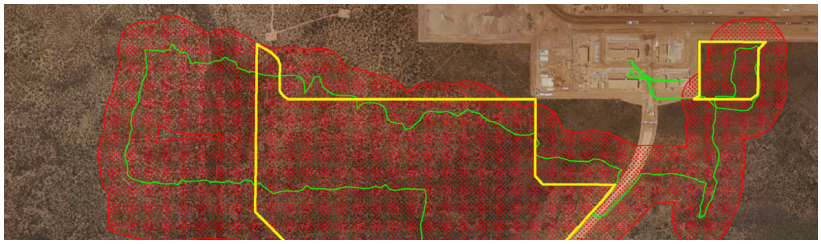
Biota Environmental Sciences

Gorgon Gas Project Additional Area Terrestrial Fauna Values



Prepared for Chevron Australia Pty Ltd

November 2013

Doc ID: G1-NT-REP00000222

Biota Environmental Sciences

ABN 49 092 687 119
Level 1, 228 Carr Place
Leederville Western Australia 6007
Ph: (08) 9328 1900 Fax: (08) 9328 6138

Project No.: 958

Prepared by: Victoria Cartledge
Roy Teale

Document Quality Checking History

Version: B	Peer review:	Roy Teale
Version: B	Director review:	Roy Teale
Version: 0	Format review:	Fiona Hedley

Approved for issue: Roy Teale

Gorgon Gas Project Additional Area, Terrestrial Fauna Values

Contents

1.0 Summary

1.1 Introduction

Chevron Australia Pty Ltd (Chevron) on behalf of the Gorgon Venturers has received Ministerial approval to develop the Gorgon gas fields located some 130 km off the northwest coast of Western Australia (Figure 2.1). Construction-phase activities and related investigations are currently underway for the development of gas processing facilities for the project on Barrow Island.

During the course of the construction works, Chevron has identified that additional ground area will be required to support the construction and operation of the Gorgon Gas Development. This additional area amounts to a further 32 ha of uncleared land (hereafter "the proposal area), located within an approximately 36 ha 'development envelope', situated to the immediate south of the original GTPS (shown in yellow on Figure 2.1; hereafter "the study area").

1.2 Scope and Objectives

Assessment of the significance of project impacts on the significant fauna of Barrow Island formed part of the project Environmental Review and Management Program (ERMP) and subsequent Public Environmental Review (PER) for the original proposal. The assessment included comprehensive studies of fauna values of potential development areas, including terrestrial fauna surveys conducted in accordance with Environmental Protection Authority's (EPA) Position Statement No. 3 "Terrestrial Biological Surveys as an Element of Biodiversity Protection" (EPA 2002) and Guidance Statement No. 56 "Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia" (EPA 2004). The surveys encompassed the study area and post approval monitoring programs have subsequently provided further information on the conservation values of the area.

The scope of this document is to provide a current assessment of the fauna values of the study area, particularly in relation to conservation significant species. The assessment was conducted via a field study, which primarily focused on detecting Boodie warrens and habitats of the study area were also noted. Considerable context for the study area is available from ongoing monitoring programs on the island. Data from monitoring was interrogated in relation to the study area for each monitored fauna species.

1.3 Fauna Values

White-winged Fairy-wren (Barrow Island)
Five fairy-wren transects have been established within the study area and fairy-wrens have consistently been recorded from all or a subset of these transects over the five years of the monitoring program. For 2012, an encounter rate of 14.4 individuals per km of transect walked within the study area was calculated. This rate is higher than the island-wide average encounter rate of 1.26 individuals per km of transect walked for the 2012 year but comparable to other areas of similar habitat on Barrow Island. The high encounter rate within the study area correlates with a high density of *Melaleuca cardiophylla*, previously demonstrated to correlate with fairy-wren presence (Biota 2012). On a per transect basis, comparable numbers of individuals to those yielded from the study areas five transects (i.e. between 5 and 10 birds per transect) were recorded from a further 16 transects (out of a total of 117 transects) surveyed as part of the 2012 monitoring program. Twelve of these transects were located in *Melaleuca* habitat (mostly in the central part of the island), three in *Spinifex longifolious* on the islands west coast and one in vegetation dominated by *Triodia wiseana*. The *Melaleuca* vegetation type is one of the most commonly occurring vegetation units surrounding the study area.

Barrow Island Golden Bandicoot

A targeted monitoring program for the Barrow Island Golden Bandicoot commenced in 2012. Four trapping arrays targeting the species occurred within 4 km of the study area. Examining the density of bandicoots calculated from these four arrays compared to the rest of the island, the estimates are comparable to the island wide density estimate of 1.98 ha^{-1} (SE 0.127 ha^{-1}, 95% CI 1.74–2.24 ha^{-1}) calculated for that year. Almost the entire range in density estimates occur within 4 km of the study area, with sites (WI12 and WI18) yielded the highest and second highest bandicoot density estimates respectively, while WI11 yielded the second lowest estimate

Based on the range of bandicoot density estimates calculated to date, 47 - 72 bandicoots are calculated to occur within the proposal area footprint of 32 ha, which compares to the 2012 and 2013 Barrow Island population estimate (based on all implemented trapping grids) of 46,225 (95% CI 40,622–52,295) and 39,688 (95% CI 34,552–45,525) respectively.

Barrow Island Burrowing Bettong (Boodie)

No warrens of the Barrow Island Burrowing Bettong (Boodie) were located within the study area when conducting the field assessment. The closest known warrens occur 240 m - 290 m east of the study area, 290 m south of the study area and 400 m west of the study area.

A targeted monitoring program in which Boodies are trapped and PIT-tagged at their warrens commenced in 2012. Three of the four known closest warrens to the study area have been sampled. The number of Boodies sheltering in these three warrens was estimated to be 5.6, 6.2 and 7.2, lower than the island-wide average calculated from 33 warrens of 15.3 Boodies per warren. From trapping at 33 warrens and extrapolating to a rough estimate of the number of warrens thought to be on the island (250 – 300), the expected number of Boodies on Barrow Island was calculated at 4,500 individuals (Biota 2013c).

Mapping the locations of individuals recaptured at multiple locations (warrens and the grids of the mammal trapping grids program) from 2012 and 2013 provides preliminary information on the paths of movement of Boodies in the area. No Boodies recorded from those warrens east of the study area have been recorded from the warren west of the study area, indicating that the study area location does not represent a path of movement between warrens. Boodies may use habitat within the study area to forage and a small number of Boodie trails were noted from the north-west of the study area during the field assessment, however, no significant trails typical of consistent Boodie pathways were found.

Spectacled Hare-wallaby and Barrow Island Euro

The Spectacled Hare-wallaby and Barrow Island Euro have been targeted via distance sampling from transects monitored since 2009. One transect partially traverses the study area and Spectacled Hare-wallabies have been consistently recorded from this transect while Euros have not been recorded on this transect in any year.

The highest densities of Spectacled Hare-wallabies on the island have been recorded from the coastal complex and dune system vegetation type described by Mattiske (2005) (Biota 2013a); this vegetation type does not occur within the study area. This type of habitat analysis has not been possible for the Euro due to low encounter rates.

Based on the density estimates calculated for the *Triodia wiseana* dominated vegetation of the study area, eight Spectacled Hare-wallabies are expected to occur within the proposal area, compared to an island-wide estimate of 7,411 ± 1,264 individuals. Two Euros are expected to occur within the proposal area compared to an island-wide estimate of 1,234 ± 449 individuals.

Eastern Osprey and White-bellied Sea-eagle

Neither of these species have nests in proximity to the study area with the closest being an osprey nest located just over 2.5 km from the study area. As a result, the project is not expected to interfere with nesting of these raptors. Both species are largely reliant on marine species as prey items and as a result the study area will not threaten core foraging habitat.

***Idiommata*: Mygalomorph Spider**

The study area supports comparable habitat to that from which the original specimen was taken and therefore may support *Idiommata*. However, combined search efforts for specimens of *Idiommata* over the non-indigenous species programs (2010-2013) (which includes one line of six pit-fall traps in the study area), mammal distance sampling programs (2010-2013) (including one transect intersecting the study area), targeted burrow searches (2010, 2012) (not conducted in the study area) and night-time road spotting (2012), have so far resulted in no additional records of *Idiommata* anywhere on the island.

This page intentionally blank

2.0 Introduction

Chevron Australia Pty Ltd (Chevron) on behalf of the Gorgon Venturers has received Ministerial approval to develop the Gorgon gas fields located approximately 130 km off the north-west coast of Western Australia. Construction-phase activities and related investigations are currently underway for the development of gas processing facilities for the project on Barrow Island.

During the course of the construction works, Chevron has identified that additional ground area will be required to support the construction and operation of the Gorgon Gas Development. This additional area amounts to a further 32 ha of uncleared land (hereafter "the proposal area"), located within an approximately 36 ha 'development envelope', situated to the immediate south of the original GTPS (shown in yellow on Figure 2.1; hereafter "the study area").

2.1 Scope and Objectives

2.1.1 Vertebrates

Assessment of the significance of project impacts on the vertebrate fauna of Barrow Island formed part of the project Environmental Review and Management Program (ERMP) and subsequent Public Environmental Review (PER) for the original proposal. The assessment included comprehensive studies of fauna values of potential development areas, consistent with the requirements of the Environmental Protection Authority's (EPA) Position Statement No. 3 "Terrestrial Biological Surveys as an Element of Biodiversity Protection" (EPA 2002) and Guidance Statement No. 56 "Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia" (EPA 2004).

Additional information on Barrow Island conservation values (including those of the study area) have been captured via implementation of the Gorgon Gas Development and Jansz Feed Gas Pipeline Terrestrial and Subterranean Environment Monitoring Program (Chevron 2009a), which identified the following conservation significant terrestrial taxa as warranting long-term monitoring:

1. Barrow Island Burrowing Bettong *(Bettongia lesueur* ssp.);
2. Barrow Island Golden Bandicoot (*Isoodon auratus barrowensis*);
3. Barrow Island Spectacled Hare-wallaby (*Lagorchestes conspicillatus conspicillatus*);
4. Barrow Island Euro (*Macropus robustus isabellinus*);
5. White-winged Fairy-wren (Barrow Island) (*Malurus leucopterus edouardi*);
6. Eastern Osprey (*Pandion cristatus*); and,
7. White-bellied Sea-eagle (*Haliaeetus leucogaster*).

Biota Environmental Sciences (Biota) has been commissioned to provide an assessment of the vertebrate fauna values of the additional area, particularly in relation to conservation significant species listed above. The assessment was conducted via a field study, which primarily focused on detecting Boodie warrens and habitats of the study area were also noted. Considerable context for the study area is available from ongoing monitoring programs on the island. Data from monitoring was interrogated in relation to the study area for each vertebrate fauna species. Additionally, a search of the Western Australian Department of Parks and Wildlife's Threatened Fauna database was commissioned for an area that included a 3 km buffer around the study area.

2.1.2 Invertebrates

In addition to vertebrates of significance, the baseline surveys recorded a number of invertebrate taxa belonging to groups known to support Short Range Endemics (Harvey 2002, Chevron 2006, Majer, J et al. 2008). The collections included a single specimen belonging to the

mygalomorph spider genus *Idiommata*, which was recorded from beneath a *Triodia* hummock in the northwest corner of the proposed GTPS footprint. At the time this represented a new record for Barrow Island (Majer, J et al. 2008). The specimen collected was female, so taxonomic affinities with mainland *Idiommata* (based on morphological characters) could not be determined, nor could its conservation significance be established. A subsequent targeted survey (Majer, J et al. 2009) failed to locate additional specimens in areas outside of the GTPS Footprint. Ministerial approval of the Revised and Expanded Gorgon Gas Development required the development of a Short Range Endemic and Subterranean Fauna Monitoring Plan and included the requirement to search for *Idiommata* outside of the development footprint. This Monitoring Plan (Chevron 2009b) prescribed an *Idiommata* sampling methodology that included day time searches (burrow excavation), pit and funnel trapping, night time searches, as well as recommendations for timing of such surveys (e.g. ideally after significant rainfall events).

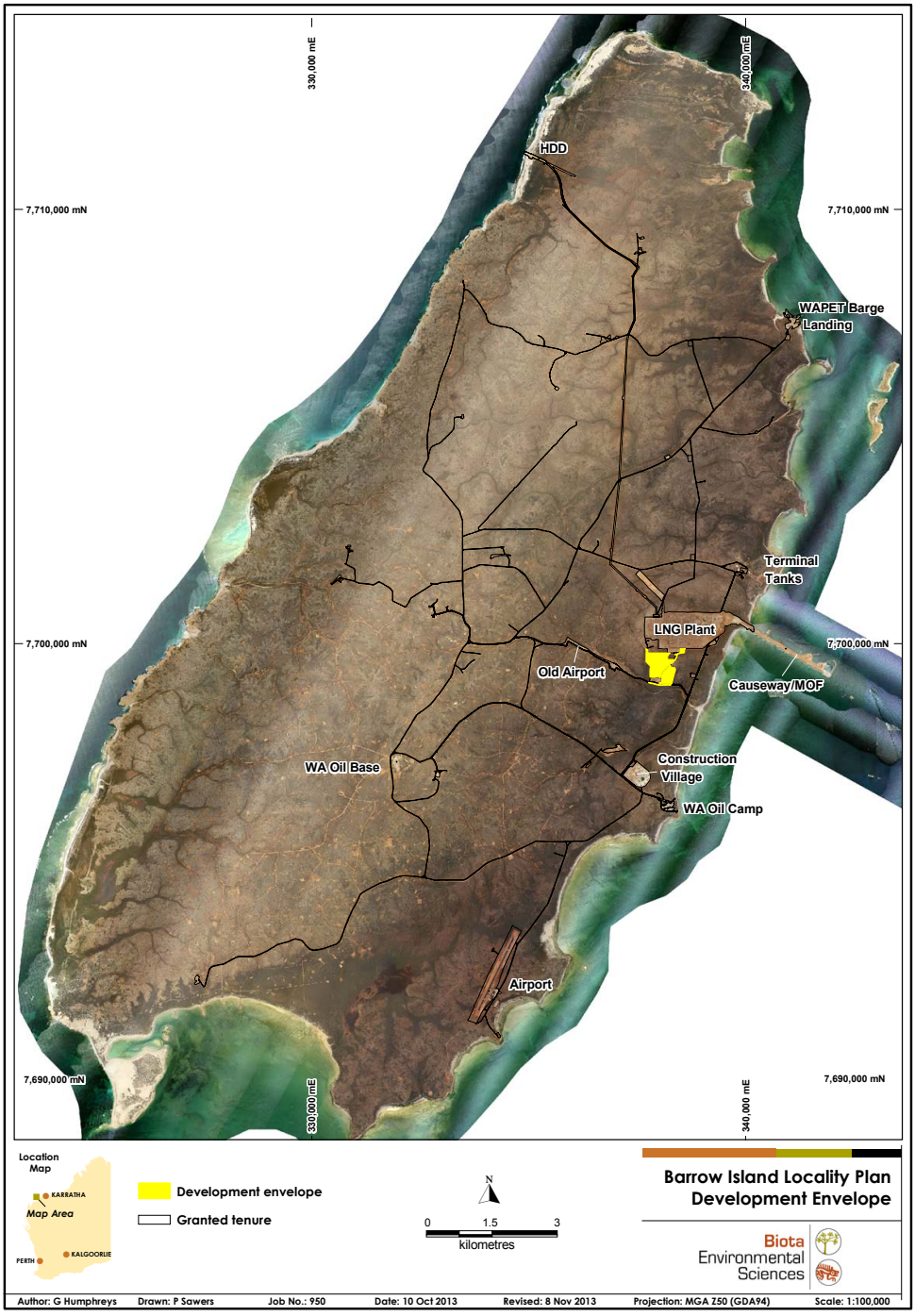


Figure 2.1: Locality plan

3.0 Relevant Studies on Barrow Island

3.1 Mammal Trapping Program

Mammal trapping is undertaken at 14 established trapping grids, eight in the At Risk zone and six in the Reference zone. Elliott traps and cage traps are used. Trapping at these same 14 grids has been undertaken annually since 2008. Figure 3.1 illustrates the location of mammal monitoring grids in relation to the study area. Four mammal monitoring grids are located within 2.5 km of the study area.

Recognition of the limitations of the grid trapping program as a tool for providing abundance and density estimates for species has led to the development of improved programs targeting individual species; Bandicoot Monitoring Program and Boodie Monitoring Program detailed below. The higher quality data provided by these alternative programs has been demonstrated over the course of the last two years and as a result, the grid program will now cease and will be substituted by these targeted programs. Abundance and density estimates of the targeted species programs will be utilised in this report in preference to the grid data. However, captures of Boodies on grids have been compared to those at the warrens to delineate probable paths of movement.

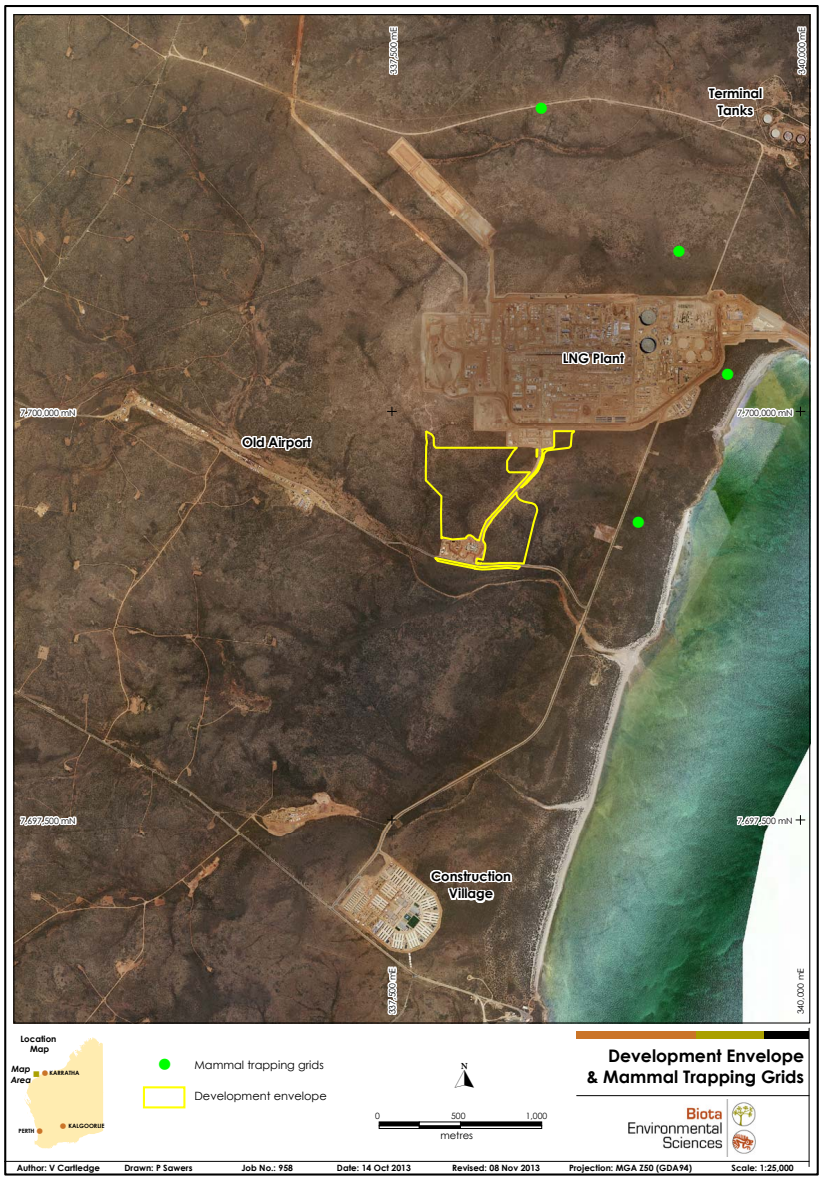


Figure 3.1: Mammal monitoring grids in relation to the study area

3.2 White-winged Fairy-wren (Barrow Island) Monitoring Program

This monitoring program commenced in 2009 and uses distance sampling methodologies to estimate absolute densities of fairy-wrens within the At Risk and Reference zones. Fairy-wrens are recorded once per year over the course of 10 – 12 days at approximately 80 – 120 transects each 400 m in length. The location of fairy-wren monitoring transects in relation to the study area is shown in Figure 3.2. This figure includes all fairy-wren transects run to date although not every single transect is run each year. Five fairy-wren transects span the study area, two transects were run within the GTPS prior to clearing, and numerous transects have been run within 2.5 km of the study area. The average number of fairy-wrens observed on the transects within the study area was compared to those historically observed in the GTPS and on the transects run in similar habitat in the surrounds. It has been noted that presence of melaleuca heath tends to correlate with the presence of White-winged Fairy-wrens. In 2012, the number of melaleuca plants on-transect was counted and this data was examined in relation to the study area and White-winged Fairy-wren numbers (Biota 2012).

Figure 3.2: White-winged Fairy-wren transects in relation to the study area

3.3 Spectacled Hare-wallaby and Barrow Island Euro Monitoring

Not reliably detected via the mammal trapping program, the Spectacled Hare-wallaby (*Lagorchestes conspicillatus conspicillatus)* and Barrow Island Euro (*Macropus robustus isabellinus*), are also sampled via distance sampling on transects in a manner similar to the White-winged Fairy-wren. This program was commenced in 2009, with the abundance of the species estimated from observations on approximately 60 x 1 km transects run once per year over the course of a 10 – 12 day survey. Figure 3.3 illustrates mammal transect locations in relation to the study area. One transect partially traverses the study area while numerous transects have been run within 2. 5 km of the study area. The number of Spectacled Hare-wallabies and Euros likely to utilise habitat within the study area was examined based on the most recent density estimates calculated in 2012 (Biota 2013a).

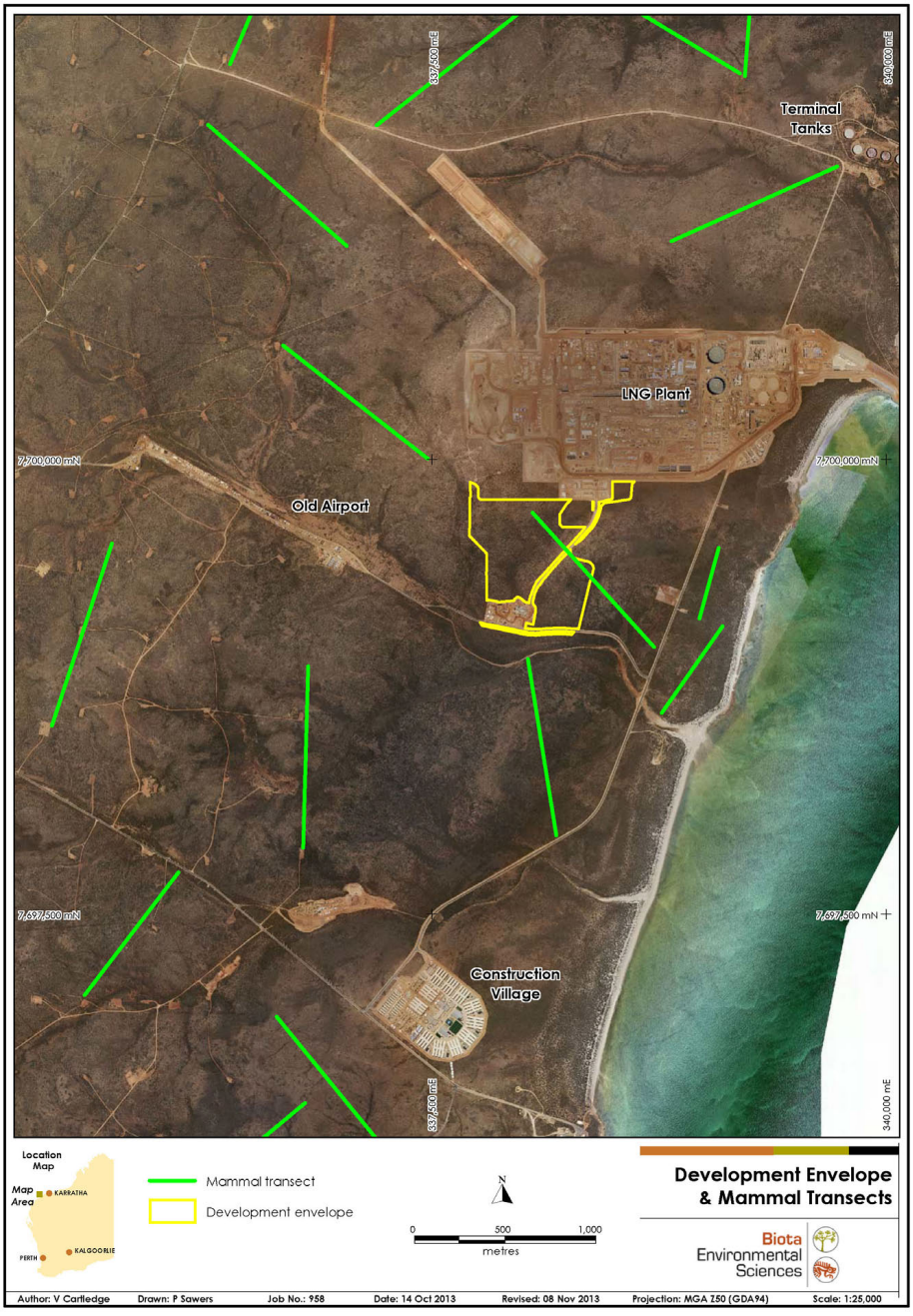


Figure 3.3: Transects for Spectacled Hare-wallaby and Euro in relation to the study area

3.4 Barrow Island Bandicoot Monitoring Program

In 2012, a targeted monitoring program for the bandicoots was introduced with the aim of overcoming limitations of the existing mammal trapping program to provide accurate density information. This program incorporates large trapping arrays randomly distributed over the island. Density estimates for the trapped areas are then calculated. This program was run again in 2013, with the 2012 data used to design an improved grid design. Figure 3.4 illustrates the location of Bandicoot trapping arrays run in 2012 in relation to the study area. Four trapping arrays were located within 4 km of the study area. The island-wide density estimate of bandicoots was compared to density estimates at arrays in proximity to the study area.

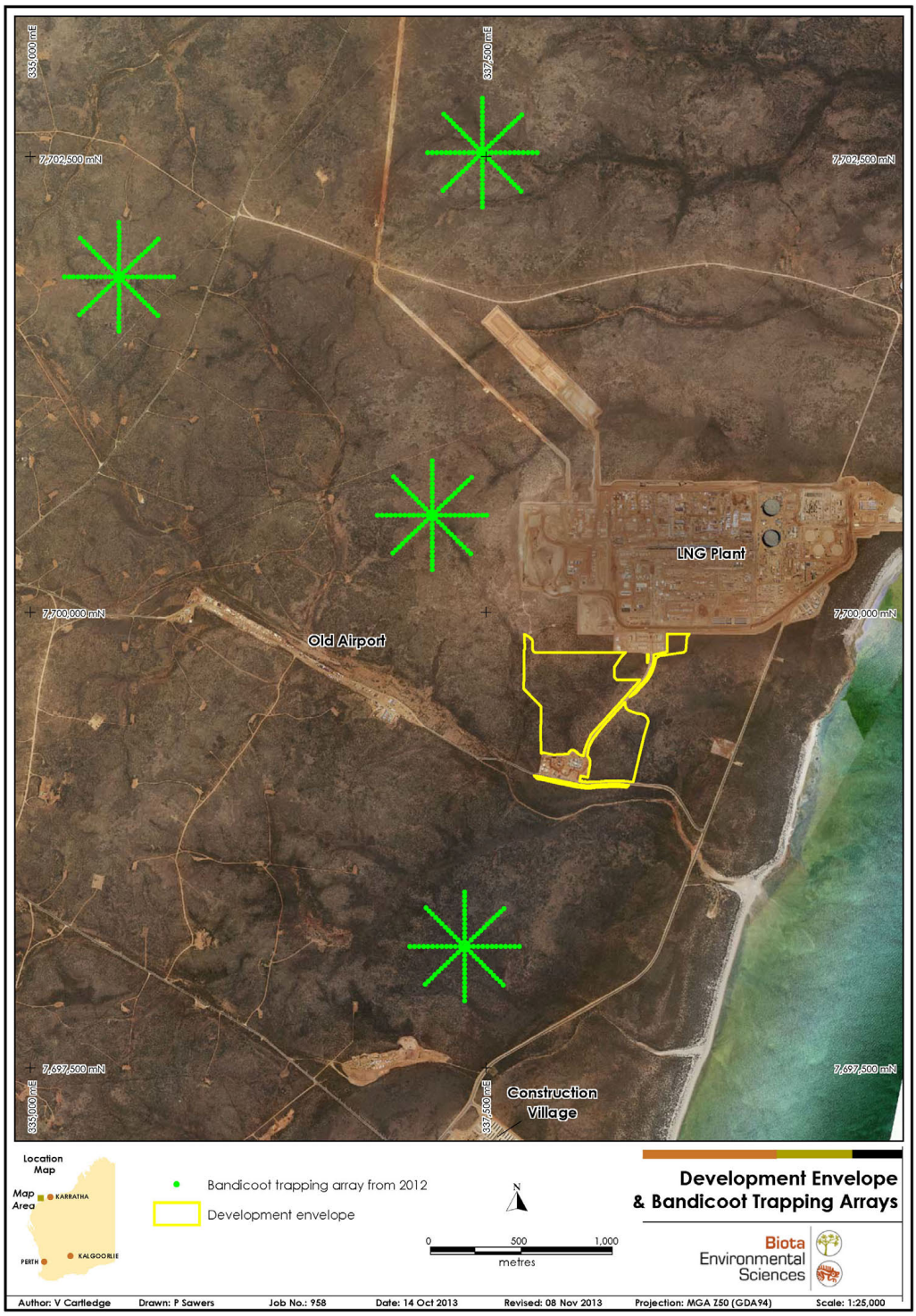


Figure 3.4: Bandicoot trapping arrays in relation to the study area

3.5 Boodie Monitoring Program

Similar to the Barrow Island Bandicoots, a targeted trapping program for the Barrow Island Boodie was introduced in 2012, designed to avoid many of the limitations imposed by the traditional mammal grid trapping program by instead monitoring directly at Boodie warrens. In 2012, trapping was carried out at 33 warrens distributed over the At Risk and Reference zones. All Boodie warrens and those included in the 2012 program are shown in relation to the study area in Figure 3.5. During the 2012 program, the number of Boodies in each warren trapped was estimated using accumulation curves. The estimated number of Boodies in those warrens nearby the study area was examined. The recapture of Boodies on multiple warrens and the trapping grids was also examined and mapped to indicate broad pathways of movement of the Boodies in the vicinity of the study area.

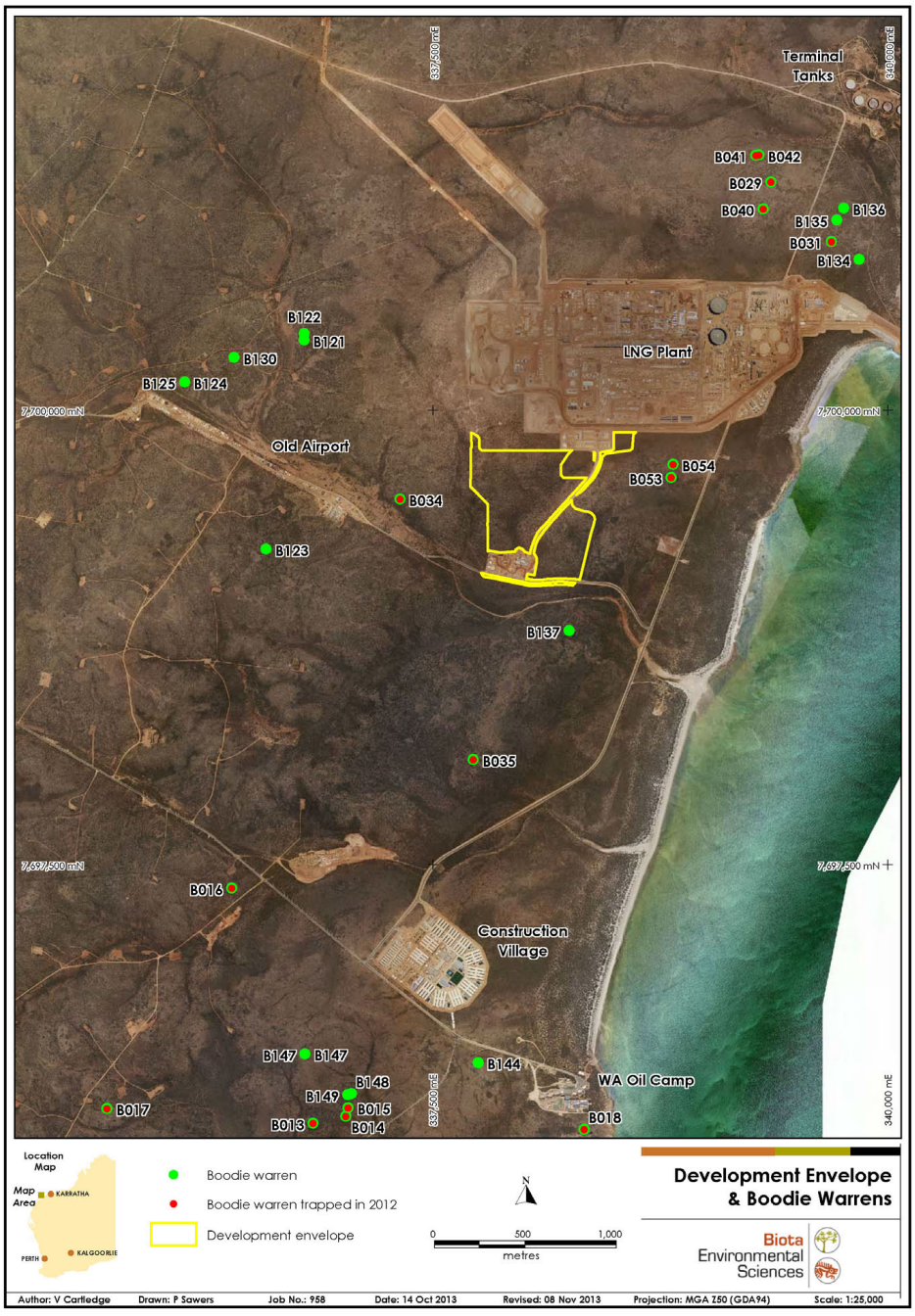


Figure 3.5: Boodie warrens in relation to the study area with those included in the 2012 monitoring program indicated (note: red circle indicates the mound was trapped in 2012).

3.6 Barrow Island Raptor Monitoring Program

This program focuses on the Eastern Osprey (*Pandion cristatus*) and the assessment of breeding activity at nests. Approximately 30 nests are assessed each year during the breeding season. Nests are scored based on the behaviour of adult birds in the vicinity of the site and are ranked as active if the resident birds exhibit nest building, breeding and or defensive behaviour or if eggs or hatchlings are observed in the nest. It is not possible to see into the majority of nests, which limits the capacity of the program to accurately assess breeding activity. As a result the raptor program does not have the capacity to detect impacts of the Gorgon Project on raptor nesting, however, it does provide valuable information about the activity status of many osprey nests on the island. The closest Osprey nests to the study area are shown in Figure 3.6 with the closest being just over 2.5 km from the study area. The closest White-bellied Sea-Eagle nest is 9.5 km from the study area.

Figure 3.6: Raptor nests in relation to the study area

3.7 *Idiommata* Surveys

Surveys for *Idiommata* have been carried out consistent with the requirements of the monitoring plan and have included burrow searches, trapping and night-time searches. Targeted burrow searches have been undertaken at a number of localities across Barrow Island though not specifically in the study area. In addition, dry pit-fall and funnel traps installed and run as part of the vertebrate Non-indigenous Species Detection Program, provide the opportunity to capture wandering male mygalomorph spiders. Pit lines are typically established as an array of three pits (though this varied between two and six), spaced at approximately 10 m intervals along a continuous drift fence. Funnel arrays comprised between eight and 12 traps spaced at approximately 10 m intervals along a continuous drift fence. Over the course of 2011 and 2012, 132 pit lines and 68 funnel lines in total were opened for between one and four trapping periods. The location of trapping sites is shown in Figure 3.7. Individual trap lines were open for between four and seven nights at up to seven locations around Barrow Island, yielding a total trapping effort of 6,992 trap nights.

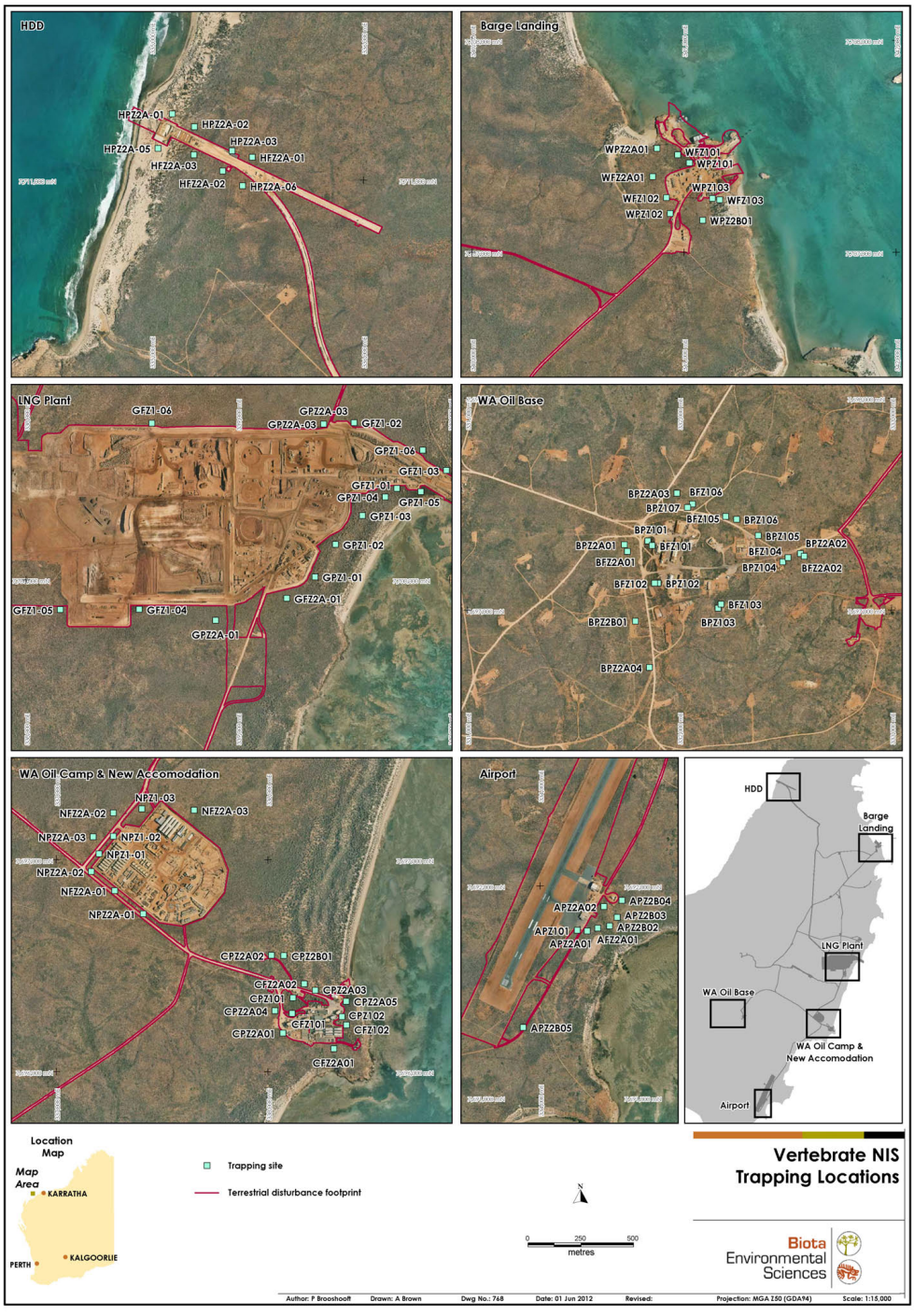


Figure 3.7. Non-indigenous species targeted trapping locations of 2011 and 2012

3.8 Field Assessment of the Study Area

Biologists walked transects over the entire study area, walking in parallel 50 m apart. The total area searched is shown in Figure 3.8, with the green line representing the track file logged by one zoologist and the buffer in red representing the area included by the other zoologists walking in parallel. The purpose of the field assessment was to detect the presence of any Boodie warrens, document the occurrence of any other fauna or their secondary evidence and to ground-truth the fauna habitats of the study area.

The field team comprised Mr Roy Teale, Dr Stewart Ford, Mr Michael Greenham, and Mr Chris Cole all of whom have extensive experience in the vertebrate fauna monitoring programs on Barrow Island, having participated in the field work and/or reporting on multiple monitoring programs for 2 – 5 years. Andrew Sheppard, and Preeti Chukowry accompanied the more experienced field members.

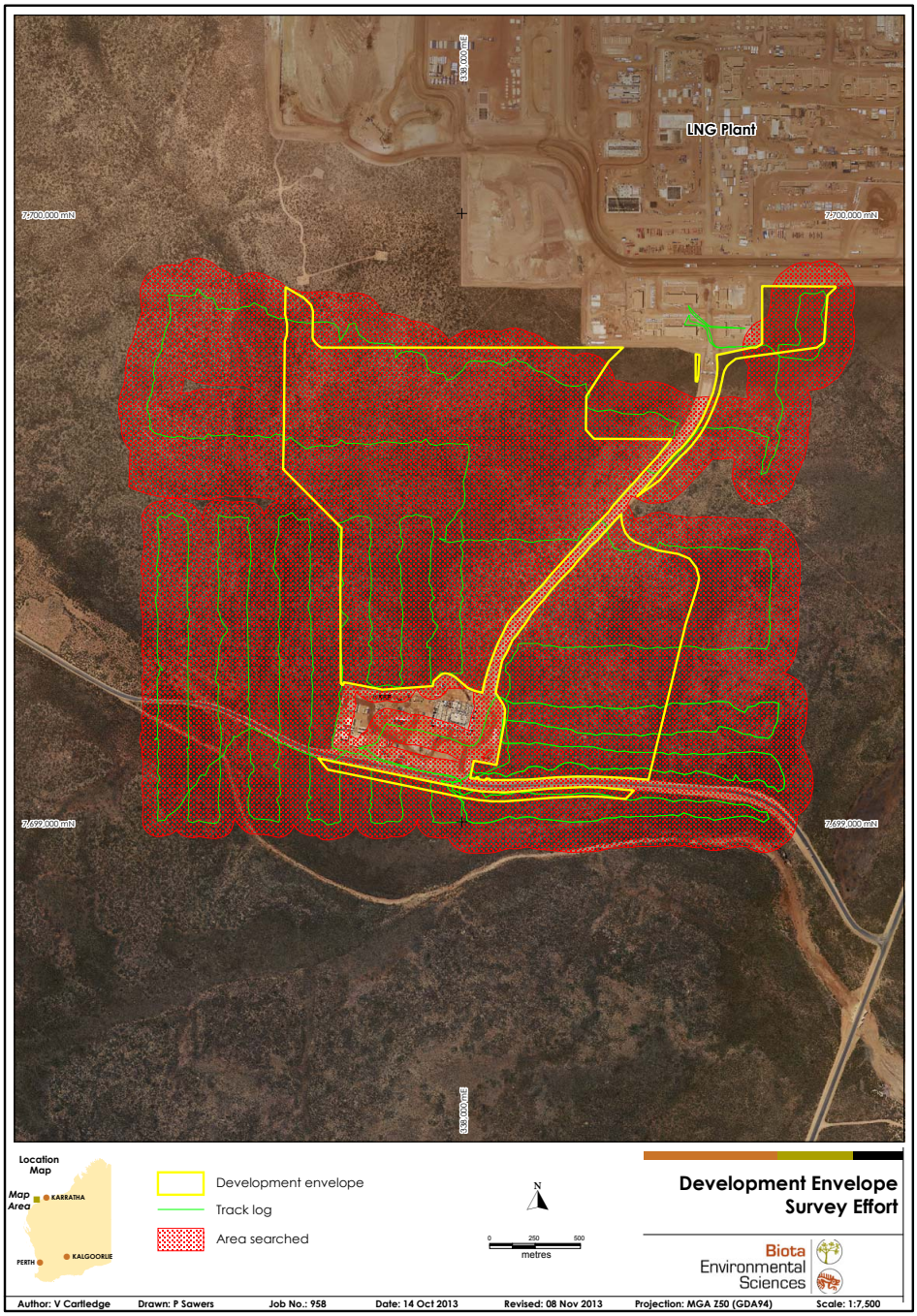


Figure 3.8: The area searched in relation to the proposed tenure amendment

4.0 Terrestrial Fauna Values

4.1 Fauna Habitat of the Additional Area

The vegetation units of study area, the GTPS and surrounds have been mapped in various studies by Astron and RPS Bowman Bishaw Gorham which were then collated by Astron to a coding system consistent with National Vegetation Information System descriptions in 2009. These vegetation units were provided to Biota by Chevron. The mapping at Broad Floristic Formation level in relation to the study area is shown in Figure 4.1 and was used to inform the fauna habitats of the study area. Vegetation units of the study area were compared to what occurs in the surrounding areas.

The study area is dominated by one vegetation unit (L7), which accounts for 12.1 ha of the 36 ha study envelope (or 33.6%). It is broadly described as:

> "Low open shrubland to low heath of *Melaleuca cardiophylla* and *Acacia gregorii* (sometimes scattered) over hummock grassland to closed hummock grassland of *Triodia wiseana* and *T. angusta*."

This vegetation type is also one of the most commonly occurring vegetation units mapped in the surrounding area as shown in Figure 4.1 accounting for 481.5 ha or 31% of the mapped area shown.

Much smaller areas of two other vegetation units occur within the study area; L8 at 0.74 ha or 2.3% and F9 also with 0.74 ha or 2.3%. These two vegetation units have been described, respectively, as:

> "Low shrubland to open heath of *Acacia bivenosa* with *Petalostylis labicheoides* and *Stylobasium spathulatum* over mixed hummock grassland of *Triodia wiseana* and *T. angusta.*"

And,

> "Scattered low *Acacia coriacea* subsp. *coriacea* shrubs over low open shrubland of Acacia bivenosa with scattered *Trichodesma zeylanicum* shrubs over hummock grassland to closed hummock grassland of *Triodia wiseana* with patches of *T. angusta*."

The smaller areas of F9 and L8 occurring within the study area are continuous with larger areas of these vegetation types outside the study area. L8 represents 381.3 ha or 25% of the mapped area shown in Figure 4.1 and F9 represents 189.9 ha or 12% of the mapped area shown on the figure.

These two vegetation units were also common within the GTPS area prior to its clearing with L8 representing 31.9 ha or 19% and F9 representing 58.4 ha or 36%. The GTPS also contained vegetation unit L4n13, but this vegetation type is absent from the additional area.

In summary, none of the fauna habitats occurring within the study area are considered unique as compared to the GTPS area previously assessed or the wider locality for which vegetation mapping has been conducted (shown in Figure 4.1).

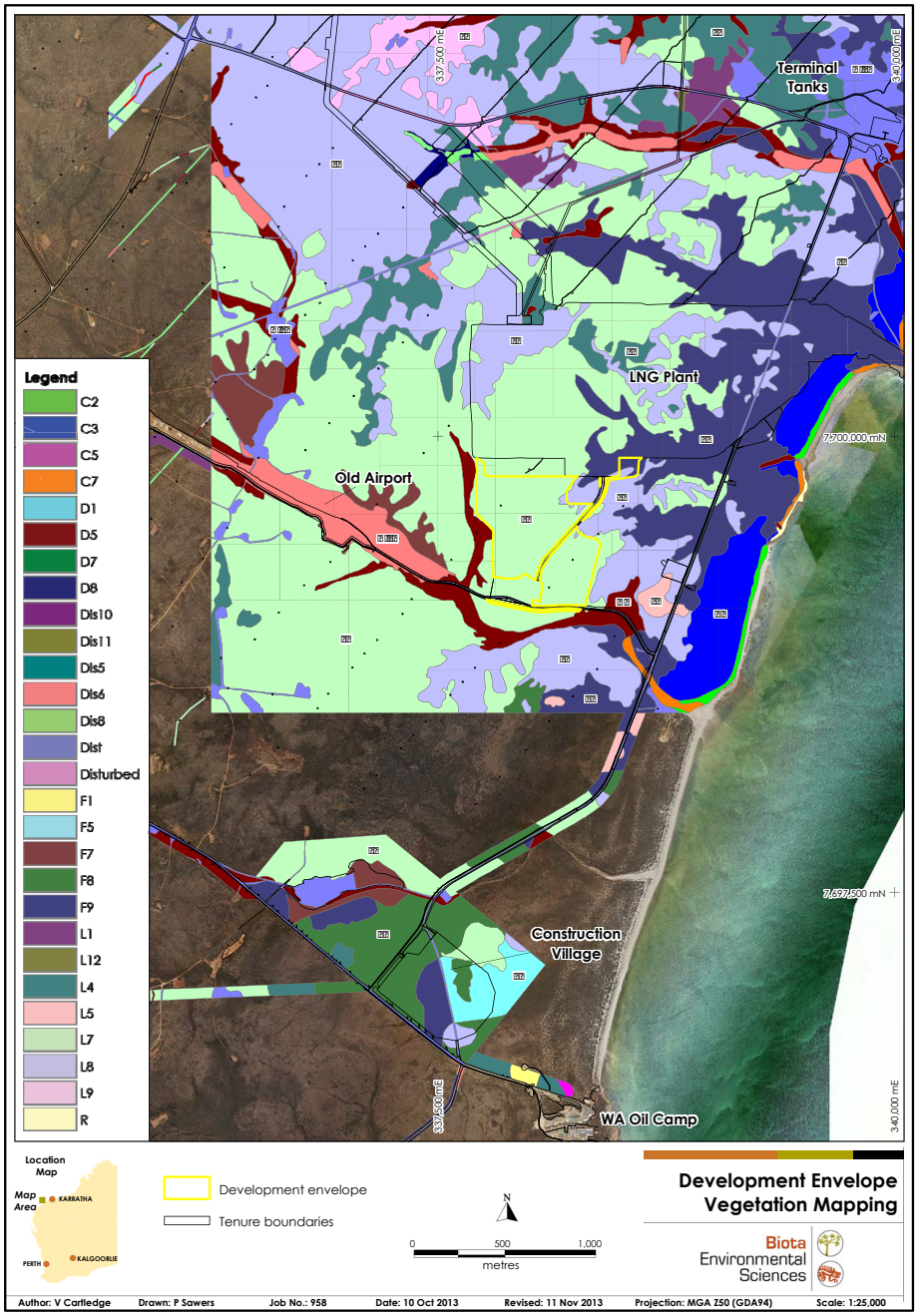


Figure 4.1: Vegetation of the study area, Gas Treatment Plant Site and surrounds

4.2 Species-specific Analyses

4.2.1 White-winged Fairy-Wren (Barrow Island)

Over the course of the past five years of monitoring, five transects have been established within the study area and fairy-wrens have consistently been recorded on all or a subset of these transects. In 2012, four of these transects were sampled covering a considerable portion of the study area (Figure 4.2). Seven clusters of fairy-wrens comprising 23 individuals were recorded from these transects. This represents an encounter rate of 14.4 individuals per km of transect walked. This is much higher than the 2012 island-wide average encounter rate of 1.26 individuals per km of transect walked. The numbers of individuals recorded per transect ranged between five and 10 with comparable numbers recorded from at least 16 other transects established as part of the 2012 monitoring program.

Two transects within the GTPS were sampled for fairy-wrens in 2009 prior to it being cleared. On these transects, seven clusters of fairy-wrens comprising 25 individuals were recorded giving an

encounter rate of 17.9 individuals per km of transect walked (nb. the two transects walked were substantially longer at 592 - 801 m than the 400 m transects used in subsequent years). Similar to the study area, this encounter rate was also considerably higher than the average for the year 2009, which was 2.05 individuals per km transect walked.

These high encounter rates indicate the presence of favourable habitat for the White-winged Fairy-wren both inside the study area and the previously assessed GTPS. The presence of *Melaleuca cardiophylla* as a correlate of fairy-wren presence has been consistently observed during the monitoring program and in 2012 this relationship was quantitatively examined by counting the number of melaleuca plants intersecting the transects surveyed and analysing the number of fairy-wren records as a function of melaleuca presence/absence. This analysis revealed marked differences in habitat preference and utilisation by White-winged Fairy-wrens, with a strong preference for melaleuca shrublands. The encounter rate, density of clusters and cluster size were all greater in areas where melaleuca shrubs were present (Biota 2012), contributing to a density in areas of melaleuca shrubland nearly 3.5 times that of areas without melaleuca shrubland. As noted in Section 4.1 and illustrated in Figure 4.1, the study area is dominated by low open shrubland to low heath of *Melaleuca cardiophylla* representing favourable habitat for the White-winged Fairy-wren. The same vegetation type occurs outside of the study area in the local area as shown in Figure 4.1. The presence of fairy-wrens in this same melaleuca dense habitat immediately to the south of the study area is illustrated in Figure 4.2. Previous authors (Pruett-Jones and Tarvin 2001, Bamford and Wilcox 2005) have likewise suggested that shrubland habitats comprising *Melaleuca cardiophylla* and other shrubs are important for fairy-wrens. Observations in 2005 by Bamford and Moro (2011) showed that 87% of fledglings were located in habitats in which *Melaleuca cardiophylla* was present, though these authors also noted that within this habitat fairy-wrens were not dependent on the *Melaleuca* for nest construction. They further noted that nesting was recorded in habitat without *Melaleuca* i.e. Hummock grassland of *Triodia angusta* and open scrubland of *A. bivenosa*.

An accurate estimate of fairy-wren density within the *Melaleuca* habitat has not been developed, as the extent of this habitat has not been accurately mapped across all areas surveyed in the monitoring program. Bamford and RPS (2005) provide estimates of fairy-wren density within a range of vegetation types, but did not fully quantify detectability in their survey methodology (Buckland *et al* 2001). Using the island wide density estimate that incorporates considerable non-core habitat would under-estimate the total number of birds in the study area. However, as most transects intersecting *Melaleuca* fall within the 'At Risk' zone we have used the density estimate for this zone as reported by Biota (2013) to estimate the number of individuals likely to occur with the 32 ha proposal area. Biota reported a density of 0.779 ± 0.159 birds per hectare for the At Risk zone, which would yield 25 ± 5 birds for the proposal area. This compares to an island wide estimate in 2012 of 10,684 ± 1,961 fairy-wrens.

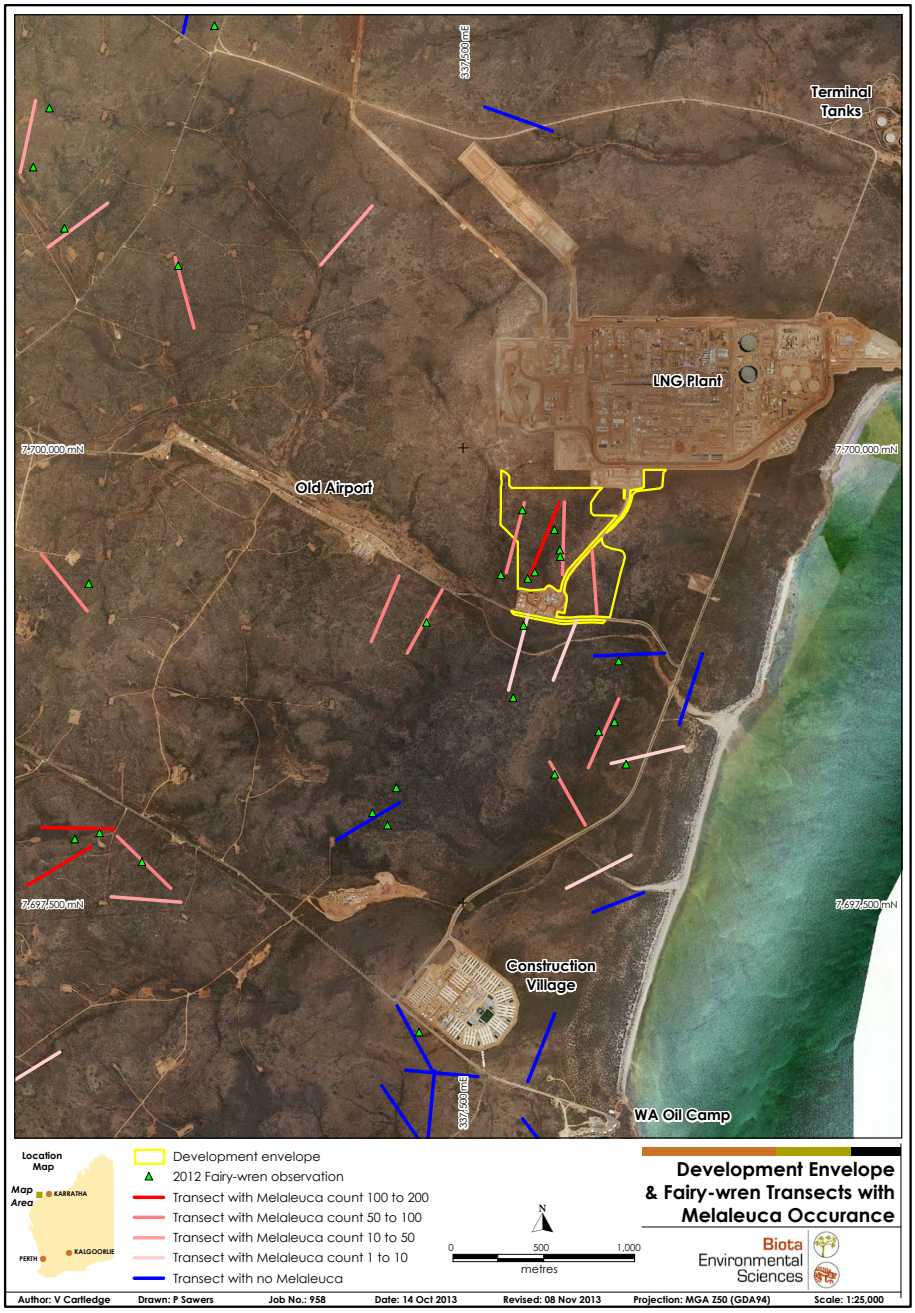


Figure 4.2: Fairy-wren observations in 2012 and melaleuca plant counts in relation to the study area

4.2.2 Spectacled Hare-wallaby and Barrow Island Euro

Of the transects run over the past five years of monitoring, one transect intersects the study area and two to five Spectacled Hare-wallabies have been recorded on the four occasions that it has been sampled (2009, 2010, 2011 and 2013). No euros have been recorded on this transect.

The highest densities of Spectacled Hare-wallabies on the island have been recorded from the coastal complex and dune system vegetation type described by Mattiske (2005) (Biota 2013a); this vegetation type does not occur within the study area. This type of habitat association analysis has not been possible for the Euro due to low encounter rates.

Based on the density estimates calculated for the *Triodia wiseana* dominated vegetation of the study area, eight Spectacled Hare-wallabies are expected to occur within the proposal area, compared to an island-wide estimate of 7,411 ± 1,264 individuals. Two Euros are expected to occur within the proposal area compared to an island-wide estimate of 1,234 ± 449 individuals.

4.2.3 Barrow Island Golden Bandicoot

Table 4.1 summarises the estimated Bandicoot densities at the four sites closest to the study area (see Figure 3.4). All density estimates are based on a preferred model (by AIC) that included a learned response for both detection parameters g_0 and σ and used sex as a co-variate. The 2012 estimates reported in Table 4.1 differ slightly from those documented by Biota (2013) in which the reported model did not use sex as a covariate.

2012 and 2013 Bandicoot density for the four sites within 4 km of the study area estimated (ha^{-1}) using Spatially Explicit Capture Recapture.

Table 4.1: Bandicoot density estimates at trapping arrays within 4 km of the study area.

Site	2012 Estimate	2013 Estimate
WI11	1.5 ha^{-1}	1.3 ha^{-1}
WI12	2.9 ha^{-1}	1.7 ha^{-1}
WI15	1.7 ha^{-1}	1.7 ha^{-1}
WI18	2.7 ha^{-1}	1.6 ha^{-1}

Of the 20 sites sampled in 2012 (Biota 2013b), sites WI12 and WI18 yielded the highest and second highest Bandicoot density estimates respectively, whilst WI11 yielded the second lowest estimate. Therefore, almost the entire range in density estimates occurs within 4 km of the study area. Nevertheless, the estimates are still comparable to the island wide density estimate of 1.98 ha^{-1} (SE 0.127 ha^{-1}, 95% CI 1.74–2.24 ha^{-1}) calculated for that year. The 2013 island wide estimate of 1.7 ha^{-1} (SE 0.12 ha^{-1}, 95% CI 1.48–1.95 ha^{-1}) based on 23 sites, whilst lower, is likewise comparable to that estimated for 2012 and all four tabulated sites yielded similar density estimates (Table 4.1) in 2013. More generally, the results from the Spatially Explicit Capture Recapture program suggest that Bandicoot density across Barrow Island is relatively homogeneous (Biota 2013 and unpublished). Given this similarity across estimates, these data provide a means of inferring the likely Bandicoot abundance in the study area.

To estimate abundance, we used the smallest and largest confidence interval of the density estimates from the two sampling programs completed to date (i.e. a minimum of 1.48 ha^{-1} and a maximum of 2.24 ha^{-1}) and the clearing footprint of 32 ha. These parameters yield a range of 47 - 72 Bandicoots, which compares to the 2012 and 2013 Barrow Island population estimate of 46,225 (95% CI 40,622–52,295) and 39,688 (95% CI 34,552–45,525) respectively. Note that we have used an area of 23,346.3 ha to represent available Bandicoot habitat on Barrow Island.

4.2.4 Barrow Island Burrowing Bettong

No Burrowing Bettong (Boodie) warrens were located within the study area when conducting the field assessment. Three warrens occurred within the GTPS prior to its clearing, one of these warrens was described as active and having 10 – 20 entrances while two others were described as being inactive and having zero and nine entrances (Bamford et al. 2005).

The location of all existing Boodie warrens, both active and inactive, in relation to the study area is shown in Figure 3.5 with the closest warrens being B054 at 240 m and B053 at 290 m east of the study area, B137 at 290 m south of the study area and B034 at 400 m west of the study area. Of these four warrens, three (B034, B053 and B054) were trapped in 2012 and estimates of the number of Boodies in these warrens is provided in Table 4.2. All of these warrens were found to be active. Compared to the island-wide averages estimate of 15.3 Boodies per warren (averaging the Chao2 and bootstrap estimates), the number individuals estimated to be within the warrens nearby the study area were half or less (Table 4.2). From extrapolation based on trapping at 33 warrens, and the assumption that the number of warrens on Barrow Island is likely to be in the range of 250-300 the expected number of Boodies on Barrow Island was calculated at 4,500 individuals (Biota 2013c).

The clearing of habitat and installation of infrastructure will introduce a barrier to movement for Boodies sheltering in nearby warrens. Warrens B053 and B054 will be particularly affected, with

movement north, currently and west potentially, both constrained (Figure 4.3). Analysis of recapture data from 2012 and 2013 warren trapping and mammal grid trapping programs was mapped to provide preliminary information on the paths of movement of Boodies in the area, these movements are shown on Figure 4.3. No individuals from B053 and B054 east of the study area have been recorded at B034 west of the study area, which would indicate that individuals do not regularly move between these warrens, and the study area location is therefore not blocking a regular path of movement between warrens. Boodies may use habitat within the study area to forage and a small number Boodie trails were noted from the north-west of the study area during the field assessment, however, no significant trails typical of consistent Boodie pathways were found.

Table 4.2: The number of Boodies in warrens near the study area. Chao2 and Bootstrap values represent accumulation curve estimates of the number of individuals in these warrens.

Warren	Trap Days	Males	Females	Individuals	Captures	Chao2	Bootstrap
B34	4	3	2	5	13	5	5.6
B53	4	5	2	7	21	7	7.2
B54	4	3	3	6	17	6	6.2
Island-wide Average				**11.91**	**28.39**	**16.51**	**14.08**

Figure 4.3: Boodies trapped in multiple locations; warrens and/or mammal trapping grids.

4.2.5 Eastern Osprey and White-bellied Sea-eagle

The Eastern Osprey is moderately common to very common in sheltered seas around the north and west-coast islands, and less common on mainland coasts, estuaries and larger rivers north of the tropic of Capricorn (Johnstone and Storr 2004). The species diet largely comprises fish and seasnakes but also seabirds and large lizards (Johnstone and Storr 2004), as such the study area is unlikely to represent core foraging habitat. The closest Eastern Osprey nest to the study area is 2.6 km to the north (Figure 3.6) so nesting is unlikely to be affected by the development.

The White-bellied Sea-eagle is often associated with marine and freshwater systems but has been sighted over inland terrestrial landscapes. No nesting sites occur within the study area or within 9 km (Figure 3.6). Similar to the case for the Eastern Osprey, the study area does not present core foraging habitat for the White-bellied Sea-eagle as the species most commonly preys upon fish, seasnakes and nestlings of seabirds, although the species has been noted to take small macropods and reptiles (Johnstone and Storr 2004).

4.2.6 *Idiommata*

Combined search efforts for specimens of *Idiommata* over the NIS programs (2010-2013), mammal distance sampling programs (2010-2013), targeted burrow searches (2010, 2012) and night-time road spotting (2012), resulted in null records of *Idiommata*. Despite null records of the targeted mygalomorph taxon, search efforts resulted in the addition of five taxa which were previously unrecorded from Barrow Island (Biota 2010). To date, over 100 mygalomorph specimens perhaps representing as many as nine species from seven genera and four families have been documented from the *Idiommata* surveys. Where multiple records occur, these taxa have been demonstrated to have island wide distributions.

4.3 DPaW Threatened Fauna Database Search

A search of DPaWs Threatened Fauna (as recommended by EPA and DEC 2010) database including a buffer of 3 km around the study area (when filtered for only terrestrial species) returned a total of eight taxa, one of which Rock Ringtail Possum is not known from the island and is therefore excluded from the list in Table 4.3. Another, the Blank-flanked Rock Wallaby is only known from the west coast and does not occur in or adjacent to the study area. The Yellow-lipped Cave Bat was recorded as a dead specimen on the island and its status as a resident is unclear. All other species listed have been addressed as part of this review.

Table 4.3 List of fauna returned from a search of Department of Parks and Wildlife Threatened fana database.

Bettongia lesueur lesueur Burrowing Bettong
Isoodon auratus barrowensis Barrow Island Golden Bandicoot
Lagorchestes conspicillatus conspicillatus Barrow Island Spectacled Hare-wallaby
Macropus robustus isabellinus Barrow Island Euro
Malurus leucopterus edouardi Barrow Island White-winged Fairy-wren
Petrogale lateralis lateralis Black-flanked Rock-wallaby,
Haliaeetus leucogaster White-bellied Sea-Eagle
Vespadelus douglasorum Yellow-lipped Cave Bat

5.0 References

Bamford, M. J., and J. A. Wilcox (2005). Gorgon Development on Barrow Island. Technical Report: White-winged Fairy-wren *Malurus leucopterus edouardi.* Unpublished Report for Chevron Australia, Perth.

Bamford, Biota, and RPS (2005). Gorgon Development on Barrow Island Technical Report: Mammals and Reptiles. Report prepared for Chevron Texaco Australia Pty Ltd. Cooperative Research Centre for National Plant Biosecurity, Bruce, ACT, Bamford, Biota Environmental Sciences, RPS Bowman Bishaw Gorham.

Bamford, M. J., and D. Moro (2011). Nest site selection of the White-winged Fairy-wren *Malurus leucopterus edouardi* on Barrow Island. *Corella* 35:84–86.

Biota (2010). 2010 Barrow Island *Idiommata* Survey. Unpublished report prepared for Chevron Texaco Australia Pty Ltd, Biota Environmental Sciences, Western Australia.

Biota (2012). White-winged Fairy-wren (Barrow Island) Monitoring 2012. Unpublished Report Prepared for Chevron Australia, Biota Environmental Sciences.

Biota (2013a). Monitoring of the Spectacled Hare-wallaby and Barrow Island Euro on Barrow Island: Distance Sampling in 2012. Unpublished report prepared for Chevron Australia, March 2013, Biota Environmental Sciences, Western Australia.

Biota (2013b). Barrow Island Bandicoot *Isoodon auratus barrowensis* Trial Monitoring Program. Unpublished report prepared for Chevron Australia, January 2013, Biota Environmental Sciences, Western Australia.

Biota (2013c). Barrow Island Mammal Trapping Program 2012: Boodie Warrens. Unpublished report prepared for Chevron Australia, Biota Environmental Sciences, Western Australia.

Chevron (2006). Final Environmental Impact Statement/Response to Submissions on the Environmental Review and Management Programme for the Proposed Gorgon Development. Chevron, Australia.

Chevron (2009a). Gorgon Gas Development and Jansz Feed Gas Pipeline. Terrestrial and Subterranean Environment Monitoring Program. Chevron, Australia. G1-NT-PLNX0000309.

Chevron (2009b). Gorgon Gas Development and Jansz Feed Gas Pipeline. Short Range Endemics and Subterranean Fauna Monitoring Plan. Chevron, Australia. G1-NT-PLNX0000295.

EPA (2002). *EPA Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection.* Environmental Protection Authority, Perth, Western Australia.

EPA (2004). *EPA Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia.* Environmental Protection Authority, Western Australia.

EPA and DEC (2010). *Technical Guide - Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment*. Environmental Protection Authority and Department of Environment and Conservation.

Harvey, M. S. (2002). Short-Range Endemism Among the Australian Fauna: Some Examples from Non-Marine Environments. *Invertebrate Systematics* 16:555–570.

Johnstone, R. E., and G. M. Storr (2004). *Handbook of Western Australian Birds*.

Majer, J, Callan, S, and Graham, R (2008). Report on the Preliminary Survey of Terrestrial Invertebrates for the Proposed Gorgon Gas Processing Facility on Barrow Ilsnad. Report Prepared for Gorgon Joint Venture, Perth, Western Australia.

Majer, J, Callan, S, and Graham, R (2009). Intensive Search for *Idiommata* sp. on Barrow Island for the Gorgon Project. Unpublished Report Prepared for Gorgon Joint Venture, Perth, Western Australia.

Mattiske (2005). Gorgon Development on Barrow Island Technical Report Flora and Vegetation. Unpublished report prepared for Chevron Texaco Australia Pty Ltd, Mattiske Consulting Pty Ltd, Western Australia.

Pruett-Jones, S. G., and K. A. Tarvin (2001). Aspects of the ecology and behaviour of White-winged Fairy-wrens on Barrow Island. *Emu* 101:73–78.