Appendix F

Environmental Impact Statement for the Proposed Blacktip Project Vegetation and Flora Study prepared by EcOz Environmental Services




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Environmental Impact Statement for the proposed Blacktip Project

Vegetation and Flora Study

Prepared for: Woodside Energy Ltd.

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EXECUTIVE SUMMARY

This report is concerned with documenting baseline information on terrestrial vegetation and flora for the Blacktip Project area, and assessing the potential impacts associated with the following onshore project activities:

- *construction and operation of the onshore processing plant.*
- *construction and operation of a 3 km buried onshore pipeline.*
- *construction and operation of associated roads and access routes (land only).*
- *construction camps and laydown areas.*

Methodology
A vegetation map of the project area was derived from high resolution satellite imagery. Desktop reviews of relevant literature and databases, and consultations with regional flora experts from the NT Herbarium, and the Weeds Branch of DIPE, were undertaken to identify the range of flora species, vegetation types and other environmental constraints that may occur in the project area. Field surveys of vegetation and flora were undertaken in May 2002, August 2003 and December 2003 to supplement the information obtained during the desktop review. The surveys involved botanical assessment of the pipeline shore crossing, at locations in representative vegetation communities along the onshore pipeline route, and in the 750m by 750m gas plant footprint.

Statutory obligations
Statutory obligations in relation to the protection of vegetation and flora apply to the project under the following NT and Commonwealth legislation:

- *NT Planning Act 1999.*
- *Territory Parks and Wildlife Conservation Act 2000.*
- *Environment Protection and Biodiversity Conservation Act 1999.*
- *Weed Management Act 2001.*

Vegetation communities
Five vegetation communities, as listed below, have been described and mapped in the project area.

1. *Mixed species low open woodland.*

2. *Eucalyptus miniata and E. tetrodonta forest with mixed species tree\shrub layer and Sarga sp. tussock grasses.*

3. *Eucalyptus miniata and E. tetrodonta tall woodland to open woodland with mixed species tree\shrub layer and Sarga sp. and Heteropogon triticeus tussock grasses.*

4. *Coastal sand dune community.*

5. *Monsoon vine forest.*

*The **pipeline shore crossing** traverses a west facing coastal sand dune, which is sparsely vegetated with the grasses Sarga plumosum and Spinifex longifolius, and a number of herbaceous species including Fimbristylis sericea and Gomphrena sp.*

*The **onshore pipeline route** traverses a low open woodland community comprised of a mixture of tree and shrub species including, Red Bush Apple (Syzygium suborbiculare), Pandanus (Pandanus spiralis), Black Wattle (Acacia auriculiformis), Billy Goat Plum (Terminalia ferdinandiana), Corymbia confertiflora and the Cycad (Cycas maconochiei ssp. maconochieii). Further landward, the onshore pipeline route traverses forests to open woodlands dominated by Darwin Woollybutt (Eucalyptus miniata) and Darwin Stringybark (E. tetrodonta).*

*The vegetation within the 750m x 750m area proposed for the **onshore gas plant** is tall open forest to woodland dominated by Darwin Stringybark (Eucalyptus tetrodonta) and Darwin Woollybutt (E. miniata). The Cycad (Cycas maconochiei ssp. maconochiei) is a common feature of the understorey.*

Flora species
Surveys and NT Herbarium records for the project area document 90 flora species from 43 genera.

Weeds
Weeds are present in low numbers in the project area. Scattered Rubber Bush (Calotropis procera) plants occur on the beach dunes, and scattered infestations of Hyptis (Hyptis suaveolens) were observed in the hind dunes and in monsoon vine forests adjacent to the project area. Snake Vine (Stachytarpheta sp). and Wild Passionfruit (Passiflora foetida) were also observed in the near coastal areas. Other weed species are likely to be present, but in low numbers. The greatest potential for transfer of weeds during construction and operation of the project will be associated with the construction of access tracks and borrow pits, and the importation of fill material into the project area.

Communities of conservation significance

Monsoon vine forest communities *occur at the northern and southern ends of Yelcher Beach where the pipeline shore crossing is located. Outside the project area monsoon vine forest occurs in association with the estuarine systems at the southern end of Yelcher Beach, south of the project area and at Injin Beach, north of the project area. Research on rainforest patches in the Northern Territory has found that they are typically species rich and contain a high proportion of the NT's rare species (Palmer 2000; Dunlop et al. 1994; Russell-Smith & Bowman 1992), and all rainforest patches are significant in a regional context because of the high level of patch interdependence (Price et al. 1998). Field assessment revealed that the monsoon vine forest communities adjacent to the project area are relatively unaffected by weeds, fire and feral animals, although some Hyptis and Rubber Bush plants were observed during field surveys. The ecological integrity of the patches further contributes to their regional conservation significance. None of the patches identified during field surveys are directly impacted by the shore crossing, onshore pipeline and gas plant components of the proposed development. However, their position in close proximity to the project area creates potential for indirect impacts through weed invasion and increased fire frequency, the alteration of water supply and disturbance of rainforest fauna.*

The coastline at the Yelcher Beach shore crossing is dominated by a ***sandy beach backed by low dunes****. Extensive beach and sand dune environments also occur to the north (Injin Beach) and south (continuation of Yelcher Beach). The sand dunes are ecologically important through their role in protecting the coastline and landward vegetation communities. Sand dunes, especially foredunes, are highly susceptible to degradation when disturbed by natural and\or man-made forces. Open trenching through the sand dunes at Yelcher Beach to construct the pipeline shore crossing will cause substantial short-term physical disturbance to the beach and dune environments during construction. In the longer term, the dunes could be destabilised by the removal of vegetation and there is a high risk of erosion occurring, although this risk can be mitigated by the use of appropriate construction and rehabilitation techniques, and the implementation of a monitoring programme.*

Open grassland and Paperbark swamps *occur in association with the estuarine systems at Injin Beach and Yelcher Beach. These communities are at least 2-4 km away from the project area and for this reason have not been subject to field assessment. The Moyle River floodplain, which is a wetland of national importance (Environment Australia 2001), is located 50 km to the east of the project area. No wetland communities occur in areas identified for development of the shore crossing, onshore pipeline and gas plant. Wetlands that occur in other areas where other project related activities will take place i.e. along access routes and at borrow pits, will be determined when the locations and extent of these aspects has been finalised.*

Riparian *vegetation communities are of regional conservation significance through their role in maintaining the health of river and creek systems. These communities are typically floristically diverse, contain distinct flora species assemblages, and provide essential habitat for many species of fauna. The closest riparian communities to the project area are associated with the estuarine systems that occur on Injin Beach, 2 km north of the project area, and on Yelcher Beach, 3-4 km to the south. Access routes and areas for sourcing of construction materials will potentially impact on riparian communities. The locations and extent of impacts will be determined once the final project design is complete.*

Species of conservation significance
None of the plant species recorded during field surveys of the project area are declared 'threatened' species under NT or Commonwealth legislation. Furthermore, a review of the known distribution of all 'threatened' plant species that occur in the Northern Territory (NT Parks and Wildlife Service http://www.nt.gov.au/ipe/pwcnt/plants) did not reveal any species with a distribution in proximity to the project area. Overall, the project area is largely comprised of eucalyptus woodland communities, which typically do not contain a high proportion of rare species. Therefore, the likelihood of 'threatened' species occurring in the project area is considered to be low.

The Cycad Cycas maconochiei ssp. maconochiei, occurs in the project area where it forms a dominant understorey component of the eucalyptus woodland communities. The epiphytic orchids, Cymbidium canaliculatum and Dendrobium spp., are abundant throughout the project area. None of the cycad and orchid species identified in the project area are classified as 'threatened'.

Potential Environmental Effects

The majority of the potential environmental effects on flora associated with the Blacktip Project will be as a result of the disturbance and removal of native vegetation during the construction phase of the project. The main potential impacts of the project on vegetation and flora have been identified as:

- *Vegetation and habitat loss.*
- *Impacts on communities of conservation significance.*
- *Introduction of weeds and exotic species.*
- *Increased risk of fire.*

Other impacts, such as those associated with Acid Sulfate Soils, dust, visual amenity, effluent and waste discharge, and spills of hazardous substances, are considered to have a lower potential impact on flora, and therefore are not discussed in detail in this report.

There is significant scope for reducing the potential ecological impacts of the project by incorporating vegetation and flora considerations in the construction specifications. There are also opportunities to mitigate some of the potential adverse effects by management actions before, during and after construction.

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ACKNOWLEDGEMENTS

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1. INTRODUCTION

EcOz Environmental Services has been contracted by Woodside Energy Ltd. (WEL) to undertake studies of the terrestrial vegetation and flora at the project area proposed for the Blacktip Project. A detailed overview of the proposed project is provided in the referral documents submitted to the NT and Commonwealth Governments and in preliminary drafts of the EIS documents. These documents form the current design specifications on which the assessment of terrestrial vegetation and flora is based.

The proposed project has both onshore and offshore components. Assessment of the potential environmental impacts of the project will therefore consider interactions with both the marine and terrestrial environments in, and surrounding, the project area. This report is concerned with documenting baseline information on terrestrial flora and vegetation, and assessing the potential impacts associated with the following onshore project activities:

- construction and operation of the onshore processing plant.
- construction and operation of a 3 km buried onshore pipeline.
- construction and operation of associated roads and access routes (land only).
- construction camps and laydown areas.

The last 2 points in the above list can only be partially assessed at this point in time as site selection and design specifications have not been finalised.

The marine environment in and surrounding the offshore project area is the subject of separate studies. For the purpose of this report, 'project area' refers to the onshore project area only.

The "Guidelines for Preparation of a Draft Environmental Impact Statement on the Proposed Blacktip Project (Department of Infrastructure, Planning and Environment, March 2004)" detail the specific requirements of the EIS document that is to be prepared for the Blacktip Project in accordance with Clause 8 of the Environmental Assessment Administrative Procedures of the *Environmental Assessment Act (1982)* and Chapter 4 Division 6 of the *Environment Protection and Biodiversity Conservation Act (1999)*. The terrestrial flora study was designed to satisfy the requirements of the Guidelines, and specifically to provide baseline information on which to base an assessment of potential impacts and development of appropriate mitigations measures for the project. This report documents the findings of field surveys, consultations and reviews of existing information undertaken to assess the potential impacts of the Blacktip Project on terrestrial vegetation and flora.

2. STATUTORY OBLIGATIONS UNDER NT AND COMMONWEALTH LEGISLATION

The main statutory requirements that apply to the potential impacts of the Blacktip Project on terrestrial vegetation and flora are discussed below.

2.1. Clearing native vegetation

Planning Act NT 1999

Interim Development Control Order No.12 declared under the *NT Planning Act 1999* prohibits clearing of more than 1 hectare of land without a Development Permit. These controls apply to all Freehold and Crown land of 2ha or more outside of existing towns and current Control Plan areas. In accordance with this legislation the proponents of the Blacktip Project should consult with Development Assessment Services (DIPE) regarding requirements for a development permit prior to any land clearing activities.

2.2. Protected vegetation communities and flora species

Territory Parks and Wildlife Conservation Act 2000 (TPWC Act)

The TPWC Act establishes lists of 'threatened wildlife' and 'areas of essential habitat' which are protected under the Act. There are currently no 'areas of essential habitat' declared in the Blacktip project area, and none of the flora species classified as 'threatened wildlife' under the Act are known to occur in the project area.

If it is intended to harvest species belonging to the Cycadaceae and Orchidaceae plant families in the project area for commercial purposes, a permit is required under section 55 of the Act.

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The EPBC Act establishes lists of nationally threatened species and ecological communities which are protected by the Act. None of the flora species or communities listed under the EPBC Act have a range that extends to the proposed onshore project area.

2.3. Management of weeds

Weeds Management Act 2001

Weed management in the Northern Territory is controlled under the *NT Weeds Management Act* (2001), which establishes lists of 'declared weeds' to which the Act applies. Weeds declared under the Act, that have been recorded in the project area or are known to occur in the region, are identified in Table 2. Section 9 of the Act establishes the responsibilities of land owners and occupiers for managing 'declared weeds'. The project proponent is responsible for the implementation of measures to ensure that 'declared weeds' are not introduced and\or spread by activities associated with the project, and that appropriate reporting strategies are in place.

3. METHODOLOGY

The methodologies adopted in undertaking the assessment of terrestrial vegetation and flora for the Blacktip Project were developed firstly to ensure that the range of potential issues are adequately covered, and secondly, to satisfy the requirements of the Draft EIS Guidelines. The methodologies were developed in consultation with the NT Parks and Wildlife Service and were provided to the NT Office of Environment and Heritage for comment. This section describes the methodologies employed in conducting desktop reviews and field surveys, and the key data sources utilised.

3.1. Desktop studies

To identify the range of flora species, vegetation types and other environmental constraints that may occur in the project area, reviews of relevant literature and databases, and consultations with regional flora experts from the NT Herbarium, and the Weeds Branch of DIPE, were undertaken.

The main data sources utilised in the desktop review were:

- *NT Herbarium database* – documents specimens previously identified and collected in the area.
- *Commonwealth Department of Environment and Heritage EPBC Act (1999) database (www.environment.gov.au)* – predicts species listed under the provisions of the EPBC Act that occur, or are likely to occur, in the area.
- *NT Parks and Wildlife Service Threatened Species Information* http://www.nt.gov.au/ipe/pwcnt/plants.
- *NT Rainforest Database* (Parks and Wildlife Service NT) – maps the boundaries of rainforest patches in the area.
- *Various scientific publications relating to NT flora.*
- *Environmental Legislation (species listed under the EPBC Act (Cth) (1999) and Territory Parks and Wildlife Conservation Act (NT) (2000).*

Vegetation communities and flora species of conservation significance identified from these data sources are discussed in section 5 of this report.

3.2. Field surveys

Field surveys of vegetation and flora in the project area were undertaken in May 2002, August 2003 and December 2003. These surveys involved botanical assessment of the pipeline shore crossing, and of locations in representative vegetation communities along the onshore pipeline route, and in the 750m by 750m gas plant footprint. During the surveys the project area was traversed on quad bikes, by 4WD vehicle and on foot.

Flora survey plots were established in representative vegetation communities. The following data were collected at each of the sample plots:

- GPS Coordinates.
- Community description.
- Dominant flora species in each stratum - where species could not be identified in the field, specimens were collected, pressed and dried, and were later verified by the NT Herbarium.
- Site photo.
- Weed species present.
- Locations of potential sensitivity such as riparian habitats, wetlands, rainforest patches etc.

In addition, foot searches for species of conservation significance and weed species were undertaken whilst traversing through the project area during the three survey periods.

The botanical surveys focussed on the description of structural characteristics and identification of species within each stratum of the community. The structural classification used in the surveys generally follows the Australian Soil and Land Survey Field Handbook (McDonald *et al.* 1998).

4. VEGETATION COMMUNITIES AND FLORA SPECIES

4.1. Regional context

The project area is located in the Darwin Coastal bioregion identified in the Interim Biogeographic Regionalisation of Australia (Environment Australia 2000). The summary of the attributes of the Darwin Coastal bioregion presented in this section is largely taken from Woinarski (2002).

The Darwin Coastal bioregion comprises gently undulating plains on lateritised Cretaceous sandstones and siltstones; sandy and loamy red and yellow earths and siliceous sands from near the mouth of the Victoria River to just west of Cobourg Peninsula. The most notable vegetation feature is the extensive and diverse floodplain environment associated with the lower reaches of the many large river systems. Floodplain environments associated with the Moyle River system occur 50km to the north-east of the project area. There are also substantial areas of mangroves, rainforest and other riparian vegetation fringing the rivers in the bioregion. Inland from the coast, the dominant vegetation type is eucalypt tall open forest, typically dominated by Darwin Woollybutt *Eucalyptus miniata* and Darwin Stringybark *E. tetrodonta*. This bioregional pattern holds true for the project area, where variations of the eucalyptus woodland to forest community are dominant.

4.2. Vegetation communities

Five vegetation communities, as listed below, have been described in the project area based on field surveys (Table 1). An additional 4 communities, namely mangrove forest, saline flats, Melaleuca swamp and Melaleuca woodland have been mapped in proximity to the project area. A map of the vegetation communities that occur in and surrounding the project area is included as Figure 1, along with the locations of sites surveyed during the field studies.

Table 1 Vegetation communities and survey sites in the onshore project area.

Vegetation community	Survey sites
Mixed species low open woodland.	OSP6, OSP1
Eucalyptus miniata and *E. tetrodonta* forest with mixed species tree\shrub layer and *Sarga sp*. tussock grasses.	OSP2, GP1, GP2, GP3
Eucalyptus miniata and *E. tetrodonta* tall woodland to open woodland with mixed species tree\shrub layer and *Sarga sp.* and *Heteropogon triticeus* tussock grasses.	OSP3, OSP4, OSP5, OUT1
Sand dune community.	SC1, SC2
Monsoon vine forest.	MVF1

The vegetation communities that occur at the pipeline shore crossing, along the onshore pipeline route and at the proposed gas plant site are described below, and botanical data collected during field surveys are collated in Appendix 1. Mangroves occur in association with rocky headlands that define the northern and southern ends of the beach where the pipeline will come onshore. Mangroves are being assessed as part of separate studies of the intertidal zone and therefore are not assessed in this report.

Shore crossing

The pipeline shore crossing traverses a west facing coastal sand dune, which is sparsely vegetated with the grasses *Sarga plumosum* and *Spinifex longifolius*, and a number of herbaceous species including *Fimbristylis sericea* and *Gomphrena sp.*(Plates 1 and 2). Patches of monsoon vine forest occur on the

hind dunes at the northern and southern ends of the beach. These patches are dominated by the trees Tamarind *Tamarindus indica,* Red Bush Apple *Syzygium suborbiculare* and Billy Goat Plum *Terminalia ferdinandiana,* and have a dense and diverse understorey of trees, shrubs and vines. Further discussion of monsoon vine forests is provided in section 5.1.3.

Plates 1 and 2 Sand dunes near shore crossing

Onshore pipeline route

The onshore pipeline route traverses a low open woodland community that occurs on damp sandy soils in the hind dunes (Plate 3). This community is comprised of a mixture of tree and shrub species including, Red Bush Apple *Syzygium suborbiculare,* Pandanus *Pandanus spiralis,* Black Wattle *Acacia auriculiformis,* Billy Goat Plum *Terminalia ferdinandiana, Corymbia confertiflora* and the Cycad *Cycas maconochiei ssp. maconochiei.* The ground layer is comprised of *Heteropogon contortus* and *H. triticeus* tussock grasses.

Further landward, the onshore pipeline route traverses forests to open woodlands dominated by Darwin Woollybutt *Eucalyptus miniata* and Darwin Stringybark *E. tetrodonta.* Seasonal variations in these communities are illustrated in Plates 4-7. Species that are common in the mid-storey of these communities include, Billy Goat Plum *Terminalia ferdinandiana,* Red-flowered Kurrajong *Brachychiton megaphyllus,* Cocky Apple *Planchonia careya* and *Cycas maconochiei ssp. maconochiei*. The ground layer is typically comprised of *Sarga sp.* and *Heteropogon sp.* tussock grasses.

Gas Plant

The vegetation within the 750m x 750m area proposed for the onshore gas plant is tall open forest to woodland dominated by Darwin Stringybark *Eucalyptus tetrodonta* and Darwin Woollybutt *E. miniata*. Other species that typically occur in the canopy include Ironwood *Erythrophleum chlorostachys* and *Terminalia ferdinandiana*. The mid-storey of this community is typically sparse and comprised of a mixture of tree and shrub species. The Cycad *Cycas maconochiei ssp. maconochiei* is a common feature of the understorey. The ground layer is mainly comprised of *Heteropogon triticeus* and *Sarga sp.* tussock grasses.

4.3. Flora species

Surveys and NT Herbarium records for the project area document 90 flora species from 43 genera. Lists of species recorded at the shore crossing, pipeline, gas plant site and in the rainforest patch at the southern end of the shore crossing beach, are provided at Appendix 2.

Plate 3 Low open woodland landward of sand dunes.

Plate 4 Eucalyptus forest traversed by the onshore pipeline – photo taken early dry season (May).

Plate 5 Eucalyptus forest traversed by the onshore pipeline – photo taken late dry season (Oct).

Plate 6 Eucalyptus forest at gas plant site – photo taken early dry season (May).

Plate 7 Eucalyptus forest at gas plant site – photo taken late dry season (Oct).

4.4. Weeds and exotic species

Weed species recorded in the project area and in regions to the east that may be used for access routes and sourcing of project materials are listed in Table 2. These species were identified in previous surveys, NT Herbarium records and in consultations with the Weeds Branch of the Department of Infrastructure, Planning and Environment.

Weeds are present in low numbers in the project area. Scattered Rubber Bush *Calotropis procera* plants occur on the beach dunes, and scattered infestations of Hyptis *Hyptis suaveolens* were observed in the hind dunes and in monsoon vine forests adjacent to the project area. Snake Vine *Stachytarpheta sp.* and Wild Passionfruit *Passiflora foetida* were also observed in the near coastal areas. Other weed species are likely to be present, but in low numbers.

The areas that will be used for access routes and sourcing of project materials had not been identified at the time of this study. The greatest potential for transfer of weeds during construction and operation of the project will be associated with these areas. The key bioregional weed management issues in, and surrounding the project area, as described by Woinarski (2002), are summarised below.

The floodplains across the Darwin Coastal bioregion face a range of serious threats from weed incursion notably by *Mimosa pigra*, which completely re-models their composition and structure, but also by Olive Hymenachne *Hymenachne amplexicaulis* and Para Grass *Brachiaria mutica.* There are no floodplain environments in the project area, however, the weed species identified may be present at river and creek crossings along the access routes and at locations where construction material will be sourced for the project. The extensive eucalypt forests in this region are affected by the rapid spread to dominance in the understorey of the exotic pasture grasses Gamba Grass *Andropogon gayanus* and Mission Grasses *Pennisetum pedicellatum* and *P. polystachion,* which exacerbate the detrimental impacts of an increasing frequency of extensive hot late dry season fires. These species are common along the highways between Darwin and the project area. Heavy infestations of weeds (such as Noogoora Burr, Parkinsonia, and Castor-oil plant) are a feature of most riparian systems in the Ord-Bonaparte bioregion. Once again, these species may be present along access routes and at locations where construction material will be sourced for the project.

Table 2 Weed species that occur in the project area and in regions to the east that will be used for access and sourcing of project materials. Notes taken from Smith (2002) and Parsons and Cuthbertson (2001).

Weed species		Classification in project area	Notes
Species name	**Common name**		
Andropogon gayanus	Gamba Grass	A, except in Finniss River, Adelaide River, Mary River and Daly River catchments where D	A highly productive annual grass that increases fuel loads, cures later than the native annual grasses and produces intense late dry season fires which seriously damage native woody species.
Bidens pilosa	Cobblers Peg	Not declared.	A nuisance weed.
Brachiaria mutica	Para Grass	Not declared.	Environmental weed that grows in wet or seasonally flooded areas. Spreads quickly choking out native species and hindering the re-establishment of more desirable species.
Calotropis procera	Rubber Bush	C	Forms dense thickets, which compete with native plant species and transform the appearance of the savanna. Hinders pastoralism by degrading pastoral lands and making mustering difficult.
Cascabela thevetia	Yellow Oleander	Potential weed	

Weed species		Classification in project area	Notes
Species name	**Common name**		
Hyptis suaveolens	Hyptis	D & C	Forms dense thickets rendering infested areas unproductive.
Hymenachne amplexicaulis	Olive Hymenachne	A except in Finniss River, Adelaide River, Mary River and Daly River catchments where D	Has the ability to smother native vegetation and form dense monospecific stands on floodplains
Jatropha gossypifolia	Bellyache Bush	C	Competes with native species and is toxic to humans and animals.
Mimosa pigra	Mimosa, Giant Sensitive Plant	C	Forms dense impenetrable thickets which exclude native plants and animals, transforming sedgeland and grassland on floodplains into monotonous tall shrublands.
Parkinsonia aculeata	Parkinsonia	C	Forms impenetrable thickets that compete with and exclude native species. Thickets block access to creek lines and rivers.
Passiflora foetida	Wild Passionfruit	Not declared.	A fast growing species that spreads, choking native vegetation.
Pennisetum pedicellatum	Annual Mission Grass	D & C	Competes with and displaces native species. Remains green until late in the dry season and provides fuel for very hot fires. Late burning is seriously changing fire regimes.
Pennisetum polystachion	Mission Grass	C	Competes with and displaces native species. Remains green until late in the dry season and provides fuel for very hot fires. Late burning is seriously changing fire regimes.
Senna obtusifolia	Sicklepod	D & C	Competes with and excludes native species. Degrades pastures and toxic to stock.
Senna occidentalis	Coffee Senna	D & C	Competes with and excludes native species. Degrades pastures and toxic to stock.
Sida acuta	Spiny Head Sida	D & C	Competes with and excludes more desirable species. Competes strongly with crops and pastures and is one of the most serious weeds of crops and pastures in the Top End of the NT.
Sida cordifolia	Flannel Weed	D & C	Competes with and excludes more desirable species. Competes strongly with crops and pastures and is one of the most serious weeds of crops and pastures in the Top End of the NT.
Sida rhombifolia	Paddy's Lucerne	D & C	Competes with and excludes more desirable species. Competes strongly with crops and pastures.
Stachytarpheta sp.	Snake Weed	C	Invades disturbed areas and monsoon vine forests. Dominates and excludes native species.
Tribulus terrestris	Caltrop	Not declared	Competes with and excludes native species.
Xanthium strumarium	Noogoora Burr	B	Thickets are quick to establish and difficult to eradicate. Exclude native shrub species and inhibits ground layers. Spines hinder pastoralism and can cause discomfort in stock and are reported to be poisonous.

Key:
Class A – to be eradicated. **Class B** – growth and spread to be controlled. **Class C** – not to be introduced. **Class D** – not to be spread by human means. **Class E** – species under an approved strategy. Note: No strategies are currently in place for the project lease area.

5. CONSERVATION SIGNIFICANCE OF VEGETATION AND FLORA

5.1. Vegetation communities of ecological conservation significance

Vegetation communities of conservation significance are those that have unique ecological attributes and perform important ecological functions. These communities are typically rare, or restricted in distribution, and are often highly susceptible to degradation through disturbance. Communities of conservation significance that occur in and around the project area include monsoon vine forests, coastal sand dune communities, mangrove forests, wetlands (swamps and floodplains), and riparian communities. The locations, attributes and significance of these communities are discussed in this section.

Monsoon vine forests

Monsoon vine forest communities occur at the northern and southern ends of Yelcher Beach where the pipeline shore crossing will be located (Figure 1). The largest monsoon vine forest patch, which covers an area of approximately 49 ha, lies to the east of a rocky headland at the southern end of the beach and continues south along the coast for approximately 3 km (Plate 8). A smaller patch of vine forest, covering an area of about 1 ha lies 50 m north of this main patch (Plate 9). The monsoon vine forest that dominates the hind dunes at the northern end of the beach is smaller in size, covering approximately 14 ha (aerial extent derived from PWCNT database). Monsoon vine forest also occurs in association with the estuarine systems at the southern end of Yelcher Beach and at Injin Beach (Figure 1).

Rainforests in northern Australia occur as scattered patches in a landscape dominated by Eucalypt savannas (Bach *et al.* 1999). Although not uncommon, rainforest patches are generally small in area and contain distinct plant species assemblages which warrant conservation measures (PWCNT 2000b). They are typically extremely species rich, containing 13% of the total known NT flora (Dunlop *et al.* 1994), yet only occupy 0.2% of the land area of the Northern Territory (Price *et al.* 1995). Many rainforest species are rare, with thirty percent of rainforest flora species having been recorded from fewer than 10 patches (Palmer 2000; Russell-Smith & Bowman 1992). Rainforests also provide fruit resources required by frugivorous birds and bats, which in turn assist in the dispersal of seed between monsoon rainforest patches to maintain gene flow (Price *et al.* 1999). All rainforest patches are significant in a regional context because of the high level of patch interdependence (Price *et al.* 1998). All of these factors contribute to the conservation significance of this vegetation community.

The monsoon vine forest communities adjacent to the project area are relatively unaffected by weeds, fire and feral animals, although some Hyptis and Rubber Bush plants were observed during field surveys. The ecological integrity of the patches further contributes to their regional conservation significance. None of the patches identified during field surveys are directly impacted by the shore crossing, onshore pipeline and gas plant components of the proposed development. However, their position in close proximity to the project area creates potential for indirect impacts through weed invasion and increased fire frequency, the alteration of water supply and disturbance of rainforest fauna.

Plate 8 Monsoon vine forest at the southern end of beach. A Rubber Bush plant can be seen in the foreground.

Plate 9 One-hectare patch of monsoon vine forest at the southern end of the beach.

Sand dunes

The pipeline comes onshore at the northern end of an area that local people identify as Yelcher Beach. The coastline here is dominated by a sandy beach backed by low dunes. Extensive beach and sand dune environments also occur to the north (Injin Beach) and south (continuation of Yelcher Beach). The sand dunes are ecologically important through their role in protecting the coastline. They act as a buffer against wave damage during storms and cyclones, protecting the land behind from salt water intrusion and allowing the development of more complex plant communities in areas protected from salt water inundation, sea spray and strong winds. The dunes also act as a reservoir of sand, to replenish and maintain the beach at times of erosion. Erosion is a natural part of coastal processes and anecdotal evidence from Traditional Owners suggests that Yelcher Beach has in the past been some distance seaward. One estimate from an Aboriginal resident from the area was that it has receded some 50 m.

Sand dunes, especially foredunes, are highly susceptible to degradation when disturbed by natural and\or man-made forces. Open trenching through the sand dunes at Yelcher Beach to construct the pipeline shore crossing will cause substantial short-term physical disturbance to the beach and dune environments during construction. In the longer term, the dunes could be destabilised by the removal of vegetation and there is a high risk of erosion occurring, although this risk can be mitigated by the use of appropriate construction and rehabilitation techniques, and the implementation of a monitoring programme.

Wetlands

Open grassland and Paperbark swamps occur in association with the estuarine systems at Injin Beach to the north of the project area, and Yelcher Beach to the south of the project area (Figure 1). These communities are at least 2-4 km away from the project area and for this reason have not been subject to field assessment. The Moyle River floodplain, which is a wetland of national importance (Environment Australia 2001), is located 50 km to the east of the project area. The wetland is considered to be a good example, and one of the least disturbed, of a Top End floodplain system associated with a small river and a mudflat-fringed bay. The Moyle floodplain has high conservation value due to its vegetation being relatively weed-free and undisturbed (Whitehead and Chatto 2001). No wetland communities occur in areas identified for development of the shore crossing, onshore pipeline and gas plant. Wetlands that occur in other areas where other project related activities will

take place i.e. along access routes and at borrow pits, can only be determined when the locations and extent of these aspects has been finalised.

Riparian

Riparian vegetation communities are of regional conservation significance through their role in maintaining the health of river and creek systems. These communities are typically floristically diverse, contain distinct flora species assemblages, and provide essential habitat for many species of fauna. The closest riparian communities to the project area are associated with the estuarine systems that occur on Injin Beach, 2 km north of the project area, and on Yelcher Beach, 3-4 km to the south. Access routes and areas for sourcing of construction materials will potentially impact on riparian communities. The locations and extent of impacts can only be determined once the final routes are chosen.

5.2. Flora species of ecological conservation significance

Flora species of conservation significance include those species that are classified as 'threatened' and\or protected under NT and Commonwealth legislation, and species that are regionally restricted in their distribution. The locations, attributes and significance of flora species in relation to the project area are discussed in the following sections.

Many of the species that occur in and around the project area will also be of conservation significance to local Aboriginal people. Local people use parts of plants for a variety of purposes and some may also have spiritual significance. There has been no systematic documentation of flora species that are of significance to the local people, however, the existence of these values is acknowledged.

'Threatened' species

None of the plant species recorded during field surveys of the project area are declared 'threatened' species under NT or Commonwealth legislation. Furthermore, a review of the known distribution of all 'threatened' plant species that occur in the Northern Territory (NT Parks and Wildlife Service http://www.nt.gov.au/ipe/pwcnt/plants) did not reveal any species with a distribution in proximity to the project area.

Zeuxine oblonga and *Schoutenia ovata* are the 'threatened' species with the closest known distribution to the project area. *Z. oblonga* is known from a wet rainforest site on the Daly River (Kerrigan, Cowie and Baker 2002a). This vegetation type does not occur in the project area. *Schoutenia ovata* is known from monsoon vine thickets on granite and limestone outcrops near Tipperary Station (Kerrigan, Cowie and Baker 2002a). The monsoon vine forest patches in close proximity to the project area have been surveyed in both the early and late dry season. No species of significance were identified during these surveys.

Overall, the project area is largely comprised of eucalyptus woodland communities, which typically do not contain a high proportion of rare species. Therefore, the likelihood of 'threatened' species occurring in the project area is considered to be low.

Other species of conservation significance

Plant species belonging to the families Cycadaceae and Orchidaceae are typically regionally restricted in distribution and are of conservation significance for this reason, but none of the cycads and orchids in the project area are declared 'threatened' species. Only 'threatened' species are declared 'Protected Wildlife' under section 3 of the *Territory Wildlife Regulations.*

One species of Cycad, *Cycas maconochiei ssp. maconochiei*, occurs in the project area (Plate 10) where it forms a dominant understorey component of the eucalyptus woodland communities (Plate 11). The epiphytic orchids, *Cymbidium canaliculatum* and *Dendrobium spp.*, are abundant throughout the project area where they have been observed growing on the trunks of Cycads and eucalyptus trees.

The Draft NT Cycad Management Plan (Parks and Wildlife Service of the Northern Territory 2003, 3.1.4) states that where land clearing has been approved under the procedures of the Northern Territory Government, no permit will be required to take unprotected cycads for non-commercial purposes on areas designated to be cleared. If commercial harvesting is intended, a permit will be required.

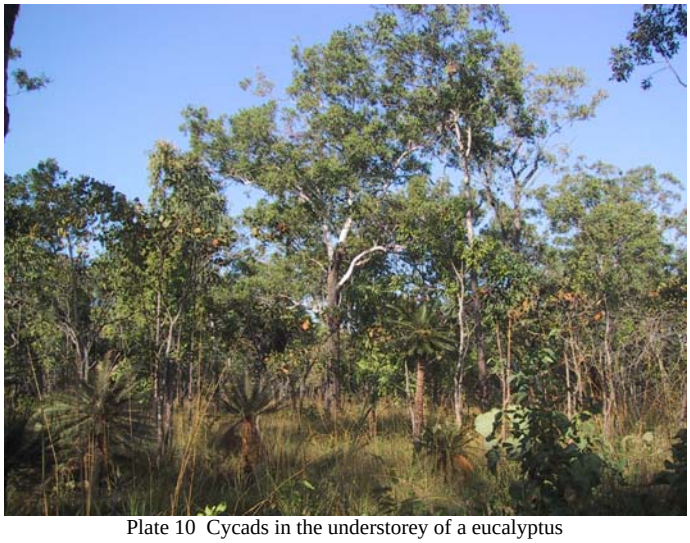

Plate 10 Cycads in the understorey of a eucalyptus woodland community in the project area.

Plate 11 Cycas maconochiei ssp. maconochiei

6. POTENTIAL ENVIRONMENTAL EFFECTS AND MANAGEMENT RECOMMENDATIONS

The majority of the potential environmental effects on flora associated with the Blacktip Project will be associated with the disturbance and removal of native vegetation during the construction phase of the project. The main potential impacts of the project on vegetation and flora have been identified as:

1. Vegetation and habitat loss.
2. Impacts on communities of conservation significance.
3. Introduction of weeds and exotic species.
4. Increased risk of fire.

Other impacts, such as those associated with Acid Sulfate Soils, dust, visual amenity, effluent and waste discharge, and spills of hazardous substances, are considered to have a lower potential impact on flora, and therefore are not discussed in detail in this report.

There is significant scope for reducing the potential ecological impacts of the project by incorporating flora considerations in the construction specifications. There are also opportunities to mitigate some of the potential adverse effects by management actions before, during and after construction. Recommendations on management measures to minimise impacts on flora are identified in this section. Additional measures for minimisation of site specific impacts should be developed following determination of the final design specifications.

6.1. Vegetation clearing and habitat loss

Potential effects

Construction in areas of intact native vegetation may cause a decline in the physical condition of vegetation and habitats beyond the actual zone of disturbance, or create other changes that reduce the suitability of surrounding habitat. The extent and nature of such effects is influenced by the initial condition of the habitats affected, the width of the area disturbed (i.e. the wider the easement the greater the potential impact), the management of construction operations, and the context of the development zone (fragmentation and isolation of habitat). A summary of vegetation clearing that will be associated with the project proposal as it currently stands is provided in Table 3, and the potential effects on native vegetation and flora are discussed below.

Table 3 Summary of vegetation clearing dimensions and total area for each component of the proposed project.

Project component	**Area to be cleared**	
	Dimensions	**Area**
Shore crossing	40m x 2.2km	8.8ha
Onshore pipeline		
Onshore lay-down near shore crossing	100m x 100m	1ha
Gas plant	750m x 750m	56.25ha
Access route from shore crossing to gas plant	To be determined	To be determined
Onshore lay-down at gas plant	Within gas plant footprint	
Access route from Wadeye to plant site	To be determined	To be determined
Project component	**Area to be cleared**	
	Dimensions	**Area**
Construction materials sources	To be determined	To be determined
Accommodation (construction and operation)	Within gas plant footprint	

Construction of the shore crossing and onshore pipeline will be via an 'open cut' technique, which will result in the clearing of 6.6 ha of native vegetation within a 40 m working width. The pipeline shore crossing traverses sand dunes, which are sparsely vegetated with grasses and herbs. Removal and\or disturbance of the vegetation cover on the dunes has the potential to destabilise the dune system and subsequently to cause erosion, which due to coastal sediment transportation processes may have impacts beyond the shore crossing site.

The vegetation traversed by the 2 km onshore pipeline route is characterised by eucalyptus woodland communities dominated by *Eucalyptus miniata* and *E. tetrodonta* (Appendix 1). The 750 m x 750 m site proposed for the gas plant is also dominated by this community. A laydown area and construction camp will be sited within the gas plant footprint. Eucalyptus woodlands dominated by *E.miniata* and *E. tetrodonta* are well represented in the Darwin Coastal bioregion (Woinarski 2002) and is the most common eucalyptus community in the Top End (Brock 1993). Given that the community is well represented and largely undisturbed by development in the region, the extent of clearing that will be associated with the project is unlikely to have a significant impact on habitat availability for flora and fauna.

Additional vegetation clearing will be associated with the:

- construction of an access route from Wadeye to the onshore plant site;
- construction of a lay-down area for storage of pipe lengths and other pipeline components during site preparation and construction/installation;
- construction of a beach barge landing and heavy vehicle access road from the beach landing to the plant site; and
- potentially other project aspects not finalised at this point in time.

The details of these aspects of the project are yet to be finalised, however, it can be established at this stage that there is potential for adverse effects on sensitive vegetation types, especially riparian zones crossed by access routes.

There is also high potential for weeds to be introduced and spread, especially in uninspected construction materials, although this potential will be greatly reduced by the implementation of weed inspections as part of a weed management plan.

Management recommendations

The following management measures should be considered to minimise the effects of vegetation clearing activities associated with the project:

1. Keep the extent of the planned working width to the minimum area necessary for construction activities. This is particularly important at the shore crossing and where the sand dune landforms and vegetation communities are sensitive to disturbance.

2. Clearly mark the working width using construction pegs or other temporary measures.

3. Stage clearing of vegetation in accordance with the construction schedule to minimise the time between clearing and rehabilitation.

4. Develop a rehabilitation plan prior to construction. Include a rehabilitation schedule, proposed techniques, species proposed for use, and the following general principles:

    a. Stockpile top soil and suitable vegetative matter near to the area from which it was taken so that it can be respread over the area during rehabilitation.

    b. Locate stockpiles within the marked working width.

c. Store excavated soil on-site in an area previously cleared of vegetation, or remove to an appropriate area off-site. Any on-site or off-site location will be approved by DIPE prior to dumping.

d. Clearly mark appropriate locations for dumping of spoil.

5. Design additional project infrastructure, including access routes, vehicle and plant storage and turn-around areas, borrow pits etc. so that:

   a. previously disturbed areas are used where possible;

   b. areas of sensitive vegetation are avoided; and

   c. low impact construction techniques are used in environmentally sensitive areas.

6. Assess the environment and heritage values of routes chosen for access roads, and locations where other project related activities will take place i.e. sourcing of construction materials.

7. Brief all construction staff about the importance of vegetation protection.

6.2. Impacts on vegetation communities and species of conservation significance

Potential effects

None of the vegetation communities that will be directly affected by clearing activities associated with construction of the shore crossing, onshore pipeline and gas plant are of notable conservation significance, and no threatened flora species have been identified in these areas.

The construction of access routes and borrow pits has the potential to directly impact on communities of conservation significance, especially riparian habitats. Two of the current access routes being considered make use of existing dirt tracks from Wadeye to the plant site, which will minimise the amount of vegetation clearing required to that needed to sufficiently upgrade the tracks to handle construction traffic. The third access route is via a barge landing at the shore crossing, which would require earthworks at the shore crossing beach to construct a landing, and the construction of a heavy vehicle access road from the shore crossing to the plant site. This option would result in high levels of disturbance through the sand dune communities, which may cause dune destabilisation and erosion.

Three small deposits of dolerite located adjacent to the Moyle River, have been identified as the most likely sources of construction materials. Development of these resources may result in disturbance or removal of riparian vegetation, which can cause destabilisation of banks and erosion and siltation of rivers and creeks, and may also disturb fauna utilising riparian areas as habitat. Disturbance of riparian areas creates potential for a decline in ecosystem condition and impacts often extend beyond the immediate site of disturbance.

Vegetation clearing and excavations will potentially alter natural drainage patterns, which is of concern for the maintenance of the monsoon vine forest patches that occur adjacent to the project area (see section 5.1.1) and for water dependent communities that may occur in areas chosen for siting of additional project infrastructure. A hydrological study is being undertaken separately, which will identify more specifically the potential effects of the project on hydrology and the ecological implications.

Weed incursion and fire are possibly the greatest threats to communities of conservation significance, especially monsoon vine forests, riparian communities and freshwater wetlands. Woinarski (2002) observes that the monsoon rainforest patch network in the Darwin Coastal bioregion is being degraded by incursion of weeds and the impacts of more frequent hot late dry season fires. The project, if not

properly managed, has the potential to create conditions for weed invasion and increased fire frequency. These issues are discussed in sections 6.3 and 6.4.

Management recommendations

The following management measures should be considered, in addition to measures 1-7, to minimise impacts on communities and species of conservation significance:

8. Investigate the feasibility of using directional drilling as a potential way to minimise impacts associated with the construction of the pipeline shore crossing.

9. Clearly mark sensitive vegetation communities that occur in the vicinity of areas where construction activities will take place, and ensure that these areas are avoided by a sufficient distance to minimise disturbance.

10. Maintain a vegetated buffer zone around any monsoon vine forest communities that occur in proximity to locations where project related activities will take place.

11. Minimise impacts on natural drainage patterns where possible.

12. Brief all construction staff on recognising and protecting sensitive vegetation communities, specifically, monsoon vine forests, wetlands and riparian forests.

13. Seek advice from the Northern Territory Parks and Wildlife Service on permit requirements for vegetation clearing activities that will impact on cycads and orchids.

6.3. Introduction and spread of weeds and exotic species

Potential effects

Activities associated with the construction and operation of the project have a high potential to introduce weeds into remote areas, which are currently relatively weed free. The greatest risk of weeds being introduced and spread will occur during the construction phase of the project when vehicles, plant and construction materials are being transported on and off the project area. Activities that involve disturbance of native vegetation create suitable conditions for weeds to rapidly establish and displace native species. Once weeds become established they compete with native vegetation, and in the case of the grassy weeds, can create conditions for hot, intense fires that adversely impact on native vegetation.

The *Weeds Management Act 2001* places obligations on land owners and occupiers to manage the introduction and spread of weeds declared under the Act, and to comply with approved weed management plans relating to declared weeds that occur on their land. The proponent of the project must take all reasonable measures to prevent the spread of Class D weeds, and to ensure that declared weeds of any class are not introduced into the project area during construction and operation of the project. Management of weed species not declared under the *Weeds Management Act 2001* is also encouraged in order to minimise the potential impacts of these species on the environment. Management of the grass weeds, Gamba Grass *Andropogon gayanus* and Mission Grasses *Pennisetum polystachion* and *P. pedicellatum,* is especially recommended, as these species provide fuel for hot, late season fires, which have the potential to negatively impact on the environment and to place project personnel and infrastructure at risk. A list of weeds declared under the *Weeds Management Act 2001* is included at Appendix 3.

Management recommendations

The following management measures should be considered to minimise the introduction and spread of weeds during project construction and operation:

14. Identify and treat existing weed infestations at the project area, along access routes and at borrow pits, prior to construction activities.

15. Develop a weed management programme for construction and operation, incorporating the following elements:
    a. Wash-down and inspection of vehicles and plant prior to moving off main roads.
    b. Inspection of construction materials sourced outside the project lease area.
    c. Requirements for providers of construction materials to certify their 'weed free' status.
    d. Weed awareness training and inductions.
    e. A weed monitoring and treatment programme that commences immediately following construction and continues throughout the operation stage of the project.

16. Only use species native to the area in rehabilitation and landscaping.

17. Determine species suitability for use in consultation with experts in rehabilitation techniques in tropical environments.

6.4. Increased risk of fire

Bushfires are frequent and widespread throughout the savannas of northern Australia. In the Wadeye area they occur throughout the dry seasons from March or April each year to the end of the dry season in about November or December. The area experiences fires on an annual basis, and half the natural vegetation may burn each year. Fire history maps indicate that the frequency and scale of fires in the Wadeye area may be less than in other areas (Allan *et al.* 2001; Russell-Smith 2001). Most fires are lit by people, although lightning has been suggested as a source of ignition in the late dry season ('build-up') when lighting storms are common, but there are no data on the frequency and occurrence of such fires (Preece 2002). Observations of Aboriginal fire practices in the area (Preece *pers. obs*. 2002, 2003) suggest that fires are lit at any time of the year, and that the fire patches are generally smaller than those occurring in other landscapes of the northern savannas. Early dry season fires are usually of less intensity than the later fires when the conditions are hotter and drier, and winds are stronger. The scale and intensity of fires can be reduced if many small patches are lit throughout the dry season.

Potential effects

There will be an increased risk of fire during the construction phase, and to a lesser extent, operational phase of the project. During the construction phase, potential fire ignition sources will include:

- vehicle and plant exhausts;
- sparks from contact with rock;
- cooking or camp fires and cigarettes; and
- deliberate ignition.

During the operational phase of the project, the risk of ignition from the above sources will be greatly reduced by decreased numbers or vehicles and workers at the site, and maintenance of vegetation in the project area. Fire could also occur as a result of plant malfunction or pipeline rupture although the risks of these occurring are negligible.

The integrity of the vegetation in and surrounding the project area would be diminished by more frequent fires. This is particularly an issue for monsoon vine forest communities and riparian areas, the edges of which may become more susceptible to fires as a result of clearing of adjacent vegetation communities. Long-term, repeated high intensity fires cause the erosion of rainforest boundaries and habitat decline (Russell-Smith and Bowman 1992). One of the most significant threats to the integrity of these communities is the combined threat of fire and weeds, which dictates the need to coordinate weed and fire management activities.

Management recommendations

The following management measures should be considered to minimise the impacts of fire on project infrastructure and the surrounding environment:

18. Develop a fire management programme for the construction phase of the project that incorporates the following elements:

    a. A fire-fighting unit and persons trained in fire fighting will be readily available at all times to extinguish fires.
    b. Spark arrestors fitted to all earthmoving equipment.
    c. Fire awareness and prevention training and induction for the construction workforce.
    d. No cooking or camp fires permitted.

19. Develop a fire management programme for the operation phase of the project that incorporates the following elements:

    a. Maintenance of fire breaks around the project area.
    b. Maintenance of vegetation in the project area.
    c. Maintenance of vegetation along road verges.
    d. An Emergency Response Plan that incorporates protection of nearby sensitive vegetation.

20. Implement a weed management plan and control programme to reduce fuel loads.

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Figure 1

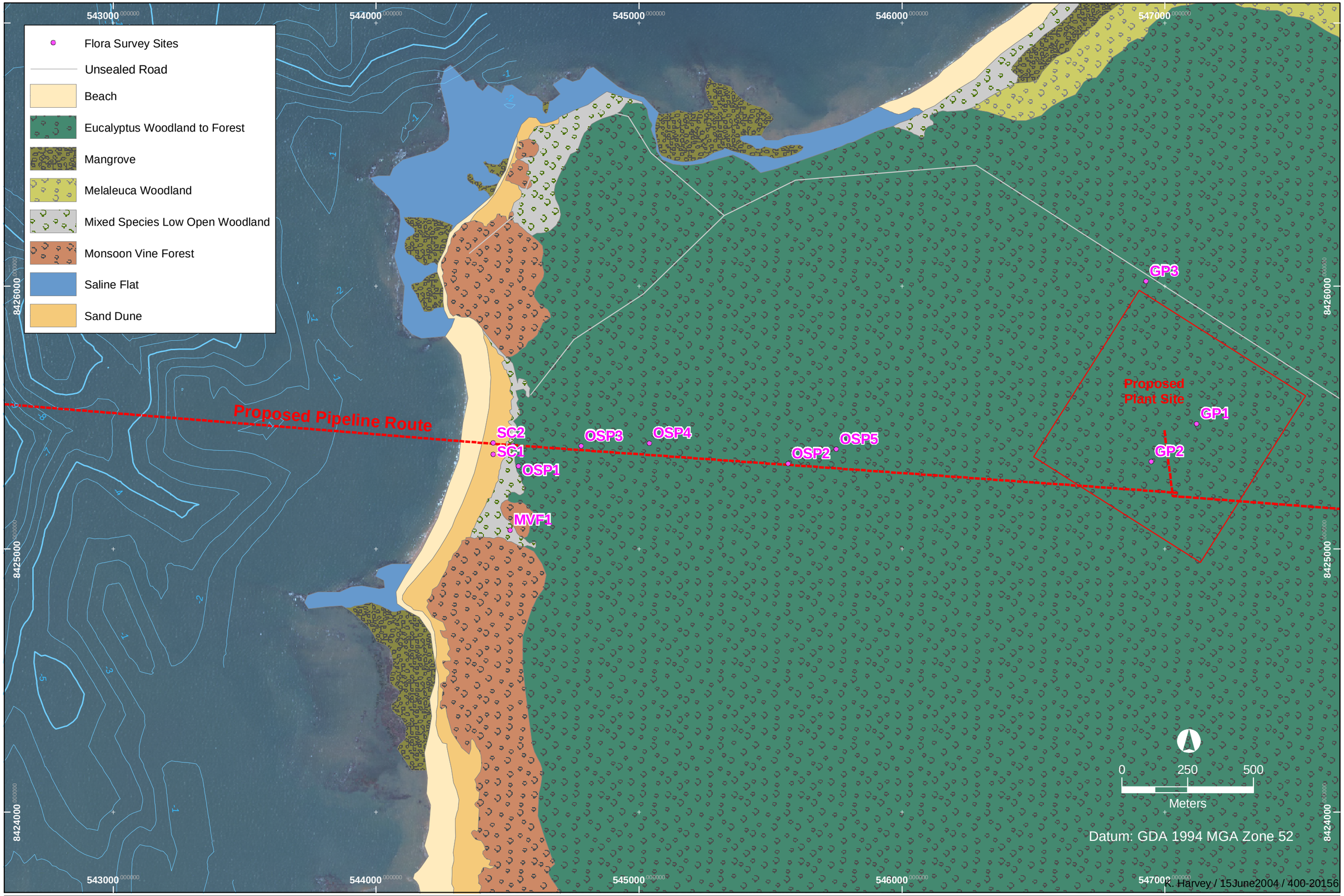

FIGURE 1: VEGETATION COMMUNITIES AND FLORA SURVEY SITES

WOODSIDE
AUSTRALIAN ENERGY

Appendix 1

Appendix 1
Vegetation survey data

SITE ID	SITE NO.	DATE	LAT	LONG	PHOTO	WEEDS	COMMUNITY	SPECIES IN CANOPY	SPECIES IN MID-STOREY	SPECIES IN GROUND LAYER
SHORE CROSSING										
SC1	100	Oct-03	-14.2430	129.4120	120-2007	Calotropis procera	Sarga plumosum and Spinifex longifolius grassland	*Sarga plumosum, Spinifex longifolius, Ipomoea pes-caprae*		
SC2	C97	May-02	-14.2426	129.4120	1038	Calotropis procera	Sarga plumosum and Spinifex longifolius grassland	*Sarga plumosum, Spinifex longifolius*		*Sparse herbs and forbs (including Fimbristylis sericea, Gomphrena sp., Asteraceae, Cyperaceae)*
MVF1	104	May-02	-14.2456	129.4126	2012, 1043, 1044	Hyptis suaveolens	Monsoon vine forest dominated by Syzygium suborbiculare, Terminalia ferdinandiana, Tamarindus indica. Approximately 200m south of the pipeline land fall site.	*Syzygium suborbiculare, Terminalia ferdinandiana, Tamarindus indica, Brachychiton diversifolius, Corymbia porrecta, Buchanania obovata, Erythrophleum chlorostachys, Bombax ceiba, Litsea glutinosa, Milletia pinnata*	*Flagellaria indica, Grewia retusifolia, Exocarpos latifolius, Carissa lanceolata, Hyptis suaveolens*, Canarium australianum, Acacia auriculiformis, Brachychiton megaphyllus, Syzygium eucalyptoides ssp. bleeseri, Strychnos lucida, Gardenia megasperma, Sterculia quadrifida, Breynia cernua, Planchonia careya, Grevillea angulata, Petalostigma pubescens, Persoonia falcata, Livistona humilis, Cupaniopsis anacardioides, Ficus scobina, Pouteria sericea, Vitex glabrata, Bridelia tomentosum, Celtis philippensis, Diospyros calcycantha, Aidia racemosa, Murraya paniculata, Micromelum minutum, Cryptocarya cunninghamii, Syzygium nervosum, Helicia australasica*	*Smilax australis, Abrus precatorius, Crinum angustifolium, Protoasparagus racemosus, Ampelocissus acetosa, Trema aspera, Opilia amentacea, Grewia multiflora, Pachygone ovata, Cassytha filiformis, Cymbopogon sp.*
ONSHORE PIPELINE										
OSP1	101	Oct-03	-14.2434	129.4129	2008	Hyptis suaveolens	Corymbia porrecta & Corrymbia grandifolia forest with mixed species tree\shrub understorey.	*Corymbia porrecta, Corymbia grandifolia, Syzygium suborbiculare, Brachychiton diversifolius*	*Terminalia ferdinandiana, Erythrophleum chlorostachys, Grevillea heliosperma, Brachychiton megasperma, Planchonia careya, Persoonia falcata, Ficus aculeata, Acacia auriculiformis, Livistona humilis, Pandanus spiralis, Trema aspera, Tinospora smilacina*	*Hyptis suaveolens**
OSP2	103	Oct-03	-14.2433	129.4224	2011	nil	Eucalyptus miniata & Eucalyptus tetrodonta forest with mixed species tree\shrub mid-storey and Sarga sp. tussock grass.	*Eucalyptus miniata, Eucalyptus tetrodonta, Terminalia ferdinandiana, Erythrophleum chlorostachys, Corymbia porrecta, Brachychiton diversifolius*	*Cycas maconochiei, Planchonia careya, Brachychiton megaphyllus, Buchanania obovata, Grevillea angulata*	*Juv Erythrophleum chlorostachys, juv Terminalia ferdinandiana, Sarga plumosum, Heteropogon contortus, Grewia retusifolia, Persoonia falcata, Ampelocissus acetosa*
OSP3	C99	May-02	-14.2427	129.4151	1042		Eucalyptus tetrodonta open woodland with mixed species dense tree\shrub mid-storey and Heteropogon triticeus tussock grass.	*Eucalyptus tetrodonta, Brachychiton diversifolius, Erythrophleum chlorostachys*	*Planchonia careya, Terminalia ferdinandiana, Persoonia falcata, Cycas maconochiei subsp. maconochiei*	*Heteropogon triticeus, Grewia retusifolia*
OSP4	C101	May-02	-14.2426	129.4175	1045		Eucalyptus tetrodonta and E. miniata tall open woodland with mixed species dense tree\shrub mid-storey and Heteropogon triticeus and Sarga sp. tussock grasses	*Eucalyptus tetrodonta, E. miniata*	*Buchanania obovata, Brachychiton diversifolius, Corymbia porrecta, Petalostigma pubescens, Terminalia ferdinandiana, Cycas maconochiei subsp. Maconochiei, Grevillea heliosperma, Acacia sp., Brachychiton tuberculatus*	*Sarga plumosum, Heteropogon triticeus*
OSP5	C102	May-02	-14.2428	129.4241	1046		Eucalyptus tetrodonta and E. miniata tall woodland with Heteropogon triticeus and Sorghum sp. tussock grasses	*Eucalyptus tetrodonta, E. miniata*	*Erythrophleum chlorostachys, Livistona humilis, Terminalia ferdinandiana, Pandanus spiralis, Cycas maconochiei subsp. maconochiei*	*Sarga plumosum, Heteropogon triticeus, Brachychiton tuberculatus, Grevillea pluricaulis and suppressed eucalypt and tree suckers*
OSP6	C98	May-02	-14.2427	129.4127	1039, 1040		Mixed species low open woodland. Community occurs on damp sandy soils behind coastal dunes. Cycas maconochiei common.	*nil*	*Syzygium suborbiculare, Pandanus spiralis, Acacia auriculifomis, Terminalia ferdinandiana, Eucalyptus confertiflora, Cycas maconochiei subsp. viridis*	*Heteropogon contortus, Heteropogon triticeus*

Appendix 1
Vegetation survey data

SITE ID	SITE NO.	DATE	LAT	LONG	PHOTO	WEEDS	COMMUNITY	SPECIES IN CANOPY	SPECIES IN MID-STOREY	SPECIES IN GROUND LAYER
GAS PLANT										
GP1	102	Oct-03	-14.2419	129.4368	2009, 2010	nil	Eucalyptus miniata & Eucalyptus tetrodonta forest with open mixed species tree\shrub mid-storey and Sarga sp. tussock grass	*Eucalyptus miniata, Eucalyptus tetrodonta, Terminalia ferdinandiana, Erythrophleum chlorostachys*	*Brachychiton diversifolius, Livistona humilis, Cycas maconochiei*	*Erythrophleum chlorostachys, Brachychiton megaphyllus, Sarga plumosum*
GP2	C103	May-02	-14.2432	129.4352	1050		Eucalyptus tetrodonta and E. miniata tall woodland with open tree\shrub midstorey and Heteropogon triticeus and Sarga plumosum tussock grasses	*Eucalyptus tetrodonta, E. miniata*	*Erythrophleum chlorostachys, Livistona humilis, Pandanus spiralis, Terminalia ferdinandiana*	*Sarga plumosum, Heteropogon triticeus and suppressed woody suckers*
GP3	99	Oct-03	-14.2370	129.4350	1992, 1997	nil	Eucalyptus miniata & Eucalyptus tetrodonta forest with open mixed species tree\shrub mid-storey and Sarga sp. tussock grass.	*Syzygium suborbiculare, Terminalia ferdinandiana, Tamarindus indica, Brachychiton diversifolius, Corymbia porrecta, Buchanania obovata, Erythrophleum chlorostachys, Bombax ceiba, Litsea glutinosa*	*Flagellaria indica, Grewia retusifolia, Exocarpos latifolius, Carissa lanceolata, Hyptis suaveolens*, Canarium australianum, Acacia auriculiformis, Brachychiton megaphylus, Syzgium eucalyptoides ssp bleeseri, Strychnos lucida, Gardenia megasperma, Sterculia quadrifida, Breynia cernua, Planchonia careya, Grevillea angulata, Petalostigma pubescens, Persoonia falcata, Livistona humilis, Cupaniopsis anacardioides, Ficus scobina*	*Smilax australis, Abrus precatorius, Crinum angustifolium, Protoasparagus racemosus, Ampelocissus acetosa, Trema aspera, Opilia amentacea, Grewia breviflora, Pachygone ovata, Cassytha filiformis*
OUTSIDE PROJECT AREA										
OUT1	105	Oct-03	-14.2451	129.4480		nil	Eucalyptus miniata & Eucalyptus tetrodonta forest with open mixed species tree\shrub mid-storey and Sarga sp. tussock grass	*Eucalyptus miniata, Eucalyptus tetrodonta, Corymbia polycarpa, Corymbia porrecta, Erythrophleum chlorostachys*	*Acacia auriculiformis, Acacia dimidiata, Brachychiton megaphyllus, Brachychiton diversifolius, Buchanania obovata, Croton arnhemicus, Cycas maconochiei, Denhamia obscura, Distichostemon hispidulus, Helicteres sp., Grevillea pluricaulis, Livistona humilis, Persoonia falcata, Planchonia careya, Petalostigma quadriloculare, Terminalia ferdinandiana, Tinospora smilacina*	*Crinum angustifolium, Ampelocissus acetosa, Plectranthus scutellarioides, Eriosema chinense, Haemodorum coccineum, Heteropogon sp, Sarga plumosum*

SC = Shore crossing

MVF = Monsoon vine forest

OSP = Onshore pipeline
OUT=Outside project area.
GP = Gas plant

Appendix 2

Appendix 2
Species list

Family	*Taxa*	Shore crossing	Onshore pipeline	Gas Plant	Other	Herbarium records
AMARANTHACEAE	*Gomphrena sp*	x				
ANACARDIACEAE	*Buchanania obovata*		x	x	MVF	
APOCYNACEAE	*Carissa lanceolata*		x		MVF	
ARECACEAE	*Livistona humilis*		x	x	MVF	x
ASCLEPIADACEAE	*Calotropis procera**	x			MVF	
BOMBACACEAE	*Bombax ceiba*		x		MVF	
BURSERACEAE	*Canarium australianum*		x		MVF	
CAESALPINIACEAE	*Erythrophleum chlorostachys*		x	x	MVF	x
CAESALPINIACEAE	*Tamarindus indica*		x		MVF	
CELASTRACEAE	*Denhamia obscura*			x		x
COMBRETACEAE	*Terminalia ferdinandiana*		x	x	MVF	
CONVOLVULACEAE	*Ipomoea pes-caprae*	x				
CONVOLVULACEAE	*Polymeria ambigua*		x			
CYCADACEAE	*Cycas maconochiei ssp maconochiei*		x	x		
CYPERACEAE	*Fimbristylis sericea*	x				
EBENACEAE	*Diospyros calcycantha*				MVF	
EUPHORBIACEAE	*Breynia cernua*		x		MVF	
EUPHORBIACEAE	*Bridelia tomentosum*				MVF	
EUPHORBIACEAE	*Croton arnhemicus*			x		
EUPHORBIACEAE	*Petalostigma pubescens*		x			
EUPHORBIACEAE	*Petalostigma quadriloculare*			x		
FABACEAE	*Abrus precatorius*		x		MVF	
FABACEAE	*Eriosema chinense*			x		
FABACEAE	*Milletia pinnata*				MVF	
FABACEAE	*Plagiocarpus axillarus*					x
FLAGELLARIACEAE	*Flagellaria indica*		x		MVF	
HAEMODORACEAE	*Haemodorum coccineum*			x		
LAMIACEAE	*Hyptis suaveolens**		x		MVF	
LAMIACEAE	*Plectranthus scutellarioides*			x		
LAURACEAE	*Cassytha filiformis*		x		MVF	
LAURACEAE	*Cryptocarya cunninghamii*				MVF	
LAURACEAE	*Litsea glutinosa*		x		MVF	
LECYTHIDACEAE	*Planchonia careya*		x	x	MVF	x
LILIACEAE	*Crinum angustifolium*		x	x	MVF	
LILIACEAE	*Protasparagus racemosus*		x		MVF	
LOGANIACEAE	*Strychnos lucida*		x		MVF	
MENISPERMACEAE	*Pachygone ovata*		x		MVF	
MENISPERMACEAE	*Tinospora smilacina*		x	x		
MIMOSACEAE	*Acacia auriculiformis*		x	x	MVF	
MIMOSACEAE	*Acacia dimidiata*			x		
MIMOSACEAE	*Acacia oncinocarpa*					x
MORACEAE	*Ficus aculeata*		x			
MORACEAE	*Ficus scobina*		x		MVF	
MYRTACEAE	*Corymbia confertiflora*		x			
MYRTACEAE	*Corymbia grandifolia*		x			
MYRTACEAE	*Corymbia polycarpa*			x		
MYRTACEAE	*Corymbia porrecta*		x	x	MVF	x
MYRTACEAE	*Eucalyptus miniata*		x	x		x
MYRTACEAE	*Eucalyptus tetrodonta*		x	x		x
MYRTACEAE	*Syzygium nervosum*				MVF	
MYRTACEAE	*Syzygium suborbiculare*		x		MVF	
MYRTACEAE	*Syzygium eucalyptoides ssp. bleeseri*		x		MVF	
OPILIACEAE	*Opilia amentacea*		x		MVF	
PANDANACEAE	*Pandanus spiralis*		x	x		x
PASSIFLORACEAE	*Passiflora foetida**	x				
POACEAE	*Cymbopogon sp*				MVF	
POACEAE	*Aristida inaequiglumis*					x
POACEAE	*Chrysopogon latifolius*					x
POACEAE	*Heteropogon contortus*		x	x		
POACEAE	*Heteropogon triticeus*		x	x		

Appendix 2
Species list

Family	*Taxa*	Shore crossing	Onshore pipeline	Gas Plant	Other	Herbarium records
POACEAE	*Sarga intrans*		x	x		
POACEAE	*Sarga plumosum*	x	x	x		
POACEAE	*Spinifex longifolius*	x				
PROTEACEAE	*Grevillea angulata*		x		MVF	
PROTEACEAE	*Grevillea goodii*			x		x
PROTEACEAE	*Grevillea heliosperma*		x			
PROTEACEAE	*Grevillea pluricaulis*		x			
PROTEACEAE	*Helicia australasica*				MVF	
PROTEACEAE	*Persoonia falcata*		x	x	MVF	x
RUBIACEAE	*Aidia racemosa*				MVF	
RUBIACEAE	*Gardenia megasperma*		x		MVF	
RUTACEAE	*Micromelum minutum*				MVF	
RUTACEAE	*Murraya paniculata*				MVF	
SANTALACEAE	*Exocarpos latifolius*		x		MVF	
SAPINDACEAE	*Cupaniopsis anacardioides*		x		MVF	
SAPINDACEAE	*Distichostemon hispidulus*			x		
SAPOTACEAE	*Pouteria sericea*				MVF	
SMILACACEAE	*Smilax australis*		x		MVF	
STERCULIACEAE	*Brachychiton diversifolius*		x	x	MVF	
STERCULIACEAE	*Brachychiton megaphyllus*		x	x	MVF	
STERCULIACEAE	*Brachychiton tuberculatus*		x			
STERCULIACEAE	*Helicteres sp*			x		
STERCULIACEAE	*Sterculia quadrifida*		x		MVF	
TILIACEAE	*Grewia breviflora*		x		MVF	
TILIACEAE	*Grewia retusifolia*		x		MVF	
ULMACEAE	*Celtis philippensis*				MVF	
ULMACEAE	*Trema aspera*		x		MVF	
VERBENACEAE	*Vitex glabrata*				MVF	
VERBENACEAE	*Stachytarpheta sp.**	x				
VITACEAE	*Ampelocissus acetosa*		x	x	MVF	
* denotes weed species						
MVF = Monsoon vine forest						

Appendix 3

NORTHERN TERRITORY *WEEDS MANAGEMENT ACT 2001*

DECLARED WEEDS OF THE NORTHERN TERRITORY

CLASS A WEEDS - to be eradicated

BOTANICAL NAME	**COMMON NAME**	**PART OF THE TERRITORY**
Acacia catechu	Cutch tree	All of the Territory
Acacia nilotica	Prickly acacia	" "
Alternanthera philoxeroides	Alligator weed	" "
Asphodelus fistulosus	Onion weed	" "
Barleria prionitis	Barleria	" "
Cabomba spp	Fanwort	" "
Cryptostegia madagascariensis	Ornamental rubber vine	" "
Dalbergia sissoo	Dalbergia	N of 18^{o} S latitude
Datura ferox	Longspine thornapple	All of the Territory
Echium plantagineum	Paterson's curse	" "
Eichhornia crassipes	Water hyacinth	" "
Jatropha curcas	Physic nut	" "
Lycium ferocissimum	African boxthorn	
Martynia annua	Devil's claw	" "
Mimosa pigra	Mimosa, giant sensitive plant	S of 14^{o} S latitude
Parthenium hysterophorus	Parthenium weed	All of the Territory
Salvinia molesta	Salvinia	" "
Ziziphus mauritiana	Chinee apple, Indian jujube	Outside Darwin city, Palmerston, Litchfield Shire, Alice Springs Region

CLASS B WEEDS - growth and spread to be controlled

BOTANICAL NAME	**COMMON NAME**	**PART OF THE TERRITORY**
Acanthospermum hispidum	Star burr, goat's head	All of the Territory
Alternanthera pungens	Khaki weed	" "
Argemone ochroleuca	Mexican poppy	" "
Calotropis procera	Rubber bush	S of 16^{o}30' S latitude
Carthamus lanatus	Saffron thistle	All of the Territory
Cenchrus echinatus	Mossman River grass	" "
Emex australis	Spiny emex	" "
Hyptis suaveolens	Hyptis	" "
Jatropha gossypifolia	Bellyache bush	" "
Lantana camara	Common lantana	Outside town areas
Lantana montevidensis	Creeping lantana	Outside town areas
Leonotis nepetifolia	Lion's tail	All of the Territory
Mimosa pigra	Mimosa, giant sensitive plant	N of 14^{o} S latitude
Mimosa pudica	Common sensitive plant	All of the Territory
Opuntia spp.	Prickly pears	S of 18^{o} S latitude, outside town areas
Pennisetum polystachion	Mission grass	All of the Territory
Pistia stratiotes	Water lettuce	" "
Parkinsonia aculeata	Parkinsonia	" "
Prosopis limensis	Mesquite, algaroba	" "
Ricinus communis	Castor oil plant	" "
Salvinia molesta	Salvinia	" "
Senna alata	Candle bush	Outside town areas
Senna obtusifolia	Sicklepod	All of the Territory
Senna occidentalis	Coffee senna	" "
Sida acuta	Spinyhead sida	" "
Sida cordifolia	Flannel weed	" "
Sida rhombifolia	Paddy's lucerne	" "
Stachytarpheta spp.	Snake weeds	Outside town areas
Tamarix aphylla	Tamarisk, Athel pine	Alice Springs Region outside of home gardens
Themeda quadrivalvis	Grader grass	All of the Territory
Tribulus cistoides	Caltrop	" "
Tribulus terrestris	Caltrop	" "
Xanthium occidentale	Noogoora burr	" "
Xanthium spinosum	Bathurst burr	" "

CLASS C WEEDS - not to be introduced to the Territory

Includes ALL Class A and Class B Noxious Weeds

BOTANICAL NAME	**COMMON NAME**
Acroptilon repens	Creeping knapweed
Ageratina riparia	Mistflower
Ambrosia artemisiifolia	Annual ragweed
Ambrosia psilostachya	Perennial ragweed
Baccharis halimifolia	Groundsel bush
Cabomba spp	Fanwort
Chromolaena odorata	Siam weed
Cryptostegia grandiflora	Rubber vine
Datura spp.	Thornapples
Egeria densa	Dense waterweed
Elodea canadensis	Canadian pondweed
Eriocereus martinii	Harrisia cactus
Hyptis capitata	Knobweed
Lagarosiphon major	Lagarosiphon
Mimosa invisa	Giant sensitive plant
Prosopis spp.	Mesquite
Sorghum halepense	Johnson grass
Xanthium spp.	Burrs