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## 1 SCOPE

This Monitoring Program (MP) describes the environmental monitoring activities that are undertaken by BHP Billiton Olympic Dam Corporation Pty Ltd (ODC) in relation to flora at Olympic Dam and the surrounding areas that may be impacted by current mining and processing activities. The purpose of this MP is to set out the measures ODC uses to quantify any change in the extent or significance of impacts of its activities on flora, to assess the performance of the control measures employed to limit these impacts, and to meet relevant legal and other requirements.

This MP addresses a number of distinct elements of flora monitoring. For each element, the MP sets out some background information, the purpose of the monitoring and the deliverables which are produced as a result of the monitoring. The MP also includes a description of the methods for measuring achievement of **compliance criteria** and the movement of trends towards **leading indicators** (where applicable).

This MP relates to flora that is normally associated with open rangeland country in central Australia and the Great Artesian Basin (GAB) springs in the wellfield areas.

Flora monitoring within the above-defined area is principally designed to determine the nature, extent and degree of any operational impacts, either positive or negative, on functional groups. The causal agents of these impacts, generically known as 'aspects' include gaseous, aerosol and dust emissions, liquid waste streams, physical ground disturbance and alteration of groundwater levels. Listed flora species and weed species are also monitored.

### 1.1 Responsible ODC personnel

The Olympic Dam Asset President is responsible for ensuring that all legal and other requirements described in this MP are met.

ODC employs an environmental scientist and sufficient other staff with experience and qualifications to fulfil the requirements of this MP.

### 1.2 Review and modification

This MP is reviewed annually. Major changes or amendments following the review are documented in the Annual EM Program Targets, Actions and Major Changes document.

It should be noted that as a result of operational activities or through optimisation of sample design some existing monitoring sites may be lost and others added (where possible) to maintain the integrity of the sampling program. Access restrictions can result in some sites occasionally being unable to be monitored.

## 2 DETAILED PROCEDURE

### 2.1 Long-term changes to perennial vegetation

#### 2.1.1 Background

Changes in the composition and structure of vegetation surrounding the Olympic Dam operation have occurred as a result of emission impacts (Fatchen Environmental 2005). Fatchen reported that in areas that continue to be affected by emissions, recovery, either from regrowth of damaged individuals or recruitment of new plants, may be depressed or even inhibited.

This section aims to determine the longer-term effects of these emissions, if any, on the surrounding perennial plant communities. Perennial species are persistent and are an ideal indicator group as they are not likely to change in abundance in response to season or to most short mesic or xeric periods. Recruitment is likely to be aperiodic and in response to unusually high rainfall periods (Griffin and Dunlop 2006).

By collecting annual data at different proximities to the emission sources and using simple assessment methods, changes in perennial plant communities as a result of emissions can be monitored.

#### 2.1.2 Purpose

- To determine what impact ODC's operations have on perennial plant communities surrounding the operations.

### 2.1.3 Deliverables

- A report on the annual changes in perennial communities within and surrounding the SML.
- Provide a comparative assessment on perennial species existing at different distances from the Main Smelter Stack.

### 2.1.4 Method

Monitoring the long-term changes to perennial vegetation occurs within and around the SML on an annual basis. Vegetation monitoring sites are located in a predominantly radial grid (centred on the Main Smelter Stack) surrounding the Olympic Dam operation. Sites are located up to 25 km from the centre (see Appendix A for flora monitoring site locations).

At each of the sites on the radial grid, a sample quadrat 100 m by 25 m is assessed for the presence of perennial vegetation species. Within the quadrat the frequency of occurrence is recorded for all perennials. Annual monitoring of these sites and vegetation composition are undertaken to detect changes. Where significant changes are found to occur, they are assessed to determine the extent to which they have been influenced by operational emissions.

## 2.2 Great Artesian Basin (GAB) springs wetland vegetation composition assessment

### 2.2.1 Background

A diverse and rare group of flora is found within the mound springs of the Great Artesian Basin (GAB) in South Australia and Queensland. These landforms occupy an extremely small percentage of semi-arid Australia. *Eriocaulon carsonii* is a distinctive plant restricted to the active mound springs of the GAB, where it relies on a constant supply of flowing water. The largest single population exists at the Hermit Hill spring complex near Wellfield A. *E. carsonii* is listed as Endangered under state and national legislation, in addition to the community of native species dependent on the natural discharge of groundwater from the GAB. Extraction of water from the GAB has the potential to alter the flow or chemistry of mound spring water within the GAB, which may have an adverse effect on *E. carsonii* and other flora populations. Changes in wetland vegetation composition may be used to assess the extent of any impacts from aquifer drawdown resulting from water extraction.

### 2.2.2 Purpose

- Quantify the changes in composition of GAB springs vegetated wetland areas that may be attributed to water extraction from the wellfields.
- Determine if the distribution and abundance of *E. carsonii* is affected by water extraction from the GAB wellfields.

### 2.2.3 Deliverables

- An evaluation of the composition of vegetated wetlands within the GAB springs.
- A comparison of the abundance and distribution of *E. carsonii*, per impact zone, with previously reported values, to determine any impacts to GAB springs.
- Triennial qualitative comparison of GAB springs monitoring data incorporating GAB spring flow and GAB springs endemic invertebrate data.

### 2.2.4 Method

The vegetation composition, cover and abundance is recorded at 110 vents from 17 different spring groups, inclusive of the Gosse Springs SEB area (see GAB MP Appendix D). In accordance with the Gosse Springs Native Vegetation Management Plan (NVMP (Environmental and Biodiversity Services 2010), this MP includes an assessment of the abundance of Phragmites (*Phragmites australis*), which is known to increase in the absence of large grazing herbivores. The level of grazing is also recorded at each spring to give an indication of the level of the presence of large herbivores in the area.

## 2.3 Pest plants

### 2.3.1 Background

Weeds within the Olympic Dam region are managed through a collaborative effort driven by ODC, in conjunction with **Arid Recovery** and the Roxby Downs Municipal Council. Weed management in the Olympic Dam region takes significant direction from overarching National and Regional Pest Strategies, especially the South Australian Arid Lands (SAAL) Natural Resource Management (NRM) Board Kingoonya NRM District Weed Strategy (Pest Management Strategy (Reseigh and Shepherd 2010)).

All infestations of species declared under the NRM Act 2004 must be controlled in accordance with the Act. Species declared under the Act (as of January 2015) that are known to be present within the Olympic Dam region are: Prickly Pear (Genus: *Opuntia*), Buffel Grass (***Cenchrus ciliaris***), Innocent Weed (***Cenchrus incertus***), Bathurst Burr (***Xanthium spinosum***), Caltrop (***Tribulus terrestris***), Salvation Jane (***Echium plantagineum***), Athel Pine (***Tamarix aphylla***), Noogoora Burr (***Xanthium pungens***) and Three-corner Jack (***Emex australis***). African Boxthorn (***Lycium ferocissimum***) and Horehound (***Marrubium vulgare***) are also found within ODC's high-voltage power line corridor from Port Augusta to Olympic Dam. If any declared species are found on ODC managed land, control and any government notification requirements are to be initiated in accordance with the relevant provisions under the Act.

Targeted weed management strategies may also occur through a coordinated approach between ODC, responsible landowners, **Arid Recovery** and Roxby Downs Municipal Council, aimed at identifying and controlling priority species.

Ground disturbance, including the movement of vehicles and the transfer of soils, can potentially increase the abundance of pest plants. ID 1.1 of the EMP, "Land Disturbance and Rehabilitation", details the controls to mitigate the spread of weeds, controlling the spread of soil in known weed infestation areas and ensuring the diligent cleaning of plant, equipment and vehicles before construction work commences and before leaving areas infested by declared weeds.

### 2.3.2 Purpose

- Determine the extent of weed infestations of declared and high risk weed species within the Olympic Dam region and SML.
- Monitor and control declared weeds and plant pathogens within the SML and surrounding areas.

### 2.3.3 Deliverable(s)

- Define and map the current distribution of extreme and high risk weed species within the Olympic Dam region, Roxby Downs Municipality, the SML and Gosse Springs SEB areas.
- Identification of whether measures are required to control declared weeds and plant pathogens in the operations area.

### 2.3.4 Method

The current distribution of extreme and high risk weed species is determined during scheduled weed monitoring. Construction sites are surveyed for weed species prior to construction activities as part of the Environmental Disturbance Permit process and 12 months after works are completed and/or after significant rains. Routine and opportunistic monitoring is also conducted in high-risk habitats and previous control locations. Areas surveyed include the SML, the Roxby Downs Municipality, pastoral leases and **Arid Recovery**. Monitoring results are used to determine whether control measures are required when an increase in the abundance or area of declared and high risk weed species is identified attributable to the operations.

## 2.4 Land disturbance

### 2.4.1 Background

All native vegetation in South Australia is protected under the provision of the **Native Vegetation Act 1991** and clearance of vegetation is prohibited unless it is approved by the Native Vegetation Council and/or an applicable exemption applies under the **Native Vegetation Regulations 2003**. In some instances, an application for clearance approvals is to be accompanied by a management plan that

describes a Significant Environmental Benefit (SEB). ODC has an SEB offset through land that is protected and managed as a set-aside area.

In 2010 the Gosse Springs Native Vegetation Management Plan was approved to establish a SEB offset area of 10,963 hectares (ha) (see Appendix B for Gosse Springs SEB area, detailing vegetation communities). New SEB areas and native vegetation management plans are progressively developed and implemented as vegetation clearance occurs and to ensure the SEB area is always greater than the SEB obligation (see Appendix C for proposed SEB offset areas in the Arid Lands NRM Region).

The various mine, process and infrastructure development activities involve the clearance of vegetation and ground surface for access roads, laydown areas, new facilities and infrastructure, surface soil stockpiles, general excavation and waste management areas. The results of all development activities include:

- Clearance of topsoil and vegetation (for the construction of newly proposed infrastructure and access tracks, extraction of sand from dunes and rock quarrying, etc.);
- The alteration of surface soils and surface water flows.

All activities that result in land clearance are subject to ODC's internal Application for an Environmental Disturbance Permit (EDP) (Document No. 56830). In addition, management plans direct the handling of vegetation, topsoil and erosion and sediment control measures.

The extent of land disturbance and the impact of drilling activity are controlled through site procedures.

Waste management and infrastructure expansion is subject to the approval of the appropriate authorities and is regulated through discussions with planning personnel and site procedures developed with earthworks contractors.

**Listed species** are protected where possible under the EDP procedure. This procedure includes the requirement to seek alternative locations for disturbance in an attempt to avoid individuals of **listed species**, or to justify the decision that a relocation of the infrastructure is not possible.

#### 2.4.2 Purpose

- Define the direct disturbance impact footprint of infrastructure, development, resource drilling and associated waste management activities.
- Ensure that all disturbance activities have been undertaken in compliance with the EDP and SEB processes.
- Identify species and areas of habitat that should be avoided where possible during land disturbance activities.

#### 2.4.3 Deliverable(s)

- A map of the direct disturbance impact footprint of ODC's Olympic Dam activities.
- A statement of comparison between the impact footprint of ODC's activities (i.e. within and outside the SML) and the offset areas under SEB processes, to track progress towards a life of mine ratio of 8ha set aside for each hectare disturbed.
- A map of the known locations of **listed species** within the impact area of the Olympic Dam operation.
- A statement of impacts to, and measures undertaken to avoid **listed species**.

#### 2.4.4 Method

The extent of physical land disturbance is measured annually using GIS technology and remotely sensed imagery. Geo-referenced imagery of the SML and when available, the Roxby Downs Municipality are analysed for physical disturbance during the period prior to image capture. Evidence of disturbance is cross-referenced against the EDP system records for the same period. For land disturbance occurring following image capture until the end of the reporting period, the area is calculated from the EDP database. These figures are adjusted appropriately in the following reporting period to reflect actual disturbance.

Locations will be investigated opportunistically for annual and/or ephemeral **listed species** and/or their habitat (e.g., Plains Rat habitat) and added to the EDP spatial database for future reference. Locations of these species and perennial **listed species** will be retained in the spatial database and considered when applications for EDPs are lodged.

A flora assessment is undertaken in areas known or likely to support **listed species** prior to any significant land disturbance activities. Where threatened flora or habitats considered important to threatened species are found, the EDP conditions flag 'no go' areas, seek justification for disturbance in these areas, and in certain circumstances require relocation of affected species where disturbance is unavoidable.

As part of the EDP process, each applicable land disturbance is allocated an appropriate SEB offset ratio. Total offset areas are then subtracted from the total SEB offset areas that have been approved by the Native Vegetation Council, and a remaining SEB offset area is reported.

## **2.5 Delivery of environmental offsets**

### **2.5.1 Background**

As discussed in section 2.4, an SEB offset has been implemented to compensate for vegetation clearance and other **environmental impacts** arising from vegetation clearances that are required (under the Native Vegetation Regulations 2003) to be offset. An existing SEB (Gosse Springs) has been approved by the South Australian and Federal Governments. Additional proposed areas in the Arid Lands NRM region include Emerald Springs and One Box to the west of Lake Eyre National Park and two further adjoining properties; Black Swan and Bedourie. In conjunction with existing national parks and reserves, the proposed offsets will aid in the formation of a contiguous conservation area of 15,650 km<sup>2</sup>. Appendix C provides a map of the potential future SEB areas.

The objective of the SEB offset area is to not only compensate for **environmental impacts** associated with any expansion, but to also achieve a net gain in biodiversity and conservation value for the region. To achieve this outcome management actions and strategies will be progressively implemented, within each SEB area, that focus on weed and feral animal control, rehabilitation of disturbed areas and other strategies that ensure the protection and recovery of native flora and fauna.

A native vegetation management plan has been developed for Gosse Springs, detailing the actions that will be undertaken to manage the area. This document also details the contributions the SEB areas will give to the biodiversity conservation priorities of the Australian and South Australian Governments. The development of each SEB area is undertaken in stages, commencing with Emerald Springs, and in correlation with offset requirements arising from vegetation clearances.

To ensure the successful and timely delivery of the actions, monitoring of these plans is conducted as part of this MP and reported in the Annual EPMP Report each year.

### **2.5.2 Purpose**

- To monitor the delivery of strategies and management actions required for the SEB offset areas.

### **2.5.3 Deliverable(s)**

- A summary of actions achieved from the SEB implementation plan within the fiscal year through the Annual EPMP Report.
- An annual report to the government on SEB management outcomes through the Annual EPMP Report.
- Shapefiles of the SEB areas for inclusion in relevant departmental databases.

### **2.5.4 Method**

All implementation plans will be routinely reviewed to ensure management actions are being addressed in a timely manner and to make modifications to proposed actions if required.

Details of actions achieved from these plans, within the fiscal year, are reported through the Annual EPMP Report.

## **3 COMMITMENTS**

### **3.1 Reporting**

The results and a discussion of the results will be presented in the Annual EPMP Report, as outlined in the EMM.

### 3.2 Summary of commitments

**Table 3.1: Summary of commitments**

Action	Parameter	Frequency
Monitor	The total area of direct impact on vegetation	Annually
Monitor	Changes in perennial vegetation in response to emissions from the Olympic Dam Operation	Annually
Monitor	Great Artesian Basin (GAB) springs wetland vegetation composition assessment	Annually
Monitor	The current status of key pest plant species within the Olympic Dam region	Ongoing
Monitor	Relative abundance of <i>Eriocaulon carsonii</i> within the wellfields	Annually
Monitor	Presence of <b>Important Biodiversity and Ecosystems</b> within the SML, region and wellfields	Opportunistically
Assess	Actions achieved from implementation plans for SEB areas	Annually
Rehabilitate	Cleared areas and take measures to avoid disturbance to <b>listed species</b> in accordance with the methods prescribed in the EDP procedure	As prescribed
Report	Annual land disturbance for the SML and Municipal Leases defined as either being credited to an SEB or not	Annually
Report	Monitoring results in the Annual EPMP Report to the Indenture Minister	Annually
Review	<b>Important Biodiversity and Ecosystems</b> Register and modify as appropriate	Annually
Review	The Flora MP and modify as appropriate	Annually

## 4 DEFINITIONS AND REFERENCES

### 4.1 Definitions

Throughout the EPMP some terms are taken to have specific meaning. These are indicated in bold text in the documentation and are defined in the glossary in section 5 of the EMM. Defined terms have the same meaning wherever they appear in bold text. Some other terms and acronyms are also defined in the glossary, but do not appear in bold text.

### 4.2 References

BHP Billiton Olympic Dam 2009, 'Olympic Dam Expansion – Draft Environmental Impact Statement 2009', BHP Billiton, Adelaide.

BHP Billiton Olympic Dam 2016, 'Olympic Dam Weed Management Strategy', unpublished report for BHP Billiton, Olympic Dam.

Environmental and Biodiversity Services 2010, **Gosse Springs Paddock Native Vegetation Management Plan**. Kurrulta Park, SA: Environmental and Biodiversity Services.

### 4.3 Bibliography

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Fatchen Environmental. 2005. An assessment of WMC (Olympic Dam Corporation) emissions impact on the flora of the special mining lease and surrounds [2004]. Report for WMC (Olympic Dam Corporation) Pty Ltd. Mt Barker, SA: Fatchen Environmental Pty Ltd.

Griffin, GF & Dunlop, SR 2006, 'Long term changes in the composition of perennial vegetation in response to emission from the Olympic Dam Operations', unpublished report for BHP Billiton Olympic Dam.

Habermehl, MA 1982, 'Springs in the Great Artesian Basin, Australia – Their origin and nature', Australian Government Printing Service.

Harris, CR 1992, 'Mound springs: South Australian conservation initiatives', **Rangeland Journal** 14 (2), pp. 157–173.

Read, JL 1995, 'Recruitment characteristics of the white cypress pine (*Callitris glaucophylla*) in arid South Australia', **Rangeland Journal** 17, pp. 228–240.



## 5 APPENDIX A: FLORA MONITORING SITE LOCATIONS

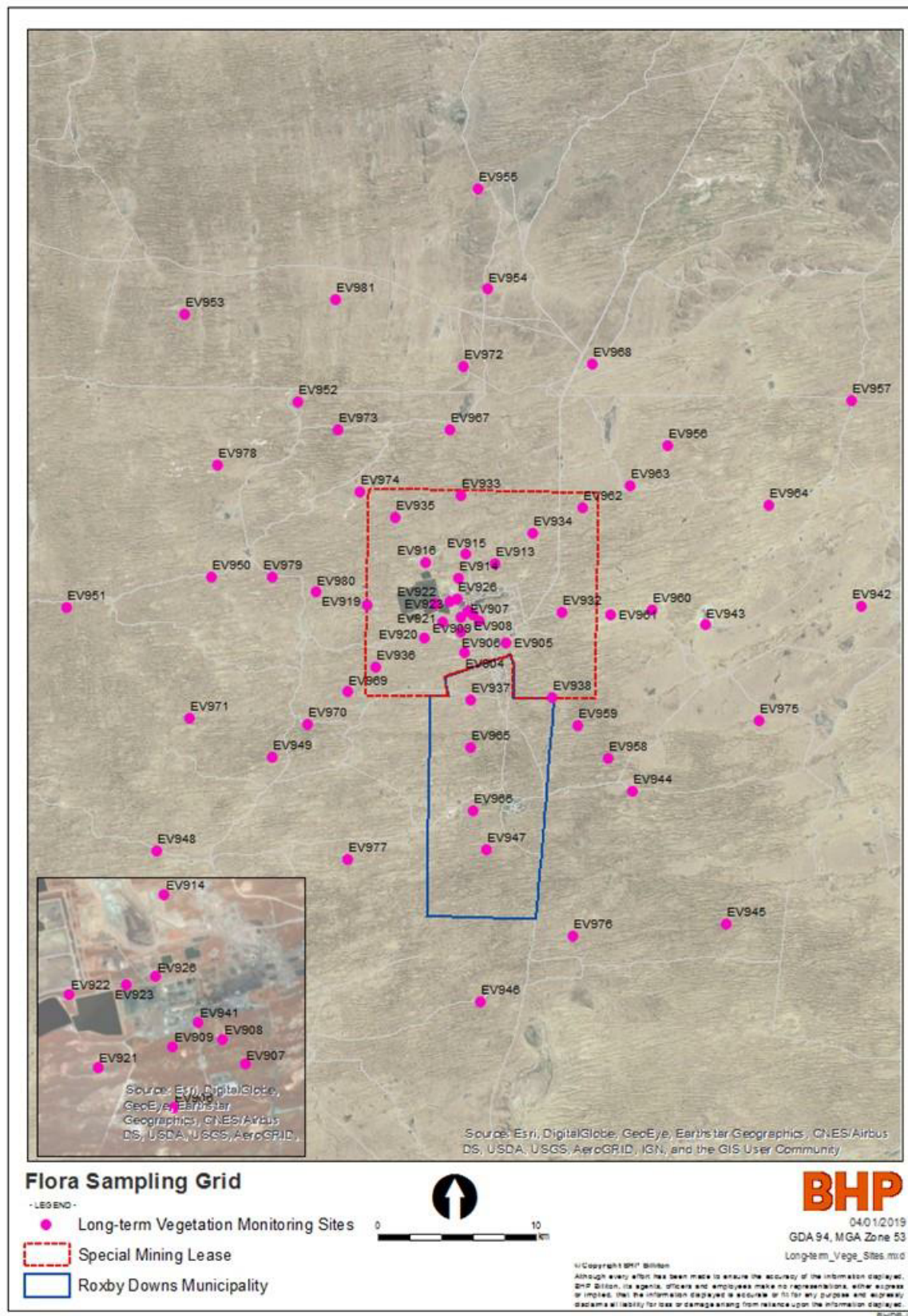


Figure 5.1: Sampling grid for OD long term flora monitoring.

## 6 APPENDIX B: VEGETATION COMMUNITIES WITHIN THE GOSSE SPRINGS SEB AREA

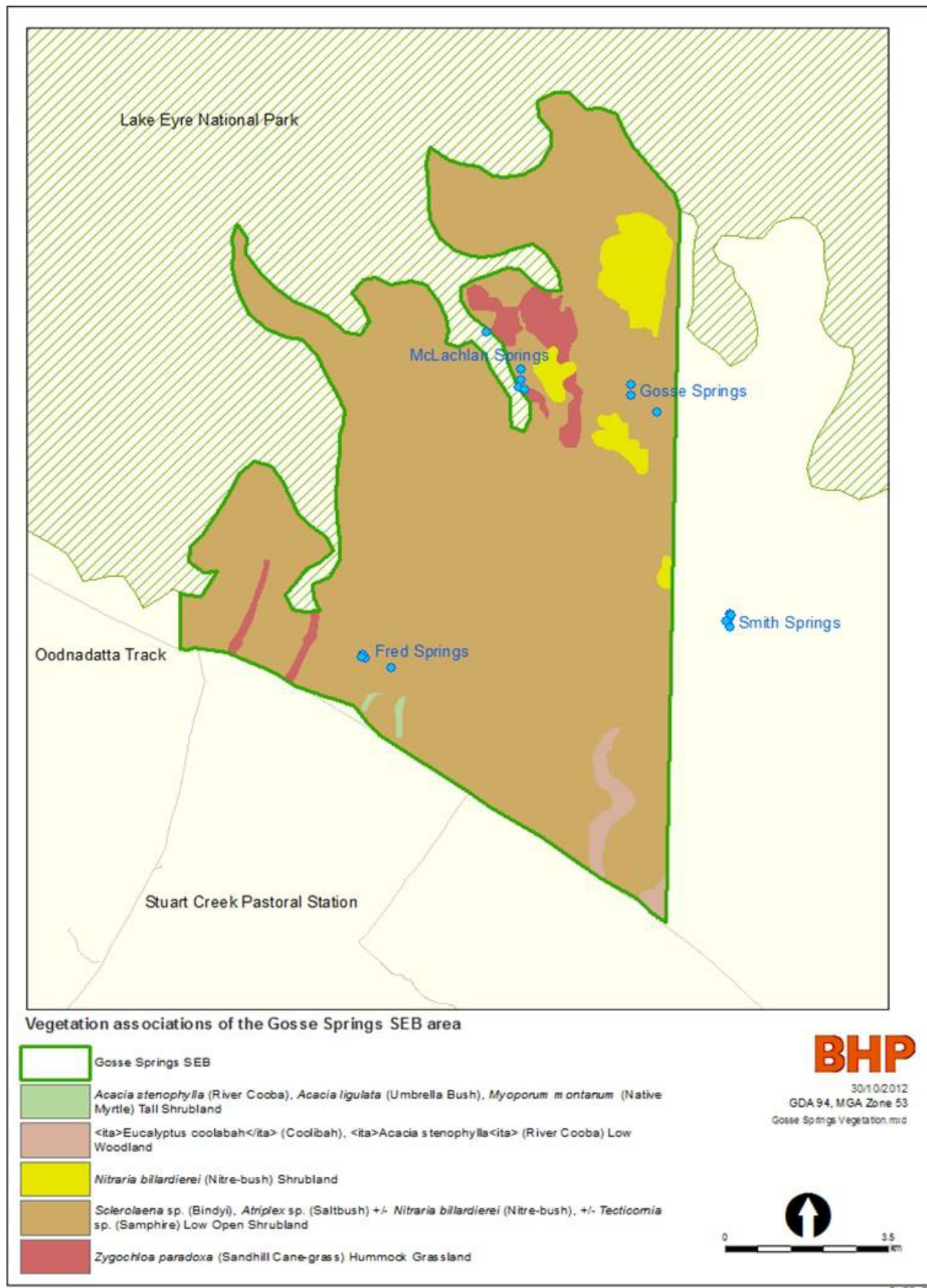
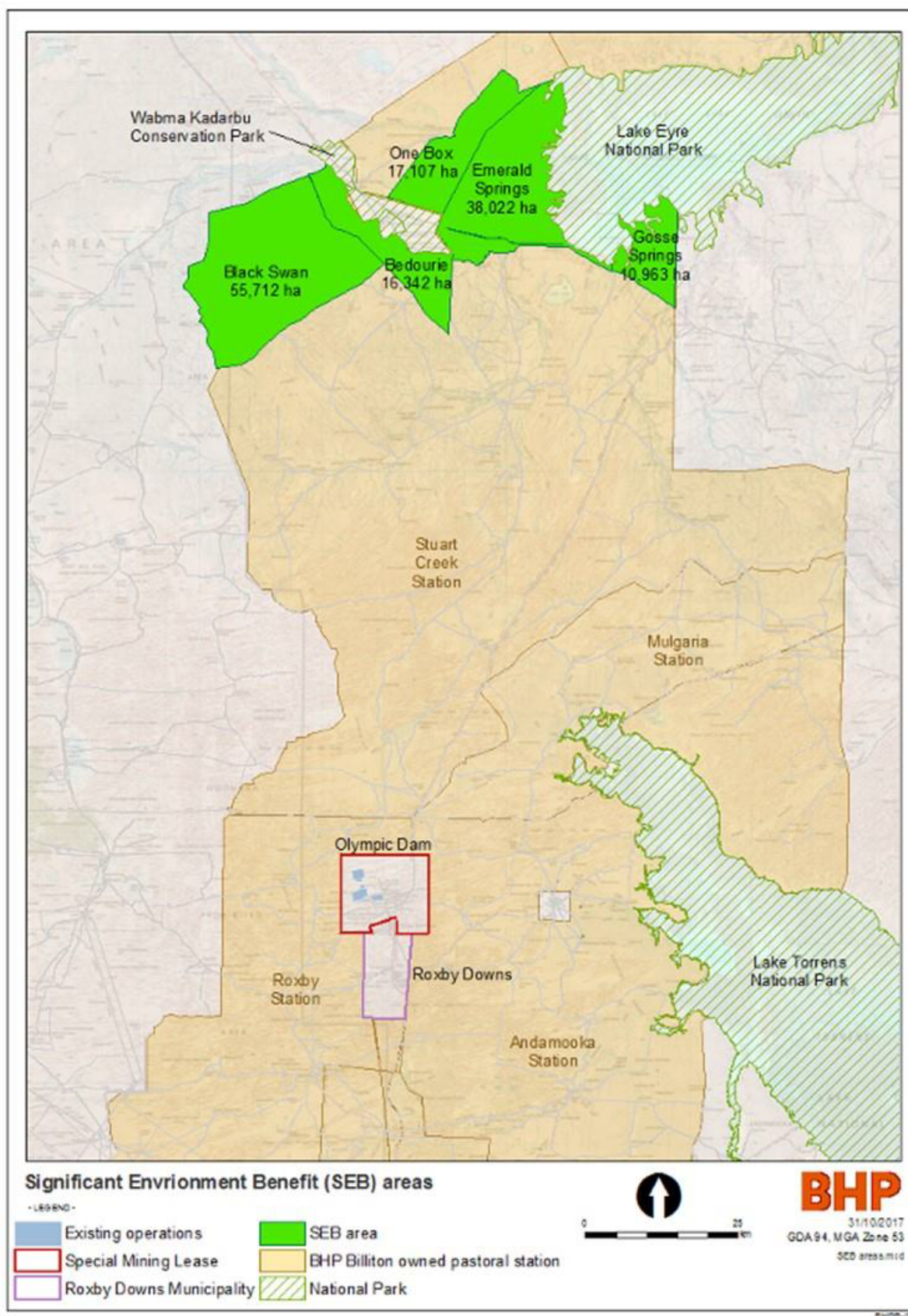


Figure 6.1: Gosse Springs SEB area vegetation associations



## 7 APPENDIX C: PROPOSED SEB AREAS



**Figure 7.1: Proposed SEB offset areas**