Information Document		Document No.	2663
Document Title	**Monitoring Program – Fauna**		
Area	HSEC	**Issue Date**	7 June 2013
Major Process	Environment	**Sub Process**	
Authoriser	Darryl Cuzzubbo – Asset President Olympic Dam	**Version Number**	16

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 fauna at Olympic Dam and the surrounding areas that may be impacted by current mining and processing activities, or construction activities as part of any future expansion. 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 fauna, 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 fauna 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 fauna that is normally associated with open rangeland ecosystems and Great Artesian Basin (GAB) springs in the wellfield areas. This MP also includes the potential area required for any future expansion, including the **expanded Special Mining Lease** (SML), Roxby Downs Municipality, the future saline water wellfield, accommodation village and airport sites (Aus 5a; State 17a).

Fauna monitoring within the SML and surrounding areas is principally designed to determine the nature, extent and degree of any impacts, both positive and negative, of the operation on several indicator species or functional groups. Results of previous research and monitoring have enabled several bioindicators to be identified. These include species of birds, reptiles and mammals. These animals have been demonstrated to respond uniquely to the impacts associated with the operation.

At-risk fauna species and feral and abundant species are also monitored. Fauna losses associated with ODC are also monitored to direct efforts which can be made to avoid them.

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 Appendix D (see section 8).

2 DETAILED PROCEDURE

2.1 Bioindicator avifauna

2.1.1 Background

Previous monitoring and research have indicated that several species or species groups of birds may be used as indicators of impacts associated with the mining operations.. It has been demonstrated that Crested Bellbirds and mixed feeding flocks of insectivorous birds decrease in abundance in close proximity to the mining operations (Read *et al.* 2000, Read *et al.* 2005). Past research has also determined a group of bird species that have been seen to benefit from the presence of the operations, known as 'disturbance' species. The presence/absence of these bioindicators and species richness of 'non-disturbance' bird species at different site types is surveyed.

2.1.2 Purpose

- Utilise avifauna survey data as an indicator of environmental change.

2.1.3 Deliverable(s)

- A map of the impact footprint of ODC's Olympic Dam activities on abundance of Crested Bellbirds and mixed feeding flocks of insectivorous birds, and species richness of 'non-disturbance' species, for the Environmental Management and Monitoring Report. (Aus 5g; State 17ki).

2.1.4 Method

Forty sites are surveyed in April, July and October of each year for all bird species present (see Figure 5.1) (Aus 5h, 5i; State 17kii, 17kiv). Each site is located on a dune containing a patch of mulga woodland and other shrub species. Each site covers an area 200 m by 200 m.

During each survey period all sites are surveyed for 10 minutes. During this time all birds, seen and heard, are recorded. Surveys are conducted in the morning, within four hours of sunrise.

Avifauna survey data are used to determine the presence/absence of bioindicator species and the species richness of 'non-disturbance' bird species at different sites.

With the introduction of activities as part of the Expansion, some existing monitoring sites were lost/New sites may be added to maintain the integrity of the sampling program if appropriate.

2.2 Bioindicator small mammals and reptiles

2.2.1 Background

Small mammals and reptiles are used as biological indicators of the condition of the environment, both adjacent to and at a distance from, construction and operational activities within the SML. These studies allow examination of the nature and extent of impacts of Olympic Dam operations on small mammals and reptiles.

Geckos, due to their sensitivity to air pollution, are the most suitable local reptiles for use as bioindicators (Read 1998). Geckos have large eyes and soft skin, making them susceptible to contaminants. Geckos are also ideal bioindicators as their fecundity (the number of offspring produced per individual) is readily measured, therefore any declines in fecundity as a result of operational and construction activities can be assessed (Aus 5j; State 17kv). .

In selecting appropriate indicator species, it was noted that *Ctenotus* skink captures generally exceed *Ctenophorus* dragon captures in unimpacted sites (Read et al. 2005). Similarly, native rodent captures (*Pseudomys* sp., *Leggadina forresti* and *Notomys alexis*) generally exceed captures of House Mice (*Mus domesticus*) at unimpacted sites (Read et al. 2005).

2.2.2 Purpose

- Utilise small mammal and reptile survey data as an indicator of environmental change.

2.2.3 Deliverable(s)

- A map of the impact footprint of ODC's Olympic Dam activities on the fecundity of geckos, *Ctenotus*/*Ctenophorus* ratios and feral/native mouse ratios (Aus 5g; State 17ki).

2.2.4 Method

Animals are captured using pitfall traps. The pits, when opened, are linked by a fly mesh fence that directs animals towards them. Between the annual sampling periods the fence is removed and pits are left in place, covered with tightly fitting caps.

Reptile abundance, mammal abundance, and gecko abundance, age and fecundity are recorded annually during a trapping session over the summer months (Aus 5i; State 17kiv). Thirteen sites are monitored, at varying distances from the operation. These include sites located near the smelter and ventilation shafts, and also intermediate and control sites. The regional locations of the fauna monitoring sites are shown in Figure 5.2 (Aus 5h; State 17kii). Note that during any potential expansion activities some existing sites may be removed and others added to the monitoring program to maintain the integrity of the program. In investigation into the potential to merge small mammal and reptile monitoring with that performed by Arid Recovery is underway and may result in the addition of sites not previously included.

2.3 Feral and abundant species

2.3.1 Background

Kangaroos are native and commonly recorded within the region, however the presence of artificial water bodies and the lack of domestic grazing on the SML influences their abundance, often resulting in higher densities than those outside the SML. Both kangaroo and rabbit numbers directly affect the condition of the vegetation on the mine and municipal leases. These herbivores also affect the success of rehabilitation measures and amenity plantings within the mine and municipal leases. Similarly, cat and fox numbers have the potential to increase in response to land management practices and have an impact on native vertebrate populations. Therefore, these species can potentially have an impact on the ecology of the region. For this reason, feral and abundant mammal populations are monitored regularly and controlled when necessary.

2.3.2 Purpose

- Monitor and control feral and abundant species within the SML and surrounding areas (Aus 29b, State 9).

2.3.3 Deliverable(s)

- A quantitative assessment of the abundance of specific feral and abundant species within the SML.
- Identification of whether measures are required to control feral or abundant species in the operations area.

(Aus 5g, 29b; State 17ki)

2.3.4 Method

The relative abundance of kangaroos, rabbits, cats, and foxes is determined on a quarterly basis using established track transects within ‘impact’ and ‘control’ zones (see Figure 5.3) (Aus 5h, 5i; State 17kii, 17kiv). Past research (Moseby. K et al. 2009) shows that the minimum average daily distance moved by foxes is 4.5 km. Cats appeared to move much less at a minimum average of 1.52 km. The research showed that both cats and foxes exhibited a preference for dune habitat.

To enable abundance comparisons between ‘impact’ and ‘control’ areas of the SML, 14 fixed transects are located within a defined ‘impact’ and ‘control’ area. ‘Impact’ sites are located within five kilometres of the existing operation. ‘Control’ transects are located at a minimum distance of ten kilometres from the centre of the operation and/or five kilometres from operational features and/or existing ‘impact’ transects. All sites are within the potential expanded SML (if required for comparisons, data from remote transect sites on Roxby Downs Station may also be available from **Arid Recovery**). Transects are 200 m in length and are located, where possible, in dune habitats. In line with past research (Read & Eldridge, 2010) transects are located at a minimum distance of 500 m apart to reduce the likelihood of the same individuals being counted twice.

Each transect is visited in the evening and the following morning during the quarterly monitoring period. The abundance of species is recorded as a percentage of the 15 transects that have evidence of cat, fox, rabbit or kangaroo tracks upon them. The number of individuals is not speculated, it is purely a presence/absence recording on each transect.

Populations of feral and abundant mammals are largely dependent on climatic conditions and fluctuate accordingly. Furthermore, populations, in particular rabbits and kangaroos, are largely independent of mining and processing operations. Control of these groups is also considered impractical on a large scale. House mice are not controlled, as the operation is located in a pastoral area and they are not considered to be a significant pest species.

Cat and fox control is conducted in and around the operations on an opportunistic basis.

2.4 Yarra Wurta Springs

2.4.1 Background

Groundwater flows into the open pit and operation of the regional saline wellfields reduces groundwater levels in the vicinity of the operations and this can reduce the supply of water to groundwater dependant ecosystems. However, it was established in the **EIS** that impact at Yarra Wurta springs was unlikely. The **EIS** also established that Yarra Wurta is not connected to the GAB springs and was not found to support listed threatened species or scientifically important stromatolites. The spring does, however, support a refuge population of a small fish called the Lake Eyre Hardyhead.

2.4.2 Purpose

- Monitor populations of the Lake Eyre Hardyhead at Yarra Wurta Springs to determine if populations are affected by ODC's Olympic Dam activities.

2.4.3 Deliverable(s)

- A qualitative assessment of the abundance of the Lake Eyre Hardyhead in the Yarra Wurta Springs and compare with previous surveys results (Aus 5g; State 17ki).

2.4.4 Method

The presence of Lake Eyre Hardyhead is determined triennially, monitoring is conducted in the second year of the **Environmental Management Manual** (EMM) triennium Aus 5i; State 17kiv), by walking downstream along fixed transects within the pools formed from the springs (Aus 5h; State 17kii). Fish sightings and the location on each transect is recorded.

2.5 'At-risk' fauna – Category 1a

A number of at-risk species have been recorded or regularly occur within the SML and the wellfields. At-risk species have been classified by ODC into three main categories – Category 1a, Category 1b and Category 2. Appendix B contains a flow chart detailing how priority species are identified (see Figure 6.1). All Category 1a species are considered 'at-risk' as their population as a whole is largely restricted to the impact area and therefore the species has a higher risk of being impacted. These species are all formally **listed species** under state, national and/or international conservation listings.

The extent of at-risk species monitoring depends largely on the category under which they fall. Monitoring of Category 1a is intensive in comparison to Category 1b and Category 2 (see section 2.6), which reflects the species' reliance on the potential impact area. A list of all Category 1a, 1b and 2 fauna occurring in the impact zone is included in Appendix C. This includes invertebrates largely restricted to the GAB springs of the Lake Eyre South region in the vicinity of the wellfields.

2.5.1 Background

A diverse, endemic invertebrate fauna group occurs in springs associated with the GAB in South Australia and Queensland. As GAB springs are small aquatic habitats, widely separated in an arid environment, it has been found that localised groups of GAB springs support their own specific types of endemic invertebrates (Ponder 1986). Invertebrate populations in GAB springs within the operational area of Olympic Dam are classified as Category 1a species, and are the only Category 1a species listed.

GAB springs in the Lake Eyre South region support at least six species of Hydrobiid in two genera (*Trochidrobia* and *Fonscochlea*), a phreatoicid isopod (*Phreatomerus latipes*), an ostracod (*Ngarawa dirga*) and an amphipod (*Austrochiltonia* sp.). All these species are aquatic and are currently only known to occur in GAB springs between Marree and Oodnadatta (the only known exception is a species of Hydrobiid recorded in low abundance from Coward Springs Railway Bore) (Ponder et al. 1989). All species of Hydrobiid present in these springs are currently recognised as internationally significant (IUCN Red List of Threatened Species 2012).

The persistence of GAB spring aquatic invertebrates is intimately linked to the availability of free-flowing water at GAB springs (Aus 5j; State 17kv). While the aquatic populations have been exposed to natural spring processes of emergence and decline over considerable time periods, it is likely that populations would be susceptible to any accelerated spring decline over comparatively short periods, which may be caused by excessive drawdown.

2.5.2 Purpose

- Qualify the level of population change that may be attributed to water extraction from the wellfields (Aus 29a; State 7, 17ki).

2.5.3 Deliverables

- Comparison of the abundance of Hydrobiid species against baseline data to quantify population change (Aus 5g; State 17ki).

2.5.4 Method

Spring groups within the potential impact zones of the GAB are visited triennially and sampled for the presence/absence of endemic invertebrate species. Sampling is conducted in the second year of the **Environmental Management Manual** (EMM) triennium, with sorting analysis completed during the same year (Aus 5i; State 17kiv).

Previous research has shown that presence/absence data provides the same level of information as measures of abundance (Tyre and Possingham 2001). Therefore a large number of springs are visited and sampled for presence/absence, as opposed to visiting a small number of springs and providing a quantitative analysis. This enables a broader impression of current population status to be gained.

Substrate samples are taken at each of the designated springs using a standardised scoop and tray, and analysed for presence/absence of key fauna species/groups.

Time series data are summarised and inspected for long-term trends. Baseline data consists of samples collected during 1995–1996 (Aus 5j; State 17kv) with further additional sampling conducted during 1999, 2000, 2002–2005, 2008 and 2011. The next round of monitoring is scheduled for the latter half of 2014 (FY15). Monitoring sites are grouped in zones for analysis based on predicted levels of impact listed in Appendix F of the Great Artesian Basin (Document No. 2789) (Aus 5h; State 17kii).

2.6 'At-risk' fauna – Categories 1b and 2

2.6.1 Background

Category 1b comprises **species** for which **important populations** may be critically reliant on areas impacted by the operation and any future expansion developments. Category 1b species are those with local sedentary populations that are exposed to impact from the operations and have limited alternative habitat in the region. Also included are highly mobile species that travel in large numbers and are attracted to hazardous areas within the operation (e.g. the Banded Stilt).

Category 2 includes all other species known to occur in the region that are listed under state, national and/or international conservation listings, but can include other regionally or locally significant species that may be adversely impacted by operations (i.e. includes some resident unlisted species) (Appendix B). Populations of Category 2 at-risk species are not critically reliant on the area of impact, (i.e. only individuals of a species are likely to be impacted).

The 36 migratory shorebird species listed in the EPBC Act 1999 Draft Policy Statement 3.21 were considered during the formation of this MP. Of the 36 species, 13 have been sighted through monitoring programs conducted at Olympic Dam and in the wellfields since 1986, and are included as Category 2 species within the 'At-Risk Fauna Species List'.

Impacts to Category 1b and 2 species are principally managed by the measures outlined in sections of the EMP addressing land disturbance, and via the implementation of ODC's internal EIHCP process. In summary, this process requires the manager of the activity to seek a clearance permit for disturbance activities, which is reviewed by environmental personnel. A review against ODC's spatial database is undertaken to determine if any at-risk species are known to occur or utilise the habitats proposed for disturbance. If the disturbance cannot be avoided, targeted surveys are undertaken to determine if any at-risk species are present. If populations are shown to exist, the area is identified as a 'no-go' area and the manager of the activity is requested to avoid the area if possible. In rare circumstances where the activity cannot avoid the area, and if appropriate, the at-risk species are relocated.

Forty-seven bird species, eight mammal species and two reptile species have been identified in the Olympic Dam and wellfields region under Categories 1b and 2 (Appendix C) (State 8).

2.6.2 Purpose

- Record the presence of Category 1b and Category 2 at-risk species in the SML, surrounding areas and wellfields region.

2.6.3 Deliverable(s)

- A quantitative assessment of the presence of Category 1b and Category 2 at-risk species in the SML, surrounding areas and wellfields region for internal records and EMMR reporting (Aus 5g, 29a; State 7, 17ki).
- A maintained and updated (where required) map of the known locations and important habitats for at-risk species, to assist the EIHCP process (Aus 5g; State 17ki).
- A statement of impacts to, and measures undertaken to avoid, Category 1b at-risk species. (Aus 5k, 29a)

2.6.4 Method

Species lists are compiled monthly (Aus 5i; State 17kiv) for all birds sighted in:

- the SML;
- the surrounding pastoral stations;
- the wellfields region (Aus 5h; State 17kii).

Category 1b and Category 2 at-risk species of mammals are observed through the annual field sampling associated with the small mammal and reptile monitoring (see section 2.2), regular surveys of local waterbird populations (see section 2.7), avifauna monitoring (see section 2.1) and through opportunistic observations.

A fauna assessment is undertaken in areas known or likely to support at-risk species prior to any significant land disturbance activities undertaken by or for ODC. Where threatened fauna or habitats considered important to threatened species (Category 1b or 2) are found, the EIHCP conditions flag ‘no go’ areas for those undertaking the disturbance activities, seek justification for disturbance in these areas, and in certain circumstances require relocation of affected species where disturbance is unavoidable (Aus 29a; State 6, 38).

2.7 Fauna losses

2.7.1 Background

Evaporation ponds and tailings storage facilities (which together form the Tailings Retention System – TRS) are sometimes visited by fauna, which can result in deaths (particularly wetland birds). ODC has trialled various measures to deter fauna from visiting the TRS, and is committed to ongoing improvement in this area.

A number of measures are used to minimise the risk of fauna losses, including intermittent deterrents, pond characteristics and fencing. Measures to be implemented for the expanded TRS include the netting or similar of the TSF decant ponds and balance ponds. Expansion of the operation will also allow ongoing optimisation of the operation’s water balance removing the requirement for new evaporation ponds. ODC also continues to research new measures to decrease the attractiveness of the TRS waterbodies to fauna.

2.7.2 Purpose

- Assess the performance of control measures that aim to minimise the risk of Category 1b and Category 2 fauna species interacting with the TRS and alert management when levels approach the **leading indicator** (State 7).

2.7.3 Deliverable(s)

- An assessment of fauna activity and losses within the TRS.
- A quantitative assessment of the numbers of waterfowl using local non-toxic water bodies and the TRS.

- An evaluation of the effectiveness of control measures and targets in reducing the number of **listed migratory birds** lost within the TRS.

(Aus 5g; State 17ki)

2.7.4 Method

Standardised monitoring of the TRS is conducted weekly to detect the presence of any fauna (dead or alive) (Aus 5h, 5i; State 17kii, 17kiv). This monitoring is conducted by trained staff members, and any fauna carcases are removed when safe to do so. Opportunistic observations of fauna on the TRS are also made by trained staff and technicians.

Monthly bird surveys are conducted at large water bodies where water birds congregate (i.e. desalination plant, sewage ponds, and mine water ponds) and also the TRS (Aus 5h, 5i; State 17kii, 17kiv). This allows the local population of water birds (especially transient species) to be determined and compared with those detected at the TRS (Aus 5j; State 17kv). Analysis is conducted on the effectiveness of control measures and targets in reducing the number of **listed migratory bird** deaths within the TRS.

3 COMMITMENTS

3.1 Reporting

The results and a discussion of the results are presented in the annual Environmental Management and Monitoring Report (EMMR), as outlined in the EMM. The monitoring results relating to fauna are made publicly available through the EMMR.

3.2 Summary of commitments

Table 3.1: Summary of commitments

Action	Parameter	Frequency
Monitor	Avifauna presence and abundance	April, July, October
Monitor	Reptile bioindicators, mammal bioindicators and gecko fecundity	Annually
Monitor	Feral animal and kangaroo abundance	Quarterly
Monitor	Lake Eyre Hardyhead abundance at Yarra Wurta Springs	Triennially
Monitor	Endemic invertebrate abundance (Category 1a species) in GAB springs	Triennially
Monitor	Presence of Category 1b, and 2 species within the SML, region and wellfields	Opportunistically
Monitor	Fauna presence and losses within the TRS	Weekly
Monitor	Waterbird abundance at large water bodies and the TRS	Monthly
Assess	Effectiveness of control measures and targets in reducing the number of listed migratory birds lost within the TRS	Annually
Employ	Environmental Scientist to undertake the requirements of the MP – Fauna	Ongoing
Report	Monitoring results in the EMMR to the Indenture Minister and make fauna data publicly available through the EMMR	Annually
Review	The Fauna 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 2009, Draft Environmental Impact Statement 2009.

ICRP 2008, Environmental Protection: the Concept and Use of Reference Animals and Plants, ICRP Publication 108, Annals of the ICRP 38 (4–6).

IUCN 2010, 'IUCN Red List of Threatened Species', Version 2010.4.

Moseby, K, Stott, J & Crisp, H 2009, 'Movement patterns of feral predators in an arid environment – implications for control through poison baiting', Wildlife Journal 36: 422-435.

Ponder, WF 1986, 'Mound Spring Snails of the Great Artesian Basin', in *Limnology in Australia*, eds DeDecker P & Williams WD, CSIRO Australia, Melbourne.

Ponder, WF, Hershler, R & Jenkins, B 1989, 'An endemic radiation of Hydrobiid Snails from artesian springs in Northern South Australia: their taxonomy, physiology, distribution and anatomy', *Malacologia* 31 (1): pp. 1–140.

Read, JL 1998, 'Are geckos useful bioindicators of air pollution?', *Oecologia* 114: pp. 180–187.

Read, JL & Eldridge, S 2010, 'An optimised rapid detection technique for simultaneously monitoring activity of rabbits, cats, foxes and dingoes in the rangelands', The Rangeland Journal 32: 389-394.

Read, JL, Kovac, K & Fatchen, TJ 2005, 'Biohyets: a method for displaying the extent and severity of environmental impacts', *Journal of Environmental Management*, 77 (2005): pp. 157–164.

Read, JL, Reid, N & Venables, WN 2000, 'Which bird species are useful bioindicators of mining and grazing impacts in arid South Australia?', *Environmental Management* 26 (2): pp. 215–232.

Tyre, AJ & Possingham, HP 2001, 'Risk Management for ecologically sustainable development: predicting extinction and recolonisation in the Mound Springs of SA – Final Report', Unpublished report for WMC Olympic Dam, University of Queensland.

4.3 Bibliography

Andersen, AN, Fisher, A, Hoffman, BD & Read, JL 2004, 'Use of terrestrial invertebrates for biodiversity monitoring in Australian rangelands, with particular reference to ants, *Austral Ecology* 29, pp. 87–92.

Anon 1991, 'Environmental Assessment Wellfield A Extension'.

Australian Nature Conservation Agency 1996, 'A directory of important wetlands in Australia Second Edition', ANCA, Canberra.

Badman, FJ 1987, 'Birds & the bore drains of inland S.A.', Nature Conservation Society of South Australia.

Badman, FJ 1991, 'Birds', in 'A natural history of the Lake Eyre region: A visitors guide', pp. 29–38, eds Badman FJ, Arnold BK and Bell SL, NPWS Northern Consultative Committee, Port Augusta.

Badman, FJ 1991, 'Mound Springs', in 'A natural history of the Lake Eyre region: A visitors guide', pp. 51–58, eds Badman FJ, Arnold BK & Bell SL, NPWS Northern Consultative Committee, Port Augusta.

Bowen, ZE & Read, JL 1998, 'Factors influencing breeding and survivorship of rabbits in the Roxby Downs region', *Wildlife Research* 25, pp. 655–662.

Casperson, KC 1979, 'Mound Springs of South Australia. Part 1, Physical features, history, biota and conservation requirements', South Australian Department of Environment and Planning SADE 20, pp. 1–23.

Colgan, DJ & Ponder, WF 1994, 'The evolutionary consequence of restrictions in gene flow: examples from Hydrobiid snails', *Nautilus*, Supplement 4, pp. 25–43.

DeDeckker, P 1979, 'Ostracods from the mound springs between Strangways and Curdimurka, South Australia', Transactions of the Royal Society of South Australia 103, pp. 155–168.

Dobrzinski, I 1994, 'Mound Springs in SA: Potential effects from aquifer drawdown to mining', Department of Mines and Energy South Australia, Adelaide.

Ferguson, D 1985, 'The mound springs: Lens on a Looming tragedy for Australia's desert lands', *Habitat* 13 (2), pp. 32–33.

GAB Consultative Council 1998, 'Draft Great Artesian Basin Strategic Management Plan', Great Artesian Basin Consultative Council, Fortitude Valley, Brisbane.

GAB Consultative Council 1998, 'Great Artesian Basin resource document', Great Artesian Basin Consultative Council, Fortitude Valley, Brisbane.

Gotch TB 2000, 'Wolf spider assemblages in the mound springs and bore drains of South Australia', unpublished honours thesis, University of Adelaide.

Greenslade, J & Reeves, A 1985, 'South Australia's Mound Springs', Nature Conservation Society of South Australia Inc., Adelaide.

Harris, CR 1981, 'Oasis in the desert: The mound springs of northern South Australia', *Proceedings of Royal Geographical Society of Australasia (South Australian Branch)* 81, pp. 26–39.

Harris, CR 1992, 'Mound springs: South Australian conservation initiatives', *Australian Rangelands Journal* 14 (2), pp.157–73.

IUCN 2012, 'IUCN Red List of Threatened Species', Version 2012.2.

Kemper, CM & Read, JL 1991, 'Mammals', in 'A natural history of the Lake Eyre region: A visitors guide', pp. 39–43, eds Badman FJ, Arnold BK & Bell SL, NPWS Northern Consultative Committee, Port Augusta.

Keane, D 1997, 'The sustainability of use of groundwater from the Great Artesian Basin, with particular reference to the south western edge of the basin and impact on the mound springs', unpublished thesis.

Kinhill-Stearns Roger 1982, 'Olympic Dam Project draft environmental impact statement', Kinhill Stearns Roger Joint Venture, Adelaide.

Kinhill Engineers 1994, 'Supplementary environmental studies Wellfield B, Mound Springs and meteorology desktop study', Kinhill Engineers Pty Ltd, Adelaide.

Kinhill Engineers 1995, 'Survey and assessment report: Supplementary environmental studies, Borefield B development', Kinhill Engineers Pty Ltd, Adelaide.

Kovac, KJ & Niejalke, DP 2004, 'Observation and breeding records of the Painted Finch *Emblema pictum* associated with artesian springs in South Australia', *South Australian Ornithologist* 34 (5), pp.181–182.

Lamb, KJ 1998, 'Grazing impacts on mound spring spider communities', unpublished honours thesis, Flinders University of South Australia.

McLaren, N, Wiltshire, D & Lesslie, R 1985, 'Biological assessment of South Australian mound springs', unpublished report prepared for South Australian Department of Environment and Planning.

Moseby, KE & Read, JL 1999, 'Population dynamics and movement patterns of Bolam's mouse, *Pseudomys bolami*, at Roxby Downs', *Australian Mammalogy* 26, pp. 479–494.

Moseby, KE & Read, JL 2001, 'Factors affecting pitfall capture rates of small ground invertebrates in arid SA. II. Optimum pitfall trapping effort', *Wildlife Research* 28, pp. 61–71.

Mudd, GM 1998, 'The sustainability of mound springs in South Australia: Implications for Olympic Dam', International Association of Hydrogeologists, Commission on Mineral and Thermal Waters Meeting, Ballarat.

Munro, NT, Kovac, K, Niejalke, D & Cunningham, RB 2009, 'The effect of a single burn event on the aquatic invertebrates in artesian springs', *Austral Ecology* 34 (8), pp. 837–847.

Murphy, D 1985, 'Mound springs: threatened outback ecosystem', *Australian Conservation Foundation Newsletter* 17 (8), p. 8.

Niejalke, DP 1998, 'Some notes on the fishes from mound springs between Marree and Oodnadatta in South Australia', *Australis,* January-March 1998, Newsletter of the SA Native Fish Group.

Niejalke, DP 1998, 'Proceedings to the 2nd Mound Spring Researchers Forum and spring management workshop', November 24 at Kinhill Engineers, Adelaide.

Noble, JC, Habermehl, MA, James, CD, Landsberg, J, Langston, AC & Morton, SR 1998, 'Biodiversity implications of water management in the Great Artesian Basin', *Rangeland Journal* 20 (2), pp. 275–300.

Ponder, WF 1994, 'Australian freshwater Mollusca: Conservation priorities and indicator species', *Memoirs of the Queensland Museum* 36, pp. 191–196.

Ponder, WF 1995, 'Mound spring snails of the Australian Great Artesian Basin', in 'The conservation biology of molluscs', Kay, EA (ed.), IUCN, Gland, Switzerland, pp. 13–18.

Ponder, WF 1997, 'Conservation status, threats and habitat requirements of Australian terrestrial and freshwater Mollusca', *Memoirs of the Museum of Victoria* 56 (2), pp. 421–430.

Ponder, WF 1997, 'Nomenclatural rectifications in Australian Hydrobiidae', *Molluscan Research* 18, pp. 67–68.

Ponder, WF 1998, 'Conservation', in 'Mollusca: The Southern Synthesis', Vol. 5A, Beesley, PL, Ross, GJB & Wells, A (eds), CSIRO Publishing, Melbourne, pp. 105–115.

Read, JL 1991, 'Reptiles and Amphibians', in A 'Natural history of the Lake Eyre region: A visitors guide, pp 44-50, eds Badman FJ, Arnold BK & Bell SL, NPWS Northern Consultative Committee, Port Augusta.

Read, JL 1991, 'Range extensions for the Flock Pigeon in South Australia', *South Australian Ornithologist* 31, p. 72.

Read, JL 1992, 'Influence of habitats, climate, grazing and mining on terrestrial vertebrates at Olympic Dam, South Australia', *The Rangeland Journal* 14 (2), pp. 143–56.

Read, JL 1992, 'How Dr Doolittle can help the mining industry', WMC Group Environmental Conference, Olympic Dam, pp. 83–85.

Read, JL 1994, 'A retrospective view of the quality of the fauna component of the Olympic Dam Project Environmental Impact Statement', *Journal of Environmental Management* 41, pp. 167–185.

Read, JL 1995, 'First South Australian record of the Oriental Cuckoo, *Cuculus saturatus'*, *South Australian Ornithologist.* 32, pp. 62–63.

Read, JL 1995, 'Subhabitat variability: A key to the high reptile diversity in chenopod shrublands', *Australian Journal of Ecology* 20, pp. 494–501.

Read, JL 1995, 'The ecology of the Grass Owl *Tyto capensis* south of Lake Eyre', *South Australian Ornithologist*. 32, pp. 62–63.

Read, JL 1996, 'Use of ants to monitor environmental impacts of salt spray from a mine in arid Australia', *Biodiversity and Conservation 5,* pp*.* 1533–1543.

Read, JL 1997, 'Comparative abnormality rates of the trilling frogs at Olympic Dam', *Herpetofauna* 27 (2), pp. 23-27.

Read, JL 1998, 'The ecology of sympatric scincid lizards *Ctenotus*in arid South Australia', *Australian Journal of Zoology* 46, pp. 617–629.

Read, JL 1999, 'Abundance and recruitment patterns of the trilling frog *Neobatrachus centralis* in the Aust. Arid zone', *Australian Journal of Zoology* 47, pp. 313–404.

Read, JL 1999, 'A strategy for minimising waterfowl deaths on toxic ponds', *Journal of Applied Ecology* 36, pp. 345–350.

Read, JL 1999, 'Bird colonisation of a remote arid settlement', *Australian Bird Watcher* 18 (2), pp. 59–67.

Read, JL 1999, 'Diet and causes of mortality of the Trilling Frog *Neobatrachus centralis'*, *Herpetofauna* 29 (1), pp. 13–18.

Read, JL 1999, 'Longevity, reproductive effort and movements of three sympatric Australian arid zone gecko species', *Australian Journal of Zoology* 47, pp. 307–316.

Read, JL 1999, 'The initial response of a chenopod shrubland plant and invertebrate community to two pulses of intensive cattle grazing', *Rangeland Journal* 21 (2), pp. 169–193.

Read, JL 2002, 'Experimental trial of Australian arid zone reptiles as early warning indicators of over grazing by cattle', *Austral Ecology* 27, pp. 55–66.

Read, JL 2003, 'Are miners the bunnies or the bilbies of the Ranglelands?', *Rangelands Journal* 25 (2), pp. 172–182.

Read, JL & Anderson, AN 2000, 'The value of ants as early warning bioindicators: Responses to pulsed cattle grazing at an the Australian arid zone locality', *Journal of Arid Environments* 45, pp. 231–251.

Read, JL & Badman, FJ 1990, 'Reptile densities in chenopod shrubland at Olympic Dam, South Australia', *Herpetofauna* 20 (1), pp. 3–8.

Read, JL & Badman FJ 1999, 'The birds of the Lake Eyre South region', Lake Eyre South Monograph Series, Volume 3, WJH Slaytor, Royal Geographical Society South Australia (eds).

Read, JL & Bowen Z 2000, 'Population dynamics, diet and aspects of the biology of feral cats and foxes in arid SA', *Wildlife Research* 28, pp. 195–203.

Read, JL, Copley P & Bird P 1999, 'The distribution, ecology and current status of *Pseudomys desertor* in SA', *Wildlife Research* 26, pp. 453–462.

Read, JL, Ebdon FR & Donohoe P 2000, 'The terrestrial birds of the Roxby Downs area: a ten year history', *SA Ornithologist* 33, pp. 71–83.

Read, JL & Moseby KE 2001, 'Factors affecting pitfall capture rates of small ground invertebrates in arid SA. I. The influence of weather and moon phase on capture rates of reptiles', *Wildlife Research* 28, pp. 53–60.

Read, JL & Niejalke, D 1995, 'Brolgas: The storks of the mound springs', *Xanthopus* 13b, pp. 6–7.

Read, JL & Pickering, R 1999, 'Ecological and toxicological effects of exposure to an acidic, radioactive tailings storage', *Environmental Monitoring and Assessment* 54, pp. 69–85.

Read, JL & Tyler, MJ 1994, 'Natural levels of abnormalities in the Trilling Frog *Neobatrachus centralis* at the Olympic Dam Mine', *Bulletin of Environmental Contamination and Toxicology* 53, pp. 25–31.

Read, JL & Wilson, D 2004, 'Scavengers and detrivores of kangaroo harvest offcuts in arid Australia', *Wildlife Research* 31, pp. 51–56.

Stanger, M, Clayton, M, Schodde, R, Wombey, J & Mason, I 1998, 'CSIRO List of Australian Vertebrates: A reference with conservation status', CSIRO Publishing, Australia.

Waterman, MH & Read, JL 1991, 'Breeding success of the Australian Pelican on Lake Eyre South in 1990', *Corella* 16, pp. 123–126.

Wilson, D & Read, JL 2003, 'Kangaroo harvesters: fertilising the rangelands', *Rangelands Journal* 25 (1), pp. :47-55.

5 APPENDIX A: MONITORING SITE LOCATIONS

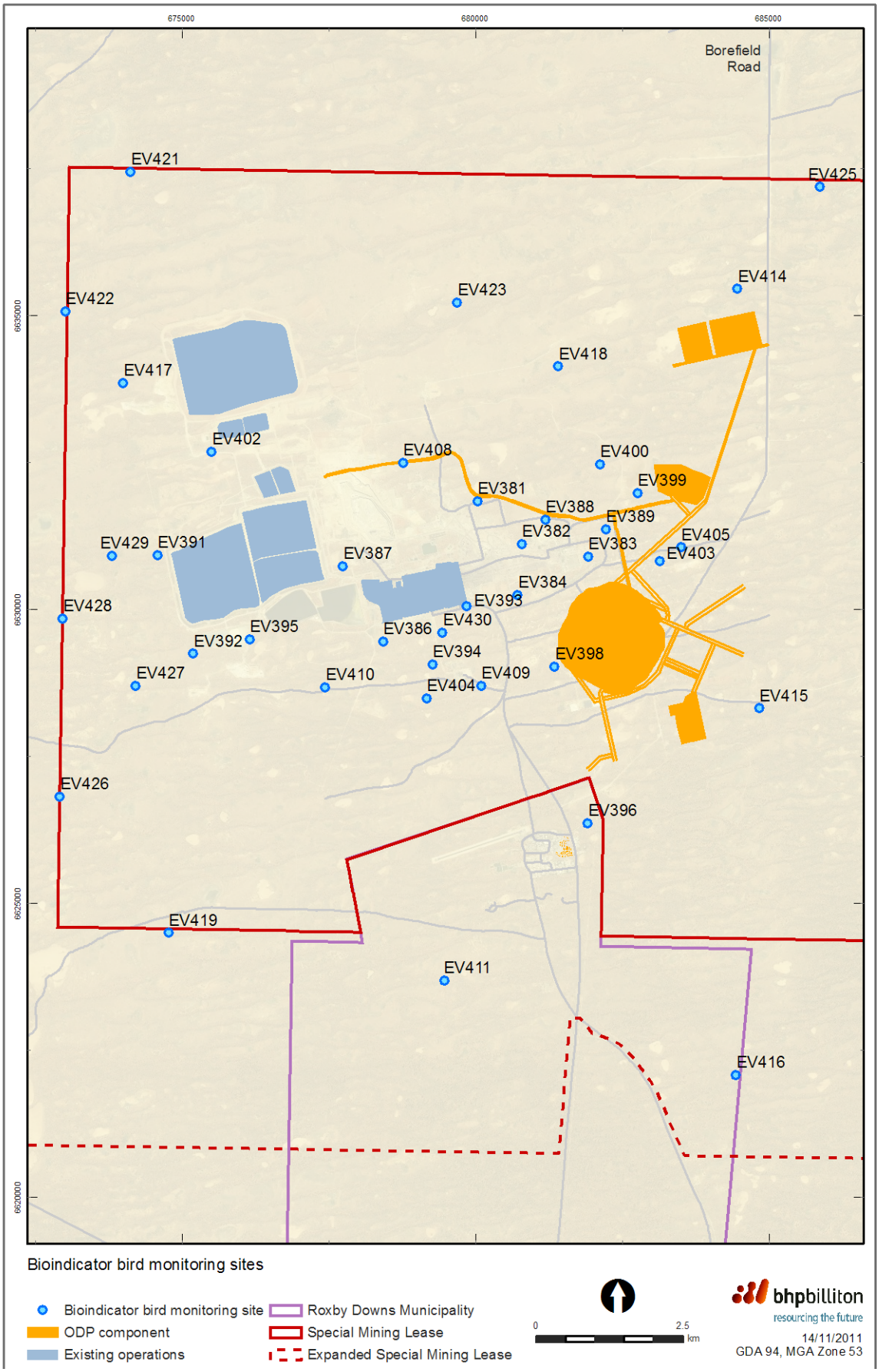


Figure 5.1: Bioindicator bird monitoring sites

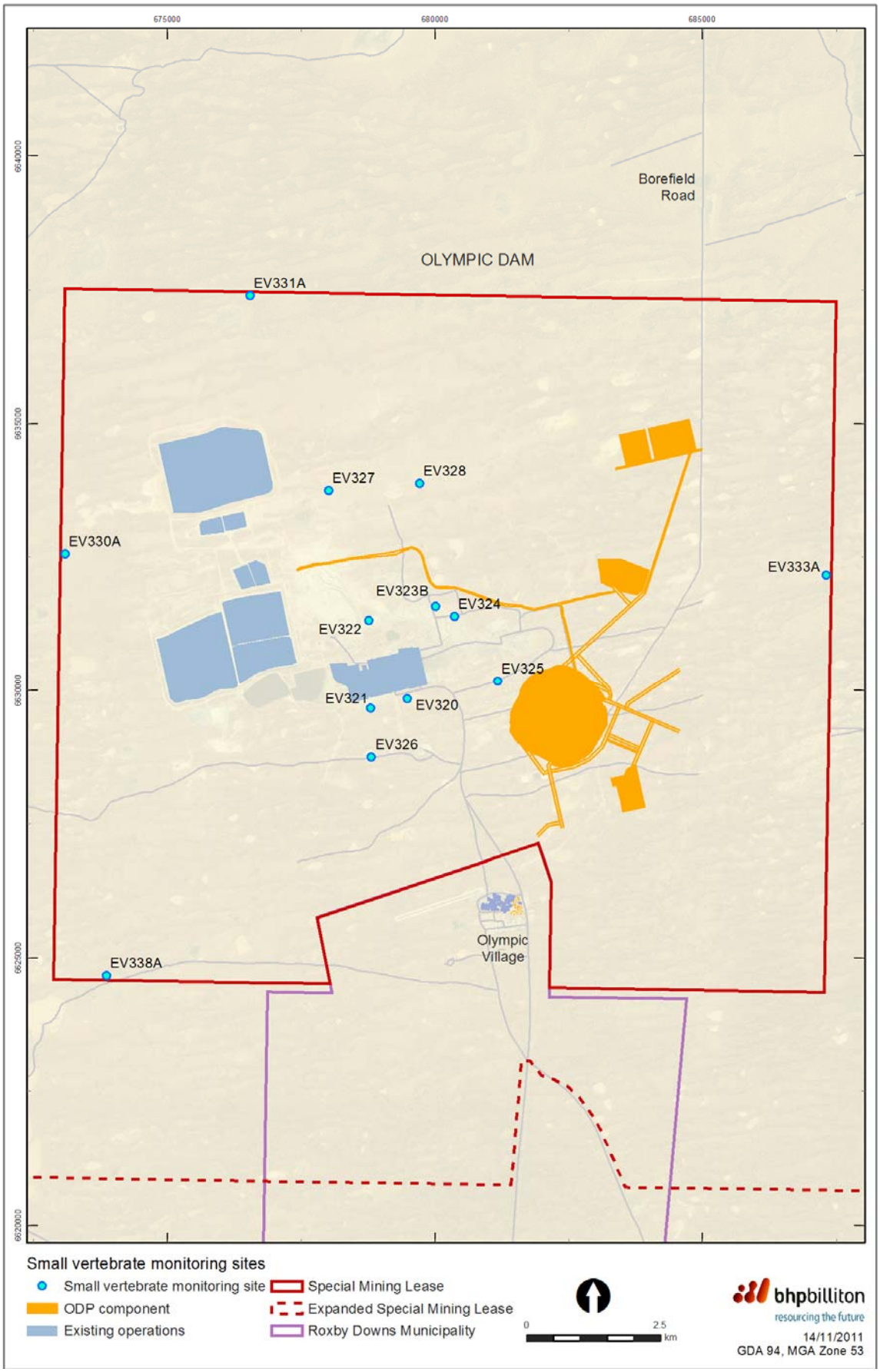


Figure 5.2: Small vertebrate monitoring sites

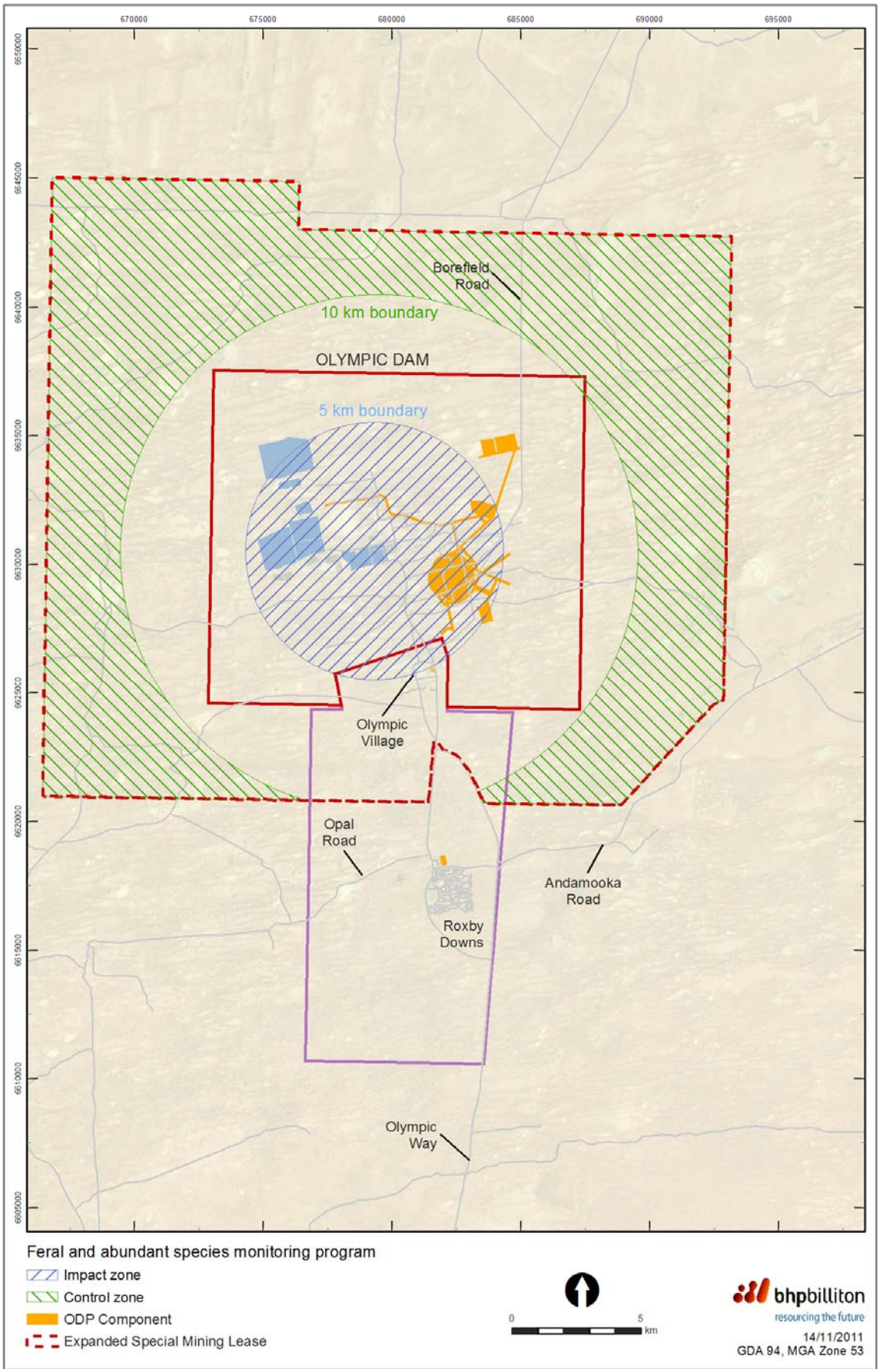
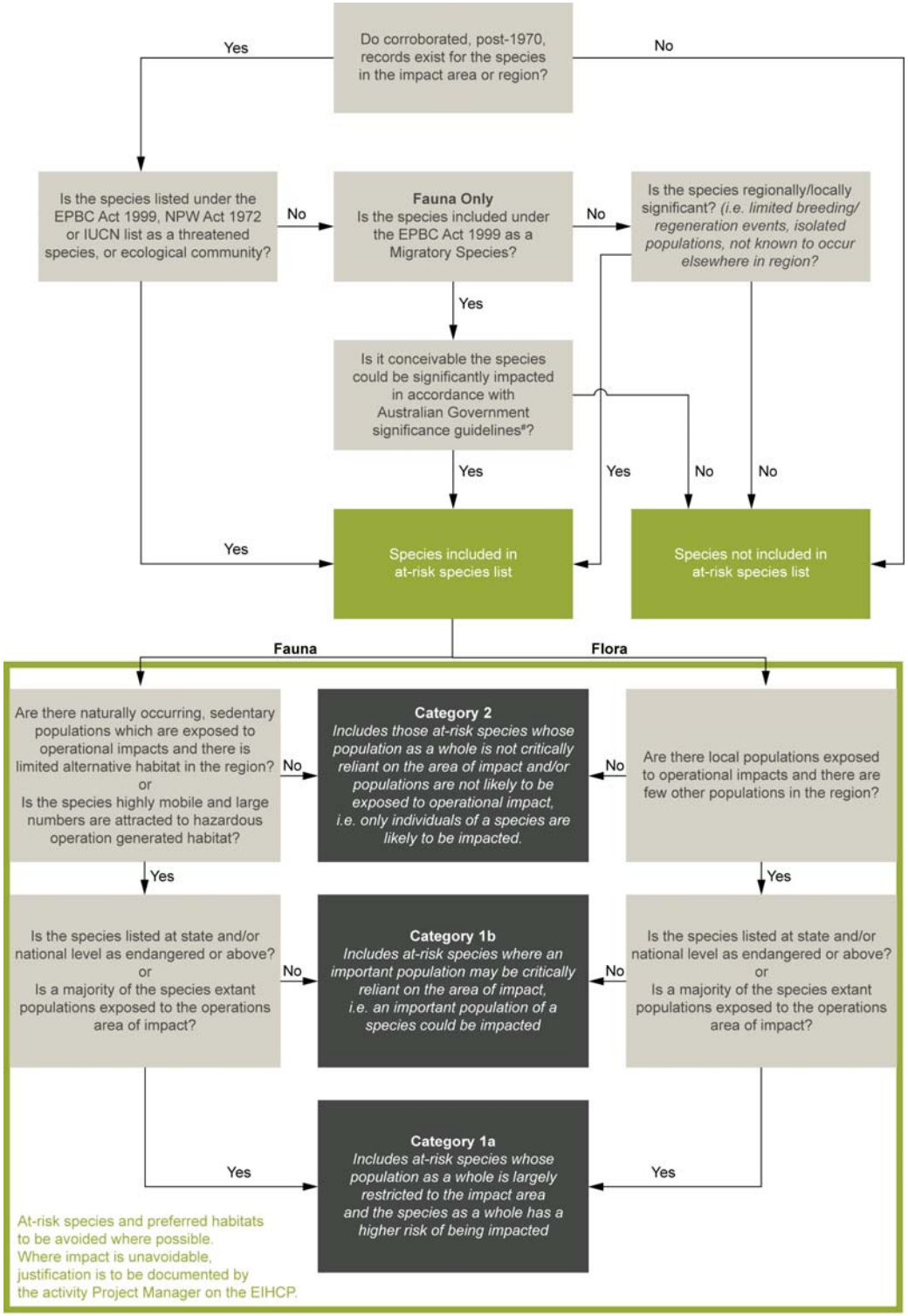


Figure 5.3: Track transect zones

6 APPENDIX B: CLASSIFICATION OF AT-RISK FAUNA SPECIES



Definitions
Impact area: area which the operations can potentially impact, including the Olympic Dam region and the wellfields and power line
NPW 1972: National Parks and Wildlife Act, 1972 (SA)
EIHCP: Environmental/Indigenous Heritage Clearance Permit
EPBC Act 1999: Environment Protection and Biodiversity Conservation Act, 1999
IUCN: IUCN Red List of Threatened Species, http://www.iucnredlist.org
http://www.environment.gov.au/epbc/publications/nes-guidelines.html

Figure 6.1: Classification of at-risk fauna species

7 APPENDIX C: AT-RISK FAUNA SPECIES LIST

Table 7.1: At-risk fauna species list

Common name	Scientific name	Well-fields	OD SML	OD region	Trans-mission line *	EPBC	IUCN	NPW (SA)	Species category	Comments
MAMMALS										
Burrowing Bettong	*Bettongia lesueur lesueur*		✓	✓		V	-	E	2	Species reintroduced into the **Arid Recovery** reserve, 4 km north of operations.
Ampurta (Crest-tailed Mulgara)	*Dasycercus hillieri*				?	E	LC	E	2	Recorded in north-eastern regions of South Australia and the Simpson Desert (State 8).
Greater Stick-nest Rat	*Leporillus conditor*		✓	✓		V	V	V	2	Species reintroduced into the **Arid Recovery** reserve, 4 km north of operations.
Greater Bilby	*Macrotis lagotis*		✓	✓		V	V	V	2	Species reintroduced into the **Arid Recovery** reserve, 4 km north of operations, and have also been released outside of the reserve.
Numbat	*Myrmecobius fasciatus*		✓	✓		V	E	E	2	Species reintroduced into the **Arid Recovery** reserve, 4 km north of operations.
Dusky Hopping Mouse	*Notomys fuscus*				?	V	V	V	2	Habitat exists within the dunefields in the northern section of the gas pipeline corridor (State 8).
Western Barred Bandicoot	*Perameles bougainville bougainville*		✓	✓		E	E	E	2	Species reintroduced into the **Arid Recovery** reserve, 4 km north of operations.

Plains Rat	*Pseudomys australis*	✓	✓			V	V	V	1B	Old record near Lake Eyre South; Recent records on Stuart Creek, **Arid Recovery** and Olympic Dam SML (State 8).
BIRDS										
Slender-billed Thornbill	*Acanthiza iredalei iredalei*				✓	V	-	V	2	Recorded within transmission line corridor (BHP Billiton, 2009).
Common Sandpiper	*Actitis hypoleucos*		✓	✓	✓	Mi	LC	R	2	Numerous records for SML, region and wellfields. Recorded mortality on TRS.
Thick-billed Grasswren	*Amytornis textilis modestus*	✓	?	✓		V	LC	-	1B	Numerous records from region and wellfields (State 8).
Australasian Shoveler	*Anas rhynchotis*	✓	✓	✓	✓	-	LC	R	2	Numerous records from SML, region and wellfields.
Darter	*Anhinga melanogaster*		✓	✓	✓	-	NT	R	2	Numerous records from SML, region and wellfields.
Cattle Egret	*Ardea ibis*		✓		✓	-	LC	R	2	Multiple records from SML and region.
Intermediate Egret	*Ardea intermedia*		✓			-	LC	R	2	Two records from SML in 1997.
Australian Bustard	*Ardeotis australis*	✓	✓	✓		-	NT	V	2	Numerous records from SML, region and wellfields.
Ruddy Turnstone	*Arenaria interpres*		✓	✓	✓	Mi	LC	R	2	Numerous records from SML, region and wellfields.
Musk Duck	*Biziura lobata*	✓	✓	✓	✓	-	LC	R	2	Numerous records from SML, region and wellfields. Recorded mortality on TRS.
Bush Stone-curlew	*Burhinus grallarius*	✓				-	NT	R	2	Historical records from wellfields (Read and Badman, 1999).

Major Mitchell's Cockatoo	*Cacatua leadbeateri*		✓	✓	✓	-	LC	R	2	Multiple records from SML, region and wellfields.
Sharp-tailed Sandpiper	*Calidris acuminata*		✓	✓	✓	Mi	LC		2	Recorded within SML, region and transmission line.
Red Knot	*Calidris canutus*		✓	✓	✓	Mi	LC		2	Recorded within SML, region and transmission line.
Red-necked Stint	*Calidris ruficollis*		✓	✓		Mi	LC		2	Recorded within SML and surrounding regions.
Oriental Plover	*Charadrius veredus*		✓	✓		Mi	LC		2	Recorded in SML and surrounding regions.
Chestnut Quail-thrush	*Cinclosoma castanotus*				✓	-	LC	R	2	Recorded within transmission line corridor (BHP Billiton, 2009).
Banded Stilt	*Cladorhynchus leucocephalus*	✓	✓	✓	✓	-	LC	V	1B	Numerous records from SML, region and wellfields. Recorded mortality on TRS.
White-browed Treecreeper	*Climacteris affinis*				✓	-	LC	R	2	Recorded within transmission line corridor (BHP Billiton, 2009).
Little Egret	*Egretta garzetta*		✓	✓	✓	-	LC	R	2	Multiple records for SML, region and wellfields. Recorded mortality on TRS.
Letter-winged Kite	*Elanus scriptus*	✓				-	NT	R	2	Several records from wellfields region.
Painted Finch	*Emblema pictum*	✓				-	LC	R	2	Recorded on numerous occasions at the Hermit Hill Spring group.
Grey Falcon	*Falco hypoleucos*	✓	✓		✓	-	NT	R	2	One record from SML and several in the wellfields.
Peregrine Falcon	*Falco peregrinus*	✓	✓	✓		-	LC	R	2	Multiple records from SML, region and wellfields.

Latham's Snipe	*Gallinago hardwickii*	✓	✓	✓		Mi	LC	R	2	Several records for SML and region.
White-throated Gerygone	*Gerygone olivacea*	✓				-	LC	R	2	Two records from 1997 in SML.
Brolga	*Grus rubicundus*	✓		✓		-	LC	V	2	Regular observations at springs and boredrains.
Black-breasted Buzzard	*Hamirostrata melanosternon*	✓	✓	✓		-	-	R	2	Multiple records from SML and wellfields.
Black-tailed Godwit	*Limosa limosa*		✓	✓	✓	Mi	NT	R	2	Multiple records from SML and wellfields.
Splendid Fairy-wren	*Malurus splendens*	✓	✓			-	LC	-	2	Isolated populations within the SML and wider region.
Restless Flycatcher	*Myiagra inquieta*		✓	✓	✓	-	LC	R	2	Several records from SML and region.
Blue-winged Parrot	*Neophema chrysostoma*	✓	✓	✓		-	LC	V	2	Numerous records from SML, region and wellfields.
Elegant Parrot	*Neophema elegans*				✓	-	LC	R	2	Recorded within transmission line corridor (BHP Billiton, 2009).
Scarlet-chested Parrot	*Neophema splendida*		✓	✓	✓	-	LC	R	2	Several records from SML and region..
Eastern Curlew	*Numenius madagascariensis*		✓	✓	✓	Mi	V	V	2	Recorded on TRS and in regional lakes.
Blue-billed Duck	*Oxyura australis*	✓	✓	✓	✓	-	NT	R	2	Numerous records from SML, region and wellfields. Recorded mortality on TRS.
Plains-wanderer	*Pedionomus torquatus*		✓			V	E	E	2	Single record from Roxby township in 1990.
Flock Bronzewing	*Phaps histrionica*	✓		✓		-	LC	R	2	Multiple records from region and wellfields.

Glossy Ibis	*Plegadis falcinellus*	✓	✓	✓	✓	-	LC	R	2	Numerous records from SML, region and wellfields.
Grey Plover	*Pluvialis squatarola*		✓	✓	✓	Mi	LC		2	Recorded within SML, region and transmission line.
Great Crested Grebe	*Podiceps cristatus*	✓	✓	✓	✓	-	LC	R	2	Several records from SML, region and wellfields. Recorded mortality on TRS.
Spotless Crake	*Porzana tabuensis*	?	✓	✓		-	LC	R	2	Multiple records from SML, region and wellfields.
Freckled Duck	*Stictonetta naevosa*	✓	✓	✓	✓	-	LC	V	2	Numerous records from SML, region and wellfields. Recorded mortality on TRS.
Wood Sandpiper	*Tringa glareola*	✓	✓	✓	✓	Mi	LC	R	2	Numerous records from SML, region and wellfields.
Common Greenshank	*Tringa nebularia*		✓	✓	✓	Mi	LC		2	Recorded within SML, region and transmission line.
Marsh Sandpiper	*Tringa stagnatilis*		✓	✓	✓	Mi	LC		2	Recorded within SML, region and transmission line.
Grass Owl	*Tyto capensis*	✓		✓		-	LC	R	2	Several records from OD Region and Coward Springs boredrain in wellfields.
REPTILES										
Woma Python	*Aspidites ramsayi*	✓	✓	✓		-	E	R	2	Records from Roxby Downs Municipality, Borefield Road and wellfields.
Pernatty Knob-tailed Gecko	*Nephrurus deleani*				✓	-	E	R	2	Population restricted to an area near infrastructure corridor (State 8).

ECOLOGICAL COMMUNITIES										
	The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin	✓				E (EC)			1a	Includes a number of species of endemic aquatic invertebrates.

✓= Species recorded from Olympic Dam or Wellfields region ? = Species that may occur in the Olympic Dam or Wellfields region

Letters under column EPBC and NPW (SA) columns represent the category of threat listed in the Environment Protection and Biodiversity Conservation Act 1999 and the National Parks and Wildlife Conservation Act 1972 (species listed as at 25/11/2011).

E = Endangered V = Vulnerable R = Rare EC = Threatened Ecological Community

Note: Indications of species listed as Marine or Migratory under the EPBC Act have not been included in the table

*Records of species located within the transmission corridor between the Roxby Downs Municipality and the Davenport Substation at Port Augusta have been sourced from BHP Billiton (2009). Species include those that have been previously recorded within 5 km of the transmission line (DEIS)

8 APPENDIX D: AMENDMENTS TO MONITORING PROGRAM – FAUNA FY13

Where applicable a summary of major changes to this MP is provided. Individual changes have not been itemised.