Appendix B (i)

Environmental Referral, North West Infrastructure Multi User Iron Ore Export (Landside) Facility

Flora, Vegetation and Mangal Studies (Woodman 2011a)

COFFEY ENVIRONMENTS

NORTH WEST IRON ORE ALLIANCE
PORT PROJECT

FLORA, VEGETATION AND MANGAL STUDIES

July 2011

woodmanenvironmentalconsulting

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1. INTRODUCTION

1.1 Description of Project and Survey Area

The North West Iron Ore Alliance (NWIOA) was formed in 2007 by three emerging iron ore companies (Atlas Iron Limited, Brockman Resources Limited and FerrAus Limited). Each company has assets in the Pilbara region of Western Australia, and a shared interest in promoting the development of a vibrant junior iron ore mining and export industry in this world-class iron ore mining province.

NWIOA are investigating options for development of a Port Project in Port Hedland. As part of the Environmental Impact Assessment (EIA) process for the Project, Coffey Environments (Coffey) commissioned Woodman Environmental Consulting Pty Ltd (Woodman Environmental) to conduct a flora, vegetation and mangal assessment of the NWIOA Port Project.

The majority of the current project area was surveyed and mapped in 2010 (Woodman Environmental *in prep*. 2011). Since this time, additional areas were added to the project area to expand the footprint, and further survey work was conducted during 2011 to obtain information in these areas. In addition, the project area has been split into two study areas: the Port Area and the Rail Area. This report presents information in relation to the Port area only. This area will be referred to as the 'survey area' for the purposes of this report, the outline of which is presented in Figure 5.

Floristic Community Type (FCT) analysis has been conducted using data relevant to the Port area. Hence the original mapping of FCTs has been revised and new FCTs, based on the combined datasets, adopted for this report. This survey area partially overlaps and adjoins the Atlas Iron Turner River Hub (TRH) project area, for which flora and vegetation surveys have been conducted by Woodman Environmental. This TRH data has been used to assist with, and refine, FCT mapping for the NWIOA Port Project.

The flora, vegetation and mangal survey for the NWIOA Port Project is a Level 2 survey as defined by the Environmental Protection Authority's (EPA) Guidance Statement No. 51 (EPA 2004). The level of survey required was determined from Table 2 of Guidance Statement No. 51 (EPA 2004), where the Bioregion Group is defined as Group 2, and the nature of the impact considered to be 'Moderate'.

A Level 2 survey consists of background research and reconnaissance survey, followed by either a detailed or comprehensive survey. For the purposes of this study, a detailed survey was required to enhance the level of knowledge at the local level and to relate this to regional data where possible. The purpose of the background research study was to review known information relevant to the survey area through all sources of literature available. The results of the background research study are presented in Section 2 of this report, with the results of the detailed survey of the survey area presented in Section 4.

1.2 Aims

The aim of this study was to determine flora and vegetation values that may be impacted by the Project within the Port survey area. The information collected during the survey will assist NWIOA in their decision-making with regard to minimising the potential impacts of project development activities to the flora, vegetation and mangal values of the survey area.

The tasks required to meet this aim were:

- Review all existing literature relating to flora, vegetation and other environmental factors relevant to the survey area;
- Establish a series of 50 m x 50 m non-permanent quadrats and detailed flora and vegetation recording sites throughout all discernible plant communities within the survey area;
- Undertake statistical analysis to define FCTs within the survey area;
- Map the distribution of FCTs within the survey area;
- Search for flora species, including Declared Rare Flora (DRF), Priority Flora and introduced taxa that may be present within the survey area;
- Provide a report and map presenting FCTs, Conservation Significant (CS) flora taxa, introduced flora taxa and vegetation condition within the survey area; and
- Provide an assessment of the potential impacts of the Project on FCTs and any CS flora taxa located within the survey area.

2. BACKGROUND

2.1 Climate

The survey area is located within the Pilbara region in the Arid Zone of Western Australia, and is classified as desert due to low, erratic rainfall (Beard 1990). The Pilbara region experiences an arid tropical climate with predominantly summer rainfall (Beard 1990), and is strongly influenced by summer cyclones. The prevalence of such cyclonic events results in the Pilbara receiving slightly higher average annual rainfall (250 - 300 mm) than the remainder of the Arid Zone.

Figure 1 displays average monthly maximum and minimum temperatures, and average monthly rainfall, recorded for Port Hedland Airport, the nearest meteorological station to the survey area (Bureau of Meteorology 2011). The temperature data is averaged over the years 1948 – 2011, and the rainfall data is averaged over the years 1942 – 2011.

The average daily maximum temperatures at Port Hedland Airport peak in March (36.8 °C), however the average temperature is above 36 °C for the period November – March. The lowest average minimum temperature is experienced in July. The average annual rainfall for this station is 314.4 mm. Average monthly rainfall peaks in summer, particularly February – March, with rainfall strongly influence by tropical cyclones, which generally form between December to April (Bureau of Meteorology 2011).

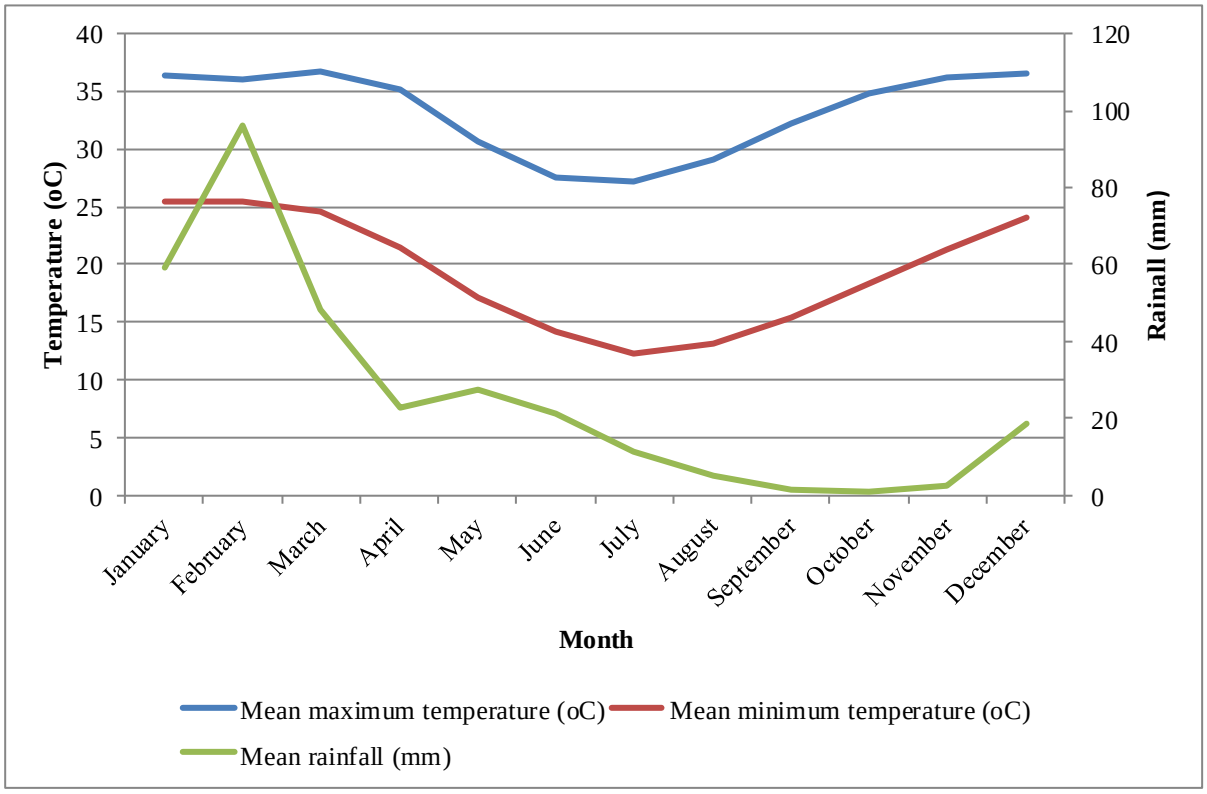

Figure 1: Average Maximum and Minimum Temperatures (° Celsius) and Average Rainfall (mm) for Port Hedland Airport (Bureau of Meteorology 2011)

2.2 Soils and Landforms

The survey area is located in the Pilbara region (Fortescue Botanical District), within the Eremaean Botanical District as defined by Beard (1990). This region is formed of a basement of Archaean rocks, overlain by massive deposits of Proterozoic sediments and volcanics. The landscape is generally mountainous, rising to 1250 m, with hard alkaline red soils on plains and pediments, and shallow and skeletal soils on ranges (Beard 1990). The survey area traverses one physiographic region, the Abydos Plain, as defined by Beard (1975).

The Abydos Plain is alluvial in origin near the coast and of Archaean granite origin further inland. It consists of a variety of features including alluvial plains, pediplains, low stony hills and dissected pediments, low granite outcrops and tors, and basic dykes. The main soils are hard alkaline red soils, some areas with coarse textured A horizons to 45 cm thick, while other areas have shallow stony A horizons. Patches of calcrete also occur. On the eastern part of the plain near the De Grey River, the soils are chiefly neutral and acidic red earths. The alluvial plains along the coast generally consist of red earthy sands with extensive areas of red earths, and hard red soils along creek lines (Beard 1975).

Churchward and McArthur (1980) undertook a study of the soil pattern in relation to physiography and geology in the Pilbara region, within two areas: the Strelley catchment (east Pilbara, immediately west of the Shaw River) and the Gorge catchment (west Pilbara). The Strelley catchment is relevant to the survey area. In the upland sections, the Strelley catchment consists of shales, cherts, banded jaspillites, sandstones and basalts, whereas in the downstream section it is composed of granite outcropping or granite at shallow depth, overlain by alluvium.

The uplands of the Strelley catchment were described as extensively and deeply incised and mantled by shallow stony red clay soil, with laterite residuals occurring on the dissected uplands, and as isolated residuals from the plain. The piedmont zone has sediments less than 2 m thick - gravelly and stoney red clays are the most common profiles, with some gravely cracking clays. The alluvial terrain of this catchment is restricted to narrow zones, eventually widening out to an extensive plain. The pediplains consist of a gently undulating surface, with low local relief, underlain by granite. The most extensive units were described as relatively uniform areas of red earths on gentle convex divides. Eroded margins of pediplains occur extensively, with granite outcrops, quartz and dolerite dykes and pockets of calcrete common. Sandy loam sediments are found on shallow drainage lines, and are laterally continuous with terraces of the main streams (Churchward and McArthur 1980).

2.3 Regional Vegetation and Flora

2.3.1 Regional Vegetation

The survey area is located within the north-eastern section of the Pilbara IBRA Region (Interim Biogeographic Regionalisation for Australia) (Government of Australia 2005), specifically within the PIL4 – Roebourne subregion.

The vegetation of the Roebourne subregion is comprised of 'grass savannah of mixed bunch and hummock grasses, and dwarf shrub steppe of *Acacia stellaticeps* or *A. pyrifolia* and *A. inaequilatera*; uplands are dominated by *Triodia* hummock grasslands; ephemeral drainage

lines support *Eucalyptus victrix* or *Corymbia hamersleyana* woodlands; samphire, *Sporobolus* and mangal occur on marine alluvial flats and river (Kendrick and Stanely 2001).

The Pilbara IBRA Region is equivalent to the Fortescue Botanical District as defined by Beard (1975), who mapped the vegetation of the Pilbara broadly at a scale of 1:1,000,000. The Fortescue Botanical District extends northwards from the *Acacia*-dominated scrub in the south, and is determined by a major biogeographic boundary, the Acacia-Triodia line, to the north of which Spinifex vegetation is the characteristic landscape element.

The survey area occurs within the Abydos Plain physiographic region, within the Fortescue Botanical District (Beard 1975). The Abydos Plain is characterised by four broad vegetation associations:

- **Shrub steppe** - the main community of the granite plain, dominated by the *Acacia pyrifolia-Triodia pungens* association with hummock grasses and dotted with widely-spaced shrubs. The plain is broken by stony rises and hills with small ranges, with *Triodia pungens* usually replaced by *T. wiseana*, *T. longiceps* or *T. angusta*, and scattered shrubs. Larger ranges tend to possess little else but *Triodia*, with only a few scattered shrubs. Major creeks and rivers are wooded with *Eucalyptus camaldulensis* and *Melaleuca leucadendron* (considered synonymous with *M. argentea*);
- **Dwarf-shrub steppe** - occurs on the seaward margin of the granite plain between the Sherlock and Strelley Rivers. This association has extensive sandplains dominated by dwarf-shrub steppe, where the general cover is *Triodia pungens* interspersed with numerous very low shrubs of *Acacia translucens* (considered synonymous with *A. stellaticeps*);
- **Grass plains** - occur where finer-grained alluvium has been deposited. These plains are often dominated by a single or a few grass species. The grass community is closed, unlike the open hummock grasslands occurring with shrub steppe and dwarf-shrub steppe; and
- **Coastal Complex** – the Abydos Plain slopes gently towards the sea, and there is a 5 – 10 km wide belt which is under the influence of tides; between the sea and the grass and spinifex-covered plains, there is a belt of bare mud which is covered by the highest spring tides, which is hypersaline and totally devoid of vegetation. Along the seaward margins mangrove of *Avicennia marina* and *Rhizophora mucronata* occurs on the creeks and inlets, with occasional samphire communities. Low limestone ridges occur along the coast near Port Hedland; covered with dwarf-shrub steppe of *Triodia pungens* and *Acacia translucens*.

Vegetation system associations have been mapped and described by the Department of Environment and Conservation (DEC) (2007a), based on earlier work undertaken by Shepherd *et al.* (2002) and Beard (1975). The survey area traverses four vegetation system associations as summarised in Table 1. Table 1 also presents the current extent of each vegetation association in relation to pre-European extent and the extent occurring in lands managed by the DEC, including conservation reserves (DEC 2007a). With the exception of Abydos Plain 43, all the vegetation system associations remain at or just below their pre-European extents. However, very little of each association is reserved in conservation estate (Table 1).

Table 1: Extent of Vegetation Associations within the Survey Area (DEC 2007a)

Vegetation System Association	Description	Current Extent (ha)	Pre-European Extent Remaining (%)	Current Extent Reserved in DEC-Managed Lands (%)
Abydos Plain 43	Low forest; mangroves (Kimberley) or thicket; mangroves (Pilbara)	179,517	82.8	22.5
Abydos Plain 127	Bare areas; mud flats	719,966	96.9	8.07
Abydos Plain 589	Mosaic: Short bunch grassland - savanna / grass plain (Pilbara) / Hummock grasslands, grass steppe; soft spinifex	809,636	99.9	1.6
Abydos Plain 647	Hummock grasslands, dwarf-shrub steppe; Acacia translucens over soft spinifex	196,371	100.0	0.0

In 2004, the Department of Agriculture described vegetation site types within the Pilbara IBRA region based on general ecological information, vegetation physiognomy and composition, patterns of variation, conservation status, gradational association and land system representation (Van Vreeswyk *et al.* 2004). The survey area is located within two land systems, of which the Littoral land system is the most regionally dominant (Table 2).

Table 2: Land Systems Located Within the Survey Area (Van Vreeswyk *et al.* 2004)

Land System	Mapped Extent (ha)	Description of Land System
Uaroo	7 681	Broad sandy plains supporting shrubby hard and soft spinifex grasslands
Littoral	157 700	Bare coastal mudflats with mangroves on seaward fringes, samphire flats, sandy islands, coastal dunes and beaches.

The DEC Threatened Ecological Communities (TEC) and Priority Ecological Communities (PEC) database was interrogated for information regarding any occurrences of TECs or PECs within or in the immediate vicinity of the survey area (DEC 2010a). There are no known occurrences of TECs or PECs within a 50 km radius of the survey area.

Two TECs are known from the Pilbara, TEC 46 – *Themeda* Grasslands and TEC 78 – Ethel Gorge Aquifer Stygobiont Community. Both of these TECs are associated with the Hamersley Range area, located over 100 km to the south of the survey area (DEC 2010c). It is considered highly unlikely that either of these TECs would occur within the survey area. Appendix A presents definitions of categories and criteria for TECs and PECs (DEC 2007b).

The DEC has undertaken a biodiversity survey of the Pilbara IBRA biogeographic region, with fieldwork conducted over the years 2002-2007 (McKenzie *et al.* 2009). The project sampled various organisms from 422 terrestrial sites, 98 sites on water bodies and 508 boreholes which were spread across the region. The study included 304 terrestrial biodiversity sample sites (sampling vertebrates, invertebrates, and perennial and annual vascular plants), with an additional 118 sites added subsequently to focus on sampling flora

only. The sites were located so that all major geological formations, landform types, soil, climate and vegetation types were included in the study. The survey was conducted during two sampling times, commencing April 2004 and April 2006. A number of the terrestrial sites occurred in the general vicinity of the survey area, however as the floristic data collected in this study is currently being analysed and interpreted, no results are available at this stage.

2.3.2 Regional Flora

The DEC DRF and Priority Flora databases were interrogated for information regarding conservation significant taxa (CS flora taxa) known from within or in the immediate vicinity of the entire Atlas survey area (DEC 2010b). As this database search area included both the Atlas Mt Dove and larger Turner River Hub Study Area (consisting of a corridor and associated mining prospects stretching approximately 150 km south-southwest from Port Hedland), records returned may be up to 100 km from the survey area.

During this database search, the Western Australian Herbarium (WAHerb) specimen database, the Declared Endangered Flora List (DEFL) database and the Declared Rare and Priority Flora lists were interrogated. The former two databases give specific data on locations of collections (WAHerb database) and submitted records of (DEFL database) conservation significant flora taxa. The Declared Rare and Priority Flora list provides information on taxa known to occur in the general region of the survey area. A total of 16 CS flora taxa were returned from this search. Appendix B presents definitions of conservation status codes (Smith 2010).

A NatureMap search, incorporating WAHerb and DEFL data, was performed for a central point located at 20^{o} 22’ 23” S and 118^{o} 31’ 41” E (with a 20 km buffer zone), to provide more up to date information (DEC 2011b). A total of 285 plant taxa are known from this area, from 43 families and 144 genera. Of these, 24 were introduced (weed) taxa, and six were conservation significant taxa:

- *Gomphrena pusilla* (P2)
- *Ptilotus appendiculatus* var. *minor* (P1)
- *Gymnanthera cunninghamii* (P3)
- *Heliotropium muticum* (P1)
- *Tephrosia rosea* var. *venulosa* (P1)
- *Goodenia nuda* (P4)

The taxa returned as a result of both of these searches are presented in Table 3, with those shaded yellow the most likely to occur within the study area (as a result of the NatureMap search).

Table 3: Results of the Interrogation of the Department of Environment and Conservation’s Threatened Flora Databases (DEC 2010b; DEC 2011b)

Taxon	Status	Description	Known Locations
Abutilon pritzelianum	P1	Erect shrub to 2.5 m high, flowers yellow/orange, August. Sand dunes and sand plains	Turner River crossing on Great Northern Highway
Acacia glaucocaesia	P3	Dense shrub or tree to 6 m, flowers yellow, July-September. Floodplains	Known from near the Shaw River and Whim Creek

Taxon	Status	Description	Known Locations
Acacia leeuweniana	P1	Tree to 14 m high with minni ritchi bark, flowers yellow, May. Granite outcrops	Obstinate Creek and Woodstock Station
Acacia levata	P3	Spreading shrub to 3 m high, flowers yellow, May. Granite outcrops and hill slopes	Woodstock Station
Bulbostylis burbidgeae	P4	Tufted, erect to spreading annual sedge to 0.25 m high, flowers brown, March/June-August. Outcrops, cliff bases	Abydos/Woodstock Reserve and Lalla Rookh Homestead, FMG Rail Corridor; Hope Downs Railway Corridor
Eremophila forrestii subsp. *viridis*	P3	Shrub to 1 m high, flowers pink/cream, August. Slopes and ridges	Coondewanna Hill, Hamersley Ranges
Euphorbia clementii	P2	Erect herb to 0.6m high, flowers green/white, May-June. Stony ground	Wodgina LNG pipeline, Abydos DSO project area
Gomphrena pusilla	P2	Annual herb to 0.2 m high, flowers white/pink, March-June. Beach foredunes on limestone	Port Hedland townsite and Finucane Island (near Boodarie Stockyard area)
Goodenia nuda	P4	Erect herb to 0.5 m high, flowers yellow, April-August. Flood plains, drainage lines	FMG Cloudbreak Mine
Gymnanthera cunninghamii	P3	Erect shrub to 2m high, flowers cream/yellow/ green, January-December. Variety of soils	Port Hedland townsite and Boodarie Station, Woodstock Station, FMG Rail Corridor; Hope Downs Railway Corridor
Heliotropium muticum	P1	Ascending to spreading perennial herb to 0.3m high, flowers white, May – August. Rocky plains	Pippingarra Station, Abydos DSO project area
Nicotiana umbratica	P3	Erect annual or short-lived perennial herb to 0.7 m high, flowers white, April – June. Granite outcrops and cliffs	Abydos Station and Woodstock Station
Polymeria distigma	P3	Prostrate trailing herb, flowers pink, July. Sandy areas, plains	Mundabullangana Station
Ptilotus appendiculatus var. *minor*	P1	Prostrate or ascending perennial herb to 0.2 m high, flowers white, September. Floodplain	Boodarie Station
Tephrosia andrewii	P1	Ascending shrub to 0.8 m high, flowers orange, September-October. Sand plains	Sandfire Roadhouse
Tephrosia rosea var. *venulosa*	P1	Erect shrub to 1.7 m high, flowers red/purple, August-September. Sand dunes, creek lines	Finucane Island

A search of the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) database, with regard to environmental matters of national significance as listed under the *Environmental Protection and Biodiversity Conservation Act 1999*, was performed for the survey area on 24th June 2011 (DSEWPC 2011). The results of this search indicate that no nationally listed threatened flora species are known from the survey area. However, the search indicated that four significant invasive taxa (or habitat for such taxa) potentially occur (likely or may occur) within the survey area. These species were *Cenchrus ciliaris*, *Parkinsonia aculeata, Prosopis* spp. and *Salvinia molesta*.

Parkinsonia aculeata, *Prosopis* spp. and *Salivinia molesta* are listed as a Declared Plant for the whole of Western Australia under the *Agriculture and Related Resources Protection Act 1976* (Department of Agriculture and Food 2011). They are classified as P1, where the movement of plants or their seeds within the state, including on contaminated machinery and

produce, is prohibited. These taxa are also classified as P2 for the Port Hedland and East Pilbara municipal districts (where the survey area is located), whereby all plants must be treated to destroy and prevent propagation each year until no plants remain (Department of Agriculture and Food 2011). *Parkinsonia aculeata*, *Prosopis* spp. and *Salvinia molesta* are also listed as Weeds of National Significance (Thorp & Lynch 2000), and are under national management for the purpose of restricting their spread and eradicating them from parts of Australia.

Cenchrus ciliaris (Buffel Grass) is not listed as a Declared Plant in Western Australia (Department of Agriculture and Food 2011) but is considered by the States and Territories to pose a particularly significant threat to biodiversity as it is particularly invasive under certain conditions (Hussey *et al.* 1997; DSEWPC 2011).

In Western Australia, these four taxa are all listed under the then Department of Conservation and Land Management's (CALM) Environmental Weed Strategy for Western Australia (CALM 1999), with *C. ciliaris* and *S. molesta* ranked 'High', *P. aculeata* 'Moderate' and *Prosopis* spp. 'Mild' or 'Low' (depending on the individual taxon). This Strategy assesses and ranks environmental weeds in terms of their environmental impact on biodiversity. Each weed species is ranked according to three criteria; invasiveness, distribution and environmental impact, and is assigned a score of 'High', 'Moderate', 'Mild' or 'Low'. Appendix C provides the description of each rating in the Environmental Weed Strategy for Western Australia.

The introduced taxa returned from the NatureMap search (DEC 2011b) are presented in Table 4. Table 4 also presents introduced flora taxa returned from the NatureMap interrogation of the entire Atlas survey area performed in February 2010 (DEC 2010e). Those highlighted in yellow were returned during the survey area specific search (DEC 2011b), and are therefore more likely to occur in the survey area. A total of 32 introduced taxa are presented in Table 4.

Table 4: Database Information Relating to Introduced Taxa Known to Occur Within or in the Vicinity of the Survey Area (DEC 2010d; DEC 2011b)

Taxon	Common Name	Comments
Aerva javanica	Kapok Bush	Rated as 'High' for priority for control and research (CALM 1999)
Andropogon gayanus	-	-
Argemone ochroleuca subsp. *ochroleuca*	Mexican Poppy	Rated as 'Mild' for priority for control and research (CALM 1999)
Bidens bipinnata	Beggar-tick	-
Cenchrus ciliaris	Buffel Grass	Federally recognised as being highly invasive and pose a significant threat to biodiversity Rated as 'High' for priority for control and research (CALM 1999)
Chloris barbata	Purpletop Chloris	Rated as 'Low' for priority for control and research (CALM 1999)
Chloris virgata	Feathertop Rhodes Grass	Rated as 'Low' for priority for control and research (CALM 1999)
Coccinia grandis	-	-
Desmodium scorpiurus	-	-
Digitaria ciliaris	Summer Grass	Rated as 'Low' for priority for control and research (CALM 1999)

Taxon	Common Name	Comments
Euphorbia tirucalli	-	Rated as 'Low' for priority for control and research (CALM 1999)
Flaveria trinervia	Speedy Weed	-
Gomphrena celosioides	Gomphrena weed	Rated as 'Low' for priority for control and research (CALM 1999)
Gossypium hirsutum	Upland Cotton	Rated as 'Low' for priority for control and research (CALM 1999)
Indigofera oblongifolia	-	Rated as 'Moderate' for priority for control and research (CALM 1999)
Indigofera sessiliflora	-	-
Jatropha gossypiifolia	Bellyache Bush	Declared Plant (P1 for whole of state, P4 for Port Hedland and East Pilbara municipal districts including survey area) Rated as 'Moderate' for priority for control and research (CALM 1999)
Lamarckia aurea	Goldentop	Rated as 'Moderate' for priority for control and research (CALM 1999)-
Leptochloa fusca subsp. uninervia	-	-
Leucaena leucocephala	Leucaena	Rated as 'Moderate' for priority for control and research (CALM 1999)-
Parkinsonia aculeata	Parkinsonia	Weed of National Significance; Declared Plant (P1 for whole of state, P2 for Port Hedland and East Pilbara municipal districts including survey area) Rated as 'Moderate' for priority for control and research (CALM 1999)
Paspalum fasciculatum	-	Rated as 'Low' for priority for control and research (CALM 1999)
Pennisetum setaceum	Fountain Grass	Rated as 'Mild' for priority for control and research (CALM 1999)
Portulaca oleracea	Purslane	-
Pupalia lappacea	-	Rated as 'Mild' for priority for control and research (CALM 1999)
Senna occidentalis	-	Rated as 'Moderate' for priority for control and research (CALM 1999)
Setaria sphacelata	South African Pigeon Grass	Rated as 'Mild' for priority for control and research (CALM 1999)
Setaria verticillata	Whorled Pigeon grass	Rated as 'Low' for priority for control and research (CALM 1999)
Stylosanthes guianensis	Stylo	Rated as 'Mild' for priority for control and research (CALM 1999)
Trianthema portulacastrum	Giant Pigweed	Rated as 'Moderate' for priority for control and research (CALM 1999)
Tribulus terrestris	Caltrop	-
Vachellia farnesiana	Mimosa Bush	Rated as 'High' for priority for control and research (CALM 1999)

Of these taxa, *Parkinsonia aculeata* (Weed of National Significance and Declared Plant), and the highly invasive *Cenchrus ciliaris* were returned. Additionally, the Declared Plant *Jatropha gossypiifolia* was also returned. Under the *Agriculture and Related Resources Protection Act 1976*, this species is classified as P1 for the whole of Western Australia and P4 for the Port Hedland and East Pilbara municipal districts (whereby infestations must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery) (Department of Agriculture and Food 2011).

2.4 Local Flora and Vegetation Surveys

Several detailed surveys have been undertaken within and in the vicinity of the survey area, describing detailed plant communities based on species composition and vegetation structure. The surveys involved linear footprints extending southward from the port area at Port Hedland, and of the port area itself.

These studies include:

- Epic Energy Pty Ltd Wodgina LNG Pipeline (Woodman Environmental 2001);
- Hope Downs Railway Corridor (Biota Environmental Sciences and Trudgen 2002);
- Fortescue Metals Group North South Railway Corridor (Biota Environmental Sciences 2004);
- Ferro Metals Australia (FMA) Balla Balla Magnetite Project (Mattiske Consulting 2008);
- Port Hedland Harriet Point Dredging Approvals (Biota Environmental Sciences 2008a);
- Utah Point Berth Development (Biota Environmental Sciences 2008b); and
- Port Hedland Nelson Point Dredging Approvals (ENV Australia 2009).

Woodman Environmental (2001) undertook a flora and vegetation survey of a natural gas pipeline route linking the Wodgina minesite (adjacent to the Wodgina ROM Access Road portion of the survey area) to the PEPL (Pilbara Energy Pipeline), a distance of approximately 80 km. A total of 19 plant communities were mapped as occurring in the survey area, consisting of Open Woodlands, Shrublands and Hummock Grasslands. The terrain was predominantly flat open plain, with steep rocky hills present in the south of the survey area, and intersected by several minor ephemeral drainage lines. One plant community was considered to be locally restricted (S7). There were no plant communities recorded as being threatened (Woodman Environmental 2001).

A total of 166 plant taxa, from 116 genera and 36 families were recorded during the survey (Woodman Environmental 2001). The most species rich families were Poaceae, Fabaceae, Amaranthaceae and Malvaceae. Two introduced species, *Aerva javanica* and *Cenchrus ciliaris*, were recorded during the survey. No DRF species were recorded along the pipeline route, however two current (as of June 2011) Priority Flora taxa were recorded during the survey. These were *Euphorbia clementii* (P2) and *Phyllanthus aridus* (P3).

Biota Environmental Sciences (Biota) and Trudgen (2002) undertook a flora and vegetation survey of the Hope Downs Iron Ore rail and port facility project in 2001, for Hope Downs Management Services. The Biota and Trudgen (2002) survey area was located within or adjacent to the Port Hedland Access Road portion of the current NIOWA survey area. Terrestrial vegetation and flora was assessed from 286 permanent 50 m x 50 m quadrats, which were distributed along the current NIOWA rail corridor survey area. A total of 122 vegetation types were mapped over the survey area.

A total of 763 vascular flora taxa, belonging to 236 genera within 72 families, were recorded along the proposed Hope Downs Iron Ore rail corridor by Biota Environmental and Trudgen (2002). The most species rich families were Poaceae, Fabaceae and Malvaceae. Introduced taxa, *Cenchrus setiger*, *Cucumis melo* subsp. *agrestis*, *Echinochloa colona*, *Eragrostis minor*, *Euphorbia hirta*, *Opuntia stricta*, *Sigesbeckia orientalis*, *Sonchus oleraceus* and *Tridax procumbens*, were all recorded in areas in close proximity to the current NIOWA survey area. No DRF flora species were located during this survey, however 14 current (as of June 2011) Priority flora taxa were recorded. Of these, four Priority flora taxa are located within or in

close proximity to the current NWIOA project area: *Bulbostylis burbidgeae* (P4), *Euphorbia clementii* (P2), *Gymnanthera cunninghamii* (P3) and *Phyllanthus aridus* (P3).

Biota (2004) undertook a baseline botanical survey for the Fortescue Metals Group (FMG) port facility at Port Hedland and a connecting railway to the location of the proposed Mindy Mindy iron ore mining operation, located 345km south south-east of Port Headland. The Biota (2004) survey area was located adjacent to the Port Hedland Access Road Area of the current NIOWA survey area. The survey was undertaken in March and April 2004, with 97 permanent 50 m x 50 m quadrats established.

Of the 122 terrestrial vegetation types described by Biota (2004) over the FMG proposed railway survey area, 57 terrestrial vegetation types were mapped by Biota (2004) as occurring within the Abydos Plain region of the current NIOWA survey area. These were further grouped into separate landform types: Littoral Areas (one vegetation type; unit As, of moderate conservation significance); Sandy Areas (17 vegetation types; units Ap1, Ap2, Ap5 and Ap5 dominated by possibly restricted *Triodia* species); Stoney Plains and Hills (six vegetation types; unit Ah5a is restricted); Major Creeklines (seven vegetation types; all of moderate conservation significance); Minor Creeklines and Floodplains (19 vegetation types; those on creeklines considered to be of moderate conservation significance; units Ac21 and Ac30 also restricted); and Rocky Outcrops (seven vegetation types; all of moderate conservation significance; units Ar 5, Ar6 and Ar 7 are uncommon).

A total of 762 vascular flora taxa, from 218 genera within 69 families, were recorded (Biota 2004). The most species rich families were Poaceae, Fabaceae and Malvaceae. No DRF taxa were recorded during the study. A total of 11 introduced taxa were recorded during the survey, of which *Citrullus colocynthis*, *Datura leichhardtii*, *Malvastrum americanum, Solanum nigrum* and *Stylosanthes hamata* were recorded in areas in close proximity to the current NIOWA survey area. There were a number of flora taxa of conservation significance (including Priority flora taxa) recorded along the rail corridor, however only two of these occur within or in close proximity to the current NIOWA project area: *Bulbostylis burbidgeae* (P4) and *Gymnanthera cunninghamii* (P3).

In 2008, Mattiske Consulting conducted flora and vegetation surveys of the Port Hedland area during a linear infrastructure corridor survey for the Balla Balla Magnatite Project for Ferro Metals Australia Pty Ltd (FMA).

A total of five vegetation communities were mapped within the Port Hedland area, including two different Hummock Grassland communities of *Triodia* species with variable emergent stands of *Acacia* species; one Woodland of *Eucalyptus camaldulensis* and *E. victrix* on major creeklines and river beds; and two Shrublands of *Acacia* species on variable sandy soils. A further three mapping units defined tidal flats, open estuarine water and mangroves. None of the pipeline corridor vegetation communities mapped were representative of any TECs listed by the Department of Environment and Conservation or under the *Environment Protection and Biodiversity Conservation Act (1999)* (EPBC Act) (Mattiske 2008). The condition of vegetation along the pipeline corridor varied from completely degraded (in previously cleared areas) to degraded (grazed areas and those affected by weed infestation) to very good. Regular fires in the area had also had adverse impacts on vegetation along the pipeline corridor (Mattiske 2008).

A total of 11 introduced taxa, most notably *Cenchrus ciliaris*, were recorded in the Port Hedland area during the survey. None of the weed species were listed as Declared Plants pursuant to Section 37 of the *Agriculture and Related Resources Act* 1976 (Mattiske 2008).

Biota (2008a) undertook a flora and vegetation survey of the DMMA A area as part of the BHPBIO approvals for dredging at Harriet Point on Finucane Island in February 2008. Two vegetation units were described in the survey area:

- *Halosarcia halocnemoides* subsp. *tenuis*, (*Halosarcia indica* subsp. *leiostachya*) low open shrubland to low open heath on the saline mudflats; and
- *Triodia epactia*/*pungens*, (*Triodia secunda)* closed hummock grassland over **Cenchrus ciliaris* and *Sporobolus virginicus* open tussock to tussock grassland on the low sandy islands occurring within the saline mudflats.

A total of 24 vascular plant taxa, from 21 genera and 17 families, were recorded in the survey area. No conservation significant flora taxa were recorded, however two introduced taxa were recorded (*Cenchrus ciliaris* and *Aerva javanica*).

Biota (2008b) undertook a flora and vegetation survey, a desktop mangrove impact assessment and fauna assessment for a port development at Port Hedland (Utah Point) in April 2008. Three terrestrial vegetation units were mapped and described in the Utah Point study area:

- *Halosarcia indica* subsp. *leiostachya, H. halocnemoides* subsp. *tenuis, Muellerolimon salicorniaceum* scattered low shrubs to low open shrubland;
- *Triodia epactia, T. secunda* hummock grassland over *Eragrostis falcata, E. setifolia, Eriachne obtusa* very open tussock grassland to open tussock grassland; and
- *Acacia stellaticeps* low open shrubland over *Triodia epactia* hummock grassland over open mixed tussock grassland and closed herbland.

The vegetation condition of the area was described as Poor to Good, mainly due to the high level of industrial development in the area. A total of 110 vascular plant taxa from 77 genera and 35 families were recorded during the survey, with *Bulbostylis burbidgeae* (P3) and five introduced taxa recorded (*Cenchrus ciliaris, Cenchrus setigera*, *Chloris virgata, Aerva javanica* and *Stylosanthes hamata*). *Bulbostylis burbidgeae* (P3) was recorded in two locations on sandy island vegetation in close proximity to the Finucane Island access road.
ENV Australia (2009) undertook a flora and vegetation survey of DMMA H as part of the dredging approvals for Nelson Point in October 2008. A total of 51 taxa from 24 families and 37 genera were recorded during the survey, including *Tephrosia rosea* var. *venulosa* ms (P1) and the introduced taxa *Cenchrus ciliaris* and *Aerva javanica*. Four vegetation units were described and mapped within the survey area, including:

- Mangroves: *Avicennia marina* and *Rhizophora stylosa* closed shrubland;
- Grassland: *Acacia colei* var. *colei* (*Acacia trachycarpa*) scattered tall shrubs over *Acacia stellaticeps* (*Myoporum montanum*) low open shrubland over *Triodia epactia* hummock grassland over *Eriachne obtusa, Panicum decompositum* var. *decompositum* very open tussock grassland over an open herbland of mixed species;
- Supratidal/Saline Mudflats: *Tecticornia halocnemoides* subsp. *tenuis* (*Tecticornia indica* subsp. *leiostachya*) low open shrubland to low open heath; and

- Low Sandy Islands: *Triodia epactia/pungens* (*Triodia secunda*) closed hummock grassland over **Cenchrus ciliaris, Sporobolus virginicus* open tussock to tussock grassland.

In 2007, V & C Semeniuk Research Group (VCSRG) studied the mangroves at Utah Point on Finucane Island near Port Hedland. A suite of mangrove species occur along the arid Pilbara coastal region, with a gradient in species richness from north to south. The Port Hedland occurs towards the northern end of this species richness gradient, with Utah Point supporting six species of mangroves: *Avicennia marina, Aegialitis annulata, Aegiceras corniculatum, Bruguiera exaristata, Ceriops tagal,* and *Rhizophora stylosa* (VCSRG 2007).

The mangroves of Port Hedland harbour cover approximately 16.37 km^2, comprised dominantly of *Avicennia marina* forests, scrubs and heaths, and less abundantly *Rhizophora stylosa* forests. Utah Point mangroves encompass approximately 0.64 km^2 (4 % of the total mangrove cover of the Port Hedland harbour system) (VCSRG 2007). The mangroves of Utah Point were found to be dominated by assemblages that inhabit muddy tidal flats, with a proportion of assemblages that inhabit limestone pavements and sand bars.

VCSRG (2007) identified eight mangroves assemblages as occurring within the Utah Point area:

- *Avicennia marina* low forest to scrub on mid- high tidal flats;
- Mixed *Avicennia marina* and *Rhizophora stylosa* low forest to scrub on mid - high tidal flats;
- *Rhizophora stylosa* low forest to scrub on mid - high tidal flats;
- *Avicennia marina* scrub to open heath, grading to low heath and low open heath on high tidal flats;
- *Ceriops tagal* scrub - closed heath to open heath on high tidal flats;
- Mixed *Ceriops tagal* and *Avicennia marina* scrub and heath on high tidal flats and high tidal beaches;
- Scrub - heath to open heath of mixed *Avicennia marina, Rhizophora stylosa, Bruguiera exaristata, Ceriops tagal, Aegialitis annulata* and *locally Osbornia octodonta*, on sandy spits and beaches in the high tidal zone; and
- Mixed *Aegialitis annulata, Aegiceras corniculatum* and *Avicennia marina* on point pars, mud channel shoals, and accreting soft mid-tidal flats in the mid tidal zone.

There were no unusual assemblages or species within the mangroves of Utah Point. *Osbornia octodonta* was not found to occur in the Utah Point area (VCSRG 2007). It was noted that the mangroves of Port Hedland are not significant in terms of the species present. However the occurrence of *Osbornia octodonta* in a localised habitat on (western) Finucane Island, is regionally significant as the species is specific to a particular habitat that is not widespread in the region. *Osbornia octodonta* has not been recorded within the Port Hedland harbour as the habitats are dominated by muddy tidal flats, tidal creeks, and point bars and shoals which do not normally support this species in the Pilbara Coast environments. Whilst the mangroves may be regionally significant from the point of view of coastal productivity, they are not of scientific, global or national significance as they have ceased to be a tidal ecosystem wilderness (VCSRG 2007).

Biota Environmental Sciences and Dr Eric Paling studied the mangroves in the Port Hedland port area in 2001, during surveys for FMG. These results have been described in the Public

Environmental Review Document produced for the project by ENVIRON Australia (ENVIRON 2004).

Paling documented six species of mangroves as occurring in the Port Hedland Harbour: A*vicennia marina, Ceriops tagal*, *Rhizophora stylosa, Aegialitis annulata* and *Aegiceras corniculatum. Bruguiera exaristata* also occurs in the area but only as scattered individuals, largely in the eastern portion of the harbour. The most abundant and widespread species in the proposed development area were *Avicennia marina* (dominant or co-dominant in most assemblages in the study area) and *Rhizophora stylosa* (which formed dense stands in more seaward areas, sometimes in association with taller *A. marina*). *Ceriops tagal* was recorded less commonly, typically on eroding banks associated with South West Creek. *Aegialitis annulata* and *Aegiceras corniculatum* were largely restricted in occurrence to depositional bank areas as is typical with these species (ENVIRON 2004).

The described occurrences of mangrove assemblages within the proposed FMG port facility area were consistent with distribution patterns observed elsewhere in the region, with areas of cyanobacterial mats ('algal mats') also occurring patchily on some tidal flat areas. These mats have a documented ecological function related to nitrogen fixation and input into coastal systems, and occur throughout similar habitats along the Pilbara coastline (ENVIRON 2004).

Nine mangrove assemblages were identified within the Port Hedland harbour area during this study:

- Closed canopy woodland of *Rhizophora stylosa*;
- Closed canopy woodland of *R. stylosa* and *Avicennia marina*;
- Closed canopy woodland of *A. marina* (seaward fringe);
- Closed canopy woodland of *A. marina* (landward margins);
- Low open woodland of *A. marina* on saline flats;
- Low scattered *A. marina* and scattered samphires;
- Low, dense *Aegiceras corniculatum*;
- Low open *Ceriops tagal*; and
- Low dense *Aegialitis annulata.*

The more structurally complex, species rich and dense mangals were found to occur in areas closer to the margins of creeks, where *Rhizophora stylosa* was typically dominant or co-dominant with *Avicennia marina*. The denser taller mangrove associations in these areas comprised pure stands of *R. stylosa*, mixed *R. stylosa* and *A. marina,* or purer tall *A. marina* in a narrow band along the most seaward areas of the major creeks (ENVIRON 2004).

All mangrove associations identified were in good to very good condition, with all associations recorded found to also occur elsewhere within Port Hedland Harbour. Mangal habitats were typically backed by open to very open samphire and halophyte communities on hypersaline flats and low rises, dominated by an open to patchily dense cover of *Halosarcia halocnemoides* subsp. *tenuis, Muellerolimon salicorniaceum, Frankenia ambita* and *Sporobolus virginicus* (ENVIRON 2004).

A summary of the CS flora taxa that are either known in or within the vicinity of the survey area are listed in Table 5. This data has been compiled from data presented in Table 3, and by historical local flora surveys as detailed above. A total of 18 taxa have the potential to occur within the survey area.

Table 5: Conservation Significant Flora Taxa Known to Occur Within or in the Vicinity of the Survey Area

Taxon	Status	Description	Known Locations
Abutilon pritzelianum	P1	Erect shrub to 2.5 m high, flowers yellow/orange, August. Sand dunes and sand plains	Turner River crossing on Great Northern Highway
Acacia glaucocaesia	P3	Dense shrub or tree to 6 m, flowers yellow, July-September. Floodplains	No locations in immediate vicinity of survey area, known from near the Shaw River and Whim Creek
Acacia leeuweniana	P1	Tree to 14 m high with minni ritchi bark, flowers yellow, May. Granite outcrops	Obstinate Creek and Woodstock Station
Acacia levata	P3	Spreading shrub to 3 m high, flowers yellow, May. Granite outcrops and hill slopes	Woodstock Station
Bulbostylis burbidgeae	P4	Tufted, erect to spreading annual sedge to 0.25 m high, flowers brown, March/June-August. Outcrops, cliff bases	Abydos/Woodstock Reserve and Lalla Rookh Homestead, FMG Rail Corridor; Hope Downs Railway Corridor
Eremophila forrestii subsp. *viridis*	P3	Shrub to 1 m high, flowers pink/cream, August. Slopes and ridges	Coondewanna Hill, Hamersley Ranges
Euphorbia clementii	P2	Erect herb to 0.6m high, flowers green/white, May-June. Stony ground	Wodgina LNG pipeline, Abydos DSO project area
Gomphrena pusilla	P2	Annual herb to 0.2 m high, flowers white/pink, March-June. Beach foredunes on limestone	Port Hedland townsite and Finucane Island
Goodenia nuda	P4	Erect herb to 0.5 m high, flowers yellow, April-August. Flood plains, drainage lines	FMG Cloudbreak Mine
Gymnanthera cunninghamii	P3	Erect shrub to 2m high, flowers cream/yellow/ green, January-December. Variety of soils	Port Hedland townsite and Boodarie Station, Woodstock Station, FMG Rail Corridor; Hope Downs Railway Corridor
Heliotropium muticum	P1	Ascending to spreading perennial herb to 0.3m high, flowers white, May – August. Rocky plains	Pippingarra Station; Abydos DSO project area
Nicotiana umbratica	P3	Erect annual or short-lived perennial herb to 0.7 m high, flowers white, April – June. Granite outcrops and cliffs	Abydos Station and Woodstock Station
Phyllanthus aridus	P3		West Kimberley, Chichester Range, West Angelas, Pardoo, Shay Gap, Doongan Homestead, Durack Rive
Polymeria distigma	P3	Prostrate trailing herb, flowers pink, July. Sandy areas, plains	Mundabullangana Station
Ptilotus appendiculatus var. *minor*	P1	Prostrate or ascending perennial herb to 0.2 m high, flowers white, September. Floodplain	Boodarie Station

Taxon	Status	Description	Known Locations
Tephrosia andrewii	P1	Ascending shrub to 0.8 m high, flowers orange, September-October. Sand plains	No locations in vicinity of survey area, nearest location near Sandfire Roadhouse
Tephrosia rosea var. *venulosa*	P1	Erect shrub to 1.7 m high, flowers red/purple, August-September. Sand dunes, creek lines	Finucane Island

A summary of the introduced taxa either known in or within the vicinity of the project area are listed in Table 6. This is a combination of results presented in Table 4 and records from historical local flora surveys.

Table 6: Weed Taxa Known to Occur Within or in the Vicinity of the Survey Area

Taxon	Common Name	Comments
Aerva javanica	Kapok Bush	Rated as 'High' for priority for control and research (CALM 1999)
Andropogon gayanus	-	-
Argemone ochroleuca subsp. *ochroleuca*	Mexican Poppy	Rated as 'Mild' for priority for control and research (CALM 1999)
Bidens bipinnata	Beggartick	-
Cenchrus ciliaris	Buffel Grass	Federally recognized as being highly invasive and pose a significant threat to biodiversity; Rated as 'High' for priority for control and research (CALM 1999)
Cenchrus setiger	Birdwood Grass	TBA
Chloris barbata	Purpletop Chloris	Rated as 'Low' for priority for control and research (CALM 1999)
Chloris virgata	Feathertop Rhodes Grass	Rated as 'Low' for priority for control and research (CALM 1999)
Coccinia grandis	-	-
Cucumis melo subsp. *agrestis*	Ulcardo Melon	TBA
Desmodium scorpiurus	-	-
Digitaria ciliaris	Summer Grass	Rated as 'Low' for priority for control and research (CALM 1999)
Echinochloa colona	Awnless Barnyard Grass	Rated as 'Mild' for priority for control and research (CALM 1999)
Eragrostis minor	Smaller Stinkgrass	Rated as 'Low' for priority for control and research (CALM 1999)
Euphorbia hirta	Asthma Plant	Rated as 'Moderate' for priority for control and research (CALM 1999)
Euphorbia tirucalli	-	Rated as 'Low' for priority for control and research (CALM 1999)
Flaveria trinervia	Speedy Weed	-
Gomphrena celosioides	Gomphrena weed	Rated as 'Low' for priority for control and research (CALM 1999)
Gossypium hirsutum	Upland Cotton	Rated as 'Low' for priority for control and research (CALM 1999)
Indigofera oblongifolia	-	Rated as 'Moderate' for priority for control and research (CALM 1999)
Indigofera sessiliflora	-	-

Taxon	Common Name	Comments
Jatropha gossypiifolia	Bellyache Bush	Declared Plant (P1 for whole of state, P4 for Port Hedland and East Pilbara municipal districts including survey area) Rated as 'Moderate' for priority for control and research (CALM 1999)
Lamarckia aurea	Goldentop	Rated as 'Moderate' for priority for control and research (CALM 1999)-
Leptochloa fusca subsp. uninervia	-	-
Leucaena leucocephala	Leucaena	Rated as 'Moderate' for priority for control and research (CALM 1999)-
Opuntia stricta	Common prickly pear	TBA
Parkinsonia aculeata	Parkinsonia	Weed of National Significance; Declared Plant (P1 for whole of state, P2 for Port Hedland and East Pilbara municipal districts including survey area) Rated as 'Moderate' for priority for control and research (CALM 1999)
Paspalum fasciculatum	-	Rated as 'Low' for priority for control and research (CALM 1999)
Pennisetum setaceum	Fountain Grass	Rated as 'Mild' for priority for control and research (CALM 1999)
Portulaca oleracea	Purslane	-
Pupalia lappacea	-	Rated as 'Mild' for priority for control and research (CALM 1999)
Senna occidentalis	-	Rated as 'Moderate' for priority for control and research (CALM 1999)
Setaria sphacelata	South African Pigeon Grass	Rated as 'Mild' for priority for control and research (CALM 1999)
Setaria verticillata	Whorled Pigeon grass	Rated as 'Low' for priority for control and research (CALM 1999)
Sigesbeckia orientalis	Indian Weed	Rated as 'Moderate' for priority for control and research (CALM 1999)
Sonchus oleraceus	Common Sowthistle	Rated as 'Moderate' for priority for control and research (CALM 1999)
Stylosanthes guianensis	Stylo	Rated as 'Mild' for priority for control and research (CALM 1999)
Trianthema portulacastrum	Giant Pigweed	Rated as 'Moderate' for priority for control and research (CALM 1999)
Tribulus terrestris	Caltrop	-
Tridax procumbens		
Vachellia farnesiana	Mimosa Bush	Rated as 'High' for priority for control and research (CALM 1999)

3. METHODS

3.1 Aerial Photography Interpretation

Initial interpretation of vegetation boundaries was conducted with the use of ortho-rectified aerial photography at a scale of 1:10 000, supplied to Woodman Environmental by Coffey Environments. Preliminary vegetation type boundaries were transcribed onto the aerial photography, to allow for ground-truthing of these boundaries to be conducted in the field. Preliminary quadrat locations were also allocated based on these vegetation type boundaries. Where possible a minimum of three quadrats were allocated to each discernible vegetation type; such replication is required for meaningful results to be produced following statistical analysis of quadrat data, and to provide local context for FCT distribution.

3.2 Plant Collecting Licenses

All plant material was collected under the following scientific licences (pursuant to *Wildlife Conservation Act 1950* Section 23C and Section 23F):

2010 Field Survey			**2011 Field Survey**		
Personnel	**Flora Collecting Permit**	**DRF Collecting Permit**	**Personnel**	**Flora Collecting Permit**	**DRF Collecting Permit**
Kim Kershaw	SL00 8951	115-0910	Alison Saligari	SL008955	153-1011
Kylie Greenacre	SL00 8949	113-0910	Bianca Taylor	SL009416	128-0809
Alison Saligari	SL00 8955	-	Frank Obbens	SW010627	151-1011
Jodi-Lee Kelt	SL00 8950	-	Lisa McFarlane	SL00-9435	-
			Beth Loudon	SL009414	

3.3 Field Survey

Field work within the initial NWIOA project area was conducted by experienced botanists from the 28th July to 4th August 2010. However the proposed project layout was altered after completion of this field work, resulting in areas of proposed disturbance outside of the original assessment areas. Therefore, further field work was conducted during April 2011 over the entire project area. A subsection of this area is being presented in this report (the 'Port' area).

3.3.1 Floristic Community Mapping

The survey area was traversed by vehicle and on foot using all available tracks and roads. A total of 26 quadrats measuring 50 m x 50 m were established within the survey area: 12 were established in 2010, and a further 14 established in 2011 (within the 'Port' area).

These quadrats were established in all vegetation types identified following interpretation of aerial photography. The number of quadrats within each identified vegetation type was determined based on the size of the area covered by the plant community and potential species richness of each plant community.

All quadrats established were non-permanent, with measuring tapes extended to define the boundary of the quadrat. The quadrats were orientated north-south-east-west where possible, with the bearings of each side recorded for any quadrats that could not be established in this fashion. All vascular taxa that were visually identifiable within each quadrat were recorded,

and collected as necessary. At least one reference specimen for each identifiable taxon was collected. The following information was recorded at each quadrat:

- Personnel
- Unique quadrat number
- Date of survey
- GPS coordinates (GDA94), and location of where coordinates were recorded
- Quadrat photograph
- Topography (including landform type and aspect)
- Soil colour and type (including the presence of outcropping and surface stones)
- Vegetation condition (adapted from Keighery 1994)
- Approximate time since fire
- Presence of disturbance (if any)
- Percentage foliage cover (for each species)
- Height (m) (for each species, excluding climbers/aerial shrubs)

Additional flora taxa were recorded opportunistically via searches around the general vicinity of each quadrat, and during traverses on foot between quadrats.

Three additional detailed recording sites were also established during the 2010 field work. These sites were located throughout the survey area in areas where particular vegetation type polygons were smaller than 50m x 50m. The sites measured 25 m in radius from a central point, with the same information recorded as mentioned above for quadrats. However due to the irregular size of the survey area at each of these locations, they were not included in the statistical analysis.

3.3.2 Mapping of Mangal Communities

A total of five detailed recording sites were established within mangal communities in 2010. These sites were established in all mangrove assemblages identified following interpretation of aerial photography. The same information was recorded as for quadrats (as mentioned above). Again, due to their irregular size, this information was not included in the statistical analysis.

3.3.3 Survey for Significant and Introduced Flora

Survey for CS flora taxa and introduced flora was also undertaken. CS flora taxa and introduced flora surveys were conducted while undertaking surveys of quadrats, and whilst traversing between quadrats and sites. Where populations of CS flora taxa or introduced flora were identified, a representative collection of the species was made, and the abundance and spatial distribution (using GPS coordinates) of individuals within each population recorded.

3.4 Plant Collections and Identifications

Specimens of any unknown taxa were collected and pressed for later identification at the Western Australian Herbarium (WAHerb). Identifications were undertaken by experienced taxonomists, Sharnya Thomson and Frank Obbens, with experts of particular Families or Genera consulted for any specimens considered to be of taxonomic interest. Species nomenclature follows *FloraBase* (Department of Environment and Conservation 2011a) with all names checked against the current DEC Max database to ensure their validity. The

conservation status of each species was checked on *FloraBase*, which provides the most up-to-date information regarding the conservation status of flora taxa in Western Australia.

Specimens of interest (DRF and Priority Flora taxa, range extensions of taxa and potential new taxa) will be vouchered at the WAHerb at the conclusion of the Project. Threatened Priority Report Forms (TPRF) will be submitted to the DEC for all locations of DRF and Priority Flora taxa.

3.5 Statistical Analysis

Statistical analysis and determination of FCTs were conducted using quadrat data only. Statistical analysis of the quadrat-derived data was conducted using methods similar to those used by Woodman Environmental during previous surveys in the Pilbara and Mid-West Regions (Woodman Environmental 2008; 2009a; 2009b, 2011). These methods are based on those used by Markey and Dillon (2008). Classification and ordination analyses were conducted on a data matrix compiled from the quadrat data, with introduced taxa, opportunistic recordings (i.e. those taxa recorded outside of the quadrat), singletons and annual taxa excluded from the analysis. Various taxa were grouped together within the data matrix for the analysis where taxonomy was unclear or where different infra-taxa were identified within the dataset and not correlated to plant community, landform or soil type. Some taxa were omitted from the analysis as they could not be positively identified because of inadequate or sterile material.

Pattern analysis was conducted using PATN (V3.03) (Belbin 1989). The Bray-Curtis coefficient was used to generate an association matrix for both the classification and ordination analyses. This association matrix consisted of pairwise coefficients of similarities between quadrats based on floristic data. Agglomerative, hierarchical clustering, using flexible UPGMA (ß=-0.1) was used to generate a species and quadrat classification (Sneath and Sokal 1973). A two-way table of the species and quadrat matrix was produced, with the matrix sorted into groups generated from the species and quadrat classification. The species and quadrat classification was used in to develop FCT mapping polygon boundaries over the survey area.

Indicator species analysis (INDVAL) was conducted using PC-Ord (McCune and Mefford 1999) using the method of Dufrene and Legendre (1997). The INDVAL measures were used to determine the indicator species for each FCT and a Monte Carlo permutation test was used to test for the significance of the indicator species.

3.6 Vegetation Condition Mapping

The condition of the vegetation within the survey area has been mapped according to the vegetation condition scale as per Keighery (1994) (Appendix D), as per notes taken during the field survey.

3.7 Conservation Significance of Vegetation

Woodman Environmental have developed local and regional conservation significance descriptions for FCTs and other communities in the survey area. Local conservation significance of FCTs relates to the percentage of the survey area which was mapped with each FCT and community type.

The criteria used to determine regional conservation significance for each FCT is described in Table 7. Please note that proposed impacts to FCTs are not used in the determination of conservation significance of FCTs. Factors used to determine regional conservation significance included the numbers and types of conservation significant flora taxa recorded from each FCT, and the inferred extent of the preferred soil type, substrate and topographical position within the region, where known.

Table 7: Descriptions of Regional Conservation Significance Rankings of Floristic Community Types and Other Communities

Local Conservation Significance Ranking	Description
1	• FCT is widespread through the survey area (>10% of mapped area); • No conservation-significant flora known from the FCT
2	• FCT is widespread through the survey area (>10% of mapped area); and • Conservation-significant flora known from the FCT
3	• FCT is restricted within the survey area (<10% of the mapped area); and • No conservation-significant flora known from the FCT
4	• FCT is restricted within the survey area (<10% of mapped area); and • Conservation-significant flora known from the FCT

3.7 Limitations of Survey

Table 8 presents the limitations of the terrestrial flora and vegetation and mangrove assessment in accordance with Environmental Protection Authority (EPA) Guidance Statement No. 51 (EPA 2004).

Table 8: Limitations of the Flora, Vegetation and Mangrove Level 2 Survey

Limitation	Comment
Level of survey	Level 2 Detailed Survey: A brief reconnaissance was conducted in March 2010, with the detailed survey field work conducted during July/August 2010, and April 2011
Competency/experience of the consultant(s) carrying out the survey	Senior field crew have had extensive experience in conducting similar assessments, with mentoring given to less experienced members of the field team throughout the surveys
Scope (What floral groups were sampled and were some sampling methods not able to be employed because of constraints?)	All vascular flora groups were sampled, including flora from mangal communities
Proportion of flora identified, recorded and/or collected	Approximately 75 % of vascular flora taxa have been recorded, with 95% of these flora taxa collected for verification at the Western Australian Herbarium

Limitation	Comment
Sources of information e.g. previously available information (whether historic or recent) as distinct from new data	All available sources were utilised: sources include databases (DEC, EPBC) and previous published and unpublished reports. Good contextual information was available including previous local experience of Woodman Environmental
The proportion of the task achieved and further work which might be needed	Detailed Level 2 Survey complete. No further work required
Timing/weather/season/cycle	Some field work was conducted post the main flowering period for the Pilbara (March – May); however Port Hedland and surrounding areas received below average rainfall during Summer - Autumn 2010 and therefore poor taxa representation in those survey results is expected; above average rainfall was experienced in Summer – Autumn 2011, which is reflected in the data collected during April 2011
Disturbances (e.g. fire, flood, accidental human intervention etc.), which affected results of survey	Previous fire history of the survey area influenced vegetation patterns discernible from aerial photography, as well as the existing structure of the vegetation affected the survey.
Intensity (In retrospect, was the intensity adequate?)	Survey intensity adequate to identify floristic and structural groupings of terrestrial flora as required by a Level 2 survey, with replication of quadrats through community types and foot searching
Completeness and mapping reliability (e.g. was relevant area fully surveyed)	All areas were surveyed adequately
Resources and experience of personnel	Adequate resources including experienced field personnel and taxonomists with appropriate expertise in Pilbara flora were utilised
Remoteness and/or access problems	Access to the majority of the survey area was adequate however access to the seaward side of the mangal communities was not available

4. RESULTS

4.1 Flora of the Survey Area

A total of 176 discrete vascular flora taxa, from 43 families and 101 genera, were recorded from within quadrats and sites within the survey area during 2010 - 2011. The most well represented families were Poaceae (30 discrete taxa), and Fabaceae (19 discrete taxa).

Of these taxa, three CS flora taxa and three introduced (weed) taxa were recorded from quadrats. One further CS flora taxon and one further introduced taxon were recorded opportunistically during the surveys. Two further CS flora taxa are also known from the survey area through historical DEC data. No DRF taxa were recorded within the survey area.

Appendix E presents a list of all vascular plant taxa recorded in the survey area by Woodman Environmental during the 2010/2011 survey.

4.1.1 Conservation Significant Flora

Table 9 presents the Priority Flora species and species of interest that were recorded in the survey area during surveys in July-August 2010 and April 2011, as well as taxa which have historically been known to occur within the survey area. Appendix B provides a description of each conservation status code (Smith 2010). Appendix F presents location details of each of these locations.

Table 9: Conservation Significant Flora Taxa Known from the Survey Area

Taxa	Conservation Code	Number of Locations	Floristic Community Types
Eragrostis crateriformis	P3	2	4, 1/2
Gomphrena leptophylla	P3	1	1/2
Gomphrena pusilla	P2	3	3, 4
Goodenia nuda	P4	1	1/2
Gymnanthera cunninghamii	P3	2	5, 11/5
Tephrosia rosea ?var. *venulosa*	P1	6	1/2, 4

Eragrostis crateriformis (P3) is an annual grass growing to 0.42 m in height, and flowering between January and July. The species preferred habitat includes creek banks and depressions, in clay-loam or clay (DEC 2011a). Although there are relatively few records of this taxon, the known locations are situated across the Carnarvon, Tanami and Pilbara IBRA regions of Western Australia. It is known from several locations approximately 70 km north-east of Port Hedland, the Millstream-Chichester National Park, Warralong Station and Yanrey Station. This taxon was recorded in one quadrat established in 2011 and in one opportunistic location within the survey area, within FCT 4 and in mosaic 1/2.

Plate 1: *Eragrostis crateriformis* (P3) (Woodman Environmental)

Gomphrena leptophylla (P3) is an erect or prostrate spreading annual herb, growing to a height of 0.15 m and flowering from March to September. This species prefers sand or sandy clay loams on granite and quartzite in creek beds, open flats, salt pan edges or stony hillsides (DEC 2011a). This taxon has a relatively widespread distribution through the Pilbara and Kimberley regions in Western Australia, however there are relatively few collections held in the WAHerb and the collection localities are scattered. *Gomphrena leptophylla* has been previously collected in the Kimberley from south west of Halls Creek and south of Broome, and in the Pilbara from the vicinity of Karratha and south of Port Hedland (DEC 2011a). This taxon is known from the survey area from within one quadrat established in 2010.

Gomphrena pusilla (P2) is an annual herb, growing to 0.2 m in height and flowering between March and June. This species is known to occur behind foredunes, on limestone (DEC 2011a). Only five collections of this taxon are held at the WAHerb, two of which have been collected at Broome, the other three in the vicinity of Port Hedland (two of which were collected in 1905). This taxon was recorded at three opportunistic locations within the survey area, within FCTs 3 and 4.

Plate 2: *Gomphrena pusilla* (P2) (Woodman Environmental)

Goodenia nuda (P4) is an erect to ascending herb growing to 0.5 m high and flowering from April to August. This taxon is relatively widespread through the Pilbara Region, with only one record known from the Kimberley (DEC 2011a). This taxon is only known from one historic DEC record in the survey area (Map Appendix Sheet 5). There is some confusion at present regarding the presence of this taxon in the Port Hedland region. It is possible that records in this area are in fact the non-conservation significant taxon, *Goodenia triodiophila*.

Plate 3: *Goodenia nuda* (P4) (DEC 2011a)

Gymnanthera cunninghamii (P3) is an erect shrub to 2 m in height, occurring on sandy soils and frequently in drainage lines, in the Carnarvon, Great Sandy Desert and Pilbara IBRA regions (DEC 2011a). This taxon has a large range within Western Australia of approximately 900 km, and is also known from the Northern Territory and Queensland. A total of 14 specimens are vouchered in the WAHerb (DEC 2011a). This taxon was not recorded during this survey, however it is known from two locations within the survey area (historical DEC data). These may actually refer to the same location, as one is the location of a specimen lodged at the WAHerb, and the other is a DEFL record. Approximately 100 individuals at this location were noted on a limestone rise. There is also a further collection known closer towards Port Hedland, on the base of a low limestone ridge of Bousset formation, above mangrove flats (DEC 2011a).

Plate 4: *Gymnanthera cunninghamii* (P3) (Woodman Environmental)

Tephrosia rosea var. venulosa (P1) is an erect shrub to 1.7 m in height, and flowers between August and September. A total of 15 specimens of this taxon are housed at the WAHerb, of which 11 have been collected in the vicinity of Port Hedland (DEC 2011a). This taxon was recorded from two quadrats and four opportunistic recordings in the survey area. The identification was incomplete due to lack of flowering material.

Plate 5: *Tephrosia rosea* ? *var. venulosa* (P1) (Woodman Environmental)

The known regional range and distribution of each of these significant flora taxa has been determined using information on NatureMap (DEC 2011b) and FloraBase (DEC 2011a) (Table 10). The number of specimens and known populations does not include information collected as a result of this current survey.

Table 10: Known Regional Distribution and Population Information for Conservation Significant Flora Taxa Recorded Within the Survey Area

Taxa	Conservation Status	Known Regional Distribution (within WA)	Number of Specimens at WAHerb	Number of Known Populations (WAHerb)
Eragrostis crateriformis	P3	1350 E-W; 300 km N-S	8 (also known from the N.T.)	5 (within W.A.)
Gomphrena leptophylla	P3	1400 km E-W; 350 km N-S	6 (including one from N.T.)	5 (within W.A.)
Gomphrena pusilla	P2	380 km E-W; 300 km N-S	5	3
Goodenia nuda	P4	870 km E-W; 510km N-S	21	21
Gymnanthera cunninghamii	P3	750 km E-W; 550 km N-S	14	9
Tephrosia rosea ?var. venulosa	P1	300 km E-W; 110 km N-S	15	3

The recording of *Murdannia graminea* is significant as there is currently only one other record known from within the Pilbara region. This specimen will be submitted to the WAHerb at the conclusion of the project.

4.1.2 Introduced Flora

No introduced species recorded within the survey area are Declared Plants (as listed under the *Agriculture and Related Resources Act 1976* (Department of Agriculture and Food 2011).

Three of the four introduced species recorded in the survey area are listed in the Environmental Weed Strategy for Western Australia (Department of Conservation and Land Management 1999). This Strategy assessed and ranked environmental weeds in terms of their environmental impact on biodiversity. Each weed species was ranked according to three criteria; invasiveness, distribution and environmental impact, and is assigned a score of 'High', 'Moderate', 'Mild' or 'Low'. Appendix D provides the description of each rating in the Environmental Weed Strategy for Western Australia.

Table 11 presents the introduced species that were recorded in the survey area and their Environmental Weed Strategy Ranking.

Table 11: Introduced Flora Taxa Known from the Survey Area

Introduced Flora Taxa	Number of Locations	Floristic Community Types	Environmental Weed Strategy W.A. Ranking
Aerva javanica	11	1/2, 3, 4	High
Cenchrus ciliaris	27	1/2, 3, 4	High
Cenchrus setiger	1	1/2	High
Portulaca oleracea	3	3, 4, 1/2	-

Aerva javanica (Kapok Bush) is a multi-stemmed, perennial herb to 1.6m high that prefers sandy soils and is commonly found along drainage lines, sand dunes and floodplains (DEC 2011a). It was recorded at 11 locations within the survey area, within FCTs 3 and 4 (Table 11). *Aerva javanica* has a relatively wide distribution throughout Western Australia and is widespread throughout the Pilbara region (DEC 2011a). This taxon is listed as 'High' under

the Environmental Weed Strategy for Western Australia; having the ability to invade waterways or bushland in good to excellent condition, having a wide distribution and having the ability to change the structure, composition and function of ecosystems (Department of Conservation and Land Management 1999).

Plate 6: *Aerva javanica* (Woodman Environmental)

Cenchrus ciliaris (Buffel Grass) is a tufted, perennial, grass like or herb growing to 1.5m high. It grows on a variety of soil types and is commonly found along road verges, creeklines and river edges (DEC 2011a). This taxon has a wide distribution in pastoral regions where it has been planted as a pastoral grass (Hussey *et. al.* 1997). *Cenchrus ciliaris* is widespread throughout Western Australia and has become a naturalised species (DEC 2011b). This taxon has been recorded at 27 locations within the survey area within FCTs 3 and 4, and mosaic 1/2 (Table 11).

Plate 7: *Cenchrus ciliaris* (Woodman Environmental)

Although *C. ciliaris* is not listed as a Declared Plant in Western Australia (Department of Agriculture and Food 2011), it is considered by the States and Territories to pose a particularly significant threat to biodiversity, as it is well known to be particularly invasive

under certain conditions (Hussey *et al.* 1997; DSEWPC 2011). *Cenchrus ciliaris* is listed as 'High' under the Environmental Weed Strategy for Western Australia; for having the ability to invade waterways or bushland in good to excellent condition, having a wide distribution and having the ability to change the structure, composition and function of ecosystems (Department of Conservation and Land Management 1999).

Cenchrus setiger is an erect, tussocky, stoloniferous perennial grass to 0.5 m in height. It is widely distributed throughout Western Australia north of Geraldton. *Cenchrus setiger* is listed as 'High' under the Environmental Weed Strategy for Western Australia; for having the ability to invade waterways or bushland in good to excellent condition, having a wide distribution and having the ability to change the structure, composition and function of ecosystems (Department of Conservation and Land Management 1999).

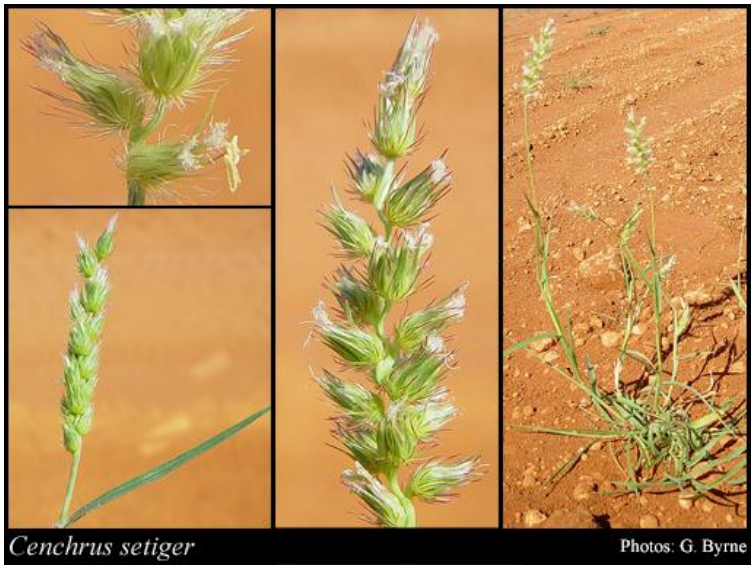

Plate 8: *Cenchrus setiger* (DEC 2011a)

Portulaca oleracea (Purslane) is a succulent, prostrate, annual herb growing to 0.2m high and preferring clay loams or sandy soils, often in disturbed areas. This taxon is considered a widespread weed of horticulture, paddocks and gardens throughout Western Australia (Hussey *et. al.* 1997). It was recorded in three locations within the survey area, within FCTs 4, and mosaic 1/2 (Table 11). *Portulaca oleracea* is widespread throughout Western Australia, in particular the Pilbara Biogeographic Region (DEC 2011b). This taxon is not listed under the Environmental Weed Strategy for Western Australia (Department of Conservation and Land Management 1999).

Plate 9: *Portulaca oleracea* (DEC 2011a)

4.2 Vegetation of the Survey Area

Appendix G presents the taxa that were either deleted or amalgamated during the statistical analysis of the quadrat data (as per Section 3.5). All annual taxa, introduced taxa, opportunistic taxa (i.e. those records that were recorded outside of quadrats) and singleton taxa records were not included in the analysis. The resulting dendrogram showing relationships between the quadrats is presented in Appendix H. The associated two-way table showing the recording of taxa in relation to the groupings of quadrats is presented in Appendix I. The results of the significant indicator taxa analysis is presented in Appendix J.

A total of 63 taxa, recorded from 26 quadrats, was analysed using PATN. Raw quadrat data of each of these quadrats is presented in Appendix K. Initially six FCTs resulted from the statistical analysis, of which one was represented by a single quadrat (FCT 3). However, groupings 5 and 6 were combined as a single FCT as part of this report, due to the similarities in species composition and habitat (FCT 5).

4.2.1 Supergroups 1 and 2

Two distinct supergroups resulted from the statistical analysis of the quadrat data, with differences between the two groups being primarily being in the species richness per quadrat and species composition.

Supergroup 1 (FCTs 1 – 4) was mapped primarily on red to red-brown sandy-loam to clay-loam on plains, depressions and drainage lines, as well as on limestone. Several quadrats were located on supratidal plains, adjacent to mangal areas. The species richness per quadrat within FCTs that grouped into Supergroup 1 was higher than that of the FCTs that grouped into Supergroup 2 (Supergroup 1 ranged from 16.6 ± 11.8 taxa per quadrat to 35 taxa per quadrat, Supergroup 2 had 3.2 ± 2.6 taxa per quadrat).

The vegetation of Supergroup 1 was represented by tall to low shrublands, to open shrublands dominated by *Acacia* spp. over low hummock grasslands dominated by a variety of *Triodia* spp., primarily *Triodia epactia*.

Supergroup 2 consisted of a single FCT (FCT 5), which was mapped on brown clay in tidal areas. This FCT consisted of those quadrats which were dominated by a sparse chenopod layer (*Tecticornia* spp.), occasionally also dominated by *Sporobolus virginicus* and *Muellerolimon salicorniaceum*.

Section 4.2.2 further describes individual FCTs mapped within the survey area.

4.2.2 Floristic Community Types

A total of five FCTs were mapped within the survey area. Appendix L presents the vascular plant taxa recorded within each of the FCTs.

The five FCTs are described below:

FCT 1: Low shrubland to open shrubland of mixed *Acacia* spp. dominated by *Acacia stellaticeps* over low hummock grassland of *Triodia epactia*, on red sandy clay loams on plains and low lying areas, including supratidal plains

Total Area: Not Available

Percentage of Project Area: Not Available

Sampling: 8 quadrats (NWI10; NWI38; NWI44; NWI45; NWI46; NW25; NW27; TRH316)

Common taxa recorded within each stratum:

Stratum	Descriptor	Taxa
Upper Stratum 1	Isolated Shrubs (>1 m)	*Acacia colei* var. *colei, Acacia tumida* var. *pilbarensis*
Mid Stratum 1	Isolated Clumps to Open Shrubland (<1 m)	*Acacia stellaticeps*
Mid Stratum 2	Isolated Shrubs (<1 m)	*Corchorus incanus* subsp. *incanus*
Lower Stratum 1	Low Grassland (<0.5 m)	*Aristida holathera, Aristida hygrometrica, Chrysopogon fallax, Eragrostis eriopoda, Eriachne obtusa, Triodia epactia*

Indicator Taxa: *Acacia stellaticeps, Corchorus incanus* subsp. *incanus, Eragrostis eriopoda, Eriachne obtusa, Hybanthus aurantiacus, Ipomoea muelleri, Mollugo molluginea, Pluchea tetranthera, Senna notabilis, Sida* sp. Rabbit Flat (B.J. Carter 626) PN

Landform Types: Simple slope, plain

Soil Types: Red sand

FCT 1 was mapped as a mosaic with FCT 2 (Figure 4). This was due to the inability to determine clear boundaries between these two similar FCTs on the aerial photography, or in the field. It is likely that FCT 1 and FCT 2 are in fact the same FCT, with the main differences possibly stemming from the survey years. Quadrats which grouped into FCT 1 were mainly surveyed in 2011, whereas the quadrats which grouped into FCT 2 were mainly

surveyed in 2010. The species richness of quadrats surveyed in 2011 was much greater than in 2010. This was attributed to the high rainfall experienced by the Pilbara region during the months January to April 2011, in comparison to 2010 when poor rainfall was experienced.

The vegetation consisted of a relatively consistent mid stratum dominated by *Acacia stellaticeps*, over a consistent grassland dominated by *Triodia epactia*. Other herbaceous and grass taxa (as detailed in the table above) were recorded regularly. An upper stratum was occasionally present, dominated by *Acacia colei* var. *colei* or *Acacia tumida* var. *pilbarensis*.

The average species richness of FCT 1 was 31.5 ± 6.1 species per quadrat. As with all FCTs of Supergroup 1, species group A was highly represented, with significant representation of species groups B, D, and E also (Appendix I). FCT 1 is most closely floristically related to FCT 2 (Appendix H).

A total of 90 vascular plant taxa were recorded in the quadrats that formed FCT 1 (Appendix L). This includes one CS flora taxa (*Tephrosia rosea* ?var. *venulosa* (P1)). No introduced taxa were recorded from quadrats within FCT 1. FCT 1 had the highest number of indicator taxa of any of the FCTs within the project area. None of these taxa are restricted, and all are commonly found on sandy and loamy soils on plains.

Five locations of *Tephrosia rosea* ?var. *venulosa* (P1) (including two from quadrats) were recorded within FCT 1 (mapped as mosaic 1/2) (Figure 4; Map Appendix Sheet 5). Plant counts or estimates were undertaken at the three opportunistic locations, with a total of 220 plants recorded. Although the total number of this taxon at each quadrat was not recorded, it can be assumed that there were numerous plants as the percentage foliage cover was 2 % and 5 % respectively.

Plate 10: Photograph of FCT 1 (Woodman Environmental)

FCT 2: Low to mid sparse shrubland of *Acacia colei* var. *colei* and *Acacia stellaticeps* over Low Hummock Grassland of *Triodia epactia* with *Eriachne mucronata*, on red sand to sandy-loam on plains, drainage lines and low lying areas including supratidal plains

Total Area: 65.4 ha

Percentage of Project Area: 2.9 %

Sampling: 5 quadrats (TRH317; TRH318; TRH319; TRH320; TRH405)

Common taxa recorded within each stratum:

Stratum	Descriptor	Taxa
Mid Stratum 1	Isolated Clumps (>1m)	*Acacia colei* var. *colei*
Mid Stratum 2	Sparse Shrubland (<1 m)	*Acacia stellaticeps*
Lower Stratum 1	Low Grassland (<0.5 m)	*Aristida holathera, Chrysopogon fallax, Eriachne mucronata, Triodia epactia, Triodia secunda*

Indicator Taxa: *Acacia colei* var. *colei, Cyperus blakeanus, Dodonaea coriacea, Eriachne mucronata, Fimbristylis dichotoma, Murdannia graminea, Triodia epactia*

Landform Types: Plain, drainage line, supratidal plain

Soil Types: Red sand, red sandy loam

FCT 2 was mapped as a mosaic with FCT 1 as previously explained for FCT 1 (Figure 4). FCT 2 itself, occupies a small percentage of the survey area.

The vegetation consisted mainly of grassland dominated by *Triodia epactia* with scattered shrubs of *Acacia stellaticeps* and/or *A. colei var. colei*. Other herbaceous and grass taxa (as detailed in the table above) were also recorded (Plate 11).

The average species richness of FCT 2 was 17.2 ± 5 species per quadrat. As with all FCTs of Supergroup 1, species group A was highly represented (Appendix I). FCT 2 is most closely floristically related to FCT 1 (Appendix H).

A total of 43 vascular plant taxa were recorded in the quadrats that formed FCT 2 (Appendix L). This includes one CS flora taxa (*Gomphrena leptophylla* (P3)) and two introduced taxa (*Aerva javanica* and *Cenchrus ciliaris*). FCT 2 had the second highest number of indicator taxa of the FCTs grouped within the project area. None of these taxa are restricted, and all are commonly found on sand and sandy loamy soils on plains and drainage areas.

One location of *Gomphrena leptophylla* (P3) was recorded within FCT 2 (Figure 4; Map Appendix Sheet 5). Although the total number of plants of this taxon was not recorded, it can be assumed that they were relatively scattered with the percentage foliage cover being 0.1 %.

One location each of *Aerva javanica* and *Cenchrus ciliaris* were recorded within the quadrats representing FCT 2 (Figure 5; Map Appendix Sheet 6).

The condition of the vegetation was mapped as 'VG/E' (Very Good/Excellent) (Appendix D) (Figure 5).

Plate 11: Photograph of FCT 2 (Woodman Environmental)

Mosaic 1/2

FCT 1 and 2 were combined to form a mosaic as they were very similar in structure and species composition, and difficult to separate.

Total Area: 1011.6 ha

Percentage of Project Area: 44.9 %

One opportunistic record of *Eragrostis crateriformis* (P3) was recorded in mosaic 1/2 during the 2010-2011 survey (Map Appendix Sheet 5). One historical (DEC) record of *Goodenia nuda* (P4) occurs within the survey area in mosaic 1/2 (Figure 4; Map Appendix Sheet 5).

Three opportunistic sitings of *Cenchrus* ciliaris, one of *Cenchrus setiger* and one of *Portulaca oleracea* were recorded in mosaic 1/2 during the 2010-2011 survey (Figure 5; Map Appendix Sheet 7).

The condition of the vegetation was mapped as 'VG/E' (Very Good/Excellent) (Appendix D) (Figure 5).

FCT 3: Tall open shrubland of *Acacia bivenosa* over Low open shrubland dominated by **Aerva javanica*, *Myoporum montanum*, and *Corchorus incanus* subsp. *incanus* over Low grassland dominated by **Cenchrus ciliaris* and *Triodia secunda* and/or *Triodia epactia* on brown sandy loam on limestone ridge

Total Area: 10.3 ha

Percentage of Project Area: 0.5 %

Sampling: 1 quadrat (NWI02); 1 site (S01)

Common taxa recorded within each stratum:

Stratum	Descriptor	Taxa
Mid Stratum 1	Open Shrubland (>2m)	*Acacia bivenosa*
Mid Stratum 2	Open Shrubland (<1m)	*Corchorus incanus* subsp. *incanus, Gomphrena canescens* subsp. *canescens, Gomphrena tenella, Myoporum montanum, Scaevola spinescens*
Lower Stratum 1	Grassland (<0.5m)	**Aerva javanica, *Cenchrus ciliaris, Triodia secunda, Triodia epactia*

Indicator Taxa: -

Landform Types: Limestone ridge

Soil Types: Brown sandy/clay loam

This community comprised three small areas of limestone rises adjacent to the western and eastern boundaries, in the north of the project area. These sites were mapped adjacent to mangal and supratidal areas. (Figure 4; Map Appendix Sheets 2 and 3). The site in the east was highly disturbed as indicated by the prevalence of introduced species, while the two areas in the west were in a healthy condition.

The vegetation consisted predominantly of scattered tall shrubs of *Acacia bivenosa* over *Triodia epactia* or *T. secunda* with scattered herbs such as *Gomphrena* spp. (Plate 12).

A total of 41 vascular flora taxa were recorded in FCT 3, including three introduced taxa (*Aerva javanica, Portulaca oleracea* and *Cenchrus ciliaris*). The condition of the vegetation of the eastern site was mapped as 'P' (Poor) due to the high cover of introduced species, while the western areas were mapped as 'E' (Excellent) (Appendix D) (Figure 5).

The average species richness of FCT 3 was 35 species per quadrat. Species group A was the most highly represented, with significant representation of species groups B also (Appendix I).

A total of 41 vascular plant taxa were recorded in the quadrat representing FCT 3 (Appendix L). This includes three introduced taxa (*Aerva javanica, Cenchrus ciliaris* and *Portulaca oleracea*). No CS flora taxa were recorded in the quadrat representing FCT 3. However two opportunistic sitings of *Gomphrena pusilla* (P2) were recorded in FCT 3 (Map Appendix Sheet 2), with an estimation of approximately 10,000 plants observed. FCT 3 has no

indicator taxa due to it being statistically represented by a single quadrat of low species composition.

A total of two locations of *Aerva javanica*, two locations of *Cenchrus ciliaris* and one location of *Portulaca oleracea* were recorded within FCT 3 (Figure 5; Map Appendix Sheets 2 and 3). Two additional opportunistic sitings of *Cenchrus ciliaris* were also recorded in FCT 3 (Map Appendix Sheet 2).

Plate 12: Photograph of FCT 3 (Woodman Environmental)

FCT 4: Low sparse shrubland of mixed spp. over low closed hummock grassland of *Triodia epactia* and/or *Triodia secunda* on red brown sandy loam on lower slopes and supratidal plain

Total Area: 301.3 ha

Percentage of Project Area: 13.4 %

Sampling: 8 quadrats (NWI08; NWI39; NWI41; NWI43; TRH402; TRH403; TRH410; TRH425)

Common taxa recorded within each stratum:

Stratum	Descriptor	Taxa
Upper Stratum 1	Isolated Shrubs (1-2m)	*Acacia tumida* var. *pilbarensis*
Mid Stratum 1	Isolated Shrubs (<1m)	*Acacia stellaticeps*
Mid Stratum 2	Grassland (<0.5m)	*Chrysopogon fallax, Triodia epactia, Triodia secunda*
Lower Stratum 1	Open Herbland	*Byblis filifolia, Bergia pedicellaris, Calandrinia pumila, Calandrinia quadrivalvis, Cyperus iria, C. squarrosus, Commelina ensifolia, Fimbristylis dichotoma, F. rara, Frankenia* ?*ambita, Lipocarpha microcephala, Marsilea drummondii, Mitrasacme exserta, Rotala diandra, Schoenoplectus laevis*

Indicator Taxa: *Triodia secunda*

Landform Types: Flat, drainage line/closed depression, supratidal plain

Soil Types: Red sandy clay, sandy loam

FCT 4 mainly occurred in the north of the project area above supratidal areas, with scattered locations (associated with clay pans) in the south amongst mosaic 1/2 (Figure 4; Map Appendix Sheets 1-3, 5-7). The vegetation consisted predominantly of grassland dominated by *Triodia epactia* or *T. secunda*, intermixed with ephemeral herbaceous taxa (as detailed in the table above). Occasional shrubs of *Acacia stellaticeps* or *Acacia tumida* var. *pilbarensis* occurred sporadically (Plate 13).

The average species richness of FCT 4 was 16.6 ± 11.8 species per quadrat. As with all FCTs of Supergroup 1, species group A was highly represented, with significant representation of species groups C, E and F also (Appendix I).

A total of 80 vascular plant taxa were recorded in quadrats which grouped in FCT 4 (Appendix L). This includes one CS flora taxa (*Eragrostis crateriformis* (P3)) and one introduced taxa (*Cenchrus ciliaris*). FCT 4 had only one indicator taxon. This species is not restricted, and is commonly found on sandy clay and sandy loam soils on the edges of plains and drainage areas.

One location of *Eragrostis crateriformis* (P3) was recorded within FCT 4 (Figure 4; Map Appendix Sheet 5). One opportunistic siting of *Gomphrena pusilla* (P2) (Map Appendix Sheet 2) and one of *Tephrosia rosea* ?var. *venulosa* (P1) (Map Appendix Sheet 6) were recorded in FCT 4. Plant counts of *Tephrosia rosea* ?var. *venulosa* (P1) and *Gomphrena pusilla* (P2) were undertaken at the opportunistic locations, with 8 plants and 30 plants

recorded respectively. Although the total number of plants of *Eragrostis crateriformis* (P3) within the quadrat was not recorded, it can be assumed that they were in relatively low numbers with the percentage foliage cover being 0.1 %.

One location of *Cenchrus ciliaris* was recorded within FCT 4 (Figure 5; Map Appendix Sheet 2). Numerous opportunistic records of *Portulaca oleracea, Aerva javanica* and *Cenchrus ciliaris* were also recorded during the 2010-2011 survey in FCT 4 (Map Appendix Sheets 2, 3 and 6).

The condition of the vegetation was mapped as 'E' (Excellent) in the north of the project area and 'VG/E' (Very Good/Excellent) in the south (Appendix D) (Figure 5).

Plate 13: Photograph of FCT 4 (Woodman Environmental)

FCT 5: Low open to sparse samphire shrubland dominated by *Tecticornia* spp. and *Muellerolimon salicorniaceum* with sparse tussock grassland of *Sporobolus virginicus* on brown clays on tidal zones

Total Area: 362.6 ha

Percentage of Project Area: 16.1 %

Sampling: 5 quadrats (NWI03; NWI40; TRH401; TRH404); 1 site (S03)

Common taxa recorded within each stratum:

Stratum	Descriptor	Taxa
Lower Stratum 1	Open Chenopod Shrubland (<0.5m)	*Frankenia ambita, Muellerolimon salicorniaceum, Tecticornia* ?*halocnemoides* subsp. *tenuis, Tecticornia indica* subsp. *bidens, Tecticornia* ?*indica* subsp. *leiostachya, Tecticornia pergranulata* subsp. *elongata*

Indicator Taxa: *Tecticornia* ?*halocnemoides* subsp. *tenuis, Tecticornia pergranulata* subsp. *elongata*

Landform Types: Tidal flats

Soil Types: Brown clay, red sandy clay

FCT 5 occurred in the north of the project area, adjacent to mangal areas (Figure 4; Map Appendix Sheets 1-3, 5, 6). The vegetation consisted predominantly of *Tecticornia* spp. (Plate 14).

The average species richness of FCT 5 was 3.2 ± 2.6 species per quadrat. Species group F was highly represented, with significant representation of species groups G also (Appendix I).

A total of 13 vascular plant taxa were recorded in quadrats which grouped in FCT 5 (Appendix L). One opportunistic siting of *Gymnanthera cunninghamii* (P3) was recorded in FCT 5 (Figure 4; Map Appendix Sheet 2). FCT 5 had two indicator taxa. None of these taxa are restricted, and all are commonly found clay soils in saline/tidal areas.

No introduced species were recorded as occurring in FCT 5.

The condition of the vegetation was mapped as 'E' (Excellent) (Appendix D) (Figure 5).

Plate 14: Photograph of FCT 5 (Woodman Environmental)

4.2.1 Coastal Communities

Mapping of mangal communities within the project area identified two main communities based on species presence and dominance. Cyanobacterial algal mats were also mapped (Figure 4; Map Appendix Sheets 1-6).

Community 10: Closed forest of *Rhizophora stylosa* occurring on brown silt on intertidal flats

Total Area: 56.6 ha

Percentage of Project Area: 2.5 %

Sampling: 2 Detailed Recording Sites (M01; M07)

Common taxa recorded within each stratum:

Stratum	Descriptor	Taxa
Upper Stratum 1	Closed Forest (<10 m)	*Rhizophora stylosa*

Landform Types: Intertidal zone

Soil Types: Brown silt

This community has been mapped previously by Paling (ENVIRON 2004) as Closed Canopy Woodland of *Rhizophora stylosa* and occurs commonly as a central band within mangals, with *Avicennia marina* occurring on both the landward and seaward sides. This band comprises primarily pure dense stands of *R. stylosa* between 3 and 8 m in height with the occasional *A. marina* scattered within the stand. This community is situated in a zone with protection from storm and tidal surge, yet retains near marine salinity levels in the substrate as a result of regular tidal flushing (Figure 4; Map Appendix Sheet 1-4).

Two vascular flora taxa were recorded in Community 10, neither of which are CS flora taxa (Appendix L) (Plate 15). The condition of the vegetation was mapped as 'E' (Excellent) (Appendix D) (Figure 5).

Plate 15: Photograph of Community 10 (Woodman Environmental)

Community 11: Closed forest of *Avicennia marina* occurring on brown clay on intertidal flats

Total Area: 62.7 ha

Percentage of Project Area: 2.8 %

Sampling: 3 Detailed Recording Sites (M02; M05; M06)

Common taxa recorded within each stratum:

Stratum	Descriptor	Taxa
Upper Stratum 1	Closed Forest (<10 m)	*Avicennia marina*

Landform Types: Intertidal zone

Soil Types: Brown clay

This community has been mapped previously by Paling (ENVIRON 2004) as two different units delineated by topographic position. The first community comprises Closed Canopy Woodland of *Avicennia marina* (seaward fringe) which occurs only along the edges of open water and often associated with depositional zones with understorey or small fringe communities of *Aegiceras corniculatum* and/or *Aegialitis annulata*. The second community comprises Closed Canopy Woodland of *A. marina* (landward margins) which occurs behind the *Rhizophora stylosa* bands and may have occasional *Ceriops australis* present or have a scattered understorey of samphires including *Suaeda arbusculoides*. Though *Ceriops australis* was not recorded in detailed recording sites for the project it is known from this community in close proximity to the project area. *Avicennia marina* and *C. australis* both have tolerance to a wide range of soil and water salinities and therefore are the dominant taxa in the more saline landward margins of mangals at Port Hedland (Figure 4; Map Appendix Sheet 3 and 4).

Two vascular flora taxa were recorded in Community 11, neither of which are CS flora taxa (Appendix L) (Plate 16). The condition of the vegetation was mapped as 'E' (Excellent) (Appendix D) (Figure 5).

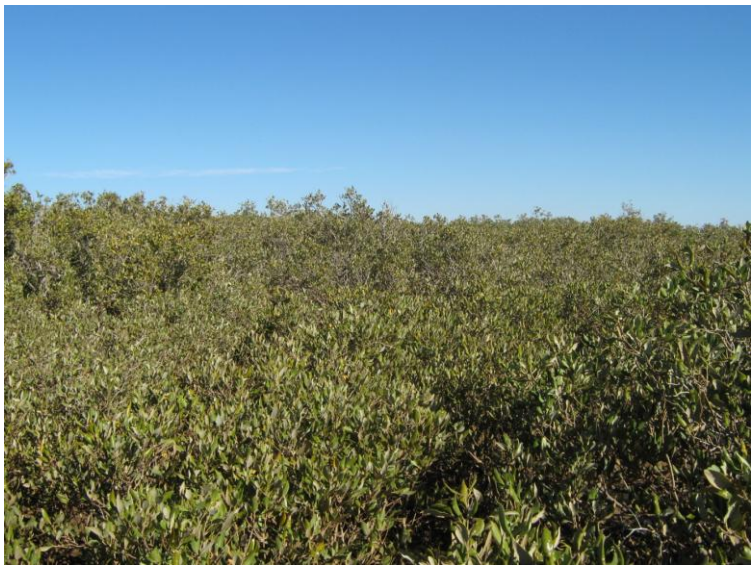

Plate 16: Photograph of Community 11 (Woodman Environmental)

Mosaic 11/5

A mosaic of FCT 11 and FCT 5 (scattered *Avicennia marina*, *Ceriops australis* and samphire shrubland) was mapped in the intertidal zone (Figure 4; Map Appendix Sheets 1, 3 and 5). This association comprises a broad ecotone between the back of the mangal and the intertidal samphire community present at the high water mark. This association has been mapped previously by Paling as Low open woodland of *A. marina* on saline flats and/or Low scattered *A. marina* and scattered samphires depending on the density of samphires. The association occurs in a zone of change between marine silt and clay sediments and more terrestrial sands and loams.

Total Area: 95.3 ha

Percentage of Project Area: 4.2 %

Two opportunistic sitings of *Gymnanthera cunninghamii* (P3) were recorded in mosaic 11/5 (Figure 4; Map Appendix Sheet 2).

Community 12: Cyanobacterial algal mat community with scattered samphire on red-brown sandy clays on intertidal flats

Total Area: 205.4 ha

Percentage of Project Area: 9.1 %

Sampling: 1 Detailed Recording Site (S02)

Common taxa recorded within each stratum:

Stratum	Descriptor	Taxa
Upper Stratum 1	Algal mat	-

Landform Types: Intertidal zone

S**oil Types:** Red-brown sandy clay

This community is defined by the presence of a coherent mat of algae on the soil surface. Development of the mat varied greatly within the project area from a thin translucent smear or crust to a membrane up to 3mm thick that could be walked on without breaking its integrity (Figure 4; Map Appendix Sheets 1-3, 5 and 6). No algae samples were collected for identification purposes during this survey however the associated samphires included; *Frankenia ambita*, *Hemichroa diandra*, *Muellerolimon salicorniaceum*, *Sporobolus virginicus*, *Suaeda arbusculoides*, *Tecticornia ?halcnemoides* subsp. *tenuis* and *Tecticornia indica* subsp. *bidens* in varying densities as this community tended to merge with FCT 5 where the algal mat was less well developed.

One vascular flora taxon was recorded in Community 12. This species is not a CS flora taxon (Appendix L) (Plate 17). The condition of the vegetation was mapped as 'E' (Excellent) (Appendix D) (Figure 5).

Cyanobacterial mats are found throughout the Pilbara coastline and occur between mangroves and saltmarshes, where they grow in a salinity range greater than that tolerated by either group (Halpern Glick Maunsell Pty Ltd 1993; Paling *et al.* 2003). These mats fix nitrogen and play an important role in providing nutrient input into coastal systems (Paling 1986; Paling *et al.* 1989; Paling and McComb 1994).

The only species noted in the literature as occurring in the Port Hedland area was the unicellular chroococcae of the genus *Aphanocapsa* sp.. The same study recommended further sampling and investigation of the mats, to determine whether there was also an occurrence of more common filamentous forms of cyanobacteria found both in the north at Broome and in the south in Dampier and Onslow (Halpern Glick Maunsell Pty Ltd 1993). Associate Professor Paling indicated both *Microcoleus* and *Phormidium* are present at Port Hedland (Associate Professor E. Paling, personal communications 15 November 2010).

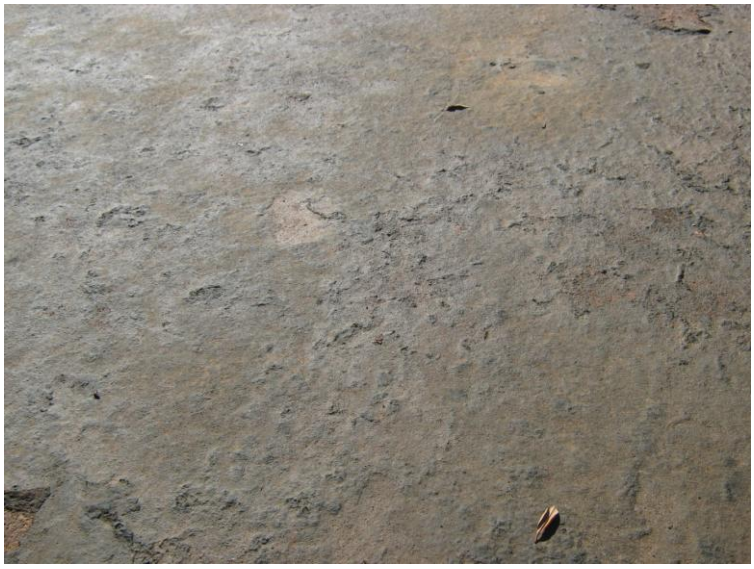

Plate 17: Photograph of Community 12 [note the algal mat as a surface crust] (Woodman Environmental)

C: Cleared Areas

Cleared Areas were mapped where previous disturbance has removed the vegetation, such as roads.

W: Water

Areas mapped with open water were demarcated 'W'.

5. DISCUSSION

5.1 Flora of the Project Area

A total of 176 discrete vascular flora taxa were recorded from within the survey area. This compares to 166 taxa recorded from the 80 km Wodgina Gas Pipeline Project survey area (Woodman Environmental 2001), 110 taxa recorded within the Utah Point survey area (Biota 2008b), 24 taxa at the DMMA A survey area (Biota 2008a) and 51 taxa in the DMMA H survey area (ENV Australia 2009) (much smaller survey areas with fewer community types). The survey results indicate the species richness is comparatively the same in comparison to other surveys in the general area.

Of the six CS flora taxa recorded or known to occur within the project area, *Gomphrena pusilla* (P2) has a limited distribution in the Pilbara region and is poorly known/collected. Only three collections of *Gomphrena pusilla* (P2) from locations near Port Hedland are housed at the WAHerb. This taxon was recorded at opportunistically at three locations within the survey area, within FCTs 3 and 4.

Eragrostis crateriformis (P3) has a relatively widespread distribution through the Pilbara region in Western Australia however collection locations are few and scattered. This taxon was recorded in two locations within the survey area, within FCT 4 and in mosaic 1/2. Observations of this species during the 2011 season, following good rainfall, saw this taxon occurring in a number of locations in reasonable numbers in the Port Hedland area.

Gomphrena leptophylla (P3) has a relatively widespread distribution through the Pilbara and Kimberley regions in Western Australia, however collection locations are scattered. This taxon was recorded at one location within the project area (mosaic 1/2), but as it is an annual taxon it is likely to be more common than indicated by collections held in the WAHerb.

Eleven collections of *Tephrosia rosea var. venulosa* (P1) from the vicinity of Port Hedland are housed at the WAHerb. What is believed to be this taxon (could not be accurately determined due to the absence of reproductive material), was recorded from two quadrats and four opportunistic recordings in the survey area. This species is restricted to the Pilbara region.

Locations of two CS flora taxa from the DEC database occur in the project area, *Gymnanthera cunninghamii* (P3) and *Goodenia nuda* (P4). Two records of *Gymnanthera cunninghamii* occur in the north of the project area, adjacent to mangal communities on a limestone rise/ridge. This taxon has limited collections housed at the WAHerb, but has a wide distribution across the Pilbara region. *Goodenia nuda* is relatively widespread through the Pilbara Region, with only one record known from the Kimberley. This taxon occurs at one location within the project area (mosaic 1/2), a previous record sourced from DEC data.

The recording of *Murdannia graminea* is significant as there is currently only one other record known from within the Pilbara region (also collected in close proximity to Port Hedland). The taxon is otherwise widely known across the Kimberley Region (DEC 2010d). This taxon was recorded in five quadrats within the project area, in mosaic 1/2 and FCT 4. There is a high level of local conservation significance attached to the Pilbara population of this taxon due to its disjunct nature in comparison with the known range of this taxon. Such disjunct populations have the potential to be removed from the taxon and described as a separate entity.

5.2 Vegetation of the Project Area

Supergroup 1 (FCTs 1 – 4) was mapped primarily on red to red-brown sandy-loam to clay-loam on plains, depressions and drainage lines. These FCTs comprised the majority of the communities on the coastal portion of the Abydos Plain and had a higher average species richness than FCT in Supergroup 2. Supergroup 2 was characterised by a species-poor FCT (intertidal samphire community). The mangal communities recorded the lowest species richness overall.

The condition of the vegetation throughout the project area was mapped as 'Excellent' to 'Very Good/Excellent', with one small area mapped as 'Poor' where the cover of introduced taxa was more significant and the level of recent human disturbance was relatively high. There was relatively little introduced taxa encroachment through the Project Area, where weeds have been introduced by grazing of cattle or clearing of access (for example along the tracks and within creek systems).

The project area contains a relatively small area of mangal associated with the South-west Creek. The mangals of Port Hedland have been studied extensively over the last 20 years in relation to impacts from development and operation of the various port infrastructure (Paling *et al*. 2001; Paling *et al*. 2003; Paling in ENVIRON 2004; VSCRG 2007). Table 12 presents the mangrove associations within Port Hedland as designated by Paling (ENVIRON 2004) and their equivalent communities from the project area. The project area contained only a limited number of mangrove associations owing to the smaller area and limited habitat present. The associations present within the project area are among the most common recorded within previous studies of Port Hedland Harbour (ENVIRON 2004).

Table 12: Mangrove Communities within the Project Area and Equivalent Associations from Port Hedland Harbour

Mangrove Associations of Port Hedland Harbour (Paling in ENVIRON 2004)	**Mangrove Communities of the Project Area**
Closed canopy woodland of *Rhizophora stylosa*	Community 10
Closed canopy woodland of *Avicennia marina* (seaward fringe)	Community 11
Closed canopy woodland of *A. marina* (landward margins)	Community 11
Low open woodland of *A. marina* on saline flats	Mosaic 11/5
Low scattered *A. marina* and scattered samphires	Mosaic 11/5

5.2.1 Local and Regional Conservation Significance of Vegetation

Table 13 presents the regional conservation significance ranking of each FCT and community type within the project area (as per Table 7).

On a local scale, FCTs 2 and 3, community types 10, 11, 12, and mosaic 11/5 all have limited distribution within the Project Area (<1% of the total Project Area). Of these, FCT 3 and mosaic 11/5 recorded CS flora taxa. In addition, FCTs 4 and 5, and mosaic ½ recorded CS flora taxa.

FCT 3 has been ranked '4' due to the relatively restricted nature of the landform and soil type which the FCT is located on, and the presence of *Gomphrena pusilla* (P2). FCTs 4 and 5 were ranked '2' due to the presence of CS flora taxa within these FCTs. FCT 2, mosaic 1/2

and 11/5, and community types 10 - 12 have been ranked '1' due to the absence of CS flora taxa recorded, and the non-restricted nature of the landform and soil types that they are associated with.

Table 13: Regional Conservation Significance Rankings of Floristic Community Types and Coastal Community Types

FCT / Mosaic / Community	Conservation Significance Ranking (Woodman Environmental in prep.)	Description
2	1*	• <10 % of survey area • Landform type is not uncommon in region
3	4	• <10% of survey area • *Gomphrena pusilla* (P2) • Landform is uncommon in region (coastal limestone ridge)
4	2	• >10 % of survey area • *Eragrostis crateriformis* (P3) • *Gomphrena pusilla* (P2) • *Tephrosia rosea* ?var. *venulosa* (P1) • Landform is not uncommon in region
5	2	• >10 % of survey area • *Gymnanthera cunninghamii* (P3) • Landform is not uncommon in region (coastal saline flats)
10	1**	• <10% of survey area • Landform is not uncommon in region (mangrove)
11	1**	• <10% of survey area • Landform is not uncommon in region (mangrove)
12	1**	• <10% of survey area • Landform is not uncommon in region (saline coastal flats)
1/2	1	• >30 % of survey area • *Eragrostis crateriformis* (P3) • *Gomphrena leptophylla* (P3) • *Goodenia nuda* (P4) • *Tephrosia rosea* ?var. *venulosa* (P1) • Landform not uncommon in region
11/5	1***	• < 10 % of survey area • *Gymnanthera cunninghamii* (P3) • Landform is not uncommon in region (saline coastal flats / mangrove)

*Note: Although FCT 2 has been mapped as <10 % of the Port survey area, much of this FCT has been mapped as a mosaic with FCT 1

Although community types 10 - 11 have been ranked with a regional conservation significance of '1', mangals and associated communities have significant value in ecological terms and occupy a unique and dynamic habitat, the marine intertidal zone (between mean sea level and the highest astronomical tides). Mangroves are significant contributors to primary productivity for both marine and coastal terrestrial systems.

The EPA Guidance Statement 1 (EPA 2001) addresses the protection of tropical arid zone mangroves and associated habitats along the Pilbara coastline, and encompasses the mangal communities of the project area. Four separate management areas were described as a result of determining the regional significance of mangal areas in the Pilbara, and their interaction with designated industrial areas and associated port areas. The project area lies immediately

east of Area 20 (Turner River Delta), and is in an area to be managed under Guideline 4 (all other mangrove areas inside designated industrial and associated port areas) (Figure 7 within EPA 2001). The operational objective for Guideline 4 areas 'is the reduction of impacts of development on mangrove habitat and ecological function of the mangroves to the minimum practicable level. The EPA would consider the significance of the environmental impacts, but would expect that the proposal in these zones are likely to be capable of being made environmentally acceptable. Accordingly, proposals in these areas will not be subject to a presumption against finding the proposal environmentally acceptable provided that:

- A high priority being placed on protecting tropical arid zone mangroves, habitat and dependent habitats; and
- Any development being planned and designed to keep impacts on mangroves, habitats and dependent habitats to a minimum practical level' (EPA 2001).

5.3 Potential Impacts of the Proposal on Vegetation

The proposed project will potentially directly impact FCTs and benthic intertidal primary producer habitats including mangal communities through clearing for infrastructure. There is also the potential for indirect impacts to vegetation and habitats from:

- Introduction of additional introduced taxa;
- Spread of existing introduced taxa;
- Changed hydrological regimes;
- Increased fire risk;
- Introduction of rubbish and waste products (including hydrocarbon spills); and
- Increased dust deposition.

Changing patterns of tidal flat hydrological flows from causeways, increased sedimentation from loss of terrestrial vegetation and dieback of mangroves from chemical pollutants such as hydrocarbons are the most common indirect impacts on mangroves from human activity (Duke 2006). Apart from direct clearing, the most significant impact to mangroves from coastal developments has been through modifications to near shore tidal flows, primarily restricting the magnitude and frequency of tidal flushing through mangrove stands (Gordon 1987). Tidal movement cleanses the soil of accumulated salts and toxic sulphur compounds and renews the supply of inorganic nutrients and oxygen to mangrove root tissues (Paling 1997).

Infrastructure location and design, particularly with regard to maintaining flow patterns on the tidal plain will be critical to minimising these indirect impacts.

5.3.1 Summary by EPA Guidance

Table 14 presents the potential impact to flora and vegetation of the proposal on significant environmental factors as determined by EPA Guidance Statement 51 (EPA 2004).

Table 14: The Potential Impacts to Flora and Vegetation of the Proposal as Assessed Following the Guidance of the EPA's Guidance Statement No. 51 (EPA 2004)

Factor	Impact and explanation
Degree of degradation or clearing within region	Low (in more extensive ecosystems with more than 50% of vegetation in better Condition)
Size/scale of proposal/impact	High (>50 ha – Bioregion Group 2)
Rarity of vegetation	Low (Vegetation that is naturally more widespread than 10% of local area (15 km radius) and the bioregion)
Significant vegetation unit	Low (Significant vegetation units are not known from the area or found by reconnaissance survey)
Refugia	Low (Refugia are not known from the area or are not found by reconnaissance survey) (FCT 5 and mangals may be refugia)
Rare or Priority flora	Moderate (Priority species are found in the area or in similar vegetation in its immediate vicinity during reconnaissance survey; and/or ii) the vegetation and area characteristics indicate that Priority species may occur. Cumulative impact on the total number of populations should be considered.)
Other significant flora	Moderate (Significant taxa are found in the area or in similar vegetation in its immediate vicinity during reconnaissance survey)
Size of remnant and condition/intactness of vegetation	Low (Area is not in a fragmented environment or an environment with extensive areas of otherwise degraded vegetation, such as some rangeland environments)
Ecological Linkage	Low (vegetation is more or less continuous)
Heterogeneity or complexity of the vegetation	Moderate (The area and/or its immediate surrounds have a similar range of component units relative to the characteristics at the local and regional scale)

Impact assessment of proposals with the potential to impact benthic primary producer habitats, including mangals, are addressed in EPA Environmental Assessment Guideline No. 3 (EPA 2009). Guideline No. 3 established cumulative loss guidelines for each benthic primary producer habitat within defined management categories. However, the guideline states that the cumulative loss guidelines are not intended as hard and fast acceptability criteria for projects.

The EPA has set three overarching environmental protection principles for proponents to address where impact to benthic primary producer habitats is proposed. The principles embody avoidance, engineering design to minimise direct impacts and best practice design to avoid or minimise indirect impacts. Once these principles have been applied, the cumulative loss guidelines must be applied to the proposal within an identified management unit. Development of a benthic primary producer habitat map for the management unit is necessary to form the basis for quantifying impacts against the loss guidelines.

Primary producer habitats for this project encompass FCT 5 (Samphires on intertidal flat), Community 12 (Cyanobacterial mats) and mangal communities 10 and 11.

6. RECOMMENDATIONS

The following recommendations are presented:

1. An impact assessment should be conducted to determine the relative areas of each FCT and community type to be impacted (directly and indirectly) by the project;

2. An impact assessment should be conducted to determine the conservation significant flora taxa which are potentially at risk of impact (both directly and indirectly) by the project;

3. Mapping of benthic primary producer habitats should be conducted within the wider management unit to quantify the cumulative percentage loss as a result of the project in accordance with EPA 2009; and

4. Recommendations for mitigation of impacts should be developed and presented in the impact assessment for the project.

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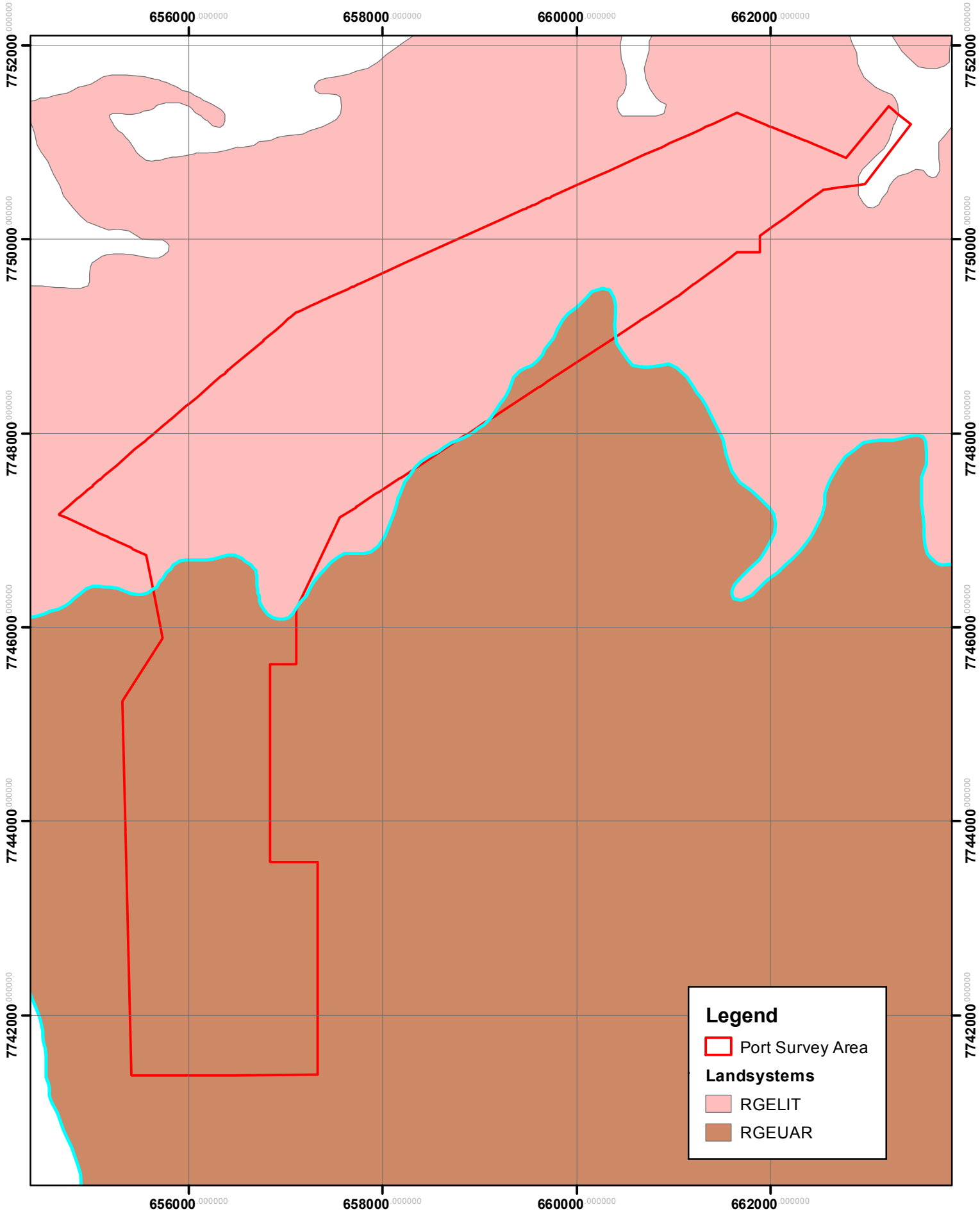

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Figure 3: NWIOA Port Survey Area

Landsystems (Dept. of Agriculture 2004)

This map should only be used in conjunction with WEC report coffey-11-19-01.

Author: Cathy Godden	WEC Ref: Coffey11-19-01	Revision: A - July 2011	Grid: MGA Zone 50
		Filename: Coffey11-19-01-f03.mxd	Scale: 1:50,000 (A4)

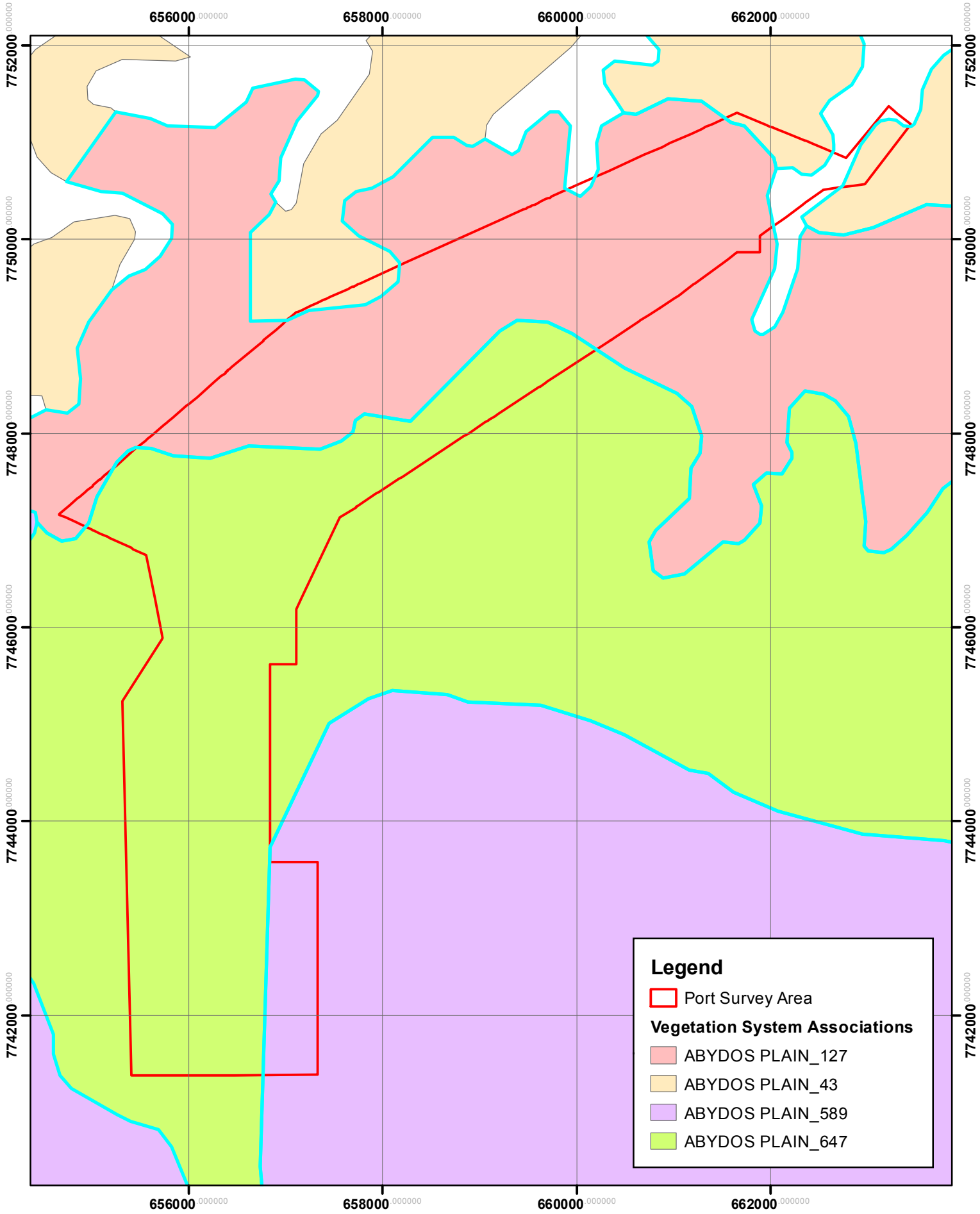

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Figure 2: NWIOA Port Survey Area Vegetation System Associations

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Author: Cathy Godden	WEC Ref: Coffey11-19-01	Revision: A - July 2011	Grid: MGA Zone 50
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Legend

Floristic Community Types

1 Low to mid sparse shrubland of mixed *Acacia* spp. dominated by *Acacia stellaticeps* over low hummock grassland of *Triodia epactia* on red sandy clay loams on plains and low lying areas including supra-tidal plains

2 Low to mid sparse shrubland of *Acacia colei* var. *colei* and *Acacia stellaticeps* over Low Hummock Grassland of *Triodia epactia* with *Eriachne mucronata* on red sand to sandy-loam on plains, drainage lines and low lying areas including supra-tidal plains

3 Tall open shrubland of *Acacia bivenosa* over Low open shrubland dominated by **Aerva javanica*, *Myoporum montanum*, and *Corchorus incanus* subsp. *incanus* over Low grassland dominated by **Cenchrus ciliaris* and *Triodia secunda* and/or *Triodia epactia* on brown sandy loam on limestone ridge

4 Low sparse shrubland of mixed spp. over low closed hummock grassland of *Triodia epactia* and/or *Triodia secunda* on red brown sandy loam on lowerslopes and supra-tidal plain

5 Low open to sparse samphire shrubland dominated by *Tecticornia* spp. and *Muellerolimon salicorniaceum* with sparse tussock grassland of *Sporobolus virginicus* on brown clays on tidal zones

Coastal Communities (not determined using floristic analysis)

10 Closed forest of *Rhizophora stylosa* occurring on brown silt on intertidal flats

11 Closed forest of *Avicennia marina* occurring on brown clay on intertidal flats

12 Cyanobacterial algal matt community with scattered samphire on red-brown sandy clays on intertidal flats

Mosaics

1/2 Mosaic of FCT 1 and FCT 2

11/5 Mosaic of community type 11 and FCT 5 (scattered *Avicennia marina* with occasional *Ceriops australis* and samphire shrubland)

Other

C Cleared

W Water

* # Conservation Significant Flora

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NWIOA Port Survey Area
Community Types, Quadrat Locations and Significant Flora Taxa Locations

Revision: A - July 2011

Author: Cathy Godden

WEC Ref: Coffey11-19-01

Filename: Coffey11-19-01-s04.mxd

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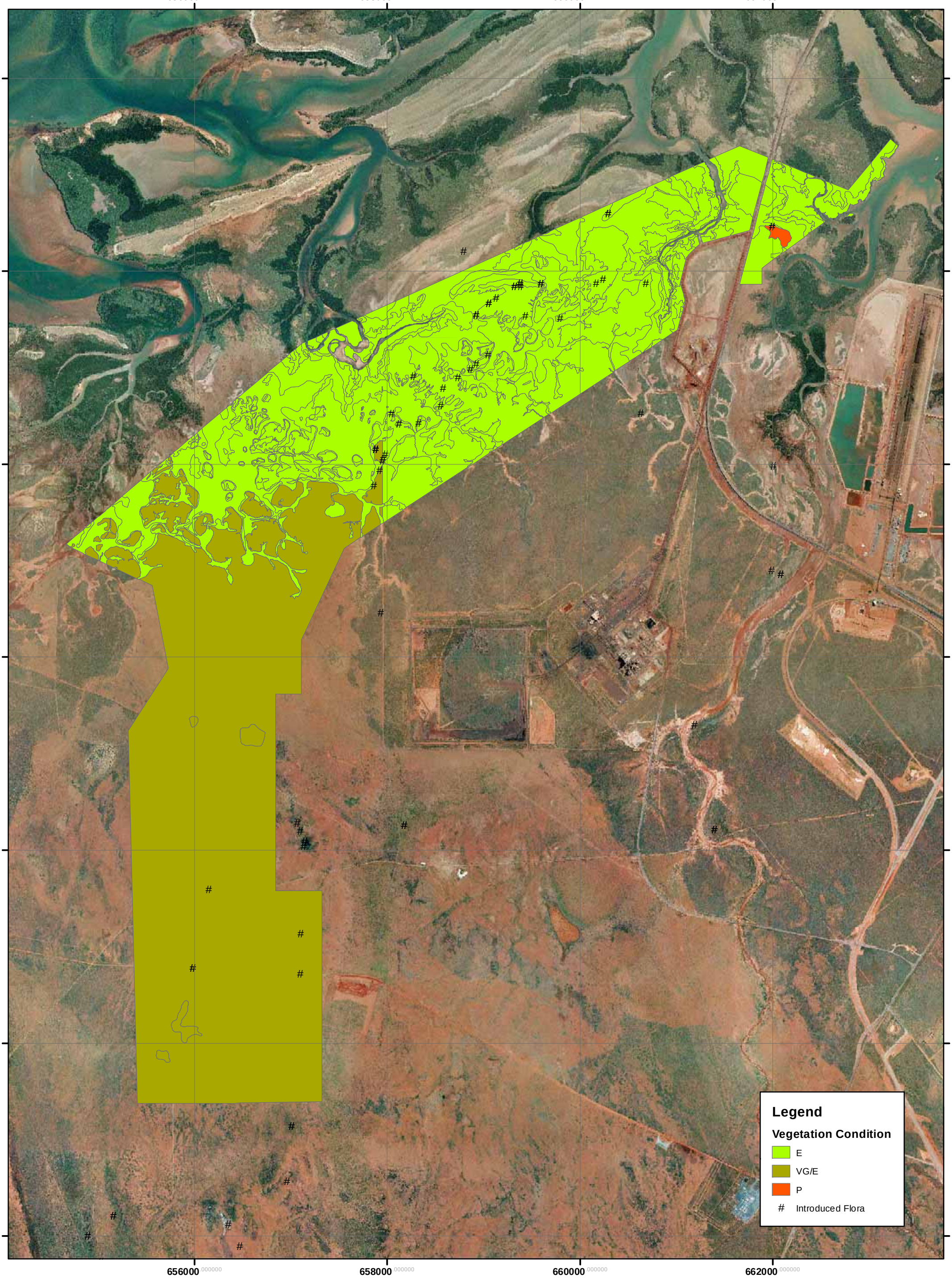

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NWIOA Port Survey Area
Vegetation Condition and
Introduced Flora Locations

Revision: A - July 2011

Author: Cathy Godden

WEC Ref: Coffey11-19-01

Filename: Coffey11-19-01-s05.mxd

Scale: 1:35,000 (A3) Grid: MGA Zone 50

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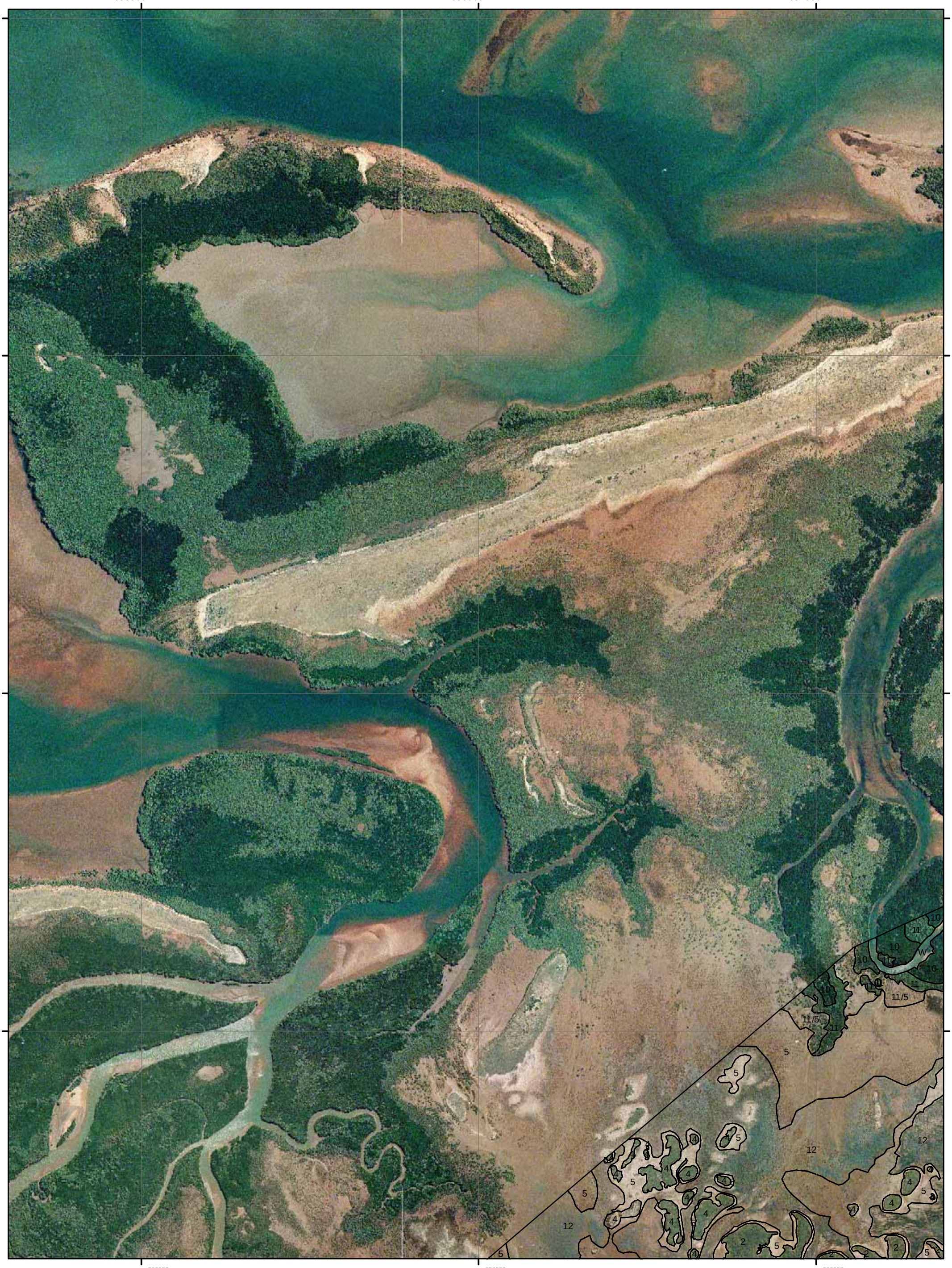

woodmanenvironmentalconsulting This map should only be used in conjunction with WEC report Coffey11-19-01.	**NWIOA Port Survey Area Community Types, Quadrat Locations and Significant Flora Taxa Locations**	Author: Cathy Godden WEC Ref: Coffey11-19-01 Filename: Coffey11-19-01-s04.mxd	**Sheet** 1 of 7
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NWIOA Port Survey Area Community Types, Quadrat Locations and Significant Flora Taxa Locations

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NWIOA Port Survey Area Community Types, Quadrat Locations and Significant Flora Taxa Locations

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Author: Cathy Godden

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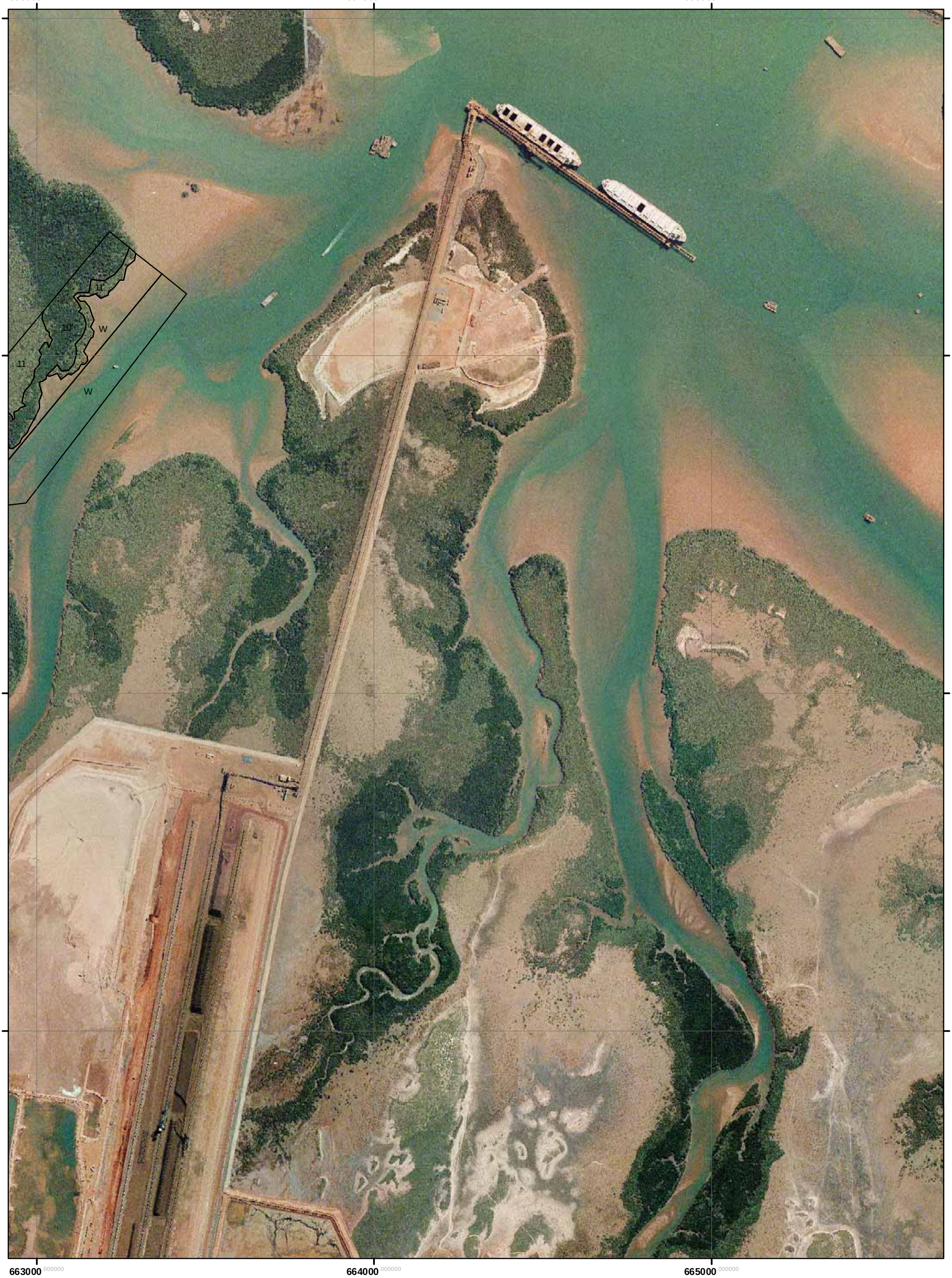

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NWIOA Port Survey Area
Community Types, Quadrat Locations and Significant Flora Taxa Locations

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NWIOA Port Survey Area Community Types, Quadrat Locations and Significant Flora Taxa Locations

Author: Cathy Godden

WEC Ref: Coffey11-19-01

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Appendix A: Definitions, Categories and Criteria for Threatened Ecological Communities and Priority Ecological Communities (Department of Environment and Conservation 2007b)

DEFINITIONS, CATEGORIES AND CRITERIA FOR THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

1. GENERAL DEFINITIONS

Ecological Community
A naturally occurring biological assemblage that occurs in a particular type of habitat.

Note: The scale at which ecological communities are defined will often depend on the level of detail in the information source, therefore no particular scale is specified.

A **threatened ecological community** (TEC) is one which is found to fit into one of the following categories; "presumed totally destroyed", "critically endangered", "endangered" or "vulnerable".

Possible threatened ecological communities that do not meet survey criteria are added to DEC's Priority Ecological Community Lists under Priorities 1, 2 and 3. Ecological Communities that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or 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.

An **assemblage** is a defined group of biological entities.

Habitat is defined as the areas in which an organism and/or assemblage of organisms lives. It includes the abiotic factors (eg. substrate and topography), and the biotic factors.

Occurrence: a discrete example of an ecological community, separated from other examples of the same community by more than 20 metres of a different ecological community, an artificial surface or a totally destroyed community.

By ensuring that every discrete occurrence is recognised and recorded future changes in status can be readily monitored.

Adequately Surveyed is defined as follows:
"An ecological community that has been searched for thoroughly in most likely habitats, by relevant experts."

Community structure is defined as follows:
"The spatial organisation, construction and arrangement of the biological elements comprising a biological assemblage" (eg. *Eucalyptus salmonophloia* woodland over scattered small shrubs over dense herbs; structure in a faunal assemblage could refer to trophic structure, eg. dominance by feeders on detritus as distinct from feeders on live plants).

Definitions of Modification and Destruction of an ecological community:

Modification: "changes to some or all of ecological processes (including abiotic processes such as hydrology), species composition and community structure as a
direct or indirect result of human activities. The level of damage involved could be ameliorated naturally or by human intervention."

Destruction: "modification such that reestablishment of ecological processes, species composition and community structure within the range of variability exhibited by the original community is unlikely within the foreseeable future even with positive human intervention."

Note: Modification and destruction are difficult concepts to quantify, and their application will be determined by scientific judgement. Examples of modification and total destruction are cited below:

Modification of ecological processes: The hydrology of Toolibin Lake has been altered by clearing of the catchment such that death of some of the original flora has occurred due to dependence on fresh water. The system may be bought back to a semblance of the original state by redirecting saline runoff and pumping waters of the rising underground watertable away to restore the hydrological balance. Total destruction of downstream lakes has occurred due to hydrology being altered to the point that few of the original flora or fauna species are able to tolerate the level of salinity and/or water logging.

Modification of structure: The understorey of a plant community may be altered by weed invasion due to nutrient enrichment by addition of fertiliser. Should the additional nutrients be removed from the system the balance may be restored, and the original plant species better able to compete. Total destruction may occur if additional nutrients continue to be added to the system causing the understorey to be completely replaced by weed species, and death of overstorey species due to inability to tolerate high nutrient levels.

Modification of species composition: Pollution may cause alteration of the invertebrate species present in a freshwater lake. Removal of pollutants may allow the return of the original inhabitant species. Addition of residual highly toxic substances may cause permanent changes to water quality, and total destruction of the community.

Threatening processes are defined as follows:
"Any process or activity that threatens to destroy or significantly modify the ecological community and/or affect the continuing evolutionary processes within any ecological community."

Examples of some of the continuing threatening processes in Western Australia include: general pollution; competition, predation and change induced in ecological communities as a result of introduced animals; competition and displacement of native plants by introduced species; hydrological changes; inappropriate fire regimes; diseases resulting from introduced microorganisms; direct human exploitation and disturbance of ecological communities.

Restoration is defined as returning an ecological community to its pre-disturbance or natural state in terms of abiotic conditions, community structure and species composition.

Rehabilitation is defined as the re-establishment of ecological attributes in a damaged ecological community although the community will remain modified.

2. DEFINITIONS AND CRITERIA FOR PRESUMED TOTALLY DESTROYED, CRITICALLY ENDANGERED, ENDANGERED AND VULNERABLE ECOLOGICAL COMMUNITIES

Presumed Totally Destroyed (PD)
An ecological community that has been adequately searched for but for which no representative occurrences have been located. 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.

An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B):

A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or

B) All occurrences recorded within the last 50 years have since been destroyed

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.

An ecological community will be listed as **Critically Endangered** when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting **any one or more** of the following criteria (A, B or C):

A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% **and either or both** of the following apply (i or ii):

i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years);

ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated.

B) Current distribution is limited, **and one or more** of the following apply (i, ii or iii):

i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years);

ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes;

iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes.

C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

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.

An ecological community will be listed as **Endangered** when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting **any one or more** of the following criteria (A, B, or C):

A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement **and either or both** of the following apply (i or ii):

i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years);

ii) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.

B) Current distribution is limited, **and one or more** of the following apply (i, ii or iii):

i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years);

ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes;

iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.

C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

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.

An ecological community will be listed as **Vulnerable** when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting **any one or more** of the following criteria (A, B or C):

A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.

B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.

C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

3. DEFINITIONS AND CRITERIA FOR PRIORITY ECOLOGICAL COMMUNITIES

PRIORITY ECOLOGICAL COMMUNITY LIST

Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community Lists under Priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as threatened ecological communities. Ecological Communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or 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.

Priority One: Poorly-known ecological communities

Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. 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.

Priority Two: Poorly-known ecological communities

Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent 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.

Priority Three: Poorly known ecological communities

(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:
(ii) communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;
(iii) communities made up of large, and/or widespread occurrences, that may or 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.

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.

Priority Four: 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.

(a) 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.

(b) 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.

(c) Ecological communities that have been removed from the list of threatened communities during the past five years.

Priority Five: Conservation Dependent ecological communities

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.

Appendix B: Definitions of Flora Conservation Status Codes (Smith 2010)

R: Declared Rare Flora – Extant Taxa

Taxa which 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.

X: Declared Rare Flor a – Presumed Extinct Taxa

Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such.

1: Priority One – Poorly Known Taxa

Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

2: Priority Two – Poorly Known Taxa

Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

3: Priority Three – Poorly Known Taxa

Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey.

4: Priority Four – Rare Taxa

Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

Appendix C: Environmental Weed Strategy - Criteria for the Assessment and Rating of Weeds in Terms of their Environmental Impact on Biodiversity (Department of Conservation and Land Management 1999)

ENVIRONMENTAL WEEDS RATING

- **Invasiveness-** ability to invade bushland in good to excellent condition or ability to invade waterways (Score as yes or no).
- **Distribution** – wide current or potential distribution including consideration of known history of wide spread distribution elsewhere in the world (Score as yes or no).
- **Environmental Impacts** – ability to change the structure, composition and function of ecosystems; in particular an ability to form a monoculture in a vegetation community (Score as yes or no).

The Rating System used in the Environmental Weed Strategy for Western Australia

High	A weed species would have to score yes for all three criteria. Rating a weed species as high would indicate prioritising this weed for control and/or research.
Moderate	A weed species would have to score yes for two of the above criteria. Rating a weed species as moderate would indicate that control or research effort should be directed to it if funds are available; however it should be monitored (possibly a reasonably high level of monitoring).
Mild	A weed species scoring one of the criteria. A mild rating would indicate monitoring of the weed and control where appropriate.
Low	A weed species would score none of the criteria. A low ranking would mean that this species would require a low level of monitoring.

Appendix D: Vegetation Condition Rankings Scale, Eremaean Province (Keighery 1994)

Condition Ranking	Description
E (Excellent)	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
VG (Very Good)	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
G (Good)	More obvious signs of damage caused by human activities since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
P (Poor)	Still retains basic vegetation structure or ability to regenerate to it after very obvious impacts of human activities since European settlement, such as grazing, patrial clearing, frequent fires or aggressive weeds.
VP (Very Poor)	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
D (Completely Degraded)	Areas that are completely or almost completely without native species in the structure of their vegetation; i.e. areas that are cleared or 'parkland cleared' with their flora comprising of weed or crop species with isolated native trees or shrubs.

Appendix E: Vascular Plant Taxa Recorded within the Port Survey Area, 2010 - 2011

Family	Taxa	Conservation Status
Acanthaceae	*Avicennia marina*	
Aizoaceae	*Trianthema pilosa*	
	Trianthema turgidifolia	
Amaranthaceae	**Aerva javanica*	
	Gomphrena canescens subsp. *canescens*	
	Gomphrena leptophylla	P3
	Gomphrena pusilla ^	P2
	Gomphrena tenella	
	Gomphrena sp.	
	Hemichroa diandra	
	Ptilotus arthrolasius	
	Ptilotus axillaris	
	Ptilotus exaltatus var. *exaltatus*	
	Ptilotus fusiformis	
	Ptilotus polystachyus	
	Ptilotus schwartzii	
Apocynaceae	*Carissa lanceolata*	
	Gymnanthera cunninghamii #	
	Sarcostemma viminale subsp. *australe*	
Asteraceae	*Pluchea ferdinandi-muelleri*	
	Pluchea rubelliflora	
	Pluchea tetranthera	
	Streptoglossa decurrens	
Byblidaceae	*Byblis filifolia*	
Caryophyllaceae	*Polycarpaea corymbosa*	
Celastraceae	*Stackhousia intermedia*	
Centrolepidaceae	*Centrolepis banksii*	
Chenopodiaceae	*Atriplex* sp.	
	Dysphania plantaginella	
	Dysphania sp.	
	Enchylaena tomentosa var. *tomentosa*	
	Neobassia astrocarpa	
	Rhagodia eremaea	
	Salsola australis	
	Suaeda arbusculoides	
	Tecticornia ?*halocnemoides* subsp. *tenuis*	
	Tecticornia indica subsp. *bidens*	
	Tecticornia ?*indica* subsp. *leiostachya*	
	Tecticornia pergranulata subsp. *elongata*	
	Tecticornia ?*pergranulata* subsp. *elongata*	
	Tecticornia sp.	
Cleomaceae	*Cleome viscosa*	

Appendix E: Vascular Plant Taxa Recorded within the Port Survey Area, 2010 - 2011

Family	Taxa	Conservation Status
Commelinaceae	*Commelina ensifolia*	
	?*Murdannia graminea*	
	Murdannia graminea	
Convolvulaceae	*Bonamia linearis*	
	Bonamia ?*linearis*	
	Bonamia media	
	Bonamia ?*media* var. *villosa*	
	Bonamia rosea	
	Bonamia ?*rosea*	
	Evolvulus alsinoides var. *villosicalyx*	
	Ipomoea muelleri	
	Ipomoea polymorpha	
	Polymeria ambigua	
Cucurbitaceae	*Cucumis maderaspatanus*	
Cyperaceae	*Bulbostylis barbata*	
	Cyperaceae sp.	
	Cyperus blakeanus	
	Cyperus ?*blakeanus*	
	Cyperus bulbosus	
	Cyperus ?*carinatus*	
	Cyperus castaneus var. *brevimucronatus*	
	Cyperus iria	
	Cyperus squarrosus	
	Fimbristylis dichotoma	
	Fimbristylis ?*dichotoma*	
	Fimbristylis neilsonii	
	Fimbristylis oxystachya	
	Fimbristylis rara	
	Lipocarpha microcephala	
	Schoenoplectus laevis	
Elatinaceae	*Bergia ammannioides*	
	Bergia henshallii	
	Bergia pedicellaris	
Euphorbiaceae	*Adriana tomentosa* var. *tomentosa*	
	Euphorbia alsiniflora	
	Euphorbia australis	
	Euphorbia tannensis subsp. *eremophila*	
Fabaceae	*Acacia bivenosa*	
	Acacia colei var. *colei*	
	Acacia sericophylla	
	Acacia stellaticeps	
	Acacia tumida var. *pilbarensis*	
	Cajanus marmoratus	
	Crotalaria ramosissima	

Appendix E: Vascular Plant Taxa Recorded within the Port Survey Area, 2010 - 2011

Family	Taxa	Conservation Status
Fabaceae (cont.)	*Desmodium filiforme*	
	Glycine tomentella	
	Indigofera colutea	
	Indigofera linifolia	
	Indigofera monophylla	
	Indigofera trita	
	Rhynchosia minima	
	Senna glutinosa subsp. *glutinosa*	
	Senna notabilis	
	Swainsona stenodonta	
	Tephrosia leptoclada	
	Tephrosia ?*leptoclada*	
	Tephrosia rosea var. ?*venulosa ms*	P1
Frankeniaceae	*Frankenia ambita*	
	Frankenia ?*ambita*	
Goodeniaceae	*Goodenia lamprosperma*	
	Goodenia nuda #	
	Goodenia triodiophila	
	Scaevola amblyanthera var. *centralis*	
	Scaevola spinescens	
Hemerocallidaceae	*Corynotheca pungens*	
Lauraceae	*Cassytha capillaris*	
Loganiaceae	*Mitrasacme connata*	
	Mitrasacme exserta	
Lythraceae	*Ammannia multiflora*	
	Nesaea muelleri	
	Rotala diandra	
Malvaceae	*Corchorus elachocarpus*	
	Corchorus incanus subsp. *incanus*	
	Corchorus ?*incanus* subsp. *incanus*	
	Corchorus trilocularis	
	Hibiscus leptocladus	
	Hibiscus sturtii var. ?*campylochlamys*	
	Melhania oblongifolia	
	Sida fibulifera	
	Sida rohlenae subsp. *rohlenae*	
	Sida sp. Pilbara (A.A. Mitchell PRP 1543) PN	
	Sida ?sp. Pilbara (A.A. Mitchell PRP 1543) PN	
	Sida sp. Rabbit Flat (B.J. Carter 626) PN	
	Sida ?sp. Rabbit Flat (B.J. Carter 626) PN	
	Waltheria indica	
	Sida aff. *cardiophylla*	
	Sida sp.	
Marsileaceae	*Marsilea drummondii*	

Appendix E: Vascular Plant Taxa Recorded within the Port Survey Area, 2010 - 2011

Family	Taxa	Conservation Status
Molluginaceae	*Mollugo molluginea*	
Nyctaginaceae	*Boerhavia coccinea*	
	Boerhavia gardneri	
	Boerhavia repleta	
	Boerhavia sp.	
Phrymaceae	*Mimulus gracilis*	
Phyllanthaceae	*Phyllanthus maderaspatensis*	
Plantaginaceae	*Stemodia lathraia*	
Plumbaginaceae	*Muellerolimon salicorniaceum*	
Poaceae	*Aristida holathera*	
	Aristida holathera var. *holathera*	
	Aristida hygrometrica	
	**Cenchrus ciliaris*	
	**Cenchrus setiger* ^	
	Chrysopogon fallax	
	Dactyloctenium radulans	
	Digitaria brownii	
	Elytrophorus spicatus	
	Enneapogon lindleyanus	
	Eragrostis crateriformis	P3
	Eragrostis cumingii	
	Eragrostis eriopoda	
	Eragrostis falcata	
	Eragrostis speciosa	
	Eriachne aristidea	
	Eriachne ?mucronata	
	Eriachne mucronata	
	Eriachne obtusa	
	Eulalia aurea	
	Panicum ?decompositum	
	Paspalidium rarum	
	Schizachyrium fragile	
	Sorghum ?plumosum	
	Sporobolus mitchellii	
	Sporobolus virginicus	
	Triodia epactia	
	Triodia lanigera	
	Triodia schinzii	
	Triodia ?secunda	
	Triodia secunda	
	Urochloa holosericea subsp. *velutina*	
	Whiteochloa cymbiformis	
	Yakirra australiensis	
Polygalaceae	*Polygala linariifolia*	

Appendix E: Vascular Plant Taxa Recorded within the Port Survey Area, 2010 - 2011

Family	Taxa	Conservation Status
Portulacaceae	*Calandrinia pumila*	
	Calandrinia quadrivalvis	
	Calandrinia sp. Pinga (T.R. Lally TRL 722) PN	
	Calandrinia ?*stagnensis*	
	Calandrinia sp.	
	**Portulaca oleracea*	
	Portulaca pilosa	
	Portulaca sp.	
Proteaceae	*Grevillea pyramidalis* subsp. *leucadendron*	
	Hakea lorea subsp. *lorea*	
Rhizophoraceae	*Rhizophora stylosa*	
Sapindaceae	*Dodonaea coriacea*	
Scrophulariaceae	*Myoporum montanum*	
	Peplidium ?*muelleri*	
Solanaceae	*Solanum diversiflorum*	
	Solanum ellipticum	
	Solanum phlomoides	
Stylidiaceae	?*Stylidium desertorum*	
Violaceae	*Hybanthus* aff. *aurantiacus*	
	Hybanthus aurantiacus	
Zygophyllaceae	*Tribulopis angustifolia*	
	Tribulus hirsutus	

* Denotes Introduced taxa

Appendix F: Location Details of Conservation Significant Flora and Introduced Flora Recorded within the Project Area, 2010 - 2011

Taxon	Status	Latitude	Longitude	Zone	Easting	Northing	Abundance
Eragrostis crateriformis	P3	-20.36508	118.50653	50	657238	7747399	1
Eragrostis crateriformis	P3	-20.38395	118.49470	50	655984	7745321	0.1%
Gomphrena leptophylla	P3	-20.37164	118.49599	50	656131	7746683	
Gomphrena pusilla	P2	-20.34400	118.52446	50	659132	7749715	30
Gomphrena pusilla	P2	-20.34281	118.52689	50	659386	7749844	5000
Gomphrena pusilla	P2	-20.34272	118.52618	50	659312	7749855	5000
Goodenia nuda	P4	-20.38576	118.49276	50	655780	7745123	
Gymnanthera cunninghamii	P3	-20.33794	118.53119	50	659840	7750379	
Gymnanthera cunninghamii	P3	-20.33795	118.53119	50	659840	7750378	
Gymnanthera cunninghamii	P3	-20.34222	118.51999	50	658667	7749916	
Tephrosia rosea ?var. *venulosa*	P1	-20.36075	118.51283	50	657900	7747872	8
Tephrosia rosea ?var. *venulosa*	P1	-20.37020	118.50252	50	656814	7746836	5
Tephrosia rosea ?var. *venulosa*	P1	-20.37064	118.50348	50	656914	7746786	20
Tephrosia rosea ?var. *venulosa*	P1	-20.37225	118.50306	50	656869	7746608	100
Tephrosia rosea ?var. *venulosa*	P1	-20.37246	118.50265	50	656826	7746585	2
Tephrosia rosea ?var. *venulosa*	P1	-20.37260	118.50266	50	656827	7746570	100
Aerva javanica	Introduced	-20.34553	118.52249	50	658924	7749547	1
Aerva javanica	Introduced	-20.35819	118.51263	50	657882	7748155	
Aerva javanica	Introduced	-20.35819	118.51263	50	657882	7748155	
Aerva javanica	Introduced	-20.35909	118.51339	50	657960	7748055	100
Aerva javanica	Introduced	-20.35016	118.52254	50	658925	7749035	1
Aerva javanica	Introduced	-20.36020	118.51303	50	657922	7747933	50
Aerva javanica	Introduced	-20.34282	118.52622	50	659317	7749844	500
Aerva javanica	Introduced	-20.33594	118.53548	50	660290	7750596	200
Aerva javanica	Introduced	-20.34258	118.52887	50	659593	7749868	500
Aerva javanica	Introduced	-20.33706	118.55179	50	661992	7750456	
Aerva javanica	Introduced	-20.34446	118.52370	50	659052	7749665	10
Aerva javanica	Introduced	-20.34257	118.52682	50	659379	7749871	
Aerva javanica	Introduced	-20.34281	118.52689	50	659386	7749844	100
Cenchrus ciliaris	Introduced	-20.40363	118.50561	50	657103	7743132	1
Cenchrus ciliaris	Introduced	-20.35819	118.51263	50	657882	7748155	
Cenchrus ciliaris	Introduced	-20.35930	118.51330	50	657951	7748032	3
Cenchrus ciliaris	Introduced	-20.35867	118.51360	50	657983	7748101	12
Cenchrus ciliaris	Introduced	-20.35064	118.52193	50	658861	7748982	30
Cenchrus ciliaris	Introduced	-20.35819	118.51263	50	657882	7748155	
Cenchrus ciliaris	Introduced	-20.40695	118.49490	50	655982	7742775	25
Cenchrus ciliaris	Introduced	-20.34553	118.52249	50	658924	7749547	50
Cenchrus ciliaris	Introduced	-20.33706	118.55179	50	661992	7750456	
Cenchrus ciliaris	Introduced	-20.34213	118.53507	50	660241	7749912	100
Cenchrus ciliaris	Introduced	-20.34248	118.53435	50	660166	7749873	1
Cenchrus ciliaris	Introduced	-20.34257	118.52682	50	659379	7749871	
Cenchrus ciliaris	Introduced	-20.34258	118.52887	50	659593	7749868	1000
Cenchrus ciliaris	Introduced	-20.34282	118.52622	50	659317	7749844	100000
Cenchrus ciliaris	Introduced	-20.35142	118.52073	50	658735	7748897	100
Cenchrus ciliaris	Introduced	-20.34446	118.52370	50	659052	7749665	50
Cenchrus ciliaris	Introduced	-20.35583	118.51491	50	658122	7748414	15
Cenchrus ciliaris	Introduced	-20.34563	118.52734	50	659431	7749532	
Cenchrus ciliaris	Introduced	-20.34579	118.53083	50	659795	7749510	20
Cenchrus ciliaris	Introduced	-20.34926	118.52373	50	659050	7749133	350
Cenchrus ciliaris	Introduced	-20.33594	118.53548	50	660290	7750596	5
Cenchrus ciliaris	Introduced	-20.35131	118.51632	50	658274	7748914	100
Cenchrus ciliaris	Introduced	-20.40742	118.50563	50	657101	7742713	5

Cenchrus ciliaris	Introduced	-20.35408	118.51906	50	658557	7748604	250
Cenchrus ciliaris	Introduced	-20.35488	118.51419	50	658048	7748520	50
Cenchrus ciliaris	Introduced	-20.35573	118.51687	50	658327	7748424	250
Cenchrus ciliaris	Introduced	-20.34400	118.52446	50	659132	7749715	1000
Cenchrus setiger	Introduced	-20.40695	118.49490	50	655982	7742775	25
Portulaca oleracea	Introduced	-20.35243	118.51927	50	658581	7748787	2
Portulaca oleracea	Introduced	-20.34247	118.53930	50	660682	7749870	10
Portulaca oleracea	Introduced	-20.39956	118.49643	50	656149	7743591	30

Appendix G: List of Vascular Plant Taxa Omitted or Grouped Together Within the Data Matrix for Analysis

Taxon	Analysis Code	Amalgamated / Deleted
Abutilon ?dioicum ms	ABUDIO	Amalgamated
Abutilon dioicum ms		
Alternanthera ?nana	ALTNAN	Amalgamated
Alternanthera nana		
Aristida ?contorta	ARICON	Amalgamated
Aristida contorta		
Aristida holathera	ARIHOL	Amalgamated
Aristida holathera var. *holathera*		
Aristida ?holathera var. *holathera*		
Aristida ?latifolia	ARILAT	Amalgamated
Aristida latifolia		
Boerhavia ?coccinea	BOECOC	Amalgamated
Boerhavia coccinea		
Bonamia ?linearis	BONLIN	Amalgamated
Bonamia linearis		
Bonamia ?media	BONMED	Amalgamated
Bonamia media		
Bonamia media var. *villosa*		
Bonamia ?media var. *villosa*		
Bonamia ?rosea	BONROS	Amalgamated
Bonamia rosea		
Calandrinia ?stagnensis	CALSTA	Amalgamated
Calandrinia stagnensis		
Chloris ?pumilio	CHLPUM	Amalgamated
Chloris pumilio		
Corymbia ?candida	CORCAN	Amalgamated
Corymbia candida		
Corymbia ?flavescens	CORFLA	Amalgamated
Corymbia flavescens		
Corymbia ?hamersleyana	CORHAM	Amalgamated
Corymbia hamersleyana		
Corchorus ?incanus subsp. *incanus*	CORINCIN	Amalgamated
Corchorus incanus subsp. *incanus*		
Cyperus ?blakeanus	CYPBLA	Amalgamated
Cyperus blakeanus		
Dysphania ?rhadinostachya	DYSRHA	Amalgamated
Dysphania rhadinostachya subsp. *rhadinostach*		
Eriachne ?benthamii	ERIBEN	Amalgamated
Eriachne benthamii		
Eriachne ?mucronata	ERIMUC	Amalgamated
Eriachne ?mucronata		
Eriachne mucronata		
Fimbristylis ?dichotoma	FIMDIC	Amalgamated
Fimbristylis dichotoma		
Frankenia ?ambita	FRAAMB	Amalgamated
Frankenia ambita		

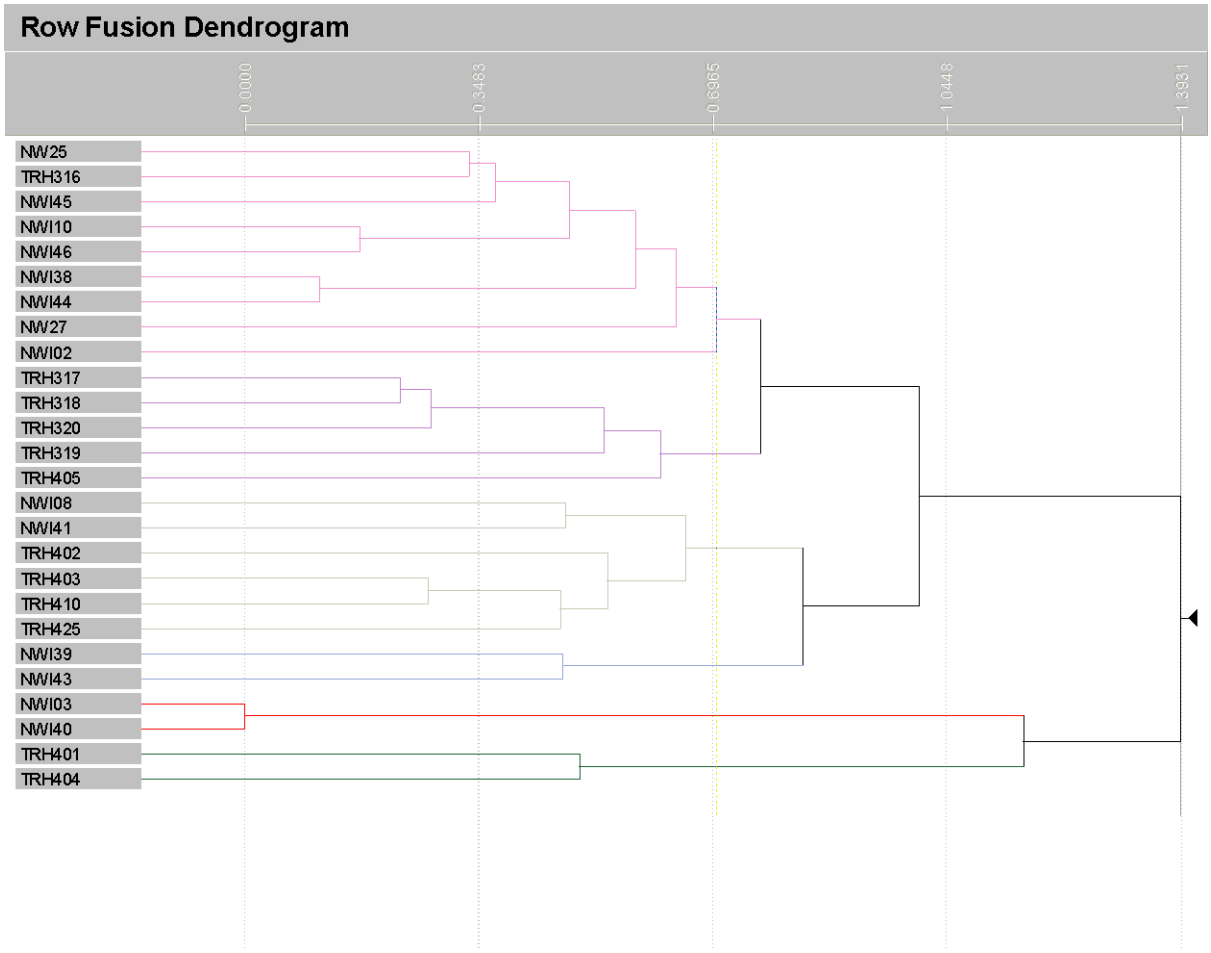
Appendix G: List of Vascular Plant Taxa Omitted or Grouped Together Within the Data Matrix for Analysis

Taxon	Analysis Code	Amalgamated / Deleted
?*Goodenia microptera*	GOOMIC	Amalgamated
Goodenia microptera		
Goodenia triodiophila	GOOTRI	Amalgamated
Goodenia ?*triodiophylla*		
Heliotropium ?*cunninghamii*	HELCUN	Amalgamated
Heliotropium cunninghamii		
Hibiscus ?*sturtii* var. *campylochlamys*	HIBSTU	Amalgamated
Hibiscus sturtii var. ?*campylochlamys*		
Hibiscus sturtii var. ?*campylochlamys*		
Hibiscus sturtii var. *campylochlamys*		
Hybanthus aff.*aurantiacus*	HYBAUR	Amalgamated
Hybanthus aurantiacus		
?*Murdannia graminea*	MURGRA	Amalgamated
Murdannia graminea		
Panicum ?*decompositum*	PANDEC	Amalgamated
Panicum decompositum		
Peplidium ?*muelleri*	PEPMUE	Amalgamated
Peplidium muelleri		
Pluchea ?*rubelliflora*	PLURUB	Amalgamated
Pluchea rubelliflora		
Ptilotus astrolasius	PTIAST	Amalgamated
Ptilotus astrolasius var. *astrolasius*		
Scaevola parvifolia	SCAPAR	Amalgamated
Scaevola parvifolia subsp. *pilbarae*		
Scaevola parvifolia subsp. ?*pilbarae*		
Sida ?*sp. Pilbara (A.A. Mitchell PRP 1543)*	SIDSP	Amalgamated
Sida ?*sp. Pilbara (A.A. Mitchell PRP 1543)*		
Sida sp. Pilbara (A.A. Mitchell PRP 1543) PN		
Sida ?*sp. Rabbit Flat (B.J. Carter 626)*	SIDSP1	Amalgamated
Sida sp. Rabbit Flat (B.J. Carter 626) PN		
Solanum ?*ellipticum*	SOLELL	Amalgamated
Solanum ?*ellipticum*		
Solanum ellipticum		
?*Stemodia viscosa*	STEVIS	Amalgamated
Stemodia viscosa		
Tecticornia ?*pergranulata* subsp. *elongata*	TECPERE	Amalgamated
Tecticornia pergranulata subsp. *elongata*		
Tephrosia ?*leptoclada*	TEPLEP	Amalgamated
Tephrosia leptoclada		
Triumfetta ?*chaetocarpa*	TRICHA	Amalgamated
Triumfetta chaetocarpa		
Triodia ?*lanigera*	TRILAN	Amalgamated
Triodia lanigera		
Triodia ?*secunda*	TRISEC	Amalgamated
Triodia secunda		

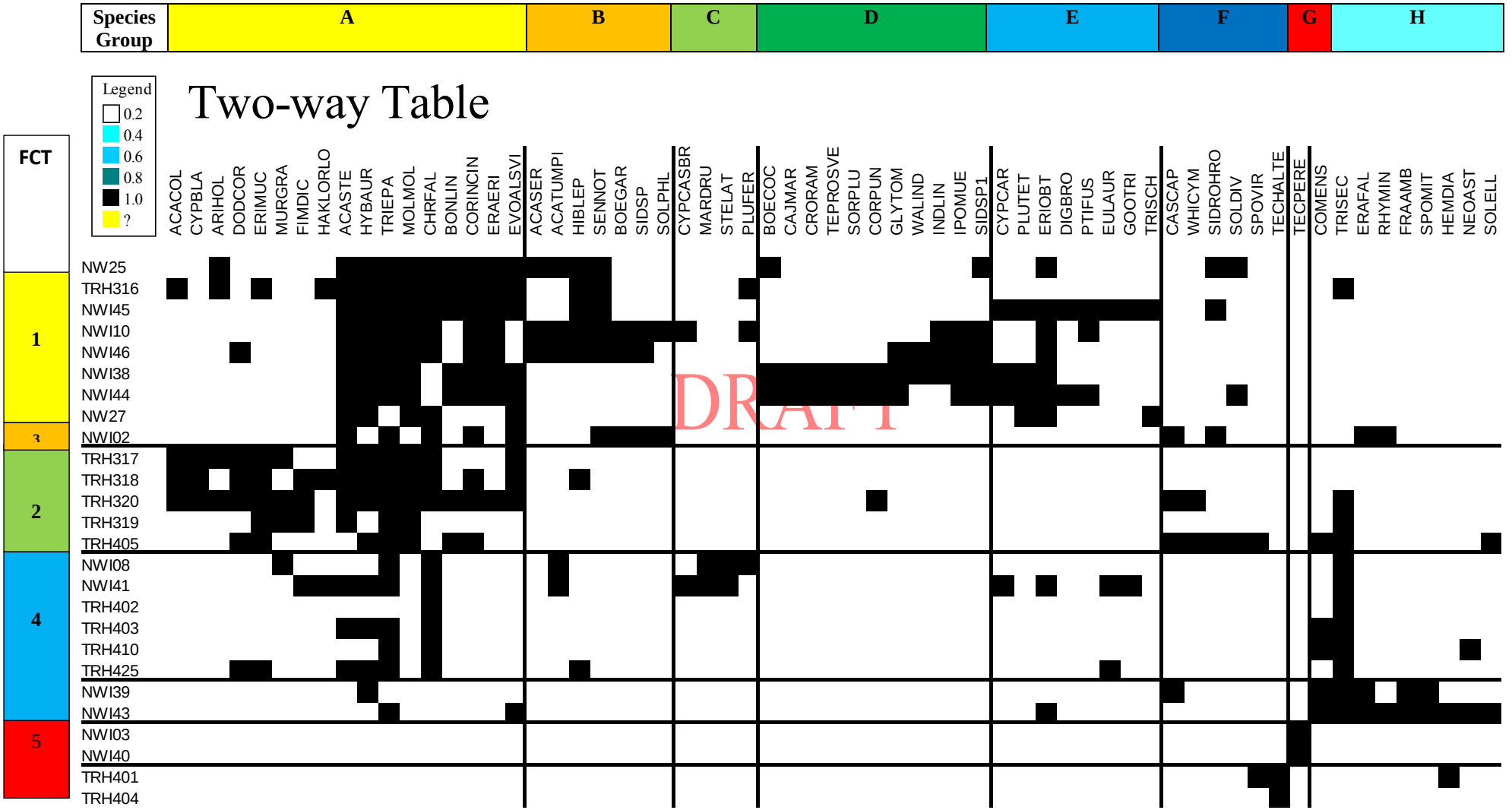
Appendix G: List of Vascular Plant Taxa Omitted or Grouped Together Within the Data Matrix for Analysis

Taxon	Analysis Code	Amalgamated / Deleted
?Asteraceae/Goodeniaceae sp.		Deleted
Atriplex sp.		Deleted
Boerhavia sp.		Deleted
Calandrinia sp.		Deleted
Corchorus sp.		Deleted
Cyperaceae sp.		Deleted
Dicot sp.		Deleted
Dysphania sp.		Deleted
Gomphrena sp.		Deleted
?Goodeniaceae sp.		Deleted
?*Hibiscus* sp.		Deleted
Keraudrenia sp.		Deleted
Malvaceae sp.		Deleted
Poaceae sp.		Deleted
Portulaca sp.		Deleted
Senna artemisioides subsp. oligophylla x *helmsii*		Deleted
Sida sp.		Deleted
Tecticornia sp.		Deleted
?*Trifumfetta* sp.		Deleted

Appendix H: Summary Dendrogram of the Floristic Community Types of the Port Survey Area



Appendix I: Two Way Table – Ordination of Quadrat Data (PATN: Belbin 1989)



Appendix J: Significant Indicator Taxa of the Five-Group Classification of Floristic Community Types

Note: Shading denotes highest indicator values per taxon. Indicator values (%) are shown only for taxa which were significant at P<0.05 (* = p <0.05; ** = p <0.01; *** = p <0.001).

FCT 3 has no indicator taxa due its representation by a single quadrat

	FCT				
Taxa	**1**	**2**	**3**	**4**	**5**
Acacia colei var. *colei* *	2	50	0	0	0
Acacia stellaticeps **	46	29	0	6	0
Corchorus incanus subsp. *incanus* *	52	24	0	0	0
Cyperus blakeanus **	0	60	0	0	0
Dodonaea coriacea **	1	61	0	1	0
Eragrostis eriopoda ***	71	4	0	0	0
Eriachne mucronata ***	1	80	0	1	0
Eriachne obtusa ***	68	0	0	6	0
Fimbristylis dichotoma *	0	50	0	2	0
Hybanthus aurantiacus **	43	28	0	11	0
Ipomoea muelleri *	50	0	0	0	0
Mollugo molluginea **	50	50	0	0	0
Murdannia graminea *	0	50	0	0	0
Pluchea tetranthera *	50	0	0	0	0
Senna notabilis **	63	0	0	0	0
Sida sp. Rabbit Flat (B.J. Carter 626) PN **	63	0	0	0	0
Tecticornia ?halocnemoides subsp. *tenuis* *	0	0	0	0	50
Tecticornia pergranulata subsp. *elongata* *	0	0	0	0	50
Triodia epactia *	29	38	0	21	0
Triodia secunda ***	1	21	0	58	0

Appendix K: Raw Quadrat Data (2010 - 2011)

Site Name:	NWI-02
Site Type:	QUADRAT
Dimensions:	50m x 50m
Survey Date:	07/04/2011
GPS Location:	GDA94 (Zone 50) 659379E 7749871N
Community:	
Landform Type:	Ridge
Slope Class:	Moderately Inclined (10 degrees)
Aspect:	
Soil Type:	Clay Loam
Soil Colour:	Brown
Soil Depth:	
Rock Outcrop:	Limestone, 20-50% bedrock exposed
CF Abundance:	20-50%
CF Sizes:	6-20mm, 20-60mm, 60-200mm, 200-600mm
CF Types:	Limestone
Vegetation Condition:	E - Excellent
Disturbance:	
Fire:	> 10 years

DOMINANT TAXA IN VEGETATION STRATA

Upper Stratum 1: *Acacia bivenosa*

Mid Stratum 1: *Acacia stellaticeps*, *Adriana tomentosa* var. *tomentosa*, **Aerva javanica*, **Cenchrus ciliaris*, *Chrysopogon fallax*, *Corchorus incanus* subsp. *incanus*, *Enneapogon lindleyanus*, *Eragrostis falcata*, *Myoporum montanum*, *Rhagodia eremaea*, *Senna glutinosa* subsp. *glutinosa*, *Sida rohlenae* subsp. *rohlenae*, *Sida* ?sp. Pilbara (A.A. Mitchell PRP 1543), *Solanum phlomoides*, *Triodia epactia*

Lower Stratum 1: *Boerhavia gardneri*, *Bulbostylis barbata*, *Cassytha capillaris*, *Cleome viscosa*, *Corchorus elachocarpus*, *Dysphania* sp., *Euphorbia tannensis* subsp. *eremophila*, *Evolvulus alsinoides* var. *villosicalyx*, *Gomphrena* sp., *Gomphrena tenella*, *Indigofera colutea*, *Indigofera trita*, *Phyllanthus maderaspatensis*, **Portulaca oleracea*, *Portulaca pilosa*, *Ptilotus axillaris*, *Rhynchosia minima*, *Scaevola amblyanthera* var. *centralis*, *Senna notabilis*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Acacia bivenosa	2.2	0.3
Acacia stellaticeps	0.6	0.2
Adriana tomentosa var. *tomentosa*	1.1	0.1

**Aerva javanica*	0.7	0.1
Boerhavia gardneri		0.1
Bulbostylis barbata	0.1	0.1
Cassytha capillaris		0.1
**Cenchrus ciliaris*	0.6	0.1
Chrysopogon fallax	0.7	0.1
Cleome viscosa	0.4	0.1
Corchorus elachocarpus	0.3	0.1
Corchorus incanus subsp. *incanus*	0.4	0.2
Dysphania sp.	0.05	0.1
Enneapogon lindleyanus	0.3	0.1
Eragrostis falcata	0.5	0.1
Euphorbia tannensis subsp. *eremophila*	0.2	0.1
Evolvulus alsinoides var. *villosicalyx*	0.2	0.1
Gomphrena sp.	0.1	0.1
Gomphrena tenella	0.2	0.1
Indigofera colutea	0.1	0.1
Indigofera trita	0.3	0.1
Myoporum montanum	0.6	0.1
Phyllanthus maderaspatensis	0.2	0.1
**Portulaca oleracea*	0.1	0.1
Portulaca pilosa	0.1	0.1
Ptilotus axillaris		0.1
Rhagodia eremaea	0.6	0.1
Rhynchosia minima		0.1
Scaevola amblyanthera var. *centralis*	0.2	0.1
Senna glutinosa subsp. *glutinosa*	1.1	0.1
Senna notabilis	0.1	0.1
Sida rohlenae subsp. *rohlenae*	0.5	0.1
Sida ?sp. Pilbara (A.A. Mitchell PRP 1543)	0.9	0.1
Solanum phlomoides	0.5	0.1
Triodia epactia	0.5	50

Site Name:	NWI-03
Site Type:	QUADRAT
Dimensions:	50m x 50m
Survey Date:	07/04/2011
GPS Location:	GDA94 (Zone 50) 659723E 7749189N
Community:	
Landform Type:	Wetland
Slope Class:	Level (0 degrees)
Aspect:	
Soil Type:	Sandy clay (other)
Soil Colour:	Red
Soil Depth:	
Rock Outcrop:	No bedrock exposed
CF Abundance:	0%
CF Sizes:	
CF Types:	
Vegetation Condition:	VG - Very Good
Disturbance:	Vehicle tracks (other)
Fire:	>5

DOMINANT TAXA IN VEGETATION STRATA

Lower Stratum 1: *Tecticornia* ?*pergranulata* subsp. *elongata*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Tecticornia ?*pergranulata* subsp. *elongata*	0.3	2

Site Name:	NWI-08
Site Type:	QUADRAT
Dimensions:	50m x 50m
Survey Date:	05/04/2011
GPS Location:	GDA94 (Zone 50) 655936E 7742117N
Community:	
Landform Type:	Flat/Closed depression (other)
Slope Class:	Level (0 degrees)
Aspect:	
Soil Type:	Sandy clay (other)
Soil Colour:	Red
Soil Depth:	
Rock Outcrop:	No bedrock exposed
CF Abundance:	0%
CF Sizes:	
CF Types:	
Vegetation Condition:	E - Excellent
Disturbance:	
Fire:	greater than 5 years

DOMINANT TAXA IN VEGETATION STRATA

Upper Stratum 1:	*Acacia tumida* var. *pilbarensis*
Mid Stratum 1:	*Chrysopogon fallax*, *Pluchea ferdinandi-muelleri*, *Triodia epactia*
Mid Stratum 2:	*Triodia epactia*
Lower Stratum 1:	*Bergia ammannioides*, *Bergia pedicellaris*, *Byblis filifolia*, *Calandrinia pumila*, *Calandrinia quadrivalvis*, *Centrolepis banksii*, *Cyperus iria*, *Cyperus squarrosus*, *Elytrophorus spicatus*, *Eriachne aristidea*, *Fimbristylis rara*, *Lipocarpha microcephala*, *Marsilea drummondii*, *Mimulus gracilis*, *Mitrasacme exserta*, *Murdannia graminea*, *Nesaea muelleri*, *Peplidium* ?*muelleri*, *Rotala diandra*, *Schoenoplectus laevis*, *Stemodia lathraia*, *Triodia* ?*secunda*
Lower Stratum 2:	0.1m, 20%, herbs (various)

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Acacia tumida var. *pilbarensis*	1	0.1
Bergia ammannioides	0.02	0.1
Bergia pedicellaris	0.03	0.1
Byblis filifolia	0.1	0.1
Calandrinia pumila	0.03	0.1

Calandrinia quadrivalvis	0.1	0.1
Centrolepis banksii	0.02	0.1
Chrysopogon fallax	1.2	0.1
Cyperus iria	0.4	0.1
Cyperus squarrosus	0.1	0.1
Elytrophorus spicatus	0.2	0.1
Eriachne aristidea	0.15	0.1
Fimbristylis rara	0.2	0.1
Lipocarpha microcephala	0.1	0.1
Marsilea drummondii	0.1	0.1
Mimulus gracilis	0.1	0.1
Mitrasacme exserta	0.2	0.1
Murdannia graminea	0.2	0.1
Nesaea muelleri	0.1	0.1
Peplidium ?muelleri	0.02	0.1
Pluchea ferdinandi-muelleri	1	0.1
Rotala diandra	0.1	0.1
Schoenoplectus laevis	0.2	0.1
Stemodia lathraia	0.05	0.1
Triodia epactia	0.6	60
Triodia ?secunda	0.2	0.5

Site Name:	NWI-10
Site Type:	QUADRAT
Dimensions:	50m x 50m
Survey Date:	05/04/2011
GPS Location:	GDA94 (Zone 50) 655561E 7741478N
Community:	
Landform Type:	Simple slope/plain (other)
Slope Class:	Very Gently Inclined (1 degree)
Aspect:	W
Soil Type:	Sand
Soil Colour:	Red
Soil Depth:	
Rock Outcrop:	No bedrock exposed
CF Abundance:	0%
CF Sizes:	
CF Types:	
Vegetation Condition:	E - Excellent
Disturbance:	
Fire:	2/3 years

DOMINANT TAXA IN VEGETATION STRATA

Upper Stratum 1: *Acacia sericophylla*, *Acacia tumida* var. *pilbarensis*

Mid Stratum 1: *Acacia stellaticeps*, *Corchorus incanus* subsp. *incanus*, *Hibiscus leptocladus*, *Pluchea ferdinandi-muelleri*

Lower Stratum 1: *Aristida hygrometrica*, *Boerhavia gardneri*, *Bonamia* ?*rosea*, *Bulbostylis barbata*, *Byblis filifolia*, *Chrysopogon fallax*, *Cyperus castaneus* var. *brevimucronatus*, *Eragrostis eriopoda*, *Eriachne aristidea*, *Eriachne* ?*mucronata*, *Eriachne obtusa*, *Euphorbia alsiniflora*, *Euphorbia australis*, *Fimbristylis oxystachya*, *Fimbristylis rara*, *Hybanthus aurantiacus*, *Indigofera linifolia*, *Ipomoea muelleri*, *Mitrasacme connata*, *Mitrasacme exserta*, *Mollugo molluginea*, *Polygala linariifolia*, *Ptilotus fusiformis*, *Senna notabilis*, *Sida* ?sp. Pilbara (A.A. Mitchell PRP 1543), *Sida* ?sp. Rabbit Flat (B.J. Carter 626), *Solanum phlomoides*, *Tribulopis angustifolia*, *Triodia epactia*, *Yakirra australiensis*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Acacia sericophylla	2	0.1
Acacia stellaticeps	1	0.5
Acacia tumida var. *pilbarensis*	1.7	1

Aristida hygrometrica	0.4	0.1
Boerhavia gardneri		0.1
Bonamia ?*rosea*	0.4	0.1
Bulbostylis barbata	0.1	0.1
Byblis filifolia	0.05	0.1
Chrysopogon fallax	1.5	0.1
Corchorus incanus subsp. *incanus*	0.8	0.1
Cyperus castaneus var. *brevimucronatus*	0.05	0.1
Eragrostis eriopoda	0.5	3
Eriachne aristidea	0.15	0.1
Eriachne ?*mucronata*	0.25	0.1
Eriachne obtusa	0.4	0.1
Euphorbia alsiniflora	0.15	0.1
Euphorbia australis		0.1
Fimbristylis oxystachya	0.2	0.1
Fimbristylis rara	0.15	0.1
Hibiscus leptocladus	0.3	0.1
Hybanthus aurantiacus	0.4	0.1
Indigofera linifolia	0.2	0.1
Ipomoea muelleri	0.03	0.1
Mitrasacme connata	0.2	0.1
Mitrasacme exserta	0.2	0.1
Mollugo molluginea	0.15	0.1
Pluchea ferdinandi-muelleri	0.6	0.1
Polygala linariifolia	0.2	0.1
Ptilotus fusiformis	0.3	0.1
Senna notabilis	0.1	0.1
Sida ?sp. Pilbara (A.A. Mitchell PRP 1543)	0.6	0.1
Sida ?sp. Rabbit Flat (B.J. Carter 626)	0.4	0.1
Solanum phlomoides	0.35	0.1
Tribulopis angustifolia	0.2	0.1
Triodia epactia	0.6	50
Yakirra australiensis	0.1	0.1

Site Name:	NWI-38
Site Type:	QUADRAT
Dimensions:	50m x 50m
Survey Date:	08/04/2011
GPS Location:	GDA94 (Zone 50) 656826E 7746585N
Community:	
Landform Type:	Ridge
Slope Class:	Level (0 degrees)
Aspect:	
Soil Type:	Sand
Soil Colour:	Red
Soil Depth:	
Rock Outcrop:	No bedrock exposed
CF Abundance:	0%
CF Sizes:	
CF Types:	
Vegetation Condition:	E - Excellent
Disturbance:	
Fire:	5+ years

DOMINANT TAXA IN VEGETATION STRATA

Mid Stratum 1: *Acacia* ?*colei* var. *colei*, *Sorghum* ?*plumosum*

Lower Stratum 1: *Acacia stellaticeps*, *Aristida holathera*, *Boerhavia coccinea*, *Bonamia* ?*linearis*, *Bulbostylis barbata*, *Cajanus marmoratus*, *Calandrinia* sp. Pinga (T.R. Lally TRL 722) PN, *Corchorus incanus* subsp. *incanus*, *Corynotheca pungens*, *Crotalaria ramosissima*, *Cyperus* ?*carinatus*, *Eragrostis eriopoda*, *Eriachne obtusa*, *Euphorbia australis*, *Evolvulus alsinoides* var. *villosicalyx*, *Fimbristylis rara*, *Glycine tomentella*, *Hybanthus aurantiacus*, *Indigofera linifolia*, *Ipomoea muelleri*, *Mitrasacme exserta*, *Mollugo molluginea*, *Pluchea tetranthera*, *Polycarpaea corymbosa*, *Portulaca pilosa*, *Ptilotus arthrolasius*, *Ptilotus polystachyus*, *Salsola australis*, *Sida* sp. Rabbit Flat (B.J. Carter 626) PN, *Tephrosia rosea* var. ?*venulosa ms*, *Triodia epactia*, *Waltheria indica*, *Yakirra australiensis*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Acacia ?*colei* var. *colei*	2	0.1
Acacia stellaticeps	0.4	1
Aristida holathera	0.3	1
Boerhavia coccinea		0.1
Bonamia ?*linearis*	0.2	0.1

Bulbostylis barbata	0.2	0.1
Cajanus marmoratus		0.1
Calandrinia sp. Pinga (T.R. Lally TRL 722) PN	0.1	0.1
Corchorus incanus subsp. *incanus*	0.4	0.1
Corynotheca pungens	0.1	0.1
Crotalaria ramosissima	0.3	1
Cyperus ?carinatus	0.2	1
Eragrostis eriopoda	0.3	1
Eriachne obtusa	0.4	10
Euphorbia australis	0.1	0.1
Evolvulus alsinoides var. *villosicalyx*	0.2	0.1
Fimbristylis rara	0.1	0.1
Glycine tomentella		0.1
Hybanthus aurantiacus	0.4	0.1
Indigofera linifolia	0.2	0.1
Ipomoea muelleri		0.1
Mitrasacme exserta	0.1	0.1
Mollugo molluginea	0.1	0.1
Pluchea tetranthera	0.4	0.1
Polycarpaea corymbosa	0.1	0.1
Portulaca pilosa	0.2	0.1
Ptilotus arthrolasius	0.3	3
Ptilotus polystachyus	0.4	0.1
Salsola australis	0.4	0.1
Sida sp. Rabbit Flat (B.J. Carter 626) PN	0.2	0.1
Sorghum ?plumosum	1.2	10
Tephrosia rosea var. *?venulosa ms*	0.6	2
Triodia epactia	0.6	20
Waltheria indica	0.6	0.1
Yakirra australiensis	0.1	0.1

Site Name: NWI-39

Site Type: QUADRAT

Dimensions: 50m x 50m

Survey Date: 09/04/2011

GPS Location: GDA94 (Zone 50) 658152E 7747850N

Community:

Landform Type: Drainage Line

Slope Class:

Aspect:

Soil Type: Sandy Loam

Soil Colour: Red

Soil Depth:

Rock Outcrop: No bedrock exposed

CF Abundance: 0%

CF Sizes:

CF Types:

Vegetation Condition: E - Excellent

Disturbance:

Fire: 3 years

DOMINANT TAXA IN VEGETATION STRATA

Lower Stratum 1: *Aristida holathera*, *Byblis filifolia*, *Calandrinia* sp. Pinga (T.R. Lally TRL 722) PN, *Cassytha capillaris*, *Commelina ensifolia*, *Cyperus bulbosus*, *Cyperus squarrosus*, *Eragrostis cumingii*, *Eragrostis falcata*, *Fimbristylis* ?*dichotoma*, *Frankenia* ?*ambita*, *Hybanthus aurantiacus*, *Lipocarpha microcephala*, *Mitrasacme exserta*, *Sporobolus mitchellii*, *Stackhousia intermedia*, *Triodia secunda*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Aristida holathera	0.3	1
Byblis filifolia	0.1	0.1
Calandrinia sp. Pinga (T.R. Lally TRL 722) PN	0.1	0.1
Cassytha capillaris		0.1
Commelina ensifolia	0.2	0.1
Cyperus bulbosus	0.1	0.1
Cyperus squarrosus	0.1	0.1
Eragrostis cumingii	0.3	0.1
Eragrostis falcata	0.2	0.1
Fimbristylis ?*dichotoma*	0.3	0.1
Frankenia ?*ambita*	0.4	0.1

Hybanthus aurantiacus	0.2	0.1
Lipocarpha microcephala	0.2	0.1
Mitrasacme exserta	0.1	0.1
Sporobolus mitchellii	0.3	0.1
Stackhousia intermedia	0.1	0.1
Triodia secunda	0.4	85

Site Name: NWI-40

Site Type: QUADRAT

Dimensions: 50m x 50m

Survey Date: 08/04/2011

GPS Location: GDA94 (Zone 50) 657440E 7747542N

Community:

Landform Type: Wetland

Slope Class: Level (0 degrees)

Aspect:

Soil Type: Clay Loam

Soil Colour: Brown

Soil Depth:

Rock Outcrop: No bedrock exposed

CF Abundance: 0%

CF Sizes:

CF Types:

Vegetation Condition: E - Excellent

Disturbance:

Fire: 7+ years

DOMINANT TAXA IN VEGETATION STRATA

Lower Stratum 1: *Tecticornia* ?*indica* subsp. *leiostachya*, *Tecticornia* ?*pergranulata* subsp. *elongata*, *Tecticornia pergranulata* subsp. *elongata*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Tecticornia ?*indica* subsp. *leiostachya*	0.4	1
Tecticornia ?*pergranulata* subsp. *elongata*	0.4	0.1
Tecticornia pergranulata subsp. *elongata*	0.4	1

Site Name:	NWI-41
Site Type:	QUADRAT
Dimensions:	50m x 50m
Survey Date:	06/04/2011
GPS Location:	GDA94 (Zone 50) 655984E 7745321N
Community:	
Landform Type:	
Slope Class:	Level (0 degrees)
Aspect:	
Soil Type:	Sandy clay (other)
Soil Colour:	Red
Soil Depth:	
Rock Outcrop:	No bedrock exposed
CF Abundance:	0%
CF Sizes:	
CF Types:	
Vegetation Condition:	E - Excellent
Disturbance:	
Fire:	greater than 5 years

DOMINANT TAXA IN VEGETATION STRATA

Upper Stratum 1:	*Carissa lanceolata*
Mid Stratum 1:	*Acacia stellaticeps*, *Acacia tumida* var. *pilbarensis*, *Cyperus* ?*carinatus*, *Eragrostis speciosa*, *Eulalia aurea*, *Hakea lorea* subsp. *lorea*, *Triodia epactia*
Mid Stratum 2:	*Eulalia aurea*
Lower Stratum 1:	*Ammannia multiflora*, *Bergia henshallii*, *Bergia pedicellaris*, *Calandrinia pumila*, *Chrysopogon fallax*, *Cyperus castaneus* var. *brevimucronatus*, *Cyperus iria*, *Cyperus squarrosus*, *Eragrostis crateriformis*, *Eragrostis cumingii*, *Eriachne obtusa*, *Fimbristylis dichotoma*, *Fimbristylis rara*, *Goodenia lamprosperma*, *Goodenia triodiophila*, *Hybanthus aurantiacus*, *Lipocarpha microcephala*, *Marsilea drummondii*, *Mimulus gracilis*, *Nesaea muelleri*, *Peplidium* ?*muelleri*, *Polygala linariifolia*, *Rotala diandra*, *Schoenoplectus laevis*, *Stemodia lathraia*, *Triodia* ?*secunda*, *Urochloa holosericea* subsp. *velutina*, *Yakirra australiensis*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Acacia stellaticeps	0.5	0.2
Acacia tumida var. *pilbarensis*	0.6	0.1
Ammannia multiflora	0.25	0.1

Bergia henshallii		0.1
Bergia pedicellaris	0.03	0.1
Calandrinia pumila	0.03	0.1
Carissa lanceolata	2	0.1
Chrysopogon fallax	1.2	0.1
Cyperus ?carinatus	0.5	0.1
Cyperus castaneus var. *brevimucronatus*	0.05	0.1
Cyperus iria	0.2	0.1
Cyperus squarrosus	0.03	0.1
Eragrostis crateriformis	0.3	0.1
Eragrostis cumingii	0.1	0.1
Eragrostis speciosa	0.8	0.1
Eriachne obtusa	0.3	0.1
Eulalia aurea	1	20
Fimbristylis dichotoma	0.3	0.1
Fimbristylis rara	0.15	0.1
Goodenia lamprosperma	0.3	0.1
Goodenia triodiophila	0.3	0.1
Hakea lorea subsp. *lorea*	0.5	0.1
Hybanthus aurantiacus	0.3	0.1
Lipocarpha microcephala	0.06	0.1
Marsilea drummondii	0.1	0.1
Mimulus gracilis	0.1	0.1
Nesaea muelleri	0.05	0.1
Peplidium ?muelleri	0.02	0.1
Polygala linariifolia	0.1	0.1
Rotala diandra	0.5	0.1
Schoenoplectus laevis	0.2	0.1
Stemodia lathraia	0.1	0.1
Triodia epactia	0.6	60
Triodia ?secunda	0.3	1
Urochloa holosericea subsp. *velutina*	0.3	0.1
Yakirra australiensis	0.1	0.1

Site Name:	NWI-43
Site Type:	QUADRAT
Dimensions:	50m x 50m
Survey Date:	07/04/2011
GPS Location:	GDA94 (Zone 50) 659431E 7749532N
Community:	
Landform Type:	Flat
Slope Class:	Very Gently Inclined (1 degree)
Aspect:	
Soil Type:	Sandy Loam
Soil Colour:	
Soil Depth:	
Rock Outcrop:	No bedrock exposed
CF Abundance:	0%
CF Sizes:	
CF Types:	
Vegetation Condition:	VG - Very Good
Disturbance:	
Fire:	greater than 5 years

DOMINANT TAXA IN VEGETATION STRATA

Mid Stratum 1: **Cenchrus ciliaris*, *Corchorus trilocularis*, *Cyperus iria*, *Dactyloctenium radulans*, *Eragrostis falcata*, *Eriachne obtusa*, *Euphorbia alsiniflora*, *Euphorbia tannensis* subsp. *eremophila*, *Frankenia* ?*ambita*, *Hemichroa diandra*, *Indigofera trita*, *Neobassia astrocarpa*, *Panicum* ?*decompositum*, *Pluchea rubelliflora*, *Solanum ellipticum*, *Sporobolus mitchellii*, *Streptoglossa decurrens*, *Swainsona stenodonta*, *Trianthema turgidifolia*, *Triodia epactia*, *Triodia* ?*secunda*

Lower Stratum 1: *Bulbostylis barbata*, *Calandrinia quadrivalvis*, *Commelina ensifolia*, *Evolvulus alsinoides* var. *villosicalyx*, *Portulaca pilosa*, *Rhynchosia minima*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Bulbostylis barbata	0.07	0.1
Calandrinia quadrivalvis	0.15	0.1
**Cenchrus ciliaris*	0.5	0.1
Commelina ensifolia	0.1	
Corchorus trilocularis	0.3	0.1
Cyperus iria	0.4	0.1
Dactyloctenium radulans	0.2	0.1

Eragrostis falcata	0.4	0.1
Eriachne obtusa	0.4	0.1
Euphorbia alsiniflora	0.3	0.1
Euphorbia tannensis subsp. *eremophila*	0.2	0.1
Evolvulus alsinoides var. *villosicalyx*	0.2	0.1
Frankenia ?ambita	0.3	0.1
Hemichroa diandra	0.3	0.1
Indigofera trita	0.3	1
Melhania oblongifolia	0.15	0.1
Neobassia astrocarpa	0.25	0.1
Panicum ?decompositum	0.4	0.1
Pluchea rubelliflora	0.3	0.1
Portulaca pilosa	0.1	0.1
Rhynchosia minima		0.1
Solanum ellipticum	0.3	0.1
Sporobolus mitchellii	0.3	0.1
Streptoglossa decurrens	0.2	0.1
Swainsona stenodonta	0.3	0.1
Trianthema turgidifolia	0.3	0.1
Triodia epactia	0.6	90
Triodia ?secunda	0.2	0.1

Site Name: NWI-44

Site Type: QUADRAT

Dimensions: 50m x 50m

Survey Date: 08/04/2011

GPS Location: GDA94 (Zone 50) 656814E 7746836N

Community:

Landform Type: Dune (other)

Slope Class: Level (0 degrees)

Aspect:

Soil Type: Sand

Soil Colour: Red

Soil Depth:

Rock Outcrop: No bedrock exposed

CF Abundance: 0%

CF Sizes:

CF Types:

Vegetation Condition: E - Excellent

Disturbance:

Fire: 5+ years

DOMINANT TAXA IN VEGETATION STRATA

Mid Stratum 1: *Sorghum* ?*plumosum*

Lower Stratum 1: *Acacia stellaticeps*, *Aristida holathera*, *Boerhavia coccinea*, *Bonamia linearis*, *Bonamia* ?*linearis*, *Bulbostylis barbata*, *Cajanus marmoratus*, *Calandrinia* sp. Pinga (T.R. Lally TRL 722) PN, *Corchorus incanus* subsp. *incanus*, *Corynotheca pungens*, *Crotalaria ramosissima*, *Cyperus* ?*carinatus*, *Digitaria brownii*, *Eragrostis eriopoda*, *Eriachne obtusa*, *Euphorbia australis*, *Evolvulus alsinoides* var. *villosicalyx*, *Glycine tomentella*, *Hybanthus aurantiacus*, *Ipomoea muelleri*, *Mitrasacme connata*, *Mollugo molluginea*, *Pluchea tetranthera*, *Polycarpaea corymbosa*, *Portulaca pilosa*, *Ptilotus fusiformis*, *Sida* sp. Rabbit Flat (B.J. Carter 626) PN, *Solanum diversiflorum*, *Tephrosia rosea* var. ?*venulosa ms*, *Trianthema pilosa*, *Triodia epactia*, *Yakirra australiensis*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Acacia stellaticeps	0.5	2
Aristida holathera	0.4	1
Boerhavia coccinea		0.1
Bonamia linearis	0.1	0.1
Bonamia ?*linearis*	0.2	0.1

Bulbostylis barbata	0.1	0.1
Cajanus marmoratus		0.1
Calandrinia sp. Pinga (T.R. Lally TRL 722) PN	0.3	0.1
Corchorus incanus subsp. *incanus*	0.4	0.1
Corynotheca pungens	0.2	0.1
Crotalaria ramosissima	0.2	0.1
Cyperus ?carinatus	0.5	1
Digitaria brownii	0.4	0.1
Eragrostis eriopoda	0.4	1
Eriachne obtusa	0.5	6
Euphorbia australis	0.2	0.1
Evolvulus alsinoides var. *villosicalyx*	0.3	0.1
Glycine tomentella		0.1
Hybanthus aurantiacus	0.4	0.1
Ipomoea muelleri		0.1
Mitrasacme connata	0.1	0.1
Mollugo molluginea	0.2	0.1
Pluchea tetranthera	0.5	0.1
Polycarpaea corymbosa	0.3	0.1
Portulaca pilosa	0.4	0.1
Ptilotus fusiformis	0.4	0.4
Sida sp. Rabbit Flat (B.J. Carter 626) PN	0.3	0.1
Solanum diversiflorum	0.4	0.1
Sorghum ?plumosum	1.3	10
Tephrosia rosea var. *?venulosa ms*	0.6	5
Trianthema pilosa	0.2	0.1
Triodia epactia	0.4	30
Yakirra australiensis	0.2	0.1

Site Name:	NWI-45
Site Type:	QUADRAT
Dimensions:	50m x 50m
Survey Date:	08/04/2011
GPS Location:	GDA94 (Zone 50) 656000E 7745602N
Community:	
Landform Type:	Flat
Slope Class:	Level (0 degrees)
Aspect:	
Soil Type:	Sandy Loam
Soil Colour:	Red
Soil Depth:	
Rock Outcrop:	No bedrock exposed
CF Abundance:	0%
CF Sizes:	
CF Types:	
Vegetation Condition:	E - Excellent
Disturbance:	
Fire:	2

DOMINANT TAXA IN VEGETATION STRATA

Mid Stratum 1: *Acacia colei* var. *colei*

Lower Stratum 1: *Acacia stellaticeps*, *Bonamia linearis*, *Bulbostylis barbata*, *Byblis filifolia*, *Calandrinia* sp. Pinga (T.R. Lally TRL 722) PN, *Chrysopogon fallax*, *Corchorus incanus* subsp. *incanus*, *Cyperus* ?*carinatus*, *Digitaria brownii*, *Eragrostis eriopoda*, *Eriachne obtusa*, *Eulalia aurea*, *Evolvulus alsinoides* var. *villosicalyx*, *Fimbristylis oxystachya*, *Goodenia triodiophila*, *Hibiscus leptocladus*, *Hybanthus aurantiacus*, *Mitrasacme exserta*, *Mollugo molluginea*, *Paspalidium rarum*, *Pluchea tetranthera*, *Polygala linariifolia*, *Ptilotus fusiformis*, *Senna notabilis*, *Sida rohlenae* subsp. *rohlenae*, *Stackhousia intermedia*, *Tephrosia leptoclada*, *Triodia epactia*, *Triodia schinzii*, *Yakirra australiensis*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Acacia colei var. *colei*	1	1
Acacia stellaticeps	0.3	10
Bonamia linearis	0.1	0.1
Bulbostylis barbata	0.2	0.1
Byblis filifolia	0.1	0.1

Calandrinia sp. Pinga (T.R. Lally TRL 722) PN	0.1	0.1
Chrysopogon fallax	0.6	1
Corchorus incanus subsp. *incanus*	0.4	0.1
Cyperus ?carinatus	0.3	0.5
Digitaria brownii	0.4	0.1
Eragrostis eriopoda	0.3	0.1
Eriachne obtusa	0.4	15
Eulalia aurea	0.4	0.1
Evolvulus alsinoides var. *villosicalyx*	0.2	0.1
Fimbristylis oxystachya	0.2	0.1
Goodenia triodiophila	0.2	0.1
Hibiscus leptocladus	0.2	0.1
Hybanthus aurantiacus	0.3	0.1
Mitrasacme exserta	0.2	0.1
Mollugo molluginea	0.1	0.1
Paspalidium rarum	0.1	0.1
Pluchea tetranthera	0.4	0.1
Polygala linariifolia	0.1	0.1
Ptilotus fusiformis	0.2	0.1
Senna notabilis	0.4	0.1
Sida rohlenae subsp. *rohlenae*	0.2	0.1
Stackhousia intermedia	0.1	0.1
Tephrosia leptoclada	0.3	0.1
Triodia epactia	0.2	1
Triodia schinzii	0.3	20
Yakirra australiensis	0.1	0.1

Site Name:	NWI-46
Site Type:	QUADRAT
Dimensions:	50m x 50m
Survey Date:	04/04/2011
GPS Location:	GDA94 (Zone 50) 657116E 7741912N
Community:	
Landform Type:	Simple slope/Plain (other)
Slope Class:	Gently Inclined (3 degrees)
Aspect:	W
Soil Type:	Sand
Soil Colour:	Red
Soil Depth:	
Rock Outcrop:	No bedrock exposed
CF Abundance:	0%
CF Sizes:	
CF Types:	
Vegetation Condition:	E - Excellent
Disturbance:	
Fire:	2/3years

DOMINANT TAXA IN VEGETATION STRATA

Upper Stratum 1:	*Acacia tumida* var. *pilbarensis*
Mid Stratum 1:	*Acacia stellaticeps*, *Chrysopogon fallax*, *Corchorus incanus* subsp. *incanus*, *Sida* ?sp. Pilbara (A.A. Mitchell PRP 1543), *Waltheria indica*
Mid Stratum 2:	*Corchorus incanus* subsp. *incanus*
Lower Stratum 1:	*Acacia sericophylla*, *Aristida hygrometrica*, *Boerhavia gardneri*, *Bonamia media*, *Bulbostylis barbata*, *Cucumis maderaspatanus*, *Dodonaea coriacea*, *Eragrostis eriopoda*, *Eriachne aristidea*, *Eriachne obtusa*, *Euphorbia alsiniflora*, *Euphorbia australis*, *Fimbristylis neilsonii*, *Fimbristylis oxystachya*, *Glycine tomentella*, *Hibiscus leptocladus*, *Hybanthus aurantiacus*, *Indigofera linifolia*, *Indigofera monophylla*, *Ipomoea muelleri*, *Ipomoea polymorpha*, *Mollugo molluginea*, *Polycarpaea corymbosa*, *Senna notabilis*, *Sida* aff. *cardiophylla*, *Sida* ?sp. Rabbit Flat (B.J. Carter 626), *Trianthema pilosa*, *Tribulopis angustifolia*, *Triodia epactia*, *Urochloa holosericea* subsp. *velutina*, *Yakirra australiensis*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Acacia sericophylla	0.5	0.1
Acacia stellaticeps	1	2

Acacia tumida var. *pilbarensis*	2.5	0.5
Aristida hygrometrica	0.4	50
Boerhavia gardneri		0.1
Bonamia media		5
Bulbostylis barbata	0.15	0.1
Chrysopogon fallax	1.5	0.1
Corchorus incanus subsp. *incanus*	0.4	0.5
Cucumis maderaspatanus		0.1
Dodonaea coriacea	0.2	0.1
Eragrostis eriopoda	0.4	50
Eriachne aristidea	0.15	0.1
Eriachne obtusa	0.4	0.2
Euphorbia alsiniflora	0.2	0.1
Euphorbia australis		0.1
Fimbristylis neilsonii	0.5	0.1
Fimbristylis oxystachya	0.2	0.1
Glycine tomentella	0.3	0.1
Hibiscus leptocladus	0.4	0.1
Hybanthus aff. *aurantiacus*	0.3	0.1
Hybanthus aurantiacus	0.3	0.25
Indigofera linifolia	0.1	0.1
Indigofera monophylla	0.3	0.1
Ipomoea muelleri	0.3	0.1
Ipomoea polymorpha	0.1	0.1
Mollugo molluginea	0.1	0.1
Polycarpaea corymbosa	0.2	0.1
Polymeria ambigua	0.1	0.1
Senna notabilis	0.1	0.1
Sida aff. *cardiophylla*	0.4	0.1
Sida ?sp. Pilbara (A.A. Mitchell PRP 1543)	0.5	0.1
Sida ?sp. Rabbit Flat (B.J. Carter 626)	0.3	0.1
Trianthema pilosa	0.2	0.1
Tribulopis angustifolia		0.1
Triodia epactia	0.5	0.5
Urochloa holosericea subsp. *velutina*	0.4	0.1
Waltheria indica	0.6	0.1
Yakirra australiensis	0.15	0.1

Site Name:	NW25
Site Type:	PLOT
Dimensions:	50m x 50m
Survey Date:	20/04/2011
GPS Location:	GDA94 (Zone 50) 655490E 7743315N
Community:	
Landform Type:	Plain
Slope Class:	Level (0 degrees)
Aspect:	
Soil Type:	Sandy Loam
Soil Colour:	red/brown (other)
Soil Depth:	
Rock Outcrop:	No bedrock exposed
CF Abundance:	0%
CF Sizes:	
CF Types:	
Vegetation Condition:	E - Excellent
Disturbance:	
Fire:	3years

DOMINANT TAXA IN VEGETATION STRATA

Mid Stratum 1:	*Acacia sericophylla*, *Acacia tumida* var. *pilbarensis*
Lower Stratum 1:	*Acacia stellaticeps*, *Aristida holathera* var. *holathera*, *Aristida hygrometrica*, *Boerhavia coccinea*, *Bonamia* ?*linearis*, *Bonamia rosea*, *Bulbostylis barbata*, *Chrysopogon fallax*, *Corchorus incanus* subsp. *incanus*, *Eragrostis eriopoda*, *Eriachne aristidea*, *Eriachne obtusa*, *Euphorbia australis*, *Evolvulus alsinoides* var. *villosicalyx*, *Hibiscus leptocladus*, *Hibiscus sturtii* var. ?*campylochlamys*, *Hybanthus aurantiacus*, *Ipomoea polymorpha*, *Mollugo molluginea*, *Portulaca pilosa*, *Ptilotus polystachyus*, *Ptilotus schwartzii*, *Senna notabilis*, *Sida rohlenae* subsp. *rohlenae*, *Sida* sp. Rabbit Flat (B.J. Carter 626) PN, *Solanum diversiflorum*, *Tribulopis angustifolia*, *Tribulus hirsutus*, *Triodia epactia*, *Urochloa holosericea* subsp. *velutina*, *Yakirra australiensis*
Lower Stratum 2:	*Triodia epactia*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Acacia sericophylla	1	0.1
Acacia stellaticeps	0.4	1
Acacia tumida var. *pilbarensis*	1	1

Aristida holathera var. *holathera*	0.4	8
Aristida hygrometrica	0.4	1
Boerhavia coccinea	0.1	0.1
Bonamia ?linearis	0.3	0.1
Bonamia rosea	0.3	0.1
Bulbostylis barbata	0.1	0.1
Chrysopogon fallax	0.6	0.1
Corchorus incanus subsp. *incanus*	0.6	8
Eragrostis eriopoda	0.5	15
Eriachne aristidea	0.4	1
Eriachne obtusa	0.4	0.1
Euphorbia australis	0.1	1
Evolvulus alsinoides var. *villosicalyx*	0.3	0.1
Hibiscus leptocladus	0.4	0.1
Hibiscus sturtii var. ?*campylochlamys*	0.3	0.1
Hybanthus aurantiacus	0.4	0.1
Ipomoea polymorpha	0.2	3
Mollugo molluginea	0.1	0.1
Portulaca pilosa	0.4	0.1
Ptilotus polystachyus	0.8	0.1
Ptilotus schwartzii	0.4	0.1
Senna notabilis	0.3	0.1
Sida rohlenae subsp. *rohlenae*	0.4	0.1
Sida sp. Rabbit Flat (B.J. Carter 626) PN	0.1	0.2
Solanum diversiflorum	0.4	0.1
Tribulopis angustifolia	0.4	0.1
Tribulus hirsutus	0.3	0.1
Triodia epactia	0.6	12
Urochloa holosericea subsp. *velutina*	0.3	0.1
Yakirra australiensis	0.1	2

Site Name: NW27

Site Type: PLOT

Dimensions: 50m x 50m

Survey Date: 20/04/2011

GPS Location: GDA94 (Zone 50) 655460E 7745356N

Community:

Landform Type: Plain

Slope Class: Level (0 degrees)

Aspect:

Soil Type:

Soil Colour:

Soil Depth:

Rock Outcrop: No bedrock exposed

CF Abundance: 0%

CF Sizes:

CF Types:

Vegetation Condition: E - Excellent

Disturbance:

Fire: greater than 5 years

DOMINANT TAXA IN VEGETATION STRATA

Lower Stratum 1: *Acacia stellaticeps*, *Bulbostylis barbata*, *Byblis filifolia*, *Calandrinia* sp. Pinga (T.R. Lally TRL 722) PN, *Chrysopogon fallax*, *Cyperus blakeanus*, *Desmodium filiforme*, *Eriachne obtusa*, *Euphorbia alsiniflora*, *Evolvulus alsinoides* var. *villosicalyx*, *Fimbristylis oxystachya*, *Hybanthus aurantiacus*, *Mitrasacme connata*, *Mollugo molluginea*, ?*Murdannia graminea*, *Pluchea tetranthera*, *Polycarpaea corymbosa*, *Polygala linariifolia*, *Schizachyrium fragile*, *Stackhousia intermedia*, ?*Stylidium desertorum*, *Triodia lanigera*, *Triodia schinzii*, *Yakirra australiensis*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Acacia stellaticeps	0.6	3
Bulbostylis barbata	0.1	0.1
Byblis filifolia	0.05	0.1
Calandrinia sp. Pinga (T.R. Lally TRL 722) PN	0.1	0.1
Chrysopogon fallax	0.3	1
Cyperus blakeanus	0.3	0.1
Desmodium filiforme	0.2	0.1
Eriachne obtusa	0.4	1
Euphorbia alsiniflora	0.2	0.1

Evolvulus alsinoides var. *villosicalyx*	0.2	0.1
Fimbristylis oxystachya	0.2	0.1
Hybanthus aurantiacus	0.6	0.1
Mitrasacme connata	0.2	0.1
Mollugo molluginea	0.1	0.1
?*Murdannia graminea*	0.2	0.1
Pluchea tetranthera	0.4	1
Polycarpaea corymbosa	0.1	0.1
Polygala linariifolia	0.1	0.1
Schizachyrium fragile	0.2	0.1
Stackhousia intermedia	0.4	0.1
?*Stylidium desertorum*	0.05	0.1
Triodia lanigera	0.4	20
Triodia schinzii	0.3	40
Yakirra australiensis	0.1	1

Site Name: TRH316

Site Type: QUADRAT

Dimensions: 50m x 50m

Survey Date: 29/07/2010

GPS Location: GDA94 (Zone 50) 656660E 7743184N

Community:

Landform Type: Low dune on plain (other)

Slope Class: Gently Inclined (3 degrees)

Aspect: SE

Soil Type: Sand

Soil Colour: Red

Soil Depth: Moderate

Rock Outcrop: No bedrock exposed

CF Abundance: 0%

CF Sizes:

CF Types:

Vegetation Condition: VG - Very Good

Disturbance: Grazing

Fire: 2

DOMINANT TAXA IN VEGETATION STRATA

Mid Stratum 1: *Acacia colei var. colei*

Mid Stratum 2: *Acacia stellaticeps, Pluchea ferdinandi-muelleri*

Lower Stratum 1: *Triodia epactia*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Acacia colei var. *colei*	0.5	10
Acacia stellaticeps	0.3	5
Aristida holathera var. *holathera*	0.3	0.5
Boerhavia sp.	0.1	0.1
Bonamia linearis	0.2	0.1
Bulbostylis barbata	0.1	0.1
Chrysopogon fallax	0.4	0.1
Corchorus ?*incanus* subsp. *incanus*	0.3	0.2
Eragrostis eriopoda	0.2	5
Eriachne mucronata	0.3	0.3
Evolvulus alsinoides var. *villosicalyx*	0.2	0.1
Grevillea pyramidalis subsp. *leucadendron*	1	0.3
Hakea lorea subsp. *lorea*	0.5	0.2

Hibiscus leptocladus	0.3	0.1
Hybanthus aurantiacus	0.3	0.1
Mollugo molluginea	0.1	0.2
Pluchea ferdinandi-muelleri	0.5	5
Senna notabilis	0.3	0.1
Sida sp.	0.2	0.3
Triodia epactia	0.3	10
Triodia secunda	0.3	0.3

Site Name: TRH317

Site Type: QUADRAT

Dimensions: 50m x 50m

Survey Date: 29/07/2010

GPS Location: GDA94 (Zone 50) 656589E 7744625N

Community:

Landform Type: Plain

Slope Class: Very gentle

Aspect: SW

Soil Type: Sand

Soil Colour: Red

Soil Depth:

Rock Outcrop:

CF Abundance:

CF Sizes:

CF Types:

Vegetation Condition: VG - Very Good

Disturbance: Grazing

Fire: 2-3

DOMINANT TAXA IN VEGETATION STRATA

Mid Stratum 1: *Acacia colei* var. *colei*

Lower Stratum 1: *Triodia epactia, Eriachne mucronata*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Acacia colei var. *colei*	1	2
Acacia stellaticeps	0.3	5
Aristida holathera var. *holathera*	0.3	3
Chrysopogon fallax	0.3	0.3
Cyperus ?blakeanus	0.2	0.2
Dodonaea coriacea	0.3	0.4
Eriachne mucronata	0.3	15
Evolvulus alsinoides var. *villosicalyx*	0.1	0.1
Fimbristylis rara	0.1	0.1
Hybanthus aurantiacus	0.3	0.3
Mollugo molluginea	0.1	0.3
Murdannia graminea	0.1	0.1
Sida sp.	0.3	0.1
Triodia epactia	0.3	45

Site Name: TRH318

Site Type: QUADRAT

Dimensions: 50m x 50m

Survey Date: 29/07/2010

GPS Location: GDA94 (Zone 50) 656821E 7744727N

Community:

Landform Type: Plain

Slope Class: Very Gently Inclined (1 degree)

Aspect: SW

Soil Type: Sandy Loam

Soil Colour: Red

Soil Depth: Moderate

Rock Outcrop: No bedrock exposed

CF Abundance: 0%

CF Sizes:

CF Types:

Vegetation Condition: VG - Very Good

Disturbance: Grazing, Fire (other)

Fire: 3-4

DOMINANT TAXA IN VEGETATION STRATA

Mid Stratum 1: *Acacia stellaticeps*

Lower Stratum 1: *Triodia epactia*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Acacia colei var. *colei*	0.5	0.1
Acacia stellaticeps	0.3	7
Chrysopogon fallax	0.3	0.5
Corchorus ?*incanus* subsp. *incanus*	0.2	0.1
Cyperus ?*blakeanus*	0.3	0.1
Dodonaea coriacea	0.3	0.2
Eriachne mucronata	0.3	5
Evolvulus alsinoides var. *villosicalyx*	0.1	0.1
Fimbristylis dichotoma	0.2	0.1
Hakea lorea subsp. *lorea*	0.3	0.3
Hibiscus leptocladus	0.2	0.1
Hybanthus aurantiacus	0.3	0.3
Mollugo molluginea	0.1	0.1
Sida sp.	0.2	0.1

Sida sp. Pilbara (A.A. Mitchell PRP 1543) PN	0.2	0.1
Tephrosia ?*leptoclada*	0.1	0.1
Triodia epactia	0.4	70

Site Name: TRH319

Site Type: QUADRAT

Dimensions: 50m x 50m

Survey Date: 29/07/2010

GPS Location: GDA94 (Zone 50) 656131E 7746683N

Community:

Landform Type: Drainage Line

Slope Class: Very Gently Inclined (1 degree)

Aspect: SE

Soil Type: Sandy Loam

Soil Colour: Red

Soil Depth: Moderate

Rock Outcrop: No bedrock exposed

CF Abundance: 2-10%

CF Sizes: 20-60mm

CF Types:

Vegetation Condition: VG - Very Good

Disturbance: Grazing, Fire (other)

Fire: 1-2

DOMINANT TAXA IN VEGETATION STRATA

Lower Stratum 1: *Triodia epactia, Triodia secunda*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Acacia stellaticeps	0.3	0.5
Calandrinia quadrivalvis	0.1	0.1
Calandrinia sp.	0.1	0.1
Calandrinia ?stagnensis	0.1	0.1
Dysphania plantaginella	0.1	0.1
Eriachne mucronata	0.3	5
Fimbristylis dichotoma	0.1	0.2
Gomphrena leptophylla	0.1	0.1
Mollugo molluginea	0.1	0.1
Murdannia graminea	0.1	0.1
Triodia epactia	0.3	15
Triodia secunda	0.3	53

Site Name: TRH320

Site Type: QUADRAT

Dimensions: 50m x 50m

Survey Date: 29/07/2010

GPS Location: GDA94 (Zone 50) 656684E 7746882N

Community:

Landform Type: Dune on plain (other)

Slope Class: Gently Inclined (3 degrees)

Aspect: NE

Soil Type: Sandy Loam

Soil Colour: Red

Soil Depth: Deep

Rock Outcrop: No bedrock exposed

CF Abundance: 0%

CF Sizes:

CF Types:

Vegetation Condition: VG - Very Good

Disturbance: Grazing, Fire (other)

Fire: 3-4

DOMINANT TAXA IN VEGETATION STRATA

Mid Stratum 1: *Acacia stellaticeps*

Lower Stratum 1: *Triodia epactia*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Acacia colei var. *colei*	0.2	0.1
Acacia stellaticeps	0.3	5
Aristida holathera var. *holathera*	0.3	0.1
Bonamia linearis	0.2	0.1
Bonamia ?*media* var. *villosa*	0.2	0.1
Bulbostylis barbata	0.1	0.1
Calandrinia sp.	0.1	0.1
Cassytha capillaris		0.3
Chrysopogon fallax	0.3	0.2
Corchorus ?*incanus* subsp. *incanus*	0.3	0.5
Corynotheca pungens	0.3	0.5
Cyperus ?*blakeanus*	0.3	0.3
Dodonaea coriacea	0.3	0.2
Eragrostis eriopoda	0.3	0.2

Eriachne mucronata	0.3	5
Evolvulus alsinoides var. *villosicalyx*	0.1	0.2
Fimbristylis dichotoma	0.1	0.1
Hybanthus aurantiacus	0.3	0.2
Mollugo molluginea	0.1	0.1
Murdannia graminea	0.1	0.1
Polycarpaea corymbosa	0.1	0.1
Sida sp.	0.2	0.2
Triodia epactia	0.3	65
Triodia secunda	0.3	3
Whiteochloa cymbiformis	0.3	0.3

Site Name:	TRH401
Site Type:	QUADRAT
Dimensions:	50m x 50m
Survey Date:	14/06/2010
GPS Location:	GDA94 (Zone 50) 660740E 7749802N
Community:	
Landform Type:	Lower Slope
Slope Class:	Very Gently Inclined (1 degree)
Aspect:	NE
Soil Type:	SAND/LIGHT CLAY (other)
Soil Colour:	Orange
Soil Depth:	Moderate
Rock Outcrop:	No bedrock exposed
CF Abundance:	<2%
CF Sizes:	6-20mm
CF Types:	
Vegetation Condition:	E - Excellent
Disturbance:	None
Fire:	>5

DOMINANT TAXA IN VEGETATION STRATA

Lower Stratum 1: *Sporobolus virginicus, Muellerolimon salicorniaceum, Tecticornia* sp., *Frankenia ambita, Hemichroa diandra*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Avicennia marina		
Frankenia ambita	0.1	5
Hemichroa diandra	0.1	5
Muellerolimon salicorniaceum	0.1	20
Sporobolus virginicus	0.1	10
Tecticornia ?*halocnemoides* subsp. *tenuis*	0.3	5
Tecticornia indica subsp. *bidens*	0.1	0.3
Tecticornia sp.	0.1	5

Site Name: TRH402

Site Type: QUADRAT

Dimensions: 50m x 50m

Survey Date: 14/06/2010

GPS Location: GDA94 (Zone 50) 660605E 7749703N

Community:

Landform Type: SUPRATIDAL PLAIN (other)

Slope Class: Very Gently Inclined (1 degree)

Aspect: NE

Soil Type: SAND/LIGHT CLAY (other)

Soil Colour: RED/BROWN (other)

Soil Depth:

Rock Outcrop: No bedrock exposed

CF Abundance: <2%

CF Sizes: 2-6mm

CF Types:

Vegetation Condition: E - Excellent

Disturbance: None

Fire: >5

DOMINANT TAXA IN VEGETATION STRATA

Lower Stratum 1: *Triodia ?secunda*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Atriplex sp.	0.4	0.5
Chrysopogon fallax	0.3	0.5
Enchylaena tomentosa var. *tomentosa*	0.1	0.1
Triodia secunda	0.3	95

Site Name: TRH403

Site Type: QUADRAT

Dimensions: 50m x 50m

Survey Date: 14/06/2010

GPS Location: GDA94 (Zone 50) 660057E 7748843N

Community:

Landform Type: LOW SANDY RISE (other)

Slope Class: Very Gently Inclined (1 degree)

Aspect: SE

Soil Type: Sandy Loam

Soil Colour: Red

Soil Depth:

Rock Outcrop: No bedrock exposed

CF Abundance: 0%

CF Sizes:

CF Types:

Vegetation Condition: E - Excellent

Disturbance: None

Fire: >5

DOMINANT TAXA IN VEGETATION STRATA

Lower Stratum 1: *Triodia epactia*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Acacia stellaticeps	0.4	2
Chrysopogon fallax	0.5	1
Commelina ensifolia	0.2	0.1
Cyperaceae sp.	0.1	0.1
Hybanthus aurantiacus	0.1	0.1
Sida sp.	0.1	0.1
Triodia epactia	0.3	80
Triodia secunda	0.1	7

Site Name: TRH404

Site Type: QUADRAT

Dimensions: 50m x 50m

Survey Date: 15/06/2010

GPS Location: GDA94 (Zone 50) 661981E 7750833N

Community:

Landform Type: TIDAL ZONE (other)

Slope Class: Very Gently Inclined (1 degree)

Aspect: NE

Soil Type: CLAY (other)

Soil Colour: Orange

Soil Depth: Deep

Rock Outcrop: No bedrock exposed

CF Abundance: 0%

CF Sizes:

CF Types:

Vegetation Condition: E - Excellent

Disturbance: Dust (other)

Fire: >5

DOMINANT TAXA IN VEGETATION STRATA

Lower Stratum 1: *Tecticornia ?halocnemoides* subsp. *tenuis*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Avicennia marina		
Suaeda arbusculoides	0.1	0.1
Tecticornia ?halocnemoides subsp. *tenuis*	0.3	3.9

Site Name: TRH405

Site Type: QUADRAT

Dimensions: 50m x 50m

Survey Date: 15/06/2010

GPS Location: GDA94 (Zone 50) 657882E 7748155N

Community:

Landform Type: Supratidal plain (other)

Slope Class: Gently Inclined (3 degrees)

Aspect:

Soil Type: Sandy Loam

Soil Colour: Red

Soil Depth: Moderate

Rock Outcrop: No bedrock exposed

CF Abundance: 0%

CF Sizes:

CF Types:

Vegetation Condition: VG - Very Good

Disturbance: Grazing, Exotic Weeds

Fire: >5

DOMINANT TAXA IN VEGETATION STRATA

Lower Stratum 1: *Triodia epactia*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Acacia colei var. *colei*	0.5	
**Aerva javanica*	0.4	1
Bonamia linearis	0.2	0.1
Cassytha capillaris		2
**Cenchrus ciliaris*	0.3	5
Commelina ensifolia	0.2	0.1
Corchorus ?incanus subsp. *incanus*	0.2	0.5
Dodonaea coriacea	0.7	0.2
Eriachne mucronata	0.2	2
Hybanthus aurantiacus	0.2	0.2
Indigofera trita	0.2	
Mollugo molluginea	0.1	0.1
Portulaca sp.	0.01	
Sida rohlenae subsp. *rohlenae*	0.3	0.1
Sida sp.	0.2	0.1

Solanum diversiflorum	0.2	0.2
Solanum ellipticum	0.2	0.2
Sporobolus virginicus	0.2	0.1
Triodia epactia	0.3	80
Triodia secunda	0.2	0.5
Whiteochloa cymbiformis	0.7	5

Site Name: TRH410

Site Type: QUADRAT

Dimensions: 50m x 50m

Survey Date: 16/06/2010

GPS Location: GDA94 (Zone 50) 658547E 7748776N

Community:

Landform Type: SUPRATIDAL PLAIN- UNDULATING (other)

Slope Class: Very Gently Inclined (1 degree)

Aspect: SW

Soil Type: Sandy Loam

Soil Colour: Orange

Soil Depth: Shallow

Rock Outcrop: No bedrock exposed

CF Abundance: 0%

CF Sizes:

CF Types:

Vegetation Condition: E - Excellent

Disturbance: None

Fire: >5

DOMINANT TAXA IN VEGETATION STRATA

Lower Stratum 1: *Sarcostemma viminale* subsp*. australe, Triodia secunda*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Chrysopogon fallax	0.4	0.1
Commelina ensifolia	0.1	0.1
Neobassia astrocarpa	0.1	0.1
Sarcostemma viminale subsp. *australe*	0.4	5
Triodia epactia	0.3	1
Triodia secunda	0.2	89

Site Name: TRH425

Site Type: QUADRAT

Dimensions: 50m x 50m

Survey Date: 18/06/2010

GPS Location: GDA94 (Zone 50) 656654E 7745254N

Community:

Landform Type: UNDULATING PLAIN (other)

Slope Class: Very Gently Inclined (1 degree)

Aspect: -

Soil Type: Sandy Loam

Soil Colour: RED/BROWN (other)

Soil Depth: Moderate

Rock Outcrop: No bedrock exposed

CF Abundance: 0%

CF Sizes:

CF Types:

Vegetation Condition: E - Excellent

Disturbance: Grazing

Fire: mixed

DOMINANT TAXA IN VEGETATION STRATA

Lower Stratum 1: *Triodia epactia*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Acacia stellaticeps	0.1	0.1
Chrysopogon fallax	0.5	0.1
Cyperaceae sp.		
Dodonaea coriacea	0.1	0.1
Eriachne mucronata	0.2	0.3
Eulalia aurea	0.5	0.1
Hibiscus leptocladus	0.1	0.1
Hybanthus aurantiacus	0.2	0.1
Triodia epactia	0.4	40
Triodia secunda	0.2	30

Site Name:	M01
Site Type:	AREA
Dimensions:	m x m
Survey Date:	14/06/2010
GPS Location:	GDA94 (Zone 50) 660879E 7749825N
Community:	
Landform Type:	MANGROVE FLAT (other)
Slope Class:	Very Gently Inclined (1 degree)
Aspect:	-
Soil Type:	SILT (other)
Soil Colour:	Orange
Soil Depth:	Deep
Rock Outcrop:	No bedrock exposed
CF Abundance:	0%
CF Sizes:	
CF Types:	
Vegetation Condition:	E - Excellent
Disturbance:	None
Fire:	>5

DOMINANT TAXA IN VEGETATION STRATA

Upper Stratum 1: *Rhizophora stylosa*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Avicennia marina	3	1.5
Rhizophora stylosa	3	98

Site Name: M02

Site Type: AREA

Dimensions: m x m

Survey Date: 14/06/2010

GPS Location: GDA94 (Zone 50) 660866E 7749815N

Community:

Landform Type: INTERTIDAL ZONE (other)

Slope Class: Very Gently Inclined (1 degree)

Aspect:

Soil Type: SILT (other)

Soil Colour: Orange

Soil Depth: Deep

Rock Outcrop: No bedrock exposed

CF Abundance: 0%

CF Sizes:

CF Types:

Vegetation Condition: E - Excellent

Disturbance: None

Fire: >5

DOMINANT TAXA IN VEGETATION STRATA

Upper Stratum 1: *Avicennia marina*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Avicennia marina	2	75

Site Name: M05

Site Type: AREA

Dimensions: m x m

Survey Date: 15/06/2010

GPS Location: GDA94 (Zone 50) 662004E 7750576N

Community:

Landform Type: INTERTIDAL ZONE (other)

Slope Class: Very Gently Inclined (1 degree)

Aspect: N

Soil Type: CLAY (other)

Soil Colour: Orange

Soil Depth: Moderate

Rock Outcrop: No bedrock exposed

CF Abundance: 0%

CF Sizes:

CF Types:

Vegetation Condition: E - Excellent

Disturbance: None

Fire: >5

DOMINANT TAXA IN VEGETATION STRATA

Upper Stratum 1: *Avicennia marina*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Avicennia marina	3	88
Suaeda arbusculoides	0.3	0.1

Site Name:	M06
Site Type:	AREA
Dimensions:	m x m
Survey Date:	15/06/2010
GPS Location:	GDA94 (Zone 50) 657598E 7748699N
Community:	
Landform Type:	INTERTIDAL ZONE (other)
Slope Class:	Gently Inclined (3 degrees)
Aspect:	NNW
Soil Type:	CLAY (other)
Soil Colour:	Orange
Soil Depth:	Moderate
Rock Outcrop:	No bedrock exposed
CF Abundance:	0%
CF Sizes:	
CF Types:	
Vegetation Condition:	E - Excellent
Disturbance:	None
Fire:	>5

DOMINANT TAXA IN VEGETATION STRATA

Upper Stratum 1: *Avicennia marina*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Avicennia marina	2.5	60

Site Name:	M07
Site Type:	AREA
Dimensions:	m x m
Survey Date:	16/06/2010
GPS Location:	GDA94 (Zone 50) 662132E 7750699N
Community:	
Landform Type:	INTERTIDAL ZONE (other)
Slope Class:	Very Gently Inclined (1 degree)
Aspect:	NE
Soil Type:	CLAY (other)
Soil Colour:	Orange
Soil Depth:	Deep
Rock Outcrop:	No bedrock exposed
CF Abundance:	0%
CF Sizes:	
CF Types:	
Vegetation Condition:	E - Excellent
Disturbance:	None
Fire:	>5

DOMINANT TAXA IN VEGETATION STRATA

Upper Stratum 1: *Rhizophora stylosa*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Rhizophora stylosa	3.5	100

Site Name: S01

Site Type: AREA

Dimensions: m x m

Survey Date: 15/06/2010

GPS Location: GDA94 (Zone 50) 661992E 7750456N

Community:

Landform Type: LIMESTONE RIDGE (other)

Slope Class: Gently Inclined (3 degrees)

Aspect: NE

Soil Type: Sandy Loam

Soil Colour: Orange

Soil Depth: Shallow

Rock Outcrop: Limestone, >50% bedrock exposed

CF Abundance: 10-20%

CF Sizes: 20-60mm, 60-200mm

CF Types:

Vegetation Condition: P - Poor

Disturbance: Exotic Weeds

Fire: >5

DOMINANT TAXA IN VEGETATION STRATA

Mid Stratum 1: *Acacia bivenosa*

Lower Stratum 1: *Triodia secunda*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Acacia bivenosa	2.5	15
**Aerva javanica*	0.5	10
Boerhavia repleta	0.1	0.1
Cassytha capillaris		0.3
**Cenchrus ciliaris*	0.4	30
Cleome viscosa	0.2	0.1
Corchorus ?incanus subsp. *incanus*	0.4	5
Gomphrena canescens subsp. *canescens*	0.3	1
Myoporum montanum	0.8	5
Phyllanthus maderaspatensis	0.2	0.1
Ptilotus exaltatus var. *exaltatus*	0.5	0.3
Scaevola spinescens	1	5
Sida fibulifera	0.3	0.2
Triodia secunda	0.2	20

Site Name: S02

Site Type: AREA

Dimensions: m x m

Survey Date: 15/04/2010

GPS Location: GDA94 (Zone 50) 657790E 7748219N

Community:

Landform Type: INTERTIDAL FLAT (other)

Slope Class: Very Gently Inclined (1 degree)

Aspect: ?NW

Soil Type: SANDY CLAY (other)

Soil Colour: Red

Soil Depth: Moderate

Rock Outcrop: No bedrock exposed

CF Abundance: 0%

CF Sizes:

CF Types:

Vegetation Condition: E - Excellent

Disturbance: Grazing

Fire:

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Algal mat community		99.7
Tecticornia sp.	0.2	0.3

Site Name: S03

Site Type: AREA

Dimensions: m x m

Survey Date: 15/06/2010

GPS Location: GDA94 (Zone 50) 657843E 7748536N

Community:

Landform Type: SUPRA-TIDAL DUNE (other)

Slope Class: Gently Inclined (3 degrees)

Aspect:

Soil Type: Sand

Soil Colour: Orange

Soil Depth: Moderate

Rock Outcrop: No bedrock exposed

CF Abundance: 0%

CF Sizes:

CF Types:

Vegetation Condition: E - Excellent

Disturbance: Grazing

Fire: >5

DOMINANT TAXA IN VEGETATION STRATA

Lower Stratum 1: *Triodia secunda, Sporobolus virginicus, Triodia pungens*

SPECIES LIST

Taxon Name	Average Height	% Cover Alive
Frankenia ambita	0.2	10
Hemichroa diandra	0.2	2
Muellerolimon salicorniaceum	0.2	1
Sporobolus virginicus	0.2	40
Triodia epactia	0.3	2
Triodia secunda	0.2	40

Appendix L: Vascular Plant Taxa Recorded within each Floristic Community Type and Other Community Type, 2010 - 2011

Taxa	Floristic Community Type					Other Community Type		
	1	2	3	4	5	10	11	12
Acacia bivenosa			X					
Acacia colei var. *colei*	X	X						
Acacia sericophylla	X							
Acacia stellaticeps	X	X	X	X				
Acacia tumida var. *pilbarensis*	X			X				
Adriana tomentosa var. *tomentosa*			X					
**Aerva javanica*		X	X					
Ammannia multiflora				X				
Aristida holathera	X			X				
Aristida holathera var. *holathera*	X	X						
Aristida hygrometrica	X							
Atriplex sp.				X				
Avicennia marina					X	X	X	
Bergia ammannioides				X				
Bergia henshallii				X				
Bergia pedicellaris				X				
Boerhavia coccinea	X							
Boerhavia gardneri	X		X					
Boerhavia repleta			X					
Boerhavia sp.	X							
Bonamia linearis	X							
Bonamia ?*linearis*	X	X						
Bonamia ?*media* var. *villosa*		X						
Bonamia media	X							
Bonamia rosea	X							
Bonamia ?*rosea*	X							
Bulbostylis barbata	X	X	X	X				
Byblis filifolia	X			X				

Appendix L: Vascular Plant Taxa Recorded within each Floristic Community Type and Other Community Type, 2010 - 2011

Taxa	Floristic Community Type					Other Community Type		
	1	2	3	4	5	10	11	12
Cajanus marmoratus	X							
Calandrinia pumila				X				
Calandrinia quadrivalvis		X		X				
Calandrinia sp.		X						
Calandrinia sp. Pinga (T.R. Lally TRL 722) PN	X			X				
Calandrinia ?stagnensis		X						
Carissa lanceolata				X				
Cassytha capillaris		X	X	X				
**Cenchrus ciliaris*		X	X	X				
Centrolepis banksii				X				
Chrysopogon fallax	X	X	X	X				
Cleome viscosa			X					
Commelina ensifolia		X		X				
Corchorus elachocarpus			X					
Corchorus incanus subsp. *incanus*	X	X	X					
Corchorus ?incanus subsp. *incanus*	X		X					
Corchorus trilocularis				X				
Corynotheca pungens	X	X						
Crotalaria ramosissima	X							
Cucumis maderaspatanus	X							
Cyperaceae sp.				X				
Cyperus blakeanus		X						
Cyperus ?blakeanus	X							
Cyperus bulbosus				X				
Cyperus ?carinatus	X			X				
Cyperus castaneus var. *brevimucronatus*	X			X				
Cyperus iria				X				
Cyperus squarrosus				X				

Appendix L: Vascular Plant Taxa Recorded within each Floristic Community Type and Other Community Type, 2010 - 2011

Taxa	Floristic Community Type					Other Community Type		
	1	2	3	4	5	10	11	12
Dactyloctenium radulans				X				
Desmodium filiforme	X							
Digitaria brownii	X							
Dodonaea coriacea	X	X		X				
Dysphania plantaginella		X						
Dysphania sp.			X					
Elytrophorus spicatus				X				
Enchylaena tomentosa var. *tomentosa*				X				
Enneapogon lindleyanus			X					
Eragrostis crateriformis (P3)				X				
Eragrostis cumingii				X				
Eragrostis eriopoda	X	X						
Eragrostis falcata			X	X				
Eragrostis speciosa				X				
Eriachne aristidea	X			X				
Eriachne mucronata	X							
Eriachne ?*mucronata*	X	X		X				
Eriachne obtusa	X			X				
Eulalia aurea	X			X				
Euphorbia alsiniflora	X			X				
Euphorbia australis	X							
Euphorbia tannensis subsp. *eremophila*			X	X				
Evolvulus alsinoides var. *villosicalyx*	X	X	X	X				
Fimbristylis dichotoma				X				
Fimbristylis ?*dichotoma*		X		X				
Fimbristylis neilsonii	X							
Fimbristylis oxystachya	X							
Fimbristylis rara	X	X		X				

Appendix L: Vascular Plant Taxa Recorded within each Floristic Community Type and Other Community Type, 2010 - 2011

Taxa	Floristic Community Type					Other Community Type		
	1	2	3	4	5	10	11	12
Frankenia ambita				X				
Frankenia ?ambita					X			
Glycine tomentella	X							
Gomphrena canescens subsp. *canescens*			X					
Gomphrena leptophylla (P3)		X						
Gomphrena sp.			X					
Gomphrena tenella			X					
Goodenia lamprosperma				X				
Goodenia triodiophila	X			X				
Grevillea pyramidalis subsp. *leucadendron*	X							
Hakea lorea subsp. *lorea*	X	X		X				
Hemichroa diandra				X	X			
Hibiscus leptocladus	X	X		X				
Hibiscus sturtii var. *?campylochlamys*	X							
Hybanthus aff.*aurantiacus*	X							
Hybanthus aurantiacus	X	X		X				
Indigofera colutea			X					
Indigofera linifolia	X							
Indigofera monophylla	X							
Indigofera trita		X	X	X				
Ipomoea muelleri	X							
Ipomoea polymorpha	X							
Lipocarpha microcephala				X				
Marsilea drummondii				X				
Melhania oblongifolia				X				
Mimulus gracilis				X				
Mitrasacme connata	X							
Mitrasacme exserta	X			X				

Appendix L: Vascular Plant Taxa Recorded within each Floristic Community Type and Other Community Type, 2010 - 2011

Taxa	Floristic Community Type					Other Community Type		
	1	2	3	4	5	10	11	12
Mollugo molluginea	X	X						
Muellerolimon salicorniaceum					X			
Murdannia graminea	X							
?Murdannia graminea		X		X				
Myoporum montanum			X					
Neobassia astrocarpa				X				
Nesaea muelleri				X				
Panicum ?decompositum				X				
Paspalidium rarum	X							
Peplidium ?muelleri				X				
Phyllanthus maderaspatensis			X					
Pluchea ferdinandi-muelleri	X			X				
Pluchea rubelliflora				X				
Pluchea tetranthera	X							
Polycarpaea corymbosa	X	X						
Polygala linariifolia	X			X				
Polymeria ambigua	X							
**Portulaca oleracea*			X					
Portulaca pilosa	X		X	X				
Portulaca sp.		X						
Ptilotus arthrolasius	X							
Ptilotus axillaris			X					
Ptilotus exaltatus var. *exaltatus*			X					
Ptilotus fusiformis	X							
Ptilotus polystachyus	X							
Ptilotus schwartzii	X							
Rhagodia eremaea			X					
Rhizophora stylosa						X		

Appendix L: Vascular Plant Taxa Recorded within each Floristic Community Type and Other Community Type, 2010 - 2011

Taxa	Floristic Community Type					Other Community Type		
	1	2	3	4	5	10	11	12
Rhynchosia minima			X	X				
Rotala diandra				X				
Salsola australis	X							
Sarcostemma viminale subsp. *australe*				X				
Scaevola amblyanthera var. *centralis*			X					
Scaevola spinescens			X					
Schizachyrium fragile	X							
Schoenoplectus laevis				X				
Senna glutinosa subsp. *glutinosa*			X					
Senna notabilis	X		X					
Sida aff. *cardiophylla*	X							
Sida fibulifera			X					
Sida rohlenae subsp. *rohlenae*	X	X	X					
Sida ?sp. Pilbara (A.A. Mitchell PRP 1543)	X		X					
Sida sp. Pilbara (A.A. Mitchell PRP 1543) PN		X						
Sida ?sp. Rabbit Flat (B.J. Carter 626)	X							
Sida sp. Rabbit Flat (B.J. Carter 626) PN	X							
Sida sp.	X	X		X				
Solanum diversiflorum	X	X						
Solanum ellipticum		X		X				
Solanum phlomoides	X		X					
Sorghum ?*plumosum*	X							
Sporobolus mitchellii				X				
Sporobolus virginicus		X			X			
Stackhousia intermedia	X			X				
Stemodia lathraia				X				
Streptoglossa decurrens				X				
?*Stylidium desertorum*	X							

Appendix L: Vascular Plant Taxa Recorded within each Floristic Community Type and Other Community Type, 2010 - 2011

Taxa	Floristic Community Type					Other Community Type		
	1	2	3	4	5	10	11	12
Suaeda arbusculoides					X		X	
Swainsona stenodonta				X				
Tecticornia ?*halocnemoides* subsp. *tenuis*					X			
Tecticornia ?*indica* subsp. *leiostachya*					X			
Tecticornia indica subsp. *bidens*					X			
Tecticornia pergranulata subsp. *elongata*					X			
Tecticornia ?*pergranulata* subsp. *elongata*					X			
Tecticornia sp.					X			X
Tephrosia leptoclada		X						
Tephrosia ?*leptoclada*	X							
Tephrosia rosea var. ?*venulosa ms* (P1)	X							
Trianthema pilosa	X							
Trianthema turgidifolia				X				
Tribulopis angustifolia	X							
Tribulus hirsutus	X							
Triodia epactia	X	X	X	X	X			
Triodia lanigera	X							
Triodia schinzii	X							
Triodia secunda				X				
Triodia ?*secunda*	X	X	X	X	X			
Urochloa holosericea subsp. *velutina*	X			X				
Waltheria indica	X							
Whiteochloa cymbiformis		X						
Yakirra australiensis	X			X				

* denotes Introduced Taxon