Appendix C

Flora, Vegetation and *Phytophthora cinnamomi* Assessment

EMPIRE OIL & GAS NL

MULLERING ONSHORE 3D SEISMIC SURVEY

FLORA, VEGETATION AND *Phytophthora cinnamomi* ASSESSMENT

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EXECUTIVE SUMMARY

Empire Oil & Gas NL (Empire) are proposing to conduct a three dimensional (3D) seismic survey to delineate the sub-surface structure of the Mullering Anticline located within the Mullering area. The survey area covers an area of approximately 66.8 sq km surrounding the Mullering No. 1 and Cataby No. 1 wells. Empire commissioned Woodman Environmental Consulting Pty Ltd to conduct detailed flora, vegetation and dieback studies of the study area to support an environmental management plan for the 3D seismic survey. The aim of this project was to obtain information on the plant communities, flora species and dieback distribution in all remnant native vegetation within the Mullering project area. Information collected during the studies will facilitate management of impacts to flora and vegetation.

Experienced botanists conducted the vegetation mapping in September and November 2005 and May 2006. Targeted rare flora searching was also conducted in May and October 2006. All areas surveyed for dieback were traversed both in a vehicle and on foot by Mr Evan Brown of Glevan Consulting who is experienced in the detection and mapping of *Phytophthora cinnamomi* and is accredited by DEC to conduct dieback interpretation on DEC estate. The fieldwork was conducted in October and November 2005.

A total of 486 vascular plant taxa belonging to 71 plant families were recorded within the Mullering 3D project area. The dominant families were Myrtaceae (50 taxa), Proteaceae (44 taxa), Haemodoraceae (31 taxa), Cyperaceae (29 taxa), Asteraceae (26 taxa) and Papilionaceae (23 taxa).

Three Declared Rare Flora were recorded within the project area, *Andersonia gracilis, Macarthuria keigheryi* and *Anigozanthos viridis* subsp. ?*terraspectans*. 13 Priority species were also recorded during the survey. In addition, an *Eremophila* with a very restricted distribution within the project area was collected from H11. Andrew Brown from the Department of Environment and Conservation determined that the closest related taxon to the specimen is *Eremophila* sp. Green Flowers. However, the specimen has bright yellow flowers and may represent a distinct form or another new *Eremophila glabra* subspecies. Three species recorded from within the project area represent extensions to their known ranges, *Philydrella ?drummondii*, *Platysace* sp. Eneabba (R. Hnatiuk 770001) and *Schoenus pennisetis* (Priority 1).

25 structural plant communities and seven other areas (including disturbed and mosaic areas) were described and mapped within the Mullering Project Area. None of the plant communities mapped within the project area are currently listed or proposed for listing as Threatened Communities by the Department of Environment and Conservation.

No areas displaying symptoms of infestation by *P. cinnamomi* and no recoveries of this pathogen were recorded from the Mullering project area. However, the wetland systems

receive drainage from the east of the project area and therefore represent a high risk of introducing the pathogen to the area.

The following recommendations are made based on the results of the flora, vegetation and dieback survey:

1. Vegetation clearing should be minimised wherever possible, with existing tracks and cleared land used if available, especially in areas with Declared Rare and Priority Flora. Clearing should avoid areas with known *Andersonia gracilis* and *Anigozanthos viridis* subsp. ?*terraspectans* populations.

2. Line preparation methods should be undertaken as per Table 5 (see Section 7).

3. All precautions should be taken to prevent accidental fires. These include the use of diesel rather than petrol vehicles and the provision of a fire tender during hot conditions.

4. A comprehensive weed and *P. cinnamomi* hygiene management plan should be developed and implemented for the operations.

5. Wetland areas that experience significant periods of inundation should not be traversed by vehicles to protect the surface from compaction and to ensure surface drainage patterns are not compromised.

6. Trees (>3m) should not be cleared during seismic line preparation.

7. Slow growing species should be avoided where possible during seismic line preparation. These species include *Macrozamia fraseri* and *Xanthorrhoea* spp.

8. Clearing within 10metres of DEC Monitoring plots within the Mullering Project Area should be avoided.

1 INTRODUCTION

Empire Oil & Gas NL (Empire) are proposing to conduct a three dimensional (3D) seismic survey to delineate the sub-surface structure of the Mullering Anticline located within the Mullering area. The survey area covers an area of approximately 66.8 sq km surrounding the Mullering No. 1 and Cataby No. 1 wells, and is located approximately 20km west of the Brand Highway, north-west of Cataby on Woolka Road. The project area is primarily located within Unallocated Crown Land (UCL) with private property (P13953 and P167377 'Tombstone Rocks') located on the western boundary (Gulliver Productions 2004).

3D survey techniques require source and receiver lines to be cleared in a grid-square pattern, with source lines requiring a higher level of clearing in comparison to receiver lines. These lines are recorded using DGPS equipment, which records the actual cleared line and therefore any deviations of the line undertaken to avoid environmentally sensitive areas. In total, 431.35 km of seismic line is proposed for this project, 216.0km under source lines, and 215.35 km under receiver lines.

The current land tenure of the majority of the survey area is Unallocated Crown Land, with a section of Vacant Crown Land stretching diagonally through the area, for the purpose of a Stock Route. Cooljarloo Swamp is located within the north-eastern corner of the survey area, and it is proposed that no works are to be undertaken in this area (Gulliver Productions 2004).

Empire commissioned Woodman Environmental Consulting Pty Ltd to conduct detailed flora, vegetation and dieback studies of the project area to support an environmental management plan for the 3D seismic survey.

2 AIMS

The aim of this project was to obtain information on the plant communities, flora species and dieback distribution in all remnant native vegetation within the Mullering project area. Information collected during the survey will facilitate management of impacts to flora and vegetation. The tasks required to meet this aim were:

Vegetation

1. Review and collate existing data on soil and vegetation within the survey area.
2. Map the plant communities within the survey area from aerial photography followed by ground confirmation.
3. Collect quantitative data from sites located within each community.
4. Review the conservation status of each plant community and its sensitivity to disturbance.
5. Record the condition of the vegetation.

6. Provide recommendations to minimise impact on sensitive plant communities and promote rehabilitation of the seismic lines.

Flora

1. Produce a list of the vascular plant species recorded within each community, based on site data as well as opportunistic collecting.
2. Review and collate existing data on Rare and Priority Flora in the survey area.
3. Search for Rare and Priority Flora species within the survey area.
4. Provide recommendations to minimise impact on significant flora species and manage weeds.

***Phytophthora cinnamomi* (Dieback)**

1. Survey for and map the presence of *Phytophthora cinnamomi* (Dieback) within the project area.
2. Provide recommendations to manage *Phytophthora cinnamomi* hygiene.

3 EXISTING ENVIRONMENT

3.1 Soils and Landforms

The soils of the general region are described as mainly recent sands and swamp deposits on the coastal plain area, with the survey area being mainly located on the Bassendean System, with the south-western corner being located in the Guilderton System (Beard 1979; 1990). The Bassendean System was described as consisting of low, vegetated hills of quartz sand with numerous interdunal swamps and lakes, with no organised drainage except where rivers cross this plain. This system is separated from the ocean by the Coastal Belt, which is formed by the Guilderton System, with a section of the Le Sueur System (part of the Irwin Botanical District) separating the Bassendean System from the Dandaragan Plateau, located further east. The soils of the Bassendean System were described as highly leached and bleached white, often with a compacted or pan-like layer below the bleach (Beard 1979).

A small section on the south-western corner of the survey area occurs on the Guilderton System, and is the northward extension of the Quindalup Dune System, although with different vegetation (Beard 1979). The soils of the Quindalup dune system are described as calcareous sands of minimal development (Beard 1979).

The survey area is located within the Perth Basin geological province, which extends from the Murchison River to the south coast, and eastwards to the Darling fault. Over 90% of the Perth Basin is covered by Pleistocene and Holocene sedimentary deposits, with the only exposures of pre-Quaternary (younger than 2 Ma) rocks located in the Hill River/Mount Lesueur region. Mesozoic (225 – 65 Ma) sedimentary units are the major sources for groundwater and hydrocarbons in the Basin (Department of Planning and Urban Development 1994).

The survey area itself is located on the Coastal Backplain, which is comprised of Aeolian, alluvial sands and clays comprising the Bassendean Sand and Guildford Formation,

interspersed with pockets of swamp and lacustrine deposits, composed of diatomite, clay, loam, silt and sand. These Bassendean sands of Pleistocene age consist of seashore sands blown up over time, in contrast with sands of the uplands (Dandaragan Plateau) which are colluvial sand sheets derived from repeated weathering and sheet wash. The Bassendean System is characterised by large areas of podsolised sand rises and wetlands, with deep yellow sands or deep white sands, over waterlogged flats of humus rich, peaty sands, or sand over clay mottled duplex soils. There is a large variability in the permeability and water holding capacity of these sands, with the most important superficial aquifer in this system being the groundwater held in sand mounds. The Bassendean Sands were originally comprised of lime sand with a small proportion of quartz sand, with the lime sand almost entirely leached out (Department of Planning and Urban Development 1994).

Soil mapping at the Cooljarloo mineral sands mine, located immediately to the east of the survey area, were grouped into three soil associations including:

- soils of the gently undulating, latertised surface - comprised of sands overlying ferruginous gravel;
- deep white sands and pale grey, light clays; soils of the dune fields – comprised of deep white sands; and
- deep yellow sands; and soils adjacent to the Mullering Brook – comprised of clayey sand, deep gradational sands and shallow clayey sands.

The soils in this area are known for their low nutrient levels, and high water infiltration rates but limited capacity for water retention (with a soil drying phase commencing in October and extending to May) (Tiwest Pty Ltd 1999).

3.2 Flora and Vegetation

The survey area is located within the Bassendean Interim Bioregion, as defined by Griffin (1998). The survey area is also within the Swan Coastal Plain IBRA (Interim Biogeographic Regionalisation for Australia), close to the boundary with the Geraldton Sandplains (Department of Environment and Heritage 2005).

The survey area is located within the Drummond Botanical Subdistrict, within the Darling Botanical District in the South-West Province, as defined by Beard (1979; 1981; 1990). Approximately 78% of the Drummond Botanical Subdistrict has been cleared. The survey area is located mainly on the Bassendean System, but also on the Guilderton System, as described by Beard (1979; 1981). The Guilderton System is amalgamated into the Coastal Belt by Beard (1990).

The vegetation of the Bassendean System is comprised of woodlands consistently of *Banksia attenuata*, *Banksia menziesii* (and in wetter areas *Banksia ilicifolia*), with *Eucalyptus todtiana* and *Nuytsia floribunda* on the dunes, with heath communities, and teatree, paperbark and reed swamps in dune swales (Beard 1990). *Banksia* low woodland understorey species are less consistent than overstorey species, but include *Xanthorrhoea preissii*, *Adenanthos cygnorum*, *Allocasuarina humilis*, *Dryandra nivea*, *Eremaea fimbriata*, *Hibbertia* sp., *Jacksonia furcellata*, *Lysinema ciliatum*, *Anigozanthos humilis*

and *Conostylis aculeata* (Beard 1979). Swampy areas north of the Moore River are underlain by a calcareous hardpan, and consist of heath communities (Beard 1981). The species composition of heath areas on these swampy patches varies widely, with combinations including *Acacia lasiocarpa* and *Melaleuca systena*, *Banksia sphaerocarpa*, or *Calytrix aurea*, *Calytrix flavescens*, *Verticordia densiflora* and *Verticordia drummondii*. Samphire can also occur in salty areas (Beard 1979).

The Guilderton System is located further towards the coastline, and occupies sands of the outer coastal belt. The dunes have a climax community of *Acacia cyclops*, however due to disturbance factors heath or low scrub of species such as *Acacia lasiocarpa* and *Melaleuca systena* are more common. On the flats and interdunal areas, the heath is similar, with *Scaevola* sp. sometimes dominating (Beard 1979).

Beard broadly mapped and described the vegetation of the State of Western Australia, including the Swan Region in 1981, at a scale of 1:1 000 000. The survey area was mapped as *Banksia attenuata* and *Banksia menziesii* Low Woodland, with *Banksia* low woodland on white sand of coastal plain, and numerous patches of heath in swamps. Beard undertook more detailed mapping of the south-west at a scale of 1:250 000, with the Moora to Hill River area being published in 1979 (Beard 1979). The survey area was again mapped as *Banksia* low woodland on coastal plain white sand, with numerous patches of heath in swamps.

Other mapping of the Sandplains area has been undertaken by Griffin and Keighery (1989), Burbidge and Boscacci (1989), *ecologia* Environmental Consultants (1995), Halpern Glick and Maunsell (2000), Mattiske Consulting Pty Ltd (1996 and 1997), Western Botanical (2002) and *ecologia* Environmental Consultants (2000).

3.2.1 Previous surveys

The survey area has formed part of several flora and vegetation surveys, at State, Regional and Local levels in recent years. These include several surveys by J. S. Beard, in his mapping and description of vegetation systems both on a State wide level (1981; 1990) and Regional level (1979). Several regional studies within the sandplain area have been undertaken by Burbidge and Boscacci (1989); Griffin and Keighery (1989), Griffin (1998).

Smaller, local studies have been conducted in the nearby area, including a biological survey of the Coastal Road from Jurien to Green Head, located north of the survey area by *ecologia* Environmental Consultants (1995), and a biological survey of the Coast Road from Lancelin to Cervantes by Halpern Glick and Maunsell (2000). Extensive flora and vegetation surveying has been undertaken at the Cooljarloo minesite (Tiwest Pty Ltd) prior to mining, which is located immediately to the east and north of the survey area. Details of these surveys are discussed in detail in the Mullering Onshore 3D Seismic Survey, Flora and Vegetation Desktop Review (Woodman Environmental Consulting, 2005).

The Department of Environment and Conservation (DEC)'s Declared Rare Flora (DRF) and Priority Flora species databases, including the Western Australian Herbarium (WAHerb) specimen database, were interrogated for information regarding significant species within an area extending 1km on every border of the survey area (NW: 334000E 6608000N; SE: 344500E 6598000N). Table 1 details the results of these interrogations. WAHerb data and DEC Threatened Flora Database data is all from within the search area as above. Information from the DEC DRF/Priority Flora List includes species previously recorded within the DEC Region of the search area, not specifically within the search area.

Table 1: DRF and Priority Flora species listed on DEC Threatened Flora Databases, and the WAHerb Specimen Database

Species	Status	Number of Specimens in WAHerb	Threatened Flora Database	DEC DRF / Priority Flora List
Acacia cummingiana	P3			*
Acacia epacantha	P3			*
Acacia forrestiana	DRF			*
Acacia sp. Dandaragan (S. van Leeuwen 269)	DRF			*
Andersonia gracilis	DRF	1	1	
Anigozanthos viridis subsp. *terraspectans*	DRF	1		
Asterolasia drummondii	P4			*
Astroloma microcalyx	P3			*
Banksia micrantha	P3			*
Conospermum scaposum	P3	6		
Conostephium magnum	P4	1		
Dampiera tephrea	P2			*
Dryandra pteridifolia subsp. *vernalis*	P3			*
Dryandra stricta	P3	1		
Eucalyptus dolorosa	DRF			*
Eucalyptus johnsoniana	DRF	1		
Gastrolobium callistachys	P4			*
Grevillea calliantha	DRF			*
Grevillea tenuiloba	P3			*
Grevillea thyrsoides subsp. *thyrsoides*	P3			*
Haloragis tenuifolia	P3		1	
Hemigenia curvifolia	P2			*
Hensmania stoniella	P3			*
Hibbertia spicata subsp. leptotheca	P3	1	1	
Hypocalymma tetrapterum	P3			*
Lasiopetalum lineare	P3	1		*
Lechenaultia galactities ms	P3			*
Loxocarya gigas	P2	1		
Macarthuria keigheryi	DRF	1	1	
Stylidium maritimum	P3			*
Synaphea aephynsa	P3			*
Tricoryne robusta	P2	2		
Verticordia lindleyi subsp. *lindleyi*	P4	1		

The DEC Threatened Ecological Communities (TEC) database was interrogated, including an area of 1km surrounding the survey area. No known TECs are located within this area, with the nearest TEC (TEC 18 Thetis-microbialite community) located approximately 30km away.

3.3 Wetlands

The survey area lies on the Bassendean Sand hydrological zone. Here ephemeral drainage occurs where chains of wetlands connect to form streams (Semeniuk 1994). Groundwater in this area is recharged by rainfall, and associated runoff, with some perched water tables superimposed. Salinity in this area is generally <1000 mg/L (Semeniuk 1994).

Wetlands within the survey area are included in the Nambung Basin, and form part of the Mullering Wetlands chain (Department of Planning and Urban Development 1994). The wetlands themselves form part of the Minyulo Suite, described by Semeniuk (1994) as microscale sumplands, damplands, and creeks, which are located at Minyulo and Mullering Brooks, and in the intermediate area in the Bassendean Dunes Unit. Water in this suite can range from fresh to hypersaline, with water maintained in wetlands through ponding, and groundwater rise. Vegetation throughout either forms complete cover, or is a mosaic with open water (Semeniuk 1994). This suite is known for the presence of the DRF species *Anigozanthos viridis* subsp. *terraspectans*, and the Priority species (P3) *Conospermum scaposum*; is an area with diverse habitats; transports sediment; is a pathway and habitat for fauna, (e.g. breeding area for Pacific Black Duck and Grey Teal); and acts with a flushing mechanism to basin wetlands, and floodplain/palusplain (Semeniuk 1994). The Minyulo Brook and Mullering Brooks are themselves locally to regionally significant (Semeniuk 1994).

3.4 Dieback

There are four species of *Phytophthora* that are regularly identified in natural ecosystems in the south-west of Western Australia including; *P. cinnamomi*, *P. citricola*, *P. megasperma* and *P. drechsleri*. Of these species, only *P. cinnamomi* has been shown to cause disease epidemic in natural ecosystems, with the remainder behaving like native pathogens and causing little harm to vegetation. *P. megasperma* and *P. citricola* have the potential to cause localised disease outbreaks where site conditions have been modified to favour their survival and pathogenicity (Podger *et al*. 1996).

Phytophthora cinnamomi is a virulent plant pathogen that belongs to the water moulds and as such requires moist conditions to propagate, spread and infect hosts. This pathogen causes disease epidemic within native vegetation of the medium to high rainfall (annual rainfall >400mm) areas of South-western Western Australia, particularly in the plant families Proteaceae (*Banksias, Grevillea*s etc), Epacridaceae (Heaths), Myrtaceae (Eucalypts, *Calothamnus* etc) and Xanthorrhoeaceae (Grass trees) (Shearer and Tippett, 1989; Department of Conservation and Land Management 2003; Podger *et al*. 1996).

These plant families dominate the plant communities between Perth and Eneabba and include most of the rare and threatened plant species present in the region. The destruction of many species susceptible to *P. cinnamomi* has had a serious impact on ecosystems in the south-west of Western Australia. The Proteaceae are most under threat from this pathogen with more than 86% of the species of Proteaceae assessed found to be susceptible to *P. cinnamomi* and various canker fungi (Wills and Keighery 1994). Studies have shown that the ecological changes brought about by *P. cinnamomi* infestation in terms of species loss and habitat structure modification are associated with low species diversity and abundance of faunal populations, particularly mammals (Wilson *et al*. 1994).

The pathogen can spread unaided by root to root contact, by native and introduced animal activity, along water drainage systems, and most commonly by human vectors in soil on machinery and footwear (Department of Conservation and Land Management 2003).

4 METHODS

Experienced botanists conducted the vegetation mapping in September and November 2005 and May 2006. Targeted rare flora searching was also conducted in May and October 2006.

4.1 Flora and Vegetation

All areas surveyed were traversed by vehicle and on foot to map vegetation boundaries and search for restricted flora species. Detailed site recordings were taken at each community boundary change and regularly within communities. At each site a standard recording sheet was used to ensure the consistent collection of flora and site data. At each site the following information was collected within a 20m radius:

- Site location (including GPS co-ordinates)
- Soil type, colour and presence of outcropping
- Position of site in the landscape
- Site condition, including fire history and presence of any disturbance (Trudgen 1991)
- Height and cover of any tree species present
- Height and cover of dominant vascular understorey plant species present
- Presence of any other vascular plant species
- Vegetation structure (Muir 1977)

Where possible, the conservation status of each plant community was determined by reference to available regional studies.

Plant species nomenclature used in this report follows Green (1985). All names were checked using the Max Database to ensure they are current. The conservation status of all species collected was checked using the current Department of Environment and Conservation list (Department of Environment and Conservation 2006).

4.2 Rare and Priority Flora

A search of the DEC Rare and Priority Flora database was carried out prior to the field-work. This provided a list of all restricted species known to occur in the area. As the entire project area was not ground truthed during the vegetation mapping and several significant species are both annual and difficult to find unless intensive searching is conducted, a risk assessment was carried out to determine those habitats where significant flora may be present and as yet undetected. Table 2 lists the DRF and Priority Flora species that were targeted during the Rare and Priority Flora searching in May and October 2006.

Table 2: Declared Rare and Priority Flora Risk Assessment

Species	Status	Area to be searched	Timing
Andersonia gracilis	DRF	H1	October
Acacia splendens Maslin & C.P. Elliot ms	DRF	W2	May
Macarthuria keigheryi	DRF	W3	October
Onychosepalum microcarpum	P1	H1	October
Anigozanthos viridis subsp. *terraspectans*	DRF	T1, H1, H7, H8 and H2	October
Eleocharis keigheryi	DRF	T1	October
Schoenus badius	P2	H1, H2, H3 and H9	October
Dampiera tephrea	P2	H6	May
Tricoryne sp. Eneabba	P2	W3	October
Verticordia blepharophylla	P2	H1, H8	October
Eremophila glabra ssp. new taxon	*	S2, T1, H1, H7, H2, H9	October
Grevillea thelemanniana/preissii	*	S2, T1, H1, H7, H2, H9	October

Note: * indicates species of interest identified by Bronwen Keighery.

4.3 Dieback

All areas surveyed were traversed both in a vehicle and on foot by Mr Evan Brown of Glevan Consulting who is experienced in the detection and mapping of *Phytophthora cinnamomi* and is accredited by DEC to conduct dieback interpretation on DEC estate. The fieldwork was conducted in October and November 2005. Samples of soil and vegetation material from dead or dying indicator plant species were collected and analysed for the presence of *P. cinnamomi*. Any obvious disease boundaries along the route were marked in the field using day-glo pink (*P. cinnamomi* infested) or white (uninterpretable) flagging tape. The sampling regime employed during the surveys also included the collection of control samples of soil from locations approximately 20m away from identified infestation boundaries into uninfested vegetation. Following receipt of the sample analysis results and an assessment of the significance and potential for management of each *P. cinnamomi* free area, field boundaries were amended as required.

5 RESULTS

5.1 Flora

A total of 486 vascular plant taxa belonging to 71 plant families were recorded within the Mullering 3D project area during the surveys (Appendix B). The dominant families were Myrtaceae (50 taxa), Proteaceae (44 taxa), Haemodoraceae (31 taxa), Cyperaceae (29 taxa), Asteraceae (26 taxa) and Papilionaceae (23 taxa).

5.1.1 Significant Flora

Three Declared Rare flora were recorded within the project area, *Andersonia gracilis, Macarthuria keigheryi* and *Anigozanthos viridis* subsp. ?*terraspectans*.

Andersonia gracilis is a straggly shrub which grows to 0.5m. The plants produce pink flowers from September to November. *Andersonia gracilis* is usually found in winter-wet areas, near swamps. Five locations of *Andersonia gracilis* were recorded during the survey, the extent of these populations is shown on Figure 1. *Andersonia gracilis* was found in Heath communities bordering drainage lines or basins (H1, H5, T1).

Macarthuria keigheryi is a perennial herb with white flowers found in grey or white sand. *Macarthuria keigheryi* is known from nine records within the DEC threatened flora database and 16 records within the WA Herbarium database. *Macarthuria keigheryi* was recorded on a number of occasions within the Mullering project area. *Macarthuria keigheryi* is locally common within the W3 community, and also occurs sporadically in the F1, M1, H2 and H5 communities (Figure 1).

Anigozanthos viridis subsp. *terraspectans* otherwise known as the Dwarf Green Kangaroo Paw is a perennial herb with distinctive green and yellow flowers. *Anigozanthos viridis* subsp. *terraspectans* is found in winter wet depressions. *Anigozanthos viridis* subsp. *?terraspectans* was recorded on two occasions during the Mullering survey (Figure 1). This species was located in the wet portions of a H1 and a H5 area in the south-east of the project area. Identification of this species from specimens collected and pressed can be difficult, with the expert in this group Dr Stephen Hopper, being currently unavailable to check specimens. However the specimens collected at the two locations are the DRF species should be regarded as definite for the purposes of this project. These specimens will be submitted to the State Herbarium.

13 Priority species were recorded during the survey. These are listed below (Table 3) and locations are given on Figure 1.

Table 3: Priority Flora recorded within the Mullering 3D Seismic Survey Project Area.

Species	Status	Community	Comment
Melaleuca clavifolia	P1	H1, H3, H9, W3, W5a	Widespread throughout project area, especially in W3 community. *Melaleuca clavifolia* is a shrub which grows to 1m. *Melaleuca clavifolia* is generally found on white-grey sand, brown sandy gravel and laterite and grows on flats, slopes and hillsides. *Melaleuca clavifolia* is common across Tiwest's Leases. Currently this species is difficult to distinguish from *Melaleuca trichophylla*. Further taxonomic verification is needed to accurately address the significance of this species.
Onychosepalum microcarpum	P1	H1	Rhizomatous, tufted perennial, herb, 0.07–0.15 m high. Found on white or yellow sand in dry heath or low woodland. This species is very common within the H1 community.
Schoenus pennisetis	P1	H5	Tufted annual, grass-like or herb (sedge), 0.05–0.15 m high. Found on grey or peaty sand, sandy clay in swamps or winter-wet depressions. This species was found at a single location in H5 in the south-east of the project area.
Acacia benthamii	P2	H10	This species is a perennial shrub to 1m found on sands on limestone breakaways on the coastal strip between Perth and Geraldton. *A. benthamii* is restricted to the H10 dunal community in western section of project area.
Verticordia blepharophylla	P2	H1	This species is a perennial shrub to 1m found on white, grey or yellow sands or sandy clays in wet depressions. It was commonly recorded in wet heath communities including H1, H5 and M2.
Baeckea sp. Perth Region (R.J.Cranfield 444)	P3	F1, H1, M2, T1	This species is very common within the H1 community.
Dryandra lindleyana subsp. *pollosta*	P3	H1, W5a	This species was recorded three times in the survey area within H1 and in W3 beside a wet community. This is a prostrate lignotuberous shrub found on sands in flats and on lateritic rises. It is likely that it is more common elsewhere in the project area.
Dryandra stricta	P3	H1	This species is a non-lignotuberous species to 3m in height. It is found on white, grey, red sands often with laterite, clays or loams. This species was found at a single location on the margin between W3 and H1 communities.
Dryandra tortifolia	P3	W3	*Dryandra tortifolia* is a low, lignotuberous shrub up to 25cm high. *Dryandra tortifolia* is found on white, grey or yellow sand over laterite. This species has been found commonly from Cataby north to Dongara with many records from both the Tiwest leases and the Iluka Eneabba leases (Woodman Environmental Consulting

			2002a and b) *Dryandra tortifolia* has been found at a number of locations within and outside Tiwests Leases (Landcare Services 2002). Research conducted by Landcare Services (2002) suggests that *D. tortifolia* is more common than existing records show.
Haloragis foliosa	P3	D2	This species was found at a single location in the south-west of the project area on Guilderton complex soils. This species is a perennial shrub to 0.5m in height found on white or grey sands on limestone. It is common to the coastal vegetation communities of the Midwest.
Olax scalariformis	P3	H3, W3, H1, F1	Widespread throughout project area, especially in H1 community. *Olax scalariformis* is a shrub which grows to 1m in height. *Olax scalariformis* is found on sandy soils in the Southwest of Western Australia. It is unlikely that the project will have a significant impact upon this species.
Dryandra platycarpa	P4	H1	*Dryandra platycarpa* is a non-lignotuberous shrub, that occurs on sandy soils, often with gravel or over laterite. *Dryandra platycarpa* has been recorded from a number of locations within the Geraldton Sandplains and Swan Coastal Plain Bioregions. It is unlikely that the proposed project will significantly impact this species.
Verticordia lindleyi subsp. *lindleyi*	P4	H1	Erect shrub, 0.2–0.75 m high. Found on sand, sandy clay in winter-wet depressions. This species was found at a single location within H1 community. It is likely that this species is more widespread within the project area in this community type.

In addition, an *Eremophila* was collected from H11. This specimen has been identified by Andrew Brown from the Department of Environment and Conservation, who determined that the closest related taxon is *Eremophila* sp. Green Flowers. However, the specimen has bright yellow flowers and may represent a distinct form or another new *Eremophila glabra* subspecies.

Three species recorded from within the project area represent extensions to their known ranges, *Philydrella ?drummondii*, *Platysace* sp. Eneabba (R. Hnatiuk 770001) and *Schoenus pennisetis* (Priority 1).

5.1.2 Introduced Flora

32 introduced (weed) species were recorded within the Project Area (Table 4). Generally, weed invasion within the Mullering 3D Project Area was very low, with most weed densities well below 1%. Areas with a higher percentage of weed cover were the W6, W6d, T1 and W3d communities. **Hypochaeris glabra* was recorded as having a density of 20% in one W3d community and **Cotula coronopifolia* was recorded as having a cover of 10% within the W6d community. Most of the weed occurances were noted within the western third of the project area. This area is privately owned and is used for stock.

Only **Moraea flaccida* is listed as a Declared Plant by Agriculture Western Australia. **Moraea flaccida* the Cape Tulip is listed under category P1, whereby the movement of plants or their seeds is prohibited within the state. This prohibits the movement of contaminated machinery and produce including livestock and fodder. **Moraea flaccida* was recorded on three occasions within the survey area, within D1, T1 and W4 in the private property.

Table 4: Introduced species recorded within the Mullering 3D Seismic Survey Project Area.

Species	Community
**Aira caryophyllea*	H2, H9, T2, W3
**Anagallis arvensis*	D1, D2, H11
**Anagallis arvensis* var. *caerulea*	D2, F, W3d, W4, W6d
**Arctotheca calendula*	T2, W3d, W6d
**Briza maxima*	W4
**Briza minor*	D1, H2
**Bromus* sp.	D1
**Cicendia filiformis*	T1
**Cotula coronopifolia*	T1, W3, W6d
**Crassula glomerata*	F
**Crassula natans* var. *minus*	S2, W6
**?Cynodon dactylon*	SE1
**Cyperus tenellus*	F, H6, S2, T1, W1, W3, W4, W5, W6d
**Dischisma arenarium*	D2, S1, W4, W6d
**Erodium cicutarium*	D2, W4, W6d
**Heliophila pusilla*	H1, H2, T2, W3, W4
**Hordeum leporinum*	D2
**Hypochaeris glabra*	W2, W5a, H9, W4, W3d,H1, W3, H2, D2, W5, W6d, T2
**Juncus bufonius*	F
**Melilotus indicus*	D2
**Mercurialis annua*	W1, W4
**Moraea flaccida*	T1, W4, D1
**Orobanche minor*	D2
**Parentucellia latifolia*	F, W6d
**Parentucellia viscosa*	T1
**Petrorhagia dubia*	W6d
**Romulea rosea*	F, W6d, H1
**Rostraria pumila*	H10, D2
**Sonchus oleraceus*	D2
**Trifolium* sp.	W6d
**Ursinia anthemoides*	W6d, W3d, H1, W5a, H5, W3, W5, W4
**Wahlenbergia capensis*	S1, W3, W6d

5.2 Vegetation

25 structural plant communities and seven other areas (including disturbed and mosaic areas) were described and mapped within the Mullering Project Area. A description of the communities mapped is given below. A list of species recorded within each community is provided in Appendix C. Vegetation mapping is provided in Figure 1.

Forests

F1 Low Forest dominated by *Banksia attenuata* over mixed herbaceous species dominated by *Anarthia laevis* on brown sand

Only one small area of Forest was recorded within the Mullering project area, to the north of Woolka Road (Figure 1). The Forest community is situated on a low rise surrounded by Heath. The F1 community was observed to be in excellent condition, with no weeds recorded.

Woodlands

W1 Woodland dominated by *Eucalyptus decipiens* subsp. *decipiens* over mixed shrubs and herbs dominated by *Austrostipa compressa* on grey sand

W2 Open Woodland of *Eucalyptus rudis* over mixed shrubs on grey sand

W3 Low Woodland of *Eucalyptus todtiana, Banksia attenuata* and *Banksia menziesii* over mixed shrubs on grey sand

W3d Degraded areas of Type W3

W4 Low Woodland dominated by *Banksia prionotes* over mixed shrubs on brown sand

W5 Open Low Woodland of *Melaleuca preissiana* and *Banksia attenuata* over mixed shrubs on brown sand

W5a Open Woodland of *Melaleuca preissiana*, *Banksia attenuata* and *Melaleuca rhaphiophylla* over mixed shrubs on brown loamy sand on the crest of a low rise

W6 Low Woodland to Low Forest dominated by *Melaleuca rhaphiophylla* on grey sand in a swamp

W6d Degraded areas of Type W6

Woodlands are the most common and widespread communities within the Mullering project area, particularly the W3 community (Figure 1). Throughout most of the project area the Woodland communities were recorded to be in excellent condition, with little disturbance and few weeds. However, on the private property in the western third of the project area a number of small degraded Woodland communities exist (Figure 1). Whilst the W3 community is the most widespread, W1, W2, W5, W5a and W6 are restricted to one or two small areas (Figure 1).

The W1 community is characterized by *Eucalyptus decipiens* subsp. *decipiens* and is restricted to a small area in the southern section of the project area associated with the boundary between the Bassendean sands and Guilderton soils (Figure 1). It formed a narrow community between W3 and S1 which had recently been burnt at the time of survey. The condition of the community was good, however due to the burn it is difficult to determine the true condition of the site, or the full species composition .

The W2 community characterized by *Eucalyptus rudis* is located within the private property. This community is associated with a large wetland in the south-west of the project area. It reflects the proximity to the Guilderton soils with the presence of *Melaleuca systena* and *Acacia lasiocarpa* subsp. *lasiocarpa*. Like the majority of the survey area, this community had experienced recent burning and its condition reflected this. However the condition of this community was good, with relatively few weeds present in response to the increased moisture.

The W3 community is the most extensive plant community mapped in the project area, dominating the dunal Bassendean sands of the eastern two thirds of the project. This community is characterised by an overstorey of scattered *Eucalyptus todtiana* with more commonly *Banksia attenuata* and *B. menziesii* over a mixed shrub layer. The understorey layer displayed some variation, possibly in response to the varied fire history of the project area, however the key species *Melaleuca seriata*, *M. clavifolia* (P1), *Hibbertia hypericioides*, *Eremaea pauciflora* and *Acacia pulchella* var *glaberrima* were common throughout and provided the dominant understorey cover. This community is also habitat for the DRF species *Macarthuria keigheryi*.

The W4 community, characterized by *Banksia prionotes* is associated with the dunal systems on the private property in the western section of the project area. These areas were generally of poor to good condition, with extensive weeds, as a result of historical burning and grazing pressure.

The W5 community was mapped as two small pockets within the W3 community in the southern central section of the project area. The W5 and W5a communities are both dominated by *Melaleuca preissiana* and *Banksia attenuata*, however, the W5a community also has *Melaleuca rhaphiophylla* and is situated on the crest of a low rise (Figure 1). It is likely that the W5a community is associated with an underground mound spring.

The W6 community is also unique in the project area and is associated with a large swampy area. The W6 community is characterized by the dominance of *Melaleuca rhaphiophylla.*

Scrub

S1 Dwarf Scrub dominated by *Melaleuca systena* and mixed shrubs and herbs on grey sand

S2 Dwarf Scrub dominated by *Halosarcia indica* subsp. *bidens* over mixed herbs and sedges on grey sand in a swamp

The S1 community is located in the south-western section of the project area on Guilderton soils and is dominated by *Melaleuca systena*. Within the community the dominance of other species is associated with the undulating landscape. In particular, *Lomandra maritima* was recorded with up to 30% cover on low rises, but is not present in lower areas.

The S2 community is located on the private property fence line in the north western portion of the project area. Both communities were recorded as being in excellent condition, with few weeds.

Thickets

T1 Thicket of *Melaleuca viminea* subsp. *viminea* over herbs and sedges on grey sand in swamps and creeks

T2 Thicket dominated by *Acacia rostellifera* on grey sand with occasional limestone outcropping
T3 Thicket of *Melaleuca lateritia* and *Melaleuca teretifolia* over herbs and sedges on grey clay in a swamp

Three Thicket communities were recorded within the Mullering project area (Figure 1). T1 and T3 are associated with wet areas such as drainage lines and swamps and T2 is associated with limestone outcropping. T3 is confined to Cooljarloo Swamp in the north-eastern portion of the project area, just south of Mullering Brook (Figure 1). T1 is the most common Thicket community within the project area and often forms narrow belts in wet depressions or associated with edge of wetlands. Hence, T1 shows a substantial amount of variability and often has features of the surrounding communities present. For example, in the T1 community approximately 1km west of the S2 community, *Casuarina obesa* is present in a very confined area. The T2 community is associated with limestone and is therefore located in the western portion of the project area where the dunal communities come into the project area.

Heaths
H1 Dense Heath dominated by *Banksia telmatiaea* with mixed shrubs on grey sand
H2 Dense Heath dominated by *Beaufortia squarrosa* over mixed shrubs and herbs on grey sand
H3 Dense Heath dominated by *Melaleuca seriata* over mixed shrubs on grey sand
H4 Heath dominated by *Dryandra armata* var. *armata* and *Gastrolobium plicatum* and mixed shrubs on brown sand
H5 Heath dominated by *Calothamnus quadrifidus* and *Hakea obliqua* subsp. *parviflora* and mixed shrubs on white sand
H6 Heath of mixed shrubs on yellow sand with limestone outcropping
H7 Heath dominated by *Banksia telmatiaea* and *Beaufortia squarrosa* and mixed shrubs and sedges on brown sand in a swamp
H8 Heath dominated by *Allocasuarina lehmanniana* subsp. *lehmanniana* and mixed shrubs and sedges on grey sandy clay in a swamp
H9 Dense Low Heath dominated by *Calothamnus quadrifidus* over mixed shrubs and sedges on grey sand
H10 Low Heath dominated by *Melaleuca systena* on yellow sand on dunes
H11 Low Heath dominated by *Melaleuca brevifolia*, *Melaleuca seriata* and *Grevillea preissii* subsp. *preissii* over mixed shrubs on grey sand in a drainage basin

After the Woodland communities, the Heath communities are the most widespread and common plant communities within the Mullering project area (Figure 1).

The H1 community is the most extensive of the Heaths as it is associated with drainage lines and therefore occurs across the project area. The two DRF species, *Andersonia gracilis* and *Anigozanthos viridis* subsp. *?terraspectans* were recorded from this community.

The H2 community characterized by *Beaufortia squarrosa* is associated with the W6 community in the south-eastern section of the project area and is a wet heath community (Figure 1).

Three locations of H3 which is characterized by *Melaleuca seriata* were recorded within the Mullering project area (Figure 1). This community is a dry heath community associated with impeded soil profiles of sand over clays or lateritic materials similar to the other heaths, however these areas would not experience inundation during winter months.

Only one small area on the eastern boundary of the project area was mapped as H4 community. This community reflects the lateritic nature of the soils at that location with species that are normally restricted to lateritic outcropping or breakaways in the region.

Similarly, H5, H6 and H7 (Figure 1) also have restricted distributions within the project area. H5 and H7 are both variations on wet heath communities in the area with species compositions typically affected by fire history and inundation regime. H6 is a heath community on limestone outcrop and therefore associated with the Guilderton system.

H8 is located on clay soils in a single isolated spot in the western portion of the project area within a major drainage system.

H9 is a dry heath community which is dominated by *Calothamnus quadrifidus* and located in areas adjacent to wet communities, but not subject to inundation.

H10 is with the dominant coastal dunal community and dominates the south-west corner of the project area in private property (Figure 1).

H11 is a very small occurrence of a saline community in a blind arm of a drainage system. The community is located on Woolka Road near the boundary with the private property (Figure 1).

Sedges

SE1 Very Open Tall Sedgeland dominated by *Gahnia trifida* on grey sandy clay in swamps

The Sedgeland community is located in the north western section of the project area (Figure 1). SE1 community is associated with swampy areas. Despite the proximity to cleared areas and being located within the private property in the western third of the project area, the SE1 community was recorded to be in excellent condition with few weeds.

Disturbed

D1 Disturbed Forest of *Casuarina obsesa* over mixed weeds on brown clay

D2 Disturbed Thicket dominated by *Allocasuarina ?lehmanniana* over mixed shrubs and herbs

D3 Disturbed Woodland of *Eucalyptus ?decipiens* over pasture

All three disturbed communities are located within the western third of the project area, on private property. These communities are weedy and have lost the majority of their original structure.

Mosaics

Areas mapped as a mosaic contained two different vegetation types that were distinguishable in the field but could not be separated on the aerial photography.

M1 Mosaic of Low Woodland of *Banksia ilicifolia, Banksia menziesii, Banksia attenuata* and *Eucalyptus todtiana* over mixed shrubs on brown sand; and Low Heath dominated by *Acacia pulchella* var. *glaberrima* and *Calothamnus quadrifidus* and mixed shrubs on grey clayey sand

M2 Mosaic of Heath dominated by *Banksia telmatiaea* and mixed shrubs on brown sand; and Low Sedgeland dominated by *Chorizandra enodis* with *Melaleuca lateriflora* subsp. *acutifolia* on brown clayey sand

The two Mosaic communities are located to the North of Woolka Road. The M1 community is in Excellent condition, however the M2 community was recorded as having evidence of some past disturbance.

Other

CL Cleared land

F Seasonally inundated wetland floor associated with plant community T1

5.3 Dieback

The interpretation of the project identified no areas displaying symptoms of infestation by *P. cinnamomi* and no recoveries of this pathogen were recorded from the project area. However, the wetland systems receive drainage from area to the east of the project area and represent a high risk of introducing the pathogen to the area (Glevan 2005).

6 DISCUSSION

6.1 Flora

The Mullering study area is situated within an area long recognized as an extremely species rich region (Griffin *et al*. 1990). This is reflected in the results of this survey which recorded a high number of species, many of which are endemic to the region. The number of significant flora taxa recorded was also very high. The dominance of the Myrtaceae and Proteaceae is also common throughout the region as is the variation in species richness within different vegetation types (Griffin *et al*. 1990).

Three Declared Rare Flora were recorded within the project area, *Andersonia gracilis, Macarthuria keigheryi* and *Anigozanthos viridis* subsp. *?terraspectans*.

Andersonia gracilis is listed as Endangered under the Environmental Protection Biodiversity Conservation Act 1999 (Commonwealth). This species is known from five locations within the project area. In addition, *Andersonia gracilis* populations have been located within the Wongonderrah Nature Reserve, on Cooljarloo Road, Woolka Road, Wongonderrah Road, within the Strathmore Road Reserve, within other areas of Tiwest's Lease area at Cooljarloo, Dongara Road, Kenwick and Cannington (Department of Environment and Conservation 2006). Landcare Services (2002) suggested that the conservation status of *Andersonia gracilis* should be downgraded to Priority 2 to reflect the growing number of populations and frequency of observations. This species will shortly be the object of a review by Tiwest Pty Ltd to determine whether it should be removed from the DRF list (N. Sibbel *pers. comm*.). The Mullering 3D seismic survey will not impact upon any of the *Andersonia gracilis* populations within the project area. Reciever lines within the vicinity of *Andersonia gracilis* plants will be hand prepared and source lines will be undershot.

Macarthuria keigheryi is listed as Endangered under the Environmental Protection Biodiversity Conservation Act 1999 (Commonwealth). This species was found at 14 locations within the project area, most commonly within plant community W3. This species is known to respond to fire (B. Keighery *pers. comm*.) and it is likely that the large number of recordings within the project area reflect the recent burn history of the site. *M. keigheryi* is represented by 15 collections in the State Herbarium and is known from the Perth region (Cannington to Forrestfield) and the current project area around Woolka Road. A Permit to Take for *Macarthuria keigheryi* will need to be applied for, as plants will almost certainly be impacted by the seismic survey. A maximum of 1.8% of the W3 community which contains *Macarthuria keigheryi* will be cleared for seismic lines within the Mullering project area.

Anigozanthos viridis subsp. *terraspectans* is listed as Vulnerable under the Environmental Protection Biodiversity Conservation Act 1999 (Commonwealth). This species is represented by four specimens within the State Herbarium, all collected from the Cataby area. *A. viridis* subsp. ?*terraspectans* was found at two locations within the project area, within wet heath plant communities H1 and H5. This species is known to respond to fire (Hopper 1993) with populations increasing rapidly following fires and then decreasing over time. It is likely that this species is more widespread within community H1 but requires fresh fire to generate plant numbers. The Mullering 3D seismic survey will not impact upon any of the *A. viridis* subsp. ?*terraspectans* populations within the project area. Reciever lines within the vicinity of *A. viridis* subsp. ?*terraspectans* plants will be hand prepared and source lines will be undershot.

Thirteen Priority Flora species have been recorded within the project area. While some populations of priority flora will be impacted by the proposed seismic survey it is unlikely that any populations will be significantly impacted provided the recommendations in Section 7 are adhered to.

In addition, an *Eremophila* was collected from H11. This specimen has been identified by Andrew Brown from the Department of Environment and Conservation, who determined that the closest related taxon is *Eremophila* sp. Green Flowers. However, the specimen has bright yellow flowers and may represent a distinct form or another new *Eremophila glabra* subspecies. Impacts to this species from the Mullering 3D seismic survey are expected to be negligible if seismic lines avoid H11 altogether.

The impact and distribution of weeds within the Mullering Project Area was very low. Only one Declared Plant requiring action under Agriculture WA guidelines was recorded, **Moraea flaccida.* **Moraea flaccida* is listed under category P1, whereby the movement of plants or their seeds is prohibited within the state. This prohibits the movement of contaminated machinery and produce including livestock and fodder. This species was recorded at the following locations (GDA94 zone 50):

337966 E 6601586 N
336335 E 6601512 N
335240 E 6604050 N

Weed species were common within degraded communities mapped within the private property (Figure 1) and also scatterred along the edges of Woolka Road.

6.2 Regional Significance & Conservation Status of Plant Communities

The Project Area is located within the Swan Coastal Plain Biogeographical Region (Environment Australia 2000), specifically within the SWA1 - Dandaragan Plateau Subregion (Desmond 2001). The project area occurs in one vegetation system described by Beard (1979), Bassendean_1026. Reservation priorities discussed in '*A Biodiversity Audit of Western Australias 53 Biogeographical Subregions in 2002*' indicate that reservation priorities are low for Bassendean_1026 (Desmond 2001), as 46.3% of the Bassendean_1026 Veg System is represented in Reserves (Shepherd *et al* 2002).

None of the plant communities mapped within the project area are currently listed or proposed for listing as Threatened Communities by the Department of Environment and Conservation. There is currently no coherent regional dataset to verify the representation of plant communities in the broader area and Reserve system that can be utilised by the public to classify communities and determine conservation status. However reference to existing publications and visual inspection of the local area indicates that the majority of the vegetation types are well represented locally within the UCL and regionally within the nearer Reserves.

The Woodland communities recorded within the project area are potentially represented in the Wongonderrah Nature Reserve, Badgingarra National Park, Mullering Reserve, Hill River Reserve and Eneminga Nature Reserve (Crook *et al* 1984; Griffin and Keighery 1989). Heath on sand communities are also widespread in the region and well represented within the reserve system: Badgingarra National Park, Mullering Reserve, Wongonderra Nature Reserve, Nambung National Park and the Hill River Reserve (Griffin and Keighery 1989). During recent survey work in the Tiwest's northern

tenements (Falcon) similar Heath on sand communities were observed within the Wongonderrah Nature Reserve and within the Falcon Project Area (Woodman Environmental Consulting 2006). Mattiske Consulting Pty Ltd (1996) also noted that Heaths on Sand are well represented within the Badgingarra National Park, Mullering Reserve and to a lesser extent within the Moore River National Park and Namming Nature Reserve.

Two of the communities identified during this assessment are likely to be locally and regionally restricted, these are W5a and H11. The W5a community is unique in that it is composed primarily of species with affinities to wetland conditions, however the community is located on a sand rise surrounded by dry Banksia woodland (W3). This situation is most probably created by a local mounding of the groundwater caused by a spring or similar factor. This community is likely to be significant and impacts to this should be avoided if possible. H11 is a saline basin within a predominantly fresh water drainage system. This community is habitat to a restricted species of *Eremophila* and impacts to this site should be avoided.

Wetland mapping and assessments have been conducted by the V & C Semeniuk Research Group (Semeniuk 1994). The survey area is within the area covered by System 5 (Mimegarra Suite). The Mimegarra suite is described as locally significant as the area is generally water deficient. Regionally, these wetlands are also uncommon. They increase the diversity of local biota by providing unique conditions for plants and animals that are adapted to waterlogging (Semeniuk 1994). The wetland systems are also habitat for the DRF species *Andersonia gracilis* and *Anigozanthos viridis* subsp. *terraspectans* and as such are significant.

The project area has been studied extensively for many years for the West Midlands Project. The data collected from over 2000 quadrats surveyed for this project is being used to define floristic communities and their regional distribution, however this analysis is incomplete and unpublished to date (A. Hopkins pers. comm.).

Griffin (1998) discusses interim Bioregions defined during the West Midlands Project. The project area lies mostly within the Bassendean interim bioregion of which approximately 70% is still vegetated. However, only 9% of this vegetation was recorded as within the Reserve system. Griffin states that the Bassendean interim bioregion, though well vegetated and on crown land, is under significant threat from mineral sands mining.

6.3 Potential Impacts of the Project

The Mullering Onshore 3D Seismic Survey has the potential to adversely impact flora and vegetation. These impacts are:

1. Clearing of plant communities – A number of plant communities are sensitive to disturbance.

2. Loss of significant flora species – There are a number of Rare and Priority Flora species that are potentially located within areas to be cleared.

3. Risk of fire – Vehicle movement and machinery operation has the potential to cause fires in the densely vegetated areas.

4. Introduction and spread of weeds and plant diseases – Ground disturbance activities and vehicle traffic has the potential to spread weeds and plant disease (particularly dieback caused by *P. cinnamomi*) into previously unaffected areas.

5. Indirect impacts – Ground disturbance activities and vehicle traffic may lead to the generation of dust and impacts to surface drainage patterns.

7 RECOMMENDATIONS

The following recommendations are made based on the results of the flora, vegetation and dieback survey:

1. Vegetation clearing should be minimised wherever possible, with existing tracks and cleared land used if available, especially in areas with Declared Rare and Priority Flora. Clearing should avoid areas with known *Andersonia gracilis* and *Anigozanthos viridis* subsp. ?*terraspectans* populations.

2. Line preparation methods should be undertaken as per Table 5 below.

3. All precautions should be taken to prevent accidental fires. These include the use of diesel rather than petrol vehicles and the provision of a fire tender during hot conditions.

4. A comprehensive weed and *P. cinnamomi* hygiene management plan should be developed and implemented for the operations.

5. Wetland areas that experience significant periods of inundation should not be traversed by vehicles to protect the surface from compaction and to ensure surface drainage patterns are not compromised.

6. Trees (>3m) should not be cleared during seismic line preparation.

7. Slow growing species should be avoided where possible during seismic line preparation. These species include *Macrozamia fraseri* and *Xanthorrhoea* spp.

8. Clearing within 10 metres of DEC monitoring plots within the Mullering Project Area should be avoided.

Table 5: Line preparation methods recommended for the Mullering Onshore 3D Seismic Survey.

Code	Description	Sensitivity to disturbance	Line preparation method
Forests			
F1	Low Forest dominated by *Banksia attenuata* over mixed herbaceous species dominated by *Anarthia laevis* on brown sand	Habitat for DRF species *Macarthuria keigheryi* Vulnerable to weed invasion and to infestation by *Phytophthora cinnamomi*	Hand-prepare receiver lines and no source line clearing if possible Avoid large trees
Woodlands			
W1	Woodland dominated by *Eucalyptus decipiens* subsp. *decipiens* over mixed shrubs and herbs dominated by *Austrostipa compressa* on grey sand	Trees slow growing	Roll lines Avoid large trees
W2	Open Woodland of *Eucalyptus rudis* over mixed shrubs on grey sand	Trees and *Xanthorrhoea* spp. slow growing Seasonal wetland Vulnerable to weed invasion and to infestation by *Phytophthora cinnamomi*	Hand-prepare receiver lines and no source line clearing if possible Access only if soil is dry Roll lines Avoid large trees
W3	Low Woodland of *Eucalyptus todtiana, Banksia attenuata* and *Banksia menziesii* over mixed shrubs on grey sand	Habitat for DRF species *Macarthuria keigheryi* and the Priority species *Melaleuca clavifolia* Vulnerable to weed invasion and to infestation by *Phytophthora cinnamomi*	Roll lines under a permit to take if avoidance is not possible Avoid large trees
W4	Low Woodland dominated by *Banksia prionotes* over mixed shrubs on brown sand	Vulnerable to weed invasion and to infestation by *Phytophthora cinnamomi*	Roll lines Avoid large trees
W5	Open Low Woodland of *Melaleuca preissiana* and *Banksia attenuata* over mixed shrubs on brown sand	Vulnerable to weed invasion and to infestation by *Phytophthora cinnamomi*	Roll lines Access only if soil is dry Avoid large trees
W5a	Open Woodland of *Melaleuca preissiana*, *Banksia attenuata* and *Melaleuca rhaphiophylla* over mixed shrubs on brown loamy sand on the crest of a low rise	Habitat for the Priority species *Melaleuca clavifolia* Vegetation type rare in the region Vulnerable to weed invasion and to infestation by *Phytophthora cinnamomi*.	Align source lines to avoid altogether Receiver line can be placed along existing firebreak through community
W6	Low Woodland to Low Forest dominated by *Melaleuca rhaphiophylla* on grey sand in a swamp	Trees slow growing Wetland community with flora sensitive to ground disturbance	Align source lines to avoid altogether Hand carry receiver lines if dry soil conditions

Scrub			
S1	Dwarf Scrub dominated by *Melaleuca systena* and mixed shrubs and herbs on grey sand	Prone to erosion	Hand-prepare receiver lines No rolling of source lines (utilize existing tracks)
S2	Dwarf Scrub dominated by *Halosarcia indica* subsp. *bidens* over mixed herbs and sedges on grey sand in a swamp	Riparian vegetation sensitive to disturbance and prone to erosion	Align lines to avoid altogether
Thickets			
T1	Thicket of *Melaleuca viminea* subsp. *viminea* over herbs and sedges on grey sand in swamps and creeks	Vulnerable to erosion, compaction and weed invasion	Hand-prepare receiver lines No rolling of source lines (utilize existing tracks)
T2	Thicket dominated by *Acacia rostellifera* on grey sand with occasional limestone outcropping	Can be vulnerable to erosion and weed invasion, however this community generally has significant weed cover	Roll lines
T3	Thicket of *Melaleuca lateritia* and *Melaleuca teretifolia* over herbs and sedges on grey clay in a swamp	Vulnerable to weed invasion Seasonally wet and vulnerable to soil compaction	Align lines to avoid altogether
Heaths			
H1	Dense Heath dominated by *Banksia telmatiaea* with mixed shrubs on grey sand	Habitat for DRF species *Andersonia gracilis* and *Anigozanthos viridis* subsp. *terraspectans* and the Priority species *Melaleuca clavifolia* and *Onychosepalum microcarpum* Vulnerable to weed invasion and to infestation by *Phytophthora cinnamomi* Seasonally wet and vulnerable to soil compaction	Preparation method depends on timing (i.e. Dry periods – roll lines; Wet periods – hand prepare lines) Avoid DRF species Permit to Take will be required if DRF populations cannot be avoided.
H2	Dense Heath dominated by *Beaufortia squarrosa* over mixed shrubs and herbs on grey sand	Vulnerable to weed invasion and to infestation by *Phytophthora cinnamomi* Seasonally wet and vulnerable to soil compaction	Preparation method depends on timing (i.e. Dry periods – roll lines; Wet periods – hand prepare lines)
H3	Dense Heath dominated by *Melaleuca seriata* over mixed shrubs on grey sand	Habitat for the Priority species *Melaleuca clavifolia* Vulnerable to weed invasion and to infestation by *Phytophthora cinnamomi*	Roll lines
H4	Heath dominated by *Dryandra armata* var. *armata* and *Gastrolobium plicatum* and mixed shrubs on brown sand	Vulnerable to weed invasion and to infestation by *Phytophthora cinnamomi*	Roll lines
H5	Heath dominated by *Calothamnus quadrifidus* and *Hakea*	Habitat for DRF species *Andersonia gracilis*	Hand prepare receiver lines in

	obliqua subsp. *parviflora* and mixed shrubs on white sand	Vulnerable to weed invasion and to infestation by *Phytophthora cinnamomi* Seasonally wet and vulnerable to soil compaction	the vicinity of DRF.
H6	Heath of mixed shrubs on yellow sand with limestone outcropping	Vulnerable to weed invasion	Roll lines
H7	Heath dominated by *Banksia telmatiaea* and *Beaufortia squarrosa* and mixed shrubs and sedges on brown sand in a swamp	Vulnerable to weed invasion and to infestation by *Phytophthora cinnamomi* Wetland community with flora sensitive to ground disturbance Seasonally wet and vulnerable to soil compaction	Hand-prepare receiver lines No rolling of source lines (utilize existing tracks)
H8	Heath dominated by *Allocasuarina lehmanniana* subsp. *lehmanniana* and mixed shrubs and sedges on grey sandy clay in a swamp	Vulnerable to weed invasion Seasonally wet and vulnerable to soil compaction	Preparation method depends on timing (i.e. Dry periods – roll lines; Wet periods – hand prepare lines)
H9	Dense Low Heath dominated by *Calothamnus quadrifidus* over mixed shrubs and sedges on grey sand	Habitat for the Priority species *Melaleuca clavifolia* Vulnerable to weed invasion and to infestation by *Phytophthora cinnamomi*	Roll lines
H10	Low Heath dominated by *Melaleuca systena* and *Desmocladus asper* on yellow sand on dunes	Habitat for the Priority species *Acacia benthamii* Vulnerable to weed invasion Prone to erosion	Hand-prepare receiver lines No rolling of source lines (utilize existing tracks)
H11	Low Heath dominated by *Melaleuca brevifolia*, *Melaleuca seriata* and *Grevillea preissii* subsp. *preissii* over mixed shrubs on grey sand in a drainage basin	Vulnerable to weed invasion Wetland community with flora sensitive to ground disturbance Seasonally wet and vulnerable to soil compaction	Align lines to avoid altogether
Sedges			
SE1	Very Open Tall Sedgeland dominated by *Gahnia trifida* on grey clay in swamps	Vulnerable to weed invasion Seasonally wet and vulnerable to soil compaction	Hand-prepare receiver lines No rolling of source lines (utilize existing tracks)
Mosaic			
M1	Mosaic of Low Woodland of *Banksia ilicifolia, Banksia menziesii, Banksia attenuata* and *Eucalyptus todtiana* over mixed shrubs on brown sand; and Low Heath dominated by	Habitat for DRF species *Macarthuria keigheryi* Vulnerable to weed invasion and to infestation by *Phytophthora cinnamomi*.	Roll lines under a Permit to Take Avoid large trees

	Acacia pulchella var. *glaberrima* and *Calothamnus quadrifidus* and mixed shrubs on grey clayey sand		
M2	Mosaic of Heath dominated by *Banksia telmatiaea* and mixed shrubs on brown sand; and Low Sedgeland dominated by *Chorizandra enodis* with *Melaleuca lateriflora* subsp. *acutifolia* on brown clayey sand	Vulnerable to weed invasion and to infestation by *Phytophthora cinnamomi* Wetland community with flora sensitive to ground disturbance Seasonally wet and vulnerable to soil compaction	Hand-prepare receiver lines No rolling of source lines (utilize existing tracks)

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APPENDIX A: DEFINITIONS FOR CATEGORIES OF THREATENED ECOLOGICAL COMMUNITIES AND DECLARED RARE AND PRIORITY FLORA

Threatened Ecological Communities

Presumed Totally Destroyed (PD)
An ecological community which 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.

Declared Rare and Priority Flora

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 Flora - 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 B: VASCULAR PLANT SPECIES RECORDED WITHIN THE MULLERING PROJECT AREA

Family	Species
	Unknown sp. 1
Zamiaceae	*Macrozamia fraseri*
Cupressaceae	*Actinostrobus arenarius*
Potamogetonaceae	*Potamogeton drummondii*
Juncaginaceae	*Triglochin linearis* *Triglochin mucronata* *Triglochin* sp. A Flora of Australia (G.J. Keighery 2477)
Poaceae	**Aira caryophyllea* *Austrodanthonia occidentalis* *Austrostipa compressa* *Austrostipa flavescens* *Austrostipa macalpinei* **Briza maxima* **Briza minor* *Bromus arenarius* **Bromus* sp. *?*Cynodon dactylon* **Hordeum leporinum* *Neurachne alopecuroidea* *Poa drummondiana* *Polypogon tenellus* **Rostraria pumila*
Cyperaceae	?*Baumea articulata* *Baumea juncea* *Caustis dioica* *Chorizandra enodis* **Cyperus tenellus* *Ficinia nodosa* *Gahnia trifida* *Lepidosperma brunonianum* *Lepidosperma longitudinale* *Lepidosperma pubisquameum* *Lepidosperma* aff.*pubisquameum* *Lepidosperma* sp. *Mesomelaena pseudostygia*

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Family	Species
	Mesomelaena tetragona
	?*Schoenus asperocarpus*
	Schoenus asperocarpus
	Schoenus brevisetis
	Schoenus clandestinus
	Schoenus curvifolius
	Schoenus grandiflorus
	Schoenus ?grandiflorus
	Schoenus odontocarpus
	Schoenus pedicellatus
	Schoenus pennisetis (1)
	Schoenus ?pleiostemoneus
	Schoenus pleiostemoneus
	Schoenus rigens
	Schoenus sp.
	Schoenus subfascicularis
	Schoenus subflavus subsp. *subflavus*
	Schoenus unispiculatus
	Tetraria capillaris
Restionaceae	*Alexgeorgea nitens*
	Anarthria laevis
	Chaetanthus aristatus
	Chordifex reseminans ms
	Chordifex ?sinuosus
	Chordifex sinuosus ms
	Desmocladus asper
	Desmocladus sp.
	Hypolaena exsulca
	Lepidobolus ?preissianus
	?*Lyginia imberbis*
	Lyginia imberbis
	Meeboldina cana
	Meeboldina ?coangustata
	Meeboldina coangustata
	Meeboldina sp.
	Onychosepalum microcarpum (1)
Centrolepidaceae	*Aphelia cyperoides*
	Centrolepis polygyna
Philydraceae	*Philydrella ?drummondii*

APPENDIX B: VASCULAR PLANT SPECIES RECORDED WITHIN THE MULLERING PROJECT AREA

Family	Species
Juncaceae	**Juncus bufonius* *Juncus pallidus*
Dasypogonaceae	*Acanthocarpus canaliculatus* *Acanthocarpus preissii* *Calectasia narragara* *Dasypogon bromeliifolius* *Dasypogon obliquifolius* *Lomandra hermaphrodita* *Lomandra maritima* *Lomandra micrantha* subsp. *micrantha* *Lomandra preissii* *Lomandra suaveolens*
Xanthorrhoeaceae	*Xanthorrhoea preissii*
Phormiaceae	*Dianella revoluta*
Anthericaceae	*Arnocrinum preissii* *Chamaescilla corymbosa* ?*Corynotheca micrantha* *Corynotheca micrantha* *Johnsonia pubescens* *Laxmannia ramosa* subsp. *ramosa* *Laxmannia sessiliflora* *Laxmannia sessiliflora* subsp. *?sessiliflora* *Laxmannia sessiliflora* subsp. *sessiliflora* *Sowerbaea laxiflora* *Thysanotus arenarius* *Thysanotus ?arenarius* *Thysanotus asper* *Thysanotus dichotomus* *Thysanotus multiflorus* *Thysanotus patersonii* *Thysanotus spiniger* *Thysanotus thyrsoideus* *Thysanotus triandrus* *Tricoryne elatior* *Tricoryne* sp.
Colchicaceae	*Burchardia ?bairdiae*

APPENDIX B: VASCULAR PLANT SPECIES RECORDED WITHIN THE MULLERING PROJECT AREA

Family	Species
	Burchardia congesta
	Burchardia sp.
	Wurmbea dilatata
Boryaceae	*Borya sphaerocephala*
Haemodoraceae	*Anigozanthos humilis* subsp. *humilis*
	Anigozanthos manglesii subsp. *quadrans*
	Anigozanthos pulcherrimus
	Anigozanthos viridis subsp. Cataby (S.D. Hopper 1786)
	Anigozanthos viridis subsp. *?terraspectans*
	Anigozanthos viridis subsp. *viridis*
	Blancoa canescens
	Conostylis ?aculeata
	Conostylis aculeata subsp. *?aculeata*
	Conostylis aculeata
	Conostylis aculeata subsp. *spinuligera*
	Conostylis ?angustifolia
	Conostylis aurea
	Conostylis candicans
	Conostylis candicans subsp. *calcicola*
	Conostylis candicans subsp. *candicans*
	Conostylis candicans subsp. *?candicans*
	Conostylis canteriata
	Conostylis crassinervia subsp. *absens*
	Conostylis crassinervia subsp. *crassinervia*
	Conostylis festucacea subsp. *festucacea*
	Conostylis ?festucacea subsp. *festucacea*
	Conostylis hiemalis
	Conostylis juncea
	Conostylis latens
	Conostylis neocymosa
	Conostylis sp.
	Conostylis teretifolia
	Conostylis teretifolia subsp. *teretifolia*
	Haemodorum spicatum
	Haemodorum venosum
	Haemodorum ?venosum
	Phlebocarya ciliata
	Phlebocarya filifolia
	Tribonanthes australis

APPENDIX B: VASCULAR PLANT SPECIES RECORDED WITHIN THE MULLERING PROJECT AREA

Family	Species
Iridaceae	**Moraea flaccida*
	Orthrosanthus laxus var. *laxus*
	Patersonia occidentalis
	**Romulea rosea*
Orchidaceae	*Caladenia flava*
	Caladenia flava subsp. *flava*
	Caladenia longicauda
	Caladenia longicauda subsp. ?albella
	Caladenia ?*longicauda* subsp. *borealis*
	Caladenia sp.
	Caladenia vulgata
	Caladenia ?vulgata
	Diuris corymbosa
	Diuris laxiflora
	Diuris sp.
	Elythranthera brunonis
	Eriochilus sp.
	Leporella fimbriata
	Microtis media subsp. *media*
	Microtis sp.
	Microtis sp.
	Prasophyllum gracile
	Petrostylis aff.*nana*
	Pterostylis sp.
	Pyrorchis nigricans
	Thelymitra antennifera
	Thelymitra sp.
Casuarinaceae	*Allocasuarina humilis*
	Allocasuarina lehmanniana
	Allocasuarina lehmanniana subsp. *lehmanniana*
	Allocasuarina microstachya
	Casuarina obesa
Proteaceae	*Adenanthos cygnorum*
	Banksia attenuata
	Banksia ilicifolia
	Banksia leptophylla
	Banksia littoralis
	Banksia menziesii
	Banksia prionotes

APPENDIX B: VASCULAR PLANT SPECIES RECORDED WITHIN THE MULLERING PROJECT AREA

Family	Species
	Banksia telmatiaea
	?*Conospermum* sp.
	Conospermum stoechadis subsp. *stoechadis*
	Dryandra armata var. *armata*
	Dryandra lindleyana
	Dryandra lindleyana var. *lindleyana*
	Dryandra lindleyana subsp. *pollosta* (3)
	Dryandra nivea
	Dryandra nivea subsp. *nivea*
	Dryandra ?*nivea* subsp. *nivea*
	Dryandra platycarpa (4)
	Dryandra sessilis
	Dryandra sessilis var. *cygnorum*
	Dryandra stricta (3)
	Dryandra tortifolia (3)
	Grevillea preissii
	Grevillea preissii subsp. *?glabrilimba*
	Grevillea preissii subsp. *glabrilimba*
	Grevillea preissii subsp. *preissii*
	Hakea candolleana
	Hakea costata
	Hakea incrassata
	Hakea lissocarpha
	Hakea obliqua subsp. *parviflora*
	Hakea prostrata
	Hakea ruscifolia
	Hakea sulcata
	Hakea trifurcata
	Hakea varia
	Isopogon sp. Watheroo (D. Foreman 477)
	Persoonia comata
	Petrophile brevifolia
	Petrophile linearis
	Petrophile macrostachya
	Petrophile ?macrostachya
	Petrophile pilostyla subsp. *austrina*
	Petrophile seminuda
	Stirlingia abrotanoides
	Stirlingia latifolia
	Synaphea spinulosa
Santalaceae	*Anthobolus foveolatus*

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Family	Species
	Exocarpos aphyllus
	Exocarpos sparteus
	?*Leptomeria empetriformis*
	Leptomeria empetriformis
	Leptomeria pauciflora
	Leptomeria preissiana
Olacaceae	*Olax scalariformis* (3)
Loranthaceae	*Nuytsia floribunda*
Polygonaceae	*Muehlenbeckia adpressa*
Chenopodiaceae	*Halosarcia indica* subsp. *bidens*
	Rhagodia preissii subsp. *preissii*
Amaranthaceae	*Ptilotus calostachyus*
	Ptilotus manglesii
	Ptilotus polystachyus
	Ptilotus stirlingii
	Ptilotus stirlingii var. *stirlingii*
Gyrostemonaceae	*Gyrostemon racemiger*
	Tersonia cyathiflora
Aizoaceae	*Carpobrotus* sp.
	Carpobrotus ?virescens
Molluginaceae	*Macarthuria apetala*
	Macarthuria australis
	Macarthuria keigheryi (R)
Portulacaceae	*Calandrinia corrigioloides*
	Calandrinia ?liniflora
	Calandrinia sp.
	Calandrinia sp. SW coastal (J. Dodd 753)
Caryophyllaceae	**Petrorhagia dubia*
Ranunculaceae	*Clematis linearifolia*
Lauraceae	*Cassytha glabella*

APPENDIX B: VASCULAR PLANT SPECIES RECORDED WITHIN THE MULLERING PROJECT AREA

Family	Species
	Cassytha glabella forma *dispar*
	Cassytha sp.
Brassicaceae	**Heliophila pusilla*
	Stenopetalum gracile
Droseraceae	*Drosera ?closterostigma*
	Drosera closterostigma
	Drosera erythrorhiza
	Drosera gigantea
	Drosera humilis
	Drosera menziesii
	Drosera menziesii subsp. *menziesii*
	Drosera menziesii subsp. *?menziesii*
	Drosera menziesii subsp. *penicillaris*
	Drosera sp.
	Drosera sp. climbing
Crassulaceae	*Crassula colorata*
	**Crassula glomerata*
	**Crassula natans* var. *minus*
Byblidaceae	*Byblis lamellata*
Mimosaceae	*Acacia benthamii* (2)
	Acacia cochlearis
	Acacia ?cochlearis
	Acacia cyclops
	Acacia dilatata
	Acacia lasiocarpa
	Acacia lasiocarpa var. *lasiocarpa*
	Acacia pulchella
	Acacia pulchella var. *glaberrima*
	Acacia pulchella var. *pulchella*
	Acacia rostellifera
	Acacia saligna subsp. *lindleyi*
	Acacia sessilis
	Acacia spathulifolia
	Acacia xanthina
Papilionaceae	*Bossiaea eriocarpa*
	Daviesia decurrens

APPENDIX B: VASCULAR PLANT SPECIES RECORDED WITHIN THE MULLERING PROJECT AREA

Family	Species
	Daviesia divaricata
	Daviesia divaricata subsp. *divaricata* ms
	Daviesia incrassata subsp. *incrassata*
	Daviesia ?oxyclada
	Daviesia podophylla
	Gastrolobium plicatum
	Gompholobium tomentosum
	Hardenbergia comptoniana
	?*Hovea pungens*
	Hovea trisperma
	Isotropis cuneifolia
	Jacksonia floribunda
	Jacksonia hakeoides
	Jacksonia nutans ms
	Jacksonia sternbergiana
	Kennedia prostrata
	**Melilotus indicus*
	Mirbelia trichocalyx
	Sphaerolobium drummondii
	**Trifolium* sp.
	Viminaria juncea
Geraniaceae	**Erodium cicutarium*
	Pelargonium littorale subsp. *littorale*
Rutaceae	*Boronia ramosa* subsp. *anethifolia*
	Boronia ramosa subsp. *ramosa*
	Philotheca spicata
Polygalaceae	*Comesperma calymega*
Euphorbiaceae	*Adriana quadripartita*
	**Mercurialis annua*
	Monotaxis grandiflora
	Monotaxis grandiflora var. *grandiflora*
	Phyllanthus calycinus
	Poranthera microphylla
Stackhousiaceae	*Stackhousia monogyna*
	Tripterococcus brunonis
Sapindaceae	*Diplopeltis huegelii* subsp. *?lehmannii*

APPENDIX B: VASCULAR PLANT SPECIES RECORDED WITHIN THE MULLERING PROJECT AREA

Family	Species
	Diplopeltis huegelii subsp. *lehmannii*
Rhamnaceae	*Cryptandra mutila*
	Cryptandra pungens
	Stenanthemum notiale subsp. *chamelum*
	Trymalium floribundum subsp. *floribundum*
Sterculiaceae	*Commersonia pulchella*
Dilleniaceae	*Hibbertia crassifolia*
	Hibbertia huegelii
	Hibbertia hypericoides
	Hibbertia racemosa
	Hibbertia spicata
	Hibbertia spicata subsp. *spicata*
	Hibbertia ?*spicata* subsp. spicata
	Hibbertia stellaris
	Hibbertia subvaginata
Frankeniaceae	*Frankenia pauciflora*
Violaceae	*Hybanthus calycinus*
Thymelaeaceae	*Pimelea angustifolia*
	Pimelea imbricata var. *?piligera*
	Pimelea suaveolens
	Pimelea suaveolens subsp. *suaveolens*
	Pimelea sulphurea
Myrtaceae	*Baeckea* sp. Perth Region (R.J. Cranfield 444) (3)
	Beaufortia squarrosa
	Calothamnus hirsutus
	Calothamnus quadrifidus
	Calothamnus sanguineus
	Calytrix angulata
	Calytrix aurea
	Calytrix flavescens
	Calytrix ?flavescens
	Calytrix fraseri
	Calytrix ?fraseri
	Calytrix sp.
	Chamelaucium uncinatum

APPENDIX B: VASCULAR PLANT SPECIES RECORDED WITHIN THE MULLERING PROJECT AREA

Family	Species
	Darwinia pinifolia
	Eremaea asterocarpa
	Eremaea ?*asterocarpa* subsp. *histoclada*
	Eremaea pauciflora
	Eremaea pauciflora var. *pauciflora*
	Eremaea sp.
	Eucalyptus decipiens subsp. *decipiens*
	Eucalyptus gomphocephala
	Eucalyptus obtusiflora subsp. *dongarraensis*
	Eucalyptus rudis
	Eucalyptus todtiana
	Hypocalymma angustifolium
	Hypocalymma xanthopetalum
	?*Kunzea glabrescens*
	Kunzea micrantha subsp. *petiolata*
	Leptospermum erubescens
	Leptospermum spinescens
	Melaleuca brevifolia
	Melaleuca clavifolia (1)
	Melaleuca lateriflora subsp. *acutifolia*
	Melaleuca lateritia
	Melaleuca preissiana
	Melaleuca rhaphiophylla
	Melaleuca seriata
	Melaleuca ?seriata
	Melaleuca sp. 1
	Melaleuca sp. 2
	Melaleuca systena
	Melaleuca teretifolia
	Melaleuca viminea subsp. *viminea*
	Pericalymma ellipticum
	Regelia ciliata
	Scholtzia involucrata
	Thryptomene baeckeacea
	Thryptomene mucronulata
	Verticordia blepharophylla (2)
	Verticordia densiflora
	Verticordia ?densiflora
	Verticordia lindleyi subsp. *lindleyi* (4)
	Verticordia ?pennigera
	Verticordia pennigera
	Verticordia sp.

APPENDIX B: VASCULAR PLANT SPECIES RECORDED WITHIN THE MULLERING PROJECT AREA

Family	Species
Haloragaceae	*Glischrocaryon aureum*
	Glischrocaryon aureum var. *angustifolium*
	Haloragis foliosa (3)
Apiaceae	*Actinotus leucocephalus*
	Daucus glochidiatus
	Platysace haplosciadia
	Platysace sp. Eneabba (R. Hnatiuk 770001)
	Platysace ?xerophila
	Trachymene coerulea subsp. *coerulea*
	Trachymene pilosa
	Xanthosia huegelii
Epacridaceae	*Andersonia gracilis* (R)
	Andersonia heterophylla
	Astroloma glaucescens
	Astroloma microcalyx
	Astroloma microdonta
	Astroloma pallidum
	Conostephium minus
	Conostephium preissii
	Leucopogon conostephioides
	Leucopogon nutans
	Leucopogon parviflorus
	Leucopogon ?polymorphus
	Leucopogon polymorphus
	Leucopogon propinquus
	Leucopogon sprengelioides
	Lysinema ciliatum
Primulaceae	**Anagallis arvensis*
	**Anagallis arvensis* var. *caerulea*
	Samolus junceus
	Samolus repens var. *?paucifolius*
	Samolus repens var. *paucifolius*
Loganiaceae	*Phyllangium ?divergens*
Gentianaceae	**Cicendia filiformis*
Menyanthaceae	*Villarsia capitata*

APPENDIX B: VASCULAR PLANT SPECIES RECORDED WITHIN THE MULLERING PROJECT AREA

Family	Species
Lamiaceae	*Hemiandra* aff.*glabra*
	Hemiandra glabra subsp. *glabra* ms
	Hemiandra pungens
	Pityrodia bartlingii
Solanaceae	*Anthocercis ilicifolia* subsp. *ilicifolia*
	Anthocercis littorea
	Solanum symonii
Scrophulariaceae	**Dischisma arenarium*
	**Parentucellia latifolia*
	**Parentucellia viscosa*
Orobanchaceae	**Orobanche minor*
Myoporaceae	*Eremophila glabra*
Rubiaceae	*Opercularia vaginata*
Campanulaceae	**Wahlenbergia capensis*
Lobeliaceae	*Isotoma hypocrateriformis*
	Lobelia ?rhytidosperma
Goodeniaceae	*Dampiera alata*
	Dampiera linearis
	Dampiera teres
	Goodenia pulchella subsp. Coastal Plain A (M. Hislop 634)
	Lechenaultia biloba
	Lechenaultia linarioides
	Scaevola ?anchusifolia
	Scaevola anchusifolia
	Scaevola canescens
	Scaevola lanceolata
	Scaevola phlebopetala
	Scaevola repens
	Scaevola repens var. *repens*
	Scaevola thesioides subsp. *thesioides*
	Velleia trinervis
	Verreauxia reinwardtii

APPENDIX B: VASCULAR PLANT SPECIES RECORDED WITHIN THE MULLERING PROJECT AREA

Family	Species
Stylidiaceae	*Stylidium* aff. *repens*
	Stylidium ?albolilacinum
	Stylidium ?brunonianum
	Stylidium brunonianum
	Stylidium ?calcaratum
	Stylidium crossocephalum
	Stylidium cygnorum
	Stylidium dichotomum
	Stylidium ?*diuroides* subsp. *diuroides*
	Stylidium diuroides subsp. *diuroides*
	Stylidium divaricatum
	Stylidium ?hymenocraspedum
	Stylidium piliferum
	Stylidium piliferum subsp. *piliferum*
	Stylidium ?purpureum
	Stylidium purpureum
	Stylidium repens
	Stylidium aff.*repens*
	Stylidium sp.
Asteraceae	**Arctotheca calendula*
	Asteridea pulverulenta
	Brachyscome ?bellidioides
	Brachyscome ?iberidifolia
	**Cotula coronopifolia*
	Euchiton sphaericus
	**Hypochaeris glabra*
	Lagenophora huegelii
	Leptorhynchos scaber
	Millotia myosotidifolia
	Olearia axillaris
	Olearia conspicua ms
	Olearia dampieri ms
	Olearia rudis
	Podolepis gracilis
	Podotheca chrysantha
	Podotheca gnaphalioides
	Pterochaeta paniculata
	Rhodanthe citrina
	Senecio pinnatifolius
	Senecio pinnatifolius var. *pinnatifolius*
	Siloxerus ?humifusus

APPENDIX B: VASCULAR PLANT SPECIES RECORDED WITHIN THE MULLERING PROJECT AREA

Family	Species
	**Sonchus oleraceus*
	**Ursinia anthemoides*
	Waitzia acuminata var. *albicans*
	Waitzia suaveolens var. *suaveolens*

APPENDIX C: PLANT SPECIES RECORDED WITHIN COMMUNITY TYPES

Species Name	Community																														
	D1	D2	F	F1	H1	H10	H11	H2	H3	H4	H5	H6	H7	H8	H9	M1	M2	S1	S2	SE1	T1	T2	T3	W1	W2	W3	W3d	W4	W5	W5a	W6	W6d
Acacia benthamii						X																										
Acacia cochlearis						X												X														
Acacia ?cochlearis															X																	
Acacia cyclops														X						X												
Acacia dilatata					X																											
Acacia lasiocarpa																										X						
Acacia lasiocarpa var. *lasiocarpa*					X	X	X											X		X					X	X		X		X		X
Acacia pulchella						X						X										X				X			X			
Acacia pulchella var. *glaberrima*					X			X	X			X			X	X										X				X		
Acacia pulchella var. *pulchella*												X																				
Acacia rostellifera		X				X												X				X					X	X				
Acacia saligna subsp. *lindleyi*					X						X					X	X									X				X		X
Acacia sessilis												X			X											X						
Acacia spathulifolia																						X				X	X	X				
Acacia xanthina		X																			X											
Acanthocarpus canaliculatus					X	X											X				X											
Acanthocarpus preissii																		X														
Actinostrobus arenarius															X																	
Actinotus leucocephalus												X														X			X			
Adenanthos cygnorum					X			X	X							X										X				X		
Adriana quadripartita																		X														
**Aira caryophyllea*								X							X							X				X						
Alexgeorgea nitens					X				X						X											X				X		
Allocasuarina humilis									X	X		X			X											X	X			X		
Allocasuarina lehmanniana		X			X	X															X	X			X							
Allocasuarina lehmanniana subsp. *lehmanniana*														X						X												
Allocasuarina microstachya									X	X					X																	
**Anagallis arvensis*	X	X					X																									
**Anagallis arvensis* var. *caerulea*		X	X																								X	X				X
Anarthria laevis				X				X								X					X					X				X		
Andersonia gracilis					X																											
Andersonia heterophylla					X																					X				X		
Anigozanthos humilis subsp. *humilis*					X				X			X			X	X						X		X	X	X	X	X	X	X		
Anigozanthos manglesii subsp. *quadrans*																		X				X				X	X	X				
Anigozanthos pulcherrimus																										X						

APPENDIX C: PLANT SPECIES RECORDED WITHIN COMMUNITY TYPES

Species Name	Community																														
	D1	D2	F	F1	H1	H10	H11	H2	H3	H4	H5	H6	H7	H8	H9	M1	M2	S1	S2	SE1	T1	T2	T3	W1	W2	W3	W3d	W4	W5	W5a	W6	W6d
Anigozanthos viridis subsp. Cataby (S.D. Hopper 1786)																																
Anigozanthos viridis subsp. *?terraspectans*																																
Anigozanthos viridis subsp. *viridis*	X				X												X				X	X										X
Anthobolus foveolatus					X																											
Anthocercis ilicifolia subsp. *ilicifolia*						X																										
Anthocercis littorea						X														X					X			X				
Aphelia cyperoides															X											X						
**Arctotheca calendula*																						X					X					X
Arnocrinum preissii																										X						
Asteridea pulverulenta												X																				
Astroloma glaucescens					X										X															X		
Astroloma microcalyx											X																					
Astroloma microdonta																X										X				X		
Astroloma pallidum															X																	
Austrodanthonia occidentalis		X										X													X				X			
Austrostipa compressa		X			X							X										X		X	X	X	X	X	X			X
Austrostipa flavescens		X																X								X	X	X				
Austrostipa macalpinei												X																				
Baeckea sp. Perth Region (R.J. Cranfield 444)				X	X												X				X											
Banksia attenuata				X	X							X				X								X	X	X	X	X	X	X		
Banksia ilicifolia				X	X											X										X						
Banksia leptophylla												X																		X		
Banksia littoralis		X																														X
Banksia menziesii				X	X											X										X	X		X	X		
Banksia prionotes		X			X	X			X									X				X		X	X	X	X	X		X		X
Banksia telmatiaea		X			X			X	X		X		X			X	X			X	X	X			X	X						X
?Baumea articulata																															X	
Baumea juncea			X																	X	X											
Beaufortia squarrosa					X			X					X																	X	X	
Blancoa canescens																										X						
Boronia ramosa subsp. *anethifolia*																										X				X		
Boronia ramosa subsp. *ramosa*												X														X						
Borya sphaerocephala																X																
Bossiaea eriocarpa								X	X			X												X		X			X	X		
Brachyscome ?bellidioides					X	X											X	X								X						

APPENDIX C: PLANT SPECIES RECORDED WITHIN COMMUNITY TYPES

Species Name	Community																														
	D1	D2	F	F1	H1	H10	H11	H2	H3	H4	H5	H6	H7	H8	H9	M1	M2	S1	S2	SE1	T1	T2	T3	W1	W2	W3	W3d	W4	W5	W5a	W6	W6d
Brachyscome ?iberidifolia					X		X																									
**Briza maxima*																												X				
**Briza minor*	X							X																								
Bromus arenarius		X																														
**Bromus* sp.	X																															
Burchardia ?bairdiae					X				X						X											X						X
Burchardia congesta					X						X	X			X											X						
Burchardia sp.										X																						
Byblis lamellata					X																											
Caladenia flava																										X						
Caladenia longicauda								X																								
Caladenia longicauda subsp. *?albella*							X																									
Caladenia ?longicauda subsp. *borealis*					X																											
Caladenia sp.								X																								
Caladenia vulgata					X																X											X
Caladenia ?vulgata																										X				X		
Calandrinia corrigioloides			X		X			X				X			X							X		X		X		X	X			X
Calandrinia ?liniflora					X																			X	X	X		X				
Calandrinia sp.																																X
Calandrinia sp. SW coastal (J. Dodd 753)																																X
Calectasia narragara									X						X											X						
Calothamnus hirsutus					X		X																									
Calothamnus quadrifidus					X					X	X	X			X	X			X		X	X				X	X	X		X		
Calothamnus sanguineus									X	X																X						
Calytrix angulata																										X						
Calytrix aurea					X						X																					
Calytrix flavescens									X																	X				X		
Calytrix ?flavescens																										X						
Calytrix fraseri										X	X					X										X						
Calytrix ?fraseri																										X						
Calytrix sp.																										X						
Carpobrotus sp.																									X							X
Carpobrotus ?virescens												X		X						X		X										
Cassytha glabella					X	X												X								X						
Cassytha glabella forma *dispar*					X				X				X		X											X				X		
Cassytha sp.					X	X	X					X					X	X		X	X		X			X					X	

APPENDIX C: PLANT SPECIES RECORDED WITHIN COMMUNITY TYPES

Species Name	Community																														
	D1	D2	F	F1	H1	H10	H11	H2	H3	H4	H5	H6	H7	H8	H9	M1	M2	S1	S2	SE1	T1	T2	T3	W1	W2	W3	W3d	W4	W5	W5a	W6	W6d
Casuarina obesa	X																														
Caustis dioica									X		X				X	X										X				X		
Centrolepis polygyna					X										X																
Chaetanthus aristatus					X		X													X											
Chamaescilla corymbosa																X															
Chamelaucium uncinatum																											X			X		
Chordifex reseminans ms								X																								
Chordifex sinuosus ms					X						X				X											X						
Chordifex ?sinuosus					X																					X						
Chorizandra enodis																	X				X											
**Cicendia filiformis*																					X											
Clematis linearifolia		X				X						X						X		X							X	X				X
Comesperma calymega																										X						
Commersonia pulchella																										X						
?Conospermum sp.					X																											
stoechadis					X				X			X			X		X									X	X	X		X		
Conostephium minus																										X						
Conostephium preissii									X															X		X				X		
Conostylis ?aculeata					X											X															
Conostylis aculeata subsp. *?aculeata*					X																											
Conostylis aculeata ?spinuligera			X		X																									X		X
Conostylis aculeata subsp. *spinuligera*					X		X				X				X		X				X	X				X			X			
Conostylis ?angustifolia																										X						
Conostylis aurea									X						X	X										X						
Conostylis candicans																										X	X					X
Conostylis candicans subsp. *calcicola*		X				X												X						X		X		X				
Conostylis candicans subsp. *candicans*																						X			X		X	X				
Conostylis candicans subsp. *?candicans*						X												X								X						
Conostylis canteriata					X																											
Conostylis crassinervia subsp. *absens*											X				X																	
crassinervia															X																	
Conostylis festucacea subsp. *festucacea*					X																X											
Conostylis ?festucacea subsp. *festucacea*																											X					X
Conostylis hiemalis																														X		
Conostylis juncea				X				X	X							X										X						
Conostylis latens					X																											

APPENDIX C: PLANT SPECIES RECORDED WITHIN COMMUNITY TYPES

Species Name	Community																														
	D1	D2	F	F1	H1	H10	H11	H2	H3	H4	H5	H6	H7	H8	H9	M1	M2	S1	S2	SE1	T1	T2	T3	W1	W2	W3	W3d	W4	W5	W5a	W6	W6d
Conostylis neocymosa																										X						
Conostylis sp.																						X										
Conostylis teretifolia									X						X											X						
Conostylis teretifolia subsp. *teretifolia*									X			X			X											X				X		
Corynotheca micrantha																										X	X	X				
?Corynotheca micrantha																								X				X				
**Cotula coronopifolia*																					X					X						X
Crassula colorata		X				X																X			X	X		X	X			X
**Crassula glomerata*			X																													
**Crassula natans* var. *minus*																			X												X	
Cryptandra mutila						X																										
Cryptandra pungens					X																					X						
**?Cynodon dactylon*																				X												
**Cyperus tenellus*			X									X							X		X			X		X		X	X			X
Dampiera alata					X														X													X
Dampiera linearis															X	X										X						
Dampiera teres																X																
Darwinia pinifolia					X												X									X						X
Dasypogon bromeliifolius																										X						
Dasypogon obliquifolius					X			X	X						X	X										X	X					
Daucus glochidiatus		X			X																	X		X								
Daviesia decurrens					X			X							X	X																
Daviesia divaricata																										X						
Daviesia divaricata subsp. *divaricata* ms																										X						
Daviesia incrassata subsp. *incrassata*					X								X			X										X				X		
Daviesia ?oxyclada																										X						
Daviesia podophylla																										X						
Desmocladus asper					X	X						X						X				X		X		X	X	X				
Desmocladus sp.					X																											
Dianella revoluta		X												X						X	X	X				X	X					
Diplopeltis huegelii subsp. *lehmannii*																						X										
Diplopeltis huegelii subsp. *?lehmannii*					X																											
**Dischisma arenarium*		X																X										X				X
Diuris corymbosa																										X						
Diuris laxiflora							X																									
Diuris sp.																										X						

APPENDIX C: PLANT SPECIES RECORDED WITHIN COMMUNITY TYPES

Species Name	Community																														
	D1	D2	F	F1	H1	H10	H11	H2	H3	H4	H5	H6	H7	H8	H9	M1	M2	S1	S2	SE1	T1	T2	T3	W1	W2	W3	W3d	W4	W5	W5a	W6	W6d
Drosera closterostigma					X										X											X						
Drosera ?closterostigma				X	X				X																	X						
Drosera erythrorhiza				X	X			X	X	X		X	X		X											X				X		
Drosera gigantea					X						X					X	X		X		X										
Drosera humilis																								X								
Drosera menziesii					X						X				X											X			X			
Drosera menziesii subsp. *menziesii*							X																									
Drosera menziesii subsp. *?menziesii*																																X
Drosera menziesii subsp. *penicillaris*					X				X							X										X				X		
Drosera sp.																										X				X		
Drosera sp. climbing					X	X																				X						
Dryandra armata var. *armata*										X																						
Dryandra lindleyana					X			X			X	X			X											X	X					
Dryandra lindleyana var. *lindleyana*					X				X						X											X						
Dryandra lindleyana subsp. *pollosta*					X																									X		
Dryandra nivea					X																											
Dryandra nivea subsp. *nivea*					X		X				X		X								X											
Dryandra ?nivea subsp. *nivea*																X										X						X
Dryandra platycarpa					X																											
Dryandra sessilis												X																				
Dryandra sessilis var. *cygnorum*												X										X				X						
Dryandra stricta					X																											
Dryandra tortifolia																										X						
Elythranthera brunonis					X										X											X						
Eremaea asterocarpa				X	X				X						X	X								X		X			X	X		
Eremaea ?asterocarpa subsp. *histoclada*																										X						
Eremaea pauciflora												X														X						
Eremaea pauciflora var. *pauciflora*					X																					X				X		
Eremaea sp.																										X						
Eremophila glabra							X																									
Eriochilus sp.						X																										
**Erodium cicutarium*		X																										X				X
Eucalyptus decipiens subsp. *decipiens*		X			X																	X		X		X	X					
Eucalyptus gomphocephala						X																										
Eucalyptus obtusiflora subsp. *dongarraensis*										X																						
Eucalyptus rudis		X																				X			X					X		X

APPENDIX C: PLANT SPECIES RECORDED WITHIN COMMUNITY TYPES

Species Name	Community																														
	D1	D2	F	F1	H1	H10	H11	H2	H3	H4	H5	H6	H7	H8	H9	M1	M2	S1	S2	SE1	T1	T2	T3	W1	W2	W3	W3d	W4	W5	W5a	W6	W6d
Eucalyptus todtiana					X				X							X										X		X		X		
Euchiton sphaericus																																X
Exocarpos aphyllus																										X						
Exocarpos sparteus														X						X	X											
Ficinia nodosa																				X												
Frankenia pauciflora							X												X													
Gahnia trifida	X	X												X					X	X	X											
Gastrolobium plicatum										X																						
Glischrocaryon aureum ?angustifolium										X																X				X		X
Glischrocaryon aureum var. *angustifolium*																X																
Gompholobium tomentosum					X											X										X				X		
Goodenia pulchella subsp. Coastal Plain A (M. Hislop 634)																			X													
Grevillea preissii												X																				
Grevillea preissii subsp. *glabrilimba*					X												X		X		X											
Grevillea preissii subsp. *?glabrilimba*					X																											
Grevillea preissii subsp. *preissii*							X																									
Gyrostemon racemiger																										X		X				
Haemodorum spicatum															X																	
Haemodorum venosum															X											X						
Haemodorum ?venosum																										X						
Hakea candolleana					X				X						X																	
Hakea costata					X						X	X			X											X				X		
Hakea incrassata										X																X						
Hakea lissocarpha					X					X					X	X																
Hakea obliqua subsp. *parviflora*					X			X	X		X		X																			
Hakea prostrata												X														X	X	X				
Hakea ruscifolia																										X						
Hakea sulcata					X						X		X																			
Hakea trifurcata					X				X	X	X	X	X		X																	
Hakea varia					X			X			X		X				X		X	X	X											X
Haloragis foliosa		X																														
Halosarcia indica subsp. *bidens*																			X													
Hardenbergia comptoniana						X												X						X								
**Heliophila pusilla*					X			X														X				X		X				
Hemiandra aff.*glabra*					X																						X					
Hemiandra glabra subsp. *glabra* ms					X	X												X														

APPENDIX C: PLANT SPECIES RECORDED WITHIN COMMUNITY TYPES

Species Name	Community																																
	D1	D2	F	F1	H1	H10	H11	H2	H3	H4	H5	H6	H7	H8	H9	M1	M2	S1	S2	SE1	T1	T2	T3	W1	W2	W3	W3d	W4	W5	W5a	W6	W6d
Hemiandra pungens					X											X										X						
Hibbertia crassifolia					X				X		X				X	X								X		X			X			
Hibbertia huegelii					X				X						X											X				X		
Hibbertia hypericoides									X	X		X			X							X		X		X	X		X	X		
Hibbertia racemosa						X																										
Hibbertia spicata					X																									X		
Hibbertia spicata subsp. *spicata*					X			X																		X						
Hibbertia ?spicata subsp. *spicata*																										X				X		
Hibbertia stellaris					X																											X
Hibbertia subvaginata												X														X		X		X		
**Hordeum leporinum*		X																														
?Hovea pungens																						X										
Hovea trisperma																										X						
Hybanthus calycinus												X												X		X						
Hypocalymma angustifolium					X											X										X						X
Hypocalymma xanthopetalum					X			X	X	X		X			X	X										X		X		X		
**Hypochaeris glabra*		X			X			X							X							X			X	X	X	X	X	X		X
Hypolaena exsulca					X								X						X		X									X		
Isopogon sp. Watheroo (D. Foreman 477)					X																											
Isotoma hypocrateriformis																		X														
Isotropis cuneifolia				X	X							X			X	X						X		X		X	X			X		
Jacksonia floribunda									X																	X						
Jacksonia hakeoides					X							X														X	X	X				X
Jacksonia nutans ms				X	X				X		X				X	X										X		X	X	X		X
Jacksonia sternbergiana								X																		X	X			X		
Johnsonia pubescens				X	X											X										X						
**Juncus bufonius*			X																													
Juncus pallidus																					X											X
Kennedia prostrata		X										X										X		X				X				X
?Kunzea glabrescens																								X				X				
Kunzea micrantha subsp. *petiolata*											X																					
Lagenophora huegelii																								X		X		X		X		X
Laxmannia ramosa subsp. ramosa					X																									X		
Laxmannia sessiliflora																										X						
Laxmannia sessiliflora subsp. *sessiliflora*					X																					X				X		
Laxmannia sessiliflora subsp. *?sessiliflora*					X																											

APPENDIX C: PLANT SPECIES RECORDED WITHIN COMMUNITY TYPES

Species Name	Community																														
	D1	D2	F	F1	H1	H10	H11	H2	H3	H4	H5	H6	H7	H8	H9	M1	M2	S1	S2	SE1	T1	T2	T3	W1	W2	W3	W3d	W4	W5	W5a	W6	W6d
Lechenaultia biloba					X																			X								
Lechenaultia linarioides												X														X		X				
Lepidobolus ?preissianus															X											X						
Lepidosperma brunonianum								X											X		X										X	
Lepidosperma longitudinale																	X						X									X
Lepidosperma pubisquameum		X			X	X									X	X		X						X		X				X		
Lepidosperma aff.*pubisquameum*						X																X										
Lepidosperma sp.					X											X										X						
Leporella fimbriata																										X						
Leptomeria empetriformis					X																											
?Leptomeria empetriformis																										X						
Leptomeria pauciflora					X																											
Leptomeria preissiana					X																											
Leptorhynchos scaber						X																				X						
Leptospermum erubescens																														X		
Leptospermum spinescens																										X						
Leucopogon conostephioides				X	X											X										X				X		
Leucopogon nutans																										X						
Leucopogon parviflorus						X								X						X		X										X
Leucopogon polymorphus					X																					X						
Leucopogon ?polymorphus															X	X										X				X		
Leucopogon propinquus		X				X																		X		X	X					
Leucopogon sprengelioides					X																					X				X		
Lobelia ?rhytidosperma																										X	X	X				X
Lomandra hermaphrodita					X						X				X	X								X		X		X				
Lomandra maritima						X												X														
Lomandra micrantha subsp. *micrantha*																		X										X				
Lomandra preissii																										X						
Lomandra suaveolens						X						X									X	X										
Lyginia imberbis					X										X											X				X		
?Lyginia imberbis																										X						
Lysinema ciliatum					X																					X				X		
Macarthuria apetala																										X						
Macarthuria australis																										X						
Macarthuria keigheryi				X												X										X						
Macrozamia fraseri																										X				X		

APPENDIX C: PLANT SPECIES RECORDED WITHIN COMMUNITY TYPES

Species Name	Community																														
	D1	D2	F	F1	H1	H10	H11	H2	H3	H4	H5	H6	H7	H8	H9	M1	M2	S1	S2	SE1	T1	T2	T3	W1	W2	W3	W3d	W4	W5	W5a	W6	W6d
Meeboldina cana					X																											
Meeboldina coangustata								X																								
Meeboldina ?coangustata					X																											
Meeboldina sp.																							X									
Melaleuca brevifolia							X																									
Melaleuca clavifolia					X				X						X											X				X		
Melaleuca lateriflora subsp. *acutifolia*																	X				X											
Melaleuca lateritia																							X									
Melaleuca preissiana					X											X					X					X			X	X	X	
Melaleuca rhaphiophylla		X			X			X								X	X		X	X	X	X			X					X	X	X
Melaleuca seriata				X	X		X	X	X		X		X		X	X	X					X			X	X			X			X
Melaleuca ?seriata					X			X																		X				X		
Melaleuca sp. 1					X																											
Melaleuca sp. 2					X									X						X												
Melaleuca systena		X				X		X				X					X	X				X			X	X	X	X				
Melaleuca teretifolia					X												X				X		X									
Melaleuca viminea subsp. *viminea*			X		X			X									X		X		X				X	X						X
**Melilotus indicus*		X																														
**Mercurialis annua*																								X				X				
Mesomelaena pseudostygia					X				X						X											X	X			X		
Mesomelaena tetragona					X										X	X										X						
Microtis media subsp. *media*																					X	X				X						
Microtis sp.							X																							X		
Millotia myosotidifolia																						X				X	X	X				X
Mirbelia trichocalyx																														X		
Monotaxis grandiflora																										X						
Monotaxis grandiflora var. *grandiflora*																										X						
**Moraea flaccida*	X																				X							X				
Muehlenbeckia adpressa																																X
Neurachne alopecuroidea															X	X										X						
Nuytsia floribunda		X			X			X	X	X	X	X			X	X				X		X				X	X		X	X		X
Olax scalariformis				X	X				X																	X						
Olearia axillaris																				X												
Olearia conspicua ms																										X						
Olearia dampieri ms																											X					
Olearia rudis																												X				

APPENDIX C: PLANT SPECIES RECORDED WITHIN COMMUNITY TYPES

Species Name	Community																														
	D1	D2	F	F1	H1	H10	H11	H2	H3	H4	H5	H6	H7	H8	H9	M1	M2	S1	S2	SE1	T1	T2	T3	W1	W2	W3	W3d	W4	W5	W5a	W6	W6d
Onychosepalum microcarpum					X																											
Opercularia vaginata				X	X	X		X			X				X	X		X		X						X	X		X	X		
**Orobanche minor*		X																														
Orthrosanthus laxus var. *laxus*																										X						
**Parentucellia latifolia*			X																													X
**Parentucellia viscosa*																					X											
Patersonia occidentalis					X			X	X		X				X	X	X									X				X		X
Pelargonium littorale subsp. *littorale*		X																								X		X				X
Pericalymma ellipticum													X																			
Persoonia comata															X											X				X		
Peterostylis aff.*nana*								X																								
Petrophile brevifolia					X				X		X		X		X	X									X	X	X	X				
Petrophile linearis											X													X		X			X	X		
Petrophile macrostachya												X														X				X		
Petrophile ?macrostachya															X											X						
Petrophile pilostyla subsp. *austrina*					X																					X				X		
Petrophile seminuda					X		X				X		X		X	X	X															
**Petrorhagia dubia*																																X
Philotheca spicata												X				X										X						
Philydrella ?drummondii																					X											
Phlebocarya ciliata					X																					X				X		
Phlebocarya filifolia																										X						
Phyllangium ?divergens																										X			X			
Phyllanthus calycinus						X												X										X				
Pimelea angustifolia																										X						
Pimelea imbricata var. *?piligera*					X																											
Pimelea suaveolens															X																	
Pimelea suaveolens subsp. *suaveolens*																										X						
Pimelea sulphurea									X			X			X	X										X						
Pityrodia bartlingii																										X						
Platysace haplosciadia					X																											
770001)					X																											
Platysace ?xerophila					X																					X						
Poa drummondiana						X																		X		X						
Podolepis gracilis						X									X			X														
Podotheca chrysantha																						X				X			X			

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Species Name	Community																														
	D1	D2	F	F1	H1	H10	H11	H2	H3	H4	H5	H6	H7	H8	H9	M1	M2	S1	S2	SE1	T1	T2	T3	W1	W2	W3	W3d	W4	W5	W5a	W6	W6d
Podotheca gnaphalioides		X			X	X					X	X												X	X	X	X	X				X
Polypogon tenellus		X				X																										
Poranthera microphylla												X														X						
Potamogeton drummondii																					X											
Prasophyllum gracile																																
Pterochaeta paniculata									X		X				X											X				X		
Pterostylis sp.					X																											
Ptilotus calostachyus						X																						X				
Ptilotus manglesii											X																					
Ptilotus polystachyus																												X				
Ptilotus stirlingii					X	X						X																				
Ptilotus stirlingii var. *stirlingii*												X										X			X	X	X	X				
Pyrorchis nigricans					X																					X				X		
Regelia ciliata					X															X												
Rhagodia preissii subsp. *preissii*		X				X								X								X						X				
Rhodanthe citrina																		X										X				
**Romulea rosea*			X		X																											X
**Rostraria pumila*		X				X																										
Samolus junceus																					X											
Samolus repens var. *paucifolius*					X														X													
Samolus repens var. *?paucifolius*							X																									
Scaevola anchusifolia											X				X																	
Scaevola ?anchusifolia																X																
Scaevola canescens		X										X														X		X				
Scaevola lanceolata					X									X						X	X											
Scaevola phlebopetala															X											X						
Scaevola repens																										X						
Scaevola repens var. *repens*		X			X				X						X	X						X		X		X						
Scaevola thesioides subsp. *thesioides*			X			X																										
Schoenus asperocarpus															X											X						
?Schoenus asperocarpus															X											X						
Schoenus brevisetis															X											X						
Schoenus clandestinus					X				X	X		X			X											X		X		X		
Schoenus curvifolius					X											X										X				X		
Schoenus grandiflorus						X						X						X				X										
Schoenus ?grandiflorus																										X						

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Species Name	Community																														
	D1	D2	F	F1	H1	H10	H11	H2	H3	H4	H5	H6	H7	H8	H9	M1	M2	S1	S2	SE1	T1	T2	T3	W1	W2	W3	W3d	W4	W5	W5a	W6	W6d
Schoenus odontocarpus																																
Schoenus pedicellatus																														X		
Schoenus pennisetis																																
Schoenus pleiostemoneus								X				X														X						
Schoenus ?pleiostemoneus																										X						
Schoenus rigens					X																											
Schoenus sp.					X								X																			
Schoenus subfascicularis					X						X																					X
Schoenus subflavus subsp. *subflavus*																														X		
Schoenus unispiculatus					X										X											X						
Scholtzia involucrata									X																	X				X		
Senecio pinnatifolius							X					X						X				X				X		X				
Senecio pinnatifolius var. *pinnatifolius*					X	X						X						X				X										
Siloxerus ?humifusus					X						X				X										X	X	X		X			
Solanum symonii	X																															
**Sonchus oleraceus*		X																														
Sowerbaea laxiflora																										X						
Sphaerolobium drummondii																										X						
Stackhousia monogyna					X							X														X	X	X		X		
Stenanthemum notiale subsp. *chamelum*												X														X						
Stenopetalum gracile					X													X									X					
Stirlingia abrotanoides					X										X																	
Stirlingia latifolia				X	X			X	X			X			X	X									X	X	X		X	X		
Stylidium aff. *repens*					X											X										X			X			
Stylidium ?albolilacinum											X															X						
Stylidium brunonianum																										X						
Stylidium ?brunonianum												X														X						
Stylidium ?calcaratum			X		X														X		X											
Stylidium crossocephalum																									X	X		X	X	X		
Stylidium cygnorum												X																	X			
Stylidium dichotomum										X	X				X	X										X			X			
Stylidium diuroides subsp. *diuroides*																										X	X		X			
Stylidium ?diuroides subsp. *diuroides*				X	X										X											X				X		
Stylidium divaricatum					X												X								X	X	X					
Stylidium ?hymenocraspedum				X																												
Stylidium piliferum																										X						

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Species Name	Community																														
	D1	D2	F	F1	H1	H10	H11	H2	H3	H4	H5	H6	H7	H8	H9	M1	M2	S1	S2	SE1	T1	T2	T3	W1	W2	W3	W3d	W4	W5	W5a	W6	W6d
Stylidium piliferum subsp. *piliferum*																										X						
Stylidium purpureum					X						X																					
Stylidium ?purpureum															X																	
Stylidium repens				X	X																					X				X		
Stylidium aff.*repens*					X																					X						
Stylidium sp.															X																	
Synaphea spinulosa					X				X						X									X		X		X		X		
Tersonia cyathiflora																										X						
Tetraria capillaris																										X						
Thelymitra antennifera					X																											
Thelymitra sp.																										X						
Thryptomene baeckeacea					X																					X				X		
Thryptomene mucronulata												X			X											X						
Thysanotus arenarius						X																										
Thysanotus ?arenarius																								X				X				
Thysanotus asper		X																X										X				X
Thysanotus dichotomus																										X				X		
Thysanotus multiflorus																										X						
Thysanotus patersonii		X			X		X											X	X		X					X		X				
Thysanotus spiniger																										X						
Thysanotus thyrsoideus											X	X			X											X			X			
Thysanotus triandrus					X																					X						
Trachymene coerulea subsp. *coerulea*												X										X		X				X				X
Trachymene pilosa		X			X	X		X	X			X						X				X		X		X	X	X	X	X		X
Tribonanthes australis					X											X			X		X					X						X
Tricoryne elatior																										X						
Tricoryne sp.																										X						
**Trifolium* sp.																																X
Triglochin linearis					X			X											X		X										X	
Triglochin mucronata			X																X													
Triglochin sp. A Flora of Australia (G.J. Keighery 2477)																			X													
Tripterococcus brunonis				X	X										X											X						
floribundum														X																		
Unknown sp. 1																	X															
**Ursinia anthemoides*					X						X															X	X	X	X	X		X
Velleia trinervis							X																									

APPENDIX C: PLANT SPECIES RECORDED WITHIN COMMUNITY TYPES

Species Name	Community																														
	D1	D2	F	F1	H1	H10	H11	H2	H3	H4	H5	H6	H7	H8	H9	M1	M2	S1	S2	SE1	T1	T2	T3	W1	W2	W3	W3d	W4	W5	W5a	W6	W6d
Verreauxia reinwardtii																										X	X					
Verticordia blepharophylla					X												X															
Verticordia densiflora					X		X	X			X				X		X				X					X						
Verticordia ?densiflora					X										X	X										X						X
Verticordia lindleyi subsp. *lindleyi*					X																											
Verticordia pennigera															X																	
Verticordia ?pennigera					X																											
Verticordia sp.					X																											
Villarsia capitata					X			X											X		X										X	
Viminaria juncea					X						X					X	X		X	X	X											X
**Wahlenbergia capensis*																		X								X						X
Waitzia acuminata var. *albicans*																										X				X		
Waitzia suaveolens var. *suaveolens*												X														X	X					
Wurmbea dilatata					X											X																
Xanthorrhoea preissii				X	X			X	X	X	X	X			X	X	X				X	X		X	X	X	X	X	X	X		X
Xanthosia huegelii											X				X	X										X				X		