

3. Potential Environmental Impacts

3.1 Geology, soils & topography

3.1.1 Acid Sulfate Soils

As there is a very low risk of ASS occurring within the impact area and the Project will not require excavations below the water-table there is a very low likelihood of impact on ASS. However, disturbance of natural ground within seasonally inundated areas and salt pans will require further assessment prior to commencing construction.

3.2 Land systems

The 13 land systems described by Mabbutt *et al.* (1963) that occur within the survey area have been assessed to determine the percentage of each land system that will be impacted by clearing of the Impact Area (Table 14). This shows that the Impact Area contains less than 0.07% of each the land systems. Therefore the expected impact on these land systems is minor.

Table 14 Percentage of land systems within the Survey Area and Impact Area

Land system	Total extent (ha)	Area (ha) within Survey Area	Area (ha) within Impact Area	Maximum percentage (%) of land system within the Impact Area
RGEWIL Wiluna Land System	261,358	452.97	13.67	0.005
RGEBEL Belele Land System	582,013	859	24.35	0.004
RGEGAB Gabanintha Land System	252,929	140.29	2.45	0.001
RGESHE Sherwood Land System	1,587,328	1,619.24	38.21	0.002
RGEYNG Yanganoo Land System	2,032,067	3,263.85	73.43	0.004
RGEBLM Bullimore Land System	4,419,747	729.45	34.2	0.0008
RGETRN Trennaman Land System	90,729	262.44	8.09	0.009
RGEGLY Glengarry Land System	220,090	1,627.36	75.96	0.03
RGECUN Cunyu Land System	330,976	2,743.76	85.6	0.026
RFEDUL Dural Land System	219,048	3,630.25	105	0.048
RGEDIA Diamond Land System	46,083	1,710.32	31.79	0.069
RGEJUN Jundee Land System	661,594	531.05	17.81	0.003
RGEVIO Violet Land System	583,687	426.73	23.99	0.004

Mabbutt *et al.* (1963)

3.3 Hydrology

The Project will involve activities that have the potential to impact surface water hydrology, including:

- Changes to land topography that modifies overland flow patterns
- Development of infrastructure that modifies overland flow patterns
- Interruption to existing surface water flow patterns
- Increased erosion and sedimentation
- Contamination of surface water by chemicals and hydrocarbons

3.3.1 Groundwater

Groundwater extraction may be required during construction. Where possible Main Roads will use existing bores and licences; however additional water licences may be required. Impacts on the PEC associated with groundwater may occur, depending on where the groundwater extraction will occur (impacts discussed in Section 3.5.3).

3.3.2 Surfacewater

Drainage impacts during construction works and operation are issues in respect to maintaining existing surface water flows. As the majority of drainage on the surveyed areas is intermittent and poorly defined the risks of significant impacts to surface water flows are low. The following impacts are likely to occur:

- There are minor risks of erosion in the pit areas
- Pit excavation has the potential to create temporary pools following rainfall

The Project requires the crossing of several water courses with the subsequent construction of bridges and culverts. The bridges and culverts will be designed to have no effect on the existing natural flows, thus minimising impacts on the watercourses.

Potential impacts to watercourses may occur during construction through clearing and earthworks. The construction of the bridges will result in the clearing of the riparian vegetation along a small section of the creeks in the construction zone. Construction is likely to occur during the dry season, thus minimising potential impacts on flows through watercourses during the construction works. Impacts will be minimised by appropriate management measures that should be implemented through the EMP.

Some localised erosion may occur during significant rainfall events. This is considered to be a greater issue during the construction phase following clearing. During operation erosion may be mitigated through measures such as rock protection placement and rehabilitation of cleared areas. Where the land is overlain by a mantle of stones the removal of these due to earthworks may lead to increased risk of erosion.

To minimise potential issues associated with drainage line erosion, rock protection or other soil protection controls should be implemented at bridges and culverts. With the implementation of these measures, the potential for erosion to occur is minor.

Water quality impacts may occur from water with changed pH, hydrocarbon pollution or mobilised dissolved metals as a result of the Project. This impact can be reduced through pollution control measures implemented during and after construction and within the operational EMP. Impacts as a result of possible changes to water quality are therefore expected to be minor.

3.3.3 Wetlands

No wetlands were recorded within or adjacent to the Impact Area and there are not expected to be any impacts on wetlands from this Project.

3.4 Regional biogeography

Clearing of the Impact Area will result in clearing of less than 0.002 % of each IBRA sub-region, as detailed in Table 15, and impacts at the IBRA region level are expected to be insignificant.

Table 15 Percentage of IBRA sub-region within Impact Area

IBRA sub-region	Total extent (ha)	Area (ha) within Survey Area	Area (ha) within Impact Area	% of total extent within Impact Area (regional impact)
Western Murchison	6,985,502.83	1,239.7	35.11	0.0005
Eastern Murchison	21,135,083.93	16,757.1	499.43	0.002

3.5 Vegetation and flora

The Project will create an Impact Area of 533.74 ha including clearing of approximately 519.24 ha of native vegetation, in Condition 4 or better.

The removal of vegetation has a number of potential impacts, including:

- Reduction in vegetation association extents
- Clearing of DPaW priority listed flora species
- Loss of fauna habitat
- Instability and increased erosion
- Increased runoff

3.5.1 Vegetation extents

The local and regional impacts on the loss of vegetation associations have been assessed using the remaining extents of the Beard (1974) vegetation associations calculated by the Department of Environment and Conservation (latest update 2012 –GOWA 2013b).

As indicated in Table 16, clearing of the Impact Area would result in clearing of less than 0.4% of the remaining extent of Beard's (1974) vegetation association at all levels. The clearing required for the Project is therefore unlikely to have a significant impact on the regional vegetation extents.

Table 16 Vegetation associations and extent (Beard 1974) within the Impact Area

Vegetation association	Scale	Pre-European Extent (ha)	Current Extent (ha)	Remaining (%)	Vegetation association within Impact Area (ha)	% of current extent within Impact Area
IBRA Region Murchison		28,120,586.77	28,044,823.42	99.73		
11	State	31,723	31,698	99.92	11.14	0.04
	Bioregion - Murchison	9,178	9,153	99.73		0.12
	Sub-region – Eastern Murchison	8,524	8,499	99.70		0.13
	LGA – Shire of Wiluna	7,037	7,012	99.64		0.16
18	State	19,892,305	198,437,27	99.76	219.14	0.001
	Bioregion - Murchison	12,403,172	12,363,252	99.68		0.002
	Sub-region –Western Murchison	2,133,276	2,128,414	99.77		0.01
	Sub-region – Eastern Murchison	10,269,896	10,234,838	99.96		0.002
	LGA – Shire of Wiluna	2,039,881	2,030,407	99.54		0.011
	LGA – Shire of Meekatharra	3,118,037	3,111,401	99.79		0.007
39	State	6,613,569	6,602,580	99.83	7.21	0.0001
	Bioregion - Murchison	1,148,400	1,138,065	99.10		0.0006
	Sub-region – Western Murchison	437,071	436,130	99.78		0.002
	LGA - Shire of Meekatharra	1,367,519	1,365,794	99.87		0.0005
29	State	7,903,991	7,900,200	99.95	227.85	0.003
	Bioregion - Murchison	2,956,382	2,955,695	99.98		0.008
	Sub-region – Western Murchison	2,160,147	2,159,669	99.98		0.01
	Sub-region – Eastern Murchison	796,235	796,026	99.97		0.03
	LGA – Shire of Wiluna	2,027,699	2,027,505	99.99		0.011
	LGA – Shire of Meekatharra	2,854,683	2,851,596	99.89		0.008
107	State	2,815,387	2,813,996	99.95	43.8	0.00003
	Bioregion - Murchison	2,792,383	2,790,992	99.95		0.002
	Sub-region – Eastern Murchison	2,785,303	2,783,912	99.95		0.002
	LGA – Shire of Meekatharra	287,359	287,359	100		0.02

Vegetation association	Scale	Pre-European Extent (ha)	Current Extent (ha)	Remaining (%)	Vegetation association within Impact Area (ha)	% of current extent within Impact Area
202	State	448,529	448,343	99.96	1.19	0.0003
	Bioregion - Murchison	339,742	339,641	99.97		0.0004
	Sub-region –Western Murchison	61,127	61,115	99.97		0.002
	Sub-region – Eastern Murchison	278,615	278,525	99.98		0.0004
	LGA – Shire of Wiluna	48,553	48,540	99.97		0.002
204	State	199,475	198,735	99.63	13.56	0.007
	Bioregion - Murchison	185,602	184,861	99.60		0.007
	Sub-region – Eastern Murchison	75,042	74,306	99.02		0.02
	LGA – Shire of Wiluna	39,117	38,380	98.12		0.04
223	LGA – Shire of Meekatharra	94,029	94,018	99.99	9.85	0.01
	Bioregion - Murchison	2,597	2,597	100		0.37
	Sub-region – Eastern Murchison	2,597	2,597	100		0.37
	LGA – Shire of Meekatharra	2,597	2,597	100		0.37

(Beard 1974; GoWA 2013b).

3.5.2 Other Significant Vegetation

The extent of the vegetation considered as 'other significant vegetation' that was mapped within the Impact Area is defined in Table 17. These vegetation types were generally restricted to very specific landforms and the Impact Area avoids impacting a majority of them. The Project will impact on less than 5% of each of the 'other significant vegetation' mapped within the Survey Area.

Table 17 Extent of 'Other significant vegetation' mapped within the Survey Area and Impact Area

Vegetation association	Extent in Survey Area (ha)	Extent in Impact Area (ha)	% of mapped vegetation association within Impact Area (Impact Area/ Survey Area)
VA05: Mixed low woodland on banded ironstone and chert hills	8.06	0	0
VA09: <i>Acacia burkittii</i> tall shrubland on quartz and ironstone hills	120.37	2.88	2.4
VA12: <i>Eremophila</i> low shrubland on low rocky hills	30.01	1.14	3.8
VA15: <i>Eucalyptus camaldulensis</i> woodland over mixed shrubland in ephemeral drainage lines and adjacent floodplains	251.2	6.48	2.6
VA20: Mixed low shrubland on calcareous breakaways	148.36	0.22	0.2
VA21: Mixed <i>Acacia</i> and <i>Eremophila</i> low shrubland on granite and quartz outcrops	18.97	0.9	4.7
VA22: Mixed <i>Acacia</i> tall shrubland on banded ironstone hills	31.46	0.03	0.1
VA23: Mixed low shrubland on outcrops	35.53	0.025	0.1
VA24: <i>Corymbia lenziana</i> open woodland on sand dunes	4.61	0	0

3.5.3 Conservation significant communities

No TECs were recorded within the survey area and there are no expected impacts on TECs from this project.

Subterranean Ecology (2014) assessed the potential impacts that the Project may have on CGAs (listed as a Priority 1 PEC). Their report based the assessment of impacts on the EPA's Environmental Assessment Guideline for consideration of subterranean fauna in environmental impact assessment in Western Australia (EPA 2013). The assessment determined that the potential direct and indirect impacts relevant to CGAs for this Project are:

- Excavation of rock /gravel (only if on calcrete)
- Groundwater extraction/dewatering (single bore/bore-field if affecting calcrete aquifer)
- Changed surface topography due to compaction or creation of hard (impermeable road) surfaces resulting in increased runoff and reduced infiltration and aquifer recharge (or modified infiltration/recharge regime)

- Potential leaks (or sediment-laden runoff) resulting in alterations to groundwater quality including wastewater, introduction of toxins or radiation (e.g. hydrocarbon spills, sediments)
- Salinisation due to pit voids or intrusion (if gravel pits extend below watertable in or near calcrete)
- Vegetation clearing (road drainage and runoff) leading to sedimentation and changed nutrient inputs (only when on or near calcrete)

Subterranean Ecology (2014) determined that all of these potential impacts can be avoided, managed or mitigated to ensure that the Project does not pose an unacceptable risk to conservation of CGAs.

Subterranean Ecology (2014) determined that there is no existing evidence and a low likelihood that the proposed Project actions will pose a threat to CGAs subject to the following assumptions:

- Groundwater pumping or drawdown will not impinge on any CGAs
- Best practice operational procedures are applied to avoid and manage potential impacts to groundwater recharge and groundwater quality that might result from road building activities on or near to CGAs including drainage, gravel pits and control of leakage/spills.

Where there is a likelihood that a CGA or other calcrete deposit may be affected by the Project then it is recommended that field inspection by a suitably qualified person be undertaken to confirm that sites selected for groundwater abstraction and gravel pits are located to avoid calcrete (Subterranean Ecology 2014). Subterranean Ecology recommended that Main Roads document the location and relevant boundaries of any calcrete deposits within two kilometres of Project operations and report these to DPaW.

Should groundwater extraction be required for this Project, or the buffer distances suggested by Subterranean Ecology (2014) cannot be enforced, then further work will be required to determine potential impacts from the Project on CGAs.

3.5.4 Conservation significant flora species

No flora species listed under the EPBC Act or the WC Act have been recorded within the Impact Area.

It is considered that the clearing required for the Project will have no impacts on flora species listed under the EPBC Act or WC Act.

Nine species listed by DPaW as Priority were recorded within the Survey Area. Two of these species occur within the Impact Area: *Ptilotus luteolus* and *Stackhousia clementii*. The population extent of these species within the state has been determined through desktop searches and is included in Table 18. The estimation of populations and plants in the whole of Western Australia, as included in Table 18, is a conservative estimate as:

- FloraBase records do not always provide details on the number of plants present. Records often provide comments such as 'scattered' and 'common' for their frequency. However, where a count was not provided the record has only been included as one plant.
- Records on FloraBase only represent those lodged with the herbarium. There may be other populations in areas not surveyed or records may not have been lodged.

Table 18 Population size of priority flora species recorded within the Impact Area and the Survey Area and known records for the state

Taxon	Status	Count in Survey Area	Count in Impact Area	State-wide record frequency	State-wide impact (# in Impact Area/ # in state)
<i>Ptilotus luteolus</i>	P3	2	2	14 records on Florabase, at least 460 individuals counted (WA Herbarium 1998-)	0.43
<i>Stackhousia clementii</i>	P3	counts averaging 180 individuals per 100 m ² .	counts averaging 180 individuals per 100 m ² .	8 records on Florabase, no counts of population size available (WA Herbarium 1998-)	unknown

The clearing of the populations of *Ptilotus luteolus* within the Impact Area is not considered likely to impact on the viability of this species as substantial populations have been recorded outside of the Impact Area. Specific impacts on *Stackhousia clementii* can not be quantified with current information but this species was noted during the field survey to occur throughout Bubble Creek within the Survey Area, not only within the Impact Area. *Stackhousia clementii* is a widespread species that occurs throughout the Carnarvon, Central Ranges, Murchison and Pilbara regions in Western Australia.

3.5.5 Introduced flora

There is potential to introduce and/or spread weed species into adjacent areas during the operational phase. The Project has the potential to:

- Increase the spread of weeds along the highway
- Introduce new weed species into the area through construction traffic and soil movement
- Introduce weeds into areas in which they did not previously occur (particularly relevant for the borrow pit areas)

However, the risk of introduction of weed species is an existing issue in the area due to the extensive disturbance from traffic and cattle. The spread of weed species is not expected to significantly increase as a result of the Project and the implementation of weed management measures should assist in minimising the risk of potential environmental impacts.

3.6 Fauna

3.6.1 Fauna habitats

Eight broad habitat types occur within the proposed Impact Area (Figure 9). Each of these habitat types are well represented in the immediate vicinity of the proposed Impact Area and in the broader Murchison region (as outlined in section 3.5.1). A summary of the area of each habitat type within the proposed Impact Area is outlined in Table 19.

The proposed Impact Area consists of approximately 510.4 ha of fauna habitat associated with remnant vegetation. The remaining 21.2 ha consists of previously disturbed areas, including existing borrow pits with and without regrowth, pastoral infrastructure and roadside margins. These disturbed areas may provide some limited habitat for native fauna.

The habitats within the proposed Impact Area are well connected both locally and regionally to native vegetation north and south of the Goldfields Highway. The proposed project would potentially reduce the overall connectivity of habitat available to the native fauna in the locality. The existing road already contributes (albeit probably only to a minor degree) to the fragmentation of habitats within the surrounding landscape. Clearing for the project, and widening the area of disturbance during construction may potentially exacerbate existing fragmentation effects and edge effects rather than completely divide a single area of habitat into two separate areas of habitat.

Construction of the project will require clearing of 510.4 ha of fauna habitat associated with remnant vegetation (Table 19). This will result in a loss of the habitat available to fauna species. The specific impacts to fauna species as a result of this loss are discussed further in section 3.6.2.

Table 19 Summary and area of each habitat type within the proposed Impact Area and value for fauna

Habitat type	Area within the proposed Impact Area (ha)	Summary of habitat value	Extent outside proposed Impact Area
<i>Acacia</i> shrubland over tussock grasses	345.9 ha	Moderate A large proportion of this habitat has been heavily disturbed via grazing and therefore lacks vegetation structure and species diversity. In areas with minimal disturbance and impacts from grazing, the habitat value is moderate.	Extensive areas of <i>Acacia</i> shrubland habitat are common in the vicinity of the proposed Impact Area and throughout the Murchison bioregion.
<i>Acacia</i> shrubland over hummock grasses	122.3 ha	High A large proportion of this habitat has been heavily disturbed via grazing and therefore lacks vegetation structure and species diversity. In areas with minimal disturbance and impacts from grazing there are mature, well-spaced hummocks interspersed with <i>Acacia</i> shrubs which provide high habitat value.	Extensive areas of <i>Acacia</i> shrubland habitat are common in the vicinity of the proposed Impact Area and throughout the Murchison bioregion.
Mixed shrubland	12.1 ha	Moderate A large proportion of this habitat has been heavily disturbed via grazing and therefore lacks vegetation structure and species diversity. In areas with minimal disturbance and impacts from grazing, the habitat value is moderate.	Extensive areas of <i>Acacia</i> shrubland habitat are common in the vicinity of the proposed Impact Area and throughout the Murchison bioregion.
Tussock grassland	0.15 ha	Low This habitat type is largely disturbed and has limited vegetation structure and diversity.	A common habitat in the Murchison bioregion.

Habitat type	Area within the proposed Impact Area (ha)	Summary of habitat value	Extent outside proposed Impact Area
Chenopod shrubland	17.9 ha	Low This habitat type is largely disturbed and has limited vegetation structure and diversity.	A common habitat in the Murchison bioregion which tends to be localised and associated with claypans, representing a small proposal of the total land area.
<i>Eucalyptus/ Corymbia</i> woodland (including riparian habitat around Bubble Creek)	6.48 ha	High This habitat type provides good structural and species diversity and a variety of habitat resources for fauna.	A common feature along more major drainage lines in the Murchison bioregion, although rare in the vicinity of the proposed Impact Area.
Rocky outcrops, breakaways and Banded Ironstone Formation (BIF) hills	5.48 ha	High This habitat type is less common in the surrounding area and is typically isolated and provides valuable refuge areas for fauna.	A rare feature in the landscape, representing a small proposal of the total land area.
Sand dune	0 ha (only present within the Survey Area)	High This habitat type was only recorded within the Survey area, and outside the proposed Impact Area. It was only recorded in one small area and is likely to rare in the surrounding area.	Very rare in the landscape and the vicinity of the proposed Impact Area. Occur more frequently to the north-east of the proposed Impact Area.
Previously cleared areas/regrowth	17.8 ha	Low This habitat type is largely disturbed and has limited vegetation structure and diversity.	Scattered throughout the landscape including borrow pits at various stages of regrowth.
Cleared/highly disturbed. This includes, roads, tracks, infrastructure and permanently cleared areas	3.38 ha	Very low This habitat type is completely disturbed and devoid of vegetation.	A common feature around major towns and near mine sites in the area.
Total area of remnant vegetation -	510.4 ha		
Total area of cleared/highly disturbed areas -	21.2 ha		
Total area-	531.6 ha		

3.6.1 Habitat linkages

Clearing of vegetation within the proposed Impact Area may exacerbate the existing fragmentation of the habitat but is unlikely to substantially reduce the connectivity of habitat at a local or regional scale. The potential impacts to habitat linkages resulting from clearing the proposed Impact Area predominantly relate to the widening of the existing road corridor prior to and during construction, as well as clearing for the material pits and access tracks. The habitats within the proposed Impact Area are well connected both locally and regionally to other areas of habitat. The majority of the proposed Impact Area has previously been grazed and therefore the habitats have experienced various levels of disturbance resulting in some areas being highly degraded. Therefore for the project is unlikely to substantially reduce the availability of habitat for fauna species in the local area or decrease the connectivity of habitat linkages to surrounding areas of remnant vegetation.

Furthermore the ongoing operational phase of the project is unlikely to substantially inhibit (i.e. reduce the number of movements across the road) or reduce the functionality of the habitat in the surrounding area. The upgrade to sections of the Goldfields Highway is unlikely to substantially increase the vehicle traffic utilising the highway, and therefore the potential impact of increased risk of vehicle strike is unlikely to a substantial impact of the project.

3.6.2 Conservation significant fauna

During the fauna assessment in November 2013, five conservation significant fauna species were recorded in the proposed Impact Area. In addition to these species, a number of conservation significant fauna were identified in the desktop review as potentially occurring within the proposed Impact Area. A likelihood of occurrence assessment of these species was undertaken (summarised in Table 12), and concluded that an additional six conservation significant fauna are likely to or may possibly occur in the proposed Impact Area.

Therefore a total of 11 conservation significant fauna species are known to, likely to or may possibly occur in the proposed Impact Area. The potential impacts to each of these species are discussed below.

It should be noted that a number of conservation significant fauna were assessed as unlikely to occur within the proposed Impact Area. The potential impacts to these species have not been assessed given that the project is unlikely to substantially impact on these species.

WC Act and EPBC Act listed species

The results of the desktop and field assessment identified four EPBC Act and/or WC Act listed fauna species known to, likely to or that may possibly occur within the proposed Impact Area. These include:

- Grey Falcon (*Falco hypoleucos*) – Threatened (Schedule 1) under WC Act
- Malleefowl (*Leipoa ocellata*) – Threatened (Schedule 1) under WC Act, Vulnerable under EPBC Act
- Peregrine Falcon (*Falco hypoleucos*) – Schedule 4 WC Act
- Major Mitchell's Cockatoo (*Cacatua leadbeateri*) – Schedule 4 WC Act

Grey Falcon

One Grey Falcon individual was observed perching on a dead tree within *Acacia* shrubland during the field survey, outside the proposed Impact Area. The Grey Falcon is an elusive species endemic to Australia, and also Australia's rarest falcon (Schoenjahn 2012). Given the rarity of this species, it is likely to occur in low numbers within the proposed Impact Area and opportunistically utilise all of the habitats available for hunting and dispersal. As outlined in Table 20, clearing for the project will result in a loss of 510.4 ha of suitable habitat for the Grey Falcon.

Given the availability of suitable habitat in the local area and surrounding region, and that the Grey Falcon is a wide ranging and highly mobile species, the proposed project is unlikely to have a significant impact on any individual Grey Falcon.

Malleefowl

The Malleefowl is likely to occur within the proposed Impact Area in low numbers. This species is known to occur in the region, and typically prefers habitat with a dense understorey of shrubs and their breeding habitat is characterized by light soil and abundant leaf litter, which is used in the construction of nesting mounds. The *Acacia* shrublands over tussock grasses and mixed shrubland habitat types within the proposed Impact Area are likely to provide feeding and dispersal habitat for Malleefowl. However given the grazing disturbance to a large proportion of these shrublands, these areas tend to lack the density of shrubs preferred by Malleefowl. As a result, the project area is unlikely to provide suitable breeding habitat for the Malleefowl. Therefore, the species is likely to move through the proposed Impact Area opportunistically.

As outlined in Table 20, clearing for the project will result in a loss of 358.0 ha of suitable habitat for the Malleefowl. Given the availability of suitable and better quality habitat in the local area and surrounding region, this loss of habitat is unlikely to significantly impact on Malleefowl.

During the construction phase of the Project, habitat clearance may result in the injury or death of Malleefowl individuals that would not otherwise occur in the absence of construction. As Malleefowl are likely to occur in low numbers in the areas surrounding the proposed Impact Area, the risk of this potential impact is low.

Peregrine Falcon

The Peregrine Falcon is likely to be an occasional visitor to the proposed Impact Area, and is known to occur in the region. This species occurs less frequently throughout desert regions, and therefore is likely to occur in low numbers, and opportunistically utilise the habitats within the proposed Impact Area for hunting and dispersal. This species diet predominantly consists of other birds, and to a lesser extent, small mammals, which it hunts from the air. The Peregrine Falcon nests primarily on ledges of cliffs, shallow tree hollows, and ledges of buildings in cities (Morcombe 2004). There are therefore no suitable nesting areas for this species present within the proposed Impact Area.

The Peregrine Falcon is wide ranging, mobile and aerial in nature, and therefore is likely to utilise all of the habitats within the proposed Impact Area. As outlined in Table 20, clearing for the project will result in a loss of 510.4 ha of suitable habitat for the Peregrine Falcon.

Given the availability of suitable habitat in the local area and surrounding region, and that the Peregrine Falcon is a wide ranging and highly mobile species, the proposed project is unlikely to have a significant impact on any individual Peregrine Falcon.

Major Mitchell's Cockatoo

The Major Mitchell's Cockatoo may potentially occur within the proposed Impact Area, around the Bubble Creek area. This species occurs in a wide variety of habitats, and has a requirement for trees with suitable nesting hollows and proximity to fresh surface water, and it is possible that this species utilises the habitats within the proposed Impact Area for foraging and potentially for nesting (in suitable *Eucalyptus* tree hollows within the riparian habitat around Bubble Creek). As outlined in Table 20, clearing for the project will result in a loss of 510.4 ha of foraging habitat for the Major Mitchell's Cockatoo, of which 6.48 ha is considered to provide suitable breeding habitat.

Given the wide ranging, mobile and aerial nature of this species, it is unlikely that the Major Mitchell's Cockatoo will be impacted by clearing of suitable habitats for the Project.

3.6.3 DPaW Priority listed species

The results of the desktop and field assessment identified six DPaW Priority listed fauna species known to, likely to or that may possibly occur within the proposed Impact Area. These include:

- Australian Bustard (*Ardeotis australis*) – Priority 4
- Striated Grasswren (inland sub-species) (*Amytornis striatus* subsp. *striatus*) – Priority 4
- Brush-tailed Mulgara (*Dasymercus blythi*) – Priority 4
- Bush Stone-curlew (*Burhinus grallarius*) – Priority 4
- Long-tailed Dunnart (*Sminthopsis longicaudata*) – Priority 4
- Good-legged Lerista skink (*Lerista eupoda*) – Priority 1

Australian Bustard

Australian Bustard tracks were recorded within hummock grassland habitats in the proposed Impact Area during the field survey (Figure 9). The Australian Bustard occurs across much of Australia, including across most of Western Australian, except in heavily wooded areas in the south. It occurs mainly in open country, such as grasslands, low heath or lightly wooded grassland (Morcombe, 2004). The Bustard is a nomadic bird which is known to migrate to suitable feeding areas dependent upon conditions.

It is likely that the Australian Bustard is a nomadic visitor to the proposed Impact Area, and is likely to utilise all of the habitat types for foraging. As outlined in Table 20, clearing for the project will result in a loss of 510.4 ha of suitable habitat for the Australian Bustard.

Given the availability of suitable habitat in the local area and surrounding region, and that the Australian Bustard is a wide ranging and highly mobile species, the proposed project is unlikely to have a significant impact on any individual Australian Bustard.

Striated Grasswren (inland sub-species)

The inland sub-species of the Striated Grasswren may potentially occur within the proposed Impact Area, within the *Acacia* shrublands over hummock grasses habitat type. The inland sub-species of the Striated Grasswren occurs in spinifex, preferring big old clumps on sand dunes, and in the eastern part of the range large spinifex clumps under mallee. This sub-species has a wide range from the sandy deserts of interior Western Australian through to mallee areas of north-western Victoria (Morcombe, 2004). There are two records of this species within 50 km of Goldfields Highway, and the species is known to occur in the region.

It is possible that this species utilises the habitats within the proposed Impact Area for foraging, dispersal and potentially for nesting. As outlined in Table 20, clearing for the project will result in a loss of 122.3 ha of suitable habitat for the inland sub-species of the Striated Grasswren.

Given the availability of suitable habitat in the local area and surrounding region, and that the Striated Grasswren is a highly mobile species, the proposed project is unlikely to have a significant impact on any individual of this species.

Brush-tailed Mulgara

A total of five Mulgara burrows (four active burrows and one old burrow) and one scat were recorded within spinifex grassland habitat in the proposed Impact Area. It has been assumed based on the information presented in section 2.8.6 that this is likely evidence of the Brush-tailed Mulgara (Figure 9). The Brush-tailed Mulgara is closely associated with *Triodia* Sand Plains and swales between low dunes and habitat typically consists of spinifex grasslands with medium to dense cover (Woolley 2005; Woolley *et al.* 2013). The *Acacia* shrublands over hummock grasses and habitat type within the proposed Impact Area is known and likely to provide feeding, breeding and dispersal habitat for Brush-tailed Mulgara.

As outlined in Table 20, clearing for the project will result in a loss of 122.3 ha of known habitat for the Brush-tailed Mulgara. Individual Mulgaras are known to seasonally move through the landscape utilising a network of burrows and foraging areas as resource availability shifts. Therefore, the active and/or old burrows recorded during the field survey are unlikely to provide important habitat for the Brush-tailed Mulgara given the availability of suitable habitat in the local area, and the ability for the species to utilise other areas with suitable substrate for burrows and adequate food and shelter. Therefore, clearing of habitat for the proposed project is unlikely to have a significant impact on any individual of this species.

In addition this species is susceptible to the increased risk of death or injury due to vehicle strike during both construction phase of the proposed project, particularly given that proximity of active burrows to the proposed Impact Area. As a result, individual Mulgaras may be impacted during the construction phase of the project, however this is unlikely to substantially impact the local population or the species.

Bush Stone-curlew

One Bush Stone-curlew individual was recorded on camera trap 4, located at the dam on the north side of the highway (near SLK 741) during the field survey. It is likely that the Bush Stone-curlew is a nomadic visitor to the proposed Impact Area, and is likely to utilise all of the habitat types for foraging and dispersal. As outlined in Table 20, clearing for the project will result in a loss of 510.4 ha of suitable habitat for the Bush Stone-curlew.

Given the availability of suitable habitat in the local area and surrounding region, and that the Bush Stone-curlew wide ranging and highly mobile species, the proposed project is unlikely to have a significant impact on any individual Bush Stone-curlew.

Long-tailed Dunnart

The Long-tailed Dunnart may potentially occur within the proposed Impact Area, within the Rocky outcrops and breakaways habitat type. Sparse records exist for this species which are rare and scattered, however it may be locally common at times. In winter the Long-tailed Dunnart feeds on arthropods, including mainly beetles and ants, but also spiders, cockroaches, centipedes, grasshoppers, flies and various larvae. The records of the Long-tailed Dunnart come from widely scattered localities in the arid zone where it inhabits rugged, rocky areas including scree slopes, boulder and stony plateaus, and adjacent stony plains with shrubs over spinifex grasslands (Van Dyck *et al.* 2013)

As outlined in Table 20, clearing for the project will result in a loss of 5.48 ha of suitable habitat for the Long-tailed Dunnart.

Given the lack of suitable rocky habitat for the Long-tailed Dunnart within the proposed Impact Area, the proposed project is unlikely to have a significant impact on any individual Long-tailed Dunnart.

Good-legged Lerista skink

The Good-legged Lerista may potentially occur within the proposed Impact Area, within the *Acacia* shrubland over hummock grasses habitat type. This species occurs in open Mulga areas on loamy soils in the arid southern interior of Western Australia, between Meekatharra and Cue (Wilson and Swan 2013). It is possible that this species utilises the habitats within the proposed Impact Area for foraging, breeding and dispersal. As outlined in Table 20, clearing for the project will result in a loss of 122.3 ha of suitable habitat for the Good-legged Lerista.

Given the availability of suitable habitat in the local area and surrounding region, and that a large proportion of the suitable habitat for this species within the proposed Impact Area is heavily disturbed proposed project is unlikely to have a significant impact on any individual Good-legged Lerista.

Migratory species

The results of the desktop and field assessment identified one Migratory fauna species known to occur within the proposed Impact Area, the Rainbow Bee-eater.

Rainbow Bee-eater

Several Rainbow Bee-eaters were observed in the proposed Impact Area during the field survey. This species occurs in a variety of habitats throughout Australia and it is likely that this species is an occasional seasonal migrant to the proposed Impact Area (foraging and dispersal). No breeding of the species was recorded however suitable breeding habitat is present throughout the alignment in sandy soils. It should be noted that Rainbow Bee-eaters often take advantage of windrows of soil pushed up by graders and earth moving equipment along tracks, and may potentially use these areas within the proposed Impact Area for breeding. As outlined in Table 20, clearing for the project will result in a loss of 510.4 ha of suitable habitat for the Rainbow Bee-eater.

Given the availability of suitable habitat in the local area and surrounding region, and that the Rainbow Bee-eater wide ranging and highly mobile species, the proposed project is unlikely to have a significant impact on any individual Rainbow Bee-eater.

Table 20 Area of fauna habitat to be cleared in the proposed Impact Area

Species	Status	Suitable habitat type	Type of habitat	Area of habitat within proposed Impact Area
WC Act and the EPBC Act listed species				
Grey Falcon (<i>Falco hypoleucos</i>)	T	All habitat types	Foraging and dispersal	510.4 ha
Malleefowl (<i>Leipoa ocellata</i>)	T, V	<i>Acacia</i> shrubland over tussock grasses and mixed shrubland	Foraging and dispersal Low value breeding habitat	358.0 ha
Peregrine Falcon (<i>Falco hypoleucos</i>)	S	All habitat types	Foraging and dispersal	510.4 ha
Major Mitchell's Cockatoo (<i>Cacatua leadbeateri</i>)	S	<i>Eucalyptus/Corymbia</i> woodland	Foraging, breeding and dispersal	510.4 ha foraging habitat (of which 6.48 ha provides potential breeding habitat)
DPaW Priority listed species				
Striated Grasswren (inland) (<i>Amytornis striatus</i> subsp. <i>striatus</i>)	P4	<i>Acacia</i> shrubland over hummock grasses	Foraging, breeding and dispersal	122.3 ha
Australian Bustard (<i>Ardeotis australis</i>)	P4	All habitat types	Foraging and dispersal	510.4 ha
Brush-tailed Mulgara (<i>Dasycercus blythi</i>)	P4	<i>Acacia</i> shrubland over hummock grasses	Foraging, breeding and dispersal	122.3 ha
Bush Stone-curlew (<i>Burhinus grallarius</i>)	P4	All habitat types	Foraging and dispersal	510.4 ha
Long-tailed Dunnart (<i>Sminthopsis longicaudata</i>)	P4	Rocky outcrops and breakaways	Foraging, breeding and dispersal	5.48 ha
Good-legged Lerista skink (<i>Lerista eupoda</i>)	P1	<i>Acacia</i> shrubland over hummock grasses	Foraging and breeding	122.3 ha
Migratory species				
Rainbow Bee-eater (<i>Merops ornatus</i>)	Mi	All habitat types	Foraging and dispersal	510.4 ha

3.7 Land vesting and existing use

The Impact Area intersects both existing road reserves and crown land (leasehold). The extent of each type of cadastre within the Impact Area is provided in Table 21.

Table 21 Extents of cadastre (ha) within Impact Area

Cadastre	Extent within Impact Area (ha)	Location
Road reserve	126.8	Across length of Impact Area
Vacant Crown Land	76.6	Isolated sections along the Impact Area where significant realignment of the road occurs
Reserve	43.2	

The Impact Area is outside the existing designated road reserve for much of its length. Therefore due process must be followed to secure the new road within the appropriate road reserve.

The Project consists of upgrading an existing road and temporary usage of areas as borrow pits and camps. These land use activities are not considered likely to significantly impact on the current landuse of the area, which is broadscale grazing. Consultation with pastoral leaseholders within the Impact Area is recommended as a matter of courtesy and to determine any potential concerns or issues such as impact on access or fencelines due to the Project.

3.7.1 Conservation areas

There are no conservation areas within the Impact Area or within the vicinity of the Project and thus this Project is not considered to impact on any conservation areas.

The Impact Area intersects Mooloogool pastoral station, which is a proposed conservation area. Within Mooloogool station the Impact Area follows the existing road alignment and impacts on this station are expected to be minimal.

3.8 Environmentally Sensitive Areas

There are no ESAs within the Impact Area and the Project will not impact on any ESAs.

3.9 Contamination

The risk of contamination of the land within the Impact Area is low given the historical and current landuse of the area. The risk that the Project will impact on existing contaminated areas is low. However, if during the construction phase any potential contaminating material, such as old drums, lead or asbestos, is encountered then work should stop in this area until the potential impacts have been considered.

There is a minor risk that the construction works will create temporary or localised pollution as a result of fuel or chemical spills or mismanagement of construction materials. This risk is low and will be managed through appropriate management measures and auditing.

3.10 Visual Amenity

There will be limited visual impact from the upgrade of the Goldfields Highway. There are few residences or other sensitive areas close to the road and the impact will be limited to potential visual impacts due to construction and traffic. The traffic along the road includes local traffic as well as tourist traffic.

Machinery storage areas, stockpiling of soils and campsite establishment during works will be a temporary source of visual impact.

Potential impacts on visual amenity from the Project are likely to be minor.

3.11 Air quality and dust

Air quality impacts from the construction and use of the Highway include dust and vehicle exhaust emissions.

3.11.1 Mechanical and wind erosion dust emissions

Construction impacts

Construction dust emissions are expected to occur through:

- Earthworks, where the movement of vehicles and construction materials produces dust
- Wind erosion, where wind speed is sufficient to cause dust from stockpiles and other unprotected areas.

Whilst the amount of construction dust is expected to be measurable above background levels within the vicinity of the construction area, impacts typically occur over a short time frame and provided typical construction dust management measures are undertaken, dust impacts are expected to be minimal.

The closest residential receptors to the road alignment are located in Meekatharra, approximately 100 m away. All other receptors are greater than 100 m. Dust impacts at receptors 100 m or further from the site are expected to be minor and will be considered during the construction phase.

Operational impacts

Vehicle traffic on the Goldfields Highway between Meekatharra and Wiluna is currently relatively low. Data sourced from the Main Roads' Reporting Centre (Table 22) show such traffic counts, and indicates that a significant percentage of traffic is heavy vehicles. For this assessment it has been assumed that future traffic volumes would still be relatively small (below 100 to 200 vehicles per day).

Table 22 Traffic flow measurements in Survey Area

Site ID	Site location	Year recorded	Average daily traffic count , both directions	Average % of heavy vehicles[2]
50579	Goldfields Hwy, W of Diamond Wells Rd	2005	31	26
50580	Goldfields Hwy, E of Golf Club Road	2007	35	14
19032	Goldfields Hwy, W of Yandil Road	2010	34	35
18656	Goldfields Hwy, E of Great Northern Hwy	2012	37	27

² Heavy vehicles are defined as Austroads class 3-12.

Wheel generated dust emissions from the existing highway are expected to be significant, as the highway is not paved. On completion of the upgrade, which includes bituminising the highway, dust emissions from the road are expected to be minimal.

3.11.2 Vehicle exhaust

Exhaust emissions from vehicles during construction and operation include products of combustion, including carbon monoxide (CO), oxides of nitrogen (NO_x), sulphur dioxide (SO₂), coarse and fine particulate matter (PM₁₀ and PM_{2.5}) and various volatile organic compounds (VOC).

Construction impacts

During construction activities, vehicle exhaust emissions will be generated from the current traffic load as well as construction vehicles. As indicated in Table 22, the current traffic load is expected to produce negligible impacts (due to the low traffic volumes). Whilst construction activities will have additional emissions from the construction vehicles, impacts are still expected to be insignificant.

Operational impacts

The low number of vehicles predicted to be traveling along the Highway (Table 22) indicates that pollutants from vehicle emissions are likely to be negligible.

3.12 Noise and vibration

3.12.1 Noise

Appendix G contains descriptions of noise terminology used in the section below.

Construction impact

Construction noise impacts associated with the highway upgrade were estimated using the following distance attenuation relationship³:

$$SPL = SWL - 20\log(d) + 10\log(Q) - 11$$

where: d = Distance between the source and receptor (m);
 Q = Directivity index (two for a flat surface);
 SPL = Sound pressure level at the distance from the source (dB); and
 SWL = Sound power level of the source (dB).

Typical noise levels produced by construction plant anticipated to be used on-site were sourced from *AS 2436 – 2010 Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites* and GHD's internal database.

³ Propagation calculations take into account sound intensity losses due to spherical spreading, with additional minor losses such as atmospheric absorption, directivity and ground absorption ignored in the calculations. As a result, predicted received noise levels are expected to slightly overstate actual received levels and thus provide a measure of conservatism.

Received noise produced by anticipated activities, during highway upgrade are shown in Table 23 for a variety of distances, with no noise barriers or acoustic shielding in place and with each plant item operating at full power. The sound pressure levels shown are maximum levels produced when machinery is operated under full load.

- The intensity and locations of construction activities;
- The type of equipment used;
- Existing local noise sources;
- Intervening terrain; and
- The prevailing weather conditions.

Construction machinery will move about the site area, altering the directivity of the noise source with respect to individual receptors. During any given period the machinery items to be used in the construction area will operate at maximum sound power levels for only brief stages. At other times the machinery may produce lower sound levels while carrying out activities not requiring full power. It is unlikely that all construction equipment would be operating at their maximum sound power levels at any one time. Finally, certain construction machinery will be present for only brief periods during construction.

Table 23 Predicted plant activity noise levels, dBA

Plant	Estimated SWL, dBA	Estimated SPL, dBA at distance (m)						
		50	250	500	750	1,000	3,000	5,000
Backhoe	104	62	48	42	39	36	26	22
Backhoe (with auger)	106	64	50	44	41	38	28	24
Bulldozer	108	66	52	46	43	40	30	26
Compactor	113	71	57	51	48	45	35	31
Compressor (silenced)	101	59	45	39	36	33	23	19
Concrete agitator truck	109	67	53	47	44	41	31	27
Concrete pump truck	108	66	52	46	43	40	30	26
Concrete saw	117	75	61	55	52	49	39	35
Concrete vibratory screed	115	73	59	53	50	47	37	33
Crane (mobile)	104	62	48	42	39	36	26	22
Excavator	107	65	51	45	42	39	29	25
Front end loader	113	71	57	51	48	45	35	31
Generator (diesel)	104	62	48	42	39	36	26	22
Grader	110	68	54	48	45	42	32	28
Hand tools (electric)	102	60	46	40	37	34	24	20
Hand tools (pneumatic)	116	74	60	54	51	48	38	34
Jack hammers	121	79	65	59	56	53	43	39
Rock breaker	118	76	62	56	53	50	40	36
Roller (vibratory)	108	66	52	46	43	40	30	26
Scraper	116	74	60	54	51	48	38	34
Truck (>20 tonnes)	107	65	51	45	42	39	29	25
Truck (dump)	117	75	61	55	52	49	39	35
Truck (water cart)	107	65	51	45	42	39	29	25
Vehicle (light commercial, 4WD)	106	64	50	44	41	38	28	24
Welder	105	63	49	43	40	37	27	23

Construction noise management

The *Environmental Protection (Noise) Regulations 1997* indicate that an assigned L_{A10} level of 45 dBA must be met at surrounding sensitive receptors (residences) during the day time (7.00 am to 7.00 pm Monday to Sunday).

However, these regulations do not apply for noise from construction activities during standard construction hours (between 7.00 am and 7.00 pm Monday to Saturday (excluding public holidays) if the construction work is:

- Carried out in accordance with control of environmental noise practices set out in Section 6 of *AS2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites*.
- The equipment used for construction must be the quietest reasonably available.
- Department of Environment Regulation (DER) may request a Noise Management Plan be prepared and submitted, and if so, the practices contained within the plan are complied with during construction activities.

If out of hours construction work is required (7.00 pm to 7.00 am Monday to Saturday and all hours Sundays or public holidays), in addition to the above conditions, additional requirements are:

- The contractor must advise all nearby sensitive receptors (residences) likely to receive noise levels which exceed 35 dBA of the work to be done at least 24 hours prior to commencing works
- The contractor must show that it is reasonably necessary for works to occur out of hours
- The contractor must prepare and submit a Noise Management Plan; the practices contained within the plan must be complied with during construction activities. The plan must include:
 - Reason for the construction work needing to be completed out of hours
 - Details of the activities which are likely to result in noise emissions that lead to exceeding the assigned level of 35 dBA
 - Predictions of noise emissions on the site
 - Details of measures used to control noise emissions
 - Procedures to be adopted for monitoring noise emissions
 - Complaint response procedures to be adopted

As noise from construction activities during standard construction hours is not required to meet the assigned levels, provided a Construction Noise Management Plan has been prepared there are no further requirements.

Should construction activities be required out of hours, an assessment of likely exceedance of the 35 dBA assigned level will be required.

The closest sensitive receptor to any potential noise source during construction is approximately 100 m from construction activities. From

Table 23, it is shown that some construction equipment may exceed the night time assigned level of 35 dBA, and therefore affected residences would require notification of potential noise impacts 24 hours prior to construction activities commencing.

Operational impacts

Preliminary modelling was undertaken using CadnaA, by Datakustik, which is a computer program for the calculation, assessment and prognosis of noise exposure.

CadnaA considers local topography, reflection, ground absorption, relevant building structures, site sources and the locations of the receptor areas to predict received noise levels. The method specified consists of specifically of octave-band algorithms (with nominal mid band frequencies from 31.5 Hz to 8 kHz) for calculating the attenuation of sound.

Road traffic noise predictions were undertaken using the United Kingdom Department of Transport Calculation of Road Traffic Noise (CoRTN) algorithm. The algorithm is adapted to Australian conditions by adjusting predicted noise levels by -1.7 dBA⁴, and converted from L_{A10, 18 hour} predicted noise levels to L_{A Eq (Day)} and L_{A Eq (Night)} using the following relationships (GHD, 2013b) to allow for comparison with SPP 5.4 (WAPC 2009) traffic noise criteria:

- $L_{A Eq (Day)} = L_{A10 18 hour} - 3 \text{ dBA}$
- $L_{A Eq (Day)} = L_{A10 18 hour} - 8 \text{ dBA}$

The following model configuration was used:

- A conservative estimate of 100 vehicles over an 18 hour period, with 30% heavy vehicles, and 100 km/hour speed limit
- Road surface type of dense graded asphalt, and source height of 0.5 m
- No topography was used in the model, which adds further conservativeness to the model.

A sensitive receptor was placed 100 metres from the road at a height of 1.4 m to simulate predicted noise impacts at the closest receptor to the Highway. The predicted noise concentrations are adjusted by +2.5 dBA to account for building façade.

The predicted noise levels at the sensitive receptor are shown in Table 24, along with the daytime and night time SPP 5.4 criterion. As shown, the predicted noise levels are well below the criterion at the receptor.

This demonstrates that there will be negligible traffic noise impacts on nearby receptors.

Table 24 Predicted traffic noise impacts, dBA

Time of day	Predicted noise level at receptor	SPP 5.4 noise target
Day (6.00 am to 10.00 pm)	L _{A Eq (Day)} = 39	L _{A Eq (Day)} = 55
Night (10.00 pm to 6.00 am)	L _{A Eq (Night)} = 34	L _{A Eq (Night)} = 50

3.12.2 Vibration

Construction impacts

Vibration impacts discussed essentially focus on potential structural damage to properties in close vicinity of the construction site and/or potentially affected by construction activities. It is possible that construction vibration will be perceived at times by local sensitive receptors. However, the level of annoyance will depend on individuals.

The nature and levels of vibration emitted by the site will vary with the activities being carried out on site. Table 25 outlines typical vibration levels for different construction activities that may be generated, sourced from the NSW Roads and Traffic Authority (RTA) *Environmental Noise Management Manual* (RTA 2001).

⁴ Research undertaken by the Australian Road Research Board (ARRB, 1983)

Table 25 Typical vibration levels for construction equipment

Plant item	Peak particle velocity at 10 m (mm/s)
Backhoe	1.0
Bulldozer	2.5-4.0
Compactor (7 tonne)	5.0-7.0
Front end loader	6.0-8.0
Jack hammer	0.5
Piling	12-30
Roller (15 tonne)	7.0-8.0

Construction activity may result in varying degrees of ground vibration depending on the equipment used and methods employed. Operation of construction equipment causes ground vibrations which spread through the ground and diminish in strength with distance. Buildings founded on the soil in the vicinity of the construction site respond to these vibrations with varying results, ranging from no perceptible effects at the lowest levels, low rumbling and perceptible vibrations at moderate levels and slight building damage at the highest levels.

From Table 25, equipment proposed for site preparation and construction of the Highway will generate low levels of vibration that are unlikely to result in any vibration risks to structures. The lower limit for vibrations resulting in building damage of five mm/s is normally not exceeded by general construction activities at distances greater than 20 m from the nearest sensitive receptor.

Given the distances involved between site works and the nearest receptors, vibrations affecting human comfort and building integrity are not expected to be an issue.

Operational impacts

Vibrational impacts from road vehicles are significantly lower than those generated during construction activities. As construction vibration activities are not expected to be an issue further than 20 m from the construction area, operational vibration is also not expected to be an issue.

3.13 European Heritage

There are no European heritage sites recorded within the Survey Area and the Project is unlikely to impact on the recorded heritage sites within the townsites of Wiluna and Meekatharra.

4. Stakeholder Consultation

For this Project the Environmental Protection Agency (EPA), Department of Environment Regulation-Native Vegetation and Conservation Branch (DER) and the Department of Aboriginal Affairs (DAA) were consulted on the key approval process that Main Roads WA was going to pursue for the Portlink project. Meeting notes with the DER and EPA are shown below. The DAA consultation will not be included in this report and will be addressed in the aboriginal heritage instead.

Table 26 Stakeholder consultation

Monday 22 July 2013 at 2 pm Atrium – Meeting with DER	
Attendees	Nick Jones (Project Manager), Ben Hollyock (Principal Environment Officer), Joann Johnston (Senior Environment Officer), Belinda Walker (Manager) and Simon Weighell (Assessment Officer).
Notes	
	The project was discussed in general and MRWA communicated its intent to apply for a project purpose clearing permit if advised by EPA that referral and assessment is not required. DER questioned why CPS 818 wouldn't be used and agreed that given the area of clearing and the timing that a separate permit would be best.
	It was noted that it would be ideal to have all expected clearing areas identified with MRWA's application and the option of having the application cover a larger area than needed was discussed. A purpose permit will be best and impacts to all 10 CP should be avoided so that unnecessary offsets are not required. There will not be much flexibility for the road design to be altered but the access track, material pits and camp sites can be moved to achieve this.
	Offsets were discussed and MRWA will need to start considering its plan for offsets which will be clearer once surveys have been completed and impacts are confirmed.
	Given that the clearing is not being undertaken on MRWA land then a letter of approval for access to the land will be required for Department of Lands (Formally Department of Regional Development and Lands). Alternatively a section 91 could potentially be used to gain access to land.
	The impact of water extraction from water bores was discussed. If MRWA overdraws from bores to the point where water table levels drop then there may be clearing created from vegetation loss. However the proposed works are unlikely to have this level of impact.
	Water draw down should also be assessed to consider negative impacts on organisms and ecological systems in the groundwater. Any issues associated with overdraw will need to be discussed with the Department of Parks and Wildlife (along with other threatened flora and fauna)

Tuesday 23 July 2013 at 9 am Atrium – meeting with Office of the EPA

Attendees	Nick Jones (Project Manager), Ben Hollyock (Principal Environment Officer), Joann Johnston (Senior Environment Officer), Hans Jacob (Manager Infrastructure Projects) and LEEANNE THOMPSON Apologies - Peta Hayward
Notes	
	A new guideline was released in June regarding application of a significance framework in EIA. In general this is what we have undertaken at desktop stage but needs to be more clearly documented. Unless there is a question regarding the significance of impact there may not be a need to talk to OEPA again.
	An arrangement will need to be made with DPAW in regards to the management of road reserve in close proximity to the proposed conservation estate ex-Mooloogool Station.
	Ensure that EIA examines the impacts of the roads' upgrade on the environment not just the construction impacts for example will the traffic volume increase and types of vehicle change so that fauna deaths are increased.
	OEPA was interested in the broader PortLink project and additional information and contact was provided.
	Speak with DoW on potential impacts from water drawdown on groundwater reliant flora and fauna.

5. Additional Actions and Referrals

5.1 Additional actions required

The Project is likely to have a minor to moderate impact on a number of environmental aspects and further work and assessment is required on some of these aspects, as detailed in Table 27.

Table 27 Summary of further assessment or approval(s) required

Aspect	Action/ Permit, Approval or Licence
Land vesting	Vesting of land will need to occur as part of road reservation process.
Landuse	Consultation with pastoral leaseholders is recommended as a matter of courtesy and to determine any potential concerns or issues such as impact on access or fencelines due to the Project.
Aboriginal Heritage	Aboriginal heritage has not been considered as part of this EIA. However an Aboriginal heritage assessment has been completed separately by MRWA.
Erosion, drainage, construction issues	The EMP should be implemented during the design, construction and operational phases of the project.
Conservation significant ecological communities	Further assessment on the potential impacts of the Project on the Priority Ecological Community Concrete Groundwater Assemblages may be required.
Vegetation clearing	Unless the Project is assessed by the Environmental Protection Authority a clearing permit will be required.

5.2 Federal approvals

5.2.1 Matters of National Environmental Significance

Referral to DoE under the EPBC Act is triggered if a proposed action has/or potentially has a significant impact on any Matter of National Environmental Significance (MNES), including National Heritage values. An assessment against each of these issues is provided in Table 28.

Table 28 Assessment of the Impact Area against MNES

Matters of National Environmental Significance	Present	Impact within Survey Area
World Heritage Places	No	None.
National Heritage Places	No	None.
Ramsar Wetlands	No	None.
Threatened Species and Ecological Communities	None present One Threatened fauna species considered is likely to occur – Malleefowl (Vulnerable)	No impacts to EPBC Act listed TECs or Threatened flora. Potential impacts to the Malleefowl include loss of up to 358 ha of suitable potential habitat, however given the availability of suitable and better quality habitat in the local area and surrounding region, this loss of habitat is unlikely to significantly impact on the Malleefowl.
Listed Migratory Species	One present – Rainbow Bee-eater	Impacts to the Rainbow Bee-eater are limited to the loss of 510.4 ha of foraging and dispersal habitat. This species utilises a wide-range of habitats and is likely to use the proposed Impact Area for foraging and dispersal. However, the species is unlikely to rely on the habitats available in the proposed Impact Area, and loss of 510.4 ha of habitat is unlikely to significantly impact on the Rainbow Bee-eater.
Commonwealth Marine Areas	No	None.
Great Barrier Reef Marine Park	No	None.
Nuclear Actions	No	None.
A water resource (in relation to coal seam gas or large coal development)	No	None.

5.2.2 Significance of impacts to Malleefowl

No Malleefowl individuals or evidence of Malleefowl was recorded within the proposed Impact Area during the field survey. Therefore, the key potential impact to the Malleefowl for the proposed project is the clearing and loss of up to 358 ha of suitable potential habitat. Given the availability of suitable and better quality habitat in the local area and surrounding region, this loss of habitat is unlikely to significantly impact on Malleefowl.

In addition, during the construction phase of the project, habitat clearance may result in the injury or death of Malleefowl individuals that would not otherwise occur in the absence of construction. As Malleefowl are likely to occur in low numbers in the areas surrounding the proposed Impact Area, the risk of this potential impact is low.

5.2.3 Significance of impacts to Rainbow Bee-eater

The Rainbow Bee-eater is known to range over vast areas and utilise a wide variety of habitats throughout most of Australia (Morcombe, 2004). Several Rainbow Bee-eaters were observed in the proposed Impact Area during the field survey, and the species is known to occur throughout the region. Clearing for the project will result in a loss of 510.4 ha of suitable habitat for the Rainbow Bee-eater.

In the absence of species specific guidelines the DotE Significant impact guidelines 1.1 (DotE 2013h) was consulted to decide whether or not a referral under the EPBC Act may be required for the Rainbow Bee-eater with regard to this Project. This assessment found that the Project is unlikely to have a significant impact on the Rainbow Bee-eater, as discussed below.

The highly mobile, wide ranging behaviour of this bird means that the proposed project is highly unlikely to lead to a long-term decrease in the size of a population of Rainbow Bee-eater. This species utilises a wide variety of habitats and there is a large area of suitable habitat for the species within the local surrounding area (including habitat suitable for breeding). As outlined in section 3.5.1, clearing of the Impact Area would result in clearing of less than 0.4% of the remaining extent of Beard's (1974) vegetation association at all levels. Therefore, as the proposed Impact Area is surrounded by remnant vegetation that is likely to provide similar habitat resources for the Rainbow Bee-eater to those available within the proposed Impact Area, the loss of 510.4 ha of potential habitat is unlikely to significantly reduce the availability of suitable habitat at a local and regional scale to the extent that the species is likely to decline. The 510.4 ha of habitat is also not considered to be critical habitat for the Rainbow Bee-eater as it is known to utilise a broad range of habitat types and traverse extensive areas.

Furthermore, clearing of 510.4 ha of potential habitat for the proposed project is unlikely to significantly reduce the area of occupancy of the Rainbow Bee-eater, due to the size of the proposed clearing in relation to the vast areas occupied by individuals and the species overall. The project is also unlikely to fragment the existing population given the mobility of the bird and regional habitat connectivity.

There is the potential for clearing activities for the construction of the proposed project to disrupt the breeding cycle of individual birds during the breeding season (between November and January), in areas with sandy soils that provide suitable breeding habitat. Rainbow Bee-eaters often take advantage of windrows of soil pushed up by graders and earth moving equipment along tracks, and therefore individuals may potentially use these areas within the proposed Impact Area for breeding. However the risk of this impact is low and is unlikely to significantly impact the Rainbow Bee-eater.

5.3 State approvals

5.3.1 Environmental Protection Authority

Significant proposals must be referred to the EPA under Section 38 of the *Environmental Protection Act 1986* (EP Act).

In deciding whether a proposal will be subject to the formal environmental impact assessment process, the EPA takes into account the environmental significance of any potential impacts that may result from the implementation of the scheme or proposal.

This EIA has found the Project will have minimal adverse impacts to the surrounding environment, will only be associated with localised increases in emissions during construction, and is not likely to have a high level of public interest. The majority of the environmental impacts associated with the Project are linked to vegetation clearing and loss of fauna habitat. These potential impacts and proposed mitigation actions (and offsets, if required) for the Project can be effectively regulated through the Environmental Protection (Clearing of Native Vegetation) Regulations 2004. Therefore, it is considered the Project is unlikely to require referral to the EPA under Section 38 of the EP Act.

5.3.2 Department of Environment and Regulation

Due to the size of the Project it will not be assessed under the Main Roads CPS 818/11 statewide clearing permit. Under the *Environmental Protection Act 1986* (EP Act), clearing of native vegetation is an offence unless you have obtained a clearing permit or an exemption applies. Exemptions for low impact routine land management practices are contained in the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. These exemptions do not apply within environmentally sensitive areas declared by the Minister for Environment under section 51B of the EP Act.

The Project will create an Impact Area of 533.74 ha including clearing of approximately 519.24 ha of native vegetation, in Condition 4 or better that will require an approved clearing permit for its removal. Clearing applications are assessed against the Ten Clearing Principles outlined under Part V of the EP Act. These principles aim to ensure that all potential impacts resulting from the removal of native vegetation can be assessed in an integrated way.

Clearing associated with the proposed Impact area has been assessed against the Ten Clearing Principles (Table 29). Clearing of the proposed Impact area (519.24 ha of native vegetation) is at variance with principle (f) and may be at variance with principle (a).

5.4 Other approvals

5.4.1 Department of Water

The RIWI Act covers the regulation, management, use and protection of water resources and irrigation in Western Australia. As the majority of the Impact Area is within an unproclaimed area water can be taken from watercourses without a licence so long as the flow is not 'sensibly diminished' and groundwater can be taken as long as it is not from an artesian aquifer. If water will be taken from the proclaimed areas that occur within sections of the Impact Area then a licence from the Department of Water will be required.

Table 29 Assessment of the Project against the Ten Clearing Principles

Principle	Assessment	Outcome
<p>(a) Native vegetation should not be cleared if it comprises a high level of biological diversity.</p>	<p>Broadscale vegetation mapping of the area undertaken by Beard (1979) identified eight vegetation associations within the Impact Area, in associations 11, 18, 29, 39, 107, 202, 204 and 223. The extent of vegetation associations which occur within the Impact Area are greater than 98% of the pre-European extents remaining at the state, IBRA bioregion, IBRA sub-region and local government authority (LGA) levels.</p> <p>During the field assessment, six structural formations containing 26 vegetation associations (including two disturbance related associations) were identified within the Impact Area and described based on field observations:</p> <ul style="list-style-type: none"> • Woodlands (containing four vegetation associations) (20.89 ha) • Tall shrublands (containing nine vegetation associations) (419.77 ha) • Low shrublands (containing five vegetation associations) (20.19 ha) • Tussock grasslands (containing two vegetation associations) (0.62 ha) • Hummock grasslands (containing one vegetation association) (48.93 ha) • Disturbed (containing two vegetation associations) (21.16 ha) <p>No TECs have previously been recorded within the Impact Area, and none were recorded during the field survey. In addition no TECs are likely to occur.</p> <p>Three occurrences of the calcrete groundwater assemblage PEC occur within the Impact Area. This PEC will not be impacted by vegetation clearing (though it may be impacted by other elements of the Project, such as groundwater extraction which is considered further in the environmental impact assessment).</p> <p>There were a number of vegetation types mapped within the wider Survey Area that were considered as 'other significant vegetation' as they supported unusual species or had a role as a refuge. These vegetation types were restricted to very specific landforms and supported the majority of the DPaW Priority flora species recorded in the field survey. The Impact Area avoids the majority of these vegetation types and clearing for the Project is likely to impact on less than 5% of each of the 'other significant vegetation' mapped within the Survey Area.</p>	<p>May be at variance</p>

Principle	Assessment	Outcome
	<p>The majority of the Survey Area was rated as <i>Excellent</i> (2) to <i>Very Good</i> (3) or <i>Very Good</i> (3) (Keighery 1994 scale), with areas in the vicinity of Meekatharra and Wiluna having lower condition ratings due to increased anthropogenic disturbances observed. Areas of better vegetation condition were generally recorded from breakaways, outcrops and stony hills. Grazing by livestock, native mammals and feral animals has altered vegetation composition across the Survey Area. Grazing and trampling impacts were generally more prevalent within drainage lines and adjacent floodplain areas, as well as the margins of artificial water sources. The most noticeable areas of disturbance throughout the Survey Area included existing borrow pits, pastoral infrastructure (e.g. dams, access tracks, holding yards) and roadside margins.</p> <p>The vegetation condition within the Impact Area was rated during the field survey and included:</p> <ul style="list-style-type: none"> • Condition 1-2 (Pristine or nearly so – Excellent) 1.22 ha • Condition 2 (Excellent) 37.65 ha • Condition 2-3 (Excellent – Very Good) 251.49 ha • Condition 3 (Very Good) 161.44 ha • Condition 3-4 (Very Good – Good) 38.32 ha • Condition 4 (Good) 29.13 ha • Condition 4-5 (Good – Degraded) 5.16 ha • Condition 5 (Degraded) 0.05 ha • Condition 5-6 (Degraded – Completely Degraded) 2.74 ha • Condition 6 (Completely Degraded) 4.4 ha <p>A search of the <i>NatureMap</i> database (DPaW 2007–) identified 707 plant taxa, representing 62 families and 223 genera that have previously been recorded within the Study Area (50 km buffer). This total comprised 683 native flora taxa and 24 naturalised (non-native) flora taxa.</p> <p>A total of 398 flora taxa (including subspecies and varieties) representing 53 families and 154 genera were recorded in the Survey Area during the October 2013 field surveys. This total comprised 391 (98%) native taxa and seven (2%) introduced taxa.</p>	

Principle	Assessment	Outcome
	<p>No flora species listed as Threatened/DRF under the EPBC Act (DotE, 2013) or the WC Act (DPaW, 2007-) were recorded during the field survey.</p> <p>Nine species listed as Priority species by DPaW were recorded in the Survey Area during the field survey, and with two within the Impact Area. These two species include:</p> <ul style="list-style-type: none"> • <i>Ptilotus luteolus</i> (Priority 3) – 2 plants recorded within the Impact Area • <i>Stackhousia clementii</i> (Priority 3) - counts averaging 180 individuals per 100 m² within the Impact Area. <p>The <i>Stackhousia clementii</i> population occurred at very large numbers both within and outside the Impact Area and counts were based on population estimates. The population was estimated to be approximately 180 individuals per 100 m² within the Study Area in the Bubble Creek floodplain. Given the high quantity of <i>Stackhousia clementii</i> outside the Impact Area it is unlikely that the removal of the individuals required for this project will be locally or regionally significant.</p> <p>A NatureMap search identified 224 fauna species as previously recorded within 50 km of the Impact Area of which 220 species are native and four are pest (introduced) species.</p> <p>The October 2013 field survey identified 102 fauna species, consisting of 63 birds, 19 reptiles, 19 mammals and one amphibian within the Survey Area. Of these, seven are introduced (feral) species. The field surveys identified five conservation significant fauna species within the Survey Area, including:</p> <ul style="list-style-type: none"> • Grey Falcon (<i>Falco hypoleucos</i>) – Threatened under the WC Act • Australian Bustard (<i>Ardeotis australis</i>) – Priority 4 listed by DPaW • Bush Stone-curlew (<i>Burhinus grallarius</i>) – Priority 4 listed by DPaW • Brush-tailed Mulgara (<i>Dasycercus blythi</i>) – Priority 4 listed by DPaW • Rainbow Bee-eater (<i>Merops ornatus</i>) – Schedule 3 under the WC Act and Migratory under the EPBC Act <p>Eight broad fauna habitat types were identified in the Impact Area, based on predominant landforms, soil and vegetation structure in the area</p> <p>The Impact Area is considered to have a similar or lower level of biodiversity to adjacent areas, at a local or bioregional scale as the Impact Area generally follows the existing road and previously disturbed areas.</p>	

Principle	Assessment	Outcome
	<p>The Survey Area passed through a number of landscapes that were considered to have value as areas of different geological features that supported higher levels of biodiversity of flora and fauna of the surrounding areas, such as breakaways and creeklines. However, these areas have generally been avoided by the alignment and the Impact Area predominantly encounters vegetation types and habitat types that are widespread in the general area.</p> <p>Much of the Impact Area occurs in an area that have been previously disturbed adjacent to the existing road. Large areas of remnant vegetation adjacent to the Impact Area, including areas (such as breakaways) that support a higher biodiversity than the Impact Area, will not be affected by this Project. The majority of the Impact Area can not be considered to support a higher biodiversity than the surrounding tracts of native vegetation. However, as the Project will impact on a population of the Priority 3 species <i>Stackhousia clementii</i> within Bubble Creek, it is considered that the Project may be at variance to this Principle.</p>	
<p>(b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.</p>	<p>A search of the NatureMap database (DPaW, 2007–) identified 224 fauna species as previously recorded within the Study Area, of which 220 species are native and four are pest (introduced) species.</p> <p>Desktop searches of the EPBC Act PMST (DotE 2013d) and NatureMap (DPaW 2007-) databases revealed the potential presence of 18 fauna taxa protected under the EPBC Act and/or WC Act or listed by DPaW as Priority within the Study Area. In addition to these species, five conservation significant fauna species not identified in the database searches were identified as potentially occurring within the Study Area as they are known to occur in the region. These species include the Bush Stone-curlew, Major Mitchell's Cockatoo, Grey Falcon, Western Spiny-tailed Skink and Brush-tailed Mulgara.</p> <p>The field survey identified 102 fauna species, consisting of 63 birds, 19 reptiles, 19 mammals and one amphibian within the Survey Area. Of these, seven are introduced (feral) species. The field surveys identified five conservation significant fauna species within the Survey Area, including:</p> <ul style="list-style-type: none"> • Grey Falcon (<i>Falco hypoleucos</i>) – Threatened under the WC Act • Australian Bustard (<i>Ardeotis australis</i>) – Priority 4 listed by DPaW • Bush Stone-curlew (<i>Burhinus grallarius</i>) – Priority 4 listed by DPaW • Brush-tailed Mulgara (<i>Dasyercus blythi</i>) – Priority 4 listed by DPaW • Rainbow Bee-eater (<i>Merops ornatus</i>) – Schedule 3 under the WC Act and Migratory under the EPBC Act 	<p>Not likely to be at variance.</p>

Principle	Assessment	Outcome
	<p>A likelihood of assessment occurrence for conservation significant fauna species concluded that an additional four species are likely to occur:</p> <ul style="list-style-type: none"> • Malleefowl (<i>Leiopoa ocellata</i>) – Vulnerable and Migratory under the EPBC Act, Threatened under the WC Act • Good-legged Lerista skink (<i>Lerista eupoda</i>) – Priority 1 listed by DPaW • Long-tailed Dunnart (<i>Sminthopsis longicaudata</i>) - Priority 4 listed by DPaW • Peregrine Falcon (<i>Falco peregrinus macropus</i>) - Schedule 4 under the WC Act <p>The likelihood of occurrence assessment also identified that two species could possibly occur within the Survey Area:</p> <ul style="list-style-type: none"> • Striated Grasswren - inland (<i>Amytornis striatus</i> subsp. <i>striatus</i>) – Priority 4 listed by DPaW • Major Mitchell’s Cockatoo (<i>Cacatua leadbeateri</i>) – Schedule 4 under the WC Act <p>Eight broad fauna habitat types were identified in the Impact Area, based on predominant landforms, soil and vegetation structure in the area. Each of these habitat types is well represented in the immediate vicinity of the proposed Impact Area and in the broader Murchison region.</p> <p>Clearing of vegetation within the proposed Impact Area is unlikely to exacerbate the existing fragmentation of the habitat or reduce the connectivity of habitat at a local or regional scale. The potential impacts to habitat linkages resulting from clearing the proposed Impact Area predominantly relate to the widening of the existing road corridor prior to and during construction, as well as clearing for the material pits and access tracks. The habitats within the proposed Impact Area are well connected both locally and regionally to other areas of habitat. The majority of the proposed Impact Area has previously been grazed and therefore the habitats have experienced various levels of disturbance resulting in some areas being highly degraded. Therefore the project is unlikely to substantially reduce the availability of habitat for fauna species in the local area or decrease the connectivity of habitat linkages to surrounding areas of remnant vegetation.</p> <p>DAFWA mapping of remnant vegetation indicates that within the general region (defined as a radius of 50 km of the Survey Area) there are substantial areas of remnant native vegetation (2,670,558 ha) of which the Impact Area (534 ha) makes up 0.02% of this vegetation. Clearing of this vegetation will therefore not significantly reduce the extent of vegetation, and fauna habitat within the general area.</p>	

Principle	Assessment	Outcome
	<p>The Impact Area is in an area that is used for broad-scale cattle grazing and is largely uncleared. The Impact Area is surrounded by predominantly intact native vegetation and the clearing required for the Project will not clear vegetation linkages. In addition, while clearing of the Impact Area will result in a loss of known habitat for five conservation significant fauna species, four of these species are wide ranging and highly mobile birds species and therefore able to migrate to other areas of suitable habitat in the surrounding area (particularly given the availability of suitable habitat in the local area for all four of these species). The Brush-tailed Mulgara is the fifth species that is known to occur in the Impact Area. Clearing for the project will result in a loss of 122.3 ha of known habitat for the species. However given the availability of suitable habitat in the local area and that the species is known to seasonally move through the landscape and utilise other areas with suitable substrate for burrows and adequate food and shelter, the habitat within the Impact Area is unlikely to provide important habitat for this species.</p> <p>Therefore, overall the native vegetation within the Impact Area is unlikely to be necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia and the Project is not likely to be at variance to this Principle.</p>	
<p>(c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.</p>	<p>The desktop assessment determined that no Threatened flora species have been previously been recorded within the Study Area and no Threatened species were recorded within the Survey Area (and therefore Impact Area) during the field survey.</p> <p>A likelihood of occurrence assessment of conservation significant species (based on the range, habitat requirements and previous records of the species) did not identify any Threatened flora species as likely to occur or possibly likely to occur within the Survey Area.</p>	<p>Not likely to be at variance.</p>
<p>(d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.</p>	<p>A desktop assessment did not identify any TECs within the Study Area and no TECs were recorded in the Survey Area during the field survey. There is only one known TEC from the Murchison area (Depot Springs) which is not known to occur within the Meekatharra – Wiluna area. This TEC is approximately 150 km south of the Impact Area and is not likely to be directly or indirectly impacted by the Project.</p> <p>It is highly unlikely that any TECs occur within the Impact Area.</p>	<p>Not likely to be at variance.</p>

Principle	Assessment	Outcome
<p>(e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.</p>	<p>Broadscale vegetation by Beard (1974) has been adapted and digitised by Shepherd <i>et al.</i> (2002). The extent of Beard's (1974) vegetation associations have been determined by the state-wide vegetation remaining extent calculations maintained by the DPaW (latest update 2012 -Government of Western Australia 2013c). The extent of vegetation associations 11, 18, 29, 39, 107, 202, 204 and 223, which occur within the Impact Area, is greater than 98% of the pre-European extent remaining at the state, IBRA bioregion, IBRA sub-region and local government authority (LGA) levels. Clearing of the Impact Area would result in clearing of less than 0.4 per cent of the remaining extent of Beard's (1979) vegetation association at all levels. The clearing required for the Project is unlikely to have a significant impact on the regional vegetation extents.</p> <p>DAFWA mapping of remnant vegetation indicates that the within the general region (defined as a radius of 50 km of the Survey Area) there are substantial areas of remnant native vegetation (2,670,558 ha) of which the Impact Area (534 ha) makes up 0.02% of this vegetation. Clearing of this vegetation will not significantly reduce the extent of vegetation within the general area.</p> <p>The Impact Area is in an area that is used for broad-scale cattle grazing and is largely uncleared. Native vegetation will remain adjacent to the Impact Area and the clearing of the Impact Area is not likely to clear vegetation linkages.</p>	<p>Not likely to be at variance.</p>
<p>(f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.</p>	<p>No wetlands were identified in the Impact Area in the desktop or field assessments.</p> <p>No defined drainage channels or rivers listed under the RIWI Act occur within the Impact Area. However, there are a number of minor ephemeral drainage channels that intersect the Impact Area including Bubble Creek at the eastern end.</p> <p>Throughout the Study Area defined drainage channels in the hilly areas tend to give way rapidly down-valley to alluvial floors and to broader alluvial plains with very restricted channelling (Mabbutt <i>et al.</i> 1963). As a result, most of the run-off forms widespread shallow flooding, which is subject to rapid evaporation.</p> <p>The ephemeral watercourses within the Impact Area contain associated vegetation mapped as the following vegetation types:</p> <ul style="list-style-type: none"> • VA15 'Eucalyptus camaldulensis woodland over mixed shrubland in ephemeral drainage lines and adjacent floodplains' 6.5 ha within the Impact Area • VA02 'Acacia aptaneura low woodland' 2 ha within the Impact Area <p>The Project will require the clearing of 8.5ha of vegetation associated with ephemeral drainage lines and as such will be at variance to this Principle.</p>	<p>At variance.</p>

Principle	Assessment	Outcome
<p>(g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.</p>	<p>The Department of Mines and Petroleum Interactive Geological Map (GeoVIEW.WA) database indicates that the Study Area is underlain by alluvial, shoreline and aeolian deposits (DMP 2014). The outstanding feature of the soils of the Wiluna-Meekatharra region is their generally leached nature and the widespread siliceous hard-pan or “cement”. Very sandy soils in sand plan on wanderrrie banks are the only widespread deep soils. There are some alluvial soils in valleys. Shallow, stony soils are found extensively on hill slopes and plateaus (Mabbutt <i>et al.</i>1963).</p> <p>The land management issues associated with the 13 land systems that occur within the Impact Area include (Mabbutt <i>et al.</i> 1963; Curry <i>et al</i> 1994):</p> <ul style="list-style-type: none"> • Wiluna Land System – Not specified • Belele Land System – Minor susceptibility to soil erosion when degraded • Gabanintha Land System – Not generally susceptible to grazing-induced erosion • Sherwood Land System – Major units not generally susceptible to erosion, but some units susceptible to accelerated erosion • Yanganoo Land System – Major unit locally susceptible to accelerated erosion • Bullimore Land System – Not normally susceptible to erosion, minor wind erosion following burning • Trennaman Land System – Not specified • Glengarry Land System – Not specified • Cunyu Land System – Mild susceptibility to accelerated erosion on some units • Dural Land System – Not specified • Diamond Land System – Not specified • Jundee Land System – Concentrated drainage zones are mildly susceptible to accelerated erosion when degrade, hardpan plains otherwise not normally susceptible to erosion unless severely degraded • Violet Land System – Some units slightly susceptible to accelerated erosion 	<p>Not likely to be at variance.</p>

Principle	Assessment	Outcome
	<p>Based on the land system mapping, the majority of the soils of the Impact Area have a low risk of wind erosion, though some of the systems have moderate to high susceptibility to accelerated erosion. The floodplain areas are more susceptible to water and wind erosion than the soils of the plains which are generally protected from erosion by stony pavements and siliceous hard-pan. The majority of the clearing that is required will occur on plains that have some protection against erosion. There is some risk of wind and water erosion in floodplain areas; however, the extent of clearing required for this Project is low compared to the remaining tracts of native vegetation surrounding the Impact Area. In addition the cleared areas will only be temporarily cleared and will be either sealed by bitumen or rehabilitated, minimising the extent of areas of open or disturbed ground and the time that the soils will be susceptible to erosion.</p> <p>A review of the ASRIS risk mapping (ASRIS 2013) indicates that the Survey Area is mapped as 'Extremely Low Probability of Occurrence/Very Low Confidence' for Acid Sulphate Soils (ASS). The confidence level for this mapping is a provisional classification inferred from surrogate data with no on ground verification.</p> <p>Large tracts of native vegetation remain adjacent to the Impact Area which, reduce the potential direct impacts of the Project on soil acidity and salinity.</p> <p>The linear, narrow and temporary (prior to sealing of the road or revegetation) nature of the clearing required for this Project and the widespread siliceous hard-pan and stony mantle of much of the areas means this clearing is not considered likely to increase wind or water erosion, ground water recharge, surface water runoff or nutrient export. As such, the Project is not likely to be at variance to this Principle.</p>	
<p>(h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.</p>	<p>The Impact Area does not intersect any conservation reserves and there are no conservation areas in the vicinity of the Survey Area.</p> <p>The Impact Area intersects Mooloogool pastoral station which is a proposed conservation area. Mooloogool Station holds no reservation status at this time. The clearing of the Impact Area within Mooloogool Station is unlikely to have a significant impact on the station as the Impact Area occurs within an existing road reserve and alongside the existing cleared highway.</p> <p>The Impact Area is surrounded by pastoral areas that have not been subject to large scale clearing and vegetation corridors surrounding the Impact Area remain largely intact. Clearing of the Impact Area is not likely to impact on vegetated linkages within the regional context. As such, the Project is not likely to be at variance to this Principle.</p>	<p>Not likely to be at variance</p>

Principle	Assessment	Outcome
<p>(i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.</p>	<p>The Impact Area is located in the Murchison River and Salt Lake Basin Surface Water Allocation Areas, within the Murchison River and Salt Lake Basin Surface Water Allocation Sub-areas. This area is not listed under the RIWI Act.</p> <p>A search of the DoW Geographic Data Atlas (DoW 2013) indicated that the entire Impact Area is within the East Murchison Groundwater Area.</p> <p>No Public Drinking Water Source Areas occur within the Impact Area, and no wetlands were identified in the Impact Area in the desktop or field assessments.</p> <p>No defined drainage channels or rivers listed under the RIWI Act occur within the Impact Area. There are a number of minor ephemeral drainage channels that intersect the Impact Area including Bubble Creek at the eastern end. There may be minor short term impacts on these creeklines during construction clearing, including potential erosion of the soil adjacent to the road during construction. However, the Project is not expected to clear vegetation that would significantly alter current surface water drainage in the long term. Existing road drains and other drainage (natural or constructed) will be re-constructed after completion of the Project, and therefore the Project is not expected to alter current surface water drainage in the long term. In addition construction will occur during the dry season which means that the creeklines are unlikely to be flowing during construction. This reduces the risk of impacting on surface water flows during construction.</p> <p>As indicated in principle (g) the probability of ASS occurring is low to extremely low.</p> <p>Borrow pits will be cleared and rehabilitated progressively to minimise potential erosion and sedimentation impacts.</p> <p>As the Project is unlikely to impact on surface water flows or groundwater quality or quantity, the Project is not likely to be at variance to this Principle.</p>	<p>Not likely to be at variance</p>
<p>(j) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.</p>	<p>The Impact Area crosses two catchment areas: 'Murchison River' and 'Salt Lake Basin'. The Murchison River has a catchment area of 8,200,000 ha and the Salt Lake Basin is 49 000,000 ha (Shepherd <i>et al.</i> 2002). The Impact Area (534 ha) comprises a very small extent of both of these catchments and is not likely to influence the potential flooding or waterlogging of the catchment areas.</p> <p>Given the narrow, linear nature of much of the Impact Area and the fact that the majority of the clearing required for the Project will occur along the existing road, the Project is unlikely to increase the risk of flooding or waterlogging within the area. In addition construction will occur within the dry season when rainfall is limited and areas of temporary clearing will be rehabilitated following construction.</p>	<p>Not likely to be at variance</p>

Principle	Assessment	Outcome
	<p>Borrow pits will be cleared and rehabilitated progressively to minimise potential runoff issues associated with cleared areas in the borrow pits.</p> <p>Given the linear nature of the Impact Area and the large extents of remnant vegetation remaining adjacent to the Impact Area, the clearing required for the Project is unlikely to increase the risk of flooding or waterlogging within the Impact Area.</p> <p>Levees and drainage works will be undertaken as part of the roadworks which will assist in management of drainage adjacent to the highway.</p> <p>Given the above the Project is unlikely to impact the incidence or intensity of flooding, the Project is not likely to be at variance to this Principle.</p>	

6. Environmental Management Plan

6.1 Environmental Management Plan

Main Roads will work to minimise impacts upon the environment associated with road construction projects.

A project specific Environmental Management Plan (EMP) should be implemented to manage potential environmental impacts associated with the project. The EMP should include management measures to:

- Minimise clearing of vegetation through the design and construction process and prevent unauthorised clearing
- Minimise the risk of erosion through design and construction processes
- Manage any contamination identified during works
- Control dust generation including standard dust suppression techniques such as the use of water carts
- Manage pollution generating activities such as refuelling or storage of chemicals during works
- Manage hazardous substances on site in accordance with material safety data sheets
- Control the introduction or spread of Declared Plants and weeds

The aim of this EMP is to minimise the environmental impacts associated with the proposed works as well as to identify areas of responsibilities required for the implementation of management strategies.

This EMP addresses specific issues that were identified during the EIA. The project management measures identified within this EMP are in addition to the standard environmental management contract specifications. Main Roads' standard environmental contract specifications (Specifications 203, 204, 301, 302 and 304) are to be adhered to where appropriate.

The areas that require special management will be addressed in terms of:

- The timing of the various management actions
- The topic (e.g. vegetation)
- The objectives for each area
- The actions that are necessary to minimise the impact
- The responsible party for implementing the action
- Whether the action arose from external advice or is a Main Roads requirement

6.2 Communication plan

Environmental issues specific to the project will be communicated as follows:

Table 30 Communication plan

Method	Frequency	Participants	Reference	Record
Project Site				
Induction	Prior to Work	All personnel and subcontractors	EMP and Contractor Environmental Policy	Induction Meeting
Toolbox Meetings	Daily	Project Personnel	Contractor Safety Plan	Minutes of Meeting
Contract Meetings	Monthly	Main Roads' Project Manager and Contractor Project Manager	EMP	Minutes of Meeting

6.3 External communication and complaints

A complaints register shall be maintained by the contractor. All complaints received shall be forwarded to the Main Roads' Project Manager for action. Serious complaints shall be investigated within 24 hours of the complaint being received.

6.4 Monitoring

After project completion and project handover, the Asset manager should develop a monitoring program to monitor for those aspects that have been identified as requiring monitoring.

6.5 Auditing

The implementation of the EMP will be audited after the contractor takes possession of site. The audit schedule will be determined dependent on the construct clearing schedule. Audits will be carried out quarterly as a minimum. This audit will be carried out by a Main Roads staff member.

A suitability audit of the Construction Environmental Management Plan (CEMP) will be completed prior to works commencing.

Table 31 Environmental Management Plan Accountability

Name	Role	Contact details
Nick Jones	Project Manager	9080 1457 nick.jones@mainroads.wa.gov.au
Emma Fitzgerald	Environmental Officer	9323 5435 emma.fitzgerald@mainroads.wa.gov.au

Table 32 Environmental Management Plan

ENVIRONMENTAL MANAGEMENT PLAN					
Topic	Objective	Management Action	Monitoring/ Maintenance Program	Responsible Party	Completion Timeframe
Environmental Management System					
Record Keeping	Maintain record keeping requirements	<ul style="list-style-type: none"> Ensure standard record keeping requirements are completed within three months of completion of the project activities 	Management system review	Environment Officer	Three months following completion of construction
Inductions	Ensure that all construction personnel and contractors are aware of environmental requirements.	<ul style="list-style-type: none"> Develop and implement an Environmental induction program to include training in the requirements of this EMP. Ensure all personnel and contractors attend the induction training and keep records of their attendance. 	Management system review	Environment Officer	End of construction period.
Project Specific Aspects					
Dust	Manage dust so that it does not create adverse social or environmental impacts	<ul style="list-style-type: none"> Clear vegetation only when necessary and treat areas requiring soil stabilisation as soon as practicable. Water tankers will be made available to dampen exposed surfaces within construction and laydown areas, particularly during ground disturbing activities. Minimise or cease project activities during periods of high wind or when excessive dust is generated. Access to private property and appropriate traffic management measures should be planned and implemented prior to the construction of works. Watering, road sweeping and signage for suitable speed limits will be used during vehicle movement. 	Construction surveillance/ complaints register	Contractor/Project Manager	Ongoing through construction phase

ENVIRONMENTAL MANAGEMENT PLAN					
Topic	Objective	Management Action	Monitoring/ Maintenance Program	Responsible Party	Completion Timeframe
		<ul style="list-style-type: none"> • Appropriate licences from the Department of Water will be obtained if required to supply water for dust suppression and other construction purposes. • The extent of cleared and other disturbed areas will be minimised as far as is practicable for construction requirements. • If stockpiles are left untouched for greater than 28 days long-term stabilisation methods such as mulch or other stabilisers should be implemented. • All vehicles carrying dusty loads will be covered through the use of tarpaulins etc. when travelling in areas with sensitive receptors both inside and outside the project area. 			
Pollution and Litter	<p>Ensure that the construction of the proposal is managed to a standard that minimises any adverse impacts on the environment.</p> <p>Appropriate disposal of construction waste.</p>	<ul style="list-style-type: none"> • All waste materials from the project area will be removed from the site upon completion of the project and to the satisfaction of the Project Manager or Site Superintendent. • Construction waste and other rubbish will be contained in bins with lids (where practicable) and removed regularly. • Confirm that non-recyclable materials/wastes are disposed of at licensed landfill facilities or in accordance with Council regulations. • Temporary storage of bitumen, asphalt, concrete or aggregate should only occur at designated depots or controlled hardstands. Precoating of aggregate will only occur in approved areas. 	Construction surveillance	Environment Officer	Ongoing through construction phase

ENVIRONMENTAL MANAGEMENT PLAN					
Topic	Objective	Management Action	Monitoring/ Maintenance Program	Responsible Party	Completion Timeframe
		<ul style="list-style-type: none"> Emergency clean-up procedures shall be implemented in the case of any spillage. These will include control of spilled material and removal of contaminated soil to an approved site. The contractor shall ensure appropriate equipment is available at all times and shall notify the Superintendent's Representative of a spill. Employees whose activities include the storage and handling of waste have been appropriately trained and are competent at undertaking tasks required. All waste oil will be collected for recycling and any empty fuel/oil containers, used filters and waste hydraulic parts to be collected and stored in an allocated area then removed to an approved landfill site. Re-fuelling on site should be avoided as much as is practical. The Project Area will be kept in a tidy manner at all times. 			
Surface Drainage	Prevent damage to environment from changes to flood regime and maintain hydrological regime that exists prior to construction.	<ul style="list-style-type: none"> Vegetation removal and soil disturbance will be minimised, where practicable. Disturbed areas will be stabilised soon after construction activities are completed. Existing natural drainage paths and channels along the road or the vicinity of the project area will not be unnecessarily blocked or restricted during project construction. Vehicle and equipment wash down areas will be located away from environmentally sensitive areas. 	Pre-construction/ construction surveillance.	Project Manager	Ongoing through construction phase

ENVIRONMENTAL MANAGEMENT PLAN					
Topic	Objective	Management Action	Monitoring/ Maintenance Program	Responsible Party	Completion Timeframe
		<ul style="list-style-type: none"> Maintain the hydrological balance on each side of the road. This will prevent ponding and scour during flood events, and with appropriate management structures in place (such as culverts) balance will be maintained. Stormwater drainage shall be treated and disposed of in accordance with Main Roads requirements. 			
Groundwater	To maintain the quality of groundwater so that existing and potential environmental values are protected.	<ul style="list-style-type: none"> Spills of > 5L of hydrocarbons or potentially polluting materials will be contained immediately and removed within 24 hours to minimise the potential for contaminants to enter groundwater. Use pollution control and containment strategies during the construction phase of the project and liaise with the DoW where necessary. If dewatering is required, Main Roads will gain approvals from DoW. <ul style="list-style-type: none"> If dewatering is required, the most appropriate method will be determined on site and dewatering kept to a minimum necessary for the safe construction; As far as practicable, infiltrate dewater back into the groundwater resource, close enough to the abstraction point that it does not create a 'recycle' effect The Construction Contractor will design, maintain and operate all necessary pumping equipment and temporary structures for dewatering. 	Construction surveillance	Contractor/Project Manager	Ongoing through construction phase

ENVIRONMENTAL MANAGEMENT PLAN					
Topic	Objective	Management Action	Monitoring/Maintenance Program	Responsible Party	Completion Timeframe
Hazardous Materials	Ensure that the construction works are managed to a standard that minimises any adverse impacts on the environment.	<ul style="list-style-type: none"> Bulk fuel and hazardous material storage areas should be excluded from the site (and stored in Meekatharra or Wiluna) as far as is practical. Regular vehicle servicing will be undertaken at designated areas, at least 100 m away from watercourses or in Meekatharra or Wiluna as much as is practical. Site personnel shall be trained in the use of emergency Fire suppressant equipment. Spill trays and spill response equipment will be available near fuel storage or refuelling areas. All hazardous material spills will be reported according to statutory requirements. Hazardous materials will be disposed of at an approved and certified facility. Temporary storage of bitumen, asphalt, concrete or aggregate shall occur at designated depots or controlled hardstands located within the project area. Pre-coating of aggregate will only occur in approved and designated areas. 	Construction surveillance	Contractor/Project Manager	Ongoing through construction phase
Fire	Ensure that the fire risk associated with the construction of the proposal is minimised.	<ul style="list-style-type: none"> No fires shall be lit within the project area. Cleared vegetation will not be burned on site. Machinery will be fitted with approved spark arresting exhaust systems. All vehicles, plant and equipment to be fitted with fire extinguishers and restricted and to designate cleared areas. 	Construction surveillance	Contractor/Project Manager	Ongoing through construction phase

ENVIRONMENTAL MANAGEMENT PLAN					
Topic	Objective	Management Action	Monitoring/ Maintenance Program	Responsible Party	Completion Timeframe
		<ul style="list-style-type: none"> • Maintain all vehicles, plant and equipment in good working order free of build-up of debris and oil. • A water tanker/fire fighter unit will be on site at all times during project construction and personnel trained in their use. • Develop and maintain a risk assessment of all construction activities. All hot works will be undertaken in accordance with standard safety procedures. When construction activities are deemed to be a moderate or high fire risk, specific fire management actions should take place such as wetting down the work area and having a dedicated spotter to watch work for fire ignition. • Reduce the amount of flammable substances stored on site (such as fuel) to the minimum required. Where possible all flammable substances should be kept off site. Where that is not practical, flammable substances should be kept in an area that is free of ignition sources and clearly identified and registered. • Construction personnel will attempt to extinguish (using safe working methods) and report fires occurring within the project area. 			
Revegetation/ Rehabilitation activities	Rehabilitate temporarily cleared areas as close as practicable to a natural state	<ul style="list-style-type: none"> • A revegetation plan will be prepared that includes the following: <ul style="list-style-type: none"> – A figure showing areas to be regenerated – Requirements for vegetation reuse – Requirements for topsoil storage and reuse and/or soil preparation or treatment – Completion criteria for revegetation success 	Construction surveillance and post construction maintenance assessment	Environment Officer	Preparation (top soil stockpiling as required) during construction phase Revegetation completed as

ENVIRONMENTAL MANAGEMENT PLAN					
Topic	Objective	Management Action	Monitoring/Maintenance Program	Responsible Party	Completion Timeframe
		<ul style="list-style-type: none"> Implement the Revegetation Plan to revegetate/rehabilitate areas cleared for temporary purposes. Revegetation will be undertaken in accordance with Main Roads' 'Guideline Revegetation Planning and Techniques (TRIM Doc D12#258089)'. Any revegetation/regeneration works will only include plant species which are indigenous to the local area. Revegetation will aim to produce a self-sustaining vegetation community that is as similar to the surrounding vegetation as possible. 			soon as is practical after completion
Topsoil	Determine adequate topsoil management in order to enhance revegetation success and minimise erosion and spread of weeds.	<ul style="list-style-type: none"> Topsoil will be managed according to Main Roads Topsoil Management Guideline (TRIM Doc D12#256186). Topsoil will be stockpiled for revegetation purposes and the movement of topsoil will be restricted to the limits of the project area. Construction activities will be undertaken where possible in the dry season to reduce the potential for soil erosion and drainage line siltation due to vegetation removal and heavy rains. 	Construction surveillance	Project Manager/ Contractor	Ongoing through construction phase and revegetation works
Clearing of vegetation and fauna habitats	Minimise direct loss of vegetation and fauna habitats.	<ul style="list-style-type: none"> Selection of design that minimises direct and indirect impacts on native vegetation and habitat in the Project area. Where possible design should minimise vegetation clearing. 	Design phase	Main Roads	Design Phase
		<ul style="list-style-type: none"> Plan and develop storage sites, laydown areas, hardstands and other areas which require clear space to occur within areas which are already cleared, otherwise disturbed or proposed to be cleared. 	Construction surveillance	Project Manager/ Contractor	Ongoing through construction phase

ENVIRONMENTAL MANAGEMENT PLAN					
Topic	Objective	Management Action	Monitoring/ Maintenance Program	Responsible Party	Completion Timeframe
		<ul style="list-style-type: none"> Vehicles and equipment shall not be driven over, or parked on, vegetation / habitat as far as is practicable. Avoid clearing known locations of priority flora species and communities (where possible) or minimise impacts to conservation significant flora. Priority flora species (listed by DPaW) identified during the GHD field survey (2013) include: <ul style="list-style-type: none"> <i>Eremophila congesta</i> (Priority 1) <i>Calytrix uncinata</i> (Priority 3) <i>Calytrix verruculosa</i> (Priority 3) <i>Gunniopsis propinqua</i> (Priority 3) <i>Homalocalyx echinulatus</i> (Priority 3) <i>Indigofera sp. Gilesii</i> (M.E. Trudgen 15869) (Priority 3) <i>Ptilotus luteolus</i> (Priority 3) <i>Sauropus ramosissimus</i> (Priority 3) <i>Stackhousia clementii</i> (Priority 3) Conservation significant flora and communities will be clearly marked on site and on clearing plans. Fencing shall be placed to delineate the Project Area from conservation significant flora and communities where they are not to be cleared or otherwise impacted. Restrict the extent of clearing in habitat considered to be significant for conservation significant fauna. In particular, restrict and minimise clearing habitat in the areas surrounding identified Brush-tailed Mulgara (Priority 4) burrows and suitable habitat (122.3 ha, see Table 20). 	<p>Construction and revegetation surveillance</p> <p>Construction surveillance</p> <p>Construction surveillance</p>		

ENVIRONMENTAL MANAGEMENT PLAN					
Topic	Objective	Management Action	Monitoring/Maintenance Program	Responsible Party	Completion Timeframe
		<ul style="list-style-type: none"> Restrict the extent of clearing in habitat considered to be significant for conservation significant fauna, and rare in the region, including: <ul style="list-style-type: none"> For the Major Mitchell's Cockatoo (Schedule 4) – Eucalyptus/ Corymbia woodland (including riparian habitat around Bubble Creek) (6.48 ha) For the Long-tailed Dunnart (Priority 4) – Rocky outcrops, breakaways and BIF hills (5.48 ha) 			
		<ul style="list-style-type: none"> A clearing line will be clearly marked onsite by a surveyor in accordance with the design. This line will be checked by a member of the Environmental Team (with appropriate experience) prior to the commencement of clearing works 	Construction surveillance	Environment Officer/Contractor	Ongoing through construction phase and revegetation works
		<ul style="list-style-type: none"> Trees to be removed shall be felled in a manner that they fall within the approved clearing area. 	Construction surveillance	Environment Officer/Contractor	Completion of clearing
Vegetation Clearing - Record-keeping	Maintain the required records relating to clearing native vegetation under the purpose permit.	<ul style="list-style-type: none"> Clearing Record Keeping required: <ul style="list-style-type: none"> A map showing the location where the clearing occurred (ESRI shapefile) The size of the area cleared (in hectares) The dates on which the clearing was done 		Project Manager	Ongoing through construction phase and revegetation works
Weeds	Minimise impact of weeds in the Project Area	<ul style="list-style-type: none"> If any weeds of significance are recorded in the Project Area during construction the Environmental Officer will manage the weeds in accordance with legislated requirements. Plant, machinery, equipment, tools and footwear will be cleaned down prior to arrival and prior to departure from the site. Clean down will consist of brushing, gouging, scraping and/or water blasting to remove any compacted soil or plant matter. 	Construction surveillance	Environment Officer/Contractor	Ongoing through construction phase and revegetation works

ENVIRONMENTAL MANAGEMENT PLAN					
Topic	Objective	Management Action	Monitoring/ Maintenance Program	Responsible Party	Completion Timeframe
		<ul style="list-style-type: none"> A weed control program will be implemented for revegetation areas as required. This will involve spraying weeds appropriately to maximise the success of revegetation works and reduce the spread of weeds. 			
Fauna	Avoid unnecessary impacts to fauna and damage to fauna habitat.	<ul style="list-style-type: none"> Fauna are not to be fed or intentionally harmed. Timing of clearing should avoid the peak breeding period for threatened and priority fauna known to occur in the Project Area: <ul style="list-style-type: none"> Mulgara (<i>Dasycercus cristicauda</i>) Rainbow Bee-eater (<i>Merops ornatus</i>) Australian Bustard (<i>Ardeotis australis</i>) Bush Stone-curlew (<i>Burhinus grallarius</i>) Grey Falcon (<i>Falco hypoleucos</i>) No pets or firearms permitted on site. The nearest DPaW office is to be contacted in the event of sick, injured or orphaned native wildlife on the site. The Environment Officer should be aware of the contact details and availability of veterinary services and wildlife careers in Wiluna or Meekatharra. Any trenched or open excavations should be checked twice daily (within two hours of dawn and within two hours of dusk) for fauna and any entrapped fauna will be removed as soon as possible by an appropriately experienced person. 	Construction surveillance	Project Manager/ Contractor/ Environment Officer	Ongoing through construction phase and revegetation works

ENVIRONMENTAL MANAGEMENT PLAN					
Topic	Objective	Management Action	Monitoring/ Maintenance Program	Responsible Party	Completion Timeframe
		<ul style="list-style-type: none"> Fauna encountered in the construction area shall be given the chance to move on if there is no threat to the person's safety in doing so. The Environmental Coordinator will be suitably experienced and licensed and will be available at all times during the construction phase to interact with fauna that cannot move away freely. Any logs or other material which has value as habitat for fauna is to be stockpiled and replaced on the revegetation area (where possible). Minimise or restrict the movement and use of plant and vehicles at dusk and dawn and during night time hours. 			
Traffic	Minimise the disturbance from traffic	<ul style="list-style-type: none"> Construction vehicles will travel along specifically designated routes that have been selected to minimise disturbance on other traffic and the community. 	Construction surveillance/complaints register	Contractor	Ongoing through construction phase and revegetation works
Visual Amenity	Minimise impacts to visual amenity for local and tourist traffic	<ul style="list-style-type: none"> Machinery storage areas, stockpiling of soils and campsite establishment during works to be located in areas which minimise any visual amenity impacts 	Construction surveillance/complaints register	Project Manager	Pre-construction

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Appendices

Appendix A – Legislation, background information, and conservation codes

Legislation

Federal Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Federal Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as matters of national environmental significance (MNES).

There are currently nine MNES protected under the EPBC Act, these include:

- World heritage properties
- National heritage places
- Wetlands of international importance (listed under the Ramsar Convention)
- Listed Threatened species and ecological communities
- Migratory species
- Commonwealth marine areas
- The Great Barrier Reef Marine Park
- Nuclear actions (including uranium mines)
- A water resource, in relation to coal seam gas development and large coal mining development

A person must not undertake an action that has, will have, or is likely to have a significant impact (direct or indirect) on MNES, without approval from the Australian Government Minister for the Environment.

State *Environmental Protection Act 1986*

The *Environmental Protection Act 1986* (EP Act) is the primary legislative Act dealing with the protection of the environment in Western Australia. It provides for an Environmental Protection Authority (EPA), for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the above.

State Environmental Protection (Clearing of Native Vegetation) Regulations 2004

Clearing of native vegetation in Western Australia requires a permit from the Department of Environment and Regulation (DER) (formerly the Department of Environment and Conservation – DEC), unless exemptions apply. Native vegetation includes aquatic and terrestrial vegetation indigenous to Western Australia, and intentionally planted vegetation declared by regulation to be native, but not vegetation planted in a plantation or planted with commercial intent.

In the EP Act Section 51A, clearing is defined as the killing or destruction of; the removal of; the severing or ringbarking of trunks or stems of; or the doing of substantial damage of some or all of the native vegetation in an area, including the flooding of land, the burning of vegetation, the grazing of stock or an act or activity that results in the above.

When making a decision to grant or refuse a permit to clear native vegetation the assessment considers clearing against the ten clearing principles as specified in Schedule 5 of the EP Act:

- a. Native vegetation should not be cleared if it comprises a high level of biodiversity.
- b. Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a significance habitat for fauna indigenous to Western Australia.
- c. Native vegetation should not be cleared if it includes, or is necessary, for the continued existence of rare flora.
- d. Native vegetation should not be cleared if it comprises the whole or part of native vegetation in an area that has been extensively cleared.
- e. Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.
- f. Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.
- g. Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.
- h. Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.
- i. Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.
- j. Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

There are a number of Environmentally Sensitive Areas (ESAs) within Western Australia where exemptions in regulations do not apply. ESAs include locations of threatened communities and species.

ESAs are declared by a notice under Section 51B of the EP Act. Table A.1 outlines the aspects of areas declared as ESA (under the Environmental Protection (Clearing of Native Vegetation) Regulations 2004 – Reg 6).

Table A.1 Aspects of Environmentally Sensitive Areas

Aspects of Environmentally Sensitive Areas
A declared World Heritage property as defined in Section 13 of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).
An area that is registered on the Register of the National Estate (RNE), because of its natural values, under the Australian Heritage Commission Act 1975 of the Commonwealth (the RNE was closed in 2007 and is no longer a statutory list – all references to the RNE were removed from the EPBC Act on 19 February 2012).
A defined wetland and the area within 50 m of the wetland.
The area covered by vegetation within 50 m of rare flora, to the extent to which the vegetation is continuous with the vegetation in which the rare flora is located.
The area covered by a TEC.
A Bush Forever Site.
The areas covered by the following policies:
a) The Environmental Protection (Gnangara Mound Crown Land) Policy 1992.
b) The Environmental Protection (Western Swamp Tortoise Habitat) Policy 2002.
The areas covered by the lakes to which the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 (SCPL) (EPP Lakes) applies.
Protected wetlands as defined in the Environmental Protection (South West Agricultural Zone Wetlands) Policy 1998.
Areas of fringing native vegetation in the policy area as defined in the Environmental Protection (Swan and Canning Rivers) Policy 1997.

State Wildlife Conservation Act 1950

The *Wildlife Conservation Act 1950* (WC Act) provides for the conservation and protection of wildlife. It is administered by the DPaW and applies to both flora and fauna.

Any person wanting to capture, collect, disturb or study fauna requires a permit to do so. A permit is required under the WC Act if removal of threatened species is required.

State Biosecurity and Agriculture Management Act 2007

The *Biosecurity and Agriculture Management Act 2007* (BAM Act) provides for the declaration of Declared Pests by the Department of Agriculture and Food Western Australia (DAFWA) which are prohibited organisms or organisms for which a declaration under Section 22(2) is in force.

The BAM Act replaces the repealed *Agriculture and Related Resources Protection Act 1976* (ARRP Act).

Background Information and Conservation Codes

Acid Sulphate Soils

Acid Sulphate Soils (ASS) are naturally occurring soils containing iron sulphides. These soils are typically benign within an anaerobic environment, however they can become oxidised when exposed, resulting in acidic soil and groundwater. The resulting sulphuric acid can also break heavy metal bonds and result in groundwater contamination. Acid sulphate soils are typically considered to be a management issue.

Wetlands

Wetlands include not only lakes with open water, but areas of seasonally, intermittently or permanently waterlogged soil.

Ramsar wetlands

The Convention of Wetlands of International Importance was signed in 1971 at the small Iranian town of Ramsar. The Convention has since been referred to as the Ramsar Convention. Ramsar wetlands are “sites containing representative, rare or unique wetlands, or wetlands that are important for conserving biological diversity ... because of their ecological, botanical, zoological, limnological or hydrological importance” (DoE, 2013b). Once a Ramsar wetland is designated, the country agrees to manage its conservation and ensure its wise use. Under the Convention, wise use is broadly defined as “maintaining the ecological character of a wetland” (DoE, 2013b).

Nationally important wetlands

Nationally important wetlands are wetlands which meet at least one of the following criteria (DoE, 2013a):

- It is a good example of a wetland type occurring within a biogeographic region in Australia
- It is a wetland which plays an important ecological or hydrological role in the natural functioning of a major wetland system/complex
- It is a wetland which is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail
- The wetland supports one percent or more of the national populations of any native plant or animal taxa
- The wetland supports native plant or animal taxa or communities which are considered endangered or vulnerable at the national level
- The wetland is of outstanding historical or cultural significance

Vegetation and Flora

Species of significant flora, fauna and communities are protected under both Federal and State Acts. The Federal EPBC Act provides a legal framework to protect and manage nationally important flora and communities. The State WC Act is the primary wildlife conservation legislation in Western Australia.

Vegetation extent & status

The National Objectives and Targets for Biodiversity Conservation 2001–2005 (Commonwealth of Australia, 2001) recognise that the retention of 30 percent or more of the pre-clearing extent of each ecological community is necessary if Australia’s biological diversity is to be protected. This is the threshold level below which species loss appears to accelerate exponentially and loss below this level should not be permitted. This level of recognition is in keeping with the targets recommended in the review of the National Strategy for the Conservation of Australia’s Biological Diversity (ANZECC, 2000) and in EPA Position Statement No. 2 on environmental protection of native vegetation in Western Australia (EPA, 2000).

From a purely biodiversity perspective and taking no account of any other land degradation issues, there are a number of key criteria now being applied to the clearing of native vegetation in Western Australia (EPA, 2000).

- The “threshold level” below which species loss appears to accelerate exponentially at an ecosystem level is regarded as being at a level of 30 percent of the pre-European extent of the vegetation type.
- A level of 10 percent of the original extent is regarded as being a level representing Endangered.
- Clearing which would put the threat level into the class below should be avoided.
- From a biodiversity perspective, stream reserves should generally be in the order of at least 200 metres (m) wide.

The extent of remnant native vegetation has been assessed by Shepherd et al. (2002) and the Government of Western Australia (2013), based on broadscale vegetation association mapping by Beard (1974).

Conservation significant communities

Ecological communities are defined as naturally occurring biological assemblages that occur in a particular type of habitat (English and Blyth, 1997). Federally listed Threatened Ecological Communities (TEC) are protected under the EPBC Act administered by the Department of the Environment (DotE) (formerly the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC)). The DPaW also maintains a list of TECs for Western Australia; some of which are also protected under the EPBC Act. TECs are ecological communities that have been assessed and assigned to one of four categories related to the status of the threat to the community, i.e. Presumed Totally Destroyed, Critically Endangered, Endangered and Vulnerable (Table A.2).

Possible TECs that do not meet survey criteria are added to the DPaW Priority Ecological Community (PEC) List under Priorities 1, 2 and 3 (Table A.3). These are ecological communities that are adequately known; are rare but not threatened, or meet criteria for Near Threatened. PEC that have been recently removed from the threatened list are placed in Priority 4. These ecological communities require regular monitoring. Conservation dependent ecological communities are placed in Priority 5. PEC are not listed under any formal Federal or State legislation.

Table A.2 Conservation codes & definitions for Threatened Ecological Communities endorsed by the Western Australian Minister for the Environment & listed under the *Environment Protection and Biodiversity Conservation Act 1999*

Status	Description
Federal Government Conservation Categories (EPBC Act)	
Critically Endangered (CR)	If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future
Endangered (EN)	If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future
Vulnerable (VU)	If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future
Western Australia Conservation Categories	
Presumed Totally Destroyed (PD)	The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.
Critically Endangered (CR)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated
Endangered (EN)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.
Vulnerable (VU)	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

Table A.3 Conservation categories & definitions for Priority Ecological Communities as listed by the Department of Parks and Wildlife

Category	Description
Priority 1	<p>Poorly known ecological communities.</p> <p>Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤ 5 occurrences or a total area of ≤ 100 ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.</p>
Priority 2	<p>Poorly known ecological communities.</p> <p>Communities that are known from few occurrences with a restricted distribution (generally ≤ 10 occurrences or a total area of ≤ 200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.</p>
Priority 3	<p>Poorly known ecological communities.</p> <p>(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:</p> <p>(ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;</p> <p>(iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.</p> <p>Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.</p>
Priority 4	<p>Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.</p> <p>(i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.</p> <p>(ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.</p> <p>(iii) Ecological communities that have been removed from the list of threatened communities during the past five years.</p>
Priority 5	<p>Conservation Dependent ecological communities.</p> <p>Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.</p>

Other significant vegetation

Vegetation may be significant for a range of reasons, other than a statutory listing as a TEC or because the extent is below a threshold level. The EPA (2004a) states that significant vegetation may include vegetation that includes the following:

- Scarcity
- Unusual species
- Novel combinations of species
- A role as a refuge
- A role as a key habitat for Threatened species or large population representing a significant proportion of the local to regional total population of a species
- Being representative of the range of a unit (particularly, a good local and/or regional example of a unit in 'prime' habitat, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range)
- A restricted distribution

This may apply at a number of levels, so the unit may be significant when considered at the fine-scale (intra-locality), intermediate-scale (locality or inter-locality) or broad-scale (local to region).

Conservation significant flora & fauna

Species of significant flora are protected under both Federal and State legislation. Any activities that are deemed to have a significant impact on species that are recognised by the EPBC Act, and/or the WC Act can warrant referral to the DoE and/or the EPA. According to the DPaW (WA Herbarium, 1998–): "Threatened flora are plants which have been assessed as being at risk of extinction. In Western Australia the term Declared Rare Flora (DRF) is applied to Threatened flora due to the laws regarding threatened flora conservation. The WC Act is the primary wildlife conservation legislation in the State and the Minister for the Environment can declare taxa (species, subspecies or variety) as "Rare Flora" if they are considered to be in danger of extinction, rare or otherwise in need of special protection." For the purposes of this report, flora listed by the WC Act as DRF is described as Threatened.

The Federal conservation level of flora and fauna species and their significance status is assessed under the EPBC Act (Table A.4). The significance levels for fauna used in the EPBC Act are those recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN).

The State conservation level of fauna species and their significance status is assessed under the State WC Act (*Wildlife Conservation (Specially Protected Fauna) Notice 2010(2)*). This Act uses a set of Schedules (Table A.4) but also classifies species using some of the IUCN categories. Schedule 3 fauna species are those which are "subject to an agreement between the Government of Australia and the Governments of Japan, China and the Republic of Korea relating to the protection of migratory birds, are declared to be fauna that is in need of special protection".

In Western Australia, the DPaW also maintains a list of Priority listed flora species. Conservation codes for Priority species are assigned by the DPaW to define the level of conservation significance (Table A.4). Priority species are not currently protected under the WC Act.

For the purposes of this assessment, all species listed under the EPBC Act, WC Act and DPaW Priority species are considered conservation significant.

Table A.4 Conservation categories & definitions for *Environment Protection and Biodiversity Conservation Act 1999* listed flora & fauna species

Conservation Category	Definition
Extinct	Taxa not definitely located in the wild during the past 50 years
Extinct in the Wild	Taxa known to survive only in captivity
Critically Endangered	Taxa facing an extremely high risk of extinction in the wild in the immediate future
Endangered	Taxa facing a very high risk of extinction in the wild in the near future
Vulnerable	Taxa facing a high risk of extinction in the wild in the medium-term
Near Threatened	Taxa that risk becoming Vulnerable in the wild
Conservation Dependent	Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classified as Vulnerable or more severely threatened.
Data Deficient (Insufficiently Known)	Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
Least Concern	Taxa that are not considered Threatened

Table A.5 Conservation codes and descriptions for Western Australian flora & fauna

Code	Conservation Category	Description
Wildlife Conservation Act 1950		
T	Schedule 1 under the WC Act	Threatened Fauna (Fauna that is rare or is likely to become extinct) Threatened Flora (Declared Rare Flora – Extant) Taxa that have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such. CR: Critically Endangered – considered to be facing an extremely high risk of extinction in the wild. EN: Endangered – considered to be facing a very high risk of extinction in the wild. VU: Vulnerable – considered to be facing a high risk of extinction in the wild.
X	Schedule 2 under the WC Act	Presumed Extinct Fauna Presumed Extinct Flora (Declared Rare Flora – Extinct) Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such.
IA	Schedule 3 under the WC Act	Birds protected under an international agreement. Birds that are subject to an agreement between governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction.

Code	Conservation Category	Description
S	Schedule 4 under the WC Act	Other specially protected fauna. Fauna that is in need of special protection, otherwise than for the reasons mentioned in the above schedules.
DPaW Priority Listed		
1	Priority One: Poorly-known taxa	Taxa that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.
2	Priority Two: Poorly-known taxa	Taxa that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
3	Priority Three: Poorly-known taxa	Taxa that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Taxa may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
4	Priority Four: Rare, Near Threatened and other taxa in need of monitoring	(a) Rare. Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands. (b) Near Threatened. Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Taxa that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
5	Priority 5: Conservation Dependent taxa	Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the taxon becoming threatened within five years.

Migratory species listed under the EPBC Act

The EPBC Act also protects land and migratory species that are listed under International Agreements. The list of migratory species established under section 209 of the EPBC Act comprises:

- Migratory species which are native to Australia and are included in the appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II)
- Migratory species included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China–Australia Migratory Bird Agreement (CAMBA)
- Native, migratory species identified in a list established under, or an instrument made under, an international agreement approved by the Minister, such as the republic of Korea–Australia Migratory Bird Agreement (ROKAMBA)

Other significant flora & fauna

Flora species, subspecies, varieties, hybrids and ecotypes may be significant for a range of reasons, other than as Threatened (Declared Rare) Flora or Priority Flora. The EPA (2004a) states that significant flora may include taxa that have:

- A keystone role in a particular habitat for threatened species or supporting large populations representing a significant proportion of the local regional population of a species
- Relic status
- Anomalous features that indicate a potential new discovery
- Being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range)
- The presence of restricted subspecies, varieties, or naturally occurring hybrids
- Locally endemic restricted distribution
- Being poorly reserved

The application of the degree of significance may apply at a range of scales.

Introduced plants (weeds)

Declared Pests

The Department of Agriculture and Food Western Australia (DAFWA) maintains a list of Declared Pests for Western Australia that have been declared under the BAM Act. If a Pest is declared for the whole of the State or for particular Local Government Areas, all landholders are obliged to comply with the specific category of control. Declared Pests are gazetted under categories, which define the action required. The category may apply to the whole of the State, districts, individual properties or even paddocks. Categories of control are defined in Table B.6. Among the factors considered in categorising Declared Pests are:

- The impact of the plant on individuals, agricultural production and the community in general
- Whether it is already established in the area
- The feasibility and cost of possible control measures

Table A.6 Department of Agriculture and Food (Western Australia) Categories for Declared Pests under the Biosecurity and Agriculture Management Act 2007

Control Class Code	Description
C1 (Exclusion)	Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2 (Eradication)	Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3 (Management)	Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

Weeds of National Significance

The spread of weeds across a range of land uses or ecosystems is important in the context of socio-economic and environmental values. The assessment of Weeds of National Significance (WoNS) is based on four major criteria:

- Invasiveness
- Impacts
- Potential for spread
- Socio-economic and environmental values

Australian state and territory governments have identified thirty two Weeds of National Significance (WoNS); a list of 20 WoNS was endorsed in 1999 and a further 12 were added in 2012 (Australian Government, 2012).

Environmental weeds

“Environmental weeds are plants that establish themselves in natural ecosystems (marine, aquatic and terrestrial) and proceed to modify natural processes, usually adversely, resulting in the decline of the communities they invade” (CALM, 1999). The Environmental Weed Strategy for Western Australia (EWSWA) was published in 1999. This document provides direction and an approach to tackling environmental weeds in WA (CALM, 1999). Following on from this strategy (in 2008), in an effort to address invasive weeds and implement an integrated approach to weed management on DPaW-managed lands in WA, the Weed Prioritisation Process was developed (DPaW, 2013). A series of workshops were held in each of the nine DPaW regions with the purpose of scoring all weeds which occurred in each of the DPaW regions according to the following key attributes (DPaW, 2013):

- Potential distribution and impact
- Invasiveness
- Current distribution
- Feasibility of control
- Weed management ability
- Weed risk

This process resulted in the following five ratings for each weed species (DPaW, 2013):

- Very high (VH)
- High (H)
- Medium (M)
- Low (L)
- Negligible (N)

The suggested management actions for each species range from no action required (the weed species ranking is as low as to not warrant any investment in regional strategic management actions), through targeted control to reduce infestation or spread, to species requiring state-wide eradication (DPaW, 2013). A total of 1350 weeds were rated through this process as high, moderate, mild or low, with 34 weed species being rated as high (DPaW, 2013).

The prioritisation for individual weeds within a DPaW region should be treated as a guide and does not diminish any other requirements of land managers or developers e.g. Declared Plants requirements of the BAM Act or Ministerial requirements under Part IV of the EP Act (DPaW, 2013).

Reserves and Conservation Areas

DPaW manages lands and waters throughout Western Australia to conserve ecosystems and species, and to provide for recreation and appreciation of the natural environment. DPaW managed lands and waters include national parks, conservation parks and reserves, marine parks and reserves, regional parks, nature reserves, State forest and timber reserves. DPaW managed conservation estate, is vested with the Conservation Commission of Western Australia. Access to, or through, some areas of DPaW managed lands may require a permit or could be restricted due to management activities. Proposed land use changes and development proposals that abut DPaW managed lands will generally be referred to DPaW throughout the assessment process.

Contaminated Sites

Contaminated sites in Western Australia are regulated under the *Contaminated Sites Act 2003*. Under this Act contaminated sites must be reported to the DER, investigated and, if necessary, remediated. The Contaminated Sites Database records information on sites classified as:

- contaminated - remediation required
- contaminated - restricted use
- remediated for restricted use.

The Contaminated Sites Database holds information on all other sites reported to DER, including sites awaiting classification. Additional contaminated sites may be present in the area but have not been reported to the DER and therefore may not be on the register.

Heritage

Federal Heritage

At the Federal level, protection of significant places is provided under the EPBC Act; the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* and the *Historic Shipwrecks Act 1976*.

The Australian Heritage Database contains information about Australian places that have natural, historic and indigenous value. This database contains information on heritage matters of national environmental significance, which are protected under the EPBC Act. This database includes places listed on the following databases:

- World Heritage List – a list of places that are important to all the peoples of the world. World Heritage sites are recognised under the World Heritage Convention as being of international significance because of their outstanding natural and/or cultural values
- National Heritage List – comprises natural, historic and indigenous places that are of outstanding heritage value to the Australian nation.

State Non-Aboriginal Heritage

The Heritage Council of Western Australia is a state government agency responsible for the management of the historic resource. The *Heritage of Western Australia Act 1990* makes a provision for the preservation of places of historic significance. This significance is based on aesthetic, social and scientific principles. Under the Act, a Heritage Place refers only to a building, a definable piece of land and contents relevant to the building.

A heritage agreement is formed between the Minister and the owner of a heritage place based on a voluntary agreement but this is then enforced by the Heritage Council on successive owners and mortgages, government departments, municipal councils and developers. Protection from inappropriate development of a heritage place is granted under the *Heritage of Western Australia Act 1990*, which requires all applications to modify a place to be referred to the Heritage Council. This protection is bestowed to buildings registered on the interim or permanent lists under sections 50 and 51 of the Act.

The State Heritage Office keeps a heritage register “InHerit” that contains comprehensive information about cultural heritage places listed in the State Register of Heritage Places, local government inventories and other lists, the Australian Government's heritage list, and other non-government lists and surveys.

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Appendix B – Methodology

Methodology

Desktop assessment

A desktop assessment was carried out prior to the commencement of the field survey in order to identify key environmental constraints known from, or predicted to occur within, the Study area. The desktop assessment included the following:

- A review of previous Main Roads projects undertaken by GHD along or in the vicinity of the Study area. The database and GIS information from these projects (e.g. previously mapped vegetation types and condition) were incorporated into this study. This information, in combination with aerial photograph interpretation, was used to target the flora and fauna survey effort.
- A description of the existing environment including physical and bio-physical aspects.
- A search of the Department of Parks and Wildlife (DPaW) threatened species and communities database for flora, fauna and ecological communities.
- A review of the following environmental aspects:
 - Acid sulfate soils
 - Air quality
 - Contamination
 - Dust
 - Environmentally sensitive areas
 - Geology, topography and soils
 - Hydrology
 - Hazardous substances
 - Heritage (non-indigenous)
 - Land systems
 - Land vesting
 - Matters of National Environmental Significance
 - Native vegetation including Beard associations, representativeness, condition, riparian vegetation, threatened flora and threatened ecological communities
 - Fauna
 - Reserves and conservation areas
 - Noise
 - Vibration
 - Topsoil management
 - Weeds
 - Disease and pathogens
 - Visual amenity
 - Wetlands

Vegetation and flora survey

GHD ecologists conducted a Level 2 vegetation and flora (EPA 2004a) survey of the Survey Area from 28 October to 5 November 2013. The survey was undertaken in order to identify and describe the dominant vegetation units, assess vegetation condition and identify and record vascular flora taxa present at the time of survey. Additionally, opportunistic searching for conservation significant or other significant ecological communities and flora taxa was undertaken.

Data collection

Field survey methods involved a combination of sampling using quadrats and transects, located in identified vegetation units, and traversing the Survey Area by foot and vehicle. A total of 59 quadrats and 27 transects were described throughout the Survey Area.

Where possible, a minimum of two quadrats were located within each identified vegetation unit, with quadrats 50 x 50 m in size (area of 2,500 m²). However, there were a number of vegetation units that were restricted in size or location and only one quadrat could be placed in these areas. Field data at each quadrat was recorded on a pro-forma data sheet and included the parameters detailed in Table B.1.

Table B.1 Quadrat data collected during the survey

Aspect	Measurement
Collection attributes	Personnel/observers, date, quadrat ID, quadrat dimensions, photograph of quadrat
Location	Brief locality description, coordinates recorded in GDA94 datum using a hand-held Global Positioning System (GPS) tool to accuracy approximately ± 10 m
Physical features	Landform, site drainage, soil colour, soil type, percentage surface cover by: rocks, logs, twigs/branches, leaf and bare ground
Vegetation condition	Vegetation condition was assessed using the condition rating scale developed by Keighery (1994)
Disturbance	Nature of disturbances (e.g. clearing, cultivation, infrastructure, weed presence, flood, animal), grazing type and intensity, fire frequency and intensity
Flora	List of dominant flora for each identified stratum, list of all species within the quadrat including stratum, average height and cover (using a modified Braun-Blanquet scale)

Transects were also surveyed throughout the Survey Area. Transects were linear to semi-linear traverses undertaken to record vegetation and flora along environmental gradients or within vegetation units. Transects varied in size depending on the area of interest.

A flora inventory was compiled from taxa listed in described quadrats, transects, rapid assessment points, and from opportunistic floristic records throughout the Survey Area.

The survey methodology employed by GHD was consistent with the Environmental Protection Authority (EPA) Guidance Statement No. 51 Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (EPA 2004a) and Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002).

Vegetation units

Vegetation units were identified and boundaries delineated using a combination of aerial photography, topographical features, previous mapping (Beard 1974) and field data/observations.

Vegetation units were described based on structure, dominant taxa and cover characteristics as defined by quadrat data and field observations. The unit descriptions follow the National Vegetation Information System (NVIS) and are consistent with NVIS Level V (Association) (ESCAVI 2003). At this level up to three taxa per stratum are used to describe the association (ESCAVI 2003)..

Vegetation mapping has been undertaken at a scale of 1:50,000; this is considered a suitable scale for this Project.

Vegetation condition

The vegetation condition of the Survey Area was assessed using the vegetation condition rating scale developed by Keighery (1994) that recognises the intactness of vegetation, which is defined by the following:

- Completeness of structural levels.
- Extent of weed invasion.
- Historical disturbance from tracks and other clearing or dumping.
- The potential for natural or assisted regeneration.

The scale, therefore, consists of six rating levels as outlined below in Table .

Table B.2 Vegetation condition rating scale (Keighery 1994)

Condition Rating	Vegetation Condition	Description
1	Pristine or Nearly so	No obvious signs of disturbance.
2	Excellent	Vegetation structure intact, disturbance affecting individual species, and weeds are non-aggressive species.
3	Very Good	Vegetation structure altered, obvious signs of disturbance.
4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances retains basic vegetation structure or ability to regenerate it.
5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not in a state approaching good condition without intensive management.
6	Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost without native species.

Flora identification and nomenclature

Species that were well known to the survey ecologists were identified in the field, while species that could not be identified in the field were collected and assigned a unique number to facilitate tracking. Plant species were identified by the use of local and regional flora keys and by comparison with the named species held at the Western Australian Herbarium (WA Herbarium).

The conservation status of all recorded flora was compared against the current lists available on *FloraBase* (WA Herbarium 1998–) and the EPBC Act Threatened species database provided by DotE (2013b).

Nomenclature used in the report follows that used by the WA Herbarium as reported on *FloraBase* (WA Herbarium 1998–). With the exception of Mulga group taxa which follow Maslin and Reid (2012).

Conservation significant flora

Targeted and opportunistic searches for conservation significant flora taxa were undertaken within the Survey Area. When conservation significant taxa were found, the location of each individual or the population boundaries were recorded by GPS and the number of individuals or estimate of population size recorded. Where conservation significant taxa were present a search was undertaken in adjacent areas to quantify the population extent.

When any conservation significant taxa were found, the following data was collected:

- Location and frequency information.
- Details on the habit and habitat.
- A photograph of the plant(s) *in situ*.

Fauna survey

Survey details and timing

Two GHD ecologists completed a fauna survey of the Survey Area from 6-13 November 2013. This survey was undertaken immediately after the completion of the vegetation and flora surveys. The fauna survey involved targeted species-specific survey methods, aimed at identifying and mapping the presence of conservation significant fauna species and suitable habitat, in order to inform a likelihood of occurrence assessment for each of these species. In addition to the targeted survey, GHD ecologists also undertook a Level 1 fauna survey (reconnaissance survey) of the Survey Area.

The methodology used to undertake the fauna assessment included:

- Opportunistic searches across all habitat types within the Survey Area. This ensured the maximum suite of species potentially occurring at the Survey Area was observed. The survey involved searching through microhabitats including turning over logs or rocks, turning over leaf litter and examining hollow logs.
- Opportunistic visual and aural surveys. This accounted for many bird species potentially utilising the Study area.
- Searching for tracks, scats, bones, diggings and feeding areas for both native and feral fauna.
- Habitat assessments.
- Nocturnal surveys undertaken throughout the Survey Area by vehicle.

Targeted surveys for conservation significant fauna

Targeted specific methods were used to sample for each of the EPBC-listed conservation significant fauna species listed in Table B.3 within the Survey Area.

Table B.3 Targeted fauna survey methods

Species	Method	Description
Bilby (<i>Macrotis lagotis</i>)	Active searches for diggings and burrows	Intensive searches in areas where suitable habitat was identified. These searches are referred to as Bilby Search Areas (BSAs), and are recommended as the preferred method to survey for the species (Southgate <i>et al</i> 2005; Southgate and Moseby 2008; Southgate 2012,). A total of 28 BSA's were undertaken in the Survey Area (Figure 9). Each BSA was approximately 50 m x 400 m (2 ha) in size and were intensively searched for burrows, prints and scats. All observations were recorded via GPS along with the approximate age of the activity.
	Remote camera traps (surveillance cameras)	24 remote camera traps were deployed throughout the Survey Area, including six in spinifex hummock grasslands, four in <i>Acacia</i> shrubland habitats and one on the Bubble Creek floodplain (Figure 9).
Crest-tailed Mulgara (<i>Dasycercus cristicauda</i>) and Brush-tailed Mulgara (<i>Dasycercus blythi</i>)	Trapping	40 Elliot traps were deployed in spinifex grassland habitats (Four quadrats of 10 Elliot s at 10 metre intervals) and sampled for between six to seven nights (Figure 9). Each quadrat was placed in areas where Mulgara evidence was present i.e. scats, tracks and burrows.
	Targeted searches	Targeted searches for Brush-tailed Mulgara in suitable spinifex hummock grassland habitat and targeted searches for Crest-tailed Mulgara in suitable sand dune habitat within the Survey Area.
	Remote camera traps (surveillance cameras)	24 remote camera traps were deployed throughout the Survey Area, including six in spinifex plain habitats (Figure 9).
Long-tailed Dunnart (<i>Sminthopsis longicaudata</i>)	Trapping	20 Elliot traps were deployed at Mt Russell (Two quadrats of 10 Elliot's at 10 metre intervals) and sampled for five nights.
	Targeted searches	Targeted searches for Long-tailed Dunnart in suitable rocky habitat within the Survey Area.
	Remote camera traps (surveillance cameras)	24 remote camera traps were deployed throughout the Survey Area, including seven in rocky habitats (Figure 9).
Malleefowl (<i>Leipoa ocellata</i>)	Active searches for individuals, diggings, burrows and mounds	Active searches throughout suitable dense <i>Acacia</i> shrubland habitat for individuals, scratchings, diggings, tracks and mounds.
	Remote camera traps (surveillance cameras)	24 remote camera traps were deployed throughout the Survey Area, including five in <i>Acacia</i> shrubland habitats (Figure 9).
Northern Marsupial Mole (<i>Notoryctes caurinus</i>)	Habitat assessment	Targeted habitat searches to determine the extent of potentially suitable dune habitat within the Survey Area. There is no proven (or accepted) survey technique to detect the Northern Marsupial Mole, however visual inspection of dune habitat was undertaken looking for signs of use.

Species	Method	Description
Pilbara Leaf-nosed Bat (<i>Rhinonictis aurantia</i>)	Bat detector	One Songmeter SM2 bat + unit was deployed at six locations for one night each within a variety of habitats to record the echolocation calls of this species. This provided roughly one songmeter sampling point every 25 km.
Great Desert Skink (<i>Liopholis kintorei</i>)	Active searches for individuals and latrine sites	Active searches for individuals and latrine sites within suitable habitats in the Survey Area. If latrine sites are identified, camera traps will be deployed to identify species use.
Western Spiny-tailed Skink (<i>Egernia stokesii badia</i>)	Active searches for individuals and latrine sites	Active searches for individuals and latrine sites in rocky areas of the Project. If required, remote camera traps will be deployed to identify species use.

Trapping effort

Targeted trapping for each of the above species was undertaken using a combination of Elliot traps, camera traps, a bat detector, active searches and night searches. This targeted trapping included:

- Six Elliot trap lines located within hummock grassland sites across the Survey Area (10 Elliot traps per line, spaced 10 m apart) (Table B.4). In total 370 trap nights were undertaken.
- Songmeter SM2 bat + unit deployed over six nights in different locations (Table B.5).
- Twenty-four remote camera traps (23 Reconyx-Hyperfire and one Scout Guard 550) located within a variety of different habitat types in the Survey Area. In total 155 camera trap nights were undertaken. Each camera trap was baited with universal bait to attract fauna. Camera trap locations and trap effort is shown in Table B.6.

Table B.4 Elliot trap line locations

Site	Location		Nights Open	Elliot Traps	
	Easting	Northing		No.	Total Trap Nights
Site 1	737466	7070992	7	10	70
Site 2	741364	7070262	7	10	70
Site 3	739530	7070810	7	10	70
Site 4	737537	7070546	6	10	60
Site 5	783489	7066109	5	10	50
Site 6	783574	7066123	5	10	50
Total				60	370

Table B.5 Songmeter SM2 bat + unit locations

Date	Location	Easting	Northing
7/11/2013	Meekatharra Plain	657527	7058496
8/11/2013	Bubble Creek	805487	7055628
9/11/2013	Mt Russell	783502	7065755
10/11/2013	Mulga/Spinifex Plain	737499	7070505
11/11/2013	Breakaway	698335	7073748
12/11/2013	BIF Hill	675595	7060461

Table B.6 Camera trap locations and survey effort

Camera trap no.	Location Description	Zone	Easting	Northing	Night in	Night out	Nights in use
1	Calcareous outcrop	50	664230	7058543	4/11	9/11	5
2	BIF Hill	50	675432	7060504	6/11	13/11	7
3	Spinifex plain	50	688661	7068292	9/11	13/11	4
4	Dam	50	696929	7073272	1/11	6/11	5
5	Calcareous outcrop	50	698278	7073535	1/11	6/11	5
6	Granite outcrop	50	698230	7073872	7/11	13/11	6
7	Gorge (near creekline)	50	701147	7073818	1/11	6/11	5
8	Creekline	50	705200	7074760	1/11	6/11	5
9	Sand dune	50	705651	7075176	4/11	13/11	9
10	Small BIF Hill	50	718346	7075308	2/11	13/11	11
11	Thick <i>Acacia</i> shrubland	50	730680	7072050	7/11	13/11	6
12	Spinifex plain	50	737685	7070613	7/11	13/11	6
13	Spinifex plain	50	738839	7070464	6/11	13/11	7
14	Spinifex plain - active Mulgara burrow	50	739040	7070503	6/11	13/11	7
15	Spinifex plain	50	739481	7070705	1/11	13/11	12
16	<i>Acacia</i> shrubland	50	741390	7070155	6/11	13/11	7
17	<i>Acacia</i> shrubland	50	758198	7068463	6/11	13/11	7
18	<i>Acacia</i> shrubland	50	758267	7068541	6/11	13/11	7
19	Spinifex plain	50	768623	7067486	9/11	13/11	4
20	Mt Russell	50	783650	7066166	3/11	13/11	10
21	Mulga grove	50	789487	7062088	8/11	13/11	5
22	Red Gum woodland near Bubble Creek	51	202072	7058070	8/11	13/11	5
23	Bubble Creek floodplain	51	207295	7055871	8/11	13/11	5
24	Bubble Creek	51	207849	7055990	3/11	8/11	5
Total							155

Permits and ethics

A Regulation 17 Licence to Take Fauna for Scientific Purposes was obtained from DPaW prior to undertaking the fauna surveys (Licence Number: SF009533).

The fauna surveys (specifically trapping and animal handling) were undertaken in accordance with Standard Operating Procedures (SOPs) which were required to be followed under the conditions of GHD's fauna trapping permit. At the time of survey, compliance with these SOPs was accepted by DPaW as evidence of ethical treatment of animals:

- SOP No. 9.1 Elliott traps for live capture of terrestrial vertebrates (DEC 2009a).
- SOP No. 9.6 Hand capture of wildlife (DEC 2009b).
- SOP No. 10.1 Animal handling/restraint using soft containment (DEC 2009c).
- SOP No. 10.2 Hand restraint of wildlife (DEC 2009d).
- SOP No. 14.2 First Aid for animals (DEC 2009e).

Data collection

The survey methodology GHD employed was consistent with the EPA Guidance Statement No. 56, *Terrestrial Fauna and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004b) and DPaW and EPA's *Technical Guide Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA and DEC 2010).

Fauna identification and nomenclature

Nomenclature used in this report follows that used by the WA Museum as reported on *NatureMap* (DPaW 2007–). This nomenclature is deemed the most up-to-date species information for Western Australia groups: Reptiles, Amphibians, Invertebrates and Mammals. All Aves nomenclature follows Christidis and Boles (2008). Other reference materials used are presented in Table B.7.

Table B.7 Fauna references

Fauna Group	Field Guide
Mammals	Menkhorst and Knight (2004), Van Dyck and Strahan (2008), Van Dyck <i>et al.</i> (2013)
Bats	Churchill (2008), Menkhorst and Knight (2010), Van Dyck <i>et al.</i> (2013)
Birds	Morcombe (2004), Pizzey and Knight (2012)
Geckos	Wilson and Swan (2013)
Skinks	Storr <i>et al.</i> (1999), Wilson and Swan (2013)
Dragons	Wilson and Swan (2013)
Varanids	Wilson and Swan (2013)
Legless Lizards	Wilson and Swan (2013)
Snakes	Storr <i>et al.</i> (2002), Wilson and Swan (2013)
Amphibians	Tyler and Doughty (2009)

Survey limitations

Guidance Statement No. 51 and No. 56 (EPA 2004a, 2004b) states that flora and fauna survey reports for environmental impact assessment in Western Australia should contain a section describing the limitations of the survey methods used. The limitations and constraints associated with the vegetation, flora and fauna field surveys are discussed in Table B.8.

Table B.8 Field survey constraints and limitations

Limitation	Constraint	Impact on Survey Outcomes
Scope (what faunal groups were sampled)	Nil	Vascular flora taxa were sampled during the survey. Non-vascular flora taxa were not assessed. Terrestrial vertebrate fauna were sampled during the survey. Invertebrate and aquatic fauna were not assessed.
Proportion of flora/fauna identified, recorded and/or collected	Minor	<p>The survey was undertaken in November 2013 (end of the Spring season). The proportion of flora collected and identified was considered high; however, many ephemeral and grass species were unable to be confidently identified to species due to the absence of flowering parts and/or fruiting bodies.</p> <p>Some flora species, such as annuals, are only available for collection at certain times of the year and others are only identifiable at certain times (such as when they are flowering). Additionally, climatic and stochastic events (such as fire) may affect the presence of plant species. Species that have a very low abundance in the area are more difficult to locate, due to the above factors.</p> <p>Complete flora and fauna surveys can require multiple surveys, at different times of year, and over a period of a number of years, to enable observation of all species present.</p> <p>The targeted fauna survey was undertaken in early November 2013 and included specific targeted methods as well as a general reconnaissance survey. The fauna assessment therefore only sampled the specific conservation significant outlined in Table B.2, as well as species those species that can be easily seen, heard or have distinctive signs, such as tracks, scats, diggings etc. Many cryptic and nocturnal species would not have been identified during the survey and seasonal variation within species often requires targeted surveys at a particular time of the year. Of the fauna species recorded during the survey, the majority of species were identified to a species level. Evidence of Mulgara (<i>Dasyercus</i> sp.) was recorded during the field survey, which could definitively be classified as either <i>Dasyercus blythi</i> or <i>Dasyercus cristicauda</i>. Based on recent work by Woolley <i>et al.</i> (2013), it is likely that this evidence is of the Brush-tailed Mulgara (<i>Dasyercus blythi</i>) (see discussion in section 2.8.6).</p> <p>The fauna assessment was aimed at identifying habitat types and terrestrial vertebrate fauna utilising the Survey Area. No sampling for invertebrates or aquatic species occurred. The information available on the identification, distribution and conservation status of invertebrates is generally less extensive than that of vertebrate species.</p>
Sources of information and availability of contextual information	Minor	<p>Adequate information is available for the Survey Area, this includes:</p> <ul style="list-style-type: none"> • Regional biogeography (Desmond <i>et al.</i> 2001; McKenzie <i>et al.</i> 2002; Cowan 2001) • Broad scale (1:1,000,000) mapping by Beard (1974) and Shepherd <i>et al.</i> (2002) • Land systems (Mabbutt <i>et al.</i> 1963) • Previous reports including GHD 2011; 2013 • Birdata Australia

Limitation	Constraint	Impact on Survey Outcomes
Proportion of the task achieved and further work which might be needed	Minor	Fauna assessments that capture the full spectrum of species in an area often include numerous surveys over different seasons over a number of years. This assessment included one fauna surveys over one season and although meets the guideline requirements for terrestrial surveys may not identify all species present or that utilise the Survey Area. Further targeted surveys for Mulgara may be required, in order to determine the extent of the species occurrence within the proposed Impact Area.
Flora determination	Nil	<p>Flora determination was undertaken by GHD ecologists in field and at the Western Australian Herbarium. All potential Priority flora taxa were submitted to the WA Herbarium for identification and/or verification (Accession 5735).</p> <p>The taxonomy and conservation status of the Western Australian flora is dynamic. This report was prepared with reliance on taxonomy and conservation current at the time issuing, but it should be noted this may change.</p>
Timing, weather, season, cycle	Minor	<p>The field survey was conducted during the spring, on 6-13 November 2013.</p> <p>In the three months prior to the survey (Aug-Oct), Meekatharra Airport (station number 7045, BoM 2013a) recorded a total of 1.2 mm of rainfall. This total is significantly less than the long term average for the same period (Aug-Oct; 22 mm) (BoM, 2013a).</p> <p>The weather conditions at Meekatharra Airport during the field survey included:</p> <ul style="list-style-type: none"> • Daily maximum temperature ranging from 32.0 to 38.7 °C. • Daily minimum temperature ranging from 18.7 to 22.8 °C • Daily rainfall 0 mm. <p>In the three months prior to the survey (Aug-Oct), Wiluna (station number 13012, BoM 2013b) recorded a total of 54.4 mm of rainfall. This total is approximately double the long term average for the same period (Jun-Aug; 22.1 mm) (BoM, 2013b).</p> <p>The weather conditions at Wiluna (when recorded) during the field survey included:</p> <ul style="list-style-type: none"> • Daily maximum temperature ranging from 30.4 to 42.7 °C. • Daily minimum temperature ranging from 15.8 to 21.8 °C • Daily rainfall 0 mm. <p>The weather conditions recorded during the survey period were considered likely to have impacted upon the fauna survey. The hot and dry conditions are likely to have reduced species activity and the number of species recorded during the fauna survey. Additionally some species observed were in very poor condition in particular skinks which had hip bone perfusion, evidence of a harsh period.</p>
Disturbances (fire, flood, accidental human intervention etc.)	Minor	There were two areas where roadworks were being undertaken during the November survey (five km sections). These roadworks may have interfered with the fauna species that were present during the field survey.

Limitation	Constraint	Impact on Survey Outcomes
Resources	Nil	Adequate resources were employed during the survey. A total of 28 person days were spent undertaking the vegetation and flora survey.
Remoteness and/or access problems	Minor	There were two areas where roadworks were being undertaken during the November survey (five km sections). Access to the Survey Area was restricted in the areas surrounding these roadworks.
Experience levels	Nil	The ecologists who executed the survey were practitioners suitably qualified in their respective fields.

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Appendix C – Desktop searches

EPBC Act Protected Matters Search

***NatureMap* Flora**

***NatureMap* Fauna**



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: 17/10/13 12:48:37

[Summary](#)

[Details](#)

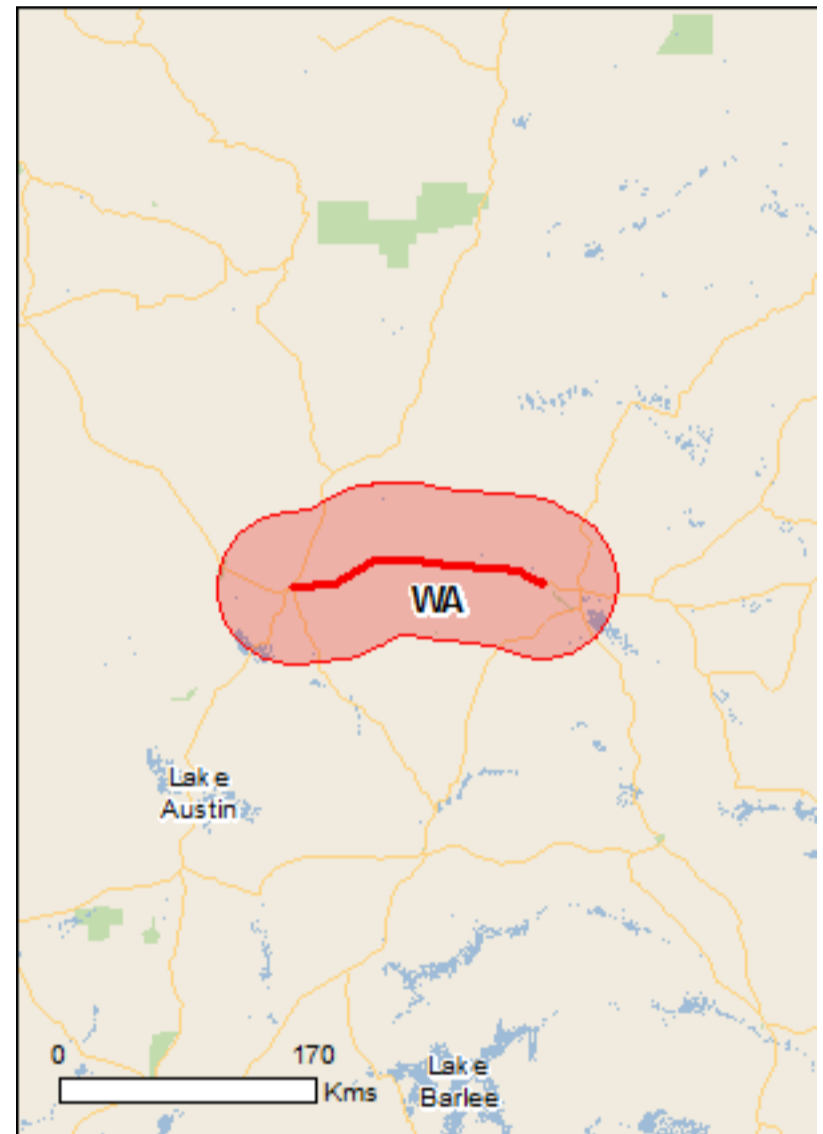
[Matters of NES](#)

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

[Extra Information](#)

[Caveat](#)

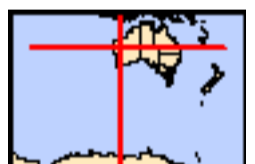
[Acknowledgements](#)



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

[Coordinates](#)

Buffer: 50.0Km



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 Areas:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	7
Listed Migratory Species:	4

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 and the heritage values of a place on the Register of the National Estate.

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.

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:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	4
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.

Place on the RNE:	2
State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	11
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Acanthiza iredalei iredalei Slender-billed Thornbill (western) [25967]	Vulnerable	Species or species habitat known to occur within area
Polytelis alexandrae Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat may occur within area
Mammals		
Notoryctes caurinus Karkarratul, Northern Marsupial Mole [295]	Endangered	Species or species habitat likely to occur within area
Rhinonictoris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat likely to occur within area
Other		
Idiosoma nigrum Shield-backed Trapdoor Spider, Black Rugose Trapdoor Spider [66798]	Vulnerable	Species or species habitat likely to occur within area
Plants		
Pityrodia augustensis Mt Augustus Foxglove [4962]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Liopholis kintorei Great Desert Skink, Tjakura, Warrarna, Mulyamiji [83160]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species		[Resource Information]
Name	Threatened	Type of Presence
Migratory Marine Birds		

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

Name	Threatened	Type of Presence
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		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 -

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		
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 likely to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area

Extra Information

Places on the RNE [\[Resource Information \]](#)

Note that not all Indigenous sites may be listed.

Name	State	Status
Historic		
Canning Stock Route (former)	WA	Indicative Place
Old Courthouse	WA	Registered

Invasive Species [\[Resource Information \]](#)

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

Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
--	--	--

Mammals

Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
---	--	--

Capra hircus Goat [2]		Species or species habitat likely to occur within area
--	--	--

Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
---	--	--

Equus caballus Horse [5]		Species or species habitat likely to occur within area
---	--	--

Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
--	--	--

Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
---	--	--

Oryctolagus cuniculus Rabbit, European Rabbit [128]		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

Carrichtera annua Ward's Weed [9511]		Species or species habitat may occur within area
---	--	--

Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
---	--	--

Nationally Important Wetlands [\[Resource Information \]](#)

Name	State
Lake Annean (Lake Nannine)	WA

Coordinates

-26.588466 118.511897,-26.568816 118.761836,-26.544248 118.814021,-26.441005
118.992549,-26.433627 119.047481,-26.433627 119.223262,-26.470512 119.451228,
-26.487721 119.72314,-26.495096 119.849483,-26.531962 119.904414,-26.561446
119.992305,-26.558989 119.992305

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 Heritage and Register of National Estate properties, Wetlands of International 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.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

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 overfly 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.

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:

- [-Department of Environment, Climate Change and Water, New South Wales](#)
- [-Department of Sustainability and Environment, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment and Natural Resources, South Australia](#)
- [-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts](#)
- [-Environmental and Resource Management, Queensland](#)
- [-Department of Environment and Conservation, Western Australia](#)
- [-Department of the Environment, Climate Change, Energy and Water](#)
- [-Birds Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-SA 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, Atherton and Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [-State Forests of NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

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

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Naturemap Flora Search combined 50 km buffer 17/10/13

Name ID	Species Name	Naturalise	Conservation Code	Endemic To Query Area
4889	<i>Abutilon cryptopetalum</i>			
4902	<i>Abutilon oxycarpum</i> (Flannel Weed)			
43020	<i>Abutilon oxycarpum</i> subsp. Prostrate (A.A. Mitchell PRP 1266)			
3194	<i>Acacia abrupta</i>			
16159	<i>Acacia acanthoclada</i> subsp. <i>acanthoclada</i>			
3217	<i>Acacia aneura</i> (Mulga Wanari)			
37260	<i>Acacia aptaneura</i>			
3232	<i>Acacia ayersiana</i>			
14622	<i>Acacia balsamea</i>			
3248	<i>Acacia burkittii</i> (Sandhill Wattle)			
36417	<i>Acacia caesaneura</i>			
3273	<i>Acacia craspedocarpa</i> (Hop Mulga)			
3280	<i>Acacia cuspidifolia</i> (Bohemia)			
15280	<i>Acacia cuthbertsonii</i> subsp. <i>cuthbertsonii</i>			
15279	<i>Acacia cuthbertsonii</i> subsp. <i>linearis</i>			
32118	<i>Acacia effusifolia</i>			
3330	<i>Acacia exocarpoides</i>			
36781	<i>Acacia fuscaneura</i>			
3355	<i>Acacia grasbyi</i> (Miniritchie)			
3364	<i>Acacia helmsiana</i>			
36418	<i>Acacia incurvaneura</i>			
3392	<i>Acacia jamesiana</i>			
3393	<i>Acacia jennerae</i>			
3399	<i>Acacia kempeana</i> (Witchetty Bush Ilykuwara)			
3419	<i>Acacia ligulata</i> (Umbrella Bush Watarka)			
3426	<i>Acacia longispinea</i>			
37240	<i>Acacia macraneura</i>			
36416	<i>Acacia mulganeura</i>			
3452	<i>Acacia murrayana</i> (Sandplain Wattle)			
3463	<i>Acacia nyssophylla</i>			
3473	<i>Acacia oswaldii</i> (Miljee Nelia)			
3475	<i>Acacia pachyacra</i>			
15724	<i>Acacia paraneura</i>			
3500	<i>Acacia pruinocarpa</i> (Gidgee)			
36800	<i>Acacia pteraneura</i>			
29015	<i>Acacia pyrifolia</i> var. <i>pyrifolia</i>			
3507	<i>Acacia quadrimarginea</i>			
19483	<i>Acacia ramulosa</i> var. <i>linophylla</i>			
19499	<i>Acacia ramulosa</i> var. <i>ramulosa</i>			
3519	<i>Acacia rhodophloia</i>			
42600	<i>Acacia salicina</i>			
13077	<i>Acacia sclerosperma</i> subsp. <i>glaucescens</i>		P3	
13078	<i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i>			
3544	<i>Acacia sibilans</i>			
8949	<i>Acacia sibirica</i> (Bastard Mulga)			
29114	<i>Acacia</i> sp. Nalgi (N.T. Burbidge 1317)			
18610	<i>Acacia</i> sp. Wiluna (B.R. Maslin 7090)			
14615	<i>Acacia speckii</i>		P4	
3568	<i>Acacia subtessarogona</i>			
13070	<i>Acacia synchronica</i>			
3577	<i>Acacia tetragonophylla</i> (Kurara Wakalpuka)			
29531	<i>Acacia thoma</i>			
3586	<i>Acacia tysonii</i>			
3595	<i>Acacia victoriae</i> (Bramble Wattle Ngatunpa)			
31511	<i>Acacia victoriae</i> subsp. <i>victoriae</i>			
3598	<i>Acacia wanyu</i>			
15295	<i>Acacia xanthocarpa</i>			
17739	<i>Acetosa vesicaria</i>		Y	
19901	<i>Actinobole oldfieldianum</i>			
7817	<i>Actinobole uliginosum</i> (Flannel Cudweed)			
2646	<i>Aerva javanica</i> (Kapok Bush)		Y	
3680	<i>Aeschynomene indica</i> (Budda Pea)			
36277	<i>Aloe vera</i> var. <i>officinalis</i>		Y	
2647	<i>Alternanthera angustifolia</i>			
19465	<i>Aluta aspera</i> subsp. <i>hesperia</i>			
19470	<i>Aluta maisonneuvei</i> subsp. <i>auriculata</i>			
19469	<i>Aluta maisonneuvei</i> subsp. <i>maisonneuvei</i>			
4907	<i>Alyogyne pinoniana</i> (Sand Hibiscus)			
2656	<i>Amaranthus caudatus</i> (Love Lies Bleeding)		Y	
2666	<i>Amaranthus mitchellii</i> (Boggabri Weed)			
12025	<i>Amphipogon caricinus</i> var. <i>caricinus</i>			

2372	<i>Amyema fitzgeraldii</i> (Pincushion Mistletoe)	
11614	<i>Amyema gibberula</i> var. <i>gibberula</i>	
11191	<i>Amyema gibberula</i> var. <i>tatei</i>	
2374	<i>Amyema hilliana</i>	
2379	<i>Amyema microphylla</i>	
2380	<i>Amyema miquelii</i> (Stalked Mistletoe)	
2382	<i>Amyema nestor</i>	
40910	<i>Androcalva luteiflora</i> (Yellow-flowered Rulingia)	
7832	<i>Angianthus milnei</i> (Cone-spike Angianthus)	
2333	<i>Anthobolus leptomerioides</i>	
17797	<i>Argemone ochroleuca</i> subsp. <i>ochroleuca</i>	Y
207	<i>Aristida contorta</i> (Bunched Kerosene Grass)	
12063	<i>Aristida holathera</i> var. <i>holathera</i>	
212	<i>Aristida inaequiglumis</i> (Feathertop Threeawn)	
218	<i>Aristida obscura</i> (Brush Threeawn)	
7847	<i>Asteridea chaetopoda</i>	
2451	<i>Atriplex bunburyana</i> (Silver Saltbush)	
2453	<i>Atriplex codonocarpa</i> (Flat-topped Saltbush)	
2461	<i>Atriplex hymenotheca</i>	
2476	<i>Atriplex semilunaris</i> (Annual Saltbush)	
2481	<i>Atriplex vesicaria</i> (Bladder Saltbush)	
17237	<i>Austrostipa elegantissima</i>	
17246	<i>Austrostipa nitida</i>	
17251	<i>Austrostipa scabra</i>	
17255	<i>Austrostipa trichophylla</i>	
14472	<i>Baeckea</i> sp. Melita Station (H. Pringle 2738)	
14473	<i>Baeckea</i> sp. Sandstone (C.A. Gardner s.n. 26 Oct. 1963)	P3
34240	<i>Beyeria lapidicola</i>	P1
7854	<i>Bidens bipinnata</i> (Bipinnate Beggartick)	Y
2774	<i>Boerhavia reptata</i>	
11167	<i>Bonamia erecta</i>	
242	<i>Brachyachne prostrata</i>	
7870	<i>Brachyscome cheilocarpa</i>	
7871	<i>Brachyscome ciliaris</i>	
11884	<i>Brachyscome ciliaris</i> var. <i>lanuginosa</i>	
7872	<i>Brachyscome ciliocarpa</i>	
7878	<i>Brachyscome iberidifolia</i>	
7881	<i>Brachyscome oncocarpa</i>	
7413	<i>Brunonia australis</i> (Native Cornflower)	
19376	<i>Bryophyllum delagoense</i>	Y
750	<i>Bulbostylis barbata</i>	
2845	<i>Calandrinia brevipedata</i> (Short-stalked Purslane)	
36500	<i>Calandrinia creethiae</i>	
2853	<i>Calandrinia eremaea</i> (Twining Purslane)	
2859	<i>Calandrinia papillata</i>	
2860	<i>Calandrinia polyandra</i> (Parakeelya)	
2864	<i>Calandrinia Ptychosperma</i>	
2865	<i>Calandrinia pumila</i>	
2868	<i>Calandrinia reticulata</i>	
2869	<i>Calandrinia schistorhiza</i>	
19455	<i>Calandrinia</i> sp. Bungalbin (G.J. Keighery & N. Gibson 1656)	
31073	<i>Calandrinia</i> sp. The Pink Hills (F. Obbens FO 19/06)	
2870	<i>Calandrinia stagnensis</i>	
30396	<i>Calandrinia translucens</i>	
8466	<i>Callitris columellaris</i> (White Cypress Pine)	
8637	<i>Callitris verrucosa</i>	
14090	<i>Calocephalus beardii</i>	
7893	<i>Calocephalus knappii</i>	
7895	<i>Calocephalus multiflorus</i> (Yellow-top)	
5398	<i>Calothamnus aridus</i>	
7903	<i>Calotis hispidula</i> (Bindy Eye)	
7905	<i>Calotis multicaulis</i> (Many-stemmed Burr-daisy)	
7906	<i>Calotis plumulifera</i>	
5438	<i>Calytrix amethystina</i>	
5451	<i>Calytrix desolata</i>	
5456	<i>Calytrix erosipetala</i>	
12373	<i>Calytrix uncinata</i>	P3
5486	<i>Calytrix verruculosa</i>	P3
1742	<i>Casuarina obesa</i> (Swamp Sheoak Kuli)	
12658	<i>Casuarina pauper</i> (Black Oak)	
258	<i>Cenchrus ciliaris</i> (Buffel Grass)	Y
7921	<i>Centipeda thespidioides</i> (Desert Sneezewood)	
7922	<i>Cephalopterum drummondii</i> (Pompom Head)	

42580 *Chamelaucium gracile*
 32 *Cheilanthes brownii*
 37 *Cheilanthes lasiophylla* (Woolly Cloak Fern)
 12818 *Cheilanthes sieberi* subsp. *sieberi*
 2489 *Chenopodium gaudichaudianum* (Cottony Saltbush)
 2494 *Chenopodium murale* (Nettle-leaf Goosefoot) Y
 3756 *Chorizema genistoides*
 33516 *Chrysocephalum gilesii*
 13138 *Chrysocephalum puteale*
 7933 *Chthonocephalus pseudevax* (Woolly Groundheads)
 12619 *Chthonocephalus viscosus*
 2985 *Cleome oxalidea*
 2778 *Codonocarpus cotinifolius* (Native Poplar Kundurangu)
 19881 *Convolvulus angustissimus* subsp. *angustissimus*
 6612 *Convolvulus clementii*
 16780 *Corymbia candida* subsp. *dipsodes*
 17077 *Corymbia ferriticola*
 17095 *Corymbia lenziana*
 17092 *Corymbia opaca*
 7943 *Cotula australis* (Common Cotula)
 7951 *Cratystylis subspinescens* (Australian Sage)
 3010 *Cuphonotus andraeanus*
 6663 *Cuscuta epithymum* (Lesser Dodder Greater Dodder) Y
 11021 *Cuscuta planiflora* Y
 279 *Cymbopogon ambiguus* (Scentgrass)
 281 *Cymbopogon obtectus* (Silkyheads)
 6584 *Cynanchum floribundum* (Dumara Bush)
 12799 *Cyperus betchei* subsp. *commiscens*
 777 *Cyperus bulbosus* (Bush Onion)
 782 *Cyperus concinnus*
 788 *Cyperus dactylotes*
 798 *Cyperus iria*
 814 *Cyperus squarrosus*
 7433 *Dampiera dentata*
 7476 *Dampiera stenophylla*
 6218 *Daucus glochidiatus* (Australian Carrot)
 3813 *Daviesia grahamii*
 13741 *Dichanthium sericeum* subsp. *humilius*
 7164 *Dicladantha forrestii*
 6753 *Dicrastylis brunnea*
 6759 *Dicrastylis flexuosa*
 31840 *Dicrastylis mitchellii* P1
 6774 *Dicrastylis sessilifolia*
 12721 *Dielitzia tysonii*
 310 *Digitaria brownii* (Cotton Panic Grass)
 12023 *Diplopeltis stuartii* var. *stuartii* (Desert Pepperflower)
 2499 *Dissocarpus paradoxus* (Curious Saltbush)
 4757 *Dodonaea ceratocarpa*
 4761 *Dodonaea ericoides*
 12034 *Dodonaea microzyga* var. *acrolobata*
 4772 *Dodonaea pachyneura*
 4773 *Dodonaea petiolaris*
 4779 *Dodonaea rigida*
 4782 *Dodonaea viscosa* (Sticky Hopbush)
 11247 *Dodonaea viscosa* subsp. *angustissima*
 11202 *Dodonaea viscosa* subsp. *spatulata* (Sticky Hop-bush)
 4460 *Drummondita miniata* P3
 6966 *Duboisia hopwoodii* (Pituri)
 31274 *Duperreya commixta*
 2500 *Dysphania glandulosa*
 11632 *Dysphania glomulifera* subsp. *eremaea*
 2502 *Dysphania kalpari* (Rat's Tail)
 33597 *Dysphania melanocarpa* forma *melanocarpa* (Black Goosefoot)
 2506 *Dysphania rhadinostachya*
 11653 *Dysphania rhadinostachya* subsp. *inflata*
 11890 *Dysphania rhadinostachya* subsp. *rhadinostachya*
 33483 *Dysphania saxatilis*
 828 *Eleocharis pallens* (Pale Spikerush)
 12064 *Enchylaena tomentosa* var. *tomentosa* (Barrier Saltbush)
 19846 *Enekbatus eremaeus*
 357 *Enneapogon caeruleus* (Limestone Grass)
 365 *Enneapogon polyphyllus* (Leafy Nineawn)
 378 *Eragrostis dielsii* (Mallee Lovegrass)

380	<i>Eragrostis eriopoda</i> (Woollybutt Grass)		
385	<i>Eragrostis lacunaria</i> (Purple Lovegrass)		
387	<i>Eragrostis lanipes</i> (Creeping Wanderrrie)		
388	<i>Eragrostis leptocarpa</i> (Drooping Lovegrass)		
392	<i>Eragrostis pergracilis</i>		
393	<i>Eragrostis setifolia</i> (Neverfail Grass)		
398	<i>Eragrostis tenellula</i> (Delicate Lovegrass)		
399	<i>Eragrostis xerophila</i> (Knotty-butt Neverfail)		
2513	<i>Eremophea spinosa</i>		
7180	<i>Eremophila alternifolia</i> (Poverty Bush)		
14508	<i>Eremophila anomala</i>	P1	
7182	<i>Eremophila battii</i>		
7189	<i>Eremophila clarkei</i> (Turpentine Bush)		
17157	<i>Eremophila compacta</i> subsp. <i>compacta</i>		
17155	<i>Eremophila compacta</i> subsp. <i>fecunda</i>		
15177	<i>Eremophila congesta</i>	P1	
12951	<i>Eremophila enata</i>		
7204	<i>Eremophila ericalyx</i> (Desert Pride)		
7205	<i>Eremophila exilifolia</i>		
7206	<i>Eremophila falcata</i>		
14510	<i>Eremophila fasciata</i>	P3	
16792	<i>Eremophila flabellata</i>		
7207	<i>Eremophila foliosissima</i>		
7208	<i>Eremophila forrestii</i> (Wilcox Bush)		
15052	<i>Eremophila forrestii</i> subsp. <i>forrestii</i>		
17152	<i>Eremophila forrestii</i> subsp. <i>hastieana</i> (Grey Poverty Bush)		
16696	<i>Eremophila fraseri</i> subsp. <i>fraseri</i>		
29532	<i>Eremophila galeata</i>		
7214	<i>Eremophila gilesii</i> (Charleville Turkey Bush)		
16732	<i>Eremophila gilesii</i> subsp. <i>gilesii</i>		
17176	<i>Eremophila gilesii</i> subsp. <i>variabilis</i>		
14340	<i>Eremophila glabra</i> subsp. <i>glabra</i>		
14191	<i>Eremophila glabra</i> subsp. <i>tomentosa</i>		
7216	<i>Eremophila glutinosa</i>		
7219	<i>Eremophila granitica</i> (Thin-leaved Poverty Bush)		
17172	<i>Eremophila hughesii</i> subsp. <i>hughesii</i>		
17189	<i>Eremophila hygrophana</i>		
7226	<i>Eremophila ionantha</i> (Violet-flowered Eremophila)		
17171	<i>Eremophila jucunda</i> subsp. <i>jucunda</i>		
7228	<i>Eremophila lachnocalyx</i> (Woolly-calyxed Eremophila)		
7230	<i>Eremophila latrobei</i> (Warty Fuchsia Bush)		
17597	<i>Eremophila latrobei</i> subsp. <i>filiformis</i>		
17169	<i>Eremophila latrobei</i> subsp. <i>glabra</i>		
17576	<i>Eremophila latrobei</i> subsp. <i>latrobei</i>		
7233	<i>Eremophila linearis</i> (Harlequin Fuchsia Bush)		
7234	<i>Eremophila longifolia</i> (Berrigan)		
7236	<i>Eremophila macmillaniana</i> (Grey Turpentine Bush)		
16363	<i>Eremophila maculata</i> subsp. <i>brevifolia</i> (Native Fuchsia)		
15157	<i>Eremophila malacoides</i>		
7239	<i>Eremophila margarethae</i> (Sandbank Poverty Bush)		
18211	<i>Eremophila micrantha</i>		
7247	<i>Eremophila oppositifolia</i> (Weeewooka)		
18570	<i>Eremophila oppositifolia</i> subsp. <i>angustifolia</i>		
7250	<i>Eremophila pantonii</i>		
15164	<i>Eremophila petrophila</i> subsp. <i>petrophila</i>		
17282	<i>Eremophila phyllopoda</i>		
17167	<i>Eremophila phyllopoda</i> subsp. <i>phyllopoda</i>		
7253	<i>Eremophila platycalyx</i> (Granite Poverty Bush)		
15058	<i>Eremophila platycalyx</i> subsp. <i>platycalyx</i>		
7255	<i>Eremophila pterocarpa</i> (Silver Poverty Bush)		
15170	<i>Eremophila pterocarpa</i> subsp. <i>pterocarpa</i>		
7256	<i>Eremophila punctata</i>		
15027	<i>Eremophila retropila</i>	P1	Y
7269	<i>Eremophila serrulata</i> (Serrate-leaved Eremophila)		
17166	<i>Eremophila simulans</i> subsp. <i>lapidensis</i>		
20236	<i>Eremophila</i> sp. Collier Range (M. Greeve 33)		
7270	<i>Eremophila spathulata</i> (Spoon-leaved Eremophila)		
7271	<i>Eremophila spectabilis</i> (Showy Poverty Bush)		
17163	<i>Eremophila spectabilis</i> subsp. <i>brevis</i>		
17190	<i>Eremophila spectabilis</i> subsp. <i>spectabilis</i>		
15168	<i>Eremophila spuria</i>		
7273	<i>Eremophila strongylophylla</i>		
15155	<i>Eremophila youngii</i> subsp. <i>youngii</i>		

400 *Eriachne aristidea*
 408 *Eriachne flaccida* (Claypan Grass)
 411 *Eriachne helmsii* (Buck Wanderrrie Grass)
 413 *Eriachne mucronata* (Mountain Wanderrrie Grass)
 417 *Eriachne pulchella* (Pretty Wanderrrie)
 16485 *Eriachne pulchella* subsp. *dominii*
 2514 *Eriochiton sclerolaenoides* (Woolly Bindii)
 4334 *Erodium crinitum* (Corkscrew)
 4335 *Erodium cygnorum* (Blue Heronsbill)
 12718 *Erymophyllum compactum*
 12739 *Erymophyllum ramosum*
 14377 *Erymophyllum ramosum* subsp. *ramosum*
 35345 *Eucalyptus camaldulensis* subsp. *obtusa* (Blunt-budded River Red Gum)
 5583 *Eucalyptus carnei* (Carne's Blackbutt)
 5636 *Eucalyptus eremicola*
 20300 *Eucalyptus eremicola* subsp. *peeneri*
 5641 *Eucalyptus ewartiana* (Ewart's Mallee)
 5660 *Eucalyptus gongylocarpa* (Marble Gum)
 18057 *Eucalyptus gypsophila*
 13528 *Eucalyptus kingsmillii* subsp. *kingsmillii*
 13057 *Eucalyptus leptopoda* subsp. *arctata*
 13058 *Eucalyptus leptopoda* subsp. *elevata*
 5703 *Eucalyptus lucasii* (Barlee Box)
 13019 *Eucalyptus mannensis* subsp. *mannensis*
 5779 *Eucalyptus striaticalyx* (Cue York Gum)
 29733 *Eucalyptus trivalva* (Victoria Spring Mallee)
 14548 *Eucalyptus victrix*
 11011 *Eulalia aurea*
 4620 *Euphorbia boophthona* (Gascoyne Spurge)
 4626 *Euphorbia drummondii* (Caustic Weed)
 42869 *Euphorbia porcata*
 12097 *Euphorbia tannensis* subsp. *eremophila* (Desert Spurge)
 17913 *Euryomyrtus inflata* P3
 10977 *Exocarpos aphyllus* (Leafless Ballart)
 5191 *Frankenia cinerea*
 5206 *Frankenia laxiflora* (Loose Flowered Frankenia)
 5212 *Frankenia setosa* (Bristly Frankenia)
 7977 *Gilruthia osbornei*
 3938 *Glycine canescens* (Silky Glycine)
 7989 *Gnephosis brevifolia* (Short-leaved Gnephosis)
 8002 *Gnephosis tenuissima*
 7495 *Goodenia berardiana*
 12512 *Goodenia berringbinensis* P4
 7498 *Goodenia centralis*
 7514 *Goodenia havilandii*
 12530 *Goodenia macroplectra*
 7525 *Goodenia maideniana*
 7527 *Goodenia mimuloides*
 7529 *Goodenia mueckeana*
 7533 *Goodenia peacockiana*
 7543 *Goodenia quasilibera*
 7556 *Goodenia tenuiloba*
 7558 *Goodenia triodiophila*
 7564 *Goodenia wilunensis*
 1946 *Grevillea acacioides*
 1963 *Grevillea berryana*
 1986 *Grevillea deflexa*
 13453 *Grevillea didymobotrya* subsp. *didymobotrya*
 2019 *Grevillea inconspicua* (Cue Grevillea) P4
 15845 *Grevillea juncifolia* subsp. *juncifolia*
 15844 *Grevillea juncifolia* subsp. *temulenta*
 19542 *Grevillea nematophylla* subsp. *supraplana*
 2077 *Grevillea pterosperma*
 13459 *Grevillea sarissa* subsp. *succincta*
 2099 *Grevillea striata* (Beefwood)
 2808 *Gunniopsis rodwayi*
 2163 *Hakea francisiana* (Emu Tree)
 16921 *Hakea leucoptera* subsp. *sericipes*
 19137 *Hakea lorea* subsp. *lorea*
 2196 *Hakea preissii* (Needle Tree)
 17556 *Hakea recurva* subsp. *arida*
 17557 *Hakea recurva* subsp. *recurva*
 2200 *Hakea rhombales*

29840 Halgania cyanea var. Allambi Stn (B.W. Strong 676)
 6690 Halgania gustafsenii
 17493 Halgania gustafsenii var. gustafsenii
 6176 Haloragis odontocarpa (Mulga Nettle)
 16371 Haloragis odontocarpa forma pterocarpa
 6180 Haloragis trigonocarpa
 17326 Harnieria kempeana
 17325 Harnieria kempeana subsp. muelleri
 29594 Helichrysum luteoalbum (Jersey Cudweed)
 17299 Heliotropium ammophilum
 6707 Heliotropium curassavicum (Smooth Heliotrope)
 6712 Heliotropium heteranthum
 17307 Heliotropium inexplicitum
 14358 Heliotropium mitchellii
 6713 Heliotropium ovalifolium
 8045 Helipterum craspedioides (Yellow Billy Buttons)
 33779 Hemigenia tomentosa
 33760 Hemigenia virescens P3
 4924 Hibiscus burtonii
 4941 Hibiscus solanifolius
 43022 Hibiscus sp. Gardneri (A.L. Payne PRP 1435)
 4942 Hibiscus sturtii (Sturt's Hibiscus)
 5809 Homalocalyx echinulatus P3
 5814 Homalocalyx staminosus
 5815 Homalocalyx thryptomenoides
 15448 Hyalosperma glutinosum subsp. venustum
 5221 Hybanthus floribundus
 453 Imperata cylindrica (Kunai Grass)
 3970 Indigofera australis (Australian Indigo)
 3974 Indigofera georgei (Bovine Indigo)
 3982 Indigofera monophylla
 41763 Indigofera sp. Chamaeclada (G.J. Keighery & N. Gibson 1224)
 41781 Indigofera sp. Gilesii (M.E. Trudgen 15869) P3
 6621 Ipomoea calobra (Weir Vine)
 459 Iseilema eremaum
 8087 Isoetopsis graminifolia (Cushion Grass)
 911 Isolepis congrua
 7397 Isotoma petraea (Rock Isotome)
 3989 Isotropis atropurpurea (Poison Sage)
 3994 Isotropis forrestii
 7118 Josephinia eugeniae (Josephinia Burr)
 4043 Kennedia prorepens
 19636 Keraudrenia velutina subsp. elliptica
 8094 Kippistia suaedifolia
 17209 Lachnostachys verbascifolia var. verbascifolia
 8096 Lactuca serriola (Prickly Lettuce) Y
 29046 Lactuca serriola forma serriola Y
 13289 Lawrencella davenportii
 4953 Lawrencia densiflora
 4956 Lawrencia helmsii (Dunna Dunna)
 12628 Lemooria burkittii
 19989 Lepidium didymum Y
 3025 Lepidium echinatum
 3033 Lepidium oxytrichum
 3039 Lepidium platypetalum (Slender Peppergrass)
 19126 Leptochloa fusca subsp. muelleri
 4055 Leptosema chambersii
 3613 Leucaena leucocephala (Leucaena) Y
 13258 Leucochrysum stipitatum
 7669 Levenhookia chippendalei
 7671 Levenhookia leptantha (Trumpet Stylewort)
 36881 Lobelia simulans
 6967 Lycium australe (Australian Boxthorn)
 2398 Lysiana murrayi (Mistletoe)
 4728 Macgregoria racemigera (Snow Flower)
 2533 Maireana amoena
 2536 Maireana atkinsiana (Bronze Bluebush)
 2537 Maireana brevifolia (Small Leaf Bluebush)
 2538 Maireana carnosa (Cottony Bluebush)
 2539 Maireana convexa (Mulga Bluebush)
 2543 Maireana eriosphaera
 2544 Maireana georgei (Satiny Bluebush)
 2545 Maireana glomerifolia (Ball Leaf Bluebush)

2551	<i>Maireana melanocoma</i> (Pussy Bluebush)	
2555	<i>Maireana pentatropis</i>	
2556	<i>Maireana planifolia</i> (Low Bluebush)	
2559	<i>Maireana prosthocochaeta</i>	P3
2560	<i>Maireana pyramidata</i> (Sago Bush)	
2566	<i>Maireana thesioides</i> (Lax Bluebush)	
2567	<i>Maireana tomentosa</i> (Felt Bluebush)	
11662	<i>Maireana tomentosa</i> subsp. <i>tomentosa</i>	
2568	<i>Maireana trichoptera</i> (Downy Bluebush)	
2569	<i>Maireana triptera</i> (Threewinged Bluebush)	
2571	<i>Maireana villosa</i>	
4961	<i>Malva parviflora</i> (Marshmallow)	Y
12949	<i>Marsdenia australis</i>	
16538	<i>Marsdenia graniticola</i>	
74	<i>Marsilea drummondii</i> (Common Nardoo)	
5929	<i>Melaleuca leiocarpa</i>	
19449	<i>Melaleuca stereophloia</i>	
5991	<i>Melaleuca xerophila</i>	
3050	<i>Menkea australis</i> (Fairy Spectacles)	
3051	<i>Menkea draboides</i>	P3
3053	<i>Menkea sphaerocarpa</i>	
3054	<i>Menkea villosula</i>	
5995	<i>Micromyrtus flaviflora</i>	
6003	<i>Micromyrtus sulphurea</i>	
12629	<i>Millotia incurva</i>	
4098	<i>Mirbelia rhagodioides</i>	
4101	<i>Mirbelia stipitata</i>	P3
490	<i>Monachather paradoxus</i>	
4111	<i>Muelleranthus trifoliolatus</i>	
8116	<i>Myriocephalus guerinae</i>	
14186	<i>Myriocephalus pygmaeus</i>	
8121	<i>Myriocephalus rudallii</i>	
6243	<i>Neosciadium glochidiatum</i>	
493	<i>Neurachne lanigera</i>	P1
494	<i>Neurachne minor</i>	
495	<i>Neurachne munroi</i>	
6786	<i>Newcastelia cephalantha</i>	
6791	<i>Newcastelia hexarrhena</i> (Lambs' Tails)	
6972	<i>Nicotiana cavicola</i> (Talara)	
11856	<i>Nicotiana occidentalis</i> subsp. <i>occidentalis</i>	
11734	<i>Nicotiana rosulata</i> subsp. <i>rosulata</i>	
6979	<i>Nicotiana simulans</i>	
12638	<i>Olearia mucronata</i>	P3
8151	<i>Olearia stuartii</i>	
8153	<i>Olearia xerophila</i>	
17	<i>Ophioglossum lusitanicum</i> (Adders Tongue)	
4355	<i>Oxalis perennans</i>	
2964	<i>Papaver hybridum</i> (Rough Poppy)	Y
514	<i>Paractaenum refractum</i>	
12670	<i>Parietaria cardiostegia</i>	
10975	<i>Paspalidium basicladum</i>	
518	<i>Paspalidium clementii</i> (Clements Paspalidium)	
519	<i>Paspalidium constrictum</i> (Knottybutt Grass)	
12486	<i>Peplidium aithocheilum</i>	
18463	<i>Peplidium</i> sp. C Evol. Fl. Fauna Arid Aust. (N.T. Burbidge & A. Kanis 8158)	
546	<i>Perotis rara</i> (Comet Grass)	
3674	<i>Petalostylis cassioides</i>	
17626	<i>Phyllanthus erwinii</i>	
13229	<i>Phyllota humilis</i>	
5245	<i>Pimelea forrestiana</i>	
5250	<i>Pimelea holroydii</i>	
5256	<i>Pimelea microcephala</i> (Shrubby Riceflower)	
11185	<i>Pimelea microcephala</i> subsp. <i>microcephala</i>	
5271	<i>Pimelea trichostachya</i> (Spiked Riceflower)	
19744	<i>Pittosporum angustifolium</i>	
10974	<i>Plagiobothrys plurisepalus</i>	
8172	<i>Podolepis canescens</i> (Bright Podolepis)	
8173	<i>Podolepis capillaris</i> (Wiry Podolepis)	
8174	<i>Podolepis gardneri</i>	
8176	<i>Podolepis kendallii</i>	
41365	<i>Polygala glaucifolia</i>	
4572	<i>Polygala isingii</i>	
2879	<i>Portulaca cyclophylla</i>	

2884	<i>Portulaca oleracea</i> (Purslane Wakati)	Y
12707	<i>Prostanthera albiflora</i>	
15822	<i>Prostanthera althoferi</i> subsp. <i>althoferi</i>	
6912	<i>Prostanthera campbellii</i>	
31783	<i>Prostanthera ferricola</i>	P3
6926	<i>Prostanthera wilkieana</i>	
18206	<i>Psydrax attenuata</i>	
18154	<i>Psydrax latifolia</i>	
18210	<i>Psydrax rigidula</i>	
18155	<i>Psydrax suaveolens</i>	
2690	<i>Ptilotus aervoides</i>	
2691	<i>Ptilotus albidus</i>	
2708	<i>Ptilotus chamaecladus</i>	
2709	<i>Ptilotus chippendalei</i>	
23487	<i>Ptilotus chrysocomus</i>	P1
2717	<i>Ptilotus divaricatus</i> (Climbing Mulla Mulla)	
2718	<i>Ptilotus drummondii</i> (Narrowleaf Mulla Mulla)	
11797	<i>Ptilotus drummondii</i> var. <i>minor</i>	
2727	<i>Ptilotus gaudichaudii</i>	
41506	<i>Ptilotus gaudichaudii</i> subsp. <i>gaudichaudii</i>	
2729	<i>Ptilotus grandiflorus</i>	
2731	<i>Ptilotus helieteroides</i> (Hairy Mulla Mulla)	
2739	<i>Ptilotus lazaridis</i>	P3
35576	<i>Ptilotus luteolus</i>	P3
2741	<i>Ptilotus macrocephalus</i> (Featherheads)	
2746	<i>Ptilotus nobilis</i> (Tall Mulla Mulla)	
41001	<i>Ptilotus nobilis</i> subsp. <i>nobilis</i> (Yellow Tails)	
2747	<i>Ptilotus obovatus</i> (Cotton Bush)	
11396	<i>Ptilotus obovatus</i> var. <i>obovatus</i>	
2751	<i>Ptilotus polystachyus</i> (Prince of Wales Feather)	
2754	<i>Ptilotus roei</i>	
2755	<i>Ptilotus rotundifolius</i> (Royal Mulla Mulla)	
2757	<i>Ptilotus schwartzii</i>	
11219	<i>Ptilotus schwartzii</i> var. <i>georgei</i>	
15855	<i>Ptilotus schwartzii</i> var. <i>schwartzii</i>	
2581	<i>Rhagodia drummondii</i>	
2582	<i>Rhagodia eremaea</i> (Thorny Saltbush)	
13306	<i>Rhodanthe battii</i>	
13308	<i>Rhodanthe charsleyae</i>	
13241	<i>Rhodanthe chlorocephala</i> subsp. <i>rosea</i>	
13242	<i>Rhodanthe chlorocephala</i> subsp. <i>splendida</i>	
13301	<i>Rhodanthe floribunda</i>	
13246	<i>Rhodanthe humboldtiana</i>	
13238	<i>Rhodanthe maryonii</i>	
13251	<i>Rhodanthe propinqua</i>	
13303	<i>Rhodanthe sterilecens</i>	
13254	<i>Rhodanthe stricta</i>	
6599	<i>Rhyncharrhena linearis</i> (Bush Bean)	
11151	<i>Rostraria pumila</i>	Y
30434	<i>Salsola australis</i>	
6484	<i>Samolus repens</i> (Creeping Brookweed)	
2357	<i>Santalum lanceolatum</i> (Northern Sandalwood)	
2359	<i>Santalum spicatum</i> (Sandalwood)	
13006	<i>Sarcostemma viminalis</i> subsp. <i>australe</i>	
13178	<i>Scaevola amblyanthera</i> var. <i>centralis</i>	
7604	<i>Scaevola collaris</i>	
7644	<i>Scaevola spinescens</i> (Currant Bush)	
7648	<i>Scaevola tomentosa</i> (Raggedleaf Fanflower)	
13285	<i>Schoenia ayersii</i>	
8200	<i>Schoenia cassiniana</i> (Schoenia)	
13287	<i>Schoenia filifolia</i> subsp. <i>filifolia</i>	
2600	<i>Sclerolaena burbidgeae</i>	
2603	<i>Sclerolaena cornishiana</i> (Cartwheel Burr)	
2606	<i>Sclerolaena cuneata</i> (Yellow Bindii)	
2607	<i>Sclerolaena densiflora</i>	
2611	<i>Sclerolaena eriacantha</i> (Tall Bindii)	
2612	<i>Sclerolaena eurotioides</i> (Fluffy Bindii)	
2613	<i>Sclerolaena fimbriolata</i>	
2615	<i>Sclerolaena fusiformis</i>	
8877	<i>Sclerolaena gardneri</i>	
2619	<i>Sclerolaena lanicuspis</i> (Spinach Burr)	
2622	<i>Sclerolaena microcarpa</i>	
2625	<i>Sclerolaena obliquicuspis</i> (Limestone Bindii)	

2628	<i>Sclerolaena recurvicauspis</i>		
8207	<i>Senecio glossanthus</i> (Slender Groundsel)		
9366	<i>Senecio gregorii</i> (Fleshy Groundsel)		
25881	<i>Senecio lacustrinus</i>		
17645	<i>Senna artemisioides</i>		
12276	<i>Senna artemisioides</i> subsp. <i>filifolia</i>		
12279	<i>Senna artemisioides</i> subsp. <i>helmsii</i>		
17558	<i>Senna artemisioides</i> subsp. <i>x artemisioides</i>		
12283	<i>Senna artemisioides</i> subsp. <i>x sturtii</i>		
18444	<i>Senna charlesiana</i>		
18449	<i>Senna glaucifolia</i>		
18346	<i>Senna glutinosa</i>		
12305	<i>Senna glutinosa</i> subsp. <i>chatelainiana</i>		
12309	<i>Senna glutinosa</i> subsp. <i>pruinosa</i>		
12308	<i>Senna glutinosa</i> subsp. <i>x luerssenii</i>		
16378	<i>Senna pleurocarpa</i>		
12314	<i>Senna pleurocarpa</i> var. <i>pleurocarpa</i>		
14579	<i>Senna</i> sp. Austin (A. Strid 20210)		
14577	<i>Senna</i> sp. Meekatharra (E. Bailey 1-26)		
18445	<i>Senna stricta</i>		
613	<i>Setaria verticillata</i> (Whorled Pigeon Grass)	Y	
4970	<i>Sida calyxhymenia</i> (Tall Sida)		
31759	<i>Sida ectogama</i>		
40861	<i>Sida picklesiana</i>		P3
19712	<i>Sida</i> sp. dark green fruits (S. van Leeuwen 2260)		
31854	<i>Sida</i> sp. <i>Excedentifolia</i> (J.L. Egan 1925)		
31857	<i>Sida</i> sp. Golden calyces glabrous (H.N. Foote 32)		
16948	<i>Sida</i> sp. verrucose glands (F.H. Mollemans 2423)		
16924	<i>Sida spodochroma</i>		
3069	<i>Sisymbrium erysimoides</i> (Smooth Mustard)	Y	
3072	<i>Sisymbrium orientale</i> (Indian Hedge Mustard)	Y	
42547	<i>Solanum austropiceum</i>		
6995	<i>Solanum centrale</i> (Desert Raisin)		
6998	<i>Solanum cleistogamum</i>		
6999	<i>Solanum coactiliferum</i> (Western Nightshade)		
7016	<i>Solanum lachnophyllum</i>		
7018	<i>Solanum lasiophyllum</i> (Flannel Bush)		
7022	<i>Solanum nigrum</i> (Black Berry Nightshade)	Y	
7023	<i>Solanum nummularium</i> (Money-leaved Solanum)		
7025	<i>Solanum oldfieldii</i>		
7026	<i>Solanum orbiculatum</i> (Wild Tomato)		
11241	<i>Solanum orbiculatum</i> subsp. <i>orbiculatum</i> (Round-leaved Solanum)		
7038	<i>Solanum terraneum</i>		
6827	<i>Spartothamnella teucriflora</i>		
8900	<i>Spergularia marina</i>	Y	
628	<i>Sporobolus actinocladus</i> (Ray Grass)		
629	<i>Sporobolus australasicus</i> (Fairy Grass)		
4729	<i>Stackhousia clementii</i>		P3
16199	<i>Stenanthemum petraeum</i>		
3074	<i>Stenopetalum anfractum</i>		
3076	<i>Stenopetalum filifolium</i>		
3078	<i>Stenopetalum nutans</i>		
8234	<i>Streptoglossa adscendens</i>		
8236	<i>Streptoglossa cylindriceps</i>		
8238	<i>Streptoglossa liatroides</i>		
7740	<i>Stylidium induratum</i> (Desert Triggerplant)		
7754	<i>Stylidium longibracteatum</i> (Long-bracted Trigger Plant)		
12355	<i>Swainsona affinis</i>		
4220	<i>Swainsona canescens</i> (Grey Swainsona)		
13595	<i>Swainsona elegantoides</i>		
12356	<i>Swainsona formosa</i>		
4231	<i>Swainsona kingii</i>		
4233	<i>Swainsona leeana</i>		
4238	<i>Swainsona oroboides</i> (Variable Swainsona)		
13581	<i>Swainsona paradoxa</i>		
13586	<i>Swainsona paucifoliolata</i>		
4239	<i>Swainsona pedunculata</i>		
4242	<i>Swainsona pterostylis</i>		
12357	<i>Swainsona purpurea</i>		
13585	<i>Swainsona tenuis</i>		
13339	<i>Synaptantha tillaeacea</i> var. <i>tillaeacea</i>		
12729	<i>Taplinia saxatilis</i>		
31844	<i>Tecticornia cymbiformis</i>		P3

31492 *Tecticornia disarticulata*
33236 *Tecticornia halocnemoides* (Shrubby Samphire)
33239 *Tecticornia halocnemoides* subsp. *catenulata*
33319 *Tecticornia indica* subsp. *bidens*
33220 *Tecticornia pterygosperma* subsp. *denticulata*
31851 *Tecticornia* sp. Yoothapina Station (A.A. Mitchell 883)
2819 *Tetragonia cristata*
16287 *Tetragonia moorei*
40680 *Tetragonia tetragonioides* (New Zealand Spinach)
6936 *Teucrium racemosum* (Grey Germander)
673 *Themeda triandra*
6054 *Thryptomene decussata*
674 *Thyridolepis mitchelliana* (Mulga Grass)
675 *Thyridolepis multiculmis* (Soft Wanderrie Grass)
1338 *Thysanotus manglesianus* (Fringed Lily)
29457 *Thysanotus* sp. Eremaean (S. van Leeuwen 1067)
1352 *Thysanotus speckii*
12649 *Tietkensia corrickiae*
6265 *Trachymene bialata*
6279 *Trachymene ornata* (Spongefruit)
2826 *Trianthema glossostigma*
2832 *Trianthema triquetra* (Red Spinach)
18065 *Tribulus adelacanthus* P3
4374 *Tribulus astrocarpus*
4377 *Tribulus hirsutus*
4381 *Tribulus platypterus* (Cork Hopbush)
18072 *Tribulus suberosus*
6727 *Trichodesma zeylanicum* (Camel Bush)
33276 *Triglochin isingiana*
680 *Triodia basedowii* (Lobed Spinifex)
682 *Triodia concinna*
17877 *Triodia melvillei*
699 *Triodia scariosa*
705 *Tripogon loliiformis* (Five Minute Grass)
717 *Urochloa piligera*
7658 *Velleia discophora* (Cabbage Poison)
7660 *Velleia glabrata* (Pee the Bed)
7661 *Velleia hispida* (Hispid Velleia)
12436 *Verticordia interioris*
8273 *Vittadinia sulcata*
7393 *Wahlenbergia tumidifructa*
8275 *Waitzia acuminata* (Orange Immortelle)
13331 *Waitzia acuminata* var. *acuminata*
1392 *Wurmbea deserticola*
31335 *Wurmbea* sp. Denham Pool (F. Hort et al. 2216) P1 Y
4386 *Zygophyllum aurantiacum* (Shrubby Twinleaf)
4388 *Zygophyllum compressum*
18140 *Zygophyllum eichleri*
4392 *Zygophyllum iodocarpum*
4393 *Zygophyllum kochii*
4394 *Zygophyllum ovatum* (Dwarf Twinleaf)
17278 *Zygophyllum tetrapterum*

Naturemap Search combined 50 km buffer 17/10/13

Name ID	Species Name	Naturalised	Conservation Code
24559	<i>Acanthagenys rufogularis</i> (Spiny-cheeked Honeyeater)		
24260	<i>Acanthiza apicalis</i> (Broad-tailed Thornbill Inland Thornbill)		
24261	<i>Acanthiza chrysorrhoa</i> (Yellow-rumped Thornbill)		
24264	<i>Acanthiza robustirostris</i> (Slaty-backed Thornbill)		
24265	<i>Acanthiza uropygialis</i> (Chestnut-rumped Thornbill)		
24281	<i>Accipiter cirrocephalus</i> subsp. <i>cirrocephalus</i> (Collared Sparrowhawk)		
25536	<i>Accipiter fasciatus</i> (Brown Goshawk)		
25544	<i>Aegotheles cristatus</i> (Australian Owlet-nightjar)		
30833	<i>Amphibolurus longirostris</i>		
24539	<i>Amytornis striatus</i> subsp. <i>striatus</i> (Striated Grasswren (inland))		P4
24312	<i>Anas gracilis</i> (Grey Teal)		
24315	<i>Anas rhynchotis</i> (Australasian Shoveler)		
24316	<i>Anas superciliosa</i> (Pacific Black Duck)		
25318	<i>Antaresia perthensis</i> (Pygmy Python)		
25241	<i>Antaresia stimsoni</i> subsp. <i>stimsoni</i> (Stimson's Python)		
24087	<i>Antechinomys laniger</i> (Kultarr)		
25528	<i>Aphelocephala leucopsis</i> (Southern Whiteface)		
24266	<i>Aphelocephala leucopsis</i> subsp. <i>castaneiventris</i> (Southern Whiteface)		
24268	<i>Aphelocephala nigricincta</i> (Banded Whiteface)		
24285	<i>Aquila audax</i> (Wedge-tailed Eagle)		
24340	<i>Ardea novaehollandiae</i> (White-faced Heron)		
24341	<i>Ardea pacifica</i> (White-necked Heron)		
24610	<i>Ardeotis australis</i> (Australian Bustard)		P4
-1751	<i>Argiope protensa</i>		
-12015	<i>Arrenurus separatus</i>		
25566	<i>Artamus cinereus</i> (Black-faced Woodswallow)		
24356	<i>Artamus personatus</i> (Masked Woodswallow)		
24318	<i>Aythya australis</i> (Hardhead)		
24161	<i>Bettongia lesueur</i> subsp. <i>graili</i> (Boodie Burrowing Bettong)		
24319	<i>Biziura lobata</i> (Musk Duck)		
24251	<i>Bos taurus</i> (European Cattle)	Y	
25331	<i>Brachyurophis approximans</i>		
25715	<i>Cacatua roseicapilla</i> (Galah)		
24725	<i>Cacatua roseicapilla</i> subsp. <i>assimilis</i> (Galah)		
25716	<i>Cacatua sanguinea</i> (Little Corella)		
24727	<i>Cacatua sanguinea</i> subsp. <i>westralensis</i> (Little Corella)		
42307	<i>Cacomantis pallidus</i> (Pallid Cuckoo)		
30883	<i>Canis lupus</i> subsp. <i>familiaris</i> (Dog)	Y	
24564	<i>Certhionyx variegatus</i> (Pied Honeyeater)		
24186	<i>Chalinolobus gouldii</i> (Gould's Wattled Bat)		
24377	<i>Charadrius ruficapillus</i> (Red-capped Plover)		
25339	<i>Chelodina steindachneri</i> (Flat-shelled Turtle)		
24488	<i>Cheramoeca leucosternus</i> (White-backed Swallow)		
24434	<i>Chrysococcyx osculans</i> (Black-eared Cuckoo)		
24833	<i>Cincloramphus cruralis</i> (Brown Songlark)		
24834	<i>Cincloramphus mathewsi</i> (Rufous Songlark)		
25580	<i>Cinclosoma castaneothorax</i> (Chestnut-breasted Quail-thrush)		
42311	<i>Cinclosoma marginatum</i> (Western Quail-thrush)		
24289	<i>Circus assimilis</i> (Spotted Harrier)		
24774	<i>Cladorhynchus leucocephalus</i> (Banded Stilt)		
25675	<i>Colluricincla harmonica</i> (Grey Shrike-thrush)		
24399	<i>Columba livia</i> (Domestic Pigeon)	Y	
24361	<i>Coracina maxima</i> (Ground Cuckoo-shrike)		
25568	<i>Coracina novaehollandiae</i> (Black-faced Cuckoo-shrike)		
24362	<i>Coracina novaehollandiae</i> subsp. <i>novaehollandiae</i> (Black-faced Cuckoo-shrike)		
24416	<i>Corvus bennetti</i> (Little Crow)		
25593	<i>Corvus orru</i> (Torresian Crow)		
24420	<i>Cracticus nigrogularis</i> (Pied Butcherbird)		
25595	<i>Cracticus tibicen</i> (Australian Magpie)		
25596	<i>Cracticus torquatus</i> (Grey Butcherbird)		
25458	<i>Ctenophorus caudicinctus</i> (Ring-tailed Dragon)		
24865	<i>Ctenophorus caudicinctus</i> subsp. <i>caudicinctus</i> (Ring-tailed Dragon)		
24869	<i>Ctenophorus caudicinctus</i> subsp. <i>mensarum</i> (Ring-tailed Dragon)		
25459	<i>Ctenophorus isolepis</i> (Crested Dragon Military Dragon)		
24875	<i>Ctenophorus isolepis</i> subsp. <i>gularis</i> (Central Military Dragon)		

24882 *Ctenophorus nuchalis* (Central Netted Dragon)
 24886 *Ctenophorus reticulatus* (Western Netted Dragon)
 24888 *Ctenophorus salinarum* (Salt Pan Dragon)
 24889 *Ctenophorus scutulatus*
 25045 *Ctenopus helenae*
 25052 *Ctenopus leonhardii*
 25054 *Ctenopus mimetes*
 25463 *Ctenopus pantherinus* (Leopard Ctenopus)
 25375 *Cyclorana maini* (Sheep Frog)
 25376 *Cyclorana platycephala* (Water-holding Frog)
 24322 *Cygnus atratus* (Black Swan)
 -11830 *Cyrtophora parnasia*
 24089 *Dasyercus cristicauda* (Crest-tailed Mulgara) T
 24997 *Delma butleri*
 25295 *Demansia psammophis* subsp. *cupreiceps* (Yellow-faced Whipsnake)
 25607 *Dicaeum hirundinaceum* (Mistletoebird)
 25469 *Diplodactylus granariensis*
 24940 *Diplodactylus pulcher*
 24470 *Dromaius novaehollandiae* (Emu)
 25092 *Egernia depressa* (Southern Pygmy Spiny-tailed Skink)
 24568 *Epthianura aurifrons* (Orange Chat)
 24570 *Epthianura tricolor* (Crimson Chat)
 25109 *Eremiascincus richardsonii* (Broad-banded Sand Swimmer)
 24379 *Erythronyctis cinctus* (Red-kneed Dotterel)
 -1632 *Ethmostigmus rubripes*
 24368 *Eurostopodus argus* (Spotted Nightjar)
 25621 *Falco berigora* (Brown Falcon)
 25622 *Falco cenchroides* (Australian Kestrel)
 25623 *Falco longipennis* (Australian Hobby)
 25624 *Falco peregrinus* (Peregrine Falcon) S
 24476 *Falco subniger* (Black Falcon)
 25727 *Fulica atra* (Eurasian Coot)
 -11605 *Gaius villosus*
 24764 *Gallinula ventralis* (Black-tailed Native-hen)
 24958 *Gehyra punctata*
 24959 *Gehyra variegata*
 24401 *Geopelia cuneata* (Diamond Dove)
 25530 *Gerygone fusca* (Western Gerygone)
 -13630 *Gerygone fusca* subsp. *mungi*
 -13764 *Gerygone mungi*
 24443 *Grallina cyanoleuca* (Magpie-lark)
 24295 *Haliastur sphenurus* (Whistling Kite)
 24297 *Hamirostra melanosternon* (Black-breasted Buzzard)
 24961 *Heteronotia binoei* (Bynoe's Gecko)
 25734 *Himantopus himantopus* (Black-winged Stilt)
 24775 *Himantopus himantopus* subsp. *leucocephalus* (Black-winged Stilt)
 24491 *Hirundo neoxena* (Welcome Swallow)
 -12116 *Hoggicosa bicolor*
 -12203 *Hoggicosa forresti*
 24367 *Lalage tricolor* (White-winged Triller)
 -1712 *Lampona cylindrata*
 24511 *Larus novaehollandiae* subsp. *novaehollandiae* (Silver Gull)
 24557 *Leipoa ocellata* (Malleefowl) T
 25125 *Lerista bipes*
 25134 *Lerista eupoda* (Good-legged Lerista skink)
 25151 *Lerista macropisthopus* subsp. *fusciceps*
 25155 *Lerista muelleri*
 42411 *Lerista timida*
 25661 *Lichmera indistincta* (Brown Honeyeater)
 25392 *Litoria rubella* (Little Red Tree Frog)
 42415 *Lucasium squarrosum*
 30933 *Lucasium stenodactylum*
 30934 *Lucasium wombeyi*
 25489 *Macropus robustus* (Euro)
 24135 *Macropus robustus* subsp. *erubescens* (Euro Biggata)
 24136 *Macropus rufus* (Red Kangaroo Marlu)
 24168 *Macrotis lagotis* (Bilby Dalgyste)

24326 *Malacorhynchus membranaceus* (Pink-eared Duck)
 25651 *Malurus lamberti* (Variegated Fairy-wren)
 25652 *Malurus leucopterus* (White-winged Fairy-wren)
 25654 *Malurus splendens* (Splendid Fairy-wren)
 24583 *Manorina flavigula* (Yellow-throated Miner)
 24736 *Melopsittacus undulatus* (Budgerigar)
 25184 *Menetia greyii*
 24598 *Merops ornatus* (Rainbow Bee-eater) IA
 25542 *Milvus migrans* (Black Kite)
 25190 *Morethia butleri*
 24182 *Mormopterus beccarii* (Beccari's Freetail-bat)
 24737 *Neophema bourkii* (Bourke's Parrot)
 24971 *Nephrurus vertebralis*
 24973 *Nephrurus wheeleri* subsp. *wheeleri*
 24094 *Ningauai ridei* (Wongai Ningau)
 25748 *Ninox novaeseelandiae* (Boobook Owl)
 -12091 *Nomindra leeuweni*
 24224 *Notomys alexis* (Spinifex Hopping-mouse)
 -12329 *Notsodipus meedo*
 24194 *Nyctophilus geoffroyi* (Lesser Long-eared Bat)
 24742 *Nymphicus hollandicus* (Cockatiel)
 24407 *Ocyphaps lophotes* (Crested Pigeon)
 24618 *Oreoica gutturalis* (Crested Bellbird)
 25680 *Pachycephala rufiventris* (Rufous Whistler)
 25254 *Parasuta monachus*
 24627 *Pardalotus rubricatus* (Red-browed Pardalote)
 25682 *Pardalotus striatus* (Striated Pardalote)
 24628 *Pardalotus striatus* subsp. *murchisoni* (Striated Pardalote)
 -1785 *Pediana tenuis*
 24648 *Pelecanus conspicillatus* (Australian Pelican)
 24659 *Petroica goodenovii* (Red-capped Robin)
 24409 *Phaps chalcoptera* (Common Bronzewing)
 24841 *Platalea flavipes* (Yellow-billed Spoonbill)
 25721 *Platycercus zonarius* (Australian Ringneck Ring-necked Parrot)
 24751 *Platycercus zonarius* subsp. *zonarius* (Port Lincoln Parrot)
 25703 *Podargus strigoides* (Tawny Frogmouth)
 24679 *Podargus strigoides* subsp. *brachypterus* (Tawny Frogmouth)
 25510 *Pogona minor* (Dwarf Bearded Dragon)
 24681 *Poliocephalus poliocephalus* (Hoary-headed Grebe)
 24683 *Pomatostomus superciliosus* (White-browed Babbler)
 25706 *Pomatostomus temporalis* (Grey-crowned Babbler)
 24684 *Pomatostomus temporalis* subsp. *rubeculus* (Grey-crowned Babbler)
 24106 *Pseudantechinus woolleyae* (Woolley's Pseudantechinus)
 42416 *Pseudonaja mengdeni* (Western Brown Snake)
 25263 *Pseudonaja modesta* (Ringed Brown Snake)
 24390 *Psophodes occidentalis* (Western Wedgebill Chiming Wedgebill)
 25724 *Ptilonorhynchus maculatus* (Spotted Bowerbird)
 24757 *Ptilonorhynchus maculatus* subsp. *guttatus* (Western Bowerbird)
 42344 *Purnella albifrons* (White-fronted Honeyeater)
 25009 *Pygopus nigriceps*
 24278 *Pyrrholaemus brunneus* (Redthroat)
 25277 *Ramphotyphlops grypus*
 25279 *Ramphotyphlops hamatus*
 25288 *Ramphotyphlops waitii*
 25614 *Rhipidura leucophrys* (Willie Wagtail)
 24982 *Rhynchoedura ornata* (Western Beaked Gecko)
 -1812 *Scolopendra morsitans*
 24199 *Scotorepens balstoni* (Inland Broad-nosed Bat)
 25266 *Simoselaps bertholdi* (Jan's Banded Snake)
 30948 *Smicrornis brevirostris* (Weebill)
 24108 *Sminthopsis crassicaudata* (Fat-tailed Dunnart)
 24109 *Sminthopsis dolichura* (Little long-tailed Dunnart)
 24115 *Sminthopsis longicaudata* (Long-tailed Dunnart)
 24116 *Sminthopsis macroura* (Stripe-faced Dunnart)
 24532 *Sterna nilotica* subsp. *macrotarsa* (Australian Gull-billed Tern)
 24329 *Stictonetta naevosa* (Freckled Duck)
 25597 *Strepera versicolor* (Grey Currawong)

24927 *Strophurus elderi*
24949 *Strophurus wellingtonae*
42310 *Sugomel niger* (Black Honeyeater)
25269 *Suta fasciata* (Rosen's Snake)
25705 *Tachybaptus novaehollandiae* (Australasian Grebe Black-throated Grebe)
24185 *Tadarida australis* (White-striped Freetail-bat)
24331 *Tadorna tadornoides* (Australian Shelduck Mountain Duck)
30870 *Taeniopygia guttata* (Zebra Finch)
30871 *Taeniopygia guttata* subsp. *castanotis* (Zebra Finch)
-13360 *Thereuopoda lesueurii*
24845 *Threskiornis spinicollis* (Straw-necked Ibis)
42351 *Todiramphus pyrrohopygius* (Red-backed Kingfisher)
25549 *Todiramphus sanctus* (Sacred Kingfisher)
-13062 *Trichocycclus nigropunctatus*
24851 *Turnix velox* (Little Button-quail)
30814 *Tympanocryptis cephalus* (Pebble Dragon)
24855 *Tyto novaehollandiae* subsp. *novaehollandiae* (Masked Owl (southern subsp)) P3
-1670 *Urodacus armatus*
-1642 *Urodacus hoplurus*
25211 *Varanus caudolineatus*
25218 *Varanus gouldii* (Bungarra or Sand Monitor)
25524 *Varanus panoptes* (Yellow-spotted Monitor)
25223 *Varanus panoptes* subsp. *rubidus*
24205 *Vespadelus finlaysoni* (Finlayson's Cave Bat)
24040 *Vulpes vulpes* (Red Fox) Y

Appendix D – Flora data

Flora species list for the Survey Area

Flora likelihood of occurrence assessment

Table D.1 Flora list recorded in the Survey Area during the field survey

Family	Taxon	Status
Acanthaceae	<i>Harnieria kempeana</i> subsp. <i>muelleri</i>	
Aizoaceae	<i>Gunniopsis propinqua</i>	Priority 3
Aizoaceae	<i>Tetragonia cristata</i>	
Aizoaceae	<i>Trianthema glossostigma</i>	
Amaranthaceae	<i>Alternanthera angustifolia</i>	
Amaranthaceae	<i>Alternanthera nodiflora</i>	
Amaranthaceae	<i>Ptilotus aevoides</i>	
Amaranthaceae	<i>Ptilotus artholasius</i>	
Amaranthaceae	<i>Ptilotus divaricatus</i>	
Amaranthaceae	<i>Ptilotus gaudichaudii</i> subsp. <i>gaudichaudii</i>	
Amaranthaceae	<i>Ptilotus helipteroides</i>	
Amaranthaceae	<i>Ptilotus luteolus</i>	Priority 3
Amaranthaceae	<i>Ptilotus macrocephalus</i>	
Amaranthaceae	<i>Ptilotus nobilis</i>	
Amaranthaceae	<i>Ptilotus obovatus</i>	
Amaranthaceae	<i>Ptilotus polystachyus</i>	
Amaranthaceae	<i>Ptilotus roei</i>	
Amaranthaceae	<i>Ptilotus rotundifolius</i>	
Amaranthaceae	<i>Ptilotus schwartzii</i>	
Amaranthaceae	<i>Ptilotus schwartzii</i> var. <i>georgei</i>	
Apocynaceae	<i>Marsdenia australis</i>	
Apocynaceae	<i>Rhyncharrhena linearis</i>	
Apocynaceae	<i>Sarcostemma viminale</i> subsp. <i>australe</i>	
Araliaceae	<i>Trachymene</i> sp. (insufficient material)	
Asparagaceae	<i>Lomandra leucocephala</i> subsp. <i>robusta</i>	
Asparagaceae	<i>Thysanotus</i> sp. (insufficient material)	
Asteraceae	<i>Actinobole uliginosum</i>	
Asteraceae	<i>Actinobole oldfieldianum</i>	
Asteraceae	<i>Angianthus milnei</i>	
Asteraceae	<i>Bidens bipinnata</i>	*
Asteraceae	<i>Brachyscome ciliaris</i>	
Asteraceae	<i>Brachyscome ciliaris</i> var. <i>lanuginosa</i>	
Asteraceae	<i>Brachyscome oncocarpa</i>	
Asteraceae	<i>Calocephalus beardii</i>	
Asteraceae	<i>Calocephalus multiflorus</i>	
Asteraceae	<i>Calotis hispidula</i>	
Asteraceae	<i>Calotis</i> sp. (insufficient material)	
Asteraceae	<i>Centipeda thespidioides</i>	
Asteraceae	<i>Centipeda</i> sp. (insufficient material)	
Asteraceae	<i>Cephalipterum drummondii</i>	
Asteraceae	<i>Chrysocephalum puteale</i>	
Asteraceae	<i>Chthonocephalus pseudevax</i>	
Asteraceae	<i>Chthonocephalus viscosus</i>	

Family	Taxon	Status
Asteraceae	<i>Dielitzia tysonii</i>	
Asteraceae	<i>Erymophyllum ramosum</i> subsp. <i>ramosum</i>	
Asteraceae	<i>Gnephosis arachnoidea</i>	
Asteraceae	<i>Gnephosis brevifolia</i>	
Asteraceae	<i>Gnephosis eriocephala</i>	
Asteraceae	<i>Gnephosis tenuissima</i>	
Asteraceae	<i>Helipterum craspedioides</i>	
Asteraceae	<i>Lemooria burkittii</i>	
Asteraceae	<i>Myriocephalus oldfieldii</i>	
Asteraceae	<i>Myriocephalus rudallii</i>	
Asteraceae	<i>Olearia stuartii</i>	
Asteraceae	<i>Pluchea dentex</i>	
Asteraceae	<i>Podolepis capillaris</i>	
Asteraceae	<i>Pterocaulon sphacelatum</i>	Range Extension
Asteraceae	<i>Rhodanthe chlorocephala</i>	
Asteraceae	<i>Rhodanthe floribunda</i>	
Asteraceae	<i>Rhodanthe</i> sp. (insufficient material)	
Asteraceae	<i>Rhodanthe sterilescens</i>	
Asteraceae	<i>Senecio</i> sp. (insufficient material)	
Asteraceae	<i>Streptoglossa cylindriceps</i>	
Asteraceae	<i>Streptoglossa liatroides</i>	
Asteraceae	<i>Tietkensia corrickiae</i>	
Asteraceae	<i>Vittadinia sulcata</i>	
Asteraceae	<i>Waitzia acuminata</i> var. <i>acuminata</i>	
Boraginaceae	<i>Trichodesma zeylanicum</i>	
Brassicaceae	<i>Lepidium echinatum</i>	
Brassicaceae	<i>Lepidium oxytrichum</i>	
Brassicaceae	<i>Menkea villosula</i>	
Brassicaceae	<i>Stenopetalum ?filifolium</i> (insufficient material)	
Brassicaceae	<i>Stenopetalum anfractum</i>	
Campanulaceae	<i>Lobelia heterophylla</i>	
Campanulaceae	<i>Lobelia</i> sp. (insufficient material)	
Campanulaceae	<i>Wahlenbergia gracilentia</i>	
Campanulaceae	<i>Wahlenbergia</i> sp. (insufficient material)	
Campanulaceae	<i>Wahlenbergia tumidifructa</i>	
Casuarinaceae	<i>Casuarina obesa</i>	
Casuarinaceae	<i>Casuarina pauper</i>	
Celastraceae	<i>Stackhousia clementii</i>	Priority 3
Celastraceae	<i>Stackhousia</i> sp. Mt Keith (G. Cockerton & G. O'Keefe 11017)	
Chenopodiaceae	<i>Atriplex codonocarpa</i>	
Chenopodiaceae	<i>Atriplex nummularia</i>	
Chenopodiaceae	<i>Atriplex semilunaris</i>	
Chenopodiaceae	<i>Chenopodium gaudichaudianum</i>	
Chenopodiaceae	<i>Dissocarpus paradoxus</i>	

Family	Taxon	Status
Chenopodiaceae	<i>Dysphania glomulifera</i> subsp. <i>eremaea</i>	
Chenopodiaceae	<i>Dysphania kalpari</i>	
Chenopodiaceae	<i>Dysphania melanocarpa</i>	
Chenopodiaceae	<i>Einadia nutans</i>	
Chenopodiaceae	<i>Enchylaena tomentosa</i>	
Chenopodiaceae	<i>Maireana carnosa</i>	
Chenopodiaceae	<i>Maireana georgei</i>	
Chenopodiaceae	<i>Maireana glomerifolia</i>	
Chenopodiaceae	<i>Maireana lobiflora</i>	
Chenopodiaceae	<i>Maireana melanocoma</i>	
Chenopodiaceae	<i>Maireana planifolia</i>	
Chenopodiaceae	<i>Maireana</i> sp. (insufficient material)	
Chenopodiaceae	<i>Maireana thesioides</i>	
Chenopodiaceae	<i>Maireana tomentosa</i> subsp. <i>tomentosa</i>	
Chenopodiaceae	<i>Maireana trichoptera</i>	
Chenopodiaceae	<i>Maireana triptera</i>	
Chenopodiaceae	<i>Maireana villosa</i>	
Chenopodiaceae	<i>Rhagodia eremaea</i>	
Chenopodiaceae	<i>Salsola australis</i>	
Chenopodiaceae	<i>Sclerolaena cornishiana</i>	
Chenopodiaceae	<i>Sclerolaena cuneata</i>	
Chenopodiaceae	<i>Sclerolaena densiflora</i>	
Chenopodiaceae	<i>Sclerolaena diacantha</i>	
Chenopodiaceae	<i>Sclerolaena eriacantha</i>	
Chenopodiaceae	<i>Sclerolaena eurotioides</i>	
Chenopodiaceae	<i>Sclerolaena fusiformis</i>	
Chenopodiaceae	<i>Sclerolaena lanicuspis</i>	
Chenopodiaceae	<i>Sclerolaena obliquicuspis</i>	
Chenopodiaceae	<i>Tecticornia calyptrata</i>	
Chenopodiaceae	<i>Tecticornia</i> sp. (insufficient material)	
Convolvulaceae	<i>Cuscuta planiflora</i>	*
Convolvulaceae	<i>Duperreya commixta</i>	
Convolvulaceae	<i>Duperreya sericea</i>	
Crassulaceae	<i>Crassula colorata</i>	
Cucurbitaceae	<i>Citrullus lanatus</i>	*
Cupressaceae	<i>Callitris columellaris</i>	
Cupressaceae	<i>Callitris</i> sp. (insufficient material)	
Cyperaceae	<i>Cyperus betchei</i> subsp. <i>commiscens</i>	
Cyperaceae	<i>Cyperus iria</i>	
Cyperaceae	<i>Isolepis congrua</i>	
Euphorbiaceae	<i>Euphorbia boophthona</i>	
Euphorbiaceae	<i>Euphorbia drummondii</i>	
Euphorbiaceae	<i>Euphorbia</i> sp. (insufficient material)	
Fabaceae	? <i>Daviesia</i> sp.(insufficient material)	

Family	Taxon	Status
Fabaceae	<i>Acacia ?balsamea</i>	
Fabaceae	<i>Acacia ?caesaneura x incurvaneura</i>	
Fabaceae	<i>Acacia ?grasbyi</i>	
Fabaceae	<i>Acacia ?mulganeura x incurvaneura</i>	
Fabaceae	<i>Acacia aneura</i>	
Fabaceae	<i>Acacia aptaneura</i>	
Fabaceae	<i>Acacia ayersiana</i>	
Fabaceae	<i>Acacia ayersiana</i> (narrow phyllode variant)	
Fabaceae	<i>Acacia burkittii</i>	
Fabaceae	<i>Acacia caesaneura</i>	
Fabaceae	<i>Acacia caesaneura</i> (narrow phyllode variant)	
Fabaceae	<i>Acacia caesaneura</i> (short phyllode variant)	
Fabaceae	<i>Acacia craspedocarpa</i>	
Fabaceae	<i>Acacia craspedocarpa</i> (hybrid)	
Fabaceae	<i>Acacia effusifolia</i>	
Fabaceae	<i>Acacia exocarpoides</i>	
Fabaceae	<i>Acacia fuscaneura</i>	
Fabaceae	<i>Acacia incurvaneura</i>	
Fabaceae	<i>Acacia jamesiana</i>	
Fabaceae	<i>Acacia kempeana</i>	
Fabaceae	<i>Acacia ligulata</i>	
Fabaceae	<i>Acacia macraneura</i>	
Fabaceae	<i>Acacia minyura</i>	
Fabaceae	<i>Acacia mulganeura</i>	
Fabaceae	<i>Acacia murrayana</i>	
Fabaceae	<i>Acacia oswaldii</i>	
Fabaceae	<i>Acacia pachyacra</i>	
Fabaceae	<i>Acacia pruinocarpa</i>	
Fabaceae	<i>Acacia pteraneura</i>	
Fabaceae	<i>Acacia quadrimarginea</i>	
Fabaceae	<i>Acacia ramulosa</i> var. <i>linophylla</i>	
Fabaceae	<i>Acacia ramulosa</i> var. <i>ramulosa</i>	
Fabaceae	<i>Acacia rhodophloia</i>	
Fabaceae	<i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i>	
Fabaceae	<i>Acacia sibirica</i>	
Fabaceae	<i>Acacia synchronicia</i>	
Fabaceae	<i>Acacia tetragonophylla</i>	
Fabaceae	<i>Acacia tysonii</i>	
Fabaceae	<i>Acacia victoriae</i>	
Fabaceae	<i>Acacia wanyu</i>	
Fabaceae	<i>Gastrolobium laytonii</i>	
Fabaceae	<i>Glycine ?canescens</i>	
Fabaceae	<i>Indigofera australis</i>	
Fabaceae	<i>Indigofera georgei</i>	

Family	Taxon	Status
Fabaceae	<i>Indigofera monophylla</i>	
Fabaceae	<i>Indigofera</i> sp. Gilesii (M.E. Trudgen 15869)	Priority 3
Fabaceae	<i>Leptosema chambersii</i>	
Fabaceae	<i>Mirbelia rhagodioides</i>	
Fabaceae	<i>Senna ?stricta</i>	
Fabaceae	<i>Senna artemisioides</i> subsp. <i>filifolia</i>	
Fabaceae	<i>Senna artemisioides</i> subsp. <i>helmsii</i>	
Fabaceae	<i>Senna artemisioides</i> subsp. <i>petiolaris</i>	
Fabaceae	<i>Senna artemisioides</i> subsp. <i>x artemisioides</i>	
Fabaceae	<i>Senna artemisioides</i> subsp. <i>x sturtii</i>	
Fabaceae	<i>Senna charlesiana</i>	
Fabaceae	<i>Senna glutinosa</i> subsp. <i>glutinosa</i>	
Fabaceae	<i>Senna glutinosa</i> subsp. <i>x luerssenii</i>	
Fabaceae	<i>Senna pleurocarpa</i>	
Fabaceae	<i>Senna pleurocarpa</i> var. <i>angustifolia</i>	
Fabaceae	<i>Senna</i> sp. Meekatharra (E. Bailey 1-26)	
Fabaceae	<i>Swainsona canescens</i>	
Fabaceae	<i>Swainsona purpurea</i>	
Frankeniaceae	<i>Frankenia setosa</i>	
Frankeniaceae	<i>Frankenia</i> sp. (insufficient material)	
Gentianaceae	<i>Schenkia australis</i>	
Geraniaceae	<i>Erodium cygnorum</i>	
Geraniaceae	<i>Erodium</i> sp. (insufficient material)	
Goodeniaceae	<i>Brunonia australis</i>	
Goodeniaceae	<i>Goodenia ?triodiophila</i>	
Goodeniaceae	<i>Goodenia centralis</i>	
Goodeniaceae	<i>Goodenia havilandii</i>	
Goodeniaceae	<i>Goodenia mimuloides</i>	
Goodeniaceae	<i>Goodenia quasilibera</i>	
Goodeniaceae	<i>Goodenia</i> sp. (insufficient material)	
Goodeniaceae	<i>Goodenia wilunensis</i>	
Goodeniaceae	<i>Scaevola spinescens</i>	
Goodeniaceae	<i>Velleia glabrata</i>	
Gyrostemonaceae	<i>Codonocarpus cotinifolius</i>	
Gyrostemonaceae	<i>Gyrostemon ?tepperi</i>	
Haloragaceae	<i>Haloragis odontocarpa</i>	
Haloragaceae	<i>Haloragis</i> sp. (insufficient material)	
Haloragaceae	<i>Haloragis trigonocarpa</i>	
Hemerocallidaceae	<i>Dianella revoluta</i>	
Juncaginaceae	<i>Triglochin</i> sp. A Flora of Australia (G. J. Keighery 2477)	
Lamiaceae	<i>Dicrastylis brunnea</i>	
Lamiaceae	<i>Dicrastylis sessilifolia</i>	
Lamiaceae	<i>Hemigenia tomentosa</i>	
Lamiaceae	<i>Prostanthera albiflora</i>	

Family	Taxon	Status
Lamiaceae	<i>Prostanthera althoferi</i> subsp. <i>althoferi</i>	
Lamiaceae	<i>Prostanthera campbellii</i>	
Lamiaceae	<i>Prostanthera wilkieana</i>	
Lamiaceae	<i>Spartothamnella teucriflora</i>	
Loranthaceae	<i>Amyema fitzgeraldii</i>	
Loranthaceae	<i>Amyema gibberula</i> var. <i>tatei</i>	
Loranthaceae	<i>Amyema hilliana</i>	
Loranthaceae	<i>Amyema nestor</i>	
Malvaceae	<i>Abutilon otocarpum</i>	
Malvaceae	<i>Abutilon oxycarpum</i>	
Malvaceae	<i>Abutilon</i> sp. (insufficient material)	
Malvaceae	<i>Alyogyne pinoniana</i>	
Malvaceae	<i>Androclava luteiflora</i>	
Malvaceae	<i>Hibiscus burtonii</i>	
Malvaceae	<i>Hibiscus</i> sp. Gardneri (A.L. Payne PRP 1435)	
Malvaceae	<i>Hibiscus sturtii</i> var. <i>truncatus</i>	
Malvaceae	<i>Keraudrenia velutina</i> subsp. <i>elliptica</i>	
Malvaceae	<i>Lawrenzia ?squamata</i>	
Malvaceae	<i>Sida calyxhymenia</i>	
Malvaceae	<i>Sida ectogama</i>	
Malvaceae	<i>Sida fibulifera</i>	
Malvaceae	<i>Sida</i> sp. (insufficient material)	
Malvaceae	<i>Sida</i> sp. dark green fruits (S. van Leeuwen 2260)	
Malvaceae	<i>Sida</i> sp. Excedentifolia (J.L. Egan 1925)	
Malvaceae	<i>Sida</i> sp. Golden calyces glabrous (H.N. Foote 32)	
Malvaceae	<i>Sida</i> sp. verrucose glands (F.H. Mollemans 2423)	
Marsileaceae	<i>Marsilea hirsuta</i>	
Myrtaceae	<i>Aluta maisonneuvei</i>	
Myrtaceae	<i>Aluta aspera</i> subsp. <i>hesperia</i>	
Myrtaceae	<i>Aluta maisonneuvei</i> subsp. <i>articulata</i>	
Myrtaceae	<i>Calothamnus aridus</i>	
Myrtaceae	<i>Calytrix amethystina</i>	
Myrtaceae	<i>Calytrix carinata</i>	
Myrtaceae	<i>Calytrix erosipetala</i>	
Myrtaceae	<i>Calytrix uncinata</i>	Priority 3
Myrtaceae	<i>Calytrix verruculosa</i>	Priority 3
Myrtaceae	<i>Corymbia lenziana</i>	
Myrtaceae	<i>Enekbatus eremaeus</i>	
Myrtaceae	<i>Eucalyptus camaldulensis</i> subsp. <i>obtusa</i>	
Myrtaceae	<i>Eucalyptus camaldulensis</i>	
Myrtaceae	<i>Eucalyptus eremicola</i>	
Myrtaceae	<i>Eucalyptus eremicola</i> subsp. <i>peeneri</i>	
Myrtaceae	<i>Eucalyptus kingsmillii</i>	
Myrtaceae	<i>Eucalyptus lucasii</i>	

Family	Taxon	Status
Myrtaceae	<i>Eucalyptus socialus</i>	
Myrtaceae	<i>Homalocalyx echinulatus</i>	Priority 3
Myrtaceae	<i>Melaleuca xerophila</i>	
Myrtaceae	<i>Micromyrtus sulphurea</i>	
Nyctaginaceae	<i>Boerhavia repleta</i>	
Phrymaceae	<i>Peplidium</i> sp. C Evol. Fl. Fauna Arid Aust (N. T. Burbidge & A. Kanis 8158)	
Phyllanthaceae	<i>Sauropus ramosissimus</i>	Priority 3
Pittosporaceae	<i>Pittosporum angustifolium</i>	
Plantaginaceae	<i>Plantago</i> sp. (insufficient material)	
Poaceae	<i>Aristida contorta</i>	
Poaceae	<i>Aristida holathera</i>	
Poaceae	<i>Aristida inaequiglumis</i>	
Poaceae	<i>Austrostipa scabra</i>	
Poaceae	<i>Cenchrus ciliaris</i>	*
Poaceae	<i>Cymbopogon ambiguus</i>	
Poaceae	<i>Cymbopogon obtectus</i>	
Poaceae	<i>Digitaria brownii</i>	
Poaceae	<i>Enneapogon caerulescens</i>	
Poaceae	<i>Enneapogon</i> sp. (insufficient material)	
Poaceae	<i>Enteropogon ramosus</i>	
Poaceae	<i>Eragrostis dielsii</i>	
Poaceae	<i>Eragrostis eriopoda</i>	
Poaceae	<i>Eragrostis lacunaria</i>	
Poaceae	<i>Eragrostis lanipes</i>	
Poaceae	<i>Eragrostis pergracilis</i>	
Poaceae	<i>Eragrostis setifolia</i>	
Poaceae	<i>Eragrostis tenellula</i>	
Poaceae	<i>Eragrostis xerophila</i>	
Poaceae	<i>Eriachne benthamii</i>	
Poaceae	<i>Eriachne flaccida</i>	
Poaceae	<i>Eriachne helmsii</i>	
Poaceae	<i>Eriachne mucronata</i>	
Poaceae	<i>Eriachne pulchella</i> subsp. <i>dominii</i>	
Poaceae	<i>Eriachne</i> sp. (insufficient material)	
Poaceae	<i>Eulalia aurea</i>	
Poaceae	<i>Leptochloa fusca</i> subsp. <i>muelleri</i>	
Poaceae	<i>Monachather paradoxus</i>	
Poaceae	<i>Neurachne minor</i>	
Poaceae	<i>Paractaenum refractum</i>	
Poaceae	<i>Paraneurachne muelleri</i>	
Poaceae	<i>Paspalidium ?constrictum</i>	
Poaceae	<i>Setaria verticillata</i>	*
Poaceae	<i>Themeda triandra</i>	

Family	Taxon	Status
Poaceae	<i>Thyridolepis mitchelliana</i>	
Poaceae	<i>Thyridolepis multiculmis</i>	
Poaceae	<i>Triodia basedowii</i>	
Poaceae	<i>Triodia concinna</i>	
Poaceae	<i>Triodia melvillei</i>	
Poaceae	<i>Triodia</i> sp. (insufficient material)	
Poaceae	<i>Tripogon loliiformis</i>	
Polygonaceae	<i>Acetosa vesicaria</i>	*
Portulacaceae	<i>Calandrinia polyandra</i>	
Portulacaceae	<i>Calandrinia schistorhiza</i>	
Portulacaceae	<i>Calandrinia</i> sp. (insufficient material)	
Primulaceae	<i>Lysimachia arvensis</i>	*
Primulaceae	<i>Samolus repens</i>	
Proteaceae	<i>Grevillea berryana</i>	
Proteaceae	<i>Grevillea juncifolia</i>	
Proteaceae	<i>Grevillea juncifolia</i> subsp. <i>juncifolia</i>	
Proteaceae	<i>Grevillea sarissa</i>	
Proteaceae	<i>Grevillea sarissa</i> subsp. <i>succincta</i>	
Proteaceae	<i>Grevillea striata</i>	
Proteaceae	<i>Hakea leucopteris</i> subsp. <i>sericeps</i>	
Proteaceae	<i>Hakea lorea</i>	
Proteaceae	<i>Hakea preissii</i>	
Proteaceae	<i>Hakea recurva</i>	
Pteridaceae	<i>Cheilanthes brownii</i>	
Pteridaceae	<i>Cheilanthes lasiophylla</i>	
Pteridaceae	<i>Cheilanthes sieberi</i>	
Rhamnaceae	<i>Stenanthemum petraeum</i>	
Rubiaceae	<i>Psydrax latifolia</i>	
Rubiaceae	<i>Psydrax rigidula</i>	
Rubiaceae	<i>Psydrax suaveolens</i>	
Rubiaceae	<i>Synaptantha tillaeacea</i> var. <i>tillaeacea</i>	
Santalaceae	<i>Anthobolus leptomerioides</i>	
Santalaceae	<i>Santalum acuminatum</i>	
Santalaceae	<i>Santalum lanceolatum</i>	
Santalaceae	<i>Santalum spicatum</i>	
Sapindaceae	<i>Dodonaea microzyga</i>	
Sapindaceae	<i>Dodonaea pachyneura</i>	
Sapindaceae	<i>Dodonaea petiolaris</i>	
Sapindaceae	<i>Dodonaea viscosa</i> subsp. <i>spatulata</i>	
Scrophulariaceae	<i>Eremophila clarkei</i>	
Scrophulariaceae	<i>Eremophila congesta</i>	Priority 1
Scrophulariaceae	<i>Eremophila demissa</i>	
Scrophulariaceae	<i>Eremophila enata</i>	
Scrophulariaceae	<i>Eremophila eriocalyx</i>	

Family	Taxon	Status
Scrophulariaceae	<i>Eremophila exilifolia</i>	
Scrophulariaceae	<i>Eremophila falcata</i>	
Scrophulariaceae	<i>Eremophila flabellata</i>	
Scrophulariaceae	<i>Eremophila forrestii</i> subsp. <i>forrestii</i>	
Scrophulariaceae	<i>Eremophila forrestii</i> subsp. <i>hastieana</i>	
Scrophulariaceae	<i>Eremophila fraseri</i>	
Scrophulariaceae	<i>Eremophila fraseri</i> subsp. <i>fraseri</i>	
Scrophulariaceae	<i>Eremophila georgei</i>	
Scrophulariaceae	<i>Eremophila gilesii</i>	
Scrophulariaceae	<i>Eremophila gilesii</i> subsp. <i>gilesii</i>	
Scrophulariaceae	<i>Eremophila gilesii</i> subsp. <i>variabilis</i>	
Scrophulariaceae	<i>Eremophila glutinosa</i>	
Scrophulariaceae	<i>Eremophila hygrophana</i>	
Scrophulariaceae	<i>Eremophila jucunda</i> subsp. <i>jucunda</i>	
Scrophulariaceae	<i>Eremophila lachnocalyx</i>	
Scrophulariaceae	<i>Eremophila latrobei</i>	
Scrophulariaceae	<i>Eremophila latrobei</i> subsp. <i>glabra</i>	
Scrophulariaceae	<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	
Scrophulariaceae	<i>Eremophila linearis</i>	
Scrophulariaceae	<i>Eremophila longifolia</i>	
Scrophulariaceae	<i>Eremophila macmillaniana</i>	
Scrophulariaceae	<i>Eremophila maculata</i> subsp. <i>brevifolia</i>	
Scrophulariaceae	<i>Eremophila malacoides</i>	
Scrophulariaceae	<i>Eremophila margarethae</i>	
Scrophulariaceae	<i>Eremophila oppositifolia</i> subsp. <i>angustifolia</i>	
Scrophulariaceae	<i>Eremophila platycalyx</i> subsp. <i>platycalyx</i>	
Scrophulariaceae	<i>Eremophila punctata</i>	
Scrophulariaceae	<i>Eremophila shonae</i> subsp. <i>shonae</i>	
Scrophulariaceae	<i>Eremophila simulans</i>	
Scrophulariaceae	<i>Eremophila</i> sp. (insufficient material)	
Scrophulariaceae	<i>Eremophila spathulata</i>	
Scrophulariaceae	<i>Eremophila spectabilis</i> subsp. <i>brevis</i>	
Scrophulariaceae	<i>Eremophila spectabilis</i> subsp. <i>spectabilis</i>	
Scrophulariaceae	<i>Eremophila spuria</i>	
Solanaceae	<i>Nicotiana cavicola</i>	
Solanaceae	<i>Nicotiana</i> sp. (insufficient material)	
Solanaceae	<i>Solanum ashbyae</i>	
Solanaceae	<i>Solanum cleistogamum</i>	
Solanaceae	<i>Solanum lasiophyllum</i>	
Solanaceae	<i>Solanum nummularium</i>	
Solanaceae	<i>Solanum</i> sp. (insufficient material)	
Stylidiaceae	<i>Stylidium longibracteatum</i>	
Thymelaeaceae	<i>Pimelea microcephala</i>	
Thymelaeaceae	<i>Pimelea trichostachya</i>	

Family	Taxon	Status
Zygophyllaceae	<i>Tribulus suberosus</i>	
Zygophyllaceae	<i>Zygophyllum aurantiacum</i>	
Zygophyllaceae	<i>Zygophyllum</i> sp. (insufficient material)	
Zygophyllaceae	<i>Zygophyllum iodocarpum</i>	

* introduced species

Table D.2 Definitions for flora likelihood of occurrence assessment

Likelihood of occurrence	Definition
Known	Species definitely recorded within the Survey Area from field survey results.
Likely	Species previously recorded within or adjacent to the Survey Area and suitable habitat occurs in the Survey Area.
Possible	Species previously recorded within 10 km with suitable habitat occurring in the Survey Area. OR Species not previously recorded within 10 km, but suitable habitat occurs in the Survey Area.
Unlikely	Species previously recorded within 10 km, but suitable habitat does not occur in the Survey Area.
Highly unlikely	Species not previously recorded within 10 km, suitable habitat does not occur in the Survey Area and/or Survey Area is outside the natural distribution of the species.

Table D.3 Aspects of assessment of efficacy of survey

Aspect	Detail
Intensity of the field survey.	Whether the whole/majority of the Survey Area was traversed.
	Whether the Survey Area was assessed in accordance with a Level 1 (reconnaissance) or Level 2 (detailed) survey.
Ease of identification of the species.	Whether the species is small and cryptic or large and easily noticeable.
	Whether the species was flowering at the time of the survey (many species cannot be identified without appropriate flowering material).

Table D.4 Flora likelihood of occurrence assessment for conservation significant flora

Family	Taxon	Status		Description and closest record information (if available) (WA Herbarium 1998–; DotE 2013)	Efficacy of field survey	Likelihood of occurrence	Source
		EPBC Act	WC Act/ DPaW				
Amaranthaceae	<i>Ptilotus chrysocomus</i>		P1	Compact, perennial, woody shrub, to one metre high, leaves bunched at shoots, oblanceolate, three to 10 mm long, 0.5 to one mm long; spikes yellow, ovoid-orbicular, six to 12 mm long, six to 10 mm wide; bracts 0.8 to one mm long; bracteoles 1.8 to 2.2 mm long; tepals 3.4 to four mm long; five fertile stamens; ovary glabrous, style 1.4 to 1.8 mm long, sigmoid, centrally fixed to ovary. Flowers yellow, Aug to Sep. Brown sandy clays. Bases of breakaways, rocky scree slopes. Closest record: Lake Way station, 28 km SE of Wiluna	Moderate	Possible – the species has been recorded in the general area and there is a small amount of suitable habitat present within the Survey Area.	NM
Amaranthaceae	<i>Ptilotus lazaridis</i>		P3	Herb or shrub, to 0.6 m high. Flowers pink/red, Jul or Oct. Clay loam. Floodplains. Closest record: Paroo station, seven km north of Goldfields Highway	Moderate	Likely – the species has been recorded within 10 km of the Survey Area and there is suitable habitat present within the Survey Area.	NM
Amaranthaceae	<i>Ptilotus luteolus</i>		P3	Compact, woody subshrub, 0.2 to 0.3 m high, 0.3 to 0.4 cm wide. Flowers green/yellow, June, Aug-Sep. Lithosol, orange/brown/red clay loam, sandy soils. Rock platforms, near river channel, gravelly slopes. Closest record: three km north of Wiluna (2004)	Moderate	Known – the species was recorded during the GHD field survey.	NM, TPFL, WAHERB

Family	Taxon	Status		Description and closest record information (if available) (WA Herbarium 1998–; DotE 2013)	Efficacy of field survey	Likelihood of occurrence	Source
		EPBC Act	WC Act/ DPaW				
Asteraceae	<i>Olearia mucronata</i>		P3	Densely branched, unpleasantly aromatic shrub, 0.6 to one metre high. Flowers white & yellow, Aug to Dec or Jan. Schistose hills, along drainage channels.	Moderate	Possible – the species has been recorded in the general area and there is suitable habitat present within the Survey Area.	NM
Brassicaceae	<i>Menkea draboides</i>		P3	Prostrate, spreading annual, herb, to 0.6 m wide. Flowers white/cream, Aug to Sep. Red sand or clay, granite. Closest record: seven km north of Meekatharra.	Moderate	Likely – the species has been recorded within 10 km of the Survey Area and there is suitable habitat present within the Survey Area.	NM, TPFL, WAHERB
Celastraceae	<i>Stackhousia clementii</i>		P3	Dense broom-like perennial, herb, to 0.45 m high. Flowers green/yellow/brown. Skeletal soils. Sandstone hills.		Known – the species was recorded during the GHD field survey.	NM, WAHERB
Chenopodiaceae	<i>Maireana prosthocochaeta</i>		P3	Open, densely-leaved shrub, 0.3 to 0.6 m high. Laterite. Hills, salty places.	Moderate	Possible – the species has been recorded in the general area and there is suitable habitat present within the Survey Area.	NM
Chenopodiaceae	<i>Tecticornia cymbiformis</i>	V	P3	Erect, perennial shrub, 0.3 to 0.5 m high. Saline soils. Along the edge of creeklines	Moderate	Possible – the species has been recorded in the general area and there is suitable habitat present within the Survey Area.	NM
Colchicaceae	<i>Wurmbea sp. Denham Pool (F. Hort et al. 2216)</i>		P1	Erect, single stemmed plant to 0.15 m high. Flowers white/pink, Apr. Moist red sandy clay. Drainage line, flat, riverbank.	Moderate	Possible – the species has been recorded in the general area and there is suitable habitat present within the Survey Area.	NM

Family	Taxon	Status		Description and closest record information (if available) (WA Herbarium 1998–; DotE 2013)	Efficacy of field survey	Likelihood of occurrence	Source
		EPBC Act	WC Act/ DPaW				
Euphorbiaceae	<i>Beyeria lapidicola</i>		P1	Erect, straggly shrub, 0.6 to two metres high. Flowers green, Jul. Dry yellow/brown sandy loam over ironstone, red-orange sandy clay, fine gravel. Iron outcrop/ breakaway on midslopes of range, banded ironstone formation, dry creek bed.	Moderate	Possible – the species has been recorded in the general area and there is a small amount of suitable habitat present within the Survey Area.	NM
Fabaceae	<i>Acacia sclerosperma</i> subsp. <i>glaucescens</i>		P3	Spreading shrub, one to three metres high, branchlets puberulous, sometimes glabrous. Flowers yellow, Jul to Aug. Sand, sandy loam, stony soils.	Moderate	Likely – the species has been recorded in the area and there is suitable habitat present within the Survey Area.	NM
Fabaceae	<i>Acacia speckii</i>		P4	Bushy, rounded shrub or tree, 1.5 to three metres high. Rocky soils over granite, basalt or dolerite. Rocky hills or rises. Closest record: S of Meekatharra (c. 500 m south of the Survey Area) (1957).	Moderate	Possible – the species has been recorded within 10 km of the Survey Area and there is a small amount of suitable habitat present within the Survey Area.	NM, WAHERB
Fabaceae	<i>Indigofera</i> sp. <i>Gilesii</i> (M.E. Trudgen 15869)		P3	Spindly thorny shrub, one to two metres high. Flowers pink, red, May-Jun, Aug. Red/brown skeletal soils, ironstone pebbles/gravel, sandstone, granite. Gorge, gully, hilltop, creekline, sandplain.	Moderate	Possible – the species has been recorded in the general area and there is a small amount of suitable habitat present within the Survey Area.	NM
Fabaceae	<i>Mirbelia stipitata</i>		P3	Spiny shrub, ca 0.6 m high. Flowers Aug. Red sandy loam	Moderate	Possible – the species has been recorded in the general area and there is suitable habitat present within the Survey Area.	NM

Family	Taxon	Status		Description and closest record information (if available) (WA Herbarium 1998–; DotE 2013)	Efficacy of field survey	Likelihood of occurrence	Source
		EPBC Act	WC Act/ DPaW				
Goodeniaceae	<i>Goodenia berringbinensis</i>		P4	Ascending annual, herb, 0.1 to 0.3 m high. Flowers yellow, Oct. Red sandy loam. Along watercourses.	Moderate	Possible – the species has been recorded in the general area and there is suitable habitat present within the Survey Area.	NM
Lamiaceae	<i>Dicrastylis mitchellii</i>		P1	Shrub, to about 0.3 m high. Sand or clay soils. Around dunes. Closest record: 11 km north of the Survey Area (1981).	Moderate	Possible – the species has been recorded in the general area and there is a small amount of suitable habitat present within the Survey Area.	NM, WAHERB
Lamiaceae	<i>Hemigenia exilis</i>		P4	Erect, multi-stemmed shrub, 0.5 to two metres high. Flowers blue-purple/white, Apr or Sep to Nov. Laterite. Breakaways, slopes.	Moderate	Possible – the species has been recorded in the general area and there is suitable habitat present within the Survey Area.	MRWA
Lamiaceae	<i>Hemigenia virescens</i>		P3	Erect, compact shrub, 0.2 to 0.4 m high, 0.4 to 0.6 m wide. Fl, white, purple, Jul, Aug. Brown rocky sand, banded ironstone gravel, yellow/red sandy clay, shallow loam. Hillside, rangeland, sand banks.	Moderate	Possible – the species has been recorded in the general area and there is suitable habitat present within the Survey Area.	NM
Lamiaceae	<i>Pityrodia augustensis</i>	V	T	Bushy shrub, ca one metre high. Flowers purple/purple-red, Aug to Sep. Amongst rocks on slopes or in drainage lines. This species occurs in rocky hillsides in the Mt Augustus area. The closest record of this species is approximately 300 km north-west of the Survey Area.	Moderate	Unlikely – the Survey Area is outside the known range of this species.	EPBC

Family	Taxon	Status		Description and closest record information (if available) (WA Herbarium 1998–; DotE 2013)	Efficacy of field survey	Likelihood of occurrence	Source
		EPBC Act	WC Act/ DPaW				
Lamiaceae	<i>Prostanthera ferricola</i>		P3	Erect, openly-branched shrub, 0.3 to one metre high. Shallow red-brown skeletal sandy loam on banded ironstone, laterite, basalt or quartz. Gently inclined mid to upper slopes of hills, rocky crests, outcrops. Closest record 15 km south of the Survey Area (2008).	Moderate	Possible – the species has been recorded in the general area and there is a small amount of suitable habitat present within the Survey Area.	NM, WAHERB
Malvaceae	<i>Sida picklesiana</i>		P3	Shrub, 0.4-0.8 m high, 0.9 to one metre wide. Fl, yellow, Apr, Aug, Nov-Dec. Sandy loam with quartz and ironstone gravel, brown stony clay. Granite breakaway, upperslopes, ridge, edge of creekline.	Moderate	Possible – the species has been recorded in the general area and there is a small amount of suitable habitat present within the Survey Area.	NM
Myrtaceae	<i>Baeckea sp. Sandstone (C.A. Gardner s.n. 26 Oct. 1963)</i>		P3	Upright shrub, ca one metre high. Flowers white, Oct. Orange sand. Flats.	Moderate	Possible – the species has been recorded in the general area and there is suitable habitat present within the Survey Area.	NM
Myrtaceae	<i>Calytrix uncinata</i>		P3	Shrub, 0.3 to one metre high. Flowers white, Aug to Nov. White or red sand, sandy clay. Granite or sandstone breakaways, rocky rises. Closest record: three km north of the Survey Area.	Moderate	Known – the species was recorded during the GHD field survey.	NM, WAHERB
Myrtaceae	<i>Calytrix verruculosa</i>		P3	Shrub, 0.4 to 0.75 m high. Flowers pink/white, Aug or Oct. Sandy clay. Closest record: Yoothapina Station, c. 15 km NNW of Meekatharra (1986)	Moderate	Possible – the species has been recorded in the general area and there is suitable habitat present within the Survey Area.	NM, TPFL, WAHERB

Family	Taxon	Status		Description and closest record information (if available) (WA Herbarium 1998–; DotE 2013)	Efficacy of field survey	Likelihood of occurrence	Source
		EPBC Act	WC Act/ DPaW				
Myrtaceae	<i>Euryomyrtus inflata</i>		P3	Shrub, 0.3 to 0.7 m high, leaves dull green, fruits erect. Flowers white-pink, Jun to Jul. Deep red sand. Flat plain. Closest record: 13 km south of the Survey Area.	Moderate	Possible – the species has been recorded in the general area and there is suitable habitat present within the Survey Area.	NM, WAHERB
Myrtaceae	<i>Homalocalyx echinulatus</i>		P3	Shrub, 0.45 to one metre high. Flowers pink, Jun to Sep. Laterite. Breakaways, sandstone hills.	Moderate	Possible – the species has been recorded in the general area and there is a small amount of suitable habitat present within the Survey Area.	NM, WAHERB
Poaceae	<i>Neurachne lanigera</i>		P1	Tufted perennial, grass-like or herb, 0.15-0.3 m high. Flowers other, Jul to Aug or Oct. Red sand, laterite. Rocky outcrops, plains.	Moderate	Possible – the species has been recorded in the general area and there is suitable habitat present within the Survey Area.	NM
Polygalaceae	<i>Comesperma viscidulum</i>		P4	Shrub, to ca 0.7 m high. Yellow sand, loam, gravel, red sand. Dune, flat, high in landscape, gently undulating terrain, sandstone breakaway.	Moderate	Possible – the species has been recorded in the general area and there is a small amount of suitable habitat present within the Survey Area.	MRWA
Proteaceae	<i>Grevillea inconspicua</i>		P4	Intricately branched, spreading shrub, 0.6 to two metres high. Flowers white/pink-white, Jun to Aug. Loam, gravel. Along drainage lines on rocky outcrops, creeklines. Closest record: Meekatharra airport (1990).	Moderate	Likely – the species has been recorded within 10 km of the Survey Area and there is suitable habitat present within the Survey Area.	NM, TPFL, WAHERB

Family	Taxon	Status		Description and closest record information (if available) (WA Herbarium 1998–; DotE 2013)	Efficacy of field survey	Likelihood of occurrence	Source
		EPBC Act	WC Act/ DPaW				
Rhamnaceae	<i>Stenanthemum mediale</i>		P1	Erect shrub, ca 0.35 m high, leaves entire. Flowers Apr to Aug. Red clayey sand.	Moderate	Possible – the species has been recorded in the general area and there is suitable habitat present within the Survey Area.	MRWA
Rutaceae	<i>Drummondita miniata</i>		P3	Divaricately branched shrub, 0.5 to two metres high. Flowers orange-red, Jul to Aug or Nov. Laterite. Breakaways. Closest record: two km east of Meekatharra (2003).	Moderate	Likely – the species has been recorded within 10 km of the Survey Area and there is suitable habitat present within the Survey Area.	NM, WAHERB
Scrophulariaceae	<i>Eremophila anomala</i>		P1	Shrub. Flowers white, Aug to Sep. Basalt outcrop.	Moderate	Unlikely – the species has been recorded in the general area, but there is no suitable habitat present within the Survey Area.	NM
Scrophulariaceae	<i>Eremophila arguta</i>		P1	Perennial, prostrate shrub, 0.3 m high, 0.5 m wide. Flowers purple, blue, May, Nov. Brown sand. Floodplain, road verge, limestone rise, creek.	Moderate	Possible – the species has been recorded in the general area and there is a small amount of suitable habitat present within the Survey Area.	MRWA
Scrophulariaceae	<i>Eremophila congesta</i>		P1	Upright shrub, to 1.2 m high. Flowers purple-blue, Aug to Sep. Lateritic outcrops in greenstone hills, stony quartzite slopes. Closest record: 2.5 km N of Goldfields Hwy (2005).	Moderate	Known – the species was recorded during the GHD field survey.	NM, TPFL, WAHERB

Family	Taxon	Status		Description and closest record information (if available) (WA Herbarium 1998–; DotE 2013)	Efficacy of field survey	Likelihood of occurrence	Source
		EPBC Act	WC Act/ DPaW				
Scrophulariaceae	<i>Eremophila fasciata</i>		P3	Erect shrub, 0.6 to 0.9 m high. Flowers blue-violet, Aug. Stony hill. Closest record: one km south of the Survey Area (1961)	Moderate	Likely – the species has been recorded in the area and there is suitable habitat present within the Survey Area.	NM, WAHERB
Scrophulariaceae	<i>Eremophila gracillima</i>		P3	Low flat shrub, ca 0.3 m high, 1.2 m wide. Flowers blue, Sep. Stony flats.	Moderate	Possible – the species has been recorded in the general area and there is suitable habitat present within the Survey Area	MRWA
Scrophulariaceae	<i>Eremophila retropila</i>		P1	Spreading shrub, 0.7 to 1.7 m high, to 4.2 m wide. Flowers purple-red-white, Aug to Sep. Gravelly loam. Stony flats. Closest record: 3.5 km S of Meekatharra (2001)	Moderate	Likely – the species has been recorded in the area and there is suitable habitat present within the Survey Area.	NM, TPFL, WAHERB
Zygophyllaceae	<i>Tribulus adelacanthus</i>		P3	Prostrate herb, plants villous; leaflet pairs three to six; fruits 5-winged, lacking spines, 10 to 14 mm high. BIF and haematite outcrop. Closest record: 15 km S of the Survey Area (2006).	Moderate	Possible – the species has been recorded in the general area and there is a small amount of suitable habitat present within the Survey Area.	NM, WAHERB

Legend:

V Vulnerable

P Priority

EPBC Act *Environment Protection and Biodiversity Conservation Act 1999*

WC Act *Wildlife Conservation Act 1950*

DPaW Department of Parks and Wildlife

MRWA Main Roads Western Australia

Sources: TPFL (DPaW); EPBC (DotE 2013e); NM - Naturemap (DPaW 2007–); WAHERB (DPaW); MRWA (data supplied by MRWA)

Refer to Appendix A for conservation code descriptions.