

DARWIN CITY WATERFRONT REDEVELOPMENT ENVIRONMENTAL IMPACT STATEMENT

TERRESTRIAL & INTERTIDAL FLORA



Prepared for

URS

by

KRISTIN METCALFE ☞ CONSULTANT ENVIRONMENTAL SCIENTIST

March 2004

DARWIN CITY WATERFRONT REDEVELOPMENT ENVIRONMENTAL IMPACT STATEMENT

TERRESTRIAL & INTERTIDAL FLORA

TABLE OF CONTENTS

Summary	4
1.0 Introduction	6
2.0 Objectives and Scope	6
Project objectives	6
Project Scope.....	7
3.0 Methodology	7
4.0 The existing environment	8
4.1 Landform and vegetation.....	8
4.2 Existing vegetation	10
Background.....	10
Flora.....	10
5.0 Vegetation communities	13
5.1 Coastal vine-forest (Map unit 1).....	13
5.2 Public open space (Map Unit 2)	14
5.3 Private Gardens (Map Unit 3)	15
5.4 Regenerating native landscape (Map Unit 4)	15
5.5 Dense weed infestations amongst native regeneration (Map Unit 5)	16
5.6 Disturbed ground with scattered plantings (Map unit 6).....	17
5.7 Mangrove (Map unit 7)	18
6.0 Vegetation of conservation significance	19
6.1 Plant species of conservation significance	19
6.2 Plant communities of conservation significance	21
Vine-forest communities.....	21
Mangroves	21
6.3 Register of Significant Trees	22
7.0 Weeds	25
8.0 Retention Value of existing vegetation	26
Retention value of vegetation communities	26
Trees of potential retention value	28
9.0 Potential Environmental Impacts and Mitigation Methods	29
9.1 Assessment of potential impacts	29
9.2 Mitigation strategies	30
References	31

LIST OF TABLES

Table 1: Summary table of major vegetation types within the DCWR project area	11
Table 2 : Introduced species recorded within the DCWR project area	26

LIST OF FIGURES

Figure 1: Aerial photograph of the DCWR project area showing contours	9
Figure 2: Vegetation map of the DCWR project area	12
Figure 3: Significant trees	23
Figure 4: Weed distribution within the project area	27

LIST OF APPENDICES

Appendix 1: Plant Species List
Appendix 2: Remnant Vegetation Map
Appendix 3: Significant Tree List
Appendix 4: Retention Value of Existing Vegetation
Appendix 5: Information on Significant Trees



The intertidal zone within the DCWR project area near Stokes Hill wharf

DARWIN CITY WATERFRONT REDEVELOPMENT ENVIRONMENTAL IMPACT STATEMENT

TERRESTRIAL & INTERTIDAL FLORA

Summary

Overview of vegetation

- The natural environment of the project area has an extended history of disturbance related to industrial development for the Stokes Hill, Fort Hill and Iron Ore wharfs and vegetation clearing associated with progressive reclamation of the shoreline.
- Only relatively small, disjunct areas of remnant vegetation remain, including coastal vine-forest and mangrove habitats and in general, these habitats have undergone substantial modification
- Overall, the vegetation of the project area is characterised by large expanses of cleared land with pockets of cultivated native and introduced plant species and abundant weeds.
- Introduced species are ubiquitous over the majority of the project area, including dense, monospecific stands of Coffee Bush (*Leucaena leucocephala*)

Flora

- The flora of the 25 ha project area was surveyed during six site visits between January and March 2004
- The area contains 3 major habitat types - escarpment, coastal flats and intertidal areas
- Existing mapping by GANT/DIPE for the area shows only one remnant vegetation community, monsoon vine-forest within the project area
- More detailed mapping undertaken for this survey distinguished seven main vegetation types
- Two remnant native vegetation communities – terrestrial vine-forest and intertidal mangrove areas - comprise only 5% of the 25 ha project area.
- Cleared or modified landscapes, native regeneration on disturbed sites, private gardens, public open space and extensive tidal mudflats occupy the remainder of the site.
- A total of 187 plant species from 68 families were recorded from the DCWR project area
- Seventy-one introduced species were recorded, comprising 38 % of the flora.
- The high proportion of introduced species is an indication of high levels of disturbance, the proximity of the site to a major urban centre and that overall, the site is significantly degraded.
- Plant families represented by the most species were: Poaceae - grasses (19 species); Fabaceae - peas (12 species) and Arecaceae – palms (11 species). Of these three families, 57% were weeds, indicating the exotic nature of the flora
- Intact, well-established coastal vine-forest (or rainforest) vegetation. is largely restricted to the heavily vegetated escarpment areas fringing the CBD,
- The vine-forest is a floristically diverse (75 species), relatively weed-free community comprising a distinctive range of non-Myrtaceous native species in a closed canopy formation.

Conservation Significance

- The majority of the project area has been significantly degraded by human activities and has therefore not retained any conservation significance
- The conservation status of plant species and communities within the project area were assessed by reference to listings under the NT and Commonwealth Biodiversity Conservation Acts (TPWC Act 2000, EPBC 1999)
- The threat status one species *Pittosporum moluccanum*, recorded within the vine-forest habitat is currently listed as near threatened (nt) on the Northern Territory IUCN listing
- However, these five *Pittosporum moluccanum* trees observed in the vine-forest appear to have been planted, probably during recent weed control/revegetation work by Greening Australia
- All other plant species recorded are not threatened and are listed as least concern (lc).
- No natural populations of cycads or orchids were recorded within the site
- Vine -forest vegetation is relatively restricted in distribution in the Darwin region and covers only 0.2% of the NT. This community retains the highest ecological importance of any vegetation type within the project area, its significance recognised at local and regional scales

- Vine-forest areas function as part of an interdependent network in which the ecological integrity of each patch is dependent on all others in the network, thus the conservation of each small isolate is important
- Minor mangrove habitat (0.57 ha) occurs within the project area containing a total of 10 species. Proposed rezoning of mangroves within Darwin Harbour as a conservation zone will require planning consent prior to mangrove clearing.
- Extensive mangroves occur within Darwin Harbour (26,200 ha) with large expanses (over 700 ha) protected within nearby Charles Darwin National Park
- Two Tamarind trees listed on the Register of Significant trees (GANT) occur on the boundary of the project area and seven listed Milkwoods occur in the southern end of Smith Street.

Potential Impacts

- The major impacts of the proposed development on terrestrial flora are expected to result from limited vegetation clearing and site disturbance during construction
- Of high importance is the possibility that clearing of an area of vine-forest may be required for improved pedestrian access
- Construction activities have the potential to exacerbate the negative impacts of weeds on vine-forest areas - the margins of these areas are particularly vulnerable to weed invasion
- Overall, negative impacts on flora may include habitat loss and increased potential for erosion, however, given the relatively degraded nature of the current site such impacts are considered to be of minor significance
- A more serious risk is the spread of weeds into relatively weed-free areas resulting from habitat disruption during construction. Areas with low weed densities have been identified as part of this flora survey
- The small area of remaining intertidal vegetation may be negatively affected by the project – loss of 0.57 ha of mangrove habitat may result from modification of the existing coastline, dredging and reclamation
- If done correctly, dredging is unlikely to have any significant impact on mangrove ecosystems elsewhere in the harbour. The nearest mangroves are too distant to be affected by smothering, sediment plumes etc
- Construction in intertidal areas must be undertaken with extreme care to avoid creation of acid – sulphate soils ie marine muds must not be placed above the tidal limit where oxidation may occur
- There is potential for the proposed development to impinge on several trees listed on the Significant Tree Register resulting in their removal
- Positive impacts may include weed control, increased floristic diversity from support planting and improved access and amenity provided by new landscape works.
- Positive impacts on intertidal flora might include rehabilitation of existing mangrove areas and the creation of new mangrove habitats.

Mitigation Procedures

- Strict management of construction activities near vine-forest habitats will need to be maintained to avoid unnecessary clearing and to implement weed control measures
- Implementation of a weed management plan for the project area will minimise the negative effects of weeds on areas of native vegetation
- The coastal vine-forest habitat contains a remnant vegetation community of some ecological importance and potential educational, recreational and aesthetic value. Future development should aim to benefit from this potential, to integrate with this environment while not impinging upon the integrity of this habitat.
- Similarly the retention and enhancement of existing mangrove areas (including rehabilitation works and construction of a boardwalk) could provide a potential educational, ecological and recreational resource
- The two Tamarind trees listed on the Register of Significant trees and several other listed Milkwood trees (*Alstonia actinophylla*) in the southern end of Smith Street have historical and aesthetic value and should be retained in the future development

DARWIN CITY WATERFRONT REDEVELOPMENT ENVIRONMENTAL IMPACT STATEMENT

TERRESTRIAL & INTERTIDAL FLORA

1.0 Introduction

This report presents the results of a survey on the flora of terrestrial and intertidal habitats occurring within the proposed Darwin City Waterfront Redevelopment (DCWR) project area, for inclusion in the Environmental Impact Statement. The natural environment of the project area has an extended history of disturbance due to industrial development for the Stokes Hill, Fort Hill and Iron Ore wharfs and clearing associated with progressive reclamation of the shoreline. Nevertheless, a number of small areas of remnant vegetation remain, including coastal vine-forest and mangrove habitats.

At the time of writing (March 2004), the final DCWR design had not been established, so the assessment of environmental issues pertaining to flora has been made on the basis of the concept plan produced by the Northern Territory Government (NTG, Department of Lands Planning and Environment, July 2003). The concept plan indicates extensive commercial and residential development of the site with possible shoreline reclamation to a maximum width of 200m from the existing shoreline. The concept plan indicates that two of the four existing wharfs may be demolished while Stokes Hill Wharf will be refurbished for community and commercial use while the infrastructure of Fort Hill wharf is enhanced for berthing vessels. A continuous waterfront promenade around the wharf precinct is proposed in addition to enhancement of pedestrian access to the city centre.

2.0 Objectives and Scope

Project objectives

A major objective of the flora survey was to assess and describe the existing vegetation within and adjacent to the proposed waterfront redevelopment project area. Terrestrial flora, including remnant native vegetation, landscaped public open space and the vegetation within a variety of disturbed and peripheral areas was examined, characterised and mapped. The flora of intertidal areas was also surveyed and the distribution and diversity of mangrove vegetation documented.

Given that much of the existing waterfront area has been cleared or heavily disturbed over several decades, detailed quantitative assessment of remnant vegetation was inappropriate in the context of this survey. Indeed, only relatively small, disjunct areas of native vegetation remain (covering approximately 11% of the site) and in general, these habitats have undergone substantial modification. Thus the primary focus of this assessment was to determine the conservation significance, botanical and/or historical value and potential retention value of existing terrestrial and intertidal vegetation within the context of the future waterfront landscape.

Overall, the vegetation of the project area is characterised by large expanses of cleared land with pockets of cultivated native and introduced plant species and abundant weeds. Indeed, introduced species are ubiquitous over the majority of the project area, including weed species that occur in dense, monospecific stands. Thus a secondary objective of this survey was to describe and map the distribution of weeds and to provide recommendations regarding weed management of the site.

Finally, an important objective of this survey is the assessment of the potential environmental impacts of the development on remnant vegetation. Potential impacts are discussed in association with specific mitigation procedures and recommendations relating to flora (eg weed management strategies, identification of significant vegetation). This approach aims to ensure that any negative impacts are anticipated prior to commencement of the project and thereby minimised or negated. The objective of this section of the report is to facilitate the protection of any areas of significant vegetation and to promote outcomes that enhance the flora within and adjacent to the project area.

Project Scope

The project area for the flora survey is defined by the Boundary for Redevelopment as shown in Figure 1, which comprises approximately 25 ha of land and tidal flats often referred to as the wharf precinct. However, important areas of existing vegetation occur immediately adjacent to, but outside the project area, including public open space bordering the new Deckchair Cinema and the Esplanade, coastal vine-forest on the escarpment fringing the CBD and the extensive private gardens of Government House and the Naval Fuel Installation. Due to the potential for construction activities associated with the waterfront redevelopment project to impinge on these and other key areas, existing vegetation of much of the southern end of the CBD been included in the current assessment (Figure 2).

Intertidal vegetation including mangroves and samphire species are considered here but sub-tidal flora is the subject of associated marine surveys undertaken by others.

3.0 Methodology

The flora of the project area was surveyed during 6 site visits between 19th January and 22nd March 2004. The flora survey was undertaken during the mid Wet season; a good time to sample deciduous and semi-deciduous species, ferns and other annual or ephemeral species absent during the dry season. All plant species observed within the project area were listed, noting habitat, dominance, lifeform and presence in the upper, mid or lower strata. Plant species unable to be identified in the field were sampled for botanical identification in reference to the Northern Territory Herbarium collection, botanical keys and literature (Booth *et al.* 2001; Dunlop *et. al.* 2003; Hearne 1975; Smith 2002).

The conservation status of plant species and communities within the project area were assessed by reference to listings under NT and Commonwealth Biodiversity Conservation legislation (TPWC Act 2000; EPBC Act 1999). The location of individual trees listed on the Register of Significant Trees (GANT, unpublished) in this part of the CBD, was identified in the field and mapped for this report. Similarly, the native/introduced status of all species observed was determined and listed in Appendix 1. The diversity and distribution of weeds was noted for mapping and weed management purposes.

An initial stratification of the vegetation, derived from preliminary air photo interpretation was ground-truthed in the field and the site characterised for mapping

of the major vegetation types. Vegetation communities both within and adjacent to the project area were mapped and structure and species composition recorded. During fieldwork, areas of remnant native vegetation were examined in detail and all vegetation was assessed for its botanical, historical, ecological and aesthetic value. Collectively, this information permitted informed consideration of the potential retention value of discrete areas of vegetation and of particular trees within the future DCWR landscape.

4.0 The existing environment

4.1 Landform and vegetation

Landform, in combination with soils and site drainage, largely determines the nature and extent of existing vegetation. On a regional scale, variations in landform and drainage typically form recurring patterns or physiographic units that can be mapped as *land systems* or *land units*. The project area, (delineated by the proposed development boundary) largely comprises the *Estuarine flat and coastal plain* landform zone described by Fogarty et. al (1979). This physiographic unit, characterised by low relief, with alluvial and marine clays generally supports mangrove and coastal grassland vegetation.

At the local scale, the current landform, indicated by the contours (shown in white) on Figure 1 determines the pattern of existing vegetation but this has been highly modified by anthropogenic activities. In the past, mangroves occupied the majority of the site, including much of the current Warehouse Area. However, several episodes of reclamation extended the shoreline to its current configuration and the new landform lies between 4m AHD (the upper tidal limit) and 7m at the base of the escarpment. It mainly comprises flat, decommissioned industrial land and parkland. However, contours shown on Figure 1 indicate a very steep intertidal zone between minus 1m and 4m AHD, which precludes the growth of extensive mangroves. However, topographic gradients become more gradual below mean sea level (0m AHD) and broad tidal flats occupy the seaward section of the project area.

To landward, much of the existing CBD is located within the *Low plateau surface* landform zone - a flat to very gently undulating surface lying between 15 and 40 metres above sea level. This landform is described as being excessively well drained and the skeletal soils of this landscape originally supported *Eucalyptus*-dominated woodland to open forest formations. Currently, none of this original vegetation remains, the plateau landform comprising the built environment of the Darwin CBD.

An escarpment (approximately 18m high) separates these two landform types and this relatively steep scarp roughly defines the boundary of the central section of the project area. The remnant vegetation of these slopes comprises mixed species coastal vine-forest or rainforest, or a modified version of this with exotic trees and enrichment planting. In fact, the escarpment landform defines the seaward-facing margin of much of the city of Darwin and extends as a continuous feature for several kilometres around to the north and east, fringing the coastline of Larrakeyah, Cullen Bay and Mindil Beach.

Natural landforms throughout the majority of the project area have been heavily modified, with removal of substantial areas of high ground for fill, the majority of which was cut for extensive reclamation works along the waterfront. The steep rocky escarpment bordering Stokes Hill remains where material has been removed, exposing a sheer rock face. Similarly, Fort Hill (shown by rounded contours on early maps) has been levelled to provide reclamation material particularly for the Iron Ore loading area (Brian Wetherall, Port Darwin, pers. comm.).



Figure 1: Aerial photograph of the DCWR project area showing contours

The current landform of the project area largely determines the three main habitat types: intertidal mudflats, coastal flats and escarpment and the vegetation of these areas is described below.

4.2 Existing vegetation

Background

The major landform changes within the project area combined with the development of Darwin city, the wharf precinct and associated industries has led to the removal of the majority of the original vegetation types mapped by Fogarty et al. (1979). This early map indicates that a mangrove shore once existed between Fort Hill and Stokes Hill with Eucalypt-dominated woodland on the plateau surface to landward. More recent mapping of vegetation of the Darwin Region (Greening Australia/DIPE, 1991) shows the current distribution of remnant native vegetation - now limited to the linear band of monsoon vine-forest vegetation that forms an almost complete western border the city (Appendix 2). To the east, remnant vegetation includes the extensive mangroves of Frances Bay and Sadgroves Creek, otherwise remnant native vegetation has been largely removed from the city area.

Flora

The nature and distribution of the existing vegetation types within the waterfront redevelopment site is shown in Figure 2, compiled from recent aerial photography and verified by extensive ground-truthing. Seven main vegetation communities within 3 major habitat types (escarpment, coastal flats and the intertidal zone) were distinguished within the project area. Similar to the existing mapping for the area (Appendix 2) only two remnant vegetation types occur, namely vine-forest (Map Unit 1) and minor mangrove areas (Map Unit 7), the remainder being cleared or modified landscapes or weescapes; native regeneration on disturbed sites; private gardens and public open space. The characteristics of these plant communities are summarised in Table 1 and the following section contains descriptions of the main vegetation types.

Appendix 1 contains a species list compiled for the project area based on six site visits. A total of 187 plant species from 68 families were recorded from the Darwin city waterfront project area (approx 25 ha). Seventy-one introduced species were recorded, comprising 38 % of the flora. The high numbers of introduced species is an indication of high levels of disturbance, the proximity of the site to a major urban centre and that overall, the site is in relatively poor condition. Plant families represented by the most species were: Poaceae - grasses (19 species); Fabaceae -peas (12 species) and Arecaceae – palms (11 species) representing quite an atypical breakdown for natural habitats. Of these 3 families, 57% of species were weeds, indicating the exotic character of the flora.

Appendix 1 also includes information on the lifeform (tree, shrub, vine, fern etc); and lists the introduced/native status; IUCN conservation code and the prevalence within each habitat of each species recorded. Dominance of particular species (D) and local abundance (A) within certain habitats is also noted. The following broad overview of the existing vegetation characterises the flora of the project area.

Table 1: Summary table of major vegetation types within the waterfront redevelopment project area

Map Unit	Vegetation type (area within DCWR project area)	Dominant upper stratum tree species	No. plant species (No. of families)	No of weed species (%)	Conservation significance
1	Coastal vine-forest (0.75 ha)	<i>Acacia auriculiformis</i> , <i>Ficus virens</i> , <i>Terminalia microcarpa</i> , <i>Albizia lebbbeck</i>	75 (40)	23 (30.7%)	No species of declared rare status (Commonwealth listing). One species <i>nt</i> or <i>near threatened</i> (Northern Territory IUCN listing). Rainforest vegetation of high ecological and aesthetic significance. Of potential recreational, aesthetic and educational value in future landscape.
2	Public open space (1.00 ha)	<i>Hibiscus tiliaceus</i> , <i>Petophorum pterocarpum</i> , <i>Eucalyptus camaldulensis</i> , <i>Pongamia pinnata</i>	29 (17)	13 (44.8%)	No conservation significance – mainly cultivated species on recently reclaimed land.
3	Private gardens (0.60 ha)	<i>Samanea saman</i> , <i>Citharexylum subserratum</i> , <i>Chrysalidocarpus latescens</i> , <i>Plumeria spp.</i>	28 (17)	10 (35.7%)	No conservation significance – high proportion of exotic species in cultivated landscape.
4	Regenerating native landscape (1.11 ha)	<i>Acacia auriculiformis</i> , <i>Lophostemon lactifluus</i> , <i>Melaleuca leucadendra</i> , <i>Alstonia actinophylla</i> ,	49 (27)	14 (28.6%)	No species of declared conservation status. Healthy native regeneration assisting in soil stabilisation and weed control. Of moderate aesthetic value for future landscape. Minor ecological significance.
5	Dense weed infestations in native regeneration (1.60 ha)	<i>Leucaena leucocephala</i> , <i>Acacia auriculiformis</i> , <i>Spathodea campanulata</i> , <i>Melaleuca leucadendra</i>	73 (33)	35 (47.9%)	No conservation significance. No botanical, aesthetic or ecological value for retention in future landscape.
6	Disturbed ground with scattered plantings (17.52 ha)	<i>Gmelina arborea.</i> , <i>Eucalyptus camaldulensis</i> , <i>Acacia auriculiformis</i> , <i>Casuarina equisetifolius</i> , <i>Delonix regia</i>	64 (26)	36 (56.2%)	Aside from two trees of historical significance (Tamarind trees No.'s 121 and 197) and several established shade trees (<i>Peltophorum pterocarpum</i>) of some aesthetic and current recreational value, no species or communities of declared conservation significance. No botanical or ecological value for retention in future landscape.
7	Mangrove (0.53 ha)	<i>Avicennia marina</i> , <i>Sonneratia alba</i> , <i>Rhizophora stylosa</i>	10 (8)	nil	Darwin Harbour mangroves are to be zoned for conservation (DIPE, 2004). Of ecological value with potential to be of recreational, educational and aesthetic value if retained and expanded within future landscape.

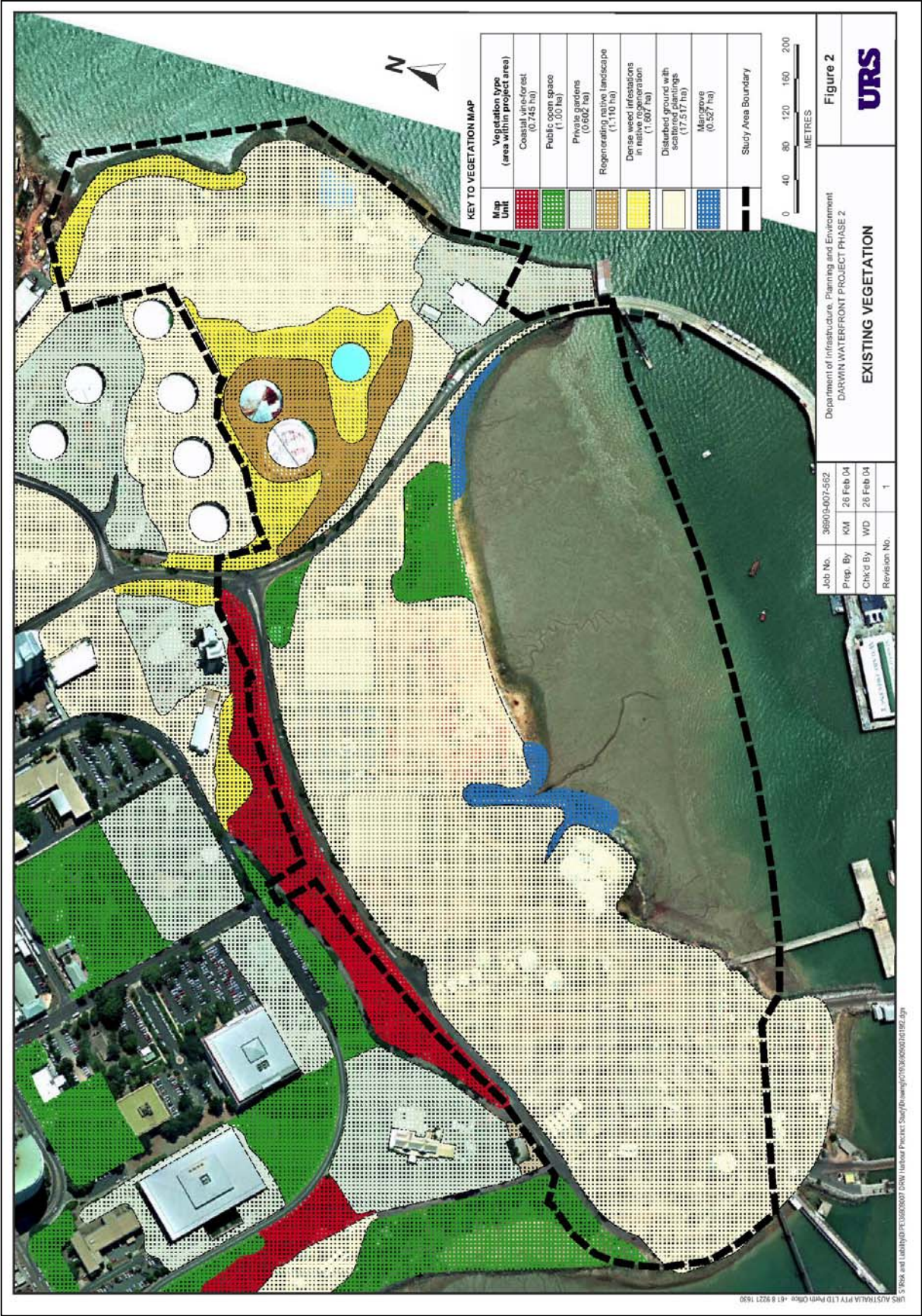


Figure 2: Vegetation map of the DCWR project area

5.0 Vegetation communities

Although referred to as ‘communities’, many of the following groupings reflect the level of human modification and disturbance within the project area rather than natural vegetation assemblages usually referred to as communities. Nevertheless, seven main types of vegetation formation were distinguished as follows:

5.1 Coastal vine-forest (Map unit 1)

Remnant native vegetation is largely restricted to the heavily vegetated escarpment areas that fringe the CBD, occupying 0.7 ha (2.8%) of the project area. These areas comprise intact, well-established coastal vine-forest (or rainforest) vegetation. Vine-forests typically support a diverse range of non-Myrtaceous native species, many of which are relatively fire-sensitive (Panton 1993) and are only found within this habitat (Wightmann and Andrews 1989). A total of 75 species from 40 families were recorded from this habitat- the most floristically diverse in the project area.

Although 23 introduced species (31% of the total) were recorded from vine-forest, a large proportion of these exotics were cultivated species that had been planted around the entrance to the oil storage tunnels on Kitchener Drive. Dense vine-forest areas were relatively free of weeds but several palms (*Caryota mitis*, *Ptychosperma mcarthurii*) and introduced tree species (*Mangifera indica*, *Spathodea campanulata* - and *Delonix regia*) have become naturalised and were occasionally present within the forest.

The vine forest in and adjacent to the project area show structural complexity with the canopy of most trees at around 15 to 20m with emergent trees reaching 25 m. Vine species are abundant and a variety of saplings and secondary tree species occur beneath the canopy. The ground layer is typically sparse or absent except for seedlings and saplings of upper stratum species.



Monsoon rainforest or vine-forest occurs on the escarpment bordering the project area.

Although scattered exotic tree species may occur within the canopy of the vine-forest, particularly large Raintrees (*Samanea saman*) and Poincianas (*Delonix regia*), this habitat is typically dominated by species native to Northern Australia. Common upper stratum trees include Northern Black Wattle (*Acacia auriculiformis*), Banyan (*Ficus virens*), *Terminalia microcarpa*, *Albizia lebbbeck*, Milkwood (*Alstonia*

actinophylla) and *Litsea glutinosa*. Dense canopy cover is characteristic and assists in preventing or reducing the introduction and proliferation of weeds. However, the margins of these areas are more vulnerable and where localised weed infestations occur, it is typically on the fringes. Coffee Bush (*Leucaena leucocephala*) and occasionally the vines Hairy Merremia (*Merremia aegyptia*) and Pink Coral Vine (*Antigonon leptopus*) were observed in vine-forest margins. The stability and integrity of this escarpment vegetation has been actively maintained by weed removal and support planting of appropriate native species by Greening Australia.

5.2 Public open space (Map Unit 2)

The limited vegetation of the CBD is characterised by small city parks and public open space (Figure 2). Largely occurring on the margins of the low plateau surface, particularly along the Esplanade, these landscapes contain a mixture of native and exotic species typically comprising scattered shade trees amongst lawn with some minor natural areas. A small area of public open space (1.00 ha) is currently found within the project area where parks have been established on recently reclaimed land.

Outside the project area, Bicentennial Park and the public open space adjacent to the new Deckchair Cinema is characterised by extensive grassed areas with scattered, planted trees comprising predominantly native species (eg *Ficus virens*, *Peltophorum pterocarpum* and *Eucalyptus camaldulensis*). Public open space also surrounds State Square, (the administrative centre of Northern Territory law and government) which is also landscaped with gardens featuring especially attractive, stately Northern Territory native species (eg *Allosyncarpia ternata*, *Hydriastele wendlandii*, *Carallia brachiata*, *Livistona mariae*).

The Esplanade features a number of old Milkwoods (*Alstonia actinophylla*) that survived Cyclone Tracey in 1974 and an avenue of Milkwood Trees also lines the southern end of Smith Street - that adjoins the project area. Each of these Milkwood trees have been listed on the Register of Significant Trees compiled by Greening Australia NT (see below – Vegetation of Conservation Significance).



Public open space on recently reclaimed land between the coastline and the escarpment.

Within the project area, public open space occupies only 1 ha (4%) of the total area and comprises grassed areas with borders of trees on recently reclaimed land. Tree

species include Beach Hibiscus (*Hibiscus tiliaceus*) and *Pongamia pinnata* (next to the Tram) and abundant *Eucalyptus camaldulensis* and *Peltophorum pterocarpum* (along the avenue leading to the Deckchair cinema). Elsewhere in the CBD, public open space is characterised by lofty, well-established trees that may form a continuous canopy. Within the project area however, the vegetation of public open space is typical of recently landscaped areas, being characterised by young, widely spaced cultivated trees. Appendix 1 lists the species present within this community.

5.3 Private Gardens (Map Unit 3)

Within the project area, private gardens are of limited extent comprising only 2.4% of the 25 ha total. Most established gardens in the project area feature mainly planted exotic species. Bordering the survey area and encompassing a substantial swathe of the escarpment opposite State Square and are the extensive private gardens of Government House. The majority of this vegetation is carefully maintained and contains a high proportion of exotic ornamental species as well as remnant and planted native trees.



Several extensive private gardens border the project area including Government House

Similarly, established plantings of largely introduced species occur in the Stokes Hill area, particularly within the Naval Fuel Installation. Although outside the project area and managed by the Navy, this land has several tall, specimen trees with some aesthetic value (eg River Red Gum, *Eucalyptus camaldulensis*, Banyan *Ficus virens*, Rain tree, *Samanea saman* and African Mahogany *Khaya senegalensis*), which presumably function as a visual screen for the fuel tank area from certain directions.

5.4 Regenerating native landscape (Map Unit 4)

The project area has several habitats in which vegetation has been cleared previously but which have shown vigorous regeneration of native species (Map Unit 4). This hardy vegetation occurs over 1.1 ha (4.4%) of the project area and is typically restricted to the sheer, rocky slopes surrounding the fuel tanks and bordering the southern face of Stokes Hill (Figure 2). Construction and reclamation works have exposed steep rock walls that now support quite advanced native regeneration. Such areas are typically dominated by the native coloniser species Northern Black Wattle (*Acacia auriculiformis*) with other trees including Paperbark (*Melaleuca leucadendra*) and *Lophostemon lactifluus*. Coffee Bush (*Leucaena leucocephala*) an

introduced species, is also a common understorey species but is usually interspersed with a reasonably diverse mid-stratum and ground layer comprising mainly native species, particularly vines.



Regeneration of vegetation on the southern slopes of Stokes Hill comprising mainly native species

Seepage from the rock surface is common and native ferns (*Lygodium flexuosum*, *Cheilanthes tenuifolia*, *Dicranopteris linearis*) abound with common vines including *Tylophora flexuosa*, *Marsdenia geminatum* and *Seccamone elliptica*. Left in its natural state, such areas should continue to increase in diversity and if protected from fire and weed invasion, may over time, develop into coastal vine-forest communities similar to that bordering the city. A total of 49 species were recorded from this community which is quite high given the steep terrain and limited distribution. Of that total, only 28% of species were introduced, the lowest recorded for terrestrial areas within the project area.

Although quite similar in overall species composition and topography to Map Unit 5 (below), this hardy landscape has been delineated and mapped separately due to its potential retention value in the future landscape. With Stokes Hill being a designated site of Aboriginal significance and therefore placed outside the redevelopment boundary, such hardy, relatively weed-free vegetation could potentially be a low-maintenance asset in the future landscape (for visual screening and stabilisation of the slopes surrounding Stokes Hill). The current vegetation is dense and quite attractive with a canopy dominated by Black Wattle at around 6m high with occasional vine-forest species (eg *Litsea glutinosa*, *Alstonia actinophylla*, *Ficus virens*).

5.5 Dense weed infestations amongst native regeneration (Map Unit 5)

In areas where Coffee Bush (*Leucaena leucocephala*) has become established in dense stands, structural variation and botanical diversity of native vegetation is greatly reduced and almost monospecific formations may result. This vegetation type typically tends to occur on disturbed ground and in unmaintained sections of the project area (Figure 2). Covering 1.6 ha (6.4% of the site), this vegetation type contains a broad range of plant species (73 species), however, almost half of these plants were weeds or exotic species (48%). Consequently these areas have low

ecological value and in their current condition are of little value for retention in the future wharf precinct landscape.



Dense infestations of Coffee Bush are common throughout the project area

Dominant species include native coloniser species such as Wattles (*Acacia auriculiformis*, *Acacia holosericea*), Cheesewood (*Alstonia scholaris*) and Coffee Bush (*Leucaena leucocephala*) with naturalised exotic trees such as Golden Shower (*Cassia fistula*) and African Tulip Tree (*Spathodea campanulata*). The upper and mid-strata of the vegetation often comprises dense stands of Coffee Bush. Due to this species' ability to produce copious quantities of seeds that remain viable in the seed bank for many years, these infestations are important targets for current and future weed control. Indeed, selective clearing or landscaping of such areas would assist in overall weed management of the site.

5.6 Disturbed ground with scattered plantings (Map unit 6)

The low plateau of the CBD overlooks the flat coastal margin where less formal landscaped areas (including road verges and isolated gardens) are interspersed with grassland and large bare areas (sealed, concrete or bitumen surfaces) within the semi-industrial landscape. Within the last 50 years almost the entire area has been reclaimed, and during that time, a range of different industrial developments have been constructed within the area. This vegetation type is by far the most extensive within the project area, covering 17.5 ha or 70% of the total area for redevelopment (Map Unit 6).

This vegetation complex contains a range of different plant species, both native and introduced, and is characterised by sporadic landscaping around vacant or demolished buildings, amongst extensive rough and sealed ground surfaces. The ground surface close to the shoreline is extremely uneven and disturbed in places where the most recent dumping and reclamation has taken place.

Trees are relatively uncommon, except for the perimeter of the old cement works, where the boundary of this property retains dense tree cover. Most of the tree species present (including *Gmelina arborea*, *Acacia auriculiformis*, *Eucalyptus camaldulensis*) are common, fast growing and of little value ecologically or aesthetically. Dense Coffee Bush infestations line the shoreline in this area

(Figure 4). However, several established Golden Flame Trees (*Peltophorum pterocarpum*) of some aesthetic value occur on the edge of the foreshore adjacent to the entrance of the Fort Hill Wharf (see section 6.0).



Disturbed coastal flat habitat with grassland, bare ground, occasional trees and abundant weeds. This vegetation type occupies 17.5 ha or 70% of the project area.

Overall, the majority of the coastal flats supports low growing native and introduced grasses, sedges and weeds that proliferate amongst the disturbed, cleared, sealed and rough ground (Appendix 1). These areas are lacking in environmental value with scattered clumps of vegetation that generally would make little or no positive contribution to a future landscape.

5.7 Mangrove (Map unit 7)

Although extensive intertidal mudflats occur along the seaward margin of the project area, relatively little mangrove vegetation exists along the shore (0.52 ha in total). The coastal flat habitat was formerly a mangrove shore, with mixed species mangroves extending almost up to the base of the escarpment (B Wetherall, Port Darwin, pers. comm.). However, mangrove vegetation has been displaced during several reclamation episodes in the project area, mangroves now comprise only 2.1% of the site.

In general, mangrove vegetation in Darwin Harbour typically occurs between certain well-defined topographic elevations with approximately 50% of mangrove vegetation growing at an elevation between 2 and 3 m AHD. The 4m AHD mark represents the upper limit of mangrove growth and –1m AHD the lower, or seaward limit of mangrove colonisation. Consequently, examination of the contours bordering the recent reclaim area demarcated by the public open space near the Tram Eatery (see Figure 1) suggests that much of the intertidal zone is currently at too low an elevation to support colonisation by mangroves.

Several small patches of mangroves occur on sections of the shore with mudflats at sufficiently high tidal elevations. However, the current distribution of mangroves is too limited to develop a clear pattern of zonation from seaward to landward and a mixed species mangrove (ie in which no one species is dominant) occurs instead.

At present, the small, but relatively diverse mangroves within the project area contain a total of 10 species. These species are the ten most common mangroves, of a possible 26 species characteristic of Darwin Harbour. The mangrove area occurs in two sections, the larger area extending approximately 60m along a small tidal creek.

Even within this small area of existing mangroves a remarkable range of fauna was observed including mudskippers (*Periophthalmus* spp.), molluscs, grapsid and fiddler crabs, and birds including the Collared Kingfisher and Rufous-banded honeyeater. The ecological value of this habitat is well known (EcoSystems 1993; Wightmann 1989) and the overall effect of a mangrove shore can be aesthetically attractive.



Small but relatively diverse mangroves occur within the project area. This habitat may have some potential as an aesthetic, educational and recreational resource in the future DCWR landscape.

If expansion of the distribution of existing mangrove vegetation within the fringing intertidal zone is considered an attractive feature in a future landscape scenario, creating a suitable habitat to achieve this aim should not be problematic. Semi-consolidated marine sediments, with a gradual slope, between an upper height of 4m AHD and a lower limit of –1m AHD would provide appropriate habitat with a suitable pattern of tidal inundation for natural mangrove colonisation. Mangroves can be rapid colonisers but rehabilitation/replanting works could facilitate this process.

6.0 Vegetation of conservation significance

The majority of the project area has been significantly degraded by human activities and has therefore not retained conservation significance. However, the local, regional and national conservation significance of the flora and vegetation was assessed with reference to species lists under the Northern Territory Parks and Wildlife Conservation Act (TPWC Act 2000) and the Environment Protection and Biodiversity Conservation Act (EPBC 1999). Conservation significance can be considered at the level of the individual plant and at the community scale as follows:

6.1 Plant species of conservation significance

The conservation status of Northern Territory plant species is considered using IUCN (International Union for the Conservation of Nature and Natural Resources) criteria version 3.1 (2000). IUCN categories comprise extinct, threatened (including critically endangered, endangered and vulnerable categories), followed by near threatened and least concern in decreasing order of significance (IUCN, 2000). The

IUCN threatened species status of the 187 plant species recorded during this survey is listed in the Plant Species List (Appendix 1).

No plants with declared endangered or vulnerable IUCN threat status were found during this survey, however one species *Pittosporum moluccanum*, recorded within the vine-forest habitat (Figure 3) is currently listed on the Northern Territory IUCN plant status database as near threatened (nt). This species is one of 386 Northern Territory plant species with near threatened status. All other plant species are not threatened and are listed as least concern (lc). A taxon is least concern when it does not qualify for threatened or near-threatened status - this category includes widespread and abundant taxa. No natural populations of cycads or orchids - protected under Section 43 of the TPWC Act (2000) - were recorded within the site

Despite its apparent conservation significance, *Pittosporum moluccanum* is also found in cultivation and is distributed through local nurseries that stock native plants. Indeed, it is probable that the five *Pittosporum moluccanum* trees observed have been grown and planted by Greening Australia. Each of the trees in the vine-forest are of similar age (exhibiting growth between 3 and 5 m) and each occurs close to the road along which other native species have been planted (indicated by wooden stakes). Further, one tree still retains a wooden stake at the base of the plant, suggesting its cultivated status.

Thus, it is assumed that these trees have been planted and have not arisen by natural means. Consequently although listed as *near threatened*, the conservation value of this occurrence is somewhat diminished. It should be noted that other, natural populations of *Pittosporum moluccanum* are known to occur in the Darwin region eg in vine-forest at Lee Point.



Although 5 Pittosporum moluccanum plants (near-threatened status under IUCN listing) were observed within the vine-forest, they are thought to be nursery cultivated trees that have been planted during weed control and revegetation works by Greening Australia

It follows that none of the 187 species recorded within the project area is found on commonwealth EPBC listings of the 508 endangered and 670 vulnerable plant species across Australia (Environment Australia, 2003).

6.2 Plant communities of conservation significance

Vine-forest communities

Although vine-forests do not have any official conservation status (they are not protected under any current NT legislation), the environmental value of these habitats in the local Darwin area has been recognised in the *Central Darwin Land Use Objectives* (Northern Territory Government 1996). One of the listed key objectives is: *To preserve remnant rainforest and integrate it with public open space and new developments.*

However, rainforest patches, as they occur in the Top End, have been steadily declining in extent in the Darwin region over the past 50 years (Panton 1993) and at the regional level they are relatively restricted in distribution (Russell-Smith and Bowman 1992). Further, it is becoming increasingly recognised that these disjunct patches form an inter-dependent network of vital importance to mobile vertebrate frugivores (animals that live on fruit) and as a resource for the long-term genetic viability of rainforest flora (Price *et al.* 1998; Russell-Smith 1992). Consequently the conservation of each small patch is important in maintaining the integrity of the network as a whole.

The remnant vegetation map of the Darwin region indicates the extent of vine-forest vegetation in the local area, indicating a linear band delineating the escarpment that fringes the city and extends as far as Mindil Beach. Weed invasion and incursion of naturalised exotic species is the major threat to the integrity of these forests. Overall, vine-forest vegetation, although modified to varying extents, retains the highest ecological importance of any vegetation type within the project area.



Intact, floristically diverse monsoon rainforest occurs within the project area and should be preserved and integrated with the new development (NTG 1996)

Mangroves

The project area is surrounded by extensive mangroves of Darwin Harbour (approximately 26,200 ha) with over 700 ha protected within nearby Charles Darwin

National Park. The national significance of mangrove stands within Darwin Harbour has been recognised in terms of their high primary production, their ecological value as a habitat and their intrinsic social and natural values as a resource (DIPE, 2001).

The mangroves of the Darwin region and in particular those within Darwin Harbour, are notably diverse and are important habitats in terms of breeding, feeding and nursery grounds for a variety of marine and terrestrial species (EcoSystems 1993; Wightmann 1989). Indeed, Darwin Harbour mangroves are listed in the Directory of Important Wetlands in Australia (ANCA, 1997). Proposed amendment to the Northern Territory Planning Scheme will acknowledge the significance of the harbour's mangrove areas by declaring the habitat a conservation zone (DIPE, 2004). The change of zoning will mean that clearing of mangroves will require planning consent. Thus overall, the ecological value of mangrove habitats needs to be recognised in the context of the current development.



Although only minor areas of mangrove vegetation remain within the project area, these habitats have conservation significance within Darwin Harbour and clearing will require planning consent

6.3 Register of Significant Trees

The significant tree register (compiled and administered by Greening Australia NT) was consulted and a listing of all significant trees for the southern section of the Darwin CBD was compiled (Appendix 3). The trees listed on this register do not have any declared conservation status under NT or national listings, however they characteristically have high historical and/or aesthetic significance. Some limited information on history is available from Greening Australia regarding specific trees (Appendix 5).

During fieldwork, significant trees within and adjacent to the project area were located in the field and the status of each tree was checked. A map of locatable significant trees, indicating their individual number on the Register of Significant Trees was compiled (Figure 3). The species of each significant tree and its GPS coordinates is listed in Appendix 3. Figure 3 also indicates the location of species of declared conservation significance (*Pittosporum moluccanum*), and those trees of

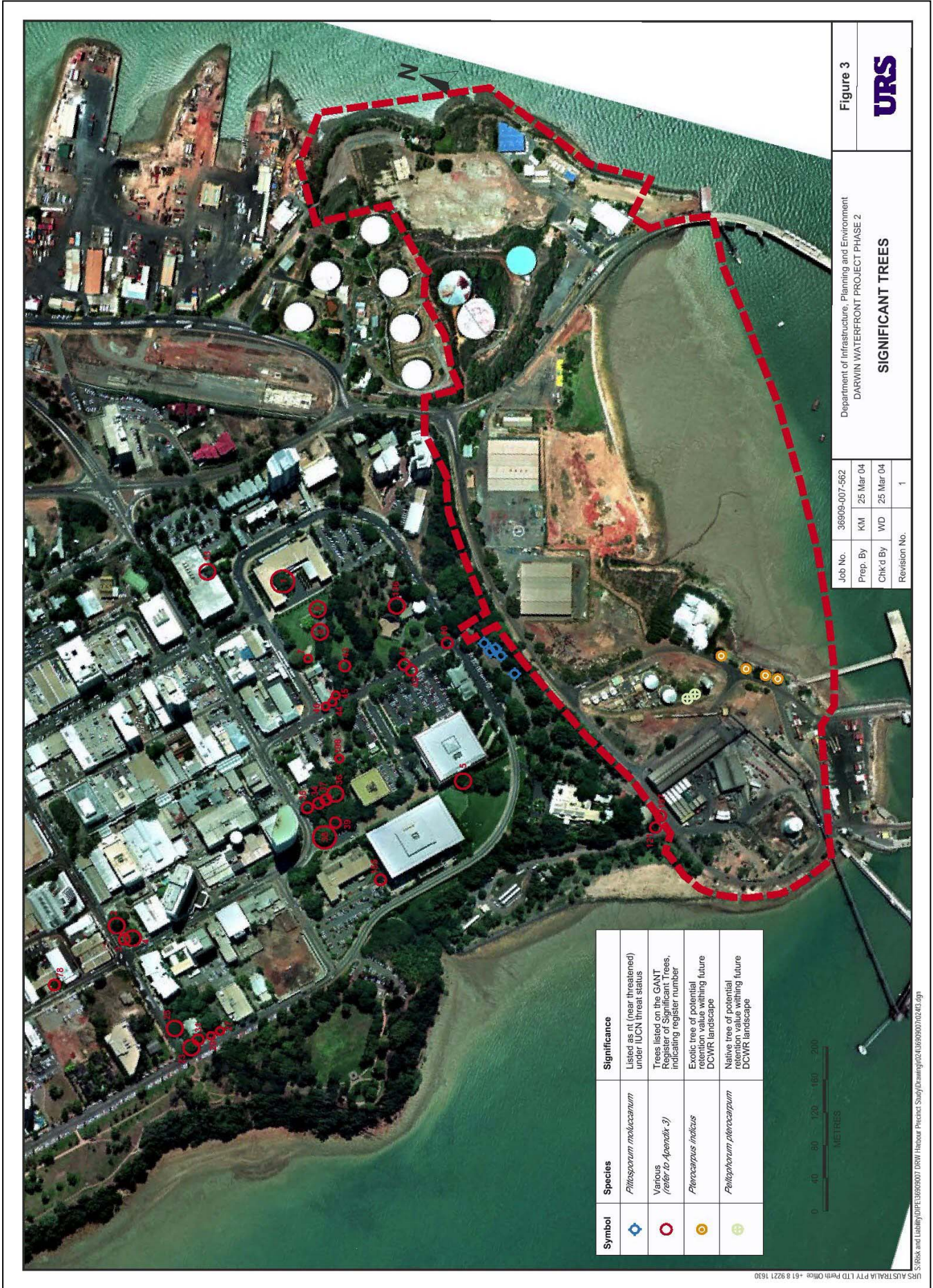


Figure 3: Significant trees

potential retention value (*Peltophorum pterocarpum*, *Pterocarpus indicus*) described below. The following is a brief discussion of trees listed on the Significant Tree Register that may be affected by the DCWR project.

Two very old Tamarind trees (*Tamarindus indica*) occur on the street verge and within the garden of the Port Darwin offices on Kitchener Drive. These trees, listed as No. 121 and No. 197 on the Register of Significant Trees (GANT, 2004) are located on the boundary of the redevelopment area.

A series of seven Milkwoods (*Alstonia actinophylla*) planted on the street verge in southern Smith Street are also listed on the Register of Significant Trees (No.'s 40 to 46). These Milkwoods were planted in 1915 (now 89 years old) and were nominated for this list in 1986 by the National Trust. Although outside the current project area, these Milkwoods are mentioned in relation to the proposed Urban Design Axis, boldly marked in red on the concept plan and described as “a strong visual axis to the waterfront with automated pedestrian facilities...” (NTG, 2003). This axis originates in this section of Smith Street, which is already fairly narrow due to the presence of the trees on the roadside (see Appendix 5).

Although not protected by legislation, significant trees form a valuable part of the historical and environmental heritage of the Darwin region. Most trees are labelled and numbered with instructions that Greening Australia is to be consulted prior to any works being commenced on, or around any such registered trees. Information from Greening Australia indicates that a large number of significant trees occur within Bicentennial Park on the Esplanade, this section of the Esplanade however, lies well outside project area.



Tamarind trees (Tamarindus indica) adjacent to Port Darwin offices, listed on the Register of Significant Trees occur on the boundary of the project area

In summary, one plant species recorded within the project area is denoted *nt* or *near threatened* on the Northern Territory listing of plants with significant conservation values. However, it is probable that the five plants observed may have been planted by Greening Australia as this species is also found in cultivation. Indeed, this species is listed on the GANT nursery schedule and the vine-forest area has been the target for long-term weed control and support planting. However, there are no species with

significant declared IUCN threat codes (ie endangered or vulnerable) and no species present occur on national lists of endangered species.

The coastal vine-forest habitat contains a remnant vegetation community of some ecological importance and potential educational, recreational and aesthetic value. Future development should aim to benefit from this potential, to integrate with this environment while not impinging upon the integrity of this habitat.

Two Tamarind trees listed on the Register of Significant trees (GANT) occur just on the boundary of the project area. The Register documents trees of historical and aesthetic value. The locations of these Tamarinds and several other listed Milkwood trees (*Alstonia actinophylla*) in the southern end of Smith Street, have been identified and mapped.

7.0 Weeds

Development involving landform change has resulted in terrain disturbance over the majority of the site, creating ideal conditions for the establishment of coloniser species and the proliferation of weeds. Indeed, introduced species dominate the vegetation in all areas outside public open space and the coastal vine-forest where active weed control measures are implemented. Weeds and introduced species comprise 38% of the 187 species recorded.

Of the 71 introduced species recorded within the site, not all are weeds, approximately 40% being exotic species planted in previous garden situations or species native to other parts of Australia (Table 2). Nevertheless, of this total, none are declared Class A Noxious Weeds ie. to be eradicated (Weeds Management Act, 2001).

However, five Class B noxious weeds were recorded in the project area (*Hyptis suaveolens*, *Lantana camara*, *Pennisetum polystachion*, *Senna obtusifolia* and *Sida acuta*). However, no *Mimosa pigra*, *Jatropha gossypifolia* or *Xanthium occidentale* (Class B weeds) were observed within the project area. Under the Weeds Management Act (2001) the spread and growth of Class B weeds is to be controlled.

Figure 4 shows the distribution of weeds throughout the survey area indicating the locations of dense infestations of Coffee Bush (*Leucaena leucocephala*). Areas with high weed densities of other species including grasses (*Melinis repens*, *Pennisetum polystachion*), vines (*Centrosema molle*, *Passiflora foetida*, *Merremia aegyptia*) and herbs (*Senna obtusifolia*, *Alysicarpus ovalifolius* and *Tridax procumbens*) are also mapped. Coffee bush may also be abundant in these areas.

Weed infestations largely occur within Map units 5 and 6 where removal of existing vegetation and associated disturbance has encouraged weeds to proliferate. Figure 4 also indicates areas that are currently relatively weed free – suggesting future priority control areas, as prevention is easier and cheaper than control.

The potential for the spread of weeds and recommendations for weed management are discussed in sections 9.1 and 9.2 respectively. Overall, the proposed development should result in a reduction in the diversity and abundance of weeds within the project area.

Table 2 : Introduced species recorded within the DCWR project area

INTRODUCED (WEED) SPECIES	Class	INTRODUCED SPECIES – ALSO IN CULTIVATION
<i>Aeschynomene americana</i>		<i>Alstonia scholaris</i>
<i>Alysicarpus ovalifolius</i>		<i>Bambusa</i> sp.
<i>Andrographis paniculata</i>		<i>Bauhinia</i> sp.
<i>Antigonon leptopus</i>		<i>Bougainvillea</i> sp.
<i>Bothriochloa</i> sp.		<i>Callistemon</i> sp.
<i>Cassia fistula</i>		<i>Caryota mitis</i>
<i>Cenchrus</i> sp.		<i>Cassia siamea</i>
<i>Centrosema molle</i>		<i>Chrysalidocarpus latescens</i>
<i>Chloris</i> sp.		<i>Citharexylum subseriatum</i>
<i>Clitoria ternatea</i>		<i>Ficus benjamina</i>
<i>Crotalaria goreensis</i>		<i>Gardenia</i> sp.
<i>Delonix regia</i>		<i>Gmelina arborea</i>
<i>Desmanthus virgatus</i>		<i>Heliconia</i> sp.
<i>Desmodium tortuosum</i>		<i>Hibiscus</i> sp.
<i>Euphorbia heterophylla</i>		<i>Ixora</i> sp.
<i>Euphorbia</i> sp.		<i>Jasminum</i> sp.
<i>Evolvulus nummularis</i>		<i>Mangifera indica</i>
<i>Hyptis suaveolens</i>	B	<i>Neodopsis decaryi</i>
<i>Indigofera tinctoria</i>		<i>Phoenix dactylifera</i>
<i>Ipomoea triloba</i>		<i>Phyllanthus multifolius</i>
<i>Lantana camara</i>	B	<i>Plumeria obtusa</i>
<i>Leucaena leucocephala</i>		<i>Plumeria rubra</i>
<i>Macroptilium atropurpureum</i>		<i>Polyalthia longifolia</i>
<i>Melinis repens</i>		<i>Pterocarpus indicus</i>
<i>Merremia aegyptia</i>		<i>Ptychosperma elegans</i>
<i>Merremia dissecta</i>		<i>Ptychosperma macarthurii</i>
<i>Passiflora foetida</i>		<i>Roystonea regia</i>
<i>Passiflora suberosa</i>		<i>Samanea saman</i>
<i>Pennisetum pedicellatum</i>		<i>Spathodea campanulata</i>
<i>Pennisetum polystachion</i>	B	
<i>Physalis minima</i>		
<i>Portulaca pilosa</i>		
<i>Ruellia tuberosa</i>		
<i>Scoparia dulcis</i>		
<i>Senna alata</i>		
<i>Senna obtusifolia</i>	B	
<i>Sida acuta</i>		
<i>Stylosanthes hamata</i>	B	
<i>Tridax procumbens</i>		
<i>Triumfetta rhomboidea</i>		
<i>Urochloa maxima</i>		
<i>Zornia</i> D3024 Darwin		

8.0 Retention Value of existing vegetation

Retention value of vegetation communities

The intrinsic environmental value of healthy remnant rainforest vegetation in such close proximity to the CBD has been recognised by the NT Government (NTG, 1996). In addition to the ecological value of this habitat, it has strong aesthetic appeal, and recreational and educational potential. Indeed, it is possible that this valuable area may become a feature of this part of the city in the framework of the waterfront redevelopment project. Dense forest in this location also provides valuable shade and protection from wind and storms for adjacent built-up areas. These amenity values need to be considered in tandem with its ecological importance in the design of the future waterfront landscape. It is crucial that any construction activities that may impinge on this habitat do not affect its integrity.

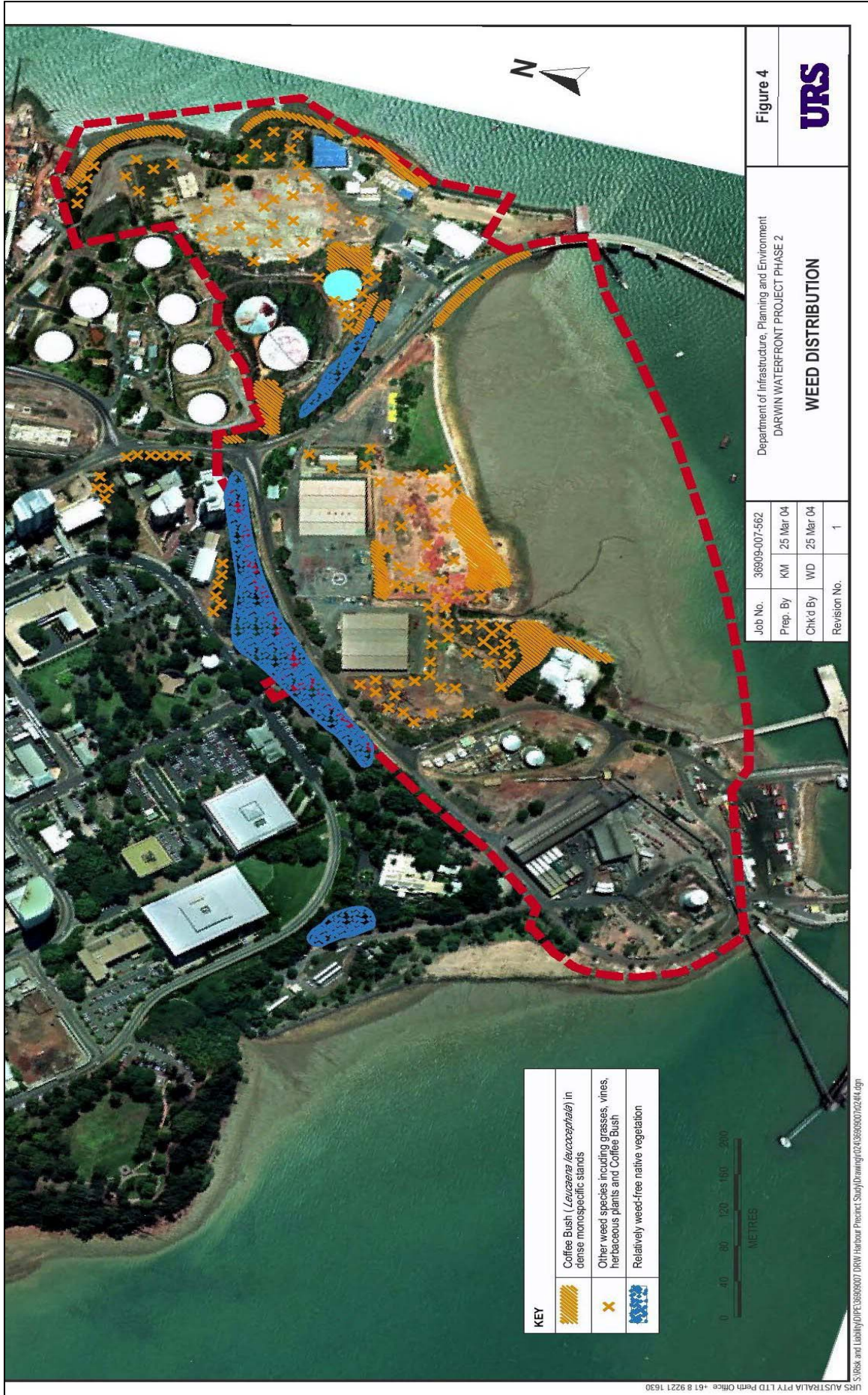


Figure 4: Weed distribution within the project area

Appendix 4 contains a summary table of the potential retention value of the seven main vegetation types within the project area.

Trees of potential retention value

Several trees of historical value listed on the Register of Significant trees, occurring immediately adjacent to the survey area should, if possible, be retained within the new DCWR landscape (see Section 6.3).

Further, although the origin of the five *Pittosporum moluccanum* trees (listed as near threatened) is uncertain, these trees are uncommon coastal species that ideally should be retained in their rainforest habitat, thereby extending their overall distribution. However, they are unfortunately located close to the end of Smith Street where selective clearing of the forest may be required for construction of proposed pedestrian access structure. Alternative design structures, including an elevated ‘canopy’ walkway are discussed in Section 9 (Mitigation Methods) to minimise clearing within the rainforest.

In addition to these listed trees, several established Golden Flame Trees (*Peltophorum pterocarpum*) of some aesthetic value occur on the edge of the foreshore adjacent to the entrance of the Fort Hill Wharf (Figure 3). These 4 trees are tall (to 12 m), spreading shade trees that produce abundant fragrant yellow flowers. This species is listed as a Northern Territory endemic species (NT IUCN database), one of 4 endemics recorded within the project area. At present these trees form an attractive green border to the bay and this location represents a popular, shady lunch spot for the local workforce.

In addition, two mature (12-14 m high) Rosewood trees (*Pterocarpus indicus*) occur within the grounds of the Shell Bitumen plant across the road. Although not an Australian native tree, this South-east Asian species is described as ‘one of the finest tropical shade trees’ with a broad dense crown of drooping branches (Hearne 1975). Combined, these six trees represent the only flora considered to be of some aesthetic value in this section of the project area that may have some potential for retention within the future landscaping for this area. However, they do not have any declared conservation significance nor are they listed on the significant trees register.



Mature Peltophorum pterocarpum (Golden Flame Tree) near Fort Hill wharf with aesthetic value

9.0 Potential Environmental Impacts and Mitigation Methods

At the time of writing (March 2004), only a relatively broad outline of the proposed development is available, which poses some difficulty in accurately predicting the potential impacts on the flora. However, it is understood that a large convention centre may be situated at the base of the escarpment in the current Warehouse area, with the creation of automated pedestrian access from the end of Smith Street to the convention centre. Residential developments are proposed for the Stokes Hill area and a continuous coastal esplanade may be built around the foreshore. Some commercial development of the waterfront is planned with the potential to dredge some areas for waterfront developments and the possibility of retaining or enhancing existing mangrove areas has been suggested.

9.1 Assessment of potential impacts

Due to the significantly degraded nature of much of the project area, potential impacts on flora are largely limited to the few remaining intact habitats. However some general implications can be identified as follows;

Potential negative impacts on flora within the project area include:

- Clearing of some existing vegetation which may lead to a short-term loss of amenity or recreational space. However, due to the limited amount of existing vegetation, negative impacts from clearing are anticipated to be minimal.
- Clearing of vegetation may result in habitat loss and displacement for existing fauna particularly goannas and birds observed on site (including Orange Footed Scrubfowl, Green-backed Gerygone, Collared Kingfisher, Large-tailed Nightjar).
- Clearing of trees may lead to a reduction in visual amenity under circumstances where existing vegetation provides privacy or visual screening of unsightly aspects of the landscape.
- Vegetation clearing involves loss of ground cover and terrain disturbance, particularly in steep areas, factors which may lead to erosion and a temporary increase in downslope sedimentation and elevated turbidity levels in runoff.
- In the dry season vegetation clearing may cause a temporary increase in dust levels which may impact on surrounding vegetation as well as being undesirable in developed areas.
- Regrading to different topographic elevations will result in changes in drainage which may affect vegetation (for instance the freshwater inflow to the small mangrove creek may be diminished, discouraging the growth of mangroves).
- Of high importance is that construction of pedestrian access to the Wharf area may involve clearing of a minor section of the coastal vine-forest
- Construction activities have the potential to exacerbate the negative impacts of weeds on vine-forest areas - the margins of these areas are particularly vulnerable to weed invasion
- Construction activities may result in the introduction and spread of weeds into relatively weed-free areas. Particularly vulnerable are the fringes of vine-forests and in recently disturbed ground elsewhere
- **Overall, negative impacts on flora are considered to be of minor significance given the relatively degraded nature of the current site. The only priority issues are the protection of vine-forest and weed management**

Potential positive impacts on flora within the project area may include:

- Overall, clearing of vegetation should reduce weed populations in the project area due to the disturbed and weedy nature of much of the existing vegetation.
- Reducing weed abundance will decrease seed production and should thereby assist in weed management and control in surrounding areas (particularly the fringes of vine-forest and private gardens).
- An elevated ‘rainforest walkway’ represents a design alternative that would reduce clearing of vegetation required for pedestrian access to the wharf. A tree top walkway could utilise the shade provided by canopy trees and provide a scenic feature while minimising disturbance to the surrounding vegetation.
- The clearing of vegetation may be considered a positive impact in circumstances where it increases views of the harbour
- A mangrove regeneration program and construction of a mangrove boardwalk could provide educational, aesthetic and recreational benefits.

9.2 Mitigation strategies

- Where clearing of vegetation is to occur within the coastal vine-forest habitat (for the proposed pedestrian access route to the CBD), it should be undertaken with a commitment to minimising any impact on the surrounding forest.
- Clearing of large trees should be avoided to maintain the character of this landscape, to maintain shade and continuity of habitat.
- An elevated tree-top walkway may be a viable alternative for improving pedestrian access while minimising clearing within the vine-forest.
- Depending on the timing for vegetation clearing, provisions for sediment control in site runoff should be installed during wet season months.
- Alternatively, during dry season months, the direction of prevailing winds should be assessed in relation to the impact of dust on surrounding vegetation, housing and offices and suitable mitigation methods implemented (eg water trucks)
- Given the high weed densities that already exist on the site, the spread and proliferation of weeds by construction activity is not of primary concern. However, a number of priority weeds can be identified and priority control areas can be selected. For instance, weeds (especially Class B noxious weeds) should not be allowed to spread into new areas or into adjacent relatively weed-free habitats (eg vine-forests, private gardens)
- Control measures (eg spraying or revegetation works) should be implemented to prevent the spread of weeds into priority areas (eg weed-free areas and in susceptible areas such as recently disturbed ground).
- Wash-down facilities should be provided for earthmoving equipment to limit the spread of weeds on and off-site and this process supervised to ensure that Class B noxious weeds are not spread.
- Development of a weed management plan for the site is advisable to assist in the prevention of further introductions and the long term control of weeds
- Rehabilitation of the previous mangrove shore may provide not only a coastal green belt but an interesting, tropical habitat of educational and recreational significance.
- Reinstating a mangrove shore could be undertaken in combination with dredging, should dredging be required in adjacent marine areas - mud substrates for mangrove establishment could be sourced from dredge spoil
- If dredge spoil is recycled for mangrove rehabilitation works the surface contaminated layer must be removed and disposed of safely and the implications for acid-sulphate soil generation need to be adequately researched
- Once a detailed design of the proposed development is available, an appropriate monitoring program can be devised that ensures the effectiveness of

environmental safeguards and that monitors the difference between predicted and actual impacts on flora. For example, flora monitoring might include regular weed surveys or annual surveys of vine-forest habitat for species richness and weed numbers).

References

- ANCA (1997) A Directory of Important Wetlands in Australia (2nd Edition) pp168-170
- Booth, R, Harwood, RK and Mangion, CP (2001). Field Key for the Monsoon Rainforest Flora of the Darwin Region. Northern Territory Botanical Bulletin, No. **28**. Parks and Wildlife Commission of the NT. NTU Press.
- Brocklehurst, P and Edmeades, B (2001.) The Mangrove Communities of Darwin Harbour. Resource Capability Assessment Branch Technical Memorandum No 96/9. Department of Lands, Planning and Environment, Darwin NT.
- Department of Infrastructure, Planning and Environment (2001) *Oil Spill Response Atlas*.
- Department of Infrastructure, Planning and Environment (2004) *Making Darwin Harbour Mangroves a Conservation Zone*. www.nt.gov.au/environment/mangroves
- Dunlop, C (ed) (2003) Checklist of Vascular Plants of the Northern Territory, Australia. Conservation Commission of the Northern Territory.
- EcoSystems (1993) The Mangrove Community. Darwin South Stage 1 Environmental Studies: Flora. Report to Department of Transport and Works.
- Environment Australia 2003. Threatened species. www.biodiversity.environment.gov.au
- EPBC (1999) *Commonwealth Environmental Protection and Biodiversity Conservation Act-Threatened Flora*.
- Fogarty, P, Howe, D and Dunlop, C (1979) *The Land Resources of the Darwin Area*, Land Conservation Unit Technical Report No LC79/5. Conservation Commission of the Northern Territory, Darwin.
- Greening Australia/DIPE (1991) Draft Remnant Vegetation Mapping – Darwin Region.
- Greening Australian Northern Territory (unpublished) Register of Significant Trees of the Darwin Region.
- Hearne, D (1975) Trees for Darwin and Northern Australia. Department of Agriculture, Forestry and Timber Bureau. Australian Government Publishing Service, Canberra.
- IUCN (2000). Threatened Species – Plants. Parks and Wildlife Commission of the NT. www.nt.gov.au
- Northern Territory Government (1996) Central Darwin Land Use Objectives. NT Govt. Printer
- Northern Territory Government, Department of Lands, Planning and Environment (2001) *Oil Spill Response Atlas*
- Northern Territory Government, Department of Lands, Planning and Environment (2003) *Waterfront Revitalisation Concept Plan*
- Panton, WJ (1993) Changes in post World War 2 distribution and status of monsoon rain forests in the Darwin area. *Australian Geographer* 24(2):50-58
- Price, O, Bach, C, Shapcott, A and Palmer, C (1988) Design of Reserves for Mobile Species in Monsoon Rainforests. Final Report to Environment Australia for NRSP Project No. 602. May 1988. Parks and Wildlife Commission of the Northern Territory.
- Russell-Smith, J and Bowman, DMJS (1992) Conservation of monsoon rainforest isolates in the Northern Territory. *Biol. Conserv.* 59: 51-63.
- Smith, N M (2002) Weeds of the Wet/Dry Tropics of Australia. A field guide. Environment Centre, NT Inc.
- TPWC (2000) Territory Parks and Wildlife Conservation Act. Section 27, Northern Territory Government.
- Wightman, G and Andrews, M (1989) Plants of Northern Territory Vine Forests. Conservation Commission of the Northern Territory. NT Govt Printer.
- Wightman, G (1989) Mangroves of the Northern Territory. *Northern Territory Botanical Bulletin* 7:1-130
-

APPENDICES

APPENDIX 1

Plant Species List

Species	Common Name	Family	Lifeform	Conservation Status	Weed	Upper stratum	Mid stratum	Lower stratum	Coastal vine-forest	Public open space	Private gardens	Regenerating native landscape	Dense weeds amidst regeneration	Disturbed ground & plantings	Mangrove
<i>Acacia auriculiformis</i>	Northern Black Wattle	MIMOSACEAE	Tr/Sh	lc		*	*		D	A	+	D	D	A	
<i>Acacia holosericea</i>		MIMOSACEAE	Sh	lc			*	*			+	A	A	+	
<i>Acacia latescens</i>		MIMOSACEAE	Tr	lc		*	*					+	+		
<i>Acacia</i> sp.		MIMOSACEAE	Tr			*								+	
<i>Adenanthera pavonina</i>	Red Bead Tree	MIMOSACEAE	Tr	lc			*		A						
<i>Aegialitis annulata</i>		PLUMBAGINACEAE	Sh	lc				*							+
<i>Aegiceras corniculatum</i>		MYRSINACEAE	Sh	lc			*	*							+
<i>Aeschynomene americana</i>		FABACEAE	Sh	lc*	X			*						+	
<i>Aidia racemosa</i>		RUBIACEAE	Tr	lc			*		+						
<i>Albizia lebbbeck</i>		MIMOSACEAE	Tr	lc		*			+	+	+			+	
<i>Alphitonia excelsa</i>		RHAMNACEAE	Tr	lc		*			A						
<i>Alstonia actinophylla</i>	Milkwood	APOCYNACEAE	Tr	lc		*	*		+			+	+	+	
<i>Alstonia scholaris</i>	Cheesewood	APOCYNACEAE	Tr		X	*	*		+		+				
<i>Alysicarpus ovalifolius</i>		FABACEAE	Fo	lc*	X			*				+	+	+	
<i>Ampelocissus acetosa</i>		VITACEAE	Vn	lc									+		
<i>Andrographis paniculata</i>		ACANTHACEAE	Fo	lc*	X			*				+	+		
<i>Antiaris toxicaria</i> var. <i>macrophylla</i>		MORACEAE	Tr	lc		*	*		+						
<i>Antidesma ghesaembilla</i>		EUPHORBIACEAE	Sh	lc			*		+						
<i>Antigonon leptopus</i>	Coral Vine	POLYGONACEAE	Vn	lc*	X			*					+		
<i>Aristida</i> sp.		POACEAE	G										+		
<i>Artocarpus glaucus</i>		MORACEAE	Tr	LC			*		+						
<i>Avicennia marina</i> var. <i>eucalyptifolia</i>	Grey Mangrove	VERBENACEAE	Tr	lc		*	*								+
<i>Bambusa</i> sp.		POACEAE	Sh		X	*								+	
<i>Bauhinia</i> sp.		CAESALPINIACEAE	Sh		X	*							+		
<i>Bothriochloa</i> sp.		POACEAE	G		X								+		
<i>Bougainvillea</i> sp.		NYCTAGINACEAE	Vn		X			*		+	+				
<i>Brachyachne convergens</i>		POACEAE	G	lc				*					+		
<i>Breynia cernua</i>		EUPHORBIACEAE	Sh	lc			*			+		+			
<i>Bridelia tomentosa</i>		EUPHORBIACEAE	Sh	lc			*					+			
<i>Bruguiera exaristata</i>		RHIZOPHORACEAE	Tr	lc			*								+
<i>Buchanania arborescens</i>		ANACARDIACEAE	Tr	lc			*		+						
<i>Bulbostylis barbata</i>		CYPERACEAE	G	lc				*					+		
<i>Callistemon</i> sp.		MYRTACEAE	Sh		X		*		+		+				

<i>Calophyllum inophyllum</i>		CLUSIACEAE	Tr	lc	X	*				+					
<i>Canarium australianum</i>		BURSERACEAE	Tr	lc		*	*		+			+			
<i>Capparis sepiaria</i>		CAPPARACEAE	Vn	lc				*	+			+	+		
<i>Carallia brachiata</i>		RHIZOPHORACEAE	Tr	lc		*	*		+		+				
<i>Carpentaria acuminata</i>	Carpentaria Palm	ARECACEAE	Pa	LC		*	*		+	+			+	+	
<i>Caryota mitis</i>		ARECACEAE	Pa	lc*	X	*		*	+				+		
<i>Cassia fistula</i>	Golden Shower	CAESALPINIACEAE	Tr	lc*	X	*			+			+	+		
<i>Cassia siamea</i>		CAESALPINIACEAE	Tr		X	*								+	
<i>Casuarina equisetifolia</i>	Beach Sheoak	CASUARINACEAE	Tr	lc		*					+		+	+	
<i>Cayratia trifolia</i>		VITACEAE	Vn	lc				*					+		
<i>Cenchrus</i> sp.		POACEAE	G		X			*	+				A		
<i>Ceriops australis</i>		RHIZOPHORACEAE	Tr	lc			*								+
<i>Cheilanthes tenuifolia</i>		ADIANTACEAE	Fe	lc								+			
<i>Chloris</i> sp.		POACEAE	G		X			*				+		D	
<i>Chrysalidocarpus latescens</i>	Golden Cane Palm	ARECACEAE	Pa		X		*		+	+	+				
<i>Citharexylum suberratum</i>	Fiddlewood	VERBENACEAE	Tr		X	*							+	+	
<i>Cleome viscosa</i>		CAPPARACEAE	Fo	lc				*						+	
<i>Clerodendrum floribundum</i>		VERBENACEAE	Sh	lc			*					+			
<i>Clitoria ternatea</i>		FABACEAE	Vn	lc*	X			*	+				+		
<i>Cocos nucifera</i>	Coconut	ARECACEAE	Pa			*				+	+			+	
<i>Cordia subcordata</i>		BORAGINACEAE	Tr	lc		*					+				
<i>Corymbia ptychocarpa</i>		MYRTACEAE	Tr	lc		*								+	
<i>Crotalaria goreensis</i>		FABACEAE	Fo	lc*	X								+		
<i>Crotalaria retusa</i>		FABACEAE	Fo	lc									+		
<i>Cupaniopsis anacardioides</i>		SAPINDACEAE	Tr	lc		*			+						
<i>Cyathostemma glabrum</i>		ANNONACEAE	Vn	lc				*	+						
<i>Cyperus</i> sp.		CYPERACEAE	G					*					+	+	
<i>Delonix regia</i>	Poinciana	CAESALPINIACEAE	Tr	lc*	X	*				+				+	
<i>Desmanthus virgatus</i>		MIMOSACEAE	Sh	lc*	X			*						+	
<i>Desmodium tortuosum</i>	Florida beggarweed	FABACEAE	Fo	lc*	X			*					+		
<i>Dicranopteris linearis</i> var. <i>linearis</i>		GLEICHENIACEAE	Fe	lc				*				+			
<i>Diospyros compacta</i>		EBENACEAE	Sh	lc			*		+						
<i>Dodonaea platyptera</i>		SAPINDACEAE	Tr	lc		*			+						
<i>Elaeocarpus arnhemicus</i>		ELEAOCARPACEAE	Tr	lc			*		+						
<i>Eragrostis</i> sp.		POACEAE	G	ne				*						+	

[illegible]

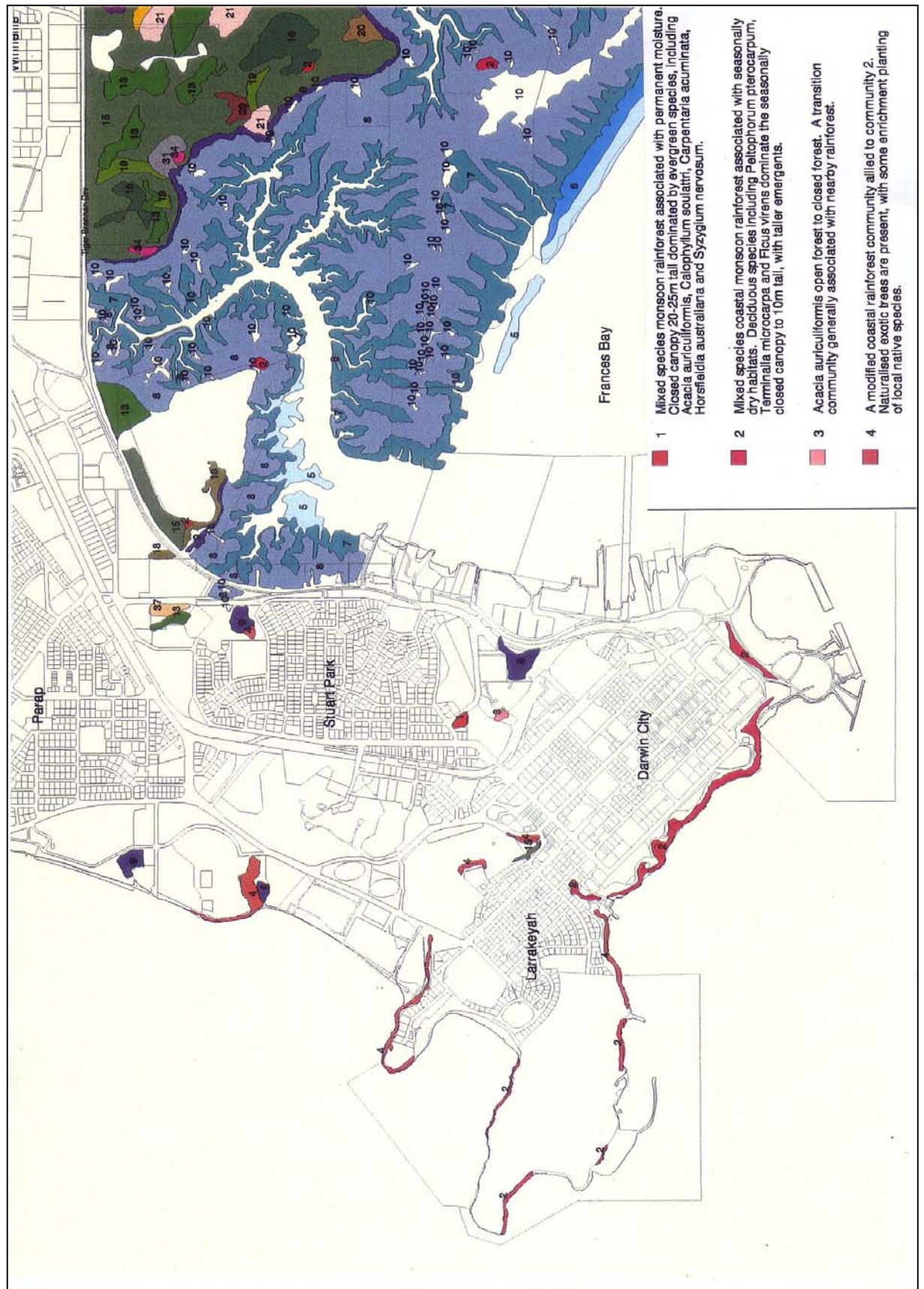
<i>Lumnitzera racemosa</i>		COMBRETACEAE	Tr	lc			*								+
<i>Lygodium flexuosum</i>		LYGODIACEAE	Fe/Vn	lc				*	+			+	+		
<i>Macropitilium atropurpureum</i>		FABACEAE	Vn	lc*	X			*		+		+	+	+	
<i>Mangifera indica</i>	Mango	ANACARDIACEAE	Tr	lc*	X		*		+						
<i>Maranthes corymbosa</i>		CHRYSOBALANACEAE	Tr	lc		*			+						
<i>Marsdenia geminata</i>		ASCLEPIADIACEAE	Vn	lc				*				+	+		
<i>Melaleuca leucadendra</i>	Paperbark	MYRTACEAE	Tr	lc		*	*		+		+	A	A	+	
<i>Melinis repens</i>		POACEAE	G	lc*	X			*				+	+		
<i>Merremia aegyptia</i>		CONVOLVULACEAE	Vn	lc*	X			*	+				+	A	
<i>Merremia dissecta</i>		CONVOLVULACEAE	Vn	lc*	X									+	
<i>Micromelum minutum</i>		RUTACEAE	Sh	lc			*		+						
<i>Morinda citrifolia</i>	Stinking Cheese-fruit	RUBIACEAE	Sh	lc			*		+						
<i>Murraya paniculata</i> var. <i>ovatifoliolata</i>		RUTACEAE	Sh	lc			*		+						
<i>Myristica insipida</i>	Native Nutmeg	MYRISTICACEAE	Sh	lc			*		+	+					
<i>Neodypsis decaryi</i>	Triangle Palm	ARECACEAE	Pa		X		*		+		+				
<i>Pachygone ovata</i>		MENISPERMACEAE	Vn	lc									+		
<i>Pandanus spiralis</i>		PANDANACEAE	Pa	lc		*					+				
<i>Parsonsia velutina</i>		APOCYNACEAE	Vn	lc				*				+	+		
<i>Paspalidium rarum</i>		POACEAE	G	lc									+		
<i>Paspalum</i> sp.		POACEAE	G										+	+	
<i>Passiflora foetida</i>		PASSIFLORACEAE	Vn	lc*	X			*	+			+	+	A	
<i>Passiflora suberosa</i>		PASSIFLORACEAE	Vn	lc*	X			*	+			+		+	
<i>Peltophorum pterocarpum</i>		CAESALPINIACEAE	Tr	LC		*	*		+	+	+		+	+	
<i>Pennisetum pedicellatum</i>		POACEAE	G		X									+	
<i>Pennisetum polystachion</i> subsp. <i>polystachion</i>		POACEAE	G	lc*	X			*				+	+	+	
<i>Phoenix dactylifera</i>	Date Palm	ARECACEAE	Pa	lc*	X		*			+					
<i>Phyllanthus multifolius</i>	Waterfall Plant	EUPHORBIACEAE	Sh/Fo		X			*	+	A					
<i>Physalis minima</i>		SOLANACEAE	Fo	lc*	X			*					+	+	
<i>Pittosporum moluccanum</i>		PITTOSPORACEAE	Tr	nt			*		+						
<i>Planchonia careya</i>		LECYTHIDACEAE	Tr/Sh	lc		*						+			
<i>Plumeria obtusa</i>	Frangipanni	APOCYNACEAE	Tr		X	*	*			+	+				
<i>Plumeria rubra</i>	Frangipanni	APOCYNACEAE	Sh		X		*		+						
<i>Polyalthia longifolia</i>		ANNONACEAE	Tr		X	*								+	
<i>Pongamia pinnata</i>		FABACEAE	Tr	lc		*			+	+	+			+	
<i>Portulaca pilosa</i>		PORTULACACEAE	Fo	lc*	X									+	
<i>Pouteria sericea</i>		SAPOTACEAE	Tr	lc			*		+						

[illegible]

APPENDIX 2

Remnant vegetation map of the Darwin area

(Source: Department of Infrastructure Planning and Environment/Greening Australia 2004)



APPENDIX 3

Significant Tree List

APPENDIX 3 – Significant Tree List

Southern CBD and wharf precinct area

(Source: Greening Australia Northern Territory, Register of Significant Trees)

Tree (Reg.) No.	Botanical Name	Location description	Name of Property	Street/Lot	Northing (WGS 84)	Easting (WGS 84)
1	<i>Ficus virens</i>	Out the front of the Civic centre	Darwin Civic centre	Lot 3981	8621371	700572
2	<i>Tamarindus indica</i>	Cnr of Mitchell St & Knucky St in Park	Tamarind Park	12 Knucky St	8621401	700084
3	<i>Erythrophleum chlorostachys</i>	Cnr of Mitchell St & Knucky St in Park	Tamarind Park	12 Knucky St	8621430	700073
4	<i>Ficus virens</i>	Cnr of Mitchell St & Knucky St in Park	Tamarind Park	12 Knucky St	8621430	700096
5	<i>Ficus virens</i>	Liberty Square	Supreme Court	Mitchell St	8621110	700384
7	<i>Ficus virens</i>	Park btw Civic centre & Browns Mart	Public Park	Lot 3981	8621328	700530
8	<i>Ficus virens</i>	Park btw Civic centre & Browns Mart	Public Park	Lot 3981	8621345	700538
9	<i>Ficus virens</i>	Park btw Civic centre & Browns Mart	Public Park	Lot 3981	8621334	700547
13	<i>Ficus virens</i>	Sunken Garden bed behind Magistrates Court	Magistrates Court	Harry Chan Ave	8621461	700544
24	<i>Calophyllum inophyllum</i>	Old Admiralty House	Esplanade	Lot 2291	8621336	699982
25	<i>Samanea saman</i>	Old Admiralty House	Esplanade	Lot 2291	8621359	700028
27	<i>Polyathia indica</i>	Old Admiralty House	Esplanade	Lot 2291	8621322	699998
29	<i>Arenga engleri</i>	Old Admiralty House	Esplanade	Lot 2291	8621335	700024
31	Frangipani	Old Admiralty House	Esplanade	Lot 2291	8621351	699986
34	<i>Calophyllum inophyllum</i>	Bennett Park	Lot 4820	Bennett Street	8621271	700312
35	<i>Calophyllum inophyllum</i>	Bennett Park	Lot 4820	Bennett Street	8621250	0700267
36	<i>Calophyllum inophyllum</i>	Bennett Park	Lot 4820	Bennett Street	8621257	700233
37	<i>Calophyllum inophyllum</i>	Bennett Park	Lot 4820	Bennett Street	8621276	700318
38	<i>Calophyllum inophyllum</i>	Bennett Park	Lot 4820	Bennett Street	8621250	0700267
39	<i>Samanea saman</i>	Bennett Park	Lot 4820	Bennett Street	8621275	700279
40	<i>Alstonia actinophylla</i>	Between Browns Mart & Esplanade	Browns Mart	Smith Street	8621167	700542
41	<i>Alstonia actinophylla</i>	Between Browns Mart & Esplanade	Browns Mart	Smith Street	8621225	700490
42	<i>Alstonia actinophylla</i>	Between Browns Mart & Esplanade	Browns Mart	Smith Street	8621237	700491
43	<i>Alstonia actinophylla</i>	Between Browns Mart & Esplanade	Browns Mart	Smith Street	8621291	700410

44	<i>Alstonia actinophylla</i>	Between Browns Mart & Esplanade	Browns Mart	Smith Street	8621292	700422
45	<i>Alstonia actinophylla</i>	Between Browns Mart & Esplanade	Browns Mart	Smith Street	8621206	700444
46	<i>Alstonia actinophylla</i>	Between Browns Mart & Esplanade	Browns Mart	Smith Street	8621286	700424
78	<i>Calophyllum inophyllum</i>	Rourkes Drift Beer Garden	Lot 3751	48 Mitchell St	8621543	699988
121	<i>Tamarindus indica</i>	Wharf Offices	Lot 5262	Kitchener Drive	8620862	700406
136	<i>Tamarindus indica</i>	Christ Church	Lot 3981	Smith Street	8621262	700561
155	<i>Tamarindus indica</i>	Footpath – outside Parliament House	Lot 3940 & 3675		8621190	700210
197	<i>Tamarindus indica</i>	Wharf Offices	Lot 5262	Kitchener Drive	8620862	700409
198	<i>Cordia subcordata</i>	Old Town Hall Ruins	Lot 4995	Smith St	8621252	700380

APPENDIX 4

Retention Value of Existing Vegetation

Appendix 4

Assessment of Retention Value of Existing Vegetation

Map Unit	Vegetation type (area within DCWR project area)	Retention Value	Dominant vegetation	Comments
1	Coastal vine-forest (0.75 ha)	High	<i>Acacia auriculiformis</i> , <i>Ficus virens</i> , <i>Terminalia microcarpa</i> , <i>Albizia lebbbeck</i> , <i>Alphitonia excelsa</i> , <i>Delonix regia</i> , <i>Litsea glutinosa</i>	Attractive, diverse, tall (to 18m high) mainly native rainforest vegetation. Some outstanding canopy trees. Weeds only on fringes and cultivated margins. Quality habitat.
2	Public open space (1.00 ha)	Low	<i>Hibiscus tiliaceus</i> , <i>Petophorum pterocarpum</i> , <i>Eucalyptus camaldulensis</i> , <i>Pongamia pinnata</i>	Small expanses on recently reclaimed land. Grassed and planted - mainly with native trees. Popular recreation areas.
3	Private gardens (0.60 ha)	Low	<i>Samanea saman</i> , <i>Citharexylum suberratum</i> , <i>Chrysalidocarpus latescens</i> , <i>Plumeria spp.</i> , <i>Cocos nucifera</i>	Restricted to Stokes Hill Wharf area, mix of exotics in well established sections, native species predominate in new landscaping.
4	Regenerating native landscape (1.11 ha)	Medium	<i>Acacia auriculiformis</i> , <i>Lophostemon lactifluus</i> , <i>Melaleuca leucadendra</i> , <i>Alstonia actinophylla</i> , <i>Acacia latescens</i>	Occurs on sheer rock faces of Stokes Hill exposed during tank construction and reclamation works. Abundant vines and ferns amongst hardy natives.
5	Dense weed infestations in native regeneration (1.60 ha)	Nil	<i>Leucaena leucocephala</i> , <i>Acacia auriculiformis</i> , <i>Cassia fistula</i> , <i>Spathodea campanulata</i> , <i>Melaleuca leucadendra</i>	Mainly Coffee Bush (<i>Leucaena</i>) infestations on steep and sloping ground fringing development. Proliferates in disturbed areas with no maintenance or weed control
6	Disturbed ground with scattered plantings (17.52 ha)	Nil – with exception of significant trees	<i>Gmelina arborea</i> , <i>Eucalyptus camaldulensis</i> , <i>Acacia auriculiformis</i> , <i>Casuarina equisetifolius</i> , <i>Delonix regia</i>	Constitutes majority of ground within the survey area. Abundant Coffee Bush. Scattered trees from plantings amongst dense introduced grasses and herbs. Very weedy.
7	Mangrove (0.53 ha)	Medium	<i>Avicennia marina</i> , <i>Sonneratia alba</i> , <i>Rhizophora stylosa</i>	Small but relatively diverse and healthy stands of mangroves in areas of suitable intertidal habitat.

APPENDIX 5

Significant Trees – Historical Information (Source: Greening Australia NT)

new # 40, 41, 42, 43, 44, 45, 46

Register of Significant Trees

Name of Tree(s)

Botanical Name	Alstonia actinophylla
Common Name	Milkwood
Register Number	18
State	Cultivated

Location of Tree(s)

Tree located on	Street Verge - southern Smith Street
Name of property	Between Browns Mart & Esplanade
Suburb	Darwin
Local Authority	Darwin City Council

Owners of Land

Name	Darwin City Council Road Reserve
Number & Street	G.P.O. Box 84
Town/Suburb/District	Darwin

Age of Tree(s)

Date planted	1915
Estimated age in years	73yrs
Planted by	

Measurement of Tree(s) in metres

Number of trees	7
Height	10m
Circumference of trunk	1.8m
Spread of canopy	11m

Condition of Tree(s)

Current state of health	Poor
Potential threat to tree(s)	Old Age, Incorrect Maintenance
Immediate threat to tree(s)	New Development

Categories of significance 4,6,10

Nominated by National Trust

Year listed 1986



Milkwood - Smith St Wst

V.18

This tree is one of an avenue of trees that extended from the Esplanade to Knuckey Street. They were planted around 1915, but most of them have since been removed to provide for parking. The name "Milkwood" derives from their characteristic milky sap, which was used medicinally and in Aboriginal ceremonies. The timber is excellent for carving and dugout canoes were made from the trunk. The timber was also used during World War II to make ammunition boxes.

Source: Nancy Eddy, G.Price Coniagrave