

Biodiversity Management and Closure Plan

Proposed Sand Excavation For Perth – Darwin Highway

Lots 2233 and 2238,
Byrne Road, Muchea

Shire of Chittering

WA Limestone

August 2017



WA LESTONE

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ATTACHMENTS

Florabase Search
EPBC Dat-9abase Search

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1.0 PROJECT OVERVIEW

BACKGROUND

The proposed Great Northern Highway upgrade, passing through Muchea, is located to the east of this property, Lots 2233 and 2238, Doyle Road, Muchea.

The property is a productive cattle grazing property and has an old private pine plantation on the western resource area.

The soils of the sand ridge have low capability because of the lack of water holding capacity as can be seen by the lack of pasture on the aerial photography.

The proposal is therefore to provide a source of local sand to assist in minimising the cost of construction of this section of the new Great Northern Highway alignment and, by removing the sand from the ridge, lower the ridge and improve the soil capability over a substantial portion of the grazing property, covering approximately 31 hectares.

OPERATIONAL INVENTORY

Summary

| ASPECT | DISTURBANCE |
|--|--|
| Resource sought | Bassendean sand |
| Area of excavation | Eastern resource, 43 hectares 1 - 3 metres deep. Western resource, 41 hectares 1 – 15 metres deep. |
| Processing Infrastructure. Product stockpiles, laydown and related areas | Included in the excavated area. |
| Excavation | Rubber tyred loader/s Off-road haul trucks, scrapers or road trucks for transport to the new Great Northern Highway alignment. 20 tonne water truck or similar for dust suppression. Self contained maintenance and refueling vehicles to attend site as required. |
| Processing | A mobile screening plant may be required. |
| Roads, dams and related infrastructure etc | 0.5 hectares additional access road to Great Northern Highway alignment. |
| Facilities | May require locked seatainer. Portable serviced toilet system. |
| Water management | Approximately 5 000 kL per year for dust suppression on the access road and pit floor as required, depending on the season. |
| Dewatering requirements | Nil |
| Total area of plant and stock | Located on the hard stand to the north. No changes. |
| Area of settling ponds | Not required |
| Wastes and tailings | There is no waste material. The only materials remaining on site will be subgrade sand and topsoil. |
| Fuel storage | Not proposed with fuel brought to site in mobile tanker as required. |
| Truck movements | Variable but approximately 4 laden trucks leaving site per hour on average, with some days having more transport and other days less. For supply to the Great Northern Highway upgrade the hourly number will rise to 10 – 20 per hour. Transport is to be directly to the Brand Highway along Byrne Road and then to the alignment of the Great Northern Highway. Any sand remaining after construction of the highway will |

| | |
|--------------------|--|
| | be transported along an approved access road to a defined and approved intersection on the highway. |
| Life of project | 10 years |
| Hours of operation | Hours of operation will be 6.00 am to 5.00 pm Monday to Saturday inclusive, excluding public holidays. |

PHYSICAL ENVIRONMENT

- **Site Description**

The sand is a series of sand ridges of Bassendean type sand, which by the vegetation, suggests leached white sands at depth under the core of the ridges, but which from the limited soil auger holes is leached white silica sand grading to light brown at depth.

Groundwater from the Gnangarra Mound flows east at this location to emerge at the eastern edges of the sand ridges as a series of seepages and springs at the interface with the alluvial clays associated with Ellen Brook. The sand interleaves with the alluvial clays.

There may also be ferricrete and coffee rock that may be causing localised minor confinement of the groundwater.

The sand ridges are up to 8 metres above the plain dropping from west to east.

The groundwater elevation also drops from west to east, touching the surface in winter on the lower wetter areas in the east, in low drainage areas in some dune swales and permanently at several springs.

The land owner wants the land to be returned to productive pasture. Currently the sand ridges are too dry to hold water in summer and do not support pasture growth as can be seen on the aerial photographs.

Ideally the separation to the water table could be lowered to 0.5 to 1.0 metres and would enable better pasture growth and pasture to be maintained into summer. Lowering the sand ridge will increase the agricultural capability of the land. Capillary action in sand is around 600 mm and root depth of pasture is in the order of 300 – 500 mm depending on the species of grass, so a separation of 0.5 to 1.0 metres is ideal for better pasture growth.

- **Climate**

The climate of the area is classified as Mediterranean, with dry hot summers and cool wet winters.

Climate data is recorded at Bullsbrook, (Pearce RAAF), Precipitation is 688 mm per annum, of which 89% falls in the months April to October inclusive. At Swan Research Station evaporation exceeds rainfall in all but the four wettest months, and the situation at Bullsbrook can be expected to be similar.

Average maximum temperatures at Bullsbrook reach 33.3 degrees Celsius for the hottest months, January and February, but fall to 17.6 degrees Celsius in July. Average minima for the coldest month August, is 8.2 degrees Celsius.

The climate data for Bullsbrook shows that the predominant summer winds are from the east at 9.00 am and from the south west at 3.00 pm.

In summer wind blows from the east 70% of the time at 9.00 am and from the west/south west for 60% of the time at 15.00 pm. Summer wind speeds tend to be 6 to 10 km/hour at 9.00 am and between 11 and 20 km/hour at 15.00 pm.

The winter wind directions are more even, but there is a slight predominance from the east at 9.00 am and south west at 15.00 pm. The average speeds are between 1 to 10 km/hour.

- ***Proposed Landuse – Excavation Methods***

Sand will be removed in a sequence with vegetation cleared, topsoil pushed to the perimeter for later use and perimeter bunds formed from the small thickness of overburden.

The end use of the site will be a return to productive pasture with belts of native vegetation on the batter slopes along the southern sides of the resource areas and the western side of the western resource.

2.0 BIODIVERSITY MANAGEMENT DURING OPERATIONS AND ON CLOSURE

2.1 Flora Survey

2.1.1 Aims of the Survey

The aims of the survey are to update the vegetation reporting and re-evaluate the significance of the vegetation and to determine whether there are any Declared Rare, Priority or Significant taxa present or any significant changes.

2.1.2 Methods of Survey

Aims of the Survey

Lindsay Stephens of Landform Research conducted a vegetation assessment in terms of plant communities, vegetation condition, plant species, and the potential for Rare and Priority Species and Threatened Ecological Communities to be present on this site.

The study was undertaken on 31 August 2016 to comply with Environmental Protection Authority (2004) Guidance Statement, *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*, No 5,1 June 2004.

However a review of the *EPA December 2016 Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* enabled the assessment to be brought into line with the new guidance.

Therefore a Clearing Permit will be required and referral to the Commonwealth under the *EPBC Act 1999* for any listed matters, namely habitat for Black Cockatoos, is considered.

Past Studies

There are no known previous studies.

Current Study

- ***On Ground Assessment***

A site inspection of the site was carried out on 31 August 2016 by Lindsay Stephens of Landform Research.

A further vegetation study was completed on 22 August 2017 following a wetter winter in which the spring flowering appears to be earlier.

During that inspection the whole of the land was traversed at intervals dependent on the quality of the vegetation. All native species noted during the traverses were recorded.

All native species found were recorded as were all exotics including weed species. An assessment was made of the vegetation condition and plant density through four 100 m² plots which included the percentage of soil cover.

As some areas had been excavated, and to give a clearer picture of the species richness and plant density remaining on the western site, five 10 m² plots were sampled to gain a clearer picture of the vegetation condition and communities.

On 22 August 2017 there were more species in flower than 2016.

Six 100 m² plots are assessed to provide compliance with EPA updated Guidelines for Flora and Vegetation Assessments (December 2016). The plots were selected in areas of the best vegetation but representative of the typical vegetation in that area. Plot 6 was selected as being typical of the vegetation under the existing pine plantation. Photographs are provided and were all taken from the north western corner.

The use of 100 m² plots using species presence alone enables comparison to other locations but does not provide any data on the vegetation condition, plant density that is useful for comparisons. For example the assessment methodology does not record and difference between one plant of a species present or whether there are 100 plants; a situation where clearly there are very significant differences in the vegetation condition and quality. This applies for exotic and native species.

Similarly the vegetation condition is not well determined by the EPA 100 m² plot methodology.

This is recognised in the EPBC Conservation Advice for *Banksia* Woodlands on the Swan Coastal Plain 2016, (Table 3 page 22) of that document where descriptors for vegetation condition are used based on percentage occurrence.

10m² plots were used because of the paucity of vegetation and the surveys pre-dated the EPA December 2016 updated Guidance. The 10 m² plots are very useful in determining species richness and plant density with a view of comparisons and providing a good measure of both that is sample based rather than observational based or not provided.

The methodology of the 2016 Guidance relies only on presence and absence data in plots and provides no indication of the actual vegetation condition or the contribution of those species to the vegetation on site.

To provide better, more meaningful, data the % vegetation cover for each species was provided for the five 10 m² sample plots. Percentage occurrence for the 100 m² plots is used in this study.

Specimens were collected and colour photocopied as soon as possible to preserve the features of the species. Not all species were collected and retained, but rather the less obvious species or those that may require further study were collected and retained.

Colour photocopying or digital scanning has been found to be the best means of retaining voucher material. Those specimens have also been retained as dried plants.

- **Desktop Reviews**

The DEC (now DPaW) Rare and Priority Flora and Ecological Communities databases were searched through Florabase. The Commonwealth EPBC databases were also searched and Naturebase was searched.

The main references for plant identification were knowledge of the assessor, published texts, and Florabase.

The Protected Matters Search Tool, Commonwealth Department of Environment for a 5 km radius was searched. See attachment.

Determinations and inferences on the Vegetation Complexes and Floristic Community Types were made in a number of ways, relating to comparisons to published floristics and geomorphic and regolith matching. The following documents were used in the reporting.

- Bush Forever used the same methodology based on comparisons to published floristics and geographic information, Bush Forever 2000, Volume 2 page 310.

- Comparisons were made to published boundaries of Vegetation Complexes in Heddle et al, 1980.
- Comparisons of species were made to the descriptions of Floristic Community Types in Gibson et al 1994, pages 29 to 45. (Gibson, N, Keighery, B.J., Keighery, G.J., Burbidge, A.H. and Lyons, M.N. (1994), *A Floristic Survey of the Swan Coastal Plain*. Unpublished Report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia).
- Comparisons of species were made to the sorted table in Gibson et al 1994, Table 12, which shows the species frequency within each Floristic Community Type. Weston 2004 states that Neil Gibson noted that such comparisons are possible.
- Comparisons were made to the descriptions of the Floristic Community Types and maps in Appendix 1 of Gibson et al 2004.
- Comparison to regolith maps such as the 1 : 50 000 Perth Metropolitan Environmental Geology Map Sheets produced by the Western Australian Geological Survey; particularly Fremantle Sheet.
- Comparisons were made to published boundaries of Landforms and Soils in Churchward and McArthur, 1980.
- Soil and regolith mapping and assessment of the geomorphology by Lindsay Stephens at the time of the site inspections. Soil and regolith mapping has been found to be very closely aligned to species composition, through extensive field mapping by Landform Research, with small changes to the clay or sesqui-oxide content being related to the introduction and deletion of particular indicator species.
- Comparisons to databases of Regolith and Vegetation Communities held by Landform Research and the field experience of Lindsay Stephens.

2.1.3 Limitations of the Survey

The surveys were conducted at an appropriate time of the year.

Considering the nature of the vegetation on site, its level of past and current disturbance, the limitations are not considered significant and the assessment is considered valid.

2.1.4 Community Types

Both resource areas have been cleared and allowed to regrow, and the eastern resource, subjected to grazing and other rural activities. Figure 1-7.

The vegetation was originally typical of the Bassendean Complex, North, as identified by Heddle et al, 1980, *Vegetation Complexes of the Darling System, Western Australia in Atlas of Natural Resources, Darling System, Western Australia*, Department of Conservation and Environment. Bassendean Complex, North which extends from Gnangara northwards to past the Moore River.

The Bassendean Complex – North is characterised by *Banksia – Eucalyptus todtiana* Shrublands to Low Woodlands. This best correlates with Shepherd et al vegetation Type 949.

However the vegetation on the resource is sufficiently degraded for this to be difficult to confirm the total native species in the four 100 m² western plots ranges from 7 to 13, which is very low and the eastern plots which as basically pasture had only 2 and 3 species per 100 m² Plot.

The low intervening wetland areas grade from the *Banksia* Woodland with elements of Yanga Complex on flats subject to wet conditions, even though that vegetation complex occurred on the lower lying land to the east.

With such alteration to the vegetation and paucity of species, it is difficult to determine the original Floristic Community. The vegetation appears to have been slightly different on the lower slopes and the eastern sand ridge compared to the vegetation on the higher western sand ridge.

The vegetation was originally *Banksia* Shrubland to Woodland and probably had affinities to FCT 23a, 22, 21c and 21a. (Gibson, N, Keighery, B.J., Keighery, G.J., Burbidge, A.H. and Lyons, M.N. 1994).

The lower elevation in the wet areas probably has affinities to FCT 12 and 14. (Gibson, N, Keighery, B.J., Keighery, G.J., Burbidge, A.H. and Lyons, M.N. 1994).

Eastern Resource

The sand resource is pasture and is covered by pasture species, predominantly grasses and with some exotic species that are often contained in pasture.

Podotheca angustifolia is a native species widespread across the pasture.

The eastern resource can be seen to have large areas of cleared pasture with approximately 50% of the resource being covered by a monoculture of *Xanthorrhoea preissii*.

There are significant cleared areas with some regrowth around the lower edges of the dunes. The regrowth vegetation consists almost solely of *Xanthorrhoea preissii* (Grass Trees). There are occasional to isolated *Eucalyptus todtiana*, *Corymbia calophylla*, and *Jacksonia furcellata*.

Damp areas off the sand ridge are identified by green pasture and *Melaleuca preissiana* and *Eucalyptus rudis* (Flooded Gum).

There are almost no other native species. This vegetation varies from Completely Degraded to Degraded.



Figure 1 – 1 Western portion of the eastern sand ridge, view west showing the regrowth monoculture of Grass Trees.



Figure 1 – 2 Western portion of the eastern sand ridge, view west showing the regrowth monoculture of Grass Trees.



Figure 1 – 3 Pasture area on the eastern part of the eastern sand ridge, view east.

Western Resource

The western dune is high with a relatively steep eastern form.

The dune is planted to Pinaster Pines of some 20 – 40 years age and with no apparent usefulness as timber.

The understory and ground cover was cleared to plant the pines and there has been some regeneration under the sparse pines.

A flora and vegetation study was completed and showed 33 species of the original *Banksia* Woodland species. There were no Threatened or Priority species.

56 species is low for *Banksia* Woodland and probably represents around 10 – 20 % of the original vegetation community. Species richness is 4.8 species /10m² and plant density is 1.26 plants /m² both of which is very low.

Vegetation Condition is predominantly Degraded to Good.



Figure 1 – 4 View of the western sand ridge from the eastern edge of the pines, view west. Note that there is little or no understory in this part of the Pine plantation.



Figure 1 – 5 View north of the western sand ridge showing the pines on the resource to the west and pasture area and bare sand to the east.



Figure 1 – 6 Typical vegetation on the western portion of the western sand ridge showing some native vegetation regrowth under sparse pines.



Figure 1 – 7 Typical vegetation on the western portion of the western sand ridge showing some native vegetation regrowth under sparse pines.

Wetlands

There are a number of wetlands on site which were first identified in 1996 for the Wetlands of the Swan Coastal Plain Atlas. The wetlands remain on Department of Water Database.

A total of 6 wetlands are nominated on DOW mapping with two resource enhancement wetlands and four drains and drainage lines across pasture.

The two Resource Enhancement Wetlands were not studied in detail because they lie outside the resource area, but have a perimeter of *Kunzea glabrescens* grading to *Astartea* Thicket with scattered *Melaleuca preissii* and other species.

The two resource enhancement wetlands are well vegetated and are excluded from the proposed excavation.

The wetland vegetation is in Good or better condition.

- **State Forest**

To the west is *Banksia* Woodland that is included in the Gnangara – Moore River State Forest. *Banksia* Woodland is now classified as Threatened under the *Commonwealth EPBC Act 1999*.

It is proposed to excavate sand to the fence line and batter the slope down at 1 : 4 vertical to horizontal, leaving a 50 metre buffer that can be revegetated through the placement of topsoil.

The buffer will be fenced and provide a long term improvement to the protection of the Bush Forever site and the listed “Threatened” – “Priority” *Banksia* Woodland Community.

2.1.5 Species List - Native Taxa

- The species recorded during the site investigation are listed in Table 1.
- The species observed are reduced in number and indicate the level of disturbance to the vegetation on both resources, but particularly the eastern resource where only ten species were identified. Some more scattered plants of additional species are likely to be observed if every metre of the vegetation was walked. It is estimated that 75% of the species have been found and that additional species will occur as scattered plants or in low numbers.
- On the western resource the species recorded was 56.
- The species observed are all common local species.
- Some species were observed from only one plant. Listing all species provides an inflated image of the vegetation richness. A better comparison is the 100 m² sample plots.
- Voucher specimens were retained of most species through scanned colour photocopy.

Table 1 Native Species List - August 2016 and August 2017

| Family | Genus Species | Eastern Resource | Western Resource |
|---------------|----------------------------|------------------|------------------|
| Anarthriaceae | <i>Lyginia barbata</i> | | x |
| Asparagaceae | <i>Lomandra caespitosa</i> | | x |

| | | | |
|---------------|------------------------------------|---|---|
| | <i>Lomandra micrantha</i> | | x |
| Asteraceae | <i>Podotheca angustifolia</i> | x | x |
| Crassulaceae | <i>Crashula colorata</i> | | X |
| Cyperaceae | <i>Lepidosperma sp angustatum?</i> | | x |
| | <i>Schoenus curvifolius</i> | | x |
| Dasyogonaceae | <i>Dasyogon bromeliifolius</i> | | x |
| Dilleniaceae | <i>Hibbertia aurea</i> | | x |
| | <i>Hibbertia cuneiformis</i> | | x |
| | <i>Hibbertia hypericoides</i> | | x |
| | <i>Hibbertia subvaginata</i> | | x |
| Droseraceae | <i>Drosera erythrorhiza</i> | | x |
| | <i>Drosera barbiger</i> | x | |
| | <i>Drosera bulbosa</i> | x | |
| | <i>Drosera menziesii</i> | | x |
| | <i>Drosera pallida</i> | | x |
| Ericaceae | <i>Astroloma microcalyx</i> | | x |
| | <i>Astroloma pallidum</i> | | x |
| | <i>Astroloma xerophyllum</i> | | x |
| | <i>Conostephium pendulum</i> | | x |
| | <i>Lecopogon polymorphus</i> | | x |
| Goodeniaceae | <i>Dampiera linearis</i> | | x |
| | <i>Lechenaultia biloba</i> | | x |
| Haemodoraceae | <i>Anigozanthos humilis</i> | | x |
| | <i>Conostylis aculeata</i> | | x |
| | <i>Conostylis caricina</i> | | x |
| | <i>Haemodorum spicatum</i> | x | x |
| Iridaceae | <i>Patersonia occidentalis</i> | | x |
| Lauraceae | <i>Cassytha glabella</i> | | x |
| Loranthaceae | <i>Nuytsia floribunda</i> | | x |
| Fabaceae | <i>Acacia pulchella</i> | | x |
| | <i>Bossiaea eriocarpa</i> | | x |
| | <i>Gastrolobium capitum</i> | | x |
| | <i>Gompholobium tomentosum</i> | | x |
| | <i>Jacksonia furcellata</i> | x | x |
| Myrtaceae | <i>Beaufortia elegans</i> | | x |
| | <i>Calothamnus hirsutus</i> | | x |
| | <i>Calytrix flavescens</i> | | x |
| | <i>Eremaea pauciflora</i> | | x |
| | <i>Eucalyptus todtiana</i> | x | |
| | <i>Kunzea glabrescens</i> | x | x |
| | <i>Scholtzia involuocrata</i> | | x |
| | <i>Verticordia densiflora</i> | | x |
| | <i>Verticordia nitens</i> | | x |
| Orchidaceae | <i>Caladenia flava</i> | | x |
| | <i>Pyrorchis nigricans</i> | | x |
| Proteaceae | <i>Adenanthos cygnorum</i> | | x |
| | <i>Banksia attenuata</i> | | x |
| | <i>Banksia menziesii</i> | | x |
| | <i>Petrophile linearis</i> | | x |
| | <i>Stirlingia latifolia</i> | | x |
| Restionaceae | <i>Desmocladus flexuosus</i> | | x |
| Rutaceae | <i>Boronia purdieana</i> | | x |
| | <i>Boronia subsessilis</i> | | x |
| | <i>Philotheca spicata</i> | | x |
| Stylidaceae | <i>Stylidium piliferum</i> | x | |
| | <i>Stylidium repens</i> | x | |

| | | | |
|------------------|------------------------------|----|----|
| Xanthorrhoeaceae | <i>Xanthorrhoea gracilis</i> | | |
| | <i>Xanthorrhoea preissii</i> | x | x |
| Zamiaceae | <i>Macrozamia riedlei</i> | | x |
| | | | |
| | TOTAL NATIVE SPECIES | 10 | 56 |

Table 2 Native Species List – 100 m² plots August 2017

| Family | Genus Species | E1 | E2 | W1 | W2 | W3 | W4 |
|----------------|------------------------------------|------------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
| | | E 400 235 N 6507187 | E 400316 N 6507197 | E 399418 N 6507210 | E 399442 N 6507406 | E 399413 N 6507565 | E 399481 N 6507646 |
| | | Percentage plant cover % | | | | | |
| Anarthriaceae | <i>Lyginia barbata</i> | | | 5% | 10% | 2% | |
| Asparagaceae | <i>Lomandra caespitosa</i> | | | | | | |
| | <i>Lomandra micrantha</i> | | | | | | |
| Asteraceae | <i>Podotheca angustifolia</i> | 5% | 3% | | <1% | | |
| Crassulaceae | <i>Crashula colorata</i> | | | | | | |
| Cyperaceae | <i>Lepidosperma sp angustatum?</i> | | | | | | |
| | <i>Schoenus curvifolius</i> | | | | | | |
| Dasypogonaceae | <i>Dasypogon bromeliifolius</i> | | | | | | |
| Dilleniaceae | <i>Hibbertia aurea</i> | | | | | <1% | |
| | <i>Hibbertia cuneiformis</i> | | | | | | |
| | <i>Hibbertia hypericoides</i> | | | | | | |
| | <i>Hibbertia subvaginata</i> | | | | | 1% | |
| Droseraceae | <i>Drosera erythrorhiza</i> | | | | | | <1% |
| | <i>Drosera barbigera</i> | | | | | | |
| | <i>Drosera bulbosa</i> | | | | | | |
| | <i>Drosera menziesii</i> | | | | | | |
| | <i>Drosera pallida</i> | | | <1% | | | |
| Ericaceae | <i>Astroloma microcalyx</i> | | | 5% | 4% | | |
| | <i>Astroloma pallidum</i> | | | 2% | | | |
| | <i>Astroloma xerophyllum</i> | | | | | | |
| | <i>Conostephium pendulum</i> | | | 3% | | 1% | 2% |
| | <i>Lecopogon polymorphus</i> | | | | | | |
| Goodeniaceae | <i>Dampiera linearis</i> | | | | | | |
| | <i>Lechenaultia biloba</i> | | | 10% | | | |
| Haemodoraceae | <i>Anigozanthos humilis</i> | | | | | | |
| | <i>Conostylis aculeata</i> | | | | | | |
| | <i>Conostylis caricina</i> | | | | | <1% | |
| | <i>Haemodorum spicatum</i> | | | | | | |
| Iridaceae | <i>Patersonia occidentalis</i> | | | 1% | | | 2% |
| Lauraceae | <i>Cassytha glabella</i> | | | <1% | <1% | | |
| Loranthaceae | <i>Nuytsia floribunda</i> | | | | | | 10% |
| Fabaceae | <i>Acacia pulchella</i> | | | 2% | | | |
| | <i>Bossiaea eriocarpa</i> | | | | | | |
| | <i>Gastrolobium capitum</i> | | | | | | |
| | <i>Gompholobium tomentosum</i> | | | | | | |
| | <i>Jacksonia furcellata</i> | | | | | 2% | 2% |
| Myrtaceae | <i>Beaufortia elegans</i> | | | 10% | | | |
| | <i>Calothamnus hirsutus</i> | | | | | | |
| | <i>Calytrix flavescens</i> | | | | | | |
| | <i>Eremaea pauciflora</i> | | | 5% | | 8% | |

| | | | | | | | |
|------------------|-------------------------------|----------------|----------------|-----------|----------|-----------|----------|
| | <i>Eucalyptus tottiana</i> | | | | | | |
| | <i>Kunzea glabrescens</i> | | | | | | <1% |
| | <i>Scholtzia involucreta</i> | | | | 20% | 20% | 2% |
| | <i>Verticordia densiflora</i> | | | | | | |
| | <i>Verticordia nitens</i> | | | | | 2% | |
| Orchidaceae | <i>Caladenia flava</i> | | | | | | |
| | <i>Pyrorchis nigricans</i> | | | | | <1% | |
| Proteaceae | <i>Adenanthos cygnorum</i> | | | | | | |
| | <i>Banksia attenuata</i> | | | 4% | | | |
| | <i>Banksia menziesii</i> | | | | | | |
| | <i>Petrophile linearis</i> | | | <1% | | | |
| | <i>Stirlingia latifolia</i> | | | | <1% | | |
| Restionaceae | <i>Desmocladus flexuosus</i> | | | | | | |
| Rutaceae | <i>Boronia purdieana</i> | | | | | | |
| | <i>Boronia subsessilis</i> | | | | <1% | | |
| | <i>Philotheca spicata</i> | | | | | | <1% |
| Stylidaceae | <i>Stylidium piliferum</i> | | | | | | |
| | <i>Stylidium repens</i> | | | | | | |
| Xanthorrhoeaceae | <i>Xanthorrhoea gracilis</i> | <1 | | | | | |
| | <i>Xanthorrhoea preissii</i> | 20% | 30% | | | | |
| Zamiaceae | <i>Macrozamia riedlei</i> | | | | | | |
| | | | | | | | |
| | TOTAL NATIVE SPECIES | 3 | 2 | 13 | 7 | 10 | 8 |
| | | | | | | | |
| | <i>Pinus</i> | | | 5% | 40% | 10% | 50% |
| | <i>Gladiolus</i> | | | <1% | <1% | | <1% |
| | <i>Ursinia</i> | | | <1% | <1% | | <1% |
| | <i>Taraxacum</i> | | | | <1% | | |
| | Pasture species not counted | O | O | | | | |
| | | | | | | | |
| | TOTAL EXOTIC SPECIES | Pasture | Pasture | 3 | 4 | 1 | 3 |
| | | | | | | | |
| | | | | | | | |



Figure 1 - 8 100 m² PLOT 1



Figure 1 - 9 100 m² PLOT 2



Figure 1 - 10 100 m² PLOT 3

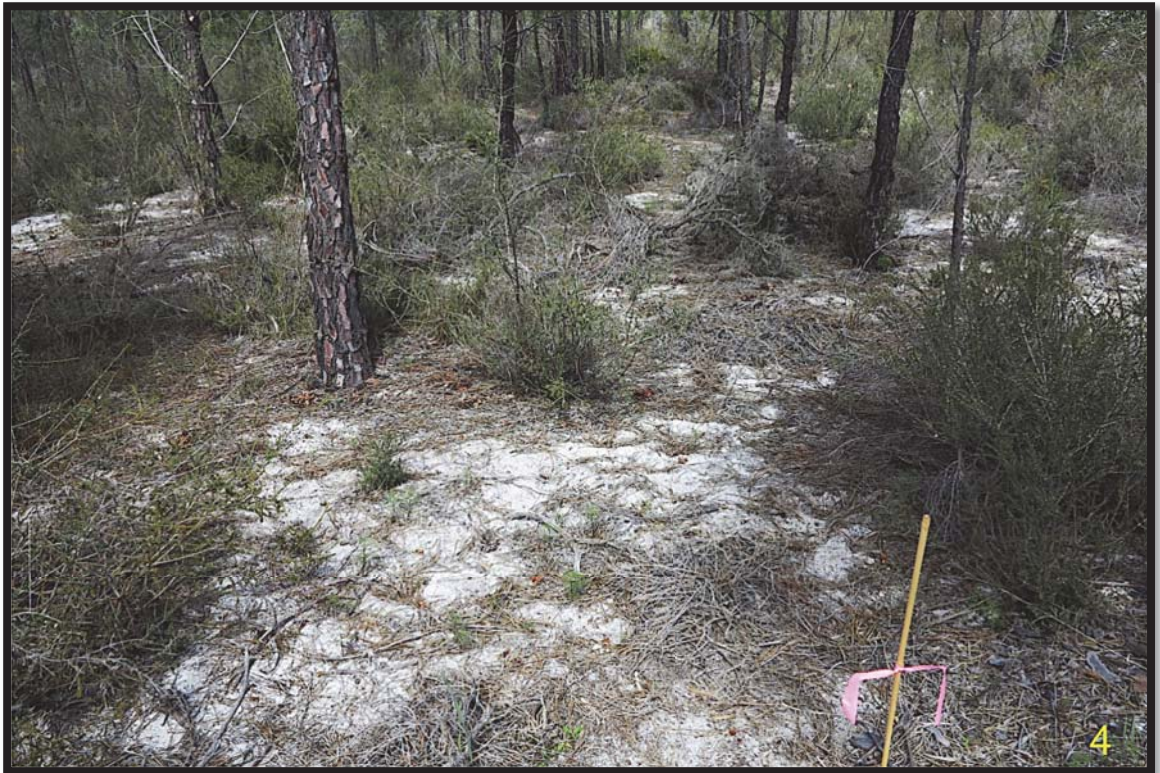


Figure 1 - 11 100 m² PLOT 4



Figure 1 – 12 100 m² PLOT 5



Figure 1 - 13 100 m² PLOT 6

Table 3 Species Richness of 10 m² Sample Plots – Native Species in 2016 (Western Resource)

10m² plots were used in August 2016 to provide baseline data on plant density. 100 m² plots are too large to provide plant density calculations.

As the samples were located in the

The sample plots were located in the visually average vegetation, based on best and worst criteria and therefore reflect average vegetation condition for the site in terms of species richness and plant density.

| | 10m ² Plot 1 | 10m ² Plot 2 | 10m ² Plot 3 | 10m ² Plot 4 | 10m ² Plot 5 |
|--|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| Number of species (Species richness) | 3 | 7 | 4 | 4 | 6 |
| Total number of plants (plant density) | 6 | 11 | 19 | 17 | 10 |

Average species richness per 10m² plot 4.8 species
Average plant density per 10 m² plot 12.6 plants or 1.26 plants/m²

2.1.6 Species List – Exotic Taxa

There appears to be little exotic species apart from the pasture species. The pasture species were not identified and only occurred outside the pine plantation. The pine plantation was almost totally weed free apart from the species listed in Table 3.

The eastern resource has a significant cover and presence of exotic pasture species.

Table 4 Species Richness of 10 m² Sample Plots – Exotic Species 2016 (Western Resource)

Named species Denotes a species identified on the site in 2004.
X Indicates a Declared Plant in Western Australia
O Indicates the species identified in 2016.

| FAMILY | GENUS – SPECIES | EXOTIC SPECIES OBSERVED |
|-----------------------------|----------------------------|-------------------------|
| Asteraceae | <i>Ursinia anthemoides</i> | X |
| | <i>Taraxacum sp</i> | X |
| Iridaceae | <i>Gladiolus spp</i> | X |
| Pinaceae | <i>Pinus pinaster</i> | X |
| | | |
| TOTAL EXOTIC SPECIES | | 4 |

For the western resource, no environmentally significant or Threatened weeds species were recorded although *Ursinia anthemoides* and *Gladiolus* sp were recorded. Both these are widespread through *Banksia* Woodlands and coastal areas in the South West and have become naturalised. They do not significantly impact native vegetation. Pinaster Pines are also present in the western resource but are readily treated if they grow.

No weeds species were recorded in the eastern resource but pasture and exotic plants associated with it occur on the eastern resource.

2.1.7 Plant Density

The species recorded during the site investigation are listed in Table 2.

The plant density can be gauged by the % of cover that is also presented in Table 2.

- An indication of the plant density can be obtained from the 10 m² plots which provide an indication of the ground cover percentage. Exotic species outnumber significantly the local native species and almost everywhere provide greater soil cover than the native species.

2.1.8 Vegetation Structure

Photographs of the vegetation are attached above, which provide information on the vegetation structure. The show that the eastern sand resource is covered by an almost monoculture of *Xanthorrhoea preissii* regrowth and that the western resource is covered by degraded pine plantation with scattered low shrub remnant understory.

The structure of the vegetation is shown in Table 4 under 6.0 Vegetation Condition.

2.1.9 Vegetation Condition

VEGETATION CONDITION NOTES – SOUTH WEST AND INTERZONE BOTANICAL PROVINCES EPBC Conservation Notice *Banksia* Woodlands Swan Coastal Plain, 2016, Table 3 page 22.

The vegetation condition mapping used is that used by EPA December 2016 Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment, modified from Keighery 1994 and Trudgen 1988.

Additional columns are added from the EPBC Guidelines for the identification of the condition of *Banksia* Woodland 2016.

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (s 266B) Approved Conservation Advice (incorporating listing advice) for the *Banksia* Woodlands of the Swan Coastal Plain ecological community.

The *EPA December 2016 Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* for the Eremaean and Northern Botanical Provinces use a slightly different scale.

| Condition Score | Vegetation Condition | Vegetation Descriptors | Indicative condition measures – thresholds (EPBC Approved Conservation Advice 2016. #) | |
|-----------------|----------------------------|---|--|--|
| | | | Typical native vegetation composition | Typical weed cover |
| 1 | Pristine | No obvious signs of disturbance | Native plant species diversity fully retained or almost so | Zero or almost no weed cover - abundance |
| 2 | Excellent | Vegetation structure intact. Disturbance only affecting individual species, Weeds are non aggressive species. | High native plant species diversity | Less than 10% |
| 3 | Very Good | Vegetation structure altered; Obvious signs of disturbance. For example disturbance to vegetation from repeated fires, dieback, logging and grazing. Aggressive weeds present. | Moderate native plant species diversity | 5 – 20% |
| 4 | Good | Vegetation structure altered but retains basic structure or ability to regenerate it. Obvious signs of disturbance eg from partial clearing, dieback, logging and grazing. Presence of very aggressive weeds. | Low native plant diversity | 5 – 50% |
| 5 | Degraded | Vegetation structure severely impacted on by disturbance. Requires intensive management. Disturbance evident such as partial clearing, dieback, logging and grazing. Presence of very aggressive weeds at high density. | Very low native plant diversity | 20 – 70% |
| 6 | Completely Degraded | Vegetation structure is no longer intact and the area is completely or almost completely without native flora. Equivalent to “parkland cleared”. | Very low to no native species diversity | >70% |

In general, the vegetation of the Eastern Resource varies from Degraded to Completely Degraded.

The Western Resource ranges from Degraded to Good vegetation condition.

The wetland remnants are in Good or better vegetation condition.

The vegetation is dominated by exotic and pasture species, even in locations where there are more native species, with the introduced species providing near >90% vegetation cover.

Another approach is to use the number of remaining species as an indicator of vegetation condition. This provides for a less subjective assessment of the vegetation condition. Kaesehagen, 1995, Bushland Condition Mapping, IN Invasive Weeds and Regenerating Ecosystems in Western Australia, Proceedings of Conference held at Murdoch University, July 1994, Institute for Science and Technology Policy, Murdoch University, 1995, A copy of the Kaesehagen 1995 vegetation condition table is shown below.

Kaesehagen 1995 Vegetation Condition Table

| Descriptor | Percentage of species remaining | Comments |
|-----------------------|---------------------------------|--|
| Very Good - Excellent | 80 – 100% | <ul style="list-style-type: none"> Vegetation structure intact or nearly so. Cover / abundance of weeds less than 5%. No or minimal signs of disturbance. |
| Fair - Good | 50 – 80% | <ul style="list-style-type: none"> Vegetation structure modified. |

| | | |
|------------------|-----------------|---|
| | | <ul style="list-style-type: none"> Cover / abundance of weed 5 – 20%, any number of individuals. Minor signs of disturbance |
| Poor | 20 – 50% | <ul style="list-style-type: none"> Vegetation structure completely modified. Cover / abundance of weeds 20 – 60% any number of individuals. Disturbance incidence high |
| Very Poor | 0 – 20% | <ul style="list-style-type: none"> Vegetation structure disappeared. Cover / abundance of weeds 60 – 100% cover, any number of individuals. Disturbance incidence very high. |

Under Kaesehagen 1995 the vegetation best fits into the category of Poor to Very Poor in the best vegetation. The number of species within the 100m2 plots is very low compared to a similar vegetation community in excellent condition. For a portion of the remainder the vegetation is classed as Degraded to Completely Degraded, having significant pasture understorey.

Table 5 Vegetation Structure Condition

| VEGETATION STRUCTURE | HEIGHT | Eastern Sand Resource | Western Sand Resource |
|-----------------------------|---------------|---|---|
| Overstorey | > 4 m | Absent, has been removed. Completely Degraded | Absent, has been removed and replaced by pine plantation in poor condition. Completely Degraded |
| Tall Shrub layer | 2 – 4 m | Absent, has been removed. Completely Degraded | Absent, has been removed. Completely Degraded |
| Lower Shrub Layer | 0.5 – 2 m | Replaced by <i>Xanthorrhoea preissii</i> regrowth monoculture. Completely Degraded to Degraded | Generally scattered and intermittent presence of low native shrubs Degraded to Good |
| Ground Cover | <0.5 m | Absent, has been removed and replaced by pasture. Completely Degraded | Generally absent, has been removed and inhibited by pine needles. Large areas of bare sand. Degraded |

- The Vegetation Condition Score used in this study is that used in EPA Guidance 2016 (see attached notes).

Exotic Taxa

The pasture species were not identified. There were no other significant exotic species identified on the eastern resource.

A total of three exotic taxa were observed during the site traverses and inspections in the western resource plus the *Pinus* as listed in Table 3.

2.1.10 Significant Vegetation

Declared Rare, Priority or Significant Taxa

No plant recorded is listed as a Threatened or Priority species.

Section February 2016 part B Response to Submissions shows the presence of an historical record of a Priority 3 species, presumably *Cyathochaeta teretifolia* on Lot 1773 well to the south, but studies for the Highway relocation did not find any evidence of the plants at that location, but did locate some plants to the south on Lot 168, outside the proposed excavation.

Table 6 Significant Species

| SPECIES | STATE | EPBC | COMMENT |
|---|-------|------|--|
| <i>Eryngium pinnatifidum</i> subsp <i>palustre</i> | P3 | | Distinctive plant that more commonly occurs in gravel. |
| <i>Platysace ramosissima</i> | P3 | | Distinctive plant with distinctive foliage. No similar plants were observed. |
| <i>Hydrocotyle striata</i> | P4 | | Aquatic plant. Unlikely on the elevated resource land. |
| <i>Chamaescilla gibsonii</i> | P3 | | Distinctive plant form. No similar plants were observed |
| <i>Caustis gigas</i> | P2 | | Distinctive grass like herb. No similar species were observed |
| <i>Cyathochaeta teretifolia</i> | P3 | | Distinctive plant that grows in lower wetter soils that do not occur on the resource area. |
| <i>Hibbertia helianthemoides</i> | P4 | | Occurs near the south coast. |
| <i>Drosera occidentalis</i> subsp <i>occidentalis</i> | P4 | | The two <i>Drosera</i> observed were climbing common species |
| <i>Drosera sewelliae</i> | P2 | | The two <i>Drosera</i> observed were climbing common species |
| <i>Leucopogon</i> sp <i>Murdoch</i> | P3 | | No <i>Leucopogon</i> was observed. Grows in winter wet soils which are not present. |
| <i>Leucopogon squarrosus</i> subsp <i>trigynus</i> | P2 | | The <i>Leucopogon</i> present has broadly ovate leaves which are not the leaf shape of <i>Leucopogon squarrosa</i> |
| <i>Acacia anomala</i> | T | V | Occurs in on the Gingin scarp in gravel which does not occur on site. |
| <i>Acacia cummingiana</i> | P3 | | Occurs in laterite and hills areas. |
| <i>Acacia drummondii</i> sp <i>affins</i> | P3 | | Distinctive. No similar foliage was observed |
| <i>Haemodorum loratum</i> | P3 | | Distinctive large leafed plant, which was not observed |
| <i>Verticordia lindleyi</i> subsp <i>lindleyi</i> | P4 | | <i>Verticordia nitens</i> was observed. <i>Verticordia lindleyi</i> subsp <i>lindleyi</i> grows in winter wet depressions and is unlikely to be present. |
| <i>Verticordia serrata</i> var <i>linearis</i> | P3 | | <i>Verticordia nitens</i> was observed. Flowers September to October |
| <i>Thelymitra stellata</i> | T | | No orchid plants or leaves were observed |
| <i>Adenanthos cygnorum</i> subsp <i>chamaephyton</i> | P3 | | Distinctive prostrate form of <i>Adenanthos cygnorum</i> , that was not observed. Often associated with gravel. |
| <i>Grevillea althoferorum</i> subsp <i>fragilis</i> | T | | Distinctive leaves. No similar plant was observed |
| <i>Grevillea canolleana</i> | P2 | | Distinctive. No similar plant was observed |
| <i>Persoonia rudis</i> | P3 | | Distinctive. No similar plant was observed. The timing of the survey was correct for flowering. |

| | | | |
|---|----|----|--|
| <i>Synaphea grandis</i> | P4 | | No <i>Synaphea</i> was observed. |
| <i>Hypolanea robusta</i> | P4 | | Distinctive. No similar plant was observed |
| <i>Stylidium paludicola</i> | P3 | | No <i>Stylidium</i> were observed |
| <i>Stylidium squamellosum</i> | P2 | | No <i>Stylidium</i> were observed |
| <i>Andersonia gracilis</i> | T | E | Grows in winter wet, and gravelly sites that do not occur on site. Unlikely. |
| <i>Anigozanthos viridis</i> subsp <i>terraspectans</i> | T | V | Distinctive. No similar plant was observed |
| <i>Caladenia huegelii</i> | T | E | No orchid plants or leaves were observed |
| <i>Chamelaucium</i> sp <i>Gingin</i> | T | E | Distinctive. No similar plant was observed |
| <i>Conospermum densiflorum</i> subsp <i>unicephalatum</i> | T | E | Grows in clay low lying soils further to the north east. Unlikely. |
| <i>Darwinia foetida</i> | T | CE | No similar plant was observed |
| <i>Diuris micrantha</i> | T | V | No orchid plants or leaves were observed |
| <i>Diuris purdiei</i> | T | E | No orchid plants or leaves were observed |
| <i>Eleocharis keigheri</i> | T | V | No orchid plants or leaves were observed |
| <i>Eucalyptus leprophloia</i> | T | E | No similar Eucalyptus was observed |
| <i>Eucalyptus x balanties</i> | T | E | No similar Eucalyptus was observed |
| <i>Grevillea corrugata</i> | T | E | Distinctive leaves. No similar plant was observed |
| <i>Grevillea curviloba</i> subsp <i>curviloba</i> | T | E | Distinctive. No similar plant was observed |
| <i>Grevillea curviloba</i> subsp <i>incurva</i> | T | E | Distinctive. No similar plant was observed |
| <i>Lepidosperma rostratum</i> | T | E | Grows in peaty sand and clay which do not occur on site. Unlikely. |
| <i>Ptychosema pusillum</i> | T | V | Small pea flower that grows further north. Timing of the survey matched the flowering period. Unlikely |
| <i>Thelymitra dedmaniarum</i> | T | E | No orchid plants or leaves of this type were observed |
| <i>Thelymitra stellata</i> | T | E | No orchid plants or leaves of this type were observed |

Threatened or Priority Ecological Communities

- ***Tumulus Springs Community***

The proposed sand excavation lies outside the general area where Tumulus Springs Community occurs which is 1.5 km to the south east (Perth to Peel Green Growth Plan Draft 2016).

EPBC Legislation

Databases held under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* were searched.

All *Banksia* Woodlands of the Swan Coastal Plain are now listed as Threatened under the *EPBC Act 1999*.

The vegetation on site is so degraded and has been cleared that it is not classified as *Banksia* Woodland.

State Legislation

All *Banksia* Woodlands are listed as Priority 3 (P3) communities. The vegetation on site does not contain any mature or taller *Banksia* and those seedlings in the understorey and ground cover are small and isolated. The seedlings are mainly located near the western boundary of Lot 2233.

The main potential impact on *Banksia* Woodland is in the adjacent State Forest to the west. Buffers and revegetation of the batter slopes to local native vegetation will be used to provide a long term vegetated buffer of 50 metres to the State Forest and *Banksia* Woodland which will assist protection of that vegetation.

2.7.11 Vegetation Representation

EPA Position Statement No 2, December 2000, *Environmental Protection of Native Vegetation in Western Australia*, specifically targets the retention of native vegetation in the Agricultural Areas in 4.1, *Clearing in the agricultural areas for agricultural purposes*. In 4.3, *Clearing in other areas of Western Australia*, it is unclear what "other areas" refers to, but may refer to retention of a 30% threshold in non agricultural areas.

Section 4.3 *Clearing in other areas of Western Australia*, (EPA Position Statement No 2, December 2000) expects that clearing will not take vegetation types below the 30% of the pre-clearing vegetation as recommended by ANZECC, 1999, *National Framework for the Management and Monitoring of Australia's Native Vegetation*. The National Objectives and Targets for Biodiversity Conservation 2001 - 2005 (Commonwealth of Australia 2001) also recognise 30% as the trigger value.

The threshold for constrained areas such as the Perth Metropolitan Region is placed at 10% by Government, (*Bush Forever 2000*, CPC 2682/1, and *EPA Guidance No 10 Level of Assessment for proposals affecting natural areas within the System 6 region and Swan Coastal Plain portion of the System 1 Region* page 9).

Table 67 Status of the vegetation (WALGA 2010 and DER)

| Area | % Remaining of Pre European Vegetation | % Protected in formal conservation areas or some protection |
|---|--|---|
| Swan Coastal Plain IBRA Region | 39% | 37% |
| Hedde Vegetation Complex Bassendean Complex – North | 52.05% | 62.17% |

The original vegetation is likely to have been Shepherd et al (2001) vegetation Type 949.

| Area | Pre-European Area | Current extent remaining | % Remaining of Pre European Vegetation | % Protected in formal IUCN Class I-IV Reserves |
|--------------------------------|-------------------|--------------------------|--|--|
| (Shepherd Vegetation Type 949) | 218,193.94 | 124,080.33 | 56.87% | 13.77% |

2.2 Fauna

Macrofauna

The main significant species identified were the potential for Black Cockatoo impacts, especially Carnaby's Black Cockatoo *Calyptorhynchus latirostris*.

Summary of potential Black Cockatoo habitats

| Potential impacts | Carnaby's Black Cockatoo (<i>Calyptorhynchus latirostris</i>) | Baudin's Black Cockatoo (<i>Calyptorhynchus baudinii</i>) | Forest Red Tail Black Cockatoo (<i>Calyptorhynchus banksii naso</i>) |
|----------------------------|---|---|---|
| Presence of breeding trees | No breeding trees were recorded. No trees with hollows were found. Carnaby's Cockatoo breeds in the wheatbelt further north but has at times increasingly been known to breed in the Perth Area. | Unlikely to lie within the breeding area. | No breeding trees were recorded. No trees with hollows were found. |
| Roosting habitat | Large white trunked trees are preferred but these do not occur on site. There are no large Eucalypt trees for roosting. | Large white trunked trees are preferred but these do not occur on site. There are no large Eucalypt trees for roosting. | Large white trunked trees are preferred but these do not occur on site. There are no large Eucalypt trees for roosting. |
| Feeding habitat | There is no Proteaceous feeding habitat on site. There are some Pines in poor condition that form part of an old plantation. The pines will be replaced by pasture with a buffer of local <i>Banksia</i> Woodland revegetation which will help compensate for the loss of feeding resources. This buffer will be planted along the western edge of the western resource and along the southern edge of both resources. The buffer will be fenced and provide a long term improvement to the protection of the Bush Forever site and the listed "Threatened" <i>Banksia</i> Woodland Community. The site adjoins <i>Banksia</i> Woodland that is included in the Gnangara – Moore River State Forest. <i>Banksia</i> Woodland. | There is no Proteaceous feeding habitat on site. There are some Pines in poor condition that form part of an old plantation. The pines will be replaced by pasture with a buffer of local <i>Banksia</i> Woodland revegetation which will help compensate for the loss of feeding resources. This buffer will be planted along the western edge of the western resource and along the southern edge of both resources. The buffer will be fenced and provide a long term improvement to the protection of the Bush Forever site and the listed "Threatened" <i>Banksia</i> Woodland Community. The site adjoins <i>Banksia</i> Woodland that is included in the Gnangara – Moore River State Forest. <i>Banksia</i> Woodland. | There is no Proteaceous feeding habitat on site. There are some Pines in poor condition that form part of an old plantation. The pines will be replaced by pasture with a buffer of local <i>Banksia</i> Woodland revegetation which will help compensate for the loss of feeding resources. This buffer will be planted along the western edge of the western resource and along the southern edge of both resources. The buffer will be fenced and provide a long term improvement to the protection of the Bush Forever site and the listed "Threatened" <i>Banksia</i> Woodland Community. The site adjoins <i>Banksia</i> Woodland that is included in the Gnangara – Moore River State Forest. <i>Banksia</i> Woodland. |

The lack of suitable habitat trees for roosting and nesting combined with the lack of suitable food results in a low potential impact on Black Cockatoos.

The degraded pines on site may form irregular feeding habitat for Black Cockatoos but will be replaced by pasture on the floor of the pit and *Banksia* Woodland on the batter slopes so that over time the impact on Black Cockatoos will be minimal to nil.

The adjoining Gngangara – Moore River National Park has large areas of *Banksia* Woodland that provide alternative long term feeding habitat. These *Banksia* Woodlands are now less likely to be cleared because of the Priority Listing under State Legislation and Threatened Listing under the EPBC 1999.

Fauna Management

Clearing will be conditioned under a Clearing Permit which will be applied for. During that process the potential presence of significant fauna will be assessed under the Clearing Principles.

Clearing will be progressive, extending from the cleared land towards to west and south towards adjoining native vegetation. That will result in fauna being able to move into safe areas ahead of excavation and not be cut off.

It is noted that for the western resource the State Forest provides a very large area of local native habitat – *Banksia* Woodland that will not be impacted, enabling fauna to move and also provide long term stable habitat. For the eastern resource the wetland vegetation, combined with the buffer to be planted along the south, will also enable a fauna corridor to be maintained to the State Forest.

On the western resource where the pine plantation exists the pines will be removed first and where possible separately, which will enable any fauna to move towards the adjoining remnant vegetation as outlined above.

On the eastern resource the land is cleared in the east and occupied by scattered to clumped *Xanthorrhoea preissiana* which, because of the monoculture, will have reduced fauna species.

At the end of excavation, the planting of the 25 metre western and southern buffers of local native vegetation – *Banksia* Woodland native vegetation, and retention of the nearby wetland vegetation with appropriate setbacks, will offset for the habitat lost.

The 25 metre buffer will support the intent of the Commonwealth Conservation Advice for the Threatened Ecological Community Listing for *Banksia* Woodland and the State Government listing as a Priority Ecological Community.

The wetlands will be retained and provided with setback buffers of 50 – 150 metres.

Short Range Endemics

The widespread Bassendean sands with *Banksia* Woodland do not have isolated pockets where short range isolated species might occur. The sites adjoin State Forest and corridors to ensure that the site is not isolated.

Stygofauna and Troglifauna

EPA Guidance 54, concentrates on Stygofauna, which occur in caves and “are aquatic subterranean animals, found in a variety of groundwater systems”.

“Troglofauna occur in air chambers in underground caves or smaller voids”.

The only excavation is in sand in which stygofauna or troglofauna are not normally significant because of the lack of cavities.

2.3 Wetlands and Riparian Communities

There are a number of wetlands on site which were first identified in 1996 for the Wetlands of the Swan Coastal Plain Atlas. The wetlands remain on Department of Water Database.

A total of 6 wetlands are nominated on DOW mapping with two resource enhancement wetlands and four drains and drainage lines across pasture. In current mapping the wetlands are combined into general areas of Resource Enhancement and Multiple Use. There are no Conservation Category Wetlands on site. Figure 1 - 9.

In reality there are two wetland areas with the remainder being drainage lines across pasture. The two Resource Enhancement Wetlands were not studied in detail because they lie outside the resource area, but have a perimeter of *Kunzea glabrescens* grading to *Astartea* Thicket with scattered *Melaleuca preissii* and other species.

Wetlands on or near the proposed excavation are sumplands, meaning that they are seasonally inundated according to the mapping.

The actual ground conditions may not now be applicable due to changes to land use and water regime over the past 20 years.

| Category | Explanation | DOW - General Description |
|----------|----------------------|---|
| C | Conservation | Wetlands which support high levels of attributes and functions |
| R | Resource Enhancement | Wetlands which have been partially modified, but still support substantial functions and attributes |
| M | Multiple Use Wetland | Wetlands with few attributes remaining which still provide important wetland functions |

| Wetland | ID Number | Category | Area | Comments | Management |
|---------|-------------|----------|---------------|---|--|
| Dr 28 | 39951650783 | R | 39.4 ha | Low lying pasture with minor scattered shrubs of native vegetation to the north of the sand resources and outside the proposed excavation. Buffer of 100 metres to the eastern excavation. | Excluded from the excavation. Buffers of 50 to 150 metres to the wetland vegetation will be provided. There will be no impact on the vegetation, no drainage changes, no excavations below the water table and no changes to recharge that might impact on the wetlands. |
| 626 | | | Drainage line | A surface drainage line that lies inside native vegetation that grades to wetland vegetation, between the northern ends of the two resource areas. Setback will be > 50 metres from the drainage. | |
| 623 | | | Drainage line | A surface drainage line that lies inside Sr 34. Surrounded by native wetland vegetation. Setback will be > 50 metres from the drainage. | |
| 686 | | | Drainage line | Pasture - devoid of native vegetation. A drain that lies 100 metres north from the eastern resource and drains east to Ellen Brook. | |
| 696 | | | Drainage line | Pasture - devoid of native vegetation. A drain that commences from the end of Sr 34, some 150 metres south east | |

| | | | | | |
|-------|-------------|---|---------|---|--|
| | | | | from the eastern resource and drains east to Ellen Brook. | |
| Sr 34 | 39993650669 | R | 16.2 ha | Well vegetated with wetland species. Lies between the two resource areas and is excluded from excavation. Wetland setback will be 50 metres from the wetland species. | |

The two Resource Enhancement Wetlands were not studied in detail because they lie outside the resource area, but have a perimeter of *Kunzea glabrescens* grading to *Astartea Thicket* with scattered *Melaleuca preissii* and other species.

Buffers of 50 – 150 metres are provided for all wetlands. On the mapping the excavation approaches the vegetation around the wetlands which is *Kunzea glabrescens*. The wetland vegetation is located inside the perimeter of the *Kunzea glabrescens* so that in effect a minimum of 50 metres buffer to the wetland vegetation will be maintained. Where necessary to achieve the minimum of 50 metres the excavation footprint will be reduced accordingly by slight modification as shown on Figure 1 of the main report

There will be no impact on the wetland vegetation, no drainage changes, no excavations below the water table and no changes to recharge that might impact on the wetlands.

For additional information on the management proposed, see Attachment 2 Water Management Plan for information on water movements and other hydrological information.

Groundwater flow is west to east below the proposed floor of the excavations and that flow will be maintained.

There are no Tumulus Spring Communities impacted by this proposal and none within 1.5 kilometres to the south east.

2.4 Clearing

Clearing is controlled under the **Environmental Protection (Clearing of Native Vegetation) Regulations 2004**. These regulations provide for a number of principles against which clearing is assessed.

| | CLEARING PRINCIPLE <i>(Schedule 5 Environmental Protection Amendment Act, 1986)</i> |
|----|---|
| 1a | <i>High Level of diversity</i> |
| 1b | <i>Significant fauna habitat</i> |
| 1c | <i>Necessary to existence of Rare flora</i> |
| 1d | <i>Threatened Ecological Community</i> |
| 1e | <i>Significant area of vegetation in an area that has been extensively cleared</i> |
| 1f | <i>Wetland or watercourse</i> |
| 1g | <i>Land degradation</i> |
| 1h | <i>Impact on adjacent or nearby conservation areas</i> |
| 1i | <i>Deterioration of underground water</i> |
| 1j | <i>Increase flooding</i> |

Although the Clearing Principles consider Biodiversity and other conservation issues, they do not specifically address the issues of the metropolitan area or resource needs. Therefore some additional principles need to be added when considering the need for Basic Raw Materials.

The *Environmental Protection ACT 1986 Section 51O* states that the “CEO may take into account other matters that the “CEO considers relevant” (*EP ACT 1986 Section 51O*). Therefore Section 51O of the *Environmental Protection Act 1986* allows the CEO to take planning matters into account when making clearing decisions, such as a State Planning Policy and community need.

Principles that have to be satisfied are apparently designed for rural regions and do not adequately address the issues of resource needs. Therefore some additional principles need to be added when considering the need for essential Raw Materials. In an attempt to provide a better balance to the clearing principles those principles have been expanded as listed in the tables below.

The issue of clearing native vegetation and fauna habitat cannot therefore be considered separately but must be considered in terms of community needs and end use of the site.

| ADDITIONAL CLEARING PRINCIPLES – EXTRACTIVE INDUSTRIES | |
|---|--|
| Environmental Protection Act 1984 Section 51O | |
| Planning Matters | |
| 1 | <i>Planning Matters</i> |
| Environmental Protection Act 1984 Section 51O | |
| Relevant Matters | |
| 2a | <i>Need for the resource</i> |
| 2b | <i>Classification of the resource and existing approvals</i> |
| 2c | <i>Availability of alternative resources and the impact of their use</i> |
| 2d | <i>Proposed final land use</i> |
| 2e | <i>Offsite Environmental impacts if the resource is not used</i> |
| 2f | <i>Sound environmental management and rehabilitation</i> |

Assessment against the Clearing Principles

| | CLEARING PRINCIPLE <i>(Schedule 5 Environmental Protection Amendment Act, 1986).</i> | COMMENT |
|----|--|--|
| 1a | High Level of diversity | <ul style="list-style-type: none"> The quarry site has been assessed in the flora survey by Landform Research. The eastern resource can be seen to have large areas of cleared pasture with approximately 50% of the resource being covered by a monoculture of <i>Xanthorrhoes preissii</i>. Almost all the native vegetation remaining on site is to be retained. <p><i>The proposed clearing is not at variance with this principle.</i></p> |
| 1b | Significant fauna habitat | <ul style="list-style-type: none"> The predominantly pasture areas will not form significant fauna habitat. Almost all the native vegetation remaining on site is to be retained. The western dune is high with a relatively steep eastern form. The dune is planted to Pinaster Pines of some 20 – 40 years age and no apparent usefulness as timber. The understory and ground cover was cleared to plant the pines and there has been some regeneration under the sparse pines. A flora and vegetation study was completed and showed 33 species of the original <i>Banksia</i> Woodland species. There were no Threatened or Priority species. 33 species is low for <i>Banksia</i> Woodland and probably represents around 10 – 20 % of the original vegetation community. Species richness is 4.8 species /10m² and plant density is 1.26 plants /m² both of which is very low. A 25 metre buffer area of local native vegetation will be established on the west to provide a buffer to the <i>Banksia</i> Woodland that adjoins. The proposed mining of sand does not generate significant amounts of uncontrolled dust. <p><i>The proposed clearing is unlikely to be at variance with this principle.</i></p> |
| 1c | Necessary to existence of Rare flora | <ul style="list-style-type: none"> No Threatened (Declared Rare) or Priority Flora was found. <p><i>The proposed clearing is not at variance with this principle.</i></p> |
| 1d | Threatened Ecological Community | <ul style="list-style-type: none"> No Priority or Threatened Ecological Community occurs on the quarry site. <i>Banksia</i> Woodland occurs on the adjoining State Forest to the west but will not be impacted. <p><i>The proposed clearing is not at variance with this principle.</i></p> |
| 1e | Significant area of vegetation in an area that has been extensively cleared | <ul style="list-style-type: none"> The Gnangara – Moore River State Forest that adjoins to the west has very large areas of <i>Banksia</i> Woodland. <p><i>The proposed clearing is not at variance with this principle.</i></p> |
| 1f | Wetland or watercourse | <ul style="list-style-type: none"> The wetlands are pasture. No wetland will be excavated and all will be provided with a 50 metre setback. <p><i>The proposed clearing not at variance with this principle.</i></p> |
| 1g | Land degradation | <ul style="list-style-type: none"> The excavation will be managed in a manner that does not lead to degradation of the soil and land integrity apart from normal development issues. Landform values return as the excavated surface is revegetated. A key aim of the proposal is to lower the sand ridge to enable better pasture to be grown. Currently the sand ridges grow little vegetation as evidenced by the bare white sand. At the end of excavation when the separation to the groundwater will be 0.5 to 1.0 metres the soil capability will have been improved. |

| | | |
|----|---|---|
| | | <i>The proposed clearing is partially at variance with this principle.</i> |
| 1h | Impact on adjacent or nearby conservation areas | <ul style="list-style-type: none"> There will be no impact on the adjoining <i>Banksia</i> Woodland. It is proposed to form a 25 metre buffer of local native vegetation (<i>Banksia</i> Woodland) along the western and southern boundaries enhancing and protecting the adjoining <i>Banksia</i> Woodland. <p><i>The proposed clearing is not at variance with this principle.</i></p> |
| 1i | Deterioration of underground water | <ul style="list-style-type: none"> Sand excavation is one of the few activities permitted in Public Drinking Water Source Areas and is permitted on the Gngara Mound to the west. Groundwater flow is west to east below the base of the proposed excavation. A separation of 0.5 – 1.0 metres will be provided, in line with the DOW South West Guideline for quarries. The excavation has been designed not to impact on the groundwater elevation, flow or direction. See Attachment 2 - Water Management Plan. <p><i>The proposed clearing is not at variance with this principle.</i></p> |
| 1j | Increase flooding | <ul style="list-style-type: none"> The sand ridge sits above the low elevation soils which will not be altered. There will be no potential for increases in flooding which will continue to depend on the amount and distribution of rainfall. The proposed excavations are designed to have no observable impact on water elevations. There is no evidence of the access roads impacting on water regimes, flooding or surrounding vegetation. <p><i>The proposed clearing is not at variance with this principle.</i></p> |

| ADDITIONAL CLEARING PRINCIPLES – EXTRACTIVE INDUSTRIES | | COMMENT |
|--|--|---|
| Environmental Protection Act 1984 Section 510 | | |
| Planning Matters | | |
| 1 | <i>Planning Matters</i> | <ul style="list-style-type: none"> The identification, protection and use of sand resources is recognised in all Government Policies. The excavation of sand complies with the Shire of Chittering Town Planning Scheme. The excavation will comply with State Planning Policy No 2.4 Basic Raw Materials, and State Planning Policy 2.5, which state that basic raw materials should be taken prior to sterilisation of the area by development. <p><i>The proposed clearing is compatible with this factor.</i></p> |
| Environmental Protection Act 1984 Section 510 | | |
| Relevant Matters | | |
| 2a | <i>Need for the resource</i> | <ul style="list-style-type: none"> The resource will provide reserves of strategically located sand for the construction of this section of Great Northern Highway. It will maximise the use of sand in the local area, to enable greenhouse gases, transport, and other environmental issues associated with alternative resources, to be minimised. The sand from this site will help to keep the prices of local sand at the lowest possible levels, by maintaining small transport distances. This benefits the whole community. <p><i>The proposed clearing is compatible with this factor.</i></p> |
| 2b | <i>Classification of the resource and existing approvals</i> | <ul style="list-style-type: none"> The proposed excavation will support the State need for construction materials. <p><i>The proposed clearing is compatible with this factor.</i></p> |
| 2c | <i>Availability of alternative resources and the impact</i> | <ul style="list-style-type: none"> There are alternative resources but they are further away and will result in greater impact of truck movements on the community |

| | | |
|----|--|--|
| | <i>of their use</i> | <p>and greater greenhouse gas emissions.</p> <ul style="list-style-type: none"> The amount of clearing is small in relation to the large resource that can be extracted and is a very positive part of the proposed excavation. <p><i>The proposed clearing is compatible with this factor.</i></p> |
| 2d | <i>Proposed final land use</i> | <ul style="list-style-type: none"> The proposed final land use is to return the site to improved pasture, buffers of native vegetation which do not currently exist The end result will be an increase in local native vegetation. <p><i>The proposed clearing is compatible with this factor.</i></p> |
| 2e | <i>Offsite Environmental impacts if the resource is not used</i> | <ul style="list-style-type: none"> Not taking the resource will require material to be taken from much further away. Any alternative area may not offer any better environmental impacts. The 25 metre setback of native vegetation along the western and southern boundaries will increase the area of <i>Banksia</i> Woodland native vegetation on site. <p><i>The proposed clearing is compatible with this factor.</i></p> |
| 2f | <i>Sound environmental management and rehabilitation</i> | <ul style="list-style-type: none"> Environmental and rehabilitation management procedures are proposed. Management Plans have been prepared to minimise potential environmental impacts. Pasture will be significantly improved. The 25 metre setback of native vegetation along the western and southern boundaries will increase the area of <i>Banksia</i> Woodland native vegetation on site. <p><i>The proposed clearing is compatible with this factor.</i></p> |

2.5 Dieback Management

Dieback of vegetation is often attributed to *Phytophthora cinamomi* even though there are other *Phytophthora* species and other diseases such as *Armillaria* that can cause dieback like symptoms. Microscopic soil-borne fungi of the genus *Phytophthora* kill a wide range of native plants and can cause severe damage to many vegetation types, particularly those from the families Proteaceae, Epacridaceae, Xanthorrhoeaceae and Myrtaceae.

In most cases dieback is caused by a pathogen which infests the plant and causes it to lose vigour, with leaves dying, and overtime may kill the plant. As such the management of Dieback is essentially related to plant hygiene when coming onto a site and within a site.

There are several guides to the management of Dieback.

- Department of Parks and Wildlife (CALM) Dieback Hygiene Manual 1992 is a practical guide to Dieback management.
- Department of Parks and Wildlife (CALM) Best Practice Guidelines for the Management of *Phytophthora cinamomi*, draft 2004.
- Dieback Working Group 2005, Management of Phytophthora Dieback in Extractive Industries.
- Dieback Working Group, 2000, Managing Phytophthora Dieback, Guidelines for Local Government.

Jarrah Dieback (*Phytophthora cinnamomi*) is widespread throughout this part of the State, but in many cases such as this site the vegetation is not interpretable because of the levels of disturbance.

It is unclear whether dieback or other pathogens already occur on site. With the level of disturbance, previous activities and the degree of disturbance to vegetation it is likely that pathogens already exist on site.

However as part of normal best practice, plant disease management actions will be used, therefore the following general principles are applied to Dieback management.

The aim of dieback management during excavation is to minimise the risk of entry of any additional plant pathogens to the site.

In many ways the management of the site for dieback is similar to that for the management of weeds, and the two management practices are considered together.

There is very little risk of the operations spreading dieback onto vegetation on adjoining properties as there is no access to those properties and they are cleared.

On the other hand good management practices are used as part of the ongoing normal quarry operations.

Not all potential impacts apply to all parts of the proposed quarry operations.

- DPAW and Dieback Working Group 2005, Guidelines will be followed.
- Vehicles are to be prohibited from entering vegetation ahead of excavation, apart from normal travel along made firebreaks and roads for normal security and maintenance activities.
- Dieback diseases are more likely to be transported under moist soil conditions.
- All vehicles and equipment used during land clearing or land reinstatement, will be clean and free from soil or plant material when arriving at site.

- When removing topsoil and clearing, vehicles will run around the perimeter and then push inwards where possible.
- Remnant vegetation ahead of the stage to be excavated is proposed to be quarantined where possible to minimise vehicles from entering.
- No soil and vegetation is to be brought to the site apart from that to be used in rehabilitation and that which is dieback free.
- Plants to be used in rehabilitation are to be certified as from dieback free sources.
- Unwanted access to vegetated areas is discouraged through reduced tracks, signage, site marking and/or fencing as appropriate.
- Excavation vehicles will be restricted to the excavation area apart from clearing land.
- Rehabilitated surfaces will be free draining and not contain wet or waterlogged conditions.
- Illegally dumped rubbish is to be removed promptly.
- When clearing land or firebreaks vehicles are to work from disturbed areas towards the pit; or, in situations where dieback interpretation is not possible, from areas of higher quality vegetation to areas of lower quality vegetation.
- Excavation will occur below ground level to the west, and south towards the better vegetation and adjoining native vegetation, which will enable excavation to occur without impacting on the native vegetation or be in contact with it.
- Roads are to be maintained as free draining and hard surfaced.
- A split operation will be worked where practicable, where the road transport vehicles only access one side of the stockpile or processing area and excavation vehicles operate on the other side of the stockpiles and processing, reducing the risk of contamination from road transport.
- DPAW has determined that material such as sand, taken from deeper in the regolith profile where there is no organic and other plant matter, carries low risk of spreading dieback. (DEC 2004).
- The Weed Management Policy will be complied with.

2.6 Weed Management Plan

Weed Management

Weed management is to be used to minimise impact on site remnant vegetation and on adjoining properties. Good management practices are to be used as part of the ongoing normal quarry operations.

The management of weeds is essentially similar to that for plant diseases. The impact of weeds is really the impact within the local area and the more they are controlled the better. It is desirable that the site does not become a haven for environmental weeds and therefore a management and control program is warranted at all sites.

No environmentally significant or Threatened weeds species were recorded.

Weeds and/or exotic species are only present in the topsoil as plants, parts of plants that can revegetate or seeds. No weed material occurs in the sand below the topsoil and the issue of weeds therefore depends on the receiving environment.

Weeds can be declared under the *Agriculture and Related Resources Protection Act 1976* which requires that Declared Weeds are eradicated. Other weeds are not Declared but may be classified as Environmental Weeds because they are well known for impacting on vegetation.

Generally if the actions taken for Dieback are applied they will also control weeds. Not all potential impacts will apply to this quarry and the main impacts affecting this site are also listed.

Weed management will be used to minimise impact on site and on adjoining properties. Good management practices will be used as part of the ongoing normal quarry operations.

This plan utilises the most appropriate on ground measures to minimise the risk of spread of Declared and Environmental weeds. The information provided here summarises the key points of the on ground management.

There is a significant amount of exotic vegetation on site including pasture and other species that can be classified as weeds to bushland. During the vegetation studies a number of exotic species were recorded. A number of these are weed species.

Weeds are most likely to impact on;

- Disturbed areas such as overburden dumps, topsoil stockpiles.
- Edges of access roads.
- Edges of firebreaks adjacent to surrounding vegetation.
- Locations accessible to the public on which rubbish is dumped.

The main sources of weeds are;

- Naturally occurring in topsoil. There is a very high exotic plant seed load with most of the vegetation being pasture and exotic species.
- Weeds from edge effects from access and local roads.
- Gradual creep of weeds along access roads.
- Rubbish dumped by the public. This is not likely as the resource is set well back from Brand Highway.

- Materials or waste brought to site by employees.
- Soil and seeds from vehicles arriving at site. This often applies to trucks that have carried something else such as grain, or vehicles to be used in earthworks.
- Wind blown seed from surrounding land.
- Birds and other vectors. This is more common than is often given credit for. eg Solanum species.

Weed Management will consist of, but not be limited to, the following actions.

- The Dieback Management Actions will be used to assist weed management.
- Inspections are to be conducted to monitor the presence and introduction of Environmental and Declared Weeds on an annual or more frequent basis. On identification, Declared and significant environmental weeds will either be removed, buried, or sprayed with a herbicide.
- Large weed plants such as Castor Oil plants were not observed but if present are to be periodically grubbed out or spot sprayed with a herbicide.
- Rehabilitation of the final land surface will be to interim revegetation for soil stabilisation. This will not involve the elimination of exotic species, but rather provide an interim cover that stabilises the soil. Weeds that impact on that interim cover will be treated.
- Areas of grass can be sprayed with Fusilade or similar grass selective herbicide if required. This can occur over the top of rehabilitated areas without significantly setting back the broad leaved species.
- All vehicles and equipment to be used during land clearing or land reinstatement, are to be clean and free from soil or plant material when arriving at site.
- No soil and vegetation will be brought to the site apart from that to be used in rehabilitation.
- Plants to be used in rehabilitation are to be free from weeds.
- Vegetated areas ahead of excavation will be quarantined to excavation vehicles until required.
- Unwanted access to vegetated areas is to be discouraged through signage, marking, a lack of tracks, perimeter bunding and/or external fencing.
- Weed affected top soils may need to be taken offsite, used in weed affected areas, buried by 500 mm soil/overburden or taken offsite.
- Illegally dumped rubbish is the major source of weeds and will be removed promptly.
- No weed contaminated or suspect soil or plant material is to be brought onto the site.
- When clearing land or firebreaks vehicles will work in conjunction with dieback principles and push from areas of better vegetation towards areas of lower quality vegetation.
- Weeds are to be sprayed with broad spectrum spray prior to planting or seeding in weed affected soils as required.
- Weed management will work from the least affected areas to most affected.

- Ongoing monitoring of weeds should be undertaken at least annually in autumn, prior to winter rains.

3.0 CLOSURE OBLIGATIONS AND COMMITMENTS

3.1 Geotechnical

The operations will fall under the supervision of the Department of Mines and Petroleum under the *Mines Safety and Inspection Act 1994*. The site will be regularly inspected by DMP for safety and geotechnical stability during the life of the operation and at closure.

The site will be installed with final land surface slopes that are safe, sustainable and compatible with the “*Guidelines on Safety Bund walls around Abandoned Open Pits*”, January 1991.

- **Proposed Final Contours**

The proposed excavation will cut the floor to between 0.5 and 1.0 metres elevation of the winter maximum water table in line with Department of Water *South West Region Guidelines Water Resource Considerations for Extractive Industries*.

- **Rehabilitation**

The end use will be a return of the sand resource area to;

- Improved pasture
- A 25 metre buffer of local native vegetation along the western and southern edges as a buffer to the *Banksia* Woodland.

The completion criteria are outlined below under Rehabilitation

3.2 Closure Inventory

Waste Rock and Tailings

There is no waste material. The only materials remaining on site will be subgrade sand and topsoil.

Potential “at risk” Inventory

| Type | Comment | Treatment |
|---------------------------------|-------------------|--|
| Saline surface water | Not present | Surface water is fresh, like all water from the Gnangara Mound. |
| Saline ground water | Not present | All water on site is fresh. |
| Acidic materials and drainage | Not present | |
| Sodic or dispersive materials | Not present | All water on site is fresh. The soils are sand and are not sodic or dispersive. |
| Asbestos – asbestiform minerals | None present | |
| Radioactive materials | Not present | |
| Metallic or chemical materials | Not present | |
| Tailings storage | Not required | |
| Ablutions waste | Removed from site | Serviced portable facilities or an approved septic system will be used. |
| Dangerous Goods | EXPLOSIVES | Not required |

| | | |
|-------------------------|--|--|
| and Hazardous Materials | | There are normally no hazardous materials used for sand excavation. |
| | FUEL The various plant will be refueled from mobile tanker. None will remain on closure. | Any soil or other materials with drips and spills will be removed offsite to an approved waste site or location. |
| | SERVICE MATERIALS Only minor lubrication will be conducted on site All major servicing will be conducted offsite. None will remain on closure | Any wastes will be collected and removed from site promptly to an approved recycling or waste disposal area. |
| General waste | None will remain on closure | Regularly removed from site to an approved disposal area |

3.3 Post Mining Landuse

The closure planning will be updated from time to time as the excavation progresses forwards. This will include both anticipated costs and procedures.

Land Use Policies

The relevant State and Local land use policies can be summarised from the Shire of Chittering Town Planning Scheme – Agricultural Resource Zone.

4.2.3 Agricultural Resource Zone

4.2.3.1 Objectives:

To preserve productive land suitable for grazing, cropping and intensive horticulture and other compatible productive rural uses in a sustainable manner;

To protect the landform and landscape values of the district against despoliation and land degradation;

To encourage intensive agriculture and associated tourist facilities, where appropriate;

To allow for the extraction of basic raw materials where it is environmentally and socially acceptable.

The proposed excavation will comply with the Shire of Chittering Town Planning Scheme;

- Pasture will be improved
- There will be minimal vegetation to be cleared.
- Additional native vegetation will be provided
- The sand resource will be able to be taken reducing community impacts.

- The use of the sand will minimise impacts on the community by taking sand close to the development, minimizing cost and environmental impacts.

The operations and the proposed closure are designed to comply with the relevant policies.

End Use

The floor of the pit will be lowered to 0.5 to 1.0 metres above the highest known water table to enable better soil moisture in summer and better pasture growth for continued agricultural production. This is in line with *Department of Water South West Region Guideline for Extractive Industries*, which is more applicable as the end use will be to agricultural activities and pasture.

The sand resource and natural soils are leached white sand over brown or yellow sand across most of the excavation footprint. The more leached sand will be removed from the sand ridges, increasing the capability of the rehabilitated soils to retain moisture and phosphorus.

By lowering the pasture land surface, capillary action will occur and the pasture will be able to gain soil moisture into summer. Capillary action allows for rises of soil moisture by 300 – 500 mm and, with root depth considered, land formed 0.5 to 1.0 metres above the groundwater will enable pasture to grow through summer, therefore providing significantly improved agricultural values.

The end use is improved grazing pasture with around 70 hectares of grazing land to be significantly improved by raising the available soil moisture and capability to hold nutrients and water.

The proposed drainage will not alter the groundwater entering Lots 2233 or 2238 or the amount of recharge from rainfall that occurs on site, leaving the quantities of water available for irrigation through summer.

Measurements of the water table will be completed using the on site water sumps and piezometres installed in the floor during excavation.

Concept final batter slopes and a contour plan are attached.

Final Contours

The end land surface will be in accordance with the safety considerations of the *Mines Safety and Inspection Act 1995* and the requirements and guidelines of the Department of Mines and Petroleum; for example *Guidelines on Safety Bund Walls Around Abandoned Open Pits 1991*.

The depth of excavation will be 1 to 5 metres. The floor will be flat to gently sloping at 1 : 5 to 1 : 10 vertical to horizontal to enable a productive agricultural end land use.

The floor of the pit will be lowered to 0.5 to 1.0 metres above the highest water table consistent with *Department of Water South West Region Guideline for Extractive Industries*.

By dropping the separation of the land surface to 0.5 to 1.0 metres above the highest known water table, the elevation will be between 59.5 to 60.0 metres AHD in the east rising to 62.5 – 63.0 metres AHD in the west. See the Existing Contour Plan.

Measurements of the water table will be completed using the on site water monitoring bores and additional piezometres installed in the floor during excavation, comparisons to the measurements collected in September 2016 and the geomorphology. The low lying non sand ridge areas are already generally at 0.5 to 1.0 metres above the winter water table and the excavated areas will be compatible with those elevations.

Some of the existing lower lying areas are in part classified as wetlands by Department of Water Mapping. These are almost totally cleared to pasture and have no wetland species on them and no native vegetation.

The final land surface will be brought into line with those nominated wetlands which will not be impacted but will end up being enlarged.

Concept final batter slopes and a contour plan are attached. See the contour plans and sections. Figures 7 – 10.

3.4 Revegetation Considerations and Closure Objectives

- The extraction of sand is seen as an interim use prior to reconstruction to agricultural land use.
- The extraction of sand is predominantly for the Great Northern Highway re-alignment and to provide improved soil capability on the grazing land. Some sand may be available for other projects
- The site is to be reformed to pasture with additional planting of local native vegetation as illustrated in the figures.
- Rehabilitation will contain Dieback and Weed Management in addition to monitoring and replanting failed areas.
- Appropriate topsoil management is seen to be an important element in achieving successful rehabilitation and pasture re-establishment on the restored surface.
- Rehabilitation will progressively follow mining, with completed areas of the excavation being revegetated as soon as practicable.
- Rehabilitation is to take place during the first winter months to minimise compaction effects.
- To offset the removal of a small portion of the native vegetation a 25 metre wide buffer of local native species, predominantly trees and shrubs, is to be provided along the western and southern boundaries as a set back and buffer to the *Banksia* Woodland remaining at that location.
- Corridors of native vegetation will be retained.

For the native vegetation areas, a most important aspect when revegetating to local native vegetation is that the planting and seeding must be completed within the first year of placement of the topsoil, and that planting in compacted ground reduces the success greatly.

In those areas, if they planted to local native species, the planting of too many trees without shrubs can also lead to many deaths and thinning of the visual screen, as the plants grow or are subject to drought stress.

The methods of revegetation which have proved successful on other sites will be used.

A definitive time for seeding and the planting of tube stock should not be prescribed, but rather a commitment to establish the vegetation within the first autumn/winter following placement of the overburden/topsoil.

Seeding and planting is undertaken at the most suitable time and can vary greatly depending on individual site conditions and the season. For example planting tube plants early in a dry winter year can lead to their probable failure because of a lack of early rains. Seeding with heat treated seed is not normally suitable for late summer, but scarified seed can be spread in late summer. North facing banks are planted earlier than south facing banks, which are better planted in August. All seeds are now subjected to smoke pre-treatment.

3.5 Completion Criteria

The aim of the rehabilitation program is to form improved pasture.

- Pasture will be improved and will provide a self sustaining cover of pasture on the floor of the pit.
- There will be minimal vegetation to be cleared.
- Additional native vegetation will be provided as a 25 metre wide buffer strip along the western and southern boundaries. Planting ratio of 1 000 trees - taller shrubs per hectare.
- The excavated surface will be a flat to gently sloping floor at 1 : 5 to 1 : 10 vertical to horizontal to enable a productive agricultural end land use at 0.5 to 1.0 metres above the highest winter water table
- The post-mining landscape should be stable with a minimum of wind erosion.
- The end land form should provide for the protection of the local groundwater resource in terms of both quality and quantity.
- Achieve weed species at levels not likely to threaten the native species on batter slopes.
- Depending on the success of rehabilitation, evolving community standards, and new research, the completion criteria may be adjusted to reflect emerging trends and also adjusted in terms of cover and species richness, depending on the results achieved and emerging technologies or techniques.

3.6 Closure Implementation

3.6.1 Closure of any ground under Rehabilitation

The closure planning will be updated from time to time as the excavation progresses forwards. This will include both anticipated costs and procedures.

The following procedures will be used for final closure and rehabilitation.

The closure of completed areas of the operations will be progressive with closure of all remaining ground at the end of operations.

Maintenance and monitoring will be conducted until completion criteria is met.

Unexpected or early closure will be completed in the same way as permanent closure below but the full rehabilitation will be completed as one operation.

Progressive Closure of completed Stages of the Pit

| Completion Criteria | Activity |
|--|---|
| | <i>To be completed as soon as site activities have been completed on any area and that area will not be required for future operations.</i> |
| <ul style="list-style-type: none"> • All conditions of approval from any agency will be complied with. | <p>Prior to undertaking permanent closure.</p> <ul style="list-style-type: none"> • Review the latest documentation and assess compliance requirements. • Design the rehabilitation to comply with, and be able to achieve the completion criteria and commitments. • Compile an audit table of all conditions and commitments that relate to closure and conduct an audit of those items upon the completion of each stage of rehabilitation and annually until sign off. • Visually audit against all conditions. |
| <ul style="list-style-type: none"> • No non natural structures will be retained on site. • All hardstand and road making materials and non natural inert materials are to be removed or buried. • All non inert materials are to be removed from site. • All ground once occupied by structures are deep ripped and soils reconstructed. | <p>Prior to earthworks and rehabilitation;</p> <ul style="list-style-type: none"> • Remove any plant or non natural materials and structures. • Remove all hydrocarbons and other fluids. • Audit of completed ground, to verify compliance. • Remove all non inert products. • Some concrete and other inert products may be removed or buried at depth and covered by overburden. |
| <ul style="list-style-type: none"> • Faces and the landform are to comply with DMP Guidelines and be safe and stable for the long term. • The land surface is to have a stepped | <p>Prior to rehabilitation;</p> <ul style="list-style-type: none"> • Complete activities to make the site safe. • Ensure that the batters are formed to comply with the requirements. • Ensure the floor is completed and formed to the proposed final contours. • Match the landform to the adjoining excavated and non excavated surfaces. • Deep rip the floors and batter slopes along contour. • Spread the overburden followed by topsoil. |

| | |
|---|---|
| <p>landform with some rocky outcrops and similar to the natural form.</p> | <ul style="list-style-type: none"> • Use weed treatment and dieback principles as required. • Spread any local native vegetation removed from ahead of excavation. • Provide fences, bunding and warning signs above faces as required. • Provide locked gates or access restraints as required. • Audit of completed ground, to verify compliance. • Visual observations of the landforms. |
| <ul style="list-style-type: none"> • Slopes are to drain to detention basins to allow water to settle and soak into the ground. | <p>Prior to rehabilitation and during audits;</p> <ul style="list-style-type: none"> • Inspect batter slopes, access points, pools and other features and inspect drainage and provide infiltration areas as necessary. • Form small internal sumps and detention basins to ensure all water is retained on site. • Visual observations of the landforms. |
| <ul style="list-style-type: none"> • Slopes and excavated areas are to be stable and free from erosion. | <p>Prior to rehabilitation and during audits;</p> <ul style="list-style-type: none"> • Inspect all areas and ensure the land surfaces and access points, are stable to erosion from wind and water. • Check the slope angles for compliance. • Visual observations of the landforms. |
| <ul style="list-style-type: none"> • All species used in rehabilitation are to be local provenance species suited to local sand soils and sloping sites. | <p>Prior to rehabilitation of vegetated areas;</p> <ul style="list-style-type: none"> • Provide additional topsoil or seed to increase the number and diversity of plants. • Spread vegetation fragments or harvested branches capable of providing seed sources from brushing where available. • Review the vegetation and add seed or additional tube plants as required. |

| | |
|--|---|
| <ul style="list-style-type: none"> Habitat values that are capable of increasing with time, measured by soil development, soil litter increases, increased plant matter, cover, vegetation, structure and habitat niches. | <p>During rehabilitation;</p> <ul style="list-style-type: none"> Ensure rehabilitation is conducted at a suitable time to achieve success. If timing is not suitable undertake remediation earthworks such as re-ripping. Use Dieback and Weed prevention methods. Collect seeds from native vegetation well in advance and retain for rehabilitation. Complete pre-rehabilitation weed control, normally in autumn. Undertake rehabilitation within the first year following ground preparation (Normally within 6 months). Determine the replanting and seed rates that are likely to achieve the Completion Criteria with an allowance for deaths (Normally 20%). Determine whether plant protection devices are required and install as necessary. Provide additional topsoil or seed to increase the number and diversity of plants. Spread vegetation fragments or harvested branches capable of providing seed sources from brushing. Add additional species as seed for those that do not germinate readily from top soil such as Proteaceous and <i>Eucalyptus</i> species. Conduct an on site audit of completed rehabilitation for species richness, diversity and structure using standard 10 or 100m² plots of rehabilitation and adjoining vegetation. Check for predators such as rabbit and goat impacts and treat accordingly through control, fencing, additional planting or other measures. Conduct audits of the completion criteria upon the completion of each stage of rehabilitation and annually until sign off. Maintain ongoing records. <p style="text-align: center;">Native Vegetation Buffer Belts</p> <ul style="list-style-type: none"> Vegetation will be provided as a 25 metre wide buffer strip along the western and southern boundaries. Planting ratio of 1 000 trees - taller shrubs per hectare. Species richness of 5 species per 100 m² in all areas. <p style="text-align: center;">Pasture</p> <p>Self sustaining pasture of species suitable for cattle or other grazing.</p> |
| <ul style="list-style-type: none"> The vegetation is to include a mixture of species that grow in local, soil substrates and be resilient to fire or readily regenerate following fire. | <p>Prior to and During Rehabilitation;</p> <ul style="list-style-type: none"> Ensure that the species selected and rehabilitation techniques are chosen to provide species that are suitable for the soil conditions and will in time be able to regenerate after fire and become self sustaining. Adjust species and rehabilitation methods to enable the completion criteria to be reached. |
| <ul style="list-style-type: none"> The soils are to be constructed from overburden overlain by topsoil where available, leaf litter, vegetation fragments as available in areas of native vegetation. | <p>Prior to vacating and during annual inspections.</p> <ul style="list-style-type: none"> Applies to the revegetated river banks Conduct an on site audit of completed rehabilitation for species richness, diversity and structure using standard 100m² plots of rehabilitation and adjoining vegetation. Conduct audits of the key indicators upon the completion of each stage of rehabilitation and annually until sign off, using lists and photographic records. Maintain ongoing records. Improve existing rehabilitated areas as necessary using additional seeding, |

| | |
|---|---|
| | <p>tube planting and weed control.</p> <ul style="list-style-type: none"> • Check damage by predators or disease and take remedial action. • Maintain ongoing records. |
| <ul style="list-style-type: none"> • Absence of Declared or Environmental weeds that could compromise the success of revegetation. • Exotic species to be no greater richness or density than adjoining vegetation. | <p>This applies to all areas.</p> <ul style="list-style-type: none"> • Add topsoil or vegetation fragments by brushing and other means or by transferring material from areas being cleared. • Monitor and allow time to naturally develop and transition through initial rehabilitation to a mature habitat. |
| <ul style="list-style-type: none"> • All conditions of approval from any agency will be complied with. | <p>Annually;</p> <ul style="list-style-type: none"> • Remove or spray environmental or declared weeds. • Provide annual inspections at the appropriate time of the year. • Provide annual follow up inspections and treatment at the appropriate time of the year. |

3.6.2 Land Clearing

Tree Removal and plant removal

1. The trees and plants will be progressively removed ahead of each stage of clearing.
2. The loss of vegetation will be compensated for by the planting of many more trees and *Banksia* and native vegetation on the buffers when the site is returned to local native vegetation.
3. Vegetation clearing requires that all topsoil and any overburden is to be recovered as ground is cleared and spread directly onto an area to be rehabilitated or retained for use in rehabilitation. The topsoil is stored separately from the overburden.
4. A Clearing Permit under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* is required under the Regulations for the clearing of the scattered trees, and will be applied for.
5. None of the Clearing Principles are likely to be significantly at variance with the proposed clearing, excavation and rehabilitation.

Topsoil and Overburden Removal

Clearing and soil management will vary from area to area because of variations in the quality and quantity of top soil and the areas to be rehabilitated.

The aim will be for best practice rehabilitation of each area, although the actual methods could change from year to year or stage to stage. For example clearing of one stage could occur in summer but the next might be required in winter. Similarly the depth of topsoil and overburden will vary as will the extent of dieback within the soil.

6. Vegetation will be cleared ahead of excavation. The vegetation will be pushed into windrows.

7. Topsoil will then be stripped from the area under development and where possible spread directly onto an area to be rehabilitated. This can be undertaken at any time but needs to be balanced against the potential for dieback spread.

Summer clearing can generate dust, and winter clearing can lead to the spread of dieback through water moving spores. Dust is a highly visible issue and it is likely to be easier to manage surface runoff than dust. Therefore it is proposed, where possible, to clear during wetter months using water management procedures to prevent run off. Note that clearing may be dictated by Main Roads time lines for the Great Northern Highway.

8. When stored topsoil is used it may be diluted and mixed with fresh topsoil.
9. The floor of the pit will be internally draining to a basal sump in later stages of excavation.

3.6.3 Land Restoration

The following procedures have been used in the past to restore the disturbed ground whether at the end of excavation, as part of ongoing rehabilitation or during premature closure. In summary the methods are;

- Rehabilitation is to occur as soon as possible following the end of excavation and other activities or as soon as a part of the operation is completed or no longer required.
- Where possible any disturbed areas that are no longer required will be rehabilitated using the methods described above within 12 months of becoming available.
- Runoff will significantly reduce as a result of rehabilitation of the excavated land. The form of the concept final land surface has taken account of the runoff and has been designed to minimise runoff from storm events and therefore manage erosion risk. It also aims to maximise infiltration of smaller rainfall events.

Pit faces – Geotechnical

- The land surface will be formed to the requirements of the *Mines Safety and Inspection Act 1994 and Regulations 1995* as a final land surface.
- All structures, plant and any other foreign materials will be removed from site.
- The pit will be prepared by pushing down, reducing and backfilling the active face with a loader, scraper or bulldozer.
- Steep slopes will be pushed down, although the batter slopes that form the level areas will be retained for future use.
- Overburden followed by topsoil will be spread directly from an area being cleared or from overburden stockpiles and placed over the land surface being restored. Any vegetation fragments will be either spread on top of the topsoil or spread with the topsoil.
- The backfilled materials will be track rolled by bulldozer where possible and covered by 600 mm of overburden to ensure that all inert and non – natural materials are covered. Some parts of faces and boulders will be retained to provide fauna habitat.

Hardstand, roads and other such areas

- All buildings, plant and any other foreign materials will be removed from site.
- Roadbase, hardstand and any other inert materials left over from the site operations will be scraped and picked up and will be used to backfill the pit faces. Note that the access road will be retained for future access.
- Steep or vertical slopes will be pushed down, although the batter slopes that form the level areas will be retained for future use.
- The floor will be deep ripped and formed at slopes of 1 : 5 to 1 : 10 vertical to horizontal.
- A minimum of 100 mm of topsoil will be spread over the surface where available to provide a substrate for agriculture.
- Where possible, overburden, followed by topsoil and recovered vegetation, will be spread directly from an area being cleared to an area being rehabilitated to minimise the potential for seed loss.
- Overburden from areas of thin soil, which contains topsoil and included seed load, will be spread across the surface.
- Where separate topsoil is available it will be spread across the overburden.
- Topsoil will be spread evenly across the rehabilitated areas in summer or early autumn prior to the winter rains. Stored topsoil rapidly loses seed viability and could be expected to be less than 50% effective if stored through one winter.

Stormwater Management

- As the excavation is in sand no particular stormwater management will be required. Any water that can flow will move or seep to the lower lying pasture areas that will not be impacted.

3.6.4 Revegetation

Vegetation Establishment

- ***Pre-Planting/Seeding Weed Control***

Pre-seeding weed control is only likely to be required where topsoils are used that contain weed species such as in the existing parkland pasture areas.

If required, this is normally only conducted after overburden and topsoil have been spread and any seeds have been allowed to germinate. Broadscale weed treatment can be detrimental to the germination and growth of native species but may be required if the weed load is to be reduced.

In May, after the first autumn rains, check for grass germination. Where grass has the potential to inhibit rehabilitation, such as areas to be returned to native vegetation, use a licensed contractor to spray with Fusillade or other suitable herbicide. In areas of parkland pasture, grass cover is desirable.

1. Any weeds likely to significantly impact on the rehabilitation will be sprayed with Roundup or similar herbicide or grubbed out, depending on the species involved. Weed affected topsoil and overburden will be buried. The Weed Management Plan will form the basis of weed treatment. Depending on the nature of the planting substrate, a broad spectrum spraying program may be used. In areas where grass only is a potential problem, grass specific sprays will be used. In some areas where topsoil from cleared native vegetation is available no spraying may be required.
2. See Weed and Dieback Management Procedures (following).

- **Western Vegetation Belt**

The trees and shrubs will be established at two rows 3 metres apart between the rows and 3 metres between the trees, planted alternately to ultimately achieve a plant density of 1 000 stems per hectare.

Planting will be in ripped lines with the pasture killed to remove competition.

The species to be used for the 25 metre wide vegetation buffer to the west will be fast growing local native species such as listed below. Others may be substituted.

| | |
|------------------|---|
| Tree | T |
| Shrub | S |
| Wet site species | W |

| | |
|---|----|
| <i>Allocasuarina fraseriana</i> | T |
| <i>Corymbia (Eucalyptus) calophylla</i> | T |
| <i>Eucalyptus marginata (sandplain)</i> | T |
| <i>Eucalyptus tottiana</i> | T |
| <i>Banksia attenuata</i> | ST |
| <i>Banksia menziesii</i> | ST |
| <i>Banksia ilicifolia</i> | ST |
| <i>Actinostrobus pyramidalis</i> | S |
| <i>Adenanthos cygnorum</i> | S |
| <i>Acacia pulchella</i> | S |
| <i>Acacia saligna</i> | S |
| <i>Calothamnus quadrifidus</i> | S |
| <i>Calistemon phonicus</i> | SW |
| <i>Eremaea pauciflora</i> | S |
| <i>Dianella divaricata</i> | S |
| <i>Hakea prostrata</i> | S |
| <i>Hakea trifurcata</i> | S |
| <i>Kunzea grabrescens</i> | S |
| <i>Jacksonia furcellata</i> | S |
| <i>Jacksonia sternbergiana</i> | S |
| <i>Stirlingia latifolia</i> | S |
| <i>Viminaria juncea</i> | SW |

- **Excavated Areas**

1. The preferred method of revegetation is to use the pasture seed from existing topsoil on pasture areas. However this may be deficient and additional seed is likely to be required.
2. Topsoil will be spread to increase the total organic carbon fraction, improving soil properties such as resistance to water and wind erosion and moisture retention.

3. Topsoil provides a useful source of seed for rehabilitation when the correct handling of the topsoil is used, stripped and replaced dry (autumn direct return).
4. However if sufficient seed is not available or does not germinate then additional seed will be added. The establishment of pasture, including the selection of the pasture species is appended to this Management Plan. The documentation is produced by the Department of Agriculture and Food.
5. For pasture land in this situation it is essential that the species are matched to the soil types and rainfall. The location falls into the "High Rainfall Coastal" planting regime with sandy soils. Suitable perennial legumes include Birdsfoot trefoil, Lucerne, Strawberry Clover, and Sulla. Perennial pasture includes Perennial Ryegrass, Phalaris, Cocksfoot, and Summer Active Tall Fescue, Kikuyu and Rhodes Grass. Annual pasture species include Italian Ryegrass, Serradella, subterranean clover.
6. The actual species used will be determined by the individual season, nature of the rainfall in the preceding months and stocking/hay production proposed by the landholder which may change from time to time.
7. Seeding rates are 2 – 5 kg/ha depending on the species used; for example Ryegrass is seeded at 3 kg/ha whereas Rhodes Grass is seeded at 4 kg/ha.
8. Studies have shown that topsoil stripping and placement is best undertaken in summer for maximum germination, but this raises the potential for additional dust generation from the fine humus particles.
9. Any weeds likely to significantly impact on the rehabilitation are to be sprayed with Roundup or similar herbicide or grubbed out, depending on the species involved. Pasture species may need to be sprayed with a grass specific spray such as Fusilade or a broad spectrum spray such as Glyphosate to reduce the competition with the revegetation.
10. If sufficient vegetation does not germinate from the respread top soil, the area will be seeded in early Autumn with a mixture of pasture species. The species will be selected on advice from a consultant or the Department of Agriculture and Food.

Fertiliser

1. Fertiliser is not always required and will add nutrients to the ground water. If used a fertiliser containing low nitrogen, low phosphorous and potassium, and trace elements, is recommended to be spread at rates of up to 100 kg/hectare, applied to rehabilitation areas in the year of planting.
2. Further investigation will be needed to determine suitable rates and the timing of fertilisation. It may be possible to integrate seed dispersal and fertilisation into a single pass. The fertiliser will need to supply macro-nutrients, phosphorus, nitrogen and potassium, and other micro-nutrients.

Irrigation

1. Experience by Landform Research has shown that, when completed well, there is no need for irrigation of the rehabilitation. It is cheaper to use additional seed than to install irrigation.

Erosion Control

1. Soil erosion occurs when soil is exposed and disturbed by wind or water. Erosion involves soil particles being detached from areas not adequately protected by vegetation, and moved down-slope or blown by the wind.
2. The soils are very permeable and runoff is normally minimal unless surface materials become non-wetting. Even so experience shows that there is minimal non wetting and surface particle movement under such conditions.
3. Water erosion on the batter slopes can be avoided by the permeability of the materials and by leaving the surface soft, rough and undulating, with the undulations running along contour. The final machinery run should be along contour and not down slope. No evidence of current erosion is present in the excavated faces.
4. Wind erosion will be controlled by rehabilitating the disturbed ground as soon as practicable and leaving the soils between 0.5 and 1.0 metres above the maximum groundwater that results from the partial drainage.
5. If wind erosion and soil stability become an issue measures will be taken to stabilise the soils. These could include but not be limited to, fence wind breaks, spray mulching, cover crops, interim native vegetation or spreading mulch and vegetation.
6. For rehabilitation areas, revegetation will take place as soon as possible following landform and soil reconstruction.
7. Cleared vegetation will be transferred from an area being cleared, to protect against erosion, assist with habitat creation and provide a seed source.
8. Control of wind erosion potential will be assisted by spreading brush and vegetation across the topsoil on the batter slopes and reconstructed soils where local native vegetation is to be established.

Monitoring

The revegetation will be monitored at least twice annually, that is before and at the end of each excavation campaign, to determine what work needs to be undertaken and to ensure that the required work is completed.

A weed monitoring and management program will be continued annually during operations and following closure to identify and control significant environmental weeds.

The revegetation will be monitored for 3 years post closure of each part of the pit or until completion criteria are achieved.

1. During late summer an assessment of the success of the rehabilitation will be made to determine the rehabilitation requirements for the following winter. This will be undertaken to the completion criteria listed above.
2. Monitoring will include visual assessments to determine the success of the rehabilitation and restoration, as follows;
 - pasture density
 - species diversity
 - plant growth
 - plant deaths
 - regeneration

- insect attack and disease
 - weed infestation
3. As necessary steps will be taken to correct any deficiencies in the vegetation.
 4. Rehabilitation of each stage will be monitored for a period of three years to ensure that the revegetation meets the completion criteria of providing self sustaining indigenous shrub vegetation.

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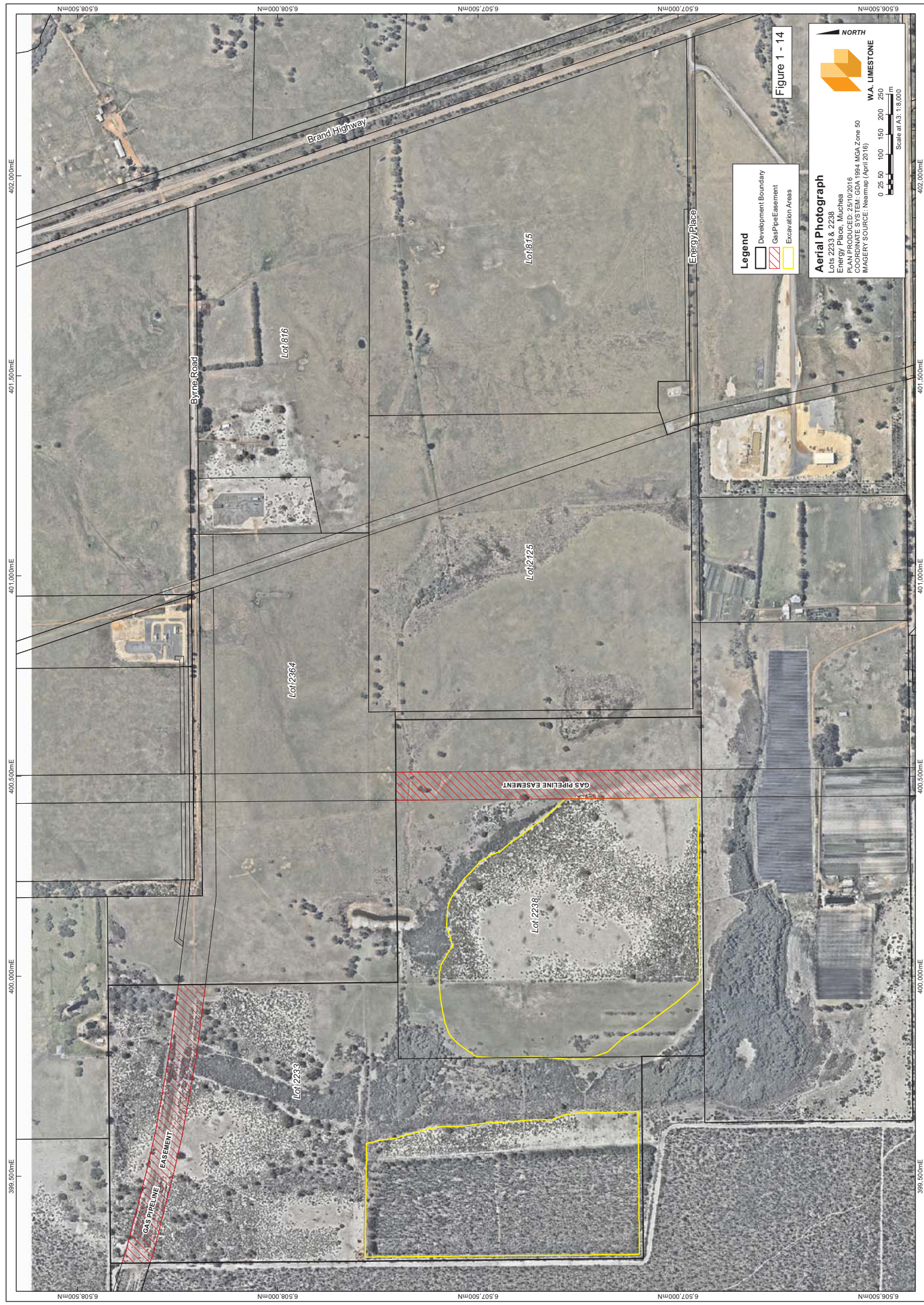


Figure 1 - 14

Aerial Photograph
 Lots 2233 & 2238
 Energy Place, Muchea
 PLAN PRODUCED: 25/10/2016
 COORDINATE SYSTEM: GDA 1984 MGA Zone 50
 IMAGERY SOURCE: Neatmap (April 2016)

Legend

- Development Boundary
- Gas Pipe Easement
- Excavation Areas

Scale at A3: 1:8,000

0 25 50 100 150 200 250 m

NORTH

W.A. LIMESTONE

VEGETATION COMMUNITIES AND CONDITION

PP Pine Plantation in Degraded condition over Completely Degraded to Degraded Understorey with patches of Good understorey

KgT *Kunzea glabrescens* Regrowth Thicket in generally Degraded Condition with some associated species

XpR *Xanthorrhoea preissii* Regrowth monoculture in Completely Degraded Condition with some minor patches in Degraded Condition.

WtT Wetland Thicket with typical wetland species such as *Melaleuca preissiana* and associated wetland species.

Figure 1 - 15

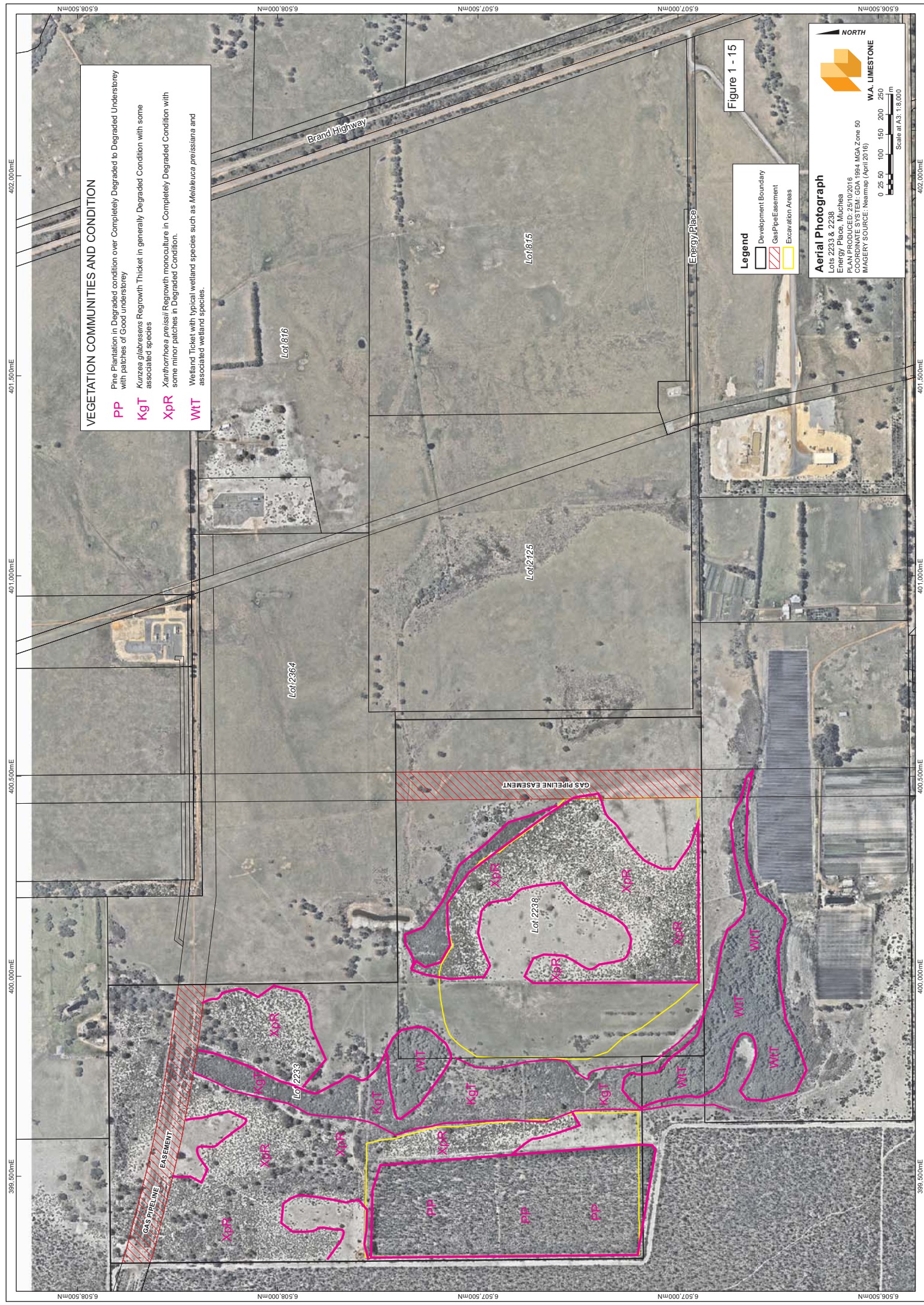
Legend

- Development Boundary
- Gas Pipe Easement
- Excavation Areas

Aerial Photograph

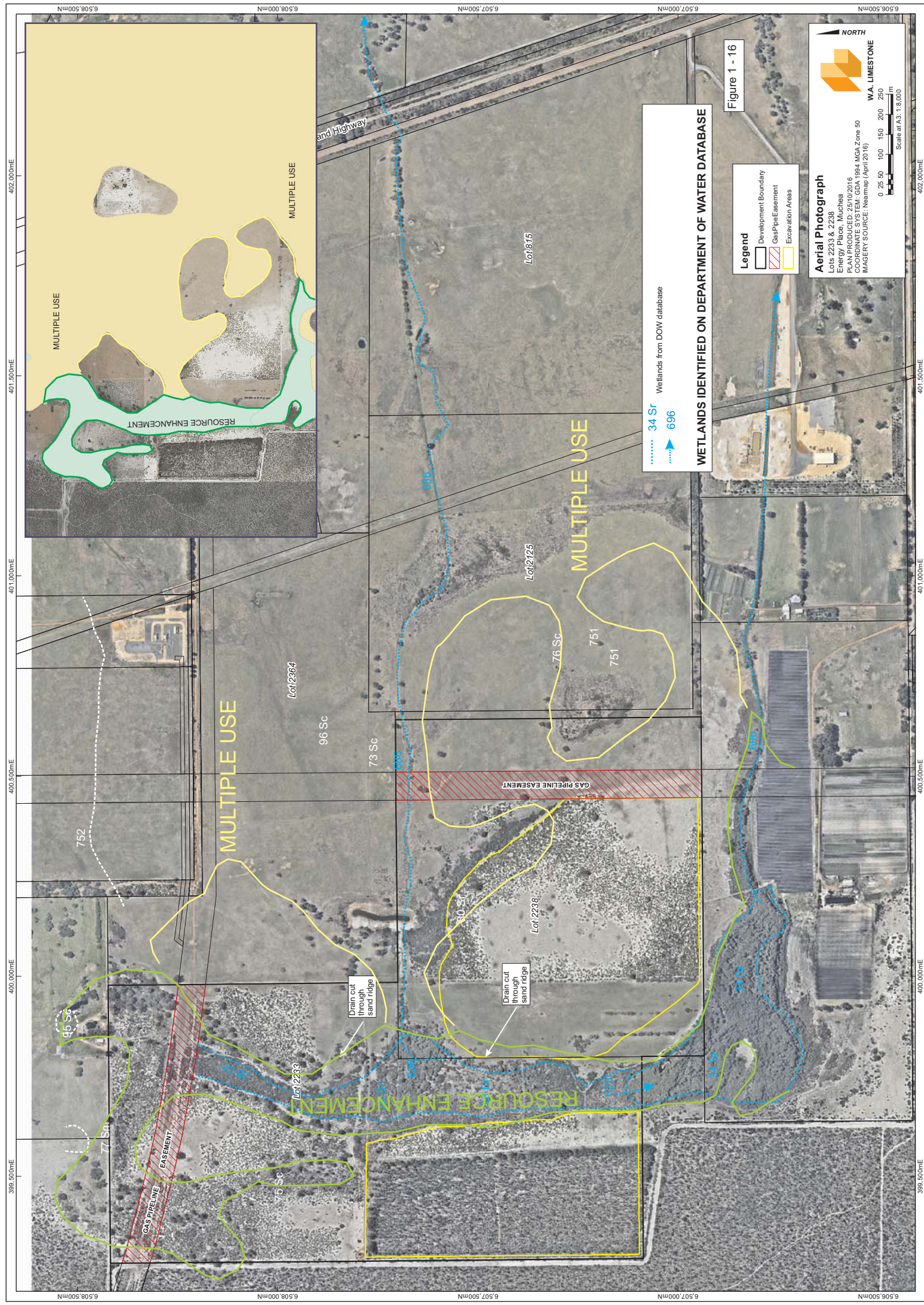
Lots 2233 & 2238
 Energy Place, Muchea
 PLAN PRODUCED: 25/10/2016
 COORDINATE SYSTEM: GDA 1984 MGA Zone 50
 IMAGERY SOURCE: Neatmap (April 2016)

Scale at A3: 1:8,000



6,508,500mN 6,508,000mN 6,507,500mN 6,507,000mN 6,506,500mN

402,000mE 401,500mE 401,000mE 400,500mE 400,000mE 399,500mE



6.506,500mE 6.508,000mE 6.507,500mE 6.507,000mE 6.506,500mE
 402,000mE 401,500mE 401,000mE 400,500mE 400,000mE 399,500mE

6.506,500mE 6.508,000mE 6.507,500mE 6.507,000mE 6.506,500mE
 402,000mE 401,500mE 401,000mE 400,500mE 400,000mE 399,500mE

Figure 1 - 16

Legend

- Development Boundary
- Gas Pipe Easement
- Excavation Areas

WETLANDS IDENTIFIED ON DEPARTMENT OF WATER DATABASE

- 34 Sf Wetlands from DOW database
- 696

Aerial Photograph
 Lots 2233 & 2238
 Energy Place, Muchea
 PLAN PRODUCED: 25/10/2016
 COORDINATE SYSTEM: GDA 1984 MGA Zone 50
 IMAGERY SOURCE: Neatmap (April 2016)

W.A. LIMESTONE

Scale at A3: 1:8,000

MULTIPLE USE

MULTIPLE USE

RESOURCE ENHANCEMENT

RESOURCE ENHANCEMENT

GAS PIPELINE EASEMENT

GAS PIPELINE EASEMENT

Drain cut through sand ridge

Drain cut through sand ridge

MULTIPLE USE

MULTIPLE USE

Lot 2364

Lot 2725

Lot 2238

Lot 2233

Lot 2339

Lot 815

76 Sc

751

751

96 Sc

73 Sc

80 Sc

96 Sc

77 Sc

75 Sc

74 Sc

73 Sc

72 Sc

71 Sc

70 Sc

69 Sc

68 Sc

67 Sc

66 Sc

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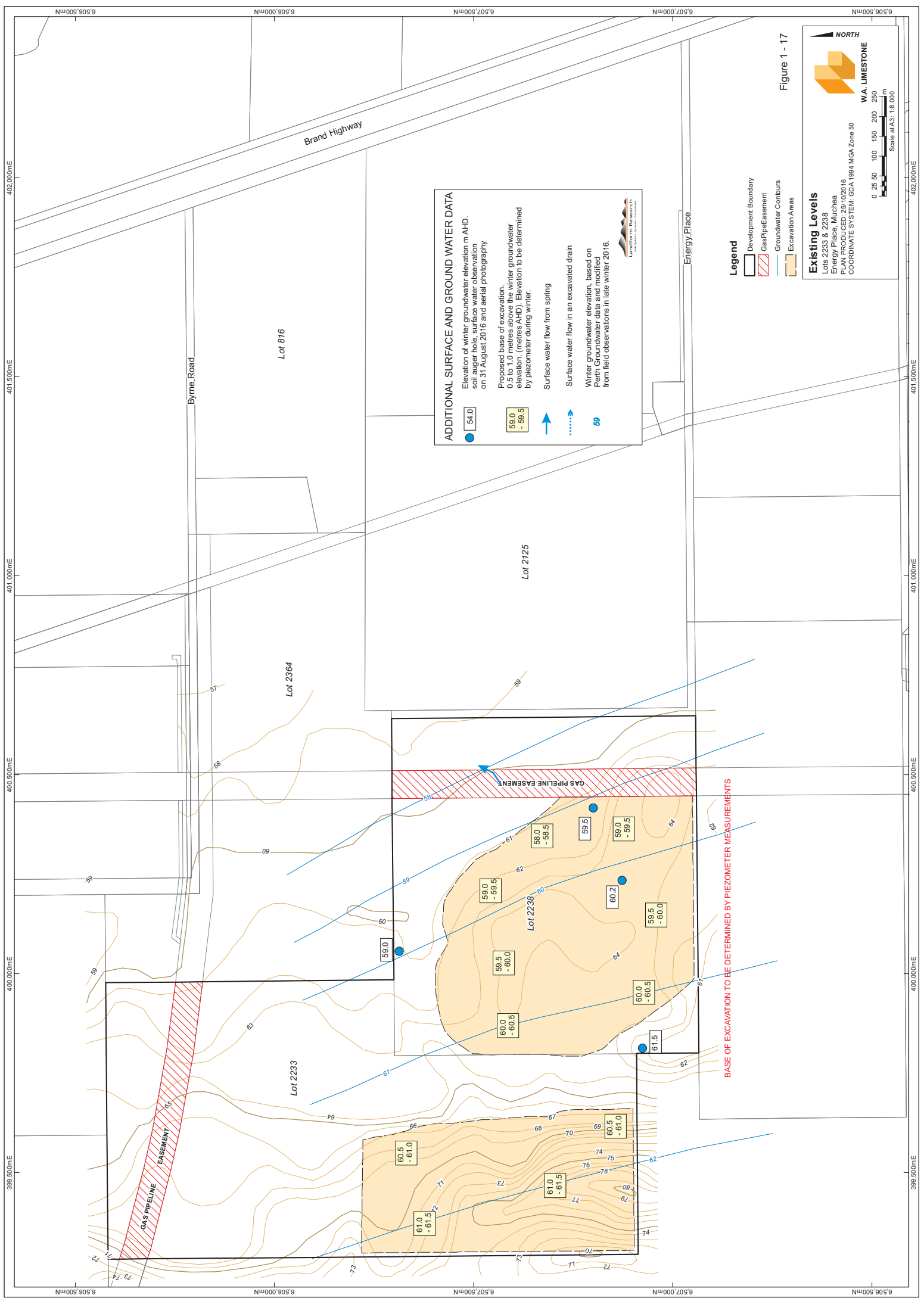
5 Sc

4 Sc

3 Sc

2 Sc

1 Sc



ADDITIONAL SURFACE AND GROUND WATER DATA

Elevation of winter groundwater elevation in AHD.
 soaker flow surface water observation
 on 31 August 2016 and aerial photography

Proposed base of excavation
 0.5 to 1.0 metres above the winter groundwater
 elevation. (metres AHD). Elevation to be determined
 by piezometer during winter.

Surface water flow from spring
 Surface water flow in an excavated drain
 Winter groundwater elevation, based on
 piezometer data and modified
 from field observations in late winter 2016.

54.0
 59.0 - 59.5
 59.5
 58.0
 60.0

Surface water flow from spring
 Surface water flow in an excavated drain
 Winter groundwater elevation, based on piezometer data and modified from field observations in late winter 2016.

Development Boundary
 Gas Pipeline Easement
 Groundwater Contours
 Excavation Areas

Existing Levels
 Lots 2233 & 2238
 Energy Place, Muchea
 Lot 2238
 COORDINATE SYSTEM: GDA 1984 MGA Zone 50
 Scale at A3: 1:8,000

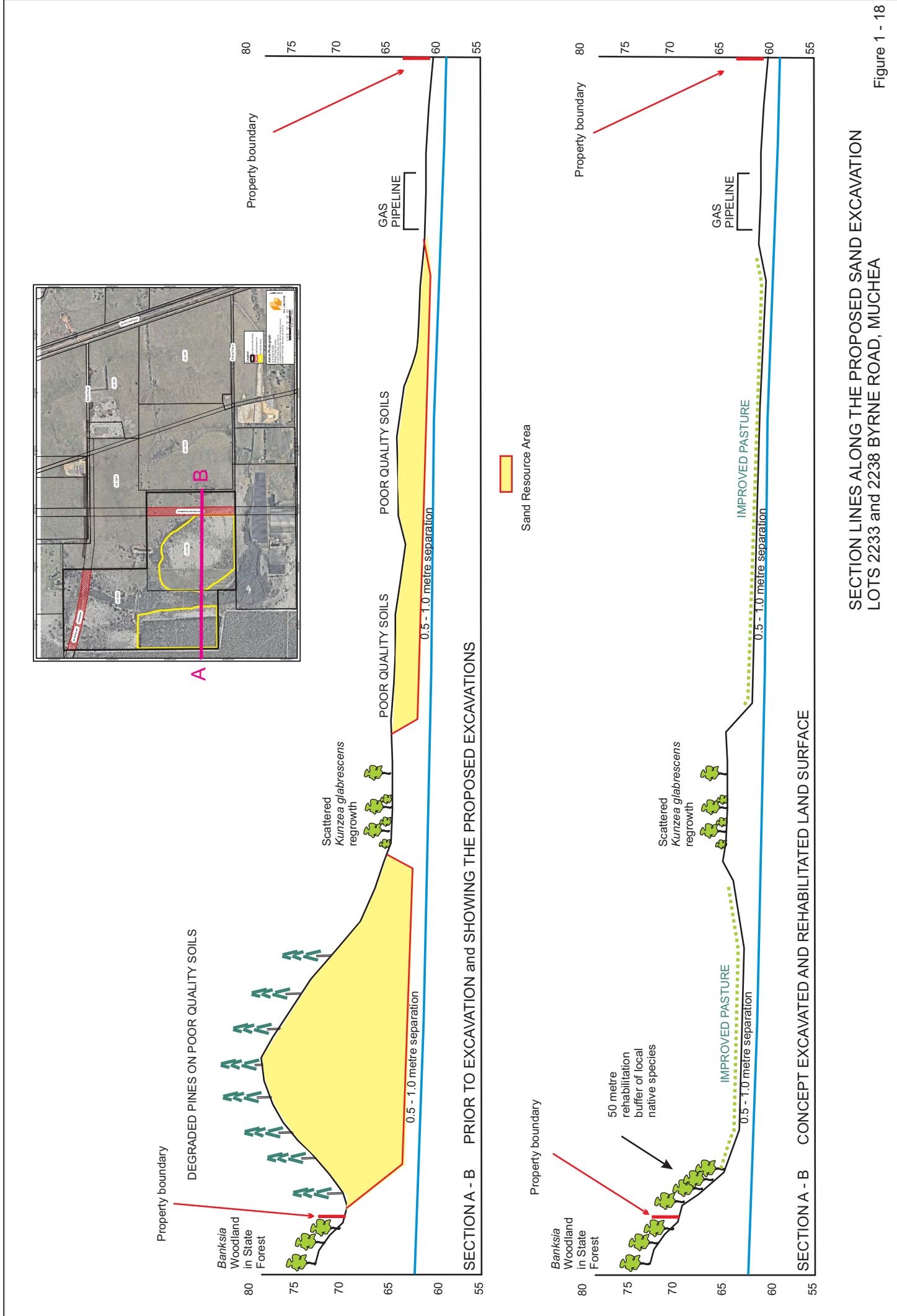
Legend

Figure 1 - 17

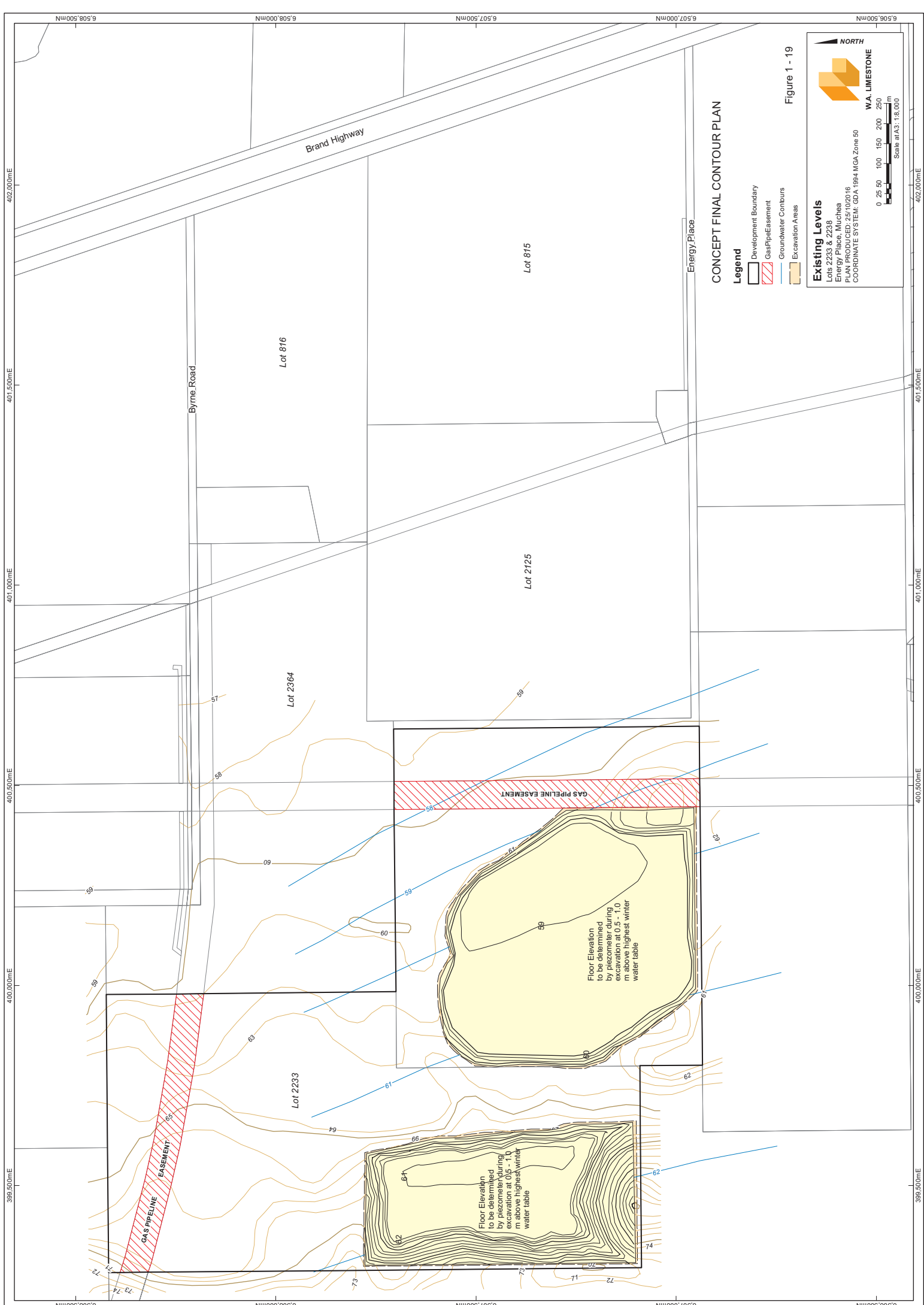
W.A. LIMESTONE

Scale at A3: 1:8,000
 0 25 50 100 150 200 250 m

BASE OF EXCAVATION TO BE DETERMINED BY PIEZOMETER MEASUREMENTS



SECTION LINES ALONG THE PROPOSED SAND EXCAVATION
 LOTS 2233 and 2238 BYRNE ROAD, MUCHEA



CONCEPT FINAL CONTOUR PLAN

- Legend**
- Development Boundary
 - Gas Pipeline Easement
 - Groundwater Contours
 - Excavation Areas

Existing Levels
 Lots 2233 & 2238
 Energy Place, Muchea
 Local Planning Scheme No. 16
 COORDINATE SYSTEM: GDA 1984 MGA Zone 50

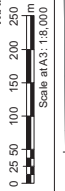


Figure 1 - 19

Species By Area

Specify a user-defined or predefined area to select.

Show optional criteria

Selection Type Predefined User-defined

Circle

Search Radius km

Latitude ° ' "S

Longitude ° ' "E

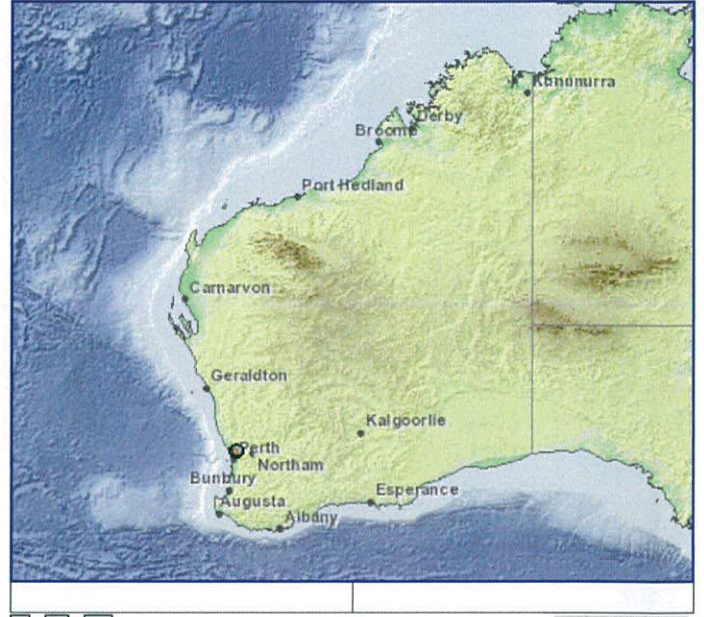
Group Results By

Family

Species Symbol Classification

Default Unique Group By

[Zoom to selected species](#)



Search Results

Method="By Circle"; Centre="115° 56' 00" E,31° 34' 00" S; Buffer=10km; Current Names Only=Yes; Core Datasets Only=Yes; Group By=Family;

| Family | Names | Records |
|------------------|-------|---------|
| Acanthizidae | 6 | 44 |
| Acariformes | 1 | 4 |
| Accipitridae | 6 | 7 |
| Acrobolbaceae | 1 | 2 |
| Actinopodidae | 1 | 1 |
| Agamidae | 2 | 15 |
| Amaranthaceae | 2 | 2 |
| Anarthriaceae | 1 | 4 |
| Anatidae | 9 | 50 |
| Anhingidae | 1 | 2 |
| Apiaceae | 6 | 6 |
| Araceae | 1 | 1 |
| Araliaceae | 3 | 4 |
| Araneidae | 4 | 6 |
| Ardeidae | 6 | 16 |
| Artamidae | 2 | 7 |
| Asparagaceae | 13 | 21 |
| Asteraceae | 20 | 37 |
| Barychelidae | 3 | 4 |
| Bignoniaceae | 1 | 1 |
| Boryaceae | 1 | 1 |
| Bothriuridae | 1 | 2 |
| Bryaceae | 1 | 1 |
| Cacatuidae | 1 | 4 |
| Campanulaceae | 3 | 7 |
| Campephagidae | 1 | 8 |
| Casuariidae | 1 | 1 |
| Casuarinaceae | 4 | 5 |
| Celastraceae | 2 | 2 |
| Centrolepidaceae | 3 | 6 |
| Charadriidae | 2 | 3 |
| Cheluidae | 1 | 1 |
| Chenopodiaceae | 1 | 1 |
| Cladoniaceae | 1 | 1 |
| Colchicaceae | 2 | 4 |
| Columbidae | 3 | 10 |
| Corvidae | 1 | 21 |
| Cracticidae | 3 | 28 |
| Crassulaceae | 3 | 4 |
| Cuculidae | 3 | 7 |
| Cupressaceae | 1 | 4 |
| Cyperaceae | 19 | 30 |
| Dasyopogonaceae | 1 | 3 |
| Dasyuridae | 2 | 6 |
| Dennstaedtiaceae | 1 | 1 |
| Dicaeidae | 1 | 1 |
| Dicruridae | 3 | 41 |
| Dilleniaceae | 10 | 24 |
| Diplodactylidae | 2 | 5 |
| Droseraceae | 15 | 24 |
| Elaeocarpaceae | 2 | 5 |
| Elmidae | 2 | 22 |

| | | |
|-------------------|-----|------|
| Elaeagnaceae | 0 | 23 |
| Ericaceae | 22 | 49 |
| Euphorbiaceae | 2 | 2 |
| Fabaceae | 49 | 106 |
| Falconidae | 3 | 7 |
| Frankeniaceae | 1 | 1 |
| Galaxiidae | 1 | 2 |
| Gekkonidae | 1 | 2 |
| Gentianaceae | 1 | 2 |
| Geraniaceae | 2 | 2 |
| Goodeniaceae | 10 | 15 |
| Haemodoraceae | 19 | 34 |
| Halcyonidae | 2 | 8 |
| Haloragaceae | 3 | 5 |
| Hemerocallidaceae | 6 | 9 |
| Hirundinidae | 2 | 16 |
| Hylidae | 2 | 15 |
| Hyriidae | 1 | 1 |
| Iridaceae | 4 | 8 |
| Julidae | 1 | 1 |
| Juncaceae | 2 | 2 |
| Juncaginaceae | 2 | 2 |
| Lamiaceae | 4 | 6 |
| Lauraceae | 3 | 4 |
| Limnodynastidae | 4 | 58 |
| Loranthaceae | 2 | 3 |
| Lycopodiaceae | 2 | 2 |
| Lycosidae | 2 | 2 |
| Lythraceae | 1 | 1 |
| Maluridae | 2 | 21 |
| Malvaceae | 2 | 2 |
| Meliphagidae | 8 | 55 |
| Menyanthaceae | 2 | 2 |
| Meropidae | 1 | 4 |
| Miturgidae | 1 | 2 |
| Molluginaceae | 1 | 2 |
| Muridae | 3 | 10 |
| Myobatrachidae | 4 | 20 |
| Myrtaceae | 60 | 143 |
| Nemesiidae | 2 | 5 |
| Neosittidae | 1 | 2 |
| Onagraceae | 2 | 2 |
| Orchidaceae | 17 | 25 |
| Orobanchaceae | 1 | 1 |
| Oxalidaceae | 1 | 1 |
| Pachycephalidae | 2 | 16 |
| Parastacidae | 3 | 4 |
| Pardalotidae | 1 | 10 |
| Peramelidae | 1 | 2 |
| Percichthyidae | 1 | 1 |
| Peronosporaceae | 1 | 15 |
| Petroicidae | 2 | 3 |
| Phalacrocoracidae | 4 | 8 |
| Pholcidae | 2 | 3 |
| Phyllanthaceae | 1 | 1 |
| Pittosporaceae | 1 | 1 |
| Plantaginaceae | 2 | 2 |
| Poaceae | 20 | 21 |
| Podicipedidae | 1 | 5 |
| Polygalaceae | 2 | 2 |
| Polygonaceae | 3 | 3 |
| Primulaceae | 2 | 4 |
| Proteaceae | 41 | 160 |
| Psittacidae | 11 | 143 |
| Pygopodidae | 7 | 35 |
| Rallidae | 2 | 3 |
| Ranunculaceae | 1 | 2 |
| Recurvirostridae | 3 | 6 |
| Restionaceae | 8 | 20 |
| Rutaceae | 2 | 3 |
| Santalaceae | 1 | 1 |
| Schizaeaceae | 1 | 1 |
| Scincidae | 12 | 90 |
| Scolopendridae | 3 | 6 |
| Scrophulariaceae | 3 | 4 |
| Selaginellaceae | 1 | 2 |
| Solanaceae | 2 | 2 |
| Sparassidae | 1 | 1 |
| Stiphidiidae | 1 | 1 |
| Stylidiaceae | 24 | 45 |
| Tachyglossidae | 1 | 1 |
| Tamaricaceae | 1 | 1 |
| Tarsipedidae | 1 | 12 |
| Threskiornithidae | 3 | 16 |
| Thymelaeaceae | 2 | 4 |
| Tilletiaceae | 1 | 1 |
| Typhlopidae | 1 | 1 |
| Urodacidae | 2 | 3 |
| Vespertilionidae | 2 | 2 |
| Violaceae | 1 | 1 |
| Vitaceae | 1 | 1 |
| Xanthorrhoeaceae | 1 | 2 |
| Zodariidae | 1 | 1 |
| Zosteropidae | 1 | 13 |
| TOTAL | 646 | 1865 |

Acanthizidae

[Acanthiza epicalis](#) ~~Great-tailed Thornbill, Intermediate Thornbill~~

[Acanthiza chrysorrhoa](#) Yellow-rumped Thornbill

[Acanthiza inornata](#) Western Thornbill

[Gerygone fusca](#) Western Gerygone

[Sericornis frontalis](#) White-browed Scrubwren

[Smicromis brevirostris](#) Weebill

6 names, 44 records

Acariformes

[Acarina sp.](#)

1 names, 4 records

Accipitridae

[Accipiter cirrocephalus](#) Collared Sparrowhawk

[Aquila audax](#) Wedge-tailed Eagle

[Circus approximans](#) Swamp Harrier

[Elanus axillaris](#)

[Elanus caeruleus subsp. axillaris](#) Australian Black-shouldered Kite

[Hieraetus morphnoides](#) Little Eagle

6 names, 7 records

Acrobolbaceae

[Goebelobryum grossitextum](#)

1 names, 2 records

Actinopodidae

[Missulena granulosa](#)

1 names, 1 records

Agamidae

[Ctenophorus adelaidensis](#) Southern Heath Dragon, Western Heath Dragon

[Pogona minor subsp. minor](#) Dwarf Bearded Dragon

2 names, 15 records

Amaranthaceae

*[Amaranthus powellii](#) Powell's Amaranth

[Ptilotus humilis](#)

2 names, 2 records

Anarthriaceae

[Lyginia barbata](#)

1 names, 4 records

Anatidae

[Anas castanea](#) Chestnut Teal

[Anas gracilis](#) Grey Teal

[Anas rhynchotis](#) Australasian Shoveler

[Anas superciliosa](#) Pacific Black Duck

[Aythya australis](#) Hardhead

[Biziura lobata](#) Musk Duck

[Chenonetta jubata](#) Australian Wood Duck, Wood Duck

[Cygnus atratus](#) Black Swan

[Tadorna tadornoides](#) Australian Shelduck, Mountain Duck

9 names, 50 records

Anhingidae

[Anhinga novaehollandiae](#) Australasian Darter

1 names, 2 records

Apiaceae

[Actinotus leucocephalus](#) Flannel Flower

*[Coriandrum sativum](#) Coriander

[Daucus glochidiatus](#) Australian Carrot

[Platysace ramosissima](#) P3

[Xanthosia ciliata](#)

[Xanthosia huegelii](#)

6 names, 6 records

Araceae

[Lemna disperma](#) Duckweed

1 names, 1 records

Araliaceae

[Hydrocotyle callicarpa](#) Small Pennywort

[Hydrocotyle striata](#) P1

[Trachymene pilosa](#) Native Parsnip

3 names, 4 records

Araneidae

[Araneus cyphoxis](#)

[Araneus senicaudatus](#)

[Austracantha minax](#)

[Backbourkia brounii](#)

4 names, 6 records

Ardeidae

[Ardea modesta](#) Eastern Great Egret IA

[Ardea novaehollandiae](#) White-faced Heron

[Ardea pacifica](#) White-necked Heron

[Botaurus poiciloptilus](#) Australasian Bittern T

[Egretta novaehollandiae](#)

[Nycticorax caledonicus](#) Rufous Night Heron

6 names, 16 records

Artamidae

[Artamus cinereus](#) Black-faced Woodswallow

[Artamus cyanopterus](#) Dusky Woodswallow

2 names, 7 records

Z. names, 7 records

Asparagaceae

[Chamaescilla gibsonii](#) P3
[Laxmannia ramosa](#) subsp. *ramosa*
[Laxmannia squarrosa](#)
[Lomandra caespitosa](#) Tufted Mat Rush
[Lomandra hermaphrodita](#)
[Lomandra preissii](#)
[Lomandra sericea](#) Silky Mat Rush
[Thysanotus arbuscula](#)
[Thysanotus arenarius](#)
[Thysanotus asper](#) Hairy Fringe Lily
[Thysanotus multiflorus](#) Many-flowered Fringe Lily
[Thysanotus patersonii](#)
[Thysanotus triandrus](#)
 13 names, 21 records

Asteraceae

[Asteridea pulverulenta](#) Common Bristle Daisy
 *[Bidens pilosa](#) Cobbler's Pegs
[Brachyscome iberidifolia](#)
 *[Conyza sumatrensis](#)
 *[Cotula coronopifolia](#) Waterbuttons
[Gnephosis drummondii](#)
[Hyalosperma cotula](#)
[Hyalosperma demissum](#)
 *[Hypochoeris glabra](#) Smooth Catsear
[Millotia mysotidifolia](#)
[Myriocephalus helichrysoides](#)
[Podolepis gracilis](#) Slender Podolepis
[Pogonolepis stricta](#)
[Quinetia urvillei](#)
[Rhodanthe spicata](#)
[Siloxerus humifusus](#) Procumbent Siloxerus
 *[Sonchus oleraceus](#) Common Sowthistle
[Trichocline spatulata](#) Native Gerbera
 *[Ursinia anthemoides](#) Ursinia
[Waitzia suaveolens](#) Fragrant Waitzia
 20 names, 37 records

Barychelidaceae

[Aureocrypta lugubris](#)
[Synothele lowei](#)
[Synothele taurus](#)
 3 names, 4 records

Bignoniaceae

*[Campsis radicans](#)
 1 names, 1 records

Boryaceae

[Borya scirpoidea](#)
 1 names, 1 records

Bothriuridae

[Cercophonius granulatus](#)
 1 names, 2 records

Bryaceae

[Gemmabryum pachythecum](#)
 1 names, 1 records

Cacatuidae

[Eolophus roseicapillus](#)
 1 names, 4 records

Campanulaceae

[Isotoma hypocrateriformis](#) Woodbridge Poison
[Lobelia anceps](#) Angled Lobelia
[Lobelia tenuior](#) Slender Lobelia
 3 names, 7 records

Campephagidae

[Coracina novaehollandiae](#) Black-faced Cuckoo-shrike
 1 names, 8 records

Casuariidae

[Dromaius novaehollandiae](#) Emu
 1 names, 1 records

Casuarinaceae

[Allocasuarina campestris](#)
[Allocasuarina humilis](#) Dwarf Sheoak
[Allocasuarina microstachya](#)
[Casuarina obesa](#) Swamp Sheoak, Kuli
 4 names, 5 records

Celastraceae

[Stackhousia monogyna](#)
[Tripterococcus brunonis](#) Winged Stackhousia
 2 names, 2 records

Centrolepidaceae

[Aphelia cyperoides](#)
[Centrolepis aristata](#) Pointed Centrolepis
[Centrolepis cephaliformis](#) subsp. *cephaloformis*
 3 names, 6 records

Names, 3 records

Charadriidae

[Charadrius ruficapillus](#) Red-capped Plover
[Euseyonis melanops](#) Black-fronted Dotterel
 2 names, 3 records

Cheluidae

[Chelodina colliei](#) South-western Snake-necked Turtle
 1 names, 1 records

Chenopodiaceae

[Sarcocornia blackiana](#)
 1 names, 1 records

Cladoniaceae

[Thysanothecium scutellatum](#)
 1 names, 1 records

Colchicaceae

[Burchardia bairdiae](#)
[Burchardia multiflora](#) Dwarf Burchardia
 2 names, 4 records

Columbidae

[Ocyphaps lophotes](#) Crested Pigeon
[Phaps chalcoptera](#) Common Bronzewing
 *[Streptopelia senegalensis](#) Laughing Turtle-Dove
 3 names, 10 records

Corvidae

[Corvus coronoides](#) Australian Raven
 1 names, 21 records

Cracticidae

[Cracticus tibicen](#) Australian Magpie
[Cracticus torquatus](#) Grey Butcherbird
[Strepera versicolor](#) Grey Currawong
 3 names, 28 records

Crassulaceae

*[Crassula alata var. alata](#)
[Crassula ciosiana](#)
 *[Crassula natans](#)
 3 names, 4 records

Cuculidae

[Cacomantis flabelliformis](#) Fan-tailed Cuckoo
[Cacomantis pallidus](#) Pallid Cuckoo
[Chrysococcyx lucidus](#) Shining Bronze Cuckoo
 3 names, 7 records

Cupressaceae

[Callitris pyramidalis](#) Swamp Cypress
 1 names, 4 records

Cyperaceae

[Baumea juncea](#) Bare Twigrush
[Baumea vaginalis](#) Sheath Twigrush
[Caustis gigas](#) Giant Twigrush P2
[Cyathochaeta avenacea](#)
[Cyathochaeta teretifolia](#) P3
 *[Cyperus tenuis](#) Tiny Flatsedge
[Isolepis cernua var. setiformis](#)
[Isolepis marginata](#) Coarse Club-rush
[Isolepis producta](#)
[Isolepis stellata](#) Star Club-rush
[Lepidosperma angustatum](#)
[Lepidosperma pubisquamum](#)
[Lepidosperma sp.](#)
[Schoenus brevisetis](#)
[Schoenus curvifolius](#)
[Schoenus griffinianus](#) P4
[Schoenus nanus](#) Tiny Bog Rush
[Schoenus sp. G Broad Sheath \(K.L. Wilson 2633\)](#)
[Schoenus subfascicularis](#)
 19 names, 30 records

Dasypogonaceae

[Dasypogon bromeliifolius](#) Pineapple Bush
 1 names, 3 records

Dasyuridae

[Dasyurus geoffroyi](#) Chuditch, Western Quoll T
[Sminthopsis griseoventer](#) Grey-bellied Dunnart
 2 names, 6 records

Dennstaedtiaceae

[Histiopteris incisa](#)
 1 names, 1 records

Dicaeidae

[Dicaeum hirundinaceum](#) Mistletoebird
 1 names, 1 records

Dicruridae

[Grallina cyanoleuca](#) Magpie-lark
[Rhindura albigera](#) Grey Fantail

[Rhipidura leucophrys](#) Willie Wagtail
3 names, 41 records

Dilleniaceae

[Hibbertia aurea](#)
[Hibbertia commutata](#)
[Hibbertia helianthemoides](#) P4
[Hibbertia huegelii](#)
[Hibbertia hypericoides](#) Yellow Buttercups
[Hibbertia hypericoides](#) subsp. [hypericoides](#)
[Hibbertia lasiopus](#) Large Hibbertia
[Hibbertia sericosepala](#)
[Hibbertia stellaris](#) Orange Stars
[Hibbertia subvaginata](#)
10 names, 24 records

Diplodactylidae

[Strophurus spinigerus](#)
[Strophurus spinigerus](#) subsp. [spinigerus](#)
2 names, 5 records

Droseraceae

[Drosera erythrorhiza](#) Red Ink Sundew
[Drosera erythrorhiza](#) subsp. [magna](#)
[Drosera gigantea](#) subsp. [gigantea](#)
[Drosera glanduligera](#) Pimpernel Sundew
[Drosera helodes](#)
[Drosera heterophylla](#) Swamp Rainbow
[Drosera menziesii](#) subsp. [penicillaris](#)
[Drosera neesii](#) Jewel Rainbow
[Drosera neesii](#) subsp. [neesii](#)
[Drosera occidentalis](#) subsp. [occidentalis](#) P4
[Drosera paleacea](#) subsp. [paleacea](#)
[Drosera pallida](#) Pale Rainbow
[Drosera pulchella](#) Pretty Sundew
[Drosera sewelliae](#) Red Woolly Sundew P2
[Drosera stolonifera](#) Leafy Sundew
15 names, 24 records

Elaeocarpaceae

[Platytheca galioides](#)
[Tetratheca hirsuta](#) Black Eyed Susan
2 names, 5 records

Elapidae

[Brachyurophis semifasciatus](#) Southern Shovel-nosed Snake
[Echiopsis curta](#) Bardick
[Elapognathus coronatus](#) Crowned Snake
[Neelaps bimaiculatus](#) Black-naped Snake
[Neelaps calonotos](#) Black-striped Snake P3
[Parasuta gouldii](#)
[Parasuta nigriceps](#)
[Simoselaps bertholdi](#) Jan's Banded Snake
8 names, 23 records

Ericaceae

[Andersonia heterophylla](#)
[Andersonia lehmanniana](#) subsp. [lehmanniana](#)
[Astroloma xerophyllum](#)
[Brachyloma preissii](#) subsp. [preissii](#)
[Conostephium minus](#) Pink-tipped Pearl flower
[Conostephium pendulum](#) Pearl Flower
[Conostephium preissii](#)
[Croninia kingiana](#)
[Leucopogon conostephioides](#)
[Leucopogon glaucifolius](#)
[Leucopogon gracillimus](#)
[Leucopogon leptanthus](#)
[Leucopogon oxycedrus](#)
[Leucopogon polymorphus](#)
[Leucopogon propinquus](#)
[Leucopogon sprengeioides](#)
[Leucopogon squarrosus](#) subsp. [squarrosus](#)
[Leucopogon squarrosus](#) subsp. [trigynus](#) P2
[Lysinema pentapetalum](#)
[Styphelia ciliosa](#)
[Styphelia filifolia](#) P3
[Styphelia tenuiflora](#) Common Pinheath
22 names, 49 records

Euphorbiaceae

*[Euphorbia terracina](#) Geraldton Carnation Weed
[Monotaxis occidentalis](#)
2 names, 2 records

Fabaceae

[Acacia anomala](#) Grass Wattle T
[Acacia applanata](#)
[Acacia barbinervis](#) subsp. [borealis](#)
[Acacia drewiana](#) subsp. [drewiana](#)
[Acacia drummondii](#) subsp. [affinis](#) P3
[Acacia huegelii](#)
[Acacia pulchella](#) Prickly Moses
[Acacia pulchella](#) var. [goadbyi](#)
[Acacia pulchella](#) var. [pulchella](#)
[Acacia pulchella](#) var. [reflexa](#)
[Acacia saligna](#) Orange Wattle Kudriana

[Acacia saligna subsp. saligna](#)
[Acacia squamata](#)
[Acacia stenoptera](#) Narrow Winged Wattle
[Aotus cordifolia](#)
[Aotus gracillima](#)
[Aotus procumbens](#)
[Bossiaea eriocarpa](#) Common Brown Pea
[Cristonia biloba subsp. biloba](#)
[Daviesia angulata](#)
[Daviesia brachyphylla](#)
[Daviesia hakeoides subsp. hakeoides](#)
[Daviesia incrassata subsp. incrassata](#)
[Daviesia longifolia](#)
[Daviesia physodes](#)
[Daviesia triflora](#)
[Euchilopsis linearis](#) Swamp Pea
[Gastrolobium calycinum](#) York Road Poison
[Gastrolobium ebracteolatum](#)
[Gastrolobium retusum](#)
[Gastrolobium spinosum](#) Prickly Poison
[*Genista linifolia](#) Flaxleaf Broom
[Gompholobium confertum](#)
[Gompholobium scabrum](#)
[Gompholobium tomentosum](#) Hairy Yellow Pea
[Hovea trisperma](#) Common Hovea
[Isotropis cuneifolia](#) Granny Bonnets
[Isotropis cuneifolia subsp. cuneifolia](#)
[Jacksonia floribunda](#) Holly Pea
[Jacksonia furcellata](#) Grey Stinkwood
[Jacksonia sternbergiana](#) Stinkwood, Kapur
[Kennedia prostrata](#) Scarlet Runner
[*Lotus subbiflorus](#)
[*Medicago polymorpha](#) Burr Medic
[*Mellilotus indicus](#)
[*Ornithopus compressus](#) Yellow Serradella
[Pultenaea reticulata](#)
[Sphaerolobium linophyllum](#)
[*Vicia sativa](#) Common Vetch
 49 names, 106 records

Falconidae

[Falco cenchroides](#) Australian Kestrel, Nankeen Kestrel
[Falco longipennis](#) Australian Hobby
[Falco peregrinus](#) Peregrine Falcon S
 3 names, 7 records

Frankeniaceae

[Frankenia pauciflora](#) Seaheath
 1 names, 1 records

Galaxiidae

[Galaxiella munda](#) Western Mud Minnow T
 1 names, 2 records

Gekkonidae

[Underwoodisaurus milii](#) Barking Gecko
 1 names, 2 records

Gentianaceae

[*Cicendia filiformis](#) Slender Cicendia
 1 names, 2 records

Geraniaceae

[*Erodium botrys](#) Long Storksbill
[*Geranium molle](#) Dove's Foot Cranesbill
 2 names, 2 records

Goodeniaceae

[Dampiera linearis](#) Common Dampiera
[Lechenaultia biloba](#) Blue Leschenaultia
[Lechenaultia expansa](#)
[Lechenaultia floribunda](#) Free-flowering Leschenaultia
[Scaevola anchusifolia](#)
[Scaevola glandulifera](#) Viscid Hand-flower
[Scaevola lanceolata](#) Long-leaved Scaevola
[Scaevola phlebopetala](#) Velvet Fanflower
[Velleia trinervis](#)
[Verreauxia reinwardtii](#) Common Verreauxia
 10 names, 15 records

Haemodoraceae

[Anigozanthos humilis](#) Catspaw
[Anigozanthos humilis subsp. humilis](#)
[Anigozanthos manglesii var. x angustifolius](#)
[Anigozanthos viridis subsp. viridis](#)
[Blancoa canescens](#) Winter Bell
[Conostylis aculeata subsp. aculeata](#)
[Conostylis aculeata subsp. preissii](#)
[Conostylis aurea](#) Golden Conostylis
[Conostylis candicans](#) Grey Cottonhead
[Conostylis candicans subsp. candicans](#)
[Conostylis caricina](#)
[Conostylis caricina subsp. caricina](#)
[Conostylis juncea](#)
[Conostylis setigera subsp. setigera](#)
[Conostylis teretifolia subsp. teretifolia](#)
[Haemodorum simplex](#)

[Haemodorum spicatum](#) Mardja
[Macropidia fuliginosa](#) Black Kangaroo Paw
[Phlebocarya ciliata](#)
 19 names, 34 records

Halcyonidae

*[Dacelo novaeguineae](#) Laughing Kookaburra
[Todiramphus sanctus](#) Sacred Kingfisher
 2 names, 8 records

Haloragaceae

[Gonocarpus cordiger](#)
[Gonocarpus nodulosus](#)
[Gonocarpus pithyoides](#)
 3 names, 5 records

Hemerocallidaceae

[Agrostocrinum scabrum subsp. scabrum](#)
[Corynotheca micrantha](#) Sand Lily
[Hensmania turbinata](#)
[Johnsonia pubescens subsp. pubescens](#)
[Tricoryne elatior](#) Yellow Autumn Lily
[Tricoryne tenella](#)
 6 names, 9 records

Hirundinidae

[Hirundo neoxena](#) Welcome Swallow
[Petrochelidon nigricans](#) Tree Martin
 2 names, 16 records

Hylidae

[Litoria adelaidensis](#) Slender Tree Frog
[Litoria moorei](#) Motorbike Frog
 2 names, 15 records

Hyriidae

[Wetralunio carteri](#) Carter's Freshwater Mussel T
 1 names, 1 records

Iridaceae

*[Gladiolus undulatus](#) Wild Gladiolus
[Patersonia occidentalis](#) Purple Flag, Koma
[Patersonia occidentalis var. angustifolia](#)
 *[Romulea obscura](#)
 4 names, 8 records

Julidae

[Ommatoiulus moreletii](#)
 1 names, 1 records

Juncaceae

[Juncus pallidus](#) Pale Rush
[Juncus planifolius](#) Broadleaf Rush
 2 names, 2 records

Juncaginaceae

[Cycnogeton lineare](#)
[Triglochin centrocarpa](#)
 2 names, 2 records

Lamiaceae

[Cyanostegia angustifolia](#) Tinsel-flower
[Hemiandra pungens](#) Snakebush
[Hemigenia barbata](#)
[Lachnostachys verbascifolia var. verbascifolia](#)
 4 names, 6 records

Lauraceae

[Cassytha flava](#) Dodder Laurel
[Cassytha racemosa](#) Dodder Laurel
[Cassytha racemosa forma racemosa](#)
 3 names, 4 records

Limnodynastidae

[Heleioporus eyrei](#) Moaning Frog
[Heleioporus psammophilus](#) Sand Frog
[Limnodynastes dorsalis](#) Western Banjo Frog
[Neobatrachus pelobatoides](#) Humming Frog
 4 names, 58 records

Loranthaceae

[Amyema miquelii](#) Stalked Mistletoe
[Nuytsia floribunda](#) Christmas Tree, Mudja
 2 names, 3 records

Lycopodiaceae

[Lycopodiella serpentina](#)
[Phylloglossum drummondii](#) Pigmy Clubmoss
 2 names, 2 records

Lycosidae

[Venator immansueta](#)
[Venator koyuga](#)
 2 names, 2 records

Lythraceae

*[Lathrum hvssodifolia](#) Lesser Loosestrife

1 names, 1 records

Maluridae

[Malurus pulcherrimus](#) Blue-breasted Fairy-wren

[Malurus splendens](#) Splendid Fairy-wren

2 names, 21 records

Malvaceae

[Lasiopetalum lineare](#)

[Thomasia grandiflora](#) Large Flowered Thomasia

2 names, 2 records

Meliphagidae

[Acanthorhynchus superciliosus](#) Western Spinebill

[Anthochaera carunculata](#) Red Wattlebird

[Anthochaera lunulata](#) Western Little Wattlebird

[Epthianura albifrons](#) White-fronted Chat

[Lichmera indistincta](#) Brown Honeyeater

[Manorina flavigula](#) Yellow-throated Miner

[Phylidonyris niger](#) White-cheeked Honeyeater

[Phylidonyris novaehollandiae](#) New Holland Honeyeater

8 names, 55 records

Menyanthaceae

[Liparophyllum capitatum](#)

[Ornduffia submersa](#) P4

2 names, 2 records

Meropidae

[Merops ornatus](#) Rainbow Bee-eater IA

1 names, 4 records

Miturgidae

[Mitulodon tarantulinus](#)

1 names, 2 records

Molluginaceae

[Macarthuria apetala](#)

1 names, 2 records

Muridae

*[Mus musculus](#) House Mouse

[Pseudomys albocinereus](#) Ash-grey Mouse

*[Rattus rattus](#) Black Rat

3 names, 10 records

Myobatrachidae

[Crinia glauerti](#) Clicking Frog

[Crinia insignifera](#) Squelching Froglet

[Myobatrachus gouldii](#) Turtle Frog

[Pseudophryne guentheri](#) Crawling Toadlet

4 names, 20 records

Myrtaceae

[Astartea scoparia](#) Common Astartea

[Babingtonia camphorosmae](#) Camphor Myrtle

[Beaufortia elegans](#) Elegant Beaufortia

[Beaufortia macrostemon](#) Darling Range Beaufortia

[Calothamnus glaber](#)

[Calothamnus lateralis](#)

[Calothamnus quadrifidus](#) One-sided Bottlebrush, Kwowdjard

[Calothamnus quadrifidus subsp. quadrifidus](#)

[Calothamnus sanguineus](#) Silky-leaved Blood flower, Pindak

[Calytrix angulata](#) Yellow Starflower

[Calytrix flavescens](#) Summer Starflower

[Calytrix fraseri](#) Pink Summer Calytrix

[Calytrix sapphirina](#)

[Calytrix sylvana](#)

[Calytrix variabilis](#)

[Chamelaucium pauciflorum](#)

[Chamelaucium sp. Gingin \(N.G. Marchant 6\)](#) T

[Darwinia foetida](#) T

[Darwinia thymoides](#)

[Eremaea asterocarpa subsp. asterocarpa](#)

[Eremaea pauciflora](#)

[Eremaea purpurea](#)

[Eucalyptus drummondii](#) Drummond's Gum

[Eucalyptus marginata](#) Jarrah, Djara

[Eucalyptus marginata subsp. thalassica](#) Blue-leaved Jarrah

[Eucalyptus rudis](#) Flooded Gum, Kulurda

[Eucalyptus todtiana](#) Coastal Blackbutt

[Hypocalymma angustifolium](#) White Myrtle, Kudjid

[Hypocalymma angustifolium subsp. Dandaragan plateau \(S. Patrick 702A\)](#)

[Hypocalymma angustifolium subsp. Swan Coastal Plain \(G.J. Keighery 16777\)](#)

[Hypocalymma robustum](#) Swan River Myrtle

[Kunzea ericifolia](#) Spearwood, Pondil

[Kunzea recurva](#)

[Leptospermum erubescens](#) Roadside Teatree

*[Leptospermum laevigatum](#) Coast Teatree

[Melaleuca brevifolia](#)

[Melaleuca concreta](#)

[Melaleuca huegellii](#) Chenille Honey Myrtle

[Melaleuca lateritia](#) Robin Redbreast Bush

[Melaleuca osullivanii](#)

[Melaleuca preissiana](#) Moonah

[Melaleuca raphiophylla](#) Swamp Paperbark

[Melaleuca ryeae](#)

[Melaleuca seriata](#)
[Melaleuca trichophylla](#)
[Melaleuca viminea subsp. viminea](#)
[Pericalymma ellipticum](#) Swamp Teatree
[Regelia ciliata](#)
[Regelia inops](#)
[Scholtzia involucrata](#) Spiked Scholtzia
[Taxandria linearifolia](#)
[Verticordia chrysantha](#)
[Verticordia densiflora var. densiflora](#)
[Verticordia insignis subsp. insignis](#)
[Verticordia lindleyi subsp. lindleyi](#) P4
[Verticordia nitens](#) Morrison Featherflower, Kodjeningara
[Verticordia ovalifolia](#)
[Verticordia pennigera](#)
[Verticordia plumosa var. brachyphylla](#)
[Verticordia serrata var. linearis](#) P3
 60 names, 143 records

Nemesiidae

[Aname mainae](#)
[Aname tepperi](#)
 2 names, 5 records

Neosittidae

[Daphoenositta chrysoptera](#) Varied Sittella
 1 names, 2 records

Onagraceae

[Epilobium billardiereanum](#) Glabrous Willow Herb
 *[Oenothera laciniata](#)
 2 names, 2 records

Orchidaceae

[Caladenia flava](#) Cowslip Orchid
[Caladenia flava subsp. flava](#)
[Caladenia marginata](#) White Fairy Orchid
[Caladenia paludosa](#)
[Calochilus uliginosus](#)
[Elythranthera brunonis](#) Purple Enamel Orchid
[Elythranthera emarginata](#) Pink Enamel Orchid
[Eriochilus dilatatus](#) White Bunny Orchid
[Leporella fimbriata](#) Hare Orchid
[Microtis media subsp. densiflora](#)
[Microtis media subsp. media](#)
[Pheladenia deformis](#)
[Prasophyllum cyphochilum](#) Pouched Leek Orchid
[Prasophyllum drummondii](#) Swamp Leek Orchid
[Pterostylis aff. nana](#)
[Thelymitra benthamiana](#) Leopard Orchid
[Thelymitra stellata](#) Star Orchid T
 17 names, 25 records

Orobanchaceae

*[Parentucellia viscosa](#) Sticky Bartsia
 1 names, 1 records

Oxalidaceae

*[Oxalis purpurea](#) Largeflower Wood Sorrel
 1 names, 1 records

Pachycephalidae

[Colluricincla harmonica](#) Grey Shrike-thrush
[Pachycephala rufiventris](#) Rufous Whistler
 2 names, 16 records

Parastacidae

[Cherax preissii](#)
[Cherax quinquecarinatus](#)
[Cherax sp.](#)
 3 names, 4 records

Pardalotidae

[Pardalotus striatus](#) Striated Pardalote
 1 names, 10 records

Peramelidae

[Isoodon obesulus subsp. fusciventer](#) Quenda, Southern Brown Bandicoot P4
 1 names, 2 records

Percichthyidae

[Nannoperca vittata](#)
 1 names, 1 records

Peronosporaceae

[Phytophthora cinnamomi](#)
 1 names, 15 records

Petroicidae

[Petroica boodang](#) Scarlet Robin
[Petroica goodenovii](#) Red-capped Robin
 2 names, 3 records

Phalacrocoracidae

[Microcarbo melanoleucos](#)
[Phalacrocorax melanoleucos](#) Little Pied Cormorant
[Phalacrocorax melanoleucos subsp. melanoleucos](#) Little Pied Cormorant

[Phalacrocorax sulcirostris](#) Little Black Cormorant
4 names, 8 records

Pholcidae

[Pholcus phalangioides](#)
[Trichocyclus nullarbor](#)
2 names, 3 records

Phyllanthaceae

[Poranthera microphylla](#) Small Poranthera
1 names, 1 records

Pittosporaceae

[Billardiera fraseri](#) Elegant Pronaya
1 names, 1 records

Plantaginaceae

[Gratiola pubescens](#)
*[Misopates orontium](#) Lesser Snapdragon
2 names, 2 records

Poaceae

*[Aira caryophyllea](#) Silvery Hairgrass
[Amphipogon laguroides](#) subsp. [laguroides](#)
[Amphipogon turbinatus](#)
[Austrostipa campylachne](#)
[Austrostipa flavescens](#)
[Austrostipa tenuifolia](#)
*[Briza maxima](#) Blowfly Grass
*[Cenchrus ciliaris](#) Buffel Grass
*[Chloris gayana](#) Rhodes Grass
[Chloris truncata](#) Windmill Grass
*[Chloris virgata](#) Feathertop Rhodes Grass
[Dactyloctenium radulans](#) Button Grass
[Lachnagrostis plebeia](#)
[Microlaena stipoides](#) Weeping Grass
*[Parapholis incurva](#) Coast Barbgrass
[Poa poiformis](#) Coastal Poa
[Poa porphyroclados](#)
[Rytidosperma caespitosum](#)
*[Vulpia bromoides](#) Squirrel Tail Fescue
*[Vulpia myuros](#) Rat's Tail Fescue
20 names, 21 records

Podicipedidae

[Tachybaptus novaehollandiae](#) Australasian Grebe, Black-throated Grebe
1 names, 5 records

Polygalaceae

[Comesperma scoparium](#) Broom Milkwort
[Comesperma virgatum](#) Milkwort
2 names, 2 records

Polygonaceae

[Muehlenbeckia adpressa](#) Climbing Lignum
*[Rumex conglomeratus](#) Clustered Dock
*[Rumex crispus](#) Curled Dock
3 names, 3 records

Primulaceae

*[Lysimachia arvensis](#) Pimpernel
[Samolus junceus](#)
2 names, 4 records

Proteaceae

[Adenanthos cygnorum](#) Common Woollybush
[Adenanthos cygnorum](#) subsp. [chamaephyton](#) P3
[Adenanthos drummondii](#)
[Adenanthos obovatus](#) Basket Flower
[Banksia attenuata](#) Slender Banksia, Piara
[Banksia bipinnatifida](#) subsp. [multifida](#)
[Banksia ilicifolia](#) Holly-leaved Banksia
[Banksia menziesii](#) Firewood Banksia
[Banksia micrantha](#)
[Banksia sphaerocarpa](#) var. [sphaerocarpa](#) Fox Banksia
[Banksia telmatiaea](#) Swamp Fox Banksia
[Conospermum acerosum](#) subsp. [acerosum](#)
[Conospermum canaliculatum](#)
[Conospermum canaliculatum](#) subsp. [canaliculatum](#)
[Conospermum crassinervium](#) Summer Smokebush
[Conospermum huegelii](#) Slender Smokebush
[Conospermum stoechadis](#) subsp. [sclerophyllum](#)
[Conospermum stoechadis](#) subsp. [stoechadis](#) Common Smokebush
[Conospermum triplinervium](#) Tree Smokebush
[Grevillea althoferorum](#)
[Grevillea althoferorum](#) subsp. [fragilis](#) T
[Grevillea bipinnatifida](#) subsp. [bipinnatifida](#)
[Grevillea candolleana](#) P2
[Grevillea curviloba](#)
[Grevillea curviloba](#) subsp. [curviloba](#) T
[Grevillea curviloba](#) subsp. [incurva](#) T
[Grevillea obtusifolia](#) Obtuse Leaved Grevillea
[Grevillea pilulifera](#) Woolly-flowered Grevillea
[Grevillea synapheae](#) subsp. [synapheae](#)
[Hakea cristata](#) Snail Hakea
[Hakea erinacea](#) Hedge-hog Hakea
[Hakea varia](#) Variable-leaved Hakea

[Isopogon asper](#)
[Lambertia multiflora var. darlingensis](#)
[Persoonia comata](#)
[Petrophile linearis](#) Pixie Mops
[Petrophile seminuda](#)
[Petrophile striata](#)
[Stirlingia latifolia](#) Blueboy
[Synaphea gracillima](#)
[Synaphea grandis](#) P4
 41 names, 160 records

Psittacidae

[Barnardius zonarius](#)
[Cacatua galerita](#) Sulphur-crested Cockatoo
 *[Cacatua galerita subsp. galerita](#) Sulphur-crested Cockatoo
[Cacatua pastinator](#) Western Long-billed Corella
[Cacatua roseicapilla](#) Galah
[Cacatua sanguinea](#) Little Corella
 *[Cacatua tenuirostris](#) Eastern Long-billed Corella
[Calyptorhynchus latirostris](#) Carnaby's Cockatoo (short-billed black-cockatoo), Carnaby's Cockatoo T
[Platycercus spurius](#) Red-capped Parrot
[Platycercus zonarius](#) Australian Ringneck, Ring-necked Parrot
[Purpureicephalus spurius](#)
 11 names, 143 records

Pygopodidae

[Aprasia repens](#) Sand-plain Worm-lizard
[Delma fraseri](#) Fraser's Legless Lizard
[Delma grayii](#)
[Lialis burtonis](#)
[Pletholax gracilis](#) Keeled Legless Lizard
[Pletholax gracilis subsp. gracilis](#) Keeled Legless Lizard
[Pygopus lepidopodus](#) Common Scaly Foot
 7 names, 35 records

Rallidae

[Fulica atra](#) Eurasian Coot
[Gallinula tenebrosa](#) Dusky Moorhen
 2 names, 3 records

Ranunculaceae

*[Ranunculus muricatus](#) Sharp Buttercup
 1 names, 2 records

Recurvirostridae

[Cladorhynchus leucocephalus](#) Banded Stilt
[Himantopus himantopus](#) Black-winged Stilt
[Recurvirostra novaehollandiae](#) Red-necked Avocet
 3 names, 6 records

Restionaceae

[Alexgeorgea nitens](#)
[Chordifex microcodon](#)
[Cytogonidium leptocarpoides](#)
[Desmodcladus lateriflorus](#)
[Dielsia stenostachya](#)
[Hypolaena exsulca](#)
[Hypolaena robusta](#) P4
[Leptocarpus scariosus](#)
 8 names, 20 records

Rutaceae

[Boronia purdieana](#) Winter Boronia
[Philotheca spicata](#) Pepper and Salt
 2 names, 3 records

Santalaceae

[Exocarpos sparteus](#) Broom Ballart, Djuk
 1 names, 1 records

Schizaeaceae

[Schizaea fistulosa](#) Narrow Comb Fern
 1 names, 1 records

Scincidae

[Acritoscincus trilineatus](#) Western Three-lined Skink
[Cryptoblepharus buchananii](#)
[Ctenotus australis](#)
[Ctenotus fallens](#)
[Egernia napoleonis](#)
[Hemiergis quadrilineata](#)
[Lerista elegans](#)
[Lerista lineopunctulata](#)
[Lerista praepedita](#)
[Menetia greyii](#)
[Morethia lineocellata](#)
[Morethia obscura](#)
 12 names, 90 records

Scolopendridae

[Cormocephalus strigosus](#)
[Cormocephalus turneri](#)
[Scolopendra laeta](#)
 3 names, 6 records

Scrophulariaceae

*[Dischisma capitatum](#) Woolly-headed Dischisma
[Eremophila glabra subsp. albicans](#)
[Myoporum caprarioides](#) Slender Myoporum
 3 names, 4 records

Selaginellaceae
[Selaginella gracillima](#) Tiny Clubmoss
 1 names, 2 records

Solanaceae
 *[Nicotiana glauca](#) Tree Tobacco
 *[Solanum nigrum](#) Black Berry Nightshade
 2 names, 2 records

Sparassidae
[Isopeda leishmani](#)
 1 names, 1 records

Stiphidiidae
[Baiami volucripes](#)
 1 names, 1 records

Stylidiaceae
[Levenhookia pusilla](#) Midget Stylewort
[Levenhookia stipitata](#) Common Stylewort
[Stylidium affine](#) Queen Triggerplant
[Stylidium albolilacinum](#)
[Stylidium amoenum](#) Lovely Triggerplant
[Stylidium androsaceum](#)
[Stylidium araeophyllum](#) Stilt Walker
[Stylidium brunonianum](#) Pink Fountain Triggerplant
[Stylidium calcaratum](#) Book Triggerplant
[Stylidium crossocephalum](#) Posy Triggerplant
[Stylidium cygnorum](#)
[Stylidium dichotomum](#) Pins-and-needles
[Stylidium diuroides](#) Donkey Triggerplant
[Stylidium diuroides subsp. diuroides](#)
[Stylidium divaricatum](#) Daddy-long-legs
[Stylidium ecorne](#) Foot Triggerplant
[Stylidium hispidum](#) White Butterfly Triggerplant
[Stylidium neurophyllum](#) Coastal Plain Triggerplant
[Stylidium paludicola](#) P3
[Stylidium recurvum](#)
[Stylidium repens](#) Matted Triggerplant
[Stylidium roseoalatum](#) Pink-wing Triggerplant
[Stylidium schoenoides](#) Cow Kicks
[Stylidium utricularioides](#) Pink Fan Triggerplant
 24 names, 45 records

Tachyglossidae
[Tachyglossus aculeatus](#) Short-beaked Echidna
 1 names, 1 records

Tamaricaceae
 *[Tamarix parviflora](#)
 1 names, 1 records

Tarsipedidae
[Tarsipes rostratus](#) Honey Possum, Noolbenger
 1 names, 12 records

Threskiornithidae
[Platalea flavipes](#) Yellow-billed Spoonbill
[Plegadis falcinellus](#) Glossy Ibis IA
[Threskiornis spinicollis](#) Straw-necked Ibis
 3 names, 16 records

Thymelaeaceae
[Pimelea imbricata var. piligera](#)
[Pimelea leucantha](#)
 2 names, 4 records

Tilletiaceae
[Tilletia viennotii](#)
 1 names, 1 records

Typhlopidae
[Anilius australis](#)
 1 names, 1 records

Urodacidae
[Urodacus novaehollandiae](#)
[Urodacus woodwardii](#)
 2 names, 3 records

Vespertilionidae
[Nyctophilus geoffroyi subsp. geoffroyi](#) Lesser Long-eared Bat
[Nyctophilus gouldi](#) Gould's Long-eared Bat
 2 names, 2 records

Violaceae
[Hybanthus calycinus](#) Wild Violet
 1 names, 1 records

Vitaceae
 *[Vitis vinifera](#)
 1 names, 1 records

Xanthorrhoeaceae
[Xanthorrhoea preissii](#) Grass tree, Palga
1 names, 2 records

Zodariidae
[Storena formosa](#)
1 names, 1 records

Zosteropidae
[Zosterops lateralis](#) Grey-breasted White-eye, Silvereye
1 names, 13 records

Conservation Status
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

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Plants → Magnoliophyta → Liliopsida → Poales → **Cyperaceae** Juss. → **Caustis** R.Br. → *Caustis gigas* R.L.Barrett

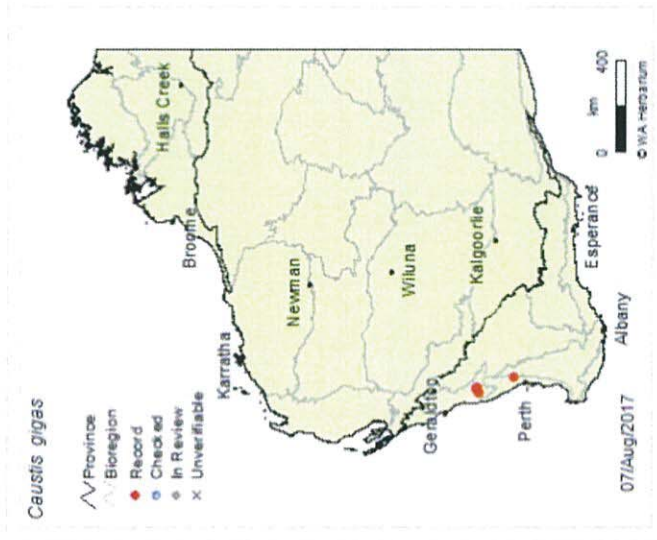
Caustis gigas R.L.Barrett Giant Twigrush

Nuytsia 26:34-35, Fig. 6 (2015)

Conservation Code: **Priority Two**

Naturalised Status: Native to Western Australia

Name Status: **Current**



Brief Description

Grazyna Paczkowska, Monday 8 August 1994

Rhizomatous, robust perennial, grass-like or herb (sedge), to 2 m high. Fl. May. White or grey sand.

Distribution

Beard's Provinces: South-West Province.

IBRA Regions: Geraldton Sandplains, Swan Coastal Plain.

IBRA Subregions: Dandaragan Plateau, Lesueur Sandplain.

Local Government Areas (LGAs): Chittering, Coorow.

Plants → Magnoliophyta → Liliopsida → Poales → [Cyperaceae Juss.](#) → [Schoenus L.](#) → *Schoenus griffinianus* K.L.Wilson

Schoenus griffinianus K.L.Wilson

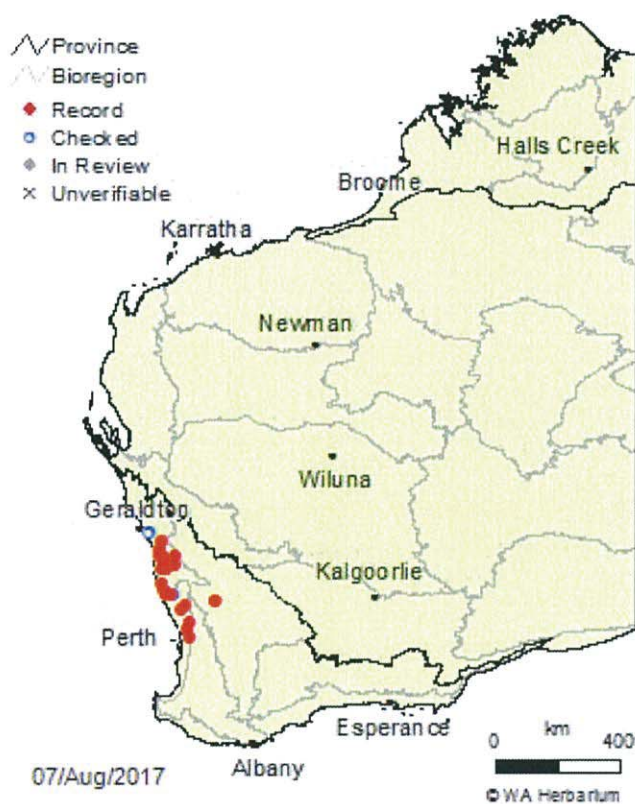
Nuytsia 11:278-280, Fig. 3A-C (1997)

Conservation Code: [Priority Four](#)

Naturalised Status: Native to Western Australia

Name Status: [Current](#)

Schoenus griffinianus



Brief Description

Amanda Spooner, Tuesday 2 September 1997

Small, tufted perennial, grass-like or herb (sedge), to 0.1 m high. Fl. Sep to Oct. White sand.

Distribution

Beard's Provinces: South-West Province.

IBRA Regions: Avon Wheatbelt, Geraldton Sandplains, Swan Coastal Plain.

IBRA Subregions: Avon Wheatbelt P2, Dandaragan Plateau, Geraldton Hills, Lesueur Sandplain, Perth.

Plants → Magnoliophyta → Magnoliopsida → Caryophyllales → [Droseraceae Salisb.](#) → [Drosera L.](#) → [Drosera occidentalis Morrison](#) → *Drosera occidentalis* subsp. *australis* N.G.Marchant & Lowrie

Drosera occidentalis subsp. *australis* N.G.Marchant & Lowrie

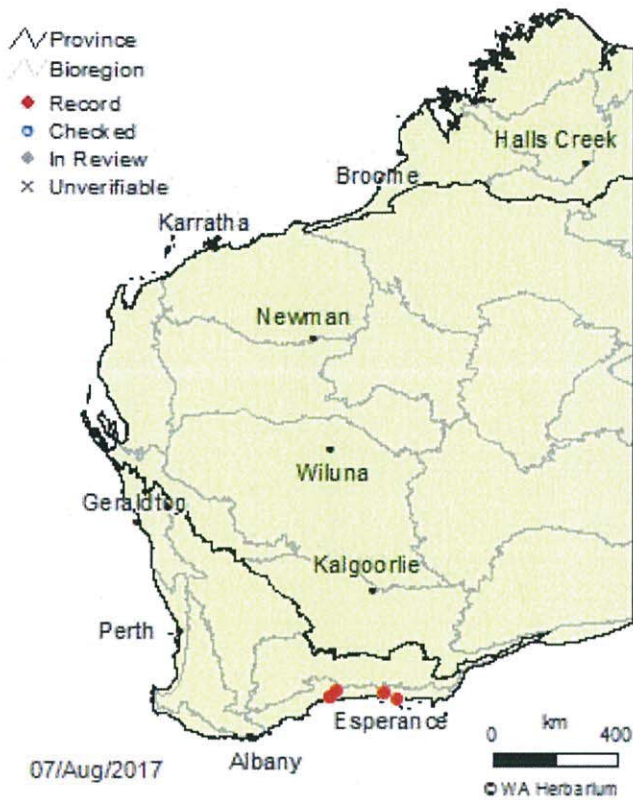
Kew Bull. 47:326 (1992)

Conservation Code: [Not threatened](#)

Naturalised Status: Native to Western Australia

Name Status: [Current](#)



Drosera occidentalis subsp. *australis*

Brief Description

Grazyna Paczkowska, Wednesday 10 April 1996

Fibrous-rooted, rosetted perennial, herb, to 0.025 m high, to 0.02 m wide. Fl. pink/white, Oct to Dec or Jan. Sandy soils with laterite pebbles.

Distribution

Beard's Provinces: South-West Province.

IBRA Regions: Esperance Plains.

IBRA Subregions: Recherche.

Local Government Areas (LGAs): Esperance, Ravensthorpe.

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Plants → Magnoliophyta → Magnoliopsida → Caryophyllales → [Droseraceae Salisb.](#) → [Drosera L.](#) → *Drosera sewelliae* Diels

Drosera sewelliae Diels Red Woolly Sundew

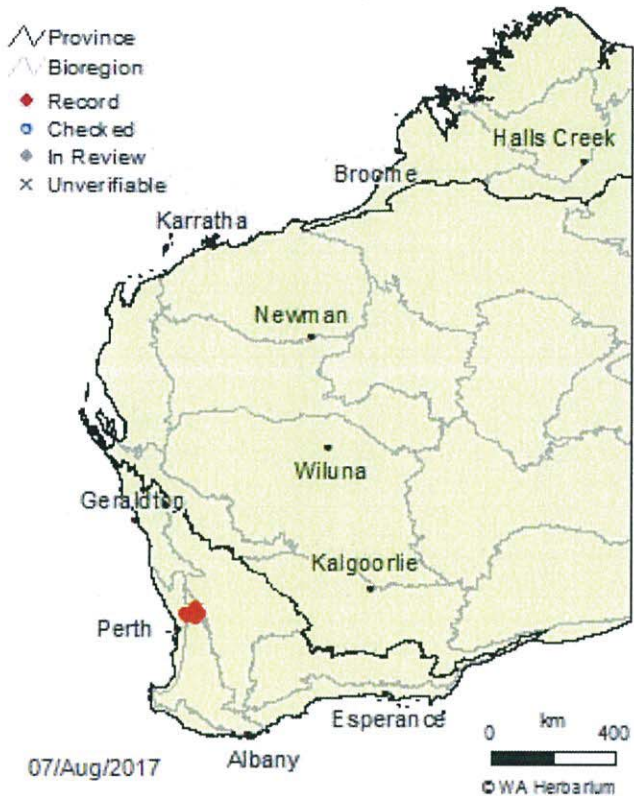
Bot.Jahrb.Syst. 35:206 (1904)

Conservation Code: [Priority Two](#)

Naturalised Status: Native to Western Australia

Name Status: [Current](#)



Drosera sewelliae

Brief Description

Grazyna Paczkowska, Friday 12 April 1996

Fibrous-rooted, rosetted perennial, herb, to 0.06 m high, to 0.025 m wide. Fl. orange, Oct. Laterite & silica sand soils.

Distribution

Beard's Provinces: South-West Province.

IBRA Regions: Jarrah Forest, Swan Coastal Plain.

IBRA Subregions: Dandaragan Plateau, Northern Jarrah Forest.

Local Government Areas (LGAs): Chittering, Toodyay.

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Plants → Magnoliophyta → Magnoliopsida → Dilleniales → [Dilleniaceae Salisb.](#) → [Hibbertia Andrews](#) → *Hibbertia helianthemoides* (Turcz.) F.Muell.

Hibbertia helianthemoides (Turcz.) F.Muell.

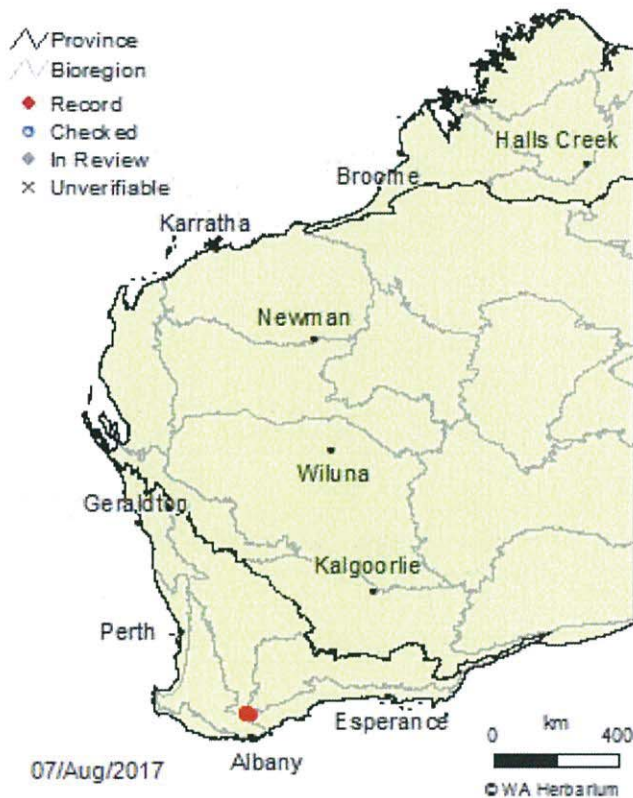
Fragm. 11:95 (1880)

Conservation Code: [Priority Four](#)

Naturalised Status: Native to Western Australia

Name Status: [Current](#)

Hibbertia helianthemoides



Brief Description

Amanda Spooner, Monday 7 February 2005

Spreading to erect, low or prostrate shrub, to 0.3 m high. Fl. yellow, Jul or Sep to Oct. Clayey sand over sandstone or loam over quartzite. Hills and scree slopes.

Distribution

Beard's Provinces: South-West Province.

IBRA Regions: Avon Wheatbelt, Esperance Plains, Jarrah Forest.

Plants → Magnoliophyta → Magnoliopsida → Ericales → [Ericaceae Juss.](#) → [Styphelia Sm.](#) → *Styphelia filifolia* Hislop & Puente-Lel.

Styphelia filifolia Hislop & Puente-Lel.

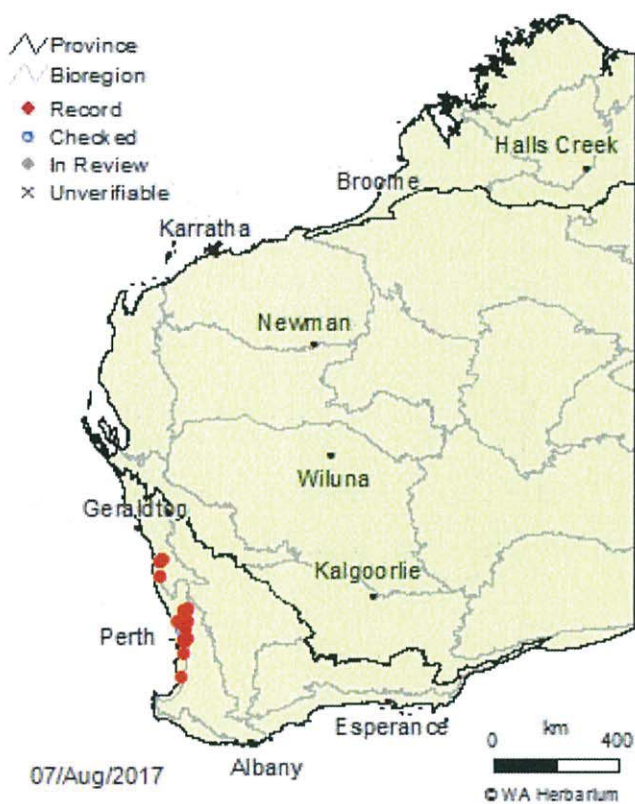
Nuytsia 28:104-107, Fig. 5 (2017)

Conservation Code: [Priority Three](#)

Naturalised Status: Native to Western Australia

Name Status: [Current](#)

Styphelia filifolia



Distribution

Beard's Provinces: South-West Province.

IBRA Regions: Geraldton Sandplains, Swan Coastal Plain.

IBRA Subregions: Dandaragan Plateau, Lesueur Sandplain, Perth.

Local Government Areas (LGAs): Canning, Carnamah, Chittering, Cockburn, Dandaragan, Gingin, Gosnells, Harvey, Irwin, Kalamunda, Melville, Serpentine-Jarrahdale, Swan, Wanneroo.

[Back to last search](#)

Plants → Magnoliophyta → Magnoliopsida → Myrtales → [Myrtaceae Juss.](#) → [Verticordia DC.](#) → [Verticordia lindleyi Schauer](#) → *Verticordia lindleyi* Schauer subsp. *lindleyi*

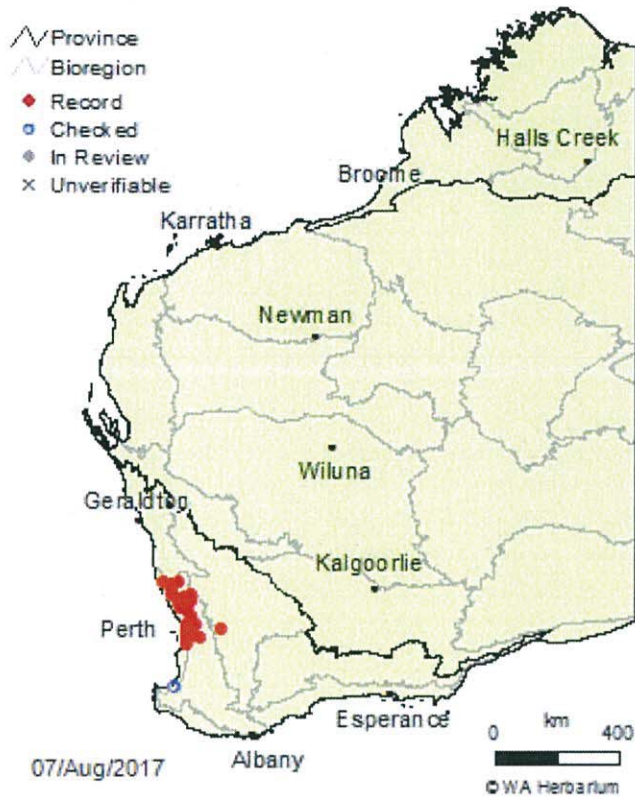
Verticordia lindleyi Schauer subsp. *lindleyi*

Conservation Code: [Priority Four](#)

Naturalised Status: Native to Western Australia

Name Status: [Current](#)



Verticordia lindleyi subsp. *lindleyi*

Brief Description

Grazyna Paczkowska, Tuesday 13 February 1996

Erect shrub, 0.2-0.75 m high. Fl. pink, May or Nov to Dec or Jan. Sand, sandy clay. Winter-wet depressions.

Distribution

Beard's Provinces: South-West Province.

IBRA Regions: Avon Wheatbelt, Geraldton Sandplains, Jarrah Forest, Swan Coastal Plain.

IBRA Subregions: Avon Wheatbelt P2, Dandaragan Plateau, Lesueur Sandplain, Northern Jarrah Forest, Perth.

Local Government Areas (LGAs): Armadale, Belmont, Busselton, Canning, Chittering, Dandaragan, Gingin, Gosnells, Kalamunda, Serpentine-Jarrahdale, Swan, Victoria Plains, York.

[Back to last search](#)



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Plants → Magnoliophyta → Magnoliopsida → Myrtales → [Myrtaceae Juss.](#) → [Verticordia DC.](#) → [Verticordia serrata \(Lindl.\) Schauer](#) → [Verticordia serrata var. linearis A.S.George](#)

***Verticordia serrata* var. *linearis* A.S.George**

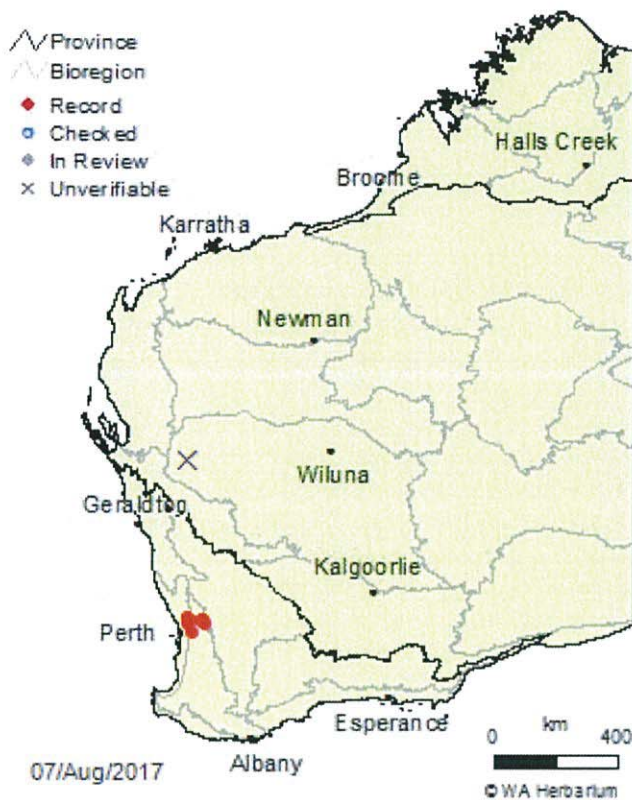
Nuytsia 7: 365 (1991)

Conservation Code: [Priority Three](#)

Naturalised Status: Native to Western Australia

Name Status: [Current](#)



Verticordia serrata var. *linearis*

Brief Description

Grazyna Paczkowska, Monday 19 February 1996

Shrub, to 1 m high, differs from other varieties in the linear acuminate leaves 6-20 mm long; cilia to 1.2 mm long. Fl. other, Sep to Oct. White sand, gravel. Open woodland.

Distribution

Beard's Provinces: Eremaean Province, South-West Province.

IBRA Regions: Jarrah Forest, Murchison, Swan Coastal Plain.

IBRA Subregions: Dandaragan Plateau, Northern Jarrah Forest, Perth, Western Murchison.

Local Government Areas (LGAs): Chittering, Mundaring, Murchison, Swan, Toodyay.

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Plants → Magnoliophyta → Liliopsida → Asparagales → [Orchidaceae Juss.](#) → [Thelymitra J.R.Forst. & G.Forst.](#) → [Thelymitra stellata Lindl.](#)

***Thelymitra stellata* Lindl. Star Sun Orchid**

Sketch Veg.Swan R. 49 (1840)

Conservation Code: [Threatened Flora \(Declared Rare Flora — Extant\)](#)

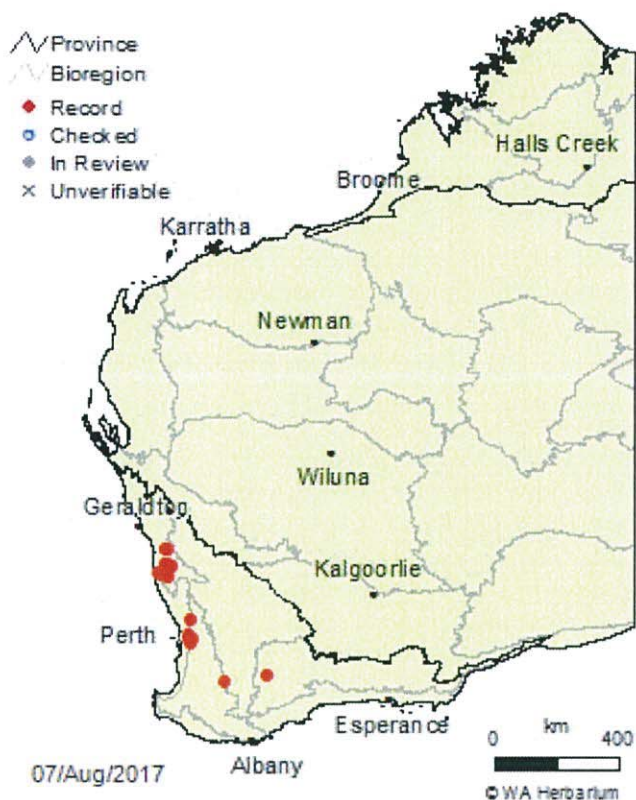
Naturalised Status: Native to Western Australia

Name Status: [Current](#)



Thelymitra stellata

Photos: A.P. Brown & I. & M. Greeve

Thelymitra stellata

Brief Description

Grazyna Paczkowska, Monday 11 April 1994

Tuberous, perennial, herb, 0.15-0.25 m high. Fl. yellow & brown, Oct to Nov. Sand, gravel, lateritic loam.

Distribution

Beard's Provinces: South-West Province.

IBRA Regions: Avon Wheatbelt, Geraldton Sandplains, Jarrah Forest, Mallee, Swan Coastal Plain.

IBRA Subregions: Avon Wheatbelt P2, Lesueur Sandplain, Northern Jarrah Forest, Perth, Western Mallee.

Local Government Areas (LGAs): Armadale, Carnamah, Chittering, Coorow, Dandaragan, Dumbleyung, Gosnells, Kalamunda, Three Springs, West Arthur.

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Plants → Magnoliophyta → Liliopsida → Poales → [Restionaceae R. Br.](#) → [Hypolaena R.Br.](#) → *Hypolaena robusta* Meney & Pate

Hypolaena robusta Meney & Pate

Telopea 6:653, Fig.3 (1996)

Conservation Code: [Priority Four](#)

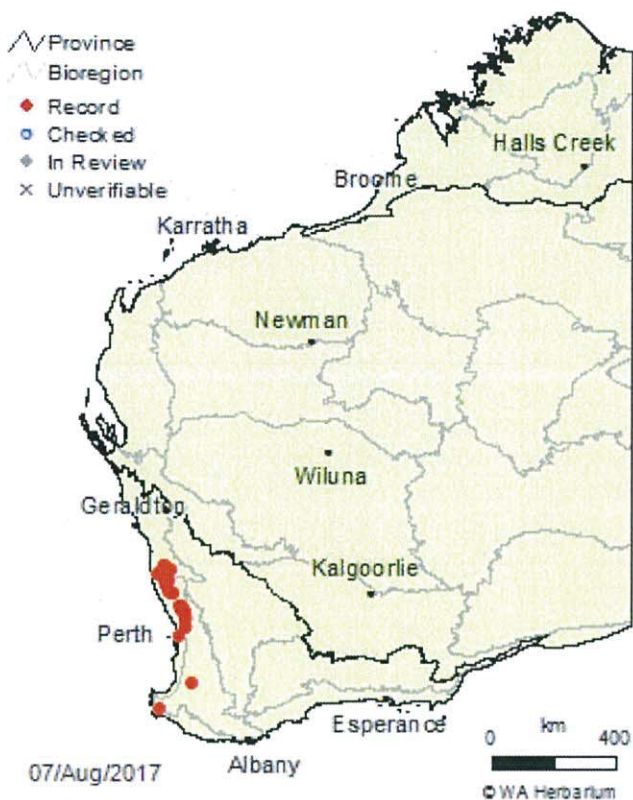
Naturalised Status: Native to Western Australia

Name Status: [Current](#)



Hypolaena robusta

Photos: A.D. Crawford

Hypolaena robusta

Brief Description

Amanda Spooner, Friday 12 September 1997

Dioecious rhizomatous, perennial, herb, ca 0.5 m high. Fl. Sep to Oct. White sand. Sandplains.

Distribution

Beard's Provinces: South-West Province.

IBRA Regions: Geraldton Sandplains, Jarrah Forest, Swan Coastal Plain.

IBRA Subregions: Dandaragan Plateau, Lesueur Sandplain, Perth, Southern Jarrah Forest.

Local Government Areas (LGAs): Augusta-Margaret River, Chittering, Collie, Coorow, Dandaragan, Gingin, Perth, Swan.

Scientific Description

Chris Hollister and Kevin Thiele, Tuesday 23 May 2017

Rhizomes spreading, glabrous. Basal sheath glabrous, dull, striate. Culms terete, internal structure (at base of culm) solid, glabrous, striate, not marbled, not fasciculate. Culm 230-570 mm long. Sheaths (including blade) spreading, dull, striate, glabrous, margins not translucent. Apex recurved, glabrous. Dioecious (with separate male and female plants). Male and female inflorescences distinctly dissimilar, posture (male inflorescences only) Distinctly drooping, Culms unbranched below the inflorescence. Male spikelet 7-10.5 mm long. Subtending bract glabrous, Outer bract 3-3.4 mm long, margins thin and translucent, Apex acute. Perianth glabrous. 2.8-3 mm long. Inner bract glabrous, margins thin and translucent, Apex acute or obtuse. Inner bract 4-5 mm long. Filament 0-0.1 mm long. Anther 1-1.5 mm long. Female spikelet 11-13 mm long. Subtending bract glabrous, margins thin and translucent, Apex

acuminate to attenuate. Outer bract 8-9.5 mm long. Perianth glabrous. 4.5-6.5 mm long. Inner bracts 5.5-10 mm long, glabrous, margins firm and opaque, Apex acuminate to attenuate. Style one, arising centrally from the ovary apex. 8-13 mm long. Fruit indehiscent (nut). Flowering Time September or October. Botanical Province South-West, IBRA Bioregions Geraldton Sandplain, Swan Coastal Plain or Jarrah Forest. Conservation Code PriorityFour (P4).

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Plants → Magnoliophyta → Magnoliopsida → Asterales → [Stylidiaceae R. Br.](#) → [Stylidium Sw.](#) → *Stylidium paludicola* Wege

Stylidium paludicola Wege

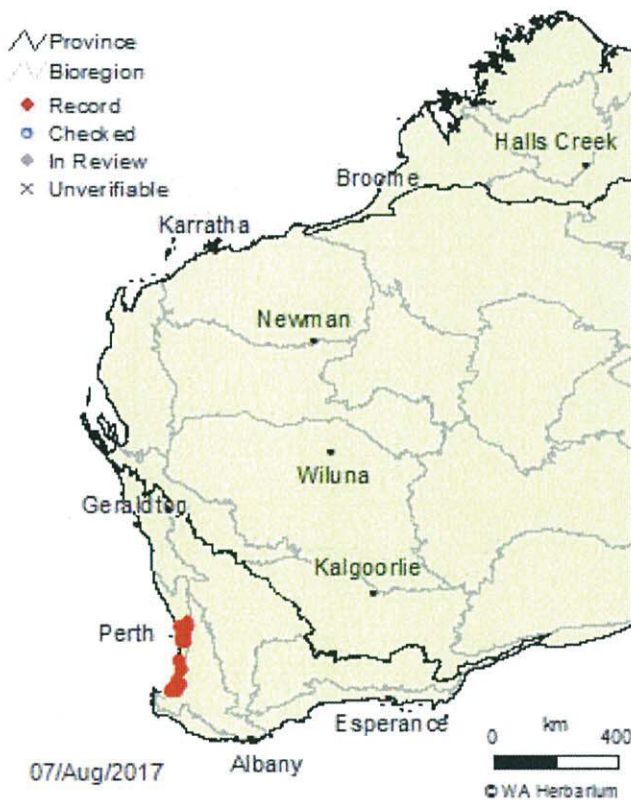
Nuytsia 24:235-237, Fig. 7 (2014)

Conservation Code: [Priority Three](#)

Naturalised Status: Native to Western Australia

Name Status: [Current](#)

Stylidium paludicola



Brief Description

Amanda Spooner, Friday 23 June 2006

Reed-like perennial, herb, 0.35-1 m high, Leaves tufted, linear or subulate or narrowly oblanceolate, 0.5-4 cm long, 0.5-1.5 mm wide, apex acute, margin entire, glabrous. Scape mostly glabrous, inflorescence axis glandular. Inflorescence racemose. Fl. pink, Oct to Dec. Peaty sand over clay. Winter wet habitats. Marri and Melaleuca woodland, Melaleuca shrubland.

Distribution

Beard's Provinces: South-West Province.

IBRA Regions: Jarrah Forest, Swan Coastal Plain.

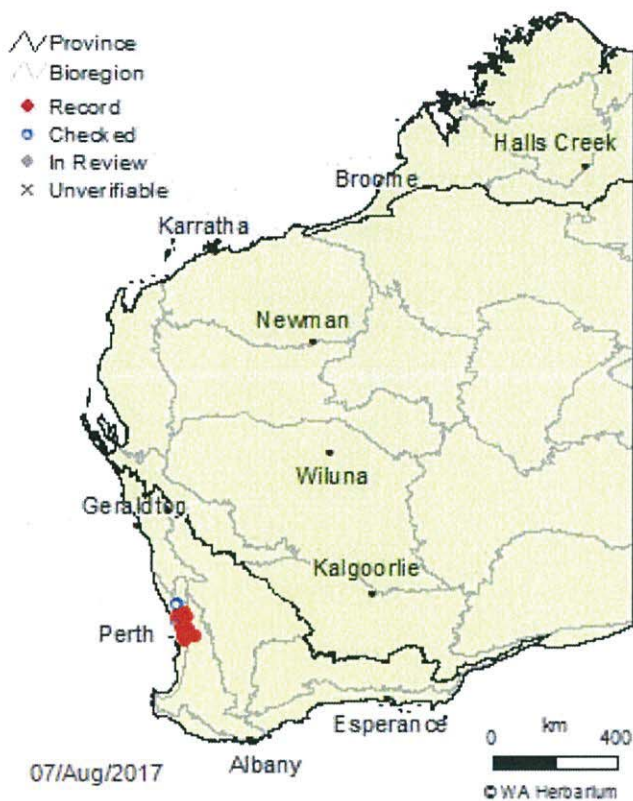
IBRA Subregions: Perth, Southern Jarrah Forest.

Local Government Areas (LGAs): Bayswater, Busselton, Canning, Capel, Cockburn, Dardanup, Harvey, Joondalup, Kwinana, Melville, Murray, Swan.

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Leucopogon squarrosus

Brief Description

Amanda Spooner, Wednesday 16 April 1997

Erect shrub, 0.4-0.7 m high. Fl. white, Feb to Oct. White/grey sand.

Distribution

Beard's Provinces: South-West Province.

IBRA Regions: Swan Coastal Plain.

IBRA Subregions: Dandaragan Plateau.

Local Government Areas (LGAs): Gingin.

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Plants → Magnoliophyta → Magnoliopsida → Ericales → [Ericaceae Juss.](#) → [Leucopogon R.Br.](#) → *Leucopogon squarrosus* Benth.

Leucopogon squarrosus Benth.

Endl., Fenzl, Benth. & Schott, Enum.Pl. 77 (1837)

Conservation Code: [Not threatened](#)

Naturalised Status: Native to Western Australia

Name Status: [Current](#)



Leucopogon squarrosus

Photos: M. Hislop & K.R. Thiele

ninent.

le.

us, ovate to lanceolate.

btuse, erect.

mpact; leaves strongly striate
leaves very variable in shape.

t hirsute or ciliate (or only very
; ovary 2-celled.

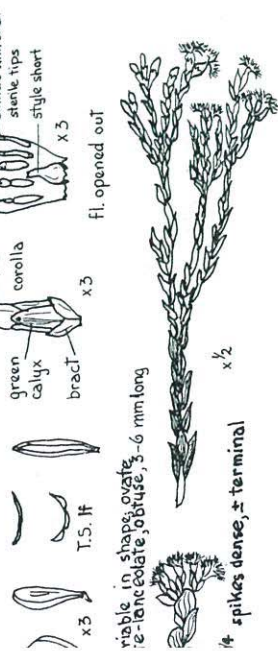
and bracts obtuse.

s ovate or ovate-lanceolate,

Low shrub ± 50 cm high.

n: Ey (C) (Mts Barren, Lucky
, Le (Eneabba), St (C), Wa
inup).

ig-Sept



11 *L. striatus*

s ovate, almost cordate at base.

and bracts acute.



9 *L. carinatus*

(see p. 319)

iate, often pubescent; ovary

Upper leaves ovate.

long.

Habit: Weak shrub 30 cm-1 m high.

Distribn: Av (Northam), Da (Cannington),
Da (C) (Bunbury), Ey (C) (Esperance
area), Ir (Coorow), Lc (Badgingarra), St
(Stirling Ra.).

Fig: June-Oct



12 *L. polymorphus*

(see p. 322)

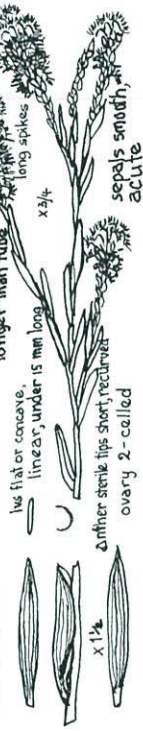
G. Leaves crowded, thick, mostly 7-15 mm
long.

E. Spikes cylindrical; striae on leaves fine but
prominent.

Habit: Erect, usually glabrous shrub 30-50 cm
high.

Distribn: Da (Wandering, Kelmscott), St (Mt
Barker), Wa (Frankland R.).

Fig: July-Oct



13 *L. tenuis*

D. Leaves mucronate acute, frequently squar-
rosc, ± spreading; upper leaves ovate.

Habit: Erect shrub ± 1 m high.

Distribn: Da (Cannington, Capel), St (C).

Fig: Aug-Oct



14 *L. squarrosus*

C. Leaves hirsute or finely pubescent.

D. Spikes ± terminal, cylindrical and many-
flowered or short and few-flowered, ovary
2-celled.



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 05/09/17 19:08:07

[Summary](#)

[Details](#)

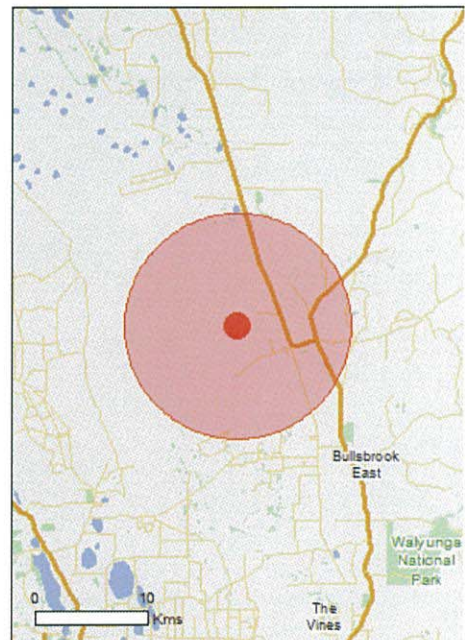
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



This map may contain data which are
©Commonwealth of Australia
(Geoscience Australia), ©PSMA 2010

[Coordinates](#)

Buffer: 10.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

| | |
|---|------|
| World Heritage Properties: | None |
| National Heritage Places: | None |
| Wetlands of International Importance: | None |
| Great Barrier Reef Marine Park: | None |
| Commonwealth Marine Area: | None |
| Listed Threatened Ecological Communities: | 3 |
| Listed Threatened Species: | 27 |
| Listed Migratory Species: | 8 |

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

| | |
|--|------|
| Commonwealth Land: | 2 |
| Commonwealth Heritage Places: | None |
| Listed Marine Species: | 14 |
| Whales and Other Cetaceans: | None |
| Critical Habitats: | None |
| Commonwealth Reserves Terrestrial: | None |
| Commonwealth Reserves Marine: | None |

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

| | |
|--|------|
| State and Territory Reserves: | 5 |
| Regional Forest Agreements: | 1 |
| Invasive Species: | 38 |
| Nationally Important Wetlands: | 1 |
| Key Ecological Features (Marine) | None |

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [\[Resource Information \]](#)

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

| Name | Status | Type of Presence |
|---|------------|---------------------------------------|
| Assemblages of plants and invertebrate animals of tumulus (organic mound) springs of the Swan Coastal Plain | Endangered | Community known to occur within area |
| Banksia Woodlands of the Swan Coastal Plain ecological community | Endangered | Community likely to occur within area |
| Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain | Endangered | Community known to occur within area |

Listed Threatened Species [\[Resource Information \]](#)

| Name | Status | Type of Presence |
|--|-----------------------|--|
| Birds | | |
| Calidris ferruginea Curlew Sandpiper [856] | Critically Endangered | Species or species habitat may occur within area |
| Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034] | Vulnerable | Species or species habitat likely to occur within area |
| Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523] | Endangered | Species or species habitat known to occur within area |
| Leipoa ocellata Malleefowl [934] | Vulnerable | Species or species habitat likely to occur within area |
| Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847] | Critically Endangered | Species or species habitat may occur within area |
| Rostratula australis Australian Painted Snipe [77037] | Endangered | Species or species habitat may occur within area |
| Mammals | | |
| Dasyurus geoffroii Chuditch, Western Quoll [330] | Vulnerable | Species or species habitat likely to occur within area |
| Plants | | |
| Acacia anomala Grass Wattle, Chittering Grass Wattle [8153] | Vulnerable | Species or species habitat likely to occur within area |
| Andersonia gracilis Slender Andersonia [14470] | Endangered | Species or species habitat likely to occur within area |

| Name | Status | Type of Presence |
|--|-----------------------|--|
| <u>Anigozanthos viridis subsp. terraspectans</u> Dwarf Green Kangaroo Paw [3435] | Vulnerable | Species or species habitat likely to occur within area |
| <u>Caladenia huegelii</u> King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309] | Endangered | Species or species habitat likely to occur within area |
| <u>Chamelaucium sp. Gingin (N.G. Marchant 6)</u> Gingin Wax [88881] | Endangered | Species or species habitat known to occur within area |
| <u>Conospermum densiflorum subsp. unicephalatum</u> One-headed Smokebush [64871] | Endangered | Species or species habitat may occur within area |
| <u>Darwinia foetida</u> Mucnea Bell [83190] | Critically Endangered | Species or species habitat known to occur within area |
| <u>Diuris micrantha</u> Dwarf Bee-orchid [55082] | Vulnerable | Species or species habitat may occur within area |
| <u>Diuris purdiei</u> Purdie's Donkey-orchid [12950] | Endangered | Species or species habitat may occur within area |
| <u>Drakaea elastica</u> Glossy-leaved Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753] | Endangered | Species or species habitat likely to occur within area |
| <u>Eleocharis keigheryi</u> Keighery's Eleocharis [64893] | Vulnerable | Species or species habitat likely to occur within area |
| <u>Eucalyptus leprophloia</u> Scaly Butt Mallee, Scaly-butt Mallee [56712] | Endangered | Species or species habitat may occur within area |
| <u>Eucalyptus x balanites</u> Cadda Road Mallee, Cadda Mallee [87816] | Endangered | Species or species habitat may occur within area |
| <u>Grevillea curviloba subsp. curviloba</u> Curved-leaf Grevillea [64908] | Endangered | Species or species habitat known to occur within area |
| <u>Grevillea curviloba subsp. incurva</u> Narrow curved-leaf Grevillea [64909] | Endangered | Species or species habitat known to occur within area |
| <u>Lepidosperma rostratum</u> Beaked Lepidosperma [14152] | Endangered | Species or species habitat likely to occur within area |
| <u>Ptychosema pusillum</u> Dwarf Pea [11268] | Vulnerable | Species or species habitat likely to occur within area |
| <u>Synaphea sp. Fairbridge Farm (D. Papenfus 696)</u> Selena's Synaphea [82881] | Critically Endangered | Species or species habitat may occur within area |
| <u>Thelymitra dedmaniarum</u> Cinnamon Sun Orchid [65105] | Endangered | Species or species habitat likely to occur within area |
| <u>Thelymitra stellata</u> Star Sun-orchid [7060] | Endangered | Species or species habitat known to occur within area |

| Listed Migratory Species | | [Resource Information] |
|--|-----------------------|--|
| * Species is listed under a different scientific name on the EPBC Act - Threatened Species list. | | |
| Name | Threatened | Type of Presence |
| Migratory Marine Birds | | |
| Apus pacificus | | |
| Fork-tailed Swift [678] | | Species or species habitat likely to occur within area |
| Migratory Terrestrial Species | | |
| Motacilla cinerea | | |
| Grey Wagtail [642] | | Species or species habitat may occur within area |
| Migratory Wetlands Species | | |
| Actitis hypoleucos | | |
| Common Sandpiper [59309] | | Species or species habitat may occur within area |
| Calidris acuminata | | |
| Sharp-tailed Sandpiper [874] | | Species or species habitat may occur within area |
| Calidris ferruginea | | |
| Curlew Sandpiper [856] | Critically Endangered | Species or species habitat may occur within area |
| Calidris melanotos | | |
| Pectoral Sandpiper [858] | | Species or species habitat may occur within area |
| Numenius madagascariensis | | |
| Eastern Curlew, Far Eastern Curlew [847] | Critically Endangered | Species or species habitat may occur within area |
| Pandion haliaetus | | |
| Osprey [952] | | Species or species habitat may occur within area |

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name

Commonwealth Land -
Defence - MUCHEA ARMAMENT RANGE

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

| Name | Threatened | Type of Presence |
|------------------------------------|------------|--|
| Birds | | |
| Actitis hypoleucos | | |
| Common Sandpiper [59309] | | Species or species habitat may occur within area |
| Apus pacificus | | |
| Fork-tailed Swift [678] | | Species or species habitat likely to occur within area |
| Ardea alba | | |
| Great Egret, White Egret [59541] | | Species or species habitat known to occur within area |
| Ardea ibis | | |
| Cattle Egret [59542] | | Species or species habitat may occur within |

| Name | Threatened | Type of Presence area |
|---|-----------------------|--|
| Calidris acuminata Sharp-tailed Sandpiper [874] | | Species or species habitat may occur within area |
| Calidris ferruginea Curlew Sandpiper [856] | Critically Endangered | Species or species habitat may occur within area |
| Calidris melanotos Pectoral Sandpiper [858] | | Species or species habitat may occur within area |
| Haliaeetus leucogaster White-bellied Sea-Eagle [943] | | Species or species habitat likely to occur within area |
| Merops ornatus Rainbow Bee-eater [670] | | Species or species habitat may occur within area |
| Motacilla cinerea Grey Wagtail [642] | | Species or species habitat may occur within area |
| Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847] | Critically Endangered | Species or species habitat may occur within area |
| Pandion haliaetus Osprey [952] | | Species or species habitat may occur within area |
| Rostratula benghalensis (sensu lato) Painted Snipe [889] | Endangered* | Species or species habitat may occur within area |
| Thinornis rubricollis Hooded Plover [59510] | | Species or species habitat may occur within area |

Extra Information

| State and Territory Reserves | | [Resource Information] |
|---|-------------------|--|
| Name | State | |
| Chandala | WA | |
| Neaves Road | WA | |
| Unnamed WA02336 | WA | |
| Unnamed WA44622 | WA | |
| Unnamed WA50678 | WA | |
| Regional Forest Agreements | | [Resource Information] |
| Note that all areas with completed RFAs have been included. | | |
| Name | State | |
| South West WA RFA | Western Australia | |

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.

| Name | Status | Type of Presence |
|---|--------|--|
| Birds | | |
| <i>Acridotheres tristis</i> Common Myna, Indian Myna [387] | | Species or species habitat likely to occur within area |
| <i>Anas platyrhynchos</i> Mallard [974] | | Species or species habitat likely to occur within area |
| <i>Carduelis carduelis</i> European Goldfinch [403] | | Species or species habitat likely to occur within area |
| <i>Columba livia</i> Rock Pigeon, Rock Dove, Domestic Pigeon [803] | | Species or species habitat likely to occur within area |
| <i>Passer domesticus</i> House Sparrow [405] | | Species or species habitat likely to occur within area |
| <i>Passer montanus</i> Eurasian Tree Sparrow [406] | | Species or species habitat likely to occur within area |
| <i>Streptopelia chinensis</i> Spotted Turtle-Dove [780] | | Species or species habitat likely to occur within area |
| <i>Streptopelia senegalensis</i> Laughing Turtle-dove, Laughing Dove [781] | | Species or species habitat likely to occur within area |
| <i>Sturnus vulgaris</i> Common Starling [389] | | Species or species habitat likely to occur within area |
| Mammals | | |
| <i>Bos taurus</i> Domestic Cattle [16] | | Species or species habitat likely to occur within area |
| <i>Canis lupus familiaris</i> Domestic Dog [82654] | | Species or species habitat likely to occur within area |
| <i>Capra hircus</i> Goat [2] | | Species or species habitat likely to occur within area |
| <i>Felis catus</i> Cat, House Cat, Domestic Cat [19] | | Species or species habitat likely to occur within area |
| Feral deer Feral deer species in Australia [85733] | | Species or species habitat likely to occur within area |
| <i>Funambulus pennantii</i> Northern Palm Squirrel, Five-striped Palm Squirrel [129] | | Species or species habitat likely to occur within area |
| <i>Mus musculus</i> House Mouse [120] | | Species or species habitat likely to occur within area |

| Name | Status | Type of Presence |
|--|--------|--|
| Oryctolagus cuniculus Rabbit, European Rabbit [128] | | Species or species habitat likely to occur within area |
| Rattus norvegicus Brown Rat, Norway Rat [83] | | Species or species habitat likely to occur within area |
| Rattus rattus Black Rat, Ship Rat [84] | | Species or species habitat likely to occur within area |
| Sus scrofa Pig [6] | | Species or species habitat likely to occur within area |
| Vulpes vulpes Red Fox, Fox [18] | | Species or species habitat likely to occur within area |
| Plants | | |
| Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473] | | Species or species habitat likely to occur within area |
| Brachiaria mutica Para Grass [5879] | | Species or species habitat may occur within area |
| Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213] | | Species or species habitat may occur within area |
| Chrysanthemoides monilifera Bitou Bush, Boneseed [18983] | | Species or species habitat may occur within area |
| Chrysanthemoides monilifera subsp. monilifera Boneseed [16905] | | Species or species habitat likely to occur within area |
| Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800] | | Species or species habitat likely to occur within area |
| Genista sp. X Genista monspessulana Broom [67538] | | Species or species habitat may occur within area |
| Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892] | | Species or species habitat likely to occur within area |
| Lycium ferocissimum African Boxthorn, Boxthorn [19235] | | Species or species habitat likely to occur within area |
| Olea europaea Olive, Common Olive [9160] | | Species or species habitat may occur within area |
| Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780] | | Species or species habitat may occur within area |
| Rubus fruticosus aggregate Blackberry, European Blackberry [68406] | | Species or species habitat likely to occur within area |
| Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497] | | Species or species habitat likely to occur |

| Name | Status | Type of Presence |
|---|--------|--|
| Salvinia molesta | | within area |
| Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665] | | Species or species habitat likely to occur within area |
| Tamarix aphylla | | |
| Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018] | | Species or species habitat likely to occur within area |
| Reptiles | | |
| Hemidactylus frenatus | | |
| Asian House Gecko [1708] | | Species or species habitat likely to occur within area |
| Ramphotyphlops braminus | | |
| Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258] | | Species or species habitat likely to occur within area |

| Nationally Important Wetlands | | [Resource Information] |
|--------------------------------|--|--------------------------|
| Name | | State |
| Chandala Swamp | | WA |

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overlie the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-31.56667 115.93333

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [Office of Environment and Heritage, New South Wales](#)
- [Department of Environment and Primary Industries, Victoria](#)
- [Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [Department of Environment, Water and Natural Resources, South Australia](#)
- [Department of Land and Resource Management, Northern Territory](#)
- [Department of Environmental and Heritage Protection, Queensland](#)
- [Department of Parks and Wildlife, Western Australia](#)
- [Environment and Planning Directorate, ACT](#)
- [Birdlife Australia](#)
- [Australian Bird and Bat Banding Scheme](#)
- [Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [Museum Victoria](#)
- [Australian Museum](#)
- [South Australian Museum](#)
- [Queensland Museum](#)
- [Online Zoological Collections of Australian Museums](#)
- [Queensland Herbarium](#)
- [National Herbarium of NSW](#)
- [Royal Botanic Gardens and National Herbarium of Victoria](#)
- [Tasmanian Herbarium](#)
- [State Herbarium of South Australia](#)
- [Northern Territory Herbarium](#)
- [Western Australian Herbarium](#)
- [Australian National Herbarium, Canberra](#)
- [University of New England](#)
- [Ocean Biogeographic Information System](#)
- [Australian Government, Department of Defence](#)
- [Forestry Corporation, NSW](#)
- [Geoscience Australia](#)
- [CSIRO](#)
- [Australian Tropical Herbarium, Cairns](#)
- [eBird Australia](#)
- [Australian Government – Australian Antarctic Data Centre](#)
- [Museum and Art Gallery of the Northern Territory](#)
- [Australian Government National Environmental Science Program](#)
- [Australian Institute of Marine Science](#)
- [Reef Life Survey Australia](#)
- [American Museum of Natural History](#)
- [Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- Other groups and individuals

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Please feel free to provide feedback via the [Contact Us](#) page.