Buffer Zones will be established and maintained at Nim B and Cattle Gorge.
  - Blasting activities at Nim B and Cattle Gorge will be restricted to daylight hours.
  - Directional night lighting, or alternative shields will be used where there is a direct line of sight between a known bat roost cave and the area where lighting is required, if the distance between the two is less than 500 m.
- A quarterly monitoring programme will be implemented. Please refer to Attachment C for details.

Further Information: BHP Billiton Iron Ore Goldsworthy Environmental Advisor.

Further Reading: Van Dyck, S. and Strahan, R. (2008). *The Mammals of Australia*, Third Edition. Queensland Museum, Reed New Holland Sydney.

BHP Billiton Iron Ore (2008b). *Goldsworthy Extension Project Management Plan for Bats Species.*

5.1.4 Mulgara (*Dasycercus cristicauda*)

Mulgara (*Dasycercus cristicauda*)

BHP Billiton Iron Ore Management Hierarchy: LEVEL 1

Description: The most striking feature is black hairs on the tail. Body is a light sandy brown above and greyish-white below. Hairs reddish on base of tail, black on distal two-thirds. Black hairs increase in length towards tip and form a dorsal crest. Ears short and rounded. Five toes on fore and hind feet. Approximate body size is 125 to 220 mm (males) and 125 to 170 mm (females).

Habitat: Arid sandy regions, living in burrows dug between low sand-dunes or slopes of high dunes.

Feeding: Hunt at night for insects, other arthropods and small vertebrates.

Status: Schedule 1 (WC Act) – fauna that is rare or is likely to become extinct.
Vulnerable (EPBC Act) – Within the next 25 years, the species is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate.

Known Locations at Goldsworthy:

- The Mulgara has been identified near the Cattle Gorge area (Section 3).
- Potentially suitable habitat for this species occurs widely in the sandplain/alluvial outwash habitat type found in the Goldsworthy area.

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- Minimise disturbance in Sandplain/Alluvial Outwash areas.
- The BHP Billiton Iron Ore Goldsworthy Environmental Advisor (or nominated delegate) will conduct periodic visual inspections of potential habitat areas for the Mulgara.
- Maintain appropriate records of impacted populations.

Further Information: BHP Billiton Iron Ore Goldsworthy Environmental Advisor

Further Reading: Van Dyck, S. and Strahan, R. (2008). *The Mammals of Australia*, Third Edition. Queensland Museum, Reed New Holland Sydney.

Image Source: Lochman Transparencies ©

5.1.5 Ngadgi or Western Pebble-mound Mouse (*Pseudomys chapmani*)

Ngadgi or Western Pebble-mound Mouse (*Pseudomys chapmani*)

BHP Billiton Iron Ore Management Hierarchy: LEVEL 1

Description: Blackish-brown head, buff brown back and sides and a buff/white underbody. Grows to 135 mm long (including 75 mm tail).

Habitat: Rocky, hummock grasslands, with little to no soil. Occupies burrows under mounds of pebbles collected from nearby.

Feeding: Grasses and seeds.

Status: Priority 4 (DEC) – Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could if present circumstances change. These taxa are usually represented on conservation lands.

Known Locations at Goldsworthy:

- The Western Pebble-mound Mouse has been recorded at Yarrie, Callawa and Cundaline (Section 3).
- Potentially suitable habitat for this species occurs widely in the scree slope habitat type and along the ridgelines and plateaus found in the Goldsworthy area.

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- BHP Billiton Iron Ore's Environmental Advisor for Goldsworthy (or nominated delegate) will determine whether the coverage of the previous surveys in the proposed clearing area (ie. the subject of the PEAHR) is adequate (in consultation with DEC where appropriate), and if required, will coordinate the undertaking of additional targeted pre-clearance surveys to improve BHP Billiton Iron Ore's knowledge of the distribution of the Western Pebble-mound Mouse (ie. in areas that it is deemed to be at risk).
- Clearance plans will be modified, where possible to minimise or avoid impacts to areas which are known to contain the Western Pebble-mound Mouse.
- During clearing/construction in the areas surrounding known locations of Western Pebble-mound Mouse that are deemed to be at risk, the BHP Billiton Iron Ore's Environmental Advisor (or nominated delegate) will:
  - Work alongside operations personnel to assist in minimising impact on Western Pebble-mound Mouse during clearing/construction operations.
  - Clearly demarcate areas which contain populations of the Western Pebble-mound Mouse in the vicinity of disturbance areas.
  - Maintain appropriate records of impacted populations.

Further Information: BHP Billiton Iron Ore Goldsworthy Environmental Advisor.

Further Reading: Lee, A. K. (1995). *The Action Plan for Australian Rodents.* Department of Environment and Heritage, Australia.

Van Dyck, S. and Strahan, R. (2008). *The Mammals of Australia*, Third Edition. Queensland Museum, Reed New Holland Sydney.

Image Source: Lochman Transparencies ©

5.1.6 Northern Quoll (*Dasyurus hallucatus*)

Northern Quoll (*Dasyurus hallucatus*)

BHP Billiton Iron Ore Management Hierarchy: LEVEL 1

Description: Grey-brown to brown above with large white spots, cream to white below. The head and body is 123 to 310 mm long and the tail is 127 to 308 mm long.

Habitat: Broken, rocky country and in open eucalyptus forest within 150 km of the coast.

Feeding: Small mammals, reptiles, worms, insects and soft fruits.

Status: Endangered (EPBC Act) - The species is likely to become extinct unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate; or its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction.

Known Locations at Goldsworthy:

- The Northern Quoll has been recorded at Yarrie, Cattle Gorge, Nimingarra, Sunrise Hill, Cundaline and Callawa (Section 3).
- Potentially suitable habitat for this species occurs widely along the ridgelines and plateaus found in the Goldsworthy area.

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- Minimise disturbance along ridgelines, plateaus and their lower slopes.
- The BHP Billiton Iron Ore Goldsworthy Environmental Advisor (or nominated delegate) will conduct periodic visual inspections of potential habitat areas for the Northern Quoll.
- Maintain appropriate records of impacted populations.

Further Information: BHP Billiton Iron Ore Goldsworthy Environmental Advisor

Further Reading: Van Dyck, S. and Strahan, R. (2008). *The Mammals of Australia*, Third Edition. Queensland Museum, Reed New Holland Sydney.

Image Source: Lochman Transparencies ©

5.1.7 Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)

Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)

BHP Billiton Iron Ore Management Hierarchy: LEVEL 1

Description: Orange fur, occasionally darkened by brown-tipped hairs, darker fur around eyes. Nose-leaf complexion, lower part broad with central gap at the front; upper part scalloped. Deep nasal pits. Ears small and acutely pointed. Body length approximately 50 mm.

Habitat: Can occupy natural cave or abandoned mines. For mines it prefers deep and partially flooded mines that trap pockets of warm, humid air in the mine's constant temperature zone or small, less complex mines for part of the year.

Feeding: Hunts food during slow manoeuvrable flight. Feeds on mostly moths but also on beetles, shield-bugs, parasitic wasps, ants, chafers and weevils.

Status: Schedule 1 (WC Act) – fauna that is rare or is likely to become extinct.
Vulnerable (EPBC Act) – Within the next 25 years, the species is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate.

Known Locations at Goldsworthy:

- Has been identified at Cattle Gorge, Nimingarra, Callawa and Cundaline (Section 3 and Attachment C).

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- A separate document ('Management Plan for Bat Species') which provides details of the specific management and monitoring measures to be implemented for this species has been prepared and is attached to this SSMP as Attachment C.
- A brief summary of the specific management measures contained in the 'Management Plan for Bat Species' is provided below: Please refer to Attachment C for specific details.
  - Buffer Zones will be established and maintained at Nim B and Cattle Gorge.
  - Blasting activities at Nim B and Cattle Gorge will be restricted to daylight hours.
  - Directional night lighting, or alternative shields will be used where there is a direct line of sight between a known bat roost cave and the area where lighting is required, if the distance between the two is less than 500 m.
- A quarterly monitoring programme will be implemented. Please refer to Attachment C for details.

Further Information: BHP Billiton Iron Ore Goldsworthy Environmental Advisor.

Further Reading:

Duncan, A., Baker, G.B., Montgomery, N. (1999). *The Action Plan for Australian Bats*, Natural Heritage Trust, Canberra.

Van Dyck, S. and Strahan, R. (2008). *The Mammals of Australia*, Third Edition. Queensland Museum, Reed New Holland Sydney.

BHP Billiton Iron Ore (2008b). *Goldsworthy Extension Project Management Plan for Bats Species.*

5.1.8 Pilbara Olive Python (*Liasis olivaceus barroni*)

Pilbara Olive Python (*Liasis olivaceus barroni*)

BHP Billiton Iron Ore Management Hierarchy: LEVEL 1

Description: Dark olive, yellowish brown to olive brown with pearly sheen. The ventral surfaces white to cream. Grow to 4.5 to 6.5 m in length.

Habitat: Rocky areas along watercourses including escarpments and gorges.

Feeding: Small animals up to the size of rock wallabies.

Status: Schedule 1 (WC Act) – fauna which are Rare or likely to become extinct, are declared to be fauna that is in need of special protection. Vulnerable (EPBC Act) – Within the next 25 years, the species is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate.

Known Locations at Goldsworthy:

- The Pilbara Olive Python has been recorded at Callawa and Cattle Gorge (Section 3).
- Potential habitat with surface water and rocky outcrops that may be suitable for this species occur in the Riverine habitat types found at Egg Creek, Eel Creek and in some of the deeper gullies found on the ridgelines and plateaus in the Goldsworthy area.

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- Clearance plans will be modified, where possible to minimise or avoid impacts to areas which are known to contain the Pilbara Olive Python.
- In the event that a Pilbara Olive Python is found within or near to an existing or proposed disturbance area, and may reasonably be expected to be harmed if left in that location, BHP Billiton Iron Ore's Environmental Advisor (or nominated delegate) will arrange for the individual to be captured and moved to a nearby protected area with similar habitat. All capture and relocation activities will be conducted by a person qualified in snake handling and in accordance with the procedures outlined in the BHP Billiton Iron Ore Snake Relocation Manual.

Further Information: BHP Billiton Iron Ore Goldsworthy Environmental Advisor

Further Reading: Wilson, S., and Swan G. (2008). *A complete Guide to Reptiles of Australia*, Reed New Holland, NSW.

Image Source: Lochman Transparencies ©

5.2 LEVEL 2 SIGNIFICANT SPECIES MANAGEMENT PLANS

5.2.1 *Euphorbia clementii*

Euphorbia clementii

BHP Billiton Iron Ore Management Hierarchy: LEVEL 2

Description: Small erect herb. Grows to 0.6 m tall.

Flowers: Nil.

Fruit: Nil.

Habitat: Gravely hillsides and stony ground.

Status: Priority 2 (DEC) – Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under threat.

Known Locations at Goldsworthy:

- *Euphorbia clementii* has been identified at Yarrie, Nimingarra and Cundaline (Section 3 and Figures 2-1, 2-3 and 2-6a).

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- Minimise disturbance to areas potentially containing *Euphorbia clementii*.
- BHP Billiton Iron Ore's Environmental Advisor (or nominated delegate) will conduct periodic visual inspections of potential habitat areas for *Euphorbia clementii*.

Further Information: BHP Billiton Iron Ore Goldsworthy Environmental Advisor.

Further Reading: DEC (2008) *Florabase – The Western Australian Flora*.
Website: http://florabase.calm.wa.gov.au

5.2.2 *Euphorbia inappendiculata*

Euphorbia inappendiculata

BHP Billiton Iron Ore Management Hierarchy: LEVEL 2

Description: Small branched prostrate herb.

Flowers: Cream flowers in June.

Fruit: Nil.

Habitat: Stony hills.

Status: Priority 3 (DEC) – Poorly Known Taxa. Taxa which are known from several populations and the taxa are not believed to be under immediate threat.

Known Locations at Goldsworthy:

Euphorbia inappendiculata has been recorded at Yarrie (Section 3 and Figure 2-1).

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- Minimise disturbance to areas potentially containing *Euphorbia inappendiculata*.
- BHP Billiton Iron Ore's Environmental Advisor (or nominated delegate) will conduct periodic visual inspections of potential habitat areas for *Euphorbia inappendiculata*.

Further Information: BHP Billiton Iron Ore Goldsworthy Environmental Advisor.

Further Reading: DEC (2008) *Florabase – The Western Australian Flora*.
Website: http //florabase.calm.wa.gov.au

5.2.3 *Goodenia nuda*

Goodenia nuda

BHP Billiton Iron Ore Management Hierarchy: LEVEL 2

Description: Small branched prostrate herb.

Flowers: Cream flowers in June.

Fruit: Nil.

Habitat: Stony hills.

Status: Priority 3 (DEC) – Poorly Known Taxa. Taxa which are known from several populations and the taxa are not believed to be under immediate threat.

Known Locations at Goldsworthy:

- *Goodenia nuda* has been recorded at Cundaline (Section 3 and Figure 2-6a).

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- Minimise disturbance to areas potentially containing *Goodenia nuda*.
- BHP Billiton Iron Ore's Environmental Advisor (or nominated delegate) will conduct periodic visual inspections of potential habitat areas for *Goodenia nuda*.

Further Information: BHP Billiton Iron Ore Goldsworthy Environmental Advisor.

Further Reading: DEC (2008) *Florabase – The Western Australian Flora*.
Website: http//florabase.calm.wa.gov.au

5.2.4 Australian Bustard (*Ardeotis australis*)

Australian Bustard (*Ardeotis australis*)

BHP Billiton Iron Ore Management Hierarchy:

LEVEL 2

Description: Back and wings are brown. Upper wing coverts black and white. Underparts white to grey. Legs and feet pale yellow to grey. The crown is black with a white eyebrow. The neck is white with a black breast band. The females crown is brown and the breast band is less visible. There is also less black on wings.

Habitat: Tussock grassland, grassy woodland and low woodlands.

Feeding: Insects, small vertebrates, seeds and fruit.

Status: Priority 4 (DEC) – Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could if present circumstances change. These taxa are usually represented on conservation lands.

Known Locations at Goldsworthy:

- The Australian Bustard has been recorded in the region between Yarrie and Cattle Gorge (Section 3).
- Potentially suitable tussock grassland and scattered woodland habitat for this species occurs in the Sandplain/Alluvial Outwash Plains, Riverine and Shrubland habitat types found between the ridgelines and plateaus in the Goldsworthy area.

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- Minimise disturbance to plains and areas adjacent to creeklines.
- The BHP Billiton Iron Ore Goldsworthy Environmental Advisor (or nominated delegate) will conduct periodic visual inspections of potential habitat areas for the Australian Bustard.

Further Information: BHP Billiton Iron Ore Goldsworthy Environmental Advisor

Further Reading: Simpson, K., Day, N. (1999). *Field Guide to the Birds of Australia*, Sixth Edition, Penguin Group, Victoria.

Garnett, S., Gabriel, C. (2000). *The Action Plan for Australian Birds*. Environment Australia, Australia

Image Source: Lochman Transparencies ©

5.2.5 Bilby (*Macrotis lagotis*)

Bilby
(*Macrotis lagotis*)

BHP Billiton Iron Ore Management Hierarchy: LEVEL 2

Description: Tail black on proximal half, then changes abruptly to white. Prominent dorsal crest and extreme tip of tail naked. Muzzle long and pointed, and has long ears at back of head. Hindfoot lacks first toe. Light and delicate in build, with soft and silky hair. Approximate body size is 300 to 550 mm (males) and 290 to 390 mm (females).

Habitat: Desert environments, with habitat ranging from clayey and stony downs soils with sparse ground cover to massive red earths with Acacia shrubland.

Feeding: Derives water from food. Diet of their larvae, seeds, bulbs, fruit and fungi.

Status: Schedule 1 (WC Act) – fauna that is rare or is likely to become extinct. Vulnerable (EPBC Act) – Within the next 25 years, the species is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate.

Known Locations at Goldsworthy:

- Although not recorded within the Goldsworthy mining leases, the Bilby has been recorded at Mount Goldsworthy and in the vicinity of the public road that is used to access Goldsworthy (north of Nimingarra-A).
- Potentially suitable habitat for this species occurs within sparse ground cover and *Acacia* shrubland that occurs within Goldsworthy.

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- The BHP Billiton Iron Ore Goldsworthy Environmental Advisor (or nominated delegate) will conduct periodic visual inspections of potential habitat areas for the Bilby.
- Promote awareness of the potential for the Bilby to occur at Goldsworthy as part of Goldsworthy Mine induction programme.

Further Information: BHP Billiton Iron Ore Goldsworthy Environmental Advisor.

Further Reading: Van Dyck, S. and Strahan, R. (2008). *The Mammals of Australia*, Third Edition. Queensland Museum, Reed New Holland Sydney.

Image Source: Lochman Transparencies ©

5.2.6 Bush Stone-curlew (*Burhinus grallarius*)

Bush Stone-curlew (*Burhinus grallarius*)

BHP Billiton Iron Ore Management Hierarchy: LEVEL 2

Description: Medium black bill. Forehead buff, pale buff eyebrow. Large yellow eyes. Black eye-stripe through to neck. Black streaking on grey-brown upperparts; buff-white underparts. Whitish shoulder patch. Approximate size is 55 cm. Sound a mournful, wailing 'wee-loo' usually at night. Fly in single pairs or loose flocks up to 100 individuals or more. Active at night. Sulking habits, rigid movements and freezes to escape notice.

Habitat: Require sparsely grassed, lightly timbered, open forests or woodland.

Feeding: Small vertebrates and invertebrates, as well as seeds and shoots.

Status: Priority 4 (DEC) - Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could if present circumstances change. These taxa are usually represented on conservation lands.

Known Locations at Goldsworthy:

- The Bush Stone-curlew has been identified at Cattle Gorge and Nimingarra (Section 3).
- Potentially suitable grassed, lightly timbered forest/woodland areas that may be suitable for this species occur in the sandplain/alluvial outwash plains, riverine and shrubland habitat types found between the ridgelines and plateaus in the Goldsworthy area.

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- Minimise disturbance to plains and areas adjacent to creeklines.
- The BHP Billiton Iron Ore Goldsworthy Environmental Advisor (or nominated delegate) will conduct periodic visual inspections of potential habitat areas for the Bush Stone-curlew.

Further Information: BHP Billiton Iron Ore Goldsworthy Environmental Advisor.

Further Reading: Simpson, K., and Day, N. (1999). *Field Guide to the Birds of Australia*, Sixth Edition, Penguin Group, Victoria.

Garnett, S., and Gabriel, C., (2000). *The Action Plan for Australian Birds*, Environment Australia, Australia.

Image Source: Lochman Transparencies ©

5.2.7 Common Sandpiper (*Actitis hypoleucos*)

Common Sandpiper (*Actitis hypoleucos*)

BHP Billiton Iron Ore Management Hierarchy: LEVEL 2

Description: White eyebrow and shoulder mark. Brown, finely scaled black above and on breast sides with white underside.

Habitat: Banks and rocks near water.

Feeding: Aquatic invertebrates.

Status: Migratory Species (EPBC Act) – species listed in the Bonn Convention, Government of Australia and the Government of the Peoples Republic of China for the Protection of Migratory Birds and their Environment (CAMBA) and Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA).

Known Locations at Goldsworthy:

- The Common Sandpiper has been recorded at Goldsworthy (Section 3).
- Potential habitat areas with surface water that may be suitable for this species occur in the riverine habitat types found at Egg Creek, Eel Creek and the ephemeral open waterbody near Elephant Rock.

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- Minimise disturbance near Egg Creek, Eel Creek and other surface waterbodies.
- The BHP Billiton Iron Ore Goldsworthy Environmental Advisor (or nominated delegate) will conduct periodic visual inspections of potential habitat areas for the Common Sandpiper.

Further Information: BHP Billiton Iron Ore Goldsworthy Environmental Advisor.

Further Reading: Simpson, K. and Day, N. (1999). *Field Guide to the Birds of Australia*, Sixth Edition, Penguin Group, Victoria.

Image Source: Lochman Transparencies ©

5.2.8 Fork-tailed Swift (*Apus pacificus*)

Fork-tailed Swift
(*Apus pacificus*)

BHP Billiton Iron Ore Management Hierarchy: LEVEL 2

Description:	Dark, sooty-coloured with a pale throat and white rump with pointed wingtips. Long and thin, deeply forked tail when fanned, with fork visible when tailed closed. Approximate size is 17.5 cm. Sounds with twittering and buzzing.
Habitat:	No specific habitat, spends the majority of time in air.
Feeding:	Mainly insects.
Status:	Migratory Species (EPBC Act) – species listed in the Bonn Convention, Government of Australia and the Government of the Peoples Republic of China for the Protection of Migratory Birds and their Environment (CAMBA) and Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA).

Known Locations at Goldsworthy:

- The Fork-tailed Swift has been recorded at Goldsworthy (Section 3).
- The Fork-tailed Swift has no particularly preferred habitat, spending the majority of its time in the air, and therefore has the potential to occur in most Goldsworthy areas.

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- The BHP Billiton Iron Ore Goldsworthy Environmental Advisor (or nominated delegate) will conduct periodic visual inspections of potential habitat areas for the Fork-tailed Swift.

Further Information:	BHP Billiton Iron Ore Goldsworthy Environmental Advisor.
Further Reading:	Simpson, K., Day, N. (1999). *Field Guide to the Birds of Australia*, Sixth Edition, Penguin Group, Victoria.

5.2.9 Common Greenshank (*Tringa nebularia*)

Common Greenshank (*Tringa nebularia*)

BHP Billiton Iron Ore Management Hierarchy:

LEVEL 2

Description: Slightly upturned black bill. Upperparts grey. Forehead underparts white, underwing barred. White on rump extends up back in wedge.

Habitat: Coastal areas or inland lakes.

Feeding: Aquatic invertebrates.

Status: Migratory Species (EPBC Act) – species listed in the Bonn Convention, Government of Australia and the Government of the Peoples Republic of China for the Protection of Migratory Birds and their Environment (CAMBA) and Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA).

Known Locations at Goldsworthy:

- The Common Greenshank has been identified at Goldsworthy.
- Potential habitat areas with surface water that may be suitable for this species occur in the riverine habitat types found at Egg Creek, Eel Creek and the ephemeral open waterbody near Elephant Rock.

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- Minimise disturbance to areas around the ephemeral lake/water body to the east of Elephant Rock.
- The BHP Billiton Iron Ore Goldsworthy Environmental Advisor (or nominated delegate) will conduct periodic visual inspections of potential habitat areas for the Common Greenshank.

Further Information: BHP Billiton Iron Ore Goldsworthy Environmental Advisor

Further Reading: Simpson, K. and Day, N. (1999). *Field Guide to the Birds of Australia*, Sixth Edition, Penguin Group, Victoria.

Image Source: Lochman Transparencies ©

5.2.10 Great Egret (*Ardea alba*)

Great Egret
(*Ardea alba*)

BHP Billiton Iron Ore Management Hierarchy: LEVEL 2

Description: For the majority of the year the plumage is white, bill and facial skin are yellow and the legs and feet are olive-grey to black. During the breeding season (October-December) the facial skin turns green, the bill becomes black, and the legs become pinkish-yellow at the top. The Great Egret grows to 41 to 49 cm.

Habitat: Floodwaters, rivers, shallows and wetlands.

Feeding: Hunts in water feeding on amphibians, aquatic insects, small reptiles, crustaceans and other small animals.

Status: Migratory Species (EPBC Act) – species listed in the Bonn Convention, Government of Australia and the Government of the Peoples Republic of China for the Protection of Migratory Birds and their Environment (CAMBA) and Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA).

Known Locations at Goldsworthy:

- The Great Egret has been recorded at Goldsworthy.
- Potential habitat areas with surface water that may be suitable for this species occur in the riverine habitat types found at Egg Creek, Eel Creek and the ephemeral open waterbody near Elephant Rock.

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- Minimise disturbance to areas around the ephemeral lake/water body to the east of Elephant Rock and areas adjacent to Egg and Eel Creeks.
- The BHP Billiton Iron Ore Goldsworthy Environmental Advisor (or nominated delegate) will conduct periodic visual inspections of potential habitat areas for the Great Egret.

Further Information: BHP Billiton Iron Ore Goldsworthy Environmental Advisor.

Further Reading: Simpson, K. and Day, N. (1999). *Field Guide to the Birds of Australia*, Sixth Edition, Penguin Group, Victoria.

Australian Museum (2003). *Great Egret Fact Sheet.*
Website: http//www.amonline.net.au/factsheets/great_egret.htm.

Image Source: Lochman Transparencies ©

5.2.11 Peregrine Falcon

Peregrine Falcon (Falco peregrinus)

BHP Billiton Iron Ore Management Hierarchy:
LEVEL 2

Description: Blue-grey upperparts and cream underparts with dark barring on belly. The head and cheeks are black. Male grows to 45 to 54 cm and the female to 52 to 56 cm (Simpson and Day, 1999).

Habitat: Most land types particularly rocky outcrops and cliffs (Simpson and Day, 1999).

Feeding: Small birds typically taken in the air (Morcombe, 2004).

Status: Schedule 4 (WC Act) – declared to be fauna that is in need of special protection, otherwise than for the reasons mentioned in paragraphs (a), (b) and (c) (i.e. reasons other than those for Schedules 1-3.).

Known Locations at Goldsworthy:

- Identified flying overhead at Cundaline (Section 3 and Attachment C).
- Habitat suitable for the breeding of the Peregrine Falcon occurs on the steep rocky slopes and ridge crests along the Goldsworthy ridges.

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- Minimise disturbance to the rocky outcrops and cliffs along the Goldsworthy ridges.
- BHP Billiton Iron Ore's Environmental Advisor (or nominated delegate) will conduct periodic visual inspections of potential habitat areas for the Peregrine Falcon.

Further Information: BHP Billiton Iron Ore Environmental Advisor for the Project.

Further Reading: Simpson, K. and Day, N. (1999) *Field Guide to the Birds of Australia*. Sixth Edition, Penguin Group, Victoria.

Morcombe, M. (2004) *Field Guide to Australian Birds*. Steve Parish Publishing Pty Ltd, Queensland.

Image Source: Lochman Transparencies ©

5.2.12 Lakeland Downs Short-tailed Mouse (*Leggadina lakedownensis*)

Lakeland Downs Short-tailed Mouse (*Leggadina lakedownensis*)

BHP Billiton Iron Ore Management Hierarchy:

LEVEL 2

Description: 60 to 75 mm body and 40 to 45 mm tail. Grey colour.

Habitat: Open grassland with pockets of savannah woodland.

Feeding: Native and introduced grass seeds.

Status: Priority 4 (DEC) - Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could if present circumstances change. These taxa are usually represented on conservation lands.

Known Locations at Goldsworthy:

- The Lakeland Downs Short-tailed Mouse has been identified along the Yarrie railway line (Section 3 and Figure 2-1).
- Potentially suitable grassland and scattered woodland habitat for this species occurs in the sandplain/alluvial outwash plains, riverine and shrubland habitat types found between the ridgelines and plateaus in the Goldsworthy area.

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- Minimise disturbance to plains and areas adjacent to creeklines.
- The BHP Billiton Iron Ore Goldsworthy Environmental Advisor (or nominated delegate) will conduct periodic visual inspections of potential habitat areas for the Lakeland Downs Short-tailed Mouse.

Further Information: BHP Billiton Iron Ore Goldsworthy Environmental Advisor

Further Reading: Van Dyck, S. and Strahan, R. (2008). *The Mammals of Australia*, Third Edition. Queensland Museum, Reed New Holland Sydney.

Image Source: Lochman Transparencies ©

5.2.13 Marsh Sandpiper (*Tringa stagnatilis*)

Marsh Sandpiper (*Tringa stagnatilis*)

BHP Billiton Iron Ore Management Hierarchy:

LEVEL 2

Description: Front and underparts white. White rump extends up back in long wedge. Long greenish legs.

Habitat: Adjacent to fresh or saltwater.

Feeding: Aquatic invertebrates.

Status: Migratory Species (EPBC Act) – species listed in the Bonn Convention, Government of Australia and the Government of the Peoples Republic of China for the Protection of Migratory Birds and their Environment (CAMBA) and Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA).

Known Locations at Goldsworthy:

- The Marsh Sandpiper has been identified at Goldsworthy.
- Potential habitat areas with surface water that may be suitable for this species occur in the Riverine habitat types found at Egg Creek, Eel Creek and the ephemeral open waterbody near Elephant Rock.

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- Minimise disturbance to areas around the ephemeral lake/water body to the east of Elephant Rock and areas adjacent to Egg and Eel Creeks.
- The BHP Billiton Iron Ore Goldsworthy Environmental Advisor (or nominated delegate) will conduct periodic visual inspections of potential habitat areas for the Marsh Sandpiper.

Further Information: BHP Billiton Iron Ore Goldsworthy Environmental Advisor

Further Reading Simpson, K. and Day, N. (1999). *Field Guide to the Birds of Australia*, Sixth Edition, Penguin Group, Victoria.

Image Source: Lochman Transparencies ©

5.2.14 Pictorella Mannikin (*Heteromunia pectoralis*)

Pictorella Mannikin (*Heteromunia pectoralis*)

BHP Billiton Iron Ore Management Hierarchy: LEVEL 2

Description: Grows to about 11 cm.
Male: Black-masked fawn-greyish finch with white breast mottled black. Cinnamon crescent over eye and ear to side of neck. Fine white spots on wings and a plain pinkish ventrum.
Female: Face brownish-black, more black on breast.

Habitat: *Acacia* spp shrublands that have grassy understorey and *Triodia* spp hummock grassland.

Feeding: Seeds and insects on the ground.

Status: Priority 4 (DEC) - Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could if present circumstances change. These taxa are usually represented on conservation lands.

Known Locations at Goldsworthy:

- The Pictorella Mannikin has been identified in the area between Cattle Gorge and Yarrie (Section 3).
- Potentially suitable *Acacia* shrublands with a grassy understorey occur widely in the Goldsworthy area, particularly on the plains adjacent to creeklines.

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- Minimise disturbance to plains and areas adjacent to creeklines.
- The BHP Billiton Iron Ore Goldsworthy Environmental Advisor (or nominated delegate) will conduct periodic visual inspections of potential habitat areas for the Pictorella Mannikin.

Further Information: BHP Billiton Iron Ore Goldsworthy Environmental Advisor

Further Reading:

Garnett, S. and Gabriel, C., (2000). *The Action Plan for Australian Birds*, Environment Australia, Australia.

Simpson, K. and Day, N. (1999). *Field Guide to the Birds of Australia*, Sixth Edition, Penguin Group, Victoria.

5.2.15 (Western) Star Finch (*Neochmia ruficauda subclarescens*)

(Western) Star Finch
(*Neochmia ruficauda subclarescens*)

BHP Billiton Iron Ore Management Hierarchy: LEVEL 2

Description: Males are red faced, with dark olive above and yellow-olive below. They are crested, rump and flank with tail spotted white. Females are duller, greyer with red only in the fronts and cheeks. The chin has coarser spots ventrally. Approximate size is 10-12 cm. Juveniles are plainer with a black bill. They have a penetrating 'sweet' sound.

Habitat: Tall grass by swamps.

Feeding: Seeds if a number of weedy grasses and among watered suburban gardens.

Status: Priority 4 (DEC) - Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could if present circumstances change. These taxa are usually represented on conservation lands.

Known Locations at Goldsworthy:

- The (Western) Star Finch has been identified in the area between Cattle Gorge and Yarrie (Section 3).
- Potential habitat areas with surface water and tall grass that may be suitable for this species occur in the Riverine habitat types found at Egg Creek, Eel Creek and the ephemeral open waterbody near Elephant Rock.

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- Minimise disturbance adjacent to Egg and Eel Creeks and the ephemeral lake/water body.
- The BHP Billiton Iron Ore Goldsworthy Environmental Advisor (or nominated delegate) will conduct periodic visual inspections of potential habitat areas for the (Western) Star Finch.

Further Information: BHP Billiton Iron Ore Goldsworthy Environmental Advisor

Further Reading: Simpson, K. and Day, N. (1999). *Field Guide to the Birds of Australia*, Sixth Edition, Penguin Group, Victoria.

Garnett, S. and Gabriel, C. (2000). *The Action Plan for Australian Birds*, Environment Australia, Australia.

Image Source: Lochman Transparencies ©

5.2.16 Wood Sandpiper (*Tringa glareola*)

Wood Sandpiper (*Tringa glareola*)

BHP Billiton Iron Ore Management Hierarchy: LEVEL 2

Description: Medium, straight, black bill. Narrow pale eyebrow to behind the eye. Pale underwing and brown back dark wings, spotted white. White rump and yellow-green legs.

Habitat: Adjacent to fresh water.

Feeding: -

Status: Migratory Species (EPBC Act) – species listed in the Bonn Convention, Government of Australia and the Government of the Peoples Republic of China for the Protection of Migratory Birds and their Environment (CAMBA) and Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA).

Known Locations at Goldsworthy:

- The Wood Sandpiper has been identified at Goldsworthy (Section 3).
- Potential habitat areas with surface water that may be suitable for this species occur in the riverine habitat types found at Egg Creek, Eel Creek and the ephemeral open waterbody near Elephant Rock.

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- Minimise disturbance adjacent Egg and Eel Creeks.
- The BHP Billiton Iron Ore Goldsworthy Environmental Advisor (or nominated delegate) will conduct periodic visual inspections of potential habitat areas for the Wood Sandpiper.

Further Information: BHP Billiton Iron Ore Goldsworthy Environmental Advisor

Further Reading: Simpson, K. and Day, N. (1999). *Field Guide to the Birds of Australia*, Sixth Edition, Penguin Group, Victoria.

5.3 LEVEL 3 SIGNIFICANT SPECIES MANAGEMENT PLANS

5.3.1 *Bulbostylis burbidgeae*

Bulbostylis burbidgeae

BHP Billiton Iron Ore Management Hierarchy: LEVEL 3

Description: Tufted, erect to spreading annual, grass-like or herb. Grows from 0.03 to 0.25 m high.

Flowers: Brown flowers between March/June and August.

Habitat: Granitic soils near granite outcrops or cliffs.

Status: Priority 3 (DEC) - Poorly Known Taxa. Taxa which are known from several populations, at least some of which are not believed to be under immediate threat.

Known Locations at Goldsworthy:

- Not identified at Goldsworthy to date**.**
- Rocky outcrops and cliffs which may provide suitable habitat for this species occur on the ridgelines and plateaus in the Goldsworthy area.

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- The BHP Billiton Iron Ore Goldsworthy Environmental Advisor (or nominated delegate) will review the results of any additional baseline or targeted surveys conducted at Goldsworthy to determine whether *Bulbostylis burbidgeae* has been recorded.
- The BHP Billiton Iron Ore Goldsworthy Environmental Advisor (or nominated delegate) will develop and implement specific management measures for *Bulbostylis burbidgeae* if required.

Further Information: BHP Billiton Iron Ore Goldsworthy Environmental Advisor.

Further Reading: DEC (2008) *Florabase – The Western Australian Flora*.
Website: http//florabase.calm.wa.gov.au

5.3.2 *Fimbristylis* sp. Shay Gap

Fimbristylis sp. Shay Gap

BHP Billiton Iron Ore Management Hierarchy: LEVEL 3

Description: Tufted annual, grass-like or herb. Grows from 0.12 to 0.15 m tall.

Flowers: Flowers between June and July.

Habitat: Sandy soils along drainage lines.

Status: Priority 1 (DEC) - Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations which are under threat.

Known Locations at Goldsworthy:

- Not identified at Goldsworthy to date.
- Sandy soils alongside drainage lines which may be suitable for this species occur in the riverine habitat types such as those found at Egg Creek, Eel Creek and the ephemeral open waterbody near Elephant Rock.

General Management Measures:

- Implement the management measures described in Section 4.

Specific Management Measures:

- The BHP Billiton Iron Ore Goldsworthy Environmental Advisor (or nominated delegate) will review the results of any additional baseline or targeted surveys conducted at Goldsworthy to determine whether *Fimbristylis* sp. Shay Gap has been recorded.
- The BHP Billiton Iron Ore Goldsworthy Environmental Advisor (or nominated delegate) will develop and implement specific management measures for *Fimbristylis* sp. Shay Gap if required.

Further Information: BHP Billiton Iron Ore Goldsworthy Environmental Advisor.

Further Reading: DEC (2008) *Florabase – The Western Australian Flora*.
Website: http//florabase.calm.wa.gov.au