16

Terrestrial Ecology

16.1 Background

Ecological Management Services Pty Ltd (EMS) was commissioned by URS to prepare a terrestrial flora and fauna assessment for components of the proposed expansion area. The target species included flora and fauna species identified in a review of previous ecological studies undertaken in the East Arm area and other data sources, and species listed in threatened categories under Commonwealth and NT Legislation as well as migratory/marine bird species listed under Commonwealth legislation that potentially occur in the vicinity of the study area (EMS, 2011).

The terrestrial vegetation within the study area predominantly consists of disturbed areas/regrowth with minor remnants of mixed species open woodland and monsoon vine forest (Thomas, 2011). The survey therefore also targeted areas identified as remnant bushland, significant vegetation types and known habit for scheduled species (EMS, 2011).

The scope of work included (EMS, 2011):

- Evaluation and description of the terrestrial flora and fauna of the study area.
- An evaluation of the likely presence/habitat suitability for other significant and/ threatened species.
- Assessment and mapping of terrestrial vegetation, including vegetation community mapping, species inventory, weeds and significant flora species/communities.
- A review of the mangrove communities based on existing mapping of the Darwin Harbour.
- An assessment of migratory shorebirds and other wetland birds.
- Evaluation of the site in terms of fauna and flora habitat significance.
- Review and assessment of flora and fauna species listed as threatened under the *Territory Parks and Conservation Act 2000* (*TPWC Act 2000*).
- Review and assessment of Matters of National Environmental Significance (MNES), including threatened flora and fauna species, under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999).*
- Assessment of the ecological values of adjacent mangrove and tidal ecosystems in relation to migratory/marine bird species.
- Assessment of potential impacts on flora and fauna and potential management measures.

Boundaries of the study area were identified from the NOI (AECOM, 2009) surveyed maps, diagrams, flagged boundaries, aerial photographs and consultation with DPC officers. EMS identified four study areas, which align with the NOI (AECOM, 2009) and project description (refer Chapter 2):

- Area 1: Additional rail loop spur into the bulk stockpile area
- Area 2: Marine Supply Base
- Area 3: Hardstand and barge ramp
- Area 4: Former LDC subdivision area.

Specific locations in the study area were acquired with a Global Positioning System (GPS), and aerial photo interpretation (API) was used to determine sites that covered recognisable terrestrial vegetation assemblages, regrowth and disturbed areas. The information obtained was then ground-truthed in the field (EMS, 2011).

16.1.1 Flora Surveys

Flora surveys were undertaken between the 8th and the 12th of November. The flora survey was primarily focussed on terrestrial vegetation within the study area.

As the vegetation in the study area is dominated by disturbed areas and regrowth, with smaller areas of remnant vegetation, a 'check site' method, as described by Brocklehurst *et al.* (2007) was utilised to determine whether vegetation at specific sites satisfied established criteria to qualify as remnant vegetation (EMS, 2011).

The location of survey sites is shown in Figure 16-1 and Table 16-1.

Table 16-1 Flora Survey Sites

Vegetation Community	Vegetation Community Description	Latitude	Longitude
1	Monsoon Vine Forest (MVF)	706450	8620238
2	Low-Mixed High (L-MH) Mixed Species Open Woodland to Woodland (OW/W)	708237	8619585
2	Low-Mixed High (L-MH) Mixed Species Open Woodland to Woodland (OW/W)	709000	8619628
2	Low-Mixed High (L-MH) Mixed Species Open Woodland to Woodland (OW/W)	709110	8621309
2	Low-Mixed High (L-MH) Mixed Species Open Woodland to Woodland (OW/W)	709141	8619635
3	Disturbed Areas with Regrowth	706706	8620429
3	Disturbed Areas with Regrowth	708113	8620937
3	Disturbed Areas with Regrowth	707696	8620845
3	Disturbed Areas with Regrowth	707539	8620755

Source: EMS, 2011

At each flora site a 20 m diameter area was assessed and basic floristic and structural data were collected. Other components of the study area were traversed on foot to (EMS, 2011):

- ensure that each vegetation assemblage was examined for its species composition
- compile short structural and floristic descriptions
- generate a species list
- determine the condition of the vegetation associations (including weeds)
- prepare a vegetation map
- target the occurrence of threatened species as listed in the *TPWC Act 2000* and the *EPBC Act 1999.*

Descriptions of the mangrove communities were based on the existing 1:25,000 Darwin Harbour mangrove mapping (Brocklehurst and Edmeades, 1996). Tidal mangrove communities were not investigated and sampled during the field survey. However, several of the mapped boundaries from existing mapping (Brocklehurst and Edmeades, 1996) were realigned based on review of recent aerial photography. Observations of weeds and other impacts were also noted (EMS, 2011).

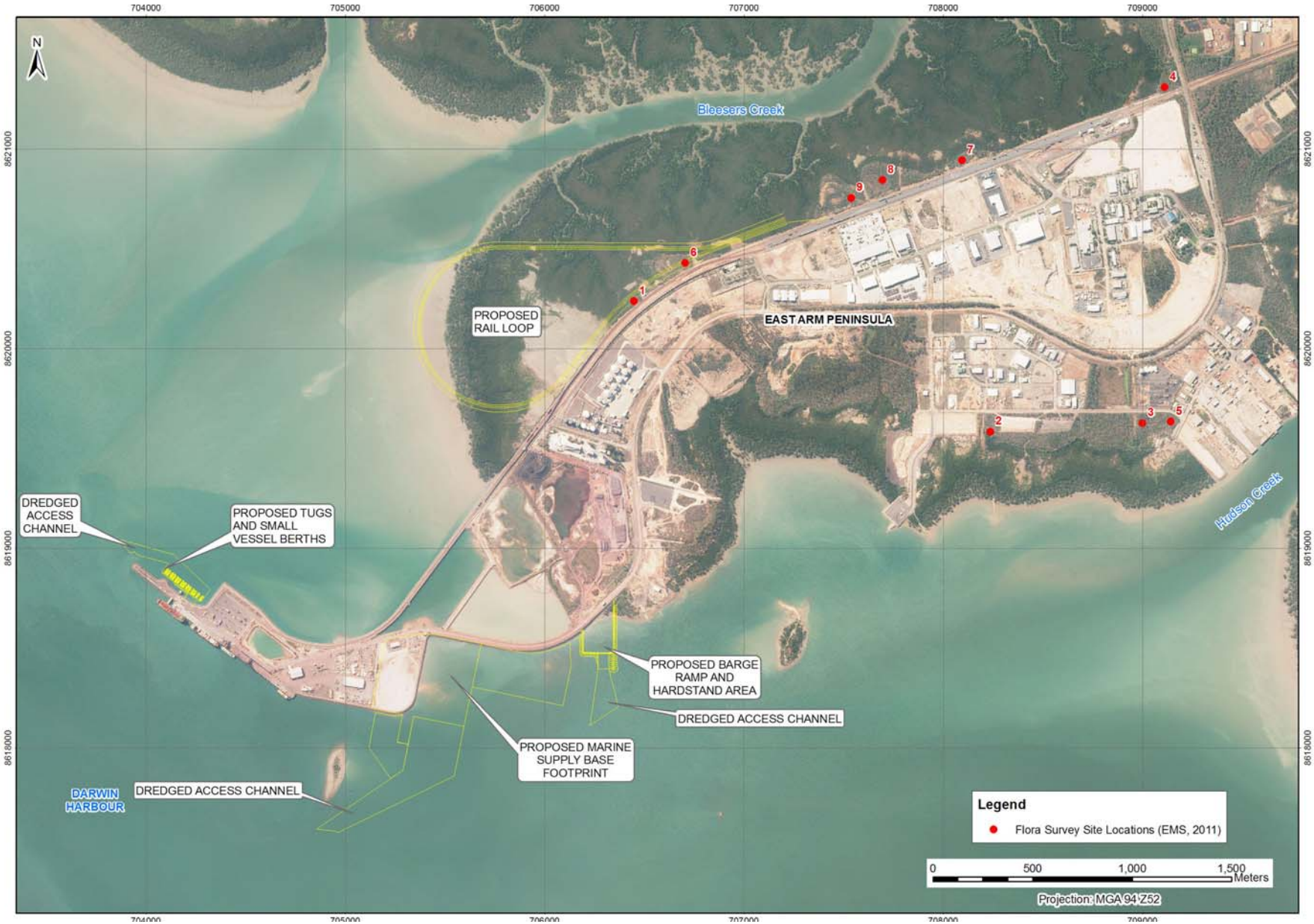

Figure 16-1 Flora Survey Sites

16.1.2 Fauna Survey

The wet season fauna survey incorporating the main vertebrate fauna trapping program was undertaken from 9th to 24th November 2010. An additional migratory bird survey was also undertaken on 16th January 2011.

Four systematic survey sites were sampled within the study area, while other components of the proposed expansion area were inspected and observational surveys/bird counts conducted (EMS, 2011).

Fauna survey sites are shown in Figure 16-2 and Table 16-2.

Table 16-2 Fauna Survey Sites

Site	Description	Site Area	Latitude	Longitude
Fauna Site 1	Monsoon vine forest/mangrove	1	706438	8620251
Fauna Site 2	Mixed species open woodland/Regrowth/ Mangrove	1	707832	8620863
Fauna Site 3	*Ceriops australis* low closed forest (mangrove)	1	708434	8621070
Fauna Site 4	Mixed species open woodland/mangrove	4	708589	8619560
Rail Spur Loop	Salt pan and mangrove forest	1	705994	8619994
Bleesers Creek	Tidal mudflat and mangrove creek frontage	1	705440	8619910
Area 2/3 Foreshore	Tidal mudflat, rocky reef, bund wall	2/3	705852	8618446
Pond A	Dredge spoil pond	EAW	706275	8618926
Pond B	Dredge spoil pond	EAW	706092	8619227
Pond C	Dredge spoil pond	EAW	706096	8618828
Pond D	Dredge spoil pond	EAW	705828	8619074
Pond K	Dredge spoil pond	EAW	705854	8618670
Rail Pond	Dredge spoil pond	EAW	705524	8618838
South Shell Island	Offshore Island	Off-shore	704944	8617895
Catalina Island	Offshore Island	Off-shore	707226	8618506

Source: EMS, 2011

Standard biological survey techniques were used during field surveys, including a number of live capture/release trapping techniques standard and general observational (birds and mammals) and habitat searches (reptiles and amphibians), as well as methods to indirectly detect the presence of terrestrial fauna (EMS, 2011).

Surveys of wetland and shore birds were focussed on a broader area to provide an assessment of adjacent terrestrial and mangrove habitats. The surveys incorporated the study area and adjacent dredge spoil ponds, islands and tidal saline wetlands. Bird surveys within these additional areas included wader counts and observational surveys (EMS, 2011).

A total of 42 shorebird point counts were conducted at sites within and adjacent to the study area. At each of the main dredge spoil ponds (Pond B, D, K and the Rail Pond), the Area 2/3 foreshore and the rail spur loop component of Area 1, five wader counts were conducted in November 2010 and one in

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January 2011. At a number of other sites counts were undertaken opportunistically (South Shell Island, Catalina Island, Bleesers Creek and the tidal mudflat within Area 4) with sites accessed by boat or on foot (6 additional counts) (EMS, 2011).

Wader counts involved scanning site with binoculars and spotting scopes and counting and identifying all shorebirds and other birds (e.g. raptors, terns and gulls). Where large numbers of an individual species were present an estimate of the number of birds was made. Each site was scanned until all visible birds were counted, and care was taken not to double count moving birds (EMS, 2011).

Wader counts conducted at dredge spoil ponds for DPC (Estbergs unpublished data, 2011) were also included in these assessments (EMS, 2011). Flora and fauna survey sampling methodologies and a full report on the results of the survey including survey limitations are presented in **Appendix M**.

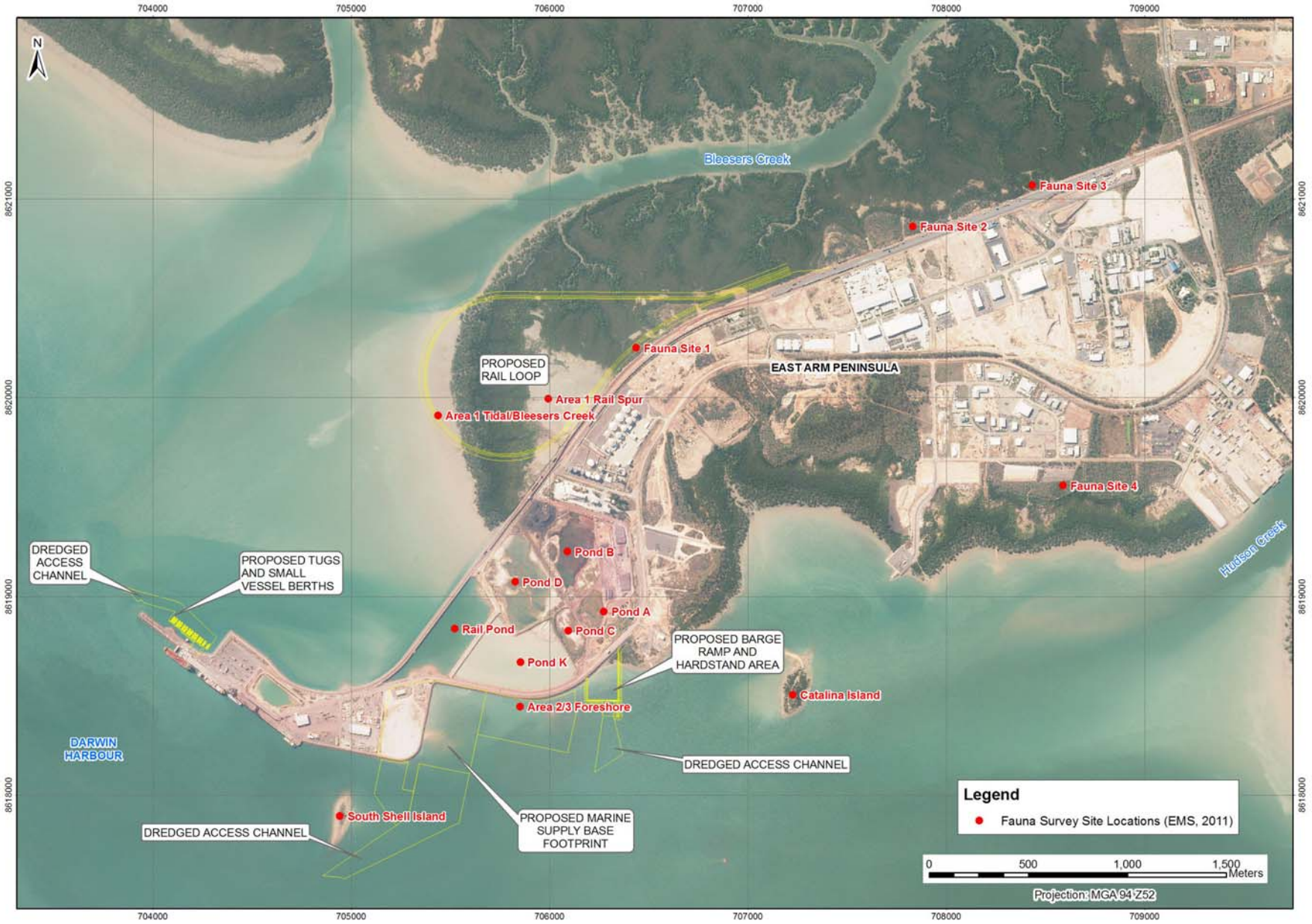

Figure 16-2 Fauna Survey Sites

16.2 Existing Environment

16.2.1 Flora

The vegetation in the study area is dominated by mangroves, with several smaller areas of terrestrial vegetation situated on the higher ground. The majority of the terrestrial vegetation is a disturbed/regrowth type and the remainder is comprised of small areas of two other remnant vegetation types. In some areas reclamation works have impacted on the condition of both the mangrove and terrestrial vegetation types (EMS, 2011).

The flora survey recorded a total of one hundred and five (105) flora species:

- Ninety four (94) native flora species
- Eleven (11) naturalised flora species.

Of these 105 species, there were:

- Five (5) 'Declared Weeds' (*Weeds Management Act 2001*)
- One (1) vulnerable scheduled flora species (*TPWC Act 2001*)
- Two (2) sensitive or significant vegetation types according to the *Northern Territory Land Clearing Guidelines* (NRETAS 2010b).

Three terrestrial vegetation communities were recorded within the study area (EMS, 2011):

- Community 1: Monsoon Vine Forest (MVF)
- Community 2: Low to Mid High, Mixed Species Open Woodland to Woodland
- Community 3: Disturbed Areas with Regrowth

(EMS, 2011)

These are described further in Tables 16-3 to 16-6, and mapped in Figure 16-3.

Mangrove communities in the tidal reaches of the study area were not investigated as part of the survey to advise this assessment (EMS, 2011). However, information is included on these communities below. This information is based on Brocklehurst and Edmeades (1996). These communities are described in Table 16-6 and also mapped in Figure 16-3.

Full species lists and details of the results of surveys are included in **Appendix M**.

Table 16-3 Community 1: Monsoon Vine Forest

Location and Distribution:

One very small area of MVF was located in the study area. This area is situated approximately 500 m to the west-south-west of the Darwin Railway Station within Area 1. It is comprised of a narrow strip of vegetation on the southeastern side of the mangal communities, adjacent to the existing railway line and measuring approximately 6320 m^2 in size. From the marine sediments at sea level there is a slight rise to the MVF which is located on a kandosol soil (NRETAS, 2010a).

Community 1

Description:

A community with a low to mid high (5.1 m to 8 m), dense canopy comprised of mixed species. Although classified as MVF this vegetation is a species-poor semi-deciduous vine forest where the common canopy tree, *Peltophorum pterocarpum* (Yellow Flame Tree) also occasionally occurs as an emergent. Other canopy components include *Allophylus cobbe* (Tit-berry), *Dodonaea platyptera* (Native Hop Bush), *Glochidion xerocarpum* (Cheese Tree), *Mimusops elengi* (Bullet-wood Tree), *Sterculia quadrifida* (Peanut Tree) and *Strychnos lucida* (Strychnine Tree). The midstratum, from 1 m to 5 m, is mid dense and includes regenerating canopy species, as well as vines and other species such as *Bridelia tomentosa* (Pop-gun Seed) and *Premna acuminata* (Firestick Tree). A lower/ground strata (<1 m) which is very sparse may include vines, *Hypoestes floribunda* (Hypoestes) and seedlings of other common species such as *Peltophorum pterocarpum* (Yellow Flame Tree), Dodonaea platyptera (Native Hop Bush) and *Premna acuminata* (Firestick Tree). Vines are very common and include *Alyxia spicata* (Chain Fruit), *Ampelocissus acetosa* (Wild Grape), *Capparis sepiaria* (Wild Orange), *Cayratia acris* (Hairy Water Vine), *C. trifolia* (Three-leaf Cayratia), *Dioscorea transversa* (Native Yam), *Flagellaria indica* (Whip Vine), *Ichnocarpus frutescens* (Black Creeper), *Ipomoea abrupta* (Bush Potato), *Jasminum didymum* (Native Jasmine), *Opilia amentacea* (Opilia), *Protasparagus racemosa* (Asparagus Fern) and *Ziziphus oenopolia* (Small-fruited Jujube).

As the slight slope drops away to the mangroves on marine and estuarine sediments, a narrow ecotonal edge with *Melaleuca leucadendra* (Weeping Paperbark), *Hibiscus tiliaceus* (Beach Hibiscus) and *Ichnocarpus frutescens* (Black Creeper) adjoins the MVF.

Relationships and significance of the vegetation community:

- This vegetation community is equivalent to a Low to Mid High Closed Forest (Walker and Hopkins, 1990), Low Closed Forest or T6d (Brocklehurst et al. 2007) and Unit 1a (Wilson et al., 1990).
- The community is recognised as significant vegetation under the *NT Land Clearing Guidelines* (NRETAS, 2010b). It is not listed as significant or threatened under the *EPBC Act 1999.*
- Species listed in the threatened species schedules of the *EPBC ACT 1999* and the *TPWC Act 2000* were not observed in the MVF community.

Condition, Declared and other Naturalised Species:

The vegetation community is generally in 'good' condition (Buchanan, 1989). However, the edge adjoining the railway line and a section to the northeast are showing signs of previous impacts with loss of structure and floristics.

Melinis repens (Red Natal Grass) is the only naturalised species observed in Community 1, where it was uncommon and recorded only from the edge of the community near the existing railway line.

Source: EMS, 2011

Table 16-4 Community 2: Low to Mid High, Mixed Species Open Woodland to Woodland

Location and Distribution:

The low to mid high mixed species open woodland to woodland is present at a number of separate locations across the study area (Figure 1). There are several areas of this habitat to the south of Hamaura Road (Area 4). Recent filling and clearing was observed in this area. Soils were identified as hydrosols on plains and drainage systems as well as kandosols on plains and rises (NRETAS, 2010a). In Area 1 there is a very small remnant of this community near the intersection of Berrimah Road and the Railway Line (2.5 kms northeast of the Darwin Railway Station). Soils at this site are hydrosols on drainage systems (NRETAS, 2010a). An additional two smaller remnants are located in Area 1 to the northeast of the railway station (1 & 1.2 kms). Soils at these sites are kandosols on plains and rises (NRETAS, 2010a).

Community 2

Description:

This vegetation community is comprised of a low to mid high (5.1 m to 10 m) very sparse to sparse canopy. The canopy can include a range of species, including *Buchanania obovata* (Green Plum), *Corymbia latifolia* (Round-leafed Bloodwood), *C. ptycho*carpa (Swamp Bloodwood), *C. polycarpa* (Longfruited Bloodwood), *Eucalyptus tetrodonta* (Stringy Bark), *Erythrophleum chlorostachys* (Cooktown Ironwood), *Livistona humilis* (Sand Palm), *Melaleuca viridiflora* (Broad-leaved Paperbark) and *Pandanus spiralis* (Screw Palm). As noted in the short description the canopy varies in composition and height; on the better drained rises a suite of *Corymbia* and *Eucalyptus* species tend to dominate while on the lower slopes and drainage systems *Corymbia polycarpa* (Long-fruited Bloodwood) occurs as an occasional emergent with a very sparse and lower canopy of *Melaleuca viridiflora* (Broad-leaved Paperbark), *Pandanus spiralis* (Screw Palm) and *Livistona humilis* (Sand Palm). The mid-stratum (generally 1.1 m to 5 m) is sparse and mainly dominated by regenerating canopy species. *Buchanania obovata* (Green Plum) and *Pandanus spiralis* (Screw Palm) are often dominant, and other common species include *Hakea arborescens* (Common Hakea), *Petalostigma quadriloculare* (Witchetty Bush) and *Planchonia careya* (Cocky Apple). The lower/ground strata (<1 m) is mid dense with various grasses and herbs common. A recent fire in these areas has made identification of some plant species difficult. Species recorded include *Mnesithea rottboellioides* (Northern Cane Grass), *Sebastiania chamaelea* (Sebastiania), *Pandanus spiralis* (Screw Pine), *Planchonia careya* (Cocky Apple), *Wrightia saligna* (Milk Bush), *Drosera petiolaris* (Sundew), *Waltheria indica* (Sleepy Morning), *Rhynchosia minima* (Burn Mouth Vine), *Ampelocissus acetosa* (Wild Grape), *Murdannia graminea* (Grass Lily) and *Heliotropium ventricosa* (White Lady Heliotrope).

Relationships and significance of the vegetation community:

- This association is equivalent to a mixed species Low to Midhigh Open Woodland/Woodland (Walker and Hopkins, 1990); mixed species Low Open Woodland to Low Woodland or T6r and T6i of Brocklehurst et al. (2007); and Units 18 and 51 of Wilson et al. (1990).
- The community is not recognised as significant vegetation under the *NT Land Clearing Guidelines* (NRETAS, 2010b), and is not listed under the *EPBC Act 1999*.
- Plant species listed in threatened species schedules of the *EPBC ACT 1999* were not observed in this community.
- One species listed as vulnerable in the *TPWC Act 2000* (*Cycas armstrongii*) was common in the narrow strip of remnant vegetation along the edge of Hamaura Road within Area 4.

Condition, Declared and other Naturalised Species:

The undisturbed remnant areas of this vegetation community are generally in ‘good’ condition (Buchanan (1989). *Passiflora foetida* (Stinking Passion Flower) is the only naturalised species observed in Community 2. This species was occasional and recorded from the area northeast of the railway station near Berrimah Road, within Area 1.

Source: EMS, 2011

Table 16-5 Community 3: Low to Mid High, Mixed Species Open Woodland to Woodland

Location and Distribution:

Two larger areas of disturbed vegetation with regrowth were mapped in the study area within Area 1. They occur on the rises north of the railway line and are bordered by the mangroves within Area 1. They appear to have been part of the previous reclamation works, with species present being representative of regeneration.

Community 3

Description:

Height of the canopy in these areas varies from 3 m to 8 m with a sparse or dense foliage cover of saplings or small trees. Acacia, Melaleuca, Corymbia and Eucalyptus are common. Species present include *Acacia holosericea* (Silver-leaf Wattle), *A. auriculiformis* (Earpod Wattle), *Melaleuca leucadendra* (Weeping Paperbark), *Melaleuca viridiflora* (Broad-leaved Paperbark), *Corymbia polycarpa* (Long-fruited Bloodwood), *Eucalyptus tetrodonta* (Darwin Stringybark) and *Buchanania obovata* (Green Plum). Grasses are very common in the ground stratum; native species include *Alloteropsis semialata* (Cockatoo Grass), *Eriachne burkittii* (Wanderrie Grass), *Eulalia mackinlayi* (Silky Brown Top), *Mnesithea rottboellioides* (Northern Cane Grass) and *Sorghum timorense* (Downs Sorghum).

Relationships and significance of the vegetation community:

- The community is not recognised as significant vegetation under the *NT Land Clearing Guidelines* (NRETAS, 2010b) and is not listed under the *EPBC Act 1999*.
- Species listed in the threatened species schedules of the *EPBC ACT 1999* and the *TPWC Act 2000* were not observed in this community.

Condition, Declared and other Naturalised Species:

Generally in 'poor' to 'very poor' condition (Buchanan, 1989).

Naturalised species were very common and included several declared weeds (Northern Territory of Australia, 2001). Declared species recorded include *Andropogon gayanus* (Gamba Grass), *Lantana camara* (Lantana), *Pennisetum polystachion* (Mission Grass) and *Sida cordifolia* (Flannel Weed). Others included *Clitoria ternatea* (Butterfly Pea), *Ipomoea quamoclit* (Cardinal Vine), *Leucaena leucocephala* (Leucaena), *Melinis repens* (Red Natal Grass), *Passiflora foetida* (Stinking Passion Flower) and *Stylosanthes scabra* (Shrubby Stylo).

Source: EMS, 2011

Table 16-6 Mangrove Communities

Location and Distribution:

Mangroves and associated marine communities are widespread and cover a large part of the study area (Figure 1). Mangroves are situated in tidal areas on marine and estuary sediments (NRETAS, 2010a) north of the existing railway line and fronting Darwin Harbour at the mouth of Blessers Creek (Area 1) and Hudson Creek (Area 4). A small area of mangrove habitat occurs within Area 2/3 and on offshore islands (Catalina Island, South Shell Island). The Darwin Harbour is often referred to as macro-tidal (Northern Territory, 2010), with tidal ranges up to 8 m, indicating that these habitats are subject to strong tidal influences.

Mangrove Communities

Short Description:

The mangal communities of the East Arm area have been previously mapped by Brocklehurst and Edmeades (1996). The communities recognised by those authors and represented in the study area are are mapped in Figure 1. These include:

- *Rhizophora stylosa*/*Camptostemon schultzii* closed-forest (tidal creek)
- *Ceriops australis* low closed-forest (mid tidal flat)
- *Ceriops australis*/*Avicennia marina* low closed forest (high tidal flat)
- Mixed species low closed forest/open forest (hinterland)
- *Sonneratia* Woodland
- Low open-woodland (low tidal mudflat)
- Samphire and Saltpans

Relationships and significance of the vegetation community:

- Several of these communities are equivalent to Closed Forest (Walker and Hopkins, 1990), Low to Tall Closed Forest T7d and T6d (Brocklehurst et al. 2007) and Unit 105 (Wilson et al., 1990).
- Mangrove communities are recognised as sensitive or significant vegetation under the *NTLand Clearing Guidelines* (NRETAS, 2010b). The mangal communities cover a large portion of Area 1 and Area 4. They are not listed as threatened under the *EPBC Act 1999*.
- Species listed in the threatened species schedules of the *EPBC ACT 1999* and the *TPWC Act 2000* were not observed in this community.

Condition, Declared and other Naturalised Species:

Generally in 'good' condition (Buchanan, 1989). However at several places, filling, clearing and tracks were recorded. Debris from the marine environment was also observed scattered throughout the mangrove vegetation. Naturalised species were not recorded.

Source: EMS, 2011

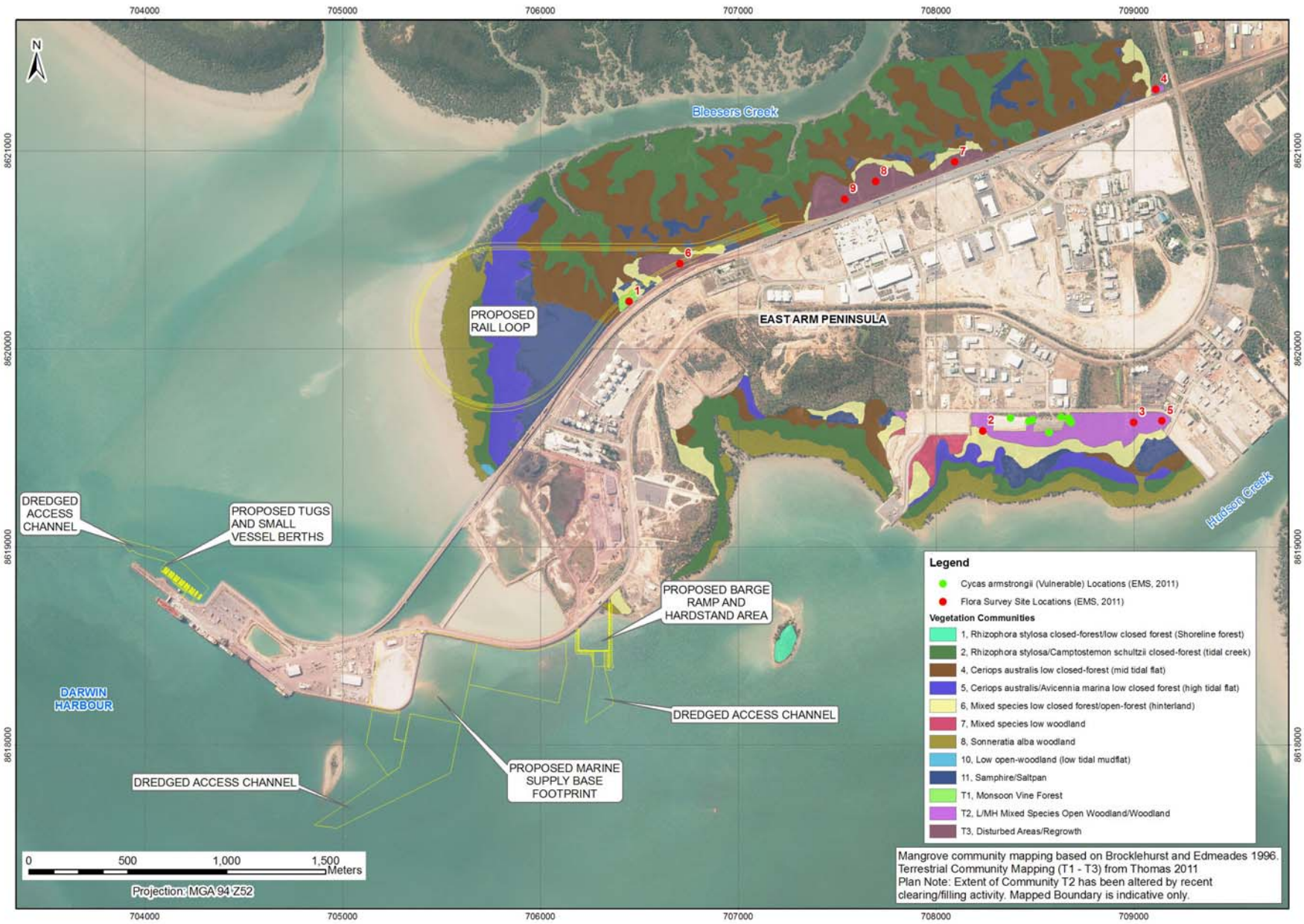

Figure 16-3 Fauna Survey Sites

16.2.2 Fauna

A total of one-hundred and forty-one (141) species of native terrestrial vertebrate species were recorded within the study area, including seven (7) amphibian, eleven (11) reptile, one-hundred and nine (109) birds and fourteen (14) mammal species. Two introduced species, the Cane Toad (*Rhinella marina*) and the Asian House Gecko (*Hemidactylus frenatus*), were recorded within the study area. An additional marine mammal, the Indo-pacific Hump-back Dolphin (*Sousa chinensis*), was observed in offshore habitat adjacent to the study area (EMS, 2011).

A summary of the species recorded is presented in Table 16-7.

Full species lists and details of the results of surveys are included in **Appendix M**.

Table 16-7 Species recorded in the Study Area

Amphibians
Seven native amphibian species were recorded during the surveys within the study area. Habitats for amphibians within Area 1 (Sites 1 - 3) are limited to small areas of terrestrial vegetation and drains on the margin of the existing railway lines. Common species at these sites include the Purple Treefrog (*Litoria rubella*), Common Tree Frog (*Litoria caerulea*) and Striped Rocket Frog (*Litoria nasuta*). More extensive habitat for amphibians was present at Site 4 (Area 4), however this area is restricted to a band of open woodland and grassland between Hamaura Road and mangrove habitats. Additional species recorded at this site included the Giant Frog (*Cyclorana australis*), Marbled Frog (*Limnodynastes convexiusculus*) and Northern Dwarf Tree Frog (*Litoria bicolor*).
Most amphibians were recorded along drain lines and inundated areas in low-lying melaleuca dominated mixed open woodland habitats in Area 4. The introduced Cane Toad was present at a number of sites and was observed along tracks and in rail yards. Native amphibians recorded in the vicinity of the project area and in the local area are generally common in the Top End and have been previously reported in the region. Habitats suitable for amphibians are extremely restricted in the study area, particularly in Area 1 and Area 2/3, due to the limited nature of terrestrial and freshwater habitat. None of the species present are listed as threatened (endangered or vulnerable) in relevant legislation.
The only amphibian species listed as threatened under NT Legislation, the Howard River Toadlet (*Uperoleia daviesae*), is known to occur in the Palmerston area. This species were not detected in the study area and there appears to be no or extremely limited suitable habitat for this species within the main study area.
Reptiles
Eleven reptile species were recorded within the study area. The most commonly encountered and widespread species was the introduced Asian house gecko. One varanid species, the Mitchell's Water Monitor (*Varanus mitchelli*), was trapped in mangroves at S3. The Slate-Grey Snake (*Stegonotus cucullatus*) was the only snake species observed during the survey.
Acer Vaughan (1993) reported one vulnerable (NT) species, the Yellow-Spotted Monitor (*Varanus panoptes*), in the study area. This species was not recorded during the 2010 - 2011 surveys. Estuarine Crocodiles (*Crocodylus porosus*) are known to occur in marine and estuarine habitats in the local area and are infrequently captured in Bleesers Creek by the NT Parks and Wildlife Service. This species is listed as a migratory and marine species under the Commonwealth *EPBC Act 1999*.
Terrestrial Birds
One-hundred and nine bird species were recorded within the study area during the survey. Acer Vaughan (1993) list eleven additional common bird species for the study area and Estbergs (2011) has recorded a number of terrestrial birds not recorded during the current assessment, including the Peregrine Falcon (*Falco peregrinus*) and Nankeen Kestrel (*Falco cenchroides*).
The most frequently recorded terrestrial bird species were the Red-headed Honeyeater (*Myzomela erythrocephala*), Rainbow Lorikeet (*Trichoglossus haematodus*), Little Corella (*Cacatua sanguinea*), Rainbow Bee-eater (*Merops ornatus*), Yellow White-eye (*Zosterops luteus*), White-throated Honeyeater (*Melithreptus albogularis*), White-gaped Honeyeater (*Lichenostomus unicolor*) and Bar-shouldered Dove (*Geopelia humeralis*). Bird species that were restricted or more frequently recorded in mangrove habitats within the study area included the Collared Kingfisher (*Todiramphus chloris*), Red-headed Honeyeater, Green-backed Gerygone (*Gerygone*

chloronota), Mangrove Gerygone (*Gerygone levigaster*), Yellow White eye, Mangrove Robin (*Peneonanthe pulverulenta*), Grey Whistler (*Pachycephala simplex*), Shining Flycatcher (*Myiagra alecto*) and Helmeted Friarbird (*Philemon buceroides*).

Three nocturnal bird species, the Tawny Frogmouth (*Podargus strigoides*), Large-tailed Nightjar (*Caprimulgus macrurus*) and Barking Owl (*Ninox connivens*), were recorded within the study area. The terrestrial bird species recorded during the current and previous surveys within the study area are not listed as threatened in relevant legislation. The Bush Stone-Curlew (*Burhinus grallarius*) is listed as near threatened under the NT TPWC Act *2000*. A number of terrestrial bird species listed in *EPBC Act 1999* migratory species schedules, including the Rainbow Bee-Eater and Cicadabird (*Coracina tenuirostris melvillensis*), were recorded within the study area.

Marine and Wetland Birds

Forty-seven marine and wetland bird species were recorded during shorebird counts within the study area. Estbergs (2011) recorded a number of additional listed migratory bird species on the dredge spoil ponds during monitoring conducted in 2009 - 2010, including an unidentified species of pratincole, an unidentified Snipe, Pacific Golden Plover (*Pluvialis fulva*), Oriental Plover (*Charadrius veredus*), Wood Sandpiper (*Tringa glareola*), Sanderling (*Calidris alba*) and Red Knot (*Calidris canutus*). A total of 31 species of birds listed as migratory wetland or marine species under the *EPBC Act 1999* have been recorded within the study area, and 59 species are classified as marine species under this Act.

A number of raptor species, including the Eastern Osprey (*Pandion cristatus*), White-bellied Sea-Eagle (*Haliaeetus leucogaster*), Brahminy Kite (*Haliastur indus*) and Whistling Kite (*Haliastur sphenurus*), have been observed in association with marine and wetland habitats within the study area. The Blackwinged Stilt (*Himantopus himantopus*) (*EPBC Act 1999* listed marine species) was recorded breeding on the dredge spoil ponds during the survey period.

The largest single count of wetland and marine birds from combined shorebird count sites across the study area was 1330 birds (22/11/2010). The largest concentrations of wetland and marine birds during November 2010 were associated with the dredge spoil ponds within the EAW study area, with important sites including Pond D, B and K. Numbers of birds at these sites generally increased during the rising tide as birds moved from foraging areas on mudflats surrounding the East Arm area as these areas were inundated. These dredge spoil ponds supported fewer birds during January 2011 as heavy rainfall had partially filled the ponds, reducing opportunities for roosting and foraging. Data from Estbergs (2011) suggests that the numbers of marine and wetland birds using these sites varies depending on local conditions, including tides, weather and seasonality.

Other components of the study area, including saline flats, mudflats and mangroves, supported shorebirds, marine birds and wetland birds dispersed throughout broad areas of habitat. During high tides small numbers of birds were roosting on saline flats and in mangrove areas, however no large aggregations (> 30 birds) of roosting birds were detected away from the dredge spoil ponds. Species present in mangrove and salt marsh habitat included Whimbrel (*Numenius phaeopus*), Far Eastern Curlew (*Numenius madagascariensis*), Marsh Sandpiper (*Tringa stagnatilis*), Common Greenshank (*Tringa nebularia*) and Greater Sand Plover (*Charadrius leschenaultii*).

A high tide survey of creeks and mangrove areas adjacent to Area 1 and Area 4 recorded small mixed flocks on migratory waders roosting at these sites, with common species including Terek Sandpiper (*Xenus* cinereus), Grey-tailed Tattler (*Tringa brevipes*) and Common Sandpiper (*Actitis hypoleucos*). A single Terek Sandpiper roosting in mangroves at high tide adjacent to Area 1 was carrying leg flags indicating that it was captured and banded in China (Chongming Dao). At low tide groups of shorebirds were feeding on tidal mudflats in Area 1 and 4.

Very few birds were observed foraging or roosting on the foreshore areas of Area 2/3 and South Shell Island. Catalina Island supported small numbers of roosting birds, mainly Intermediate Egret (*Ardea intermedia*), Eastern Reef Egret (*Egretta sacra*) and single Beach Stone-curlew (*Esacus neglectus*) and White-bellied Sea-eagle. The Chestnut Rail (*Eulabeornis castaneoventris*) was common in mangrove habitats across the study area, being detected at all standard fauna sites within the rail spur (Area 1), mangroves at the western end of Area 1 and along Bleesers Creek.

Four tern species listed as migratory species under the EPBC Act 1999, including the Common Tern, (*Sterna hirundo*), Bridled Tern (*Onychoprion anaethetus*), Little Tern (*Sterna albifrons*) and White-winged Black-tern (*Chlidonias leucopterus*), were recorded during the shorebird counts. The Roseate Tern (*Sterna dougallii*) was reported incidentally at the dredge spoil ponds during a number of surveys conducted by Estbergs (2011). Most tern species were observed foraging in near coastal areas of Area 1 and Area 2/3, and Little Tern and White-winged black tern were recorded roosting on Pond D within the dredge spoil reclamation area.

Mammals

Fourteen native mammal species were identified within the study area during the survey. Ten of these species were bats, some of which could not be identified to species level. An additional marine species, the Indo-pacific Humpback Dolphin (*Sousa chinensis*), was observed in offshore components of Area 1 and Area 2/3.

A total of 384 Elliott and wire cage trap nights resulted in the capture of a single small mammal species, the Grassland Melomys (*Melomys burtoni*), in open woodland and mangrove habitats. Spotlight survey recorded few mammals, including small numbers of Black Flying-fox (*Pteropus a*lecto), Little Red Flying-fox (*Pteropus scapulatus*) and Dingo (*Canis lupus dingo*). A single mammal species, the Northern Brown Bandicoot (*Isoodon macrourus*), was detected at a single site from hairs collected from hair funnels.

Acer VaughnVaughan (1993) recorded four native mammal species, including the Northern Quoll (*Dasyurus hallucatus*), Agile Wallaby (*Macropus agilis*), Antilopine Wallaroo (*Macropus antilopinus*) and the Common Brushtail Possum (*Trichosurus vulpecula*), that were not recorded during the 2010 - 2011 survey.

Eight microchiropteran bat species/taxa were recorded from echolocation call detection using Anabat detectors. Sequences of sufficient quality for positive identification were recorded for the Northern Freetailbat (*Chaerephon jobensis*), Mangrove Freetail-bat (*Mormopterus* [*loriae*] *cobourgiana*), Mangrove Pipistrelle (*Pipistrellus westralis*), Large-footed Myotis (*Myotis macropus*) and Little Cave Bat (*Vespadelus* caurinus). The Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) was identified tentatively from a small number of poor recordings. It is not possible to separate the calls of this species from that of the endangered Barerumped Sheathtail Bat (*Saccolaimus saccolaimus*) without better quality calls including feeding buzzes. A species of Long-eared Bat (*Nyctophilus* sp) was recorded but could not be identified to species level using the Anabat system. A number of calls were recorded with a characteristic frequency range at around 35 – 40 khz, which could represent a number of species, including Hoary Wattled Bat (*Chalinolobus nigrogriseus*) or Broad-nosed Bat (*Scotorepens greyii*/*sanborni*). Calls in the characteristic frequency range/pulse shape of the Mangrove Pipistrelle (*Pipistrellus westralis*) were recorded in mangrove areas during the survey, however it should be noted that calls of this species can be confused with the Northern Bentwing Bat (*Miniopterus orianae orianae*). The most common and widespread bat species were the Northern Freetail-bat and Mangrove Freetail-bat. The Northern Freetail-bat is frequently observed roosting in jetty and wharf structures in the Darwin Harbour area. The Large-footed Myotis (*Myotis macropus*) was recorded in mangroves and along an open drain at Site 1.

Mammal species recorded in the study area are generally common in northern Australia and none of the species are classified as threatened under the *EPBC Act 1999* and the *TPWC Act 2000*. Acer VaughnVaughan (1993) previously recorded the endangered Northern Quoll (*Dasyurus hallucatus*) within the study area, however this species was not recorded during the 2010 - 2011 surveys.

Source: EMS, 2011

16.2.3 Threatened Flora and Fauna Species

Significant threatened species in the context of this review are those which are listed in the higher categories of critically endangered, endangered, vulnerable or near threatened under Commonwealth or NT legislation (EMS, 2011).

The field surveys undertaken to advise this assessment recorded (EMS, 2011):

- One plant species, *Cycas armstrongii*, which is listed as vulnerable under the *TPWC Act 2000*.
- One fauna species, the Bush Stone-curlew (*Burhinus grallarius*), which is listed as near threatened under the *TPWC Act 2000.*
- Thirty-one (31) species of birds listed as migratory wetland or marine species under the *EPBC Act 1999*.
- Fifty-nine (59) bird species classified as marine species under the *EPBC Act 1999*.

None of the fauna species recorded within the study area are listed as endemic to the Darwin Coastal bioregion or the NT in the *Northern Territory Assessment of Key Biodiversity Values and Threats for Bioregions* (Baker et al., 2005) (EMS, 2011).

Listed flora and fauna species that have been recorded within the study area during current and past surveys are presented in Table 16-8 and discussed below.

Listed species that have been recorded in the surrounding area are discussed in Section 16.2.4.

Listed migratory and marine species are discussed in Section 16.2.5.

Table 16-8 Listed Threatened Flora and Fauna Species/Site Records

Common Name	Scientific Name	EPBC Act 1999	TPWC Act 2000	Study Area Site Records
No common name	*Cycas armstrongii*		Vulnerable	Area 4
Northern Quoll	*Dasyurus hallucatus*	Endangered	Critically Endangered	Site records from Acer Vaughan (1993). No recent records.
Yellow-spotted Monitor	*Varanus panoptes*		Vulnerable	Site records from Acer Vaughan (1993). No recent records.
Bush Stone-curlew	*Burhinus grallarius*		Near Threatened	S1, S4 in Area 1

Source: EMS, 2011

Cycas armstrongii Vulnerable TPWC Act 2000

Cycas armstrongii is classified as vulnerable under the *TPWC Act 2000*. This species was common in a narrow strip of Community 2 (Low to Mid High, Mixed Species Open Woodland to Woodland) remnant vegetation along the edge of Hamaura Road within Area 4 (Figure 16-4). This species was not observed within other components of the study area (EMS, 2011).

Cycas armstrongii is endemic to the NT and is known to occur from Gunn Point to Hayes Creek, west to within 50 km of the coast and east to the Wildman River catchment, and also occurs on the Tiwi Islands and Cobourg Peninsula (Kerrigan et al., 2006). Threatening processes include land clearing for development projects in the Darwin region and forestry operations on the Tiwi islands (Kerrigan et al., 2006).

A management program for Cycads in the NT was prepared in 2009, which aims to maintain viable wild populations of all cycad taxa and cycad habitats across their range in the NT (Liddle, 2009). To achieve this aim the program provides guidance on:

- Promoting the conservation of cycad populations through sustainable land management practices.
- Developing and apply strategies for the ecologically sustainable use of cycads.
- Providing for the wise use of cycads that will otherwise be destroyed through land use permitted under relevant legislation.
- Facilitating essential research.
- Promoting public awareness and education.

Under the *TPWC Act 2000* a permit is required by individuals to take Protected Wildlife or their parts for non-commercial purposes. In the case of cycads, *Cycas armstrongii* is protected due to its threatened status under the *TPWC Act 2000* (EMS, 2011). Where land clearing has been approved under the formal procedures of the NTG, no additional permit will be required to take cycads for non-commercial purposes on areas designated to be cleared (EMS, 2011). Cycads salvaged from such

areas for commercial purposes are subject to the commercial harvest provisions of this program (Liddle, 2009).

Source: EMS, 2011

Figure 16-4 *Cycas Armstrongii* (Vulnerable TPWC Act 2000) Area 4

Northern Quoll (Dasyurus hallucatus) Critically Endangered EPBC Act 1999

The Northern Quoll (*Dasyurus hallucatus*) is classified as endangered under the *EPBC Act 1999* and critically endangered under the *TPWC Act 2000*. This species was detected from tracks in the study area and reported to be common during surveys conducted in 1990 (Acer Vaughan, 1993).

Northern Quoll populations in the Darwin region declined rapidly following the arrival of Cane Toads in 2004 - 2005; however there had been documented declines in the NT prior to the arrival of toads, possibly due to inappropriate fire regimes or other factors (Hill and Ward, 2010). Cane Toads are currently considered the main threat to Northern Quoll populations in parts of their range within Australia (Hill and Ward, 2010).

The Northern Quoll was not detected within the study area during the 2010 - 2011 survey. At sites in the NT where Northern Quoll populations persist and animals are present in reasonable numbers, they are generally detected by the standard trapping and survey techniques applied during the current survey, including trapping, spotlighting, hair funnels and camera traps.

As recent trapping and other surveys within the project area have failed to locate this species, it is possible that Northern Quoll no longer occurs in the local area. However if they do persist they are likely to be present at significantly lower density than observations in 1990 indicate. There is a very small area of fragmented suitable habitat for the Northern Quoll present within the study area (EMS, 2011).

Yellow-spotted monitor (Varanus panoptes) Vulnerable TPWC Act 2000

The Yellow-spotted Monitor (*Varanus panoptes*) is classified as vulnerable under the *TPWC Act 2000*. Declines of this species have been associated with the invasion of the Cane Toad. This species has persisted in the Darwin region following the arrival of the Cane Toad (Smith and Firth, 2003); however it is likely to be present at lower population densities.

This species was recorded during surveys within the study area conducted in 1990 (Acer Vaughan 1993). It is potentially still present in the local area; however as for the Northern Quoll there is a limited area of fragmented suitable habitat for the Yellow-spotted Monitor present within the study area (EMS, 2011).

Bush Stone-curlew (Burhinus grallarius) Near Threatened TPWC Act 2000

The Bush Stone-curlew (*Burhinus grallarius*) is listed as near threatened the under the *TPWC Act 2000*. A species qualifies as near threatened when it has been evaluated against criteria but does not qualify as critically endangered, endangered or vulnerable at the time of assessment, but is close to qualifying for or is likely to qualify for a threatened category in the near future (IUCN, 2001).

This species is relatively common in the Darwin region and the small numbers of pairs that are present in the study area are unlikely to represent a significant population. The individuals observed within the bushland and regrowth remnants within the study area were also observed moving into adjacent areas of cleared land, railway yards and parkland (EMS, 2011).

16.2.4 Threatened Flora and Fauna Species Recorded in Surrounding Areas

Results of a review of existing databases and reports listing critically endangered, endangered and vulnerable flora and fauna species recorded in the surrounding areas are included in Table 16-9.

The search of the NTG database for the selected area included one flora species, the cycad *Cycas armstrongii*, (listed as vulnerable in the *TPWC Act 2000*) (EMS, 2011). This database also lists twenty-four plant species listed as data deficient and seventy-five weeds and potential weeds for the search area (EMS, 2011). A copy of this database search is included as Appendix 1 to **Appendix M.**

Based on existing data and known habitat preferences, thirteen threatened fauna species have been identified as potentially occurring in local habitats (EMS, 2011). In addition, the *EPBC Act 1999* protected matter search lists a range of listed migratory species that potentially occur in the East Arm area (DSEWPC, 2011). Many of these species are also listed in existing data (Appendix 1 and Appendix 3.1 of **Appendix M**) or have been previously reported in the study area (Acer Vaughan, 1993) or adjacent areas (PWCNT, 2003) (EMS, 2011). Migratory and marine species are discussed further in Section 16.2.5.

It is important to note that some of these records of threatened species are historical or are generated from data from the wider region and may no longer or may never have occurred within the study area and/or surrounding habitats (EMS, 2011). Existing data sources list a large number of fauna species that potentially occur in the region, however the small extent and limited diversity of the terrestrial habitats present within the study area indicates that local sites would support a sub-set of these species (EMS, 2011).

Table 16-9 Threatened Flora and Fauna Species Recorded in Surrounding Areas

Scientific / Common Name	*EPBC Act 1999*	*TPWC Act 2000*	Data Source	Habitat
Cycas armstrongii		V	1	Grassy woodland on yellow and red earths, well drained sites
Howard River Toadlet *Uperoleia daviesae*		V	*	Low-lying habitats with sandy soils, Melaleuca swamps
Yellow-spotted Monitor *Varanus panoptes*		V	1, 4, 5	Open forests and woodlands
Merten's Water Monitor *Varanus mertensi*		V	1,5	Swamp forest and riparian habitats
Red Goshawk *Erythrotriorchis radiatus*	V	V	1, 2, 3	Open forest/woodland and riparian habitats
Australian Bustard *Ardeotis australis*	V		1, 3	Eucalyptus forest and woodland with grassy understorey
Australian Painted Snipe *Rostratula australis*	V	V	1	Shallow, vegetated, freshwater swamps, claypans or inundated grassland
Masked Owl *Tyto novaehollandiae kimberli*	V	V	1, 3	Tall open forest, monsoon vine forest
Gouldian Finch *Erythrura gouldiae*	E	E	1, 2, 3	Wooded hills and lowland grassy woodlands
Northern Quoll *Dasyurus hallucatus*	E	CE	1, 2, 3, 4, 5	Open forest and woodlands
Northern Phascogale *Phascogale pirata*		V	1, 2, 3	Eucalypt forest and woodlands
Brush-tailed Rabbit-rat *Conilurus penicillatus*	V	V	2, 3	Open forests and woodlands
Bare-rumped Sheath-tailed Bat *Saccolaimus saccolaimus*	CE		1, 3	Tall open forest and woodlands in the coastal lowlands
Water Mouse *Xeromys myoides*	V	DD	2, 3	Mangroves and adjacent vegetation, freshwater wetlands

Source: EMS, 2011

Conservation Status: CE = Critically Endangered E = Endangered, V = Vulnerable, DD = Data Deficient
Data sources:
* Possible occurrence in the Palmerston area
1 = NT Government Data/NT NRM report, 2011
2 = EAW EPBC protected matters report, 2011
3 = Baker et al. (2005) Darwin Coastal Bioregional Assessment
4 = East Arm Wharf Precinct EIS (Acer Vaughn, 1993)
5 = Online Zoological Collections of Australian Museums (OZCAM) records

16.2.5 Migratory and Marine Species

A number of migratory species (*EPBC Act 1999*) have been recorded within the study area, predominantly within the mangroves, saline wetlands (including samphire and salt flat habitat) and the dredge spoil ponds (EMS, 2011). These are listed in Table 16-10.

The most significant habitats for listed migratory species within the local area are marine habitats and mangrove areas, and roost and foraging sites associated with the dredge spoil ponds (EMS, 2011).

Numbers of migratory shore-birds present in local roost sites, mangroves and near-coastal habitats are low when compared to other sites to the north of Darwin (e.g. Lee Point) and Darwin Harbour has not been found to support Nationally or Internationally significant numbers of migratory shorebirds or wetland birds (Chatto, 2003; Harrison et al., 2009). However the area does support locally significant numbers of some migratory shorebirds (EMS, 2011).

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The most significant aggregations of migratory birds within the study area are associated with the dredge spoil ponds, which provide high tide foraging and roosting sites for birds that move onto adjacent mud flats, rocky shores and saline wetlands at low tide (EMS, 2011).

Other wetland bird species also occur on the water-bodies at the dredge spoil ponds, including ducks, stilt, Australian Pelican (*Pelecanus conspicillatus*), ibis and spoonbill (Figure 16-5). Acer Vaughan (1993) reported that significant numbers of migratory birds were known to roost on off-shore islands, including South Shell Island, however few birds were observed on these islands during the 2010 - 2011 surveys (EMS, 2011).

Source: EMS, 2011

Figure 16-5 Australian Pelican (*Pelecanus conspicillatus*) Pond B EAW

Table 16-9 EPBC Act 1999 Listed Migratory and Marine Species Records

Common Name	Scientific Name	EPBC Migratory Terrestrial Species	EPBC Migratory Wetland/ Marine Species	EPBC Listed Marine Species	EAW Maximum Count EMS	EAW Maximum Count Estbergs 2011	EAW Max Single Count
Estuarine Crocodile	*Crocodylus porosus*		X	X			
Wandering Whistling-Duck	*Dendrocygna arcuata*			X	8	269	269
Radjah Shelduck	*Tadorna radjah*			X	17	17	17
Green Pygmy-goose	*Nettapus pulchellus*			X	1		1
Pied Imperial-Pigeon	*Ducula bicolor*			X			
Australian Pelican	*Pelecanus conspicillatus*			X	40	39	40
Eastern Great Egret	*Ardea modesta*		X	X	3	1	3
Intermediate Egret	*Ardea intermedia*			X	2		2
Little Egret	*Egretta garzetta*			X	4	10	10
Eastern Reef Egret	*Egretta sacra*		X	X	12	2	12
Australian White Ibis	*Threskiornis molucca*			X	2		2
Eastern Osprey	*Pandion cristatus*		X	X	1	1	1
Whistling Kite	*Haliastur sphenurus*			X		1	
Brahminy Kite	*Haliastur indus*			X	2	2	2
White-bellied Sea-Eagle	*Haliaeetus leucogaster*		X	X	3		3
Buff-banded Rail	*Gallirallus philippensis*			X	1		1
Beach Stone-curlew	*Esacus neglectus*			X	1		1
Black-winged Stilt	*Himantopus himantopus*			X	60	47	60
Grey Plover	*Pluvialis squatarola*		X	X	6	17	17
Pacific Golden Plover	*Pluvialis fulva*		X	X		12	12
Oriental Plover	*Charadrius veredus*		X	X		1	1

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Common Name	Scientific Name	EPBC Migratory Terrestrial Species	EPBC Migratory Wetland/ Marine Species	EPBC Listed Marine Species	EAW Maximum Count EMS	EAW Maximum Count Estbergs 2011	EAW Max Single Count
Lesser Sand Plover	*Charadrius mongolus*		X	X	302	7	302
Greater Sand Plover	*Charadrius leschenaultii*		X	X	210	70	210
Red-capped Plover	*Charadrius ruficapillus*			X	9	43	43
Black-tailed Godwit	*Limosa limosa*		X	X	23	20	23
Bar-tailed Godwit	*Limosa lapponica*		X	X	21	11	21
Little Curlew	*Numenius minutus*		X	X	4		4
Whimbrel	*Numenius phaeopus*		X	X	8	45	45
Far Eastern Curlew	*Numenius madagascariensis*		X	X	99	120	120
Marsh Sandpiper	*Tringa stagnatilis*		X	X	263	3	263
Wood Sandpiper	*Tringa glareola*		X	X		1	1
Common Greenshank	*Tringa nebularia*		X	X	20	31	31
Terek Sandpiper	*Xenus cinereus*		X	X	52		52
Common Sandpiper	*Actitis hypoleucos*		X	X	23	2	23
Grey-tailed Tattler	*Tringa brevipes*		X	X	15	24	24
Great Knot	*Calidris tenuirostris*		X	X	20	51	51
Red Knot	*Calidris tenuirostris*		X	X		150	150
Sanderling	*Calidris alba*		X	X		1	1
Red-necked Stint	*Calidris ruficollis*		X	X	89	47	89
Sharp-tailed Sandpiper	*Calidris acuminata*		X	X	200	34	200
Curlew Sandpiper	*Calidris ferruginea*		X	X	23	2	23
Gull-billed Tern	*Gelochelidon nilotica*			X	26	65	65
Crested Tern	*Thalasseus bergii*			X	5		5

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Common Name	Scientific Name	EPBC Migratory Terrestrial Species	EPBC Migratory Wetland/ Marine Species	EPBC Listed Marine Species	EAW Maximum Count EMS	EAW Maximum Count Estbergs 2011	EAW Max Single Count
Common Tern	*Sterna hirundo*		X	X	10		10
Little Tern	*Sternula albifrons*		X	X	11	90	90
Bridled Tern	*Onychoprion anaethetus*		X	X	2		2
Whiskered Tern	*Chlidonias hybrida*			X	65	62	65
White-winged Black Tern	*Chlidonias leucopterus*		X	X	150	25	150
Silver Gull	*Chroicocephalus novaehollandiae*			X	18	40	40
Little Bronze-Cuckoo	*Chalcites minutillus*			X			
Eastern Koel	*Eudynamys orientalis*			X			
Sacred Kingfisher	*Todiramphus sanctus*			X			
Rainbow Bee-eater	*Merops ornatus*	X		X			
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*			X			
White-bellied Cuckoo-shrike	*Coracina papuensis*			X			
Cicadabird	*Coracina tenuirostris melvillensis*	X		X			
Magpie-lark	*Grallina cyanoleuca*			X			
Australasian Pipit	*Anthus novaeseelandiae*			X			
Tree Martin	*Petrochelidon nigricans*			X			
Total Listed Species		2	31	59			

Source: EMS, 2011

Total counts of wetland and marine waders and shorebirds for the combined sites compiled by Estbergs (2011) and during the current survey record relatively high numbers of birds for some species, however none of the total counts exceed the threshold for determining site significance criteria under the Ramsar Convention (20,000 wetland birds or 1% of the estimated flyway population, species or subspecies population) (Table 16-11) (EMS, 2011).

The Ramsar convention criteria states that a wetland should be considered internationally important if it (Bamford et al., 2008):

- Regularly supports 20,000 or more waterbirds or;
- Regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.

Some migratory species, such as Far Eastern Curlew (*Numenius madagascariensis*), are present at numbers that are approaching significant populations levels under the Ramsar criteria (Table 16-11). The Far Eastern Curlew has been counted roosting on the dredge spoil ponds within the EAW in numbers between 100 and 120 birds on a number of occasions and the maximum count from the study area is equivalent to 0.31% of the East Asian - Australasian Flyway (EAA) flyway (global) population (EMS, 2011).

A site is recognised as a significant staging site for a species if at least one migration period count is equal to or greater than 0.25% of the estimated flyway population size (Bamford et al., 2008). Based on the Estbergs (2011) count conducted in April 2010 (northern staging period), none of the migratory shorebird species present within the study area were present in significant numbers (0.25% of the flyway estimate or greater) during the EAA flyway northern migration staging period (Table 16-11). It should however be noted that his assessment is based on a single count. These counts are also likely to underestimate the waders present in the local area, as they do not assess waders roosting saline flats and in mangroves (EMS, 2011).

While the international criteria provided by Ramsar are effective in identifying important shorebird sites in many countries across the EAA flyway, they are insufficient to provide protection for migratory shorebirds within Australia (DEWHA, 2009). The distribution of migratory shorebirds in Australia is more dispersed than in other areas, suggesting that international criteria are not applicable (DEWHA, 2009). EPBC Act policy statement 3.21 (Significant Impact Guidelines for 36 Migratory Shorebird Species) provides a set of criteria for determining the importance of habitat for migratory shorebirds in Australia (DEWHA, 2009), which rates a site as important habitat if:

- The site is identified as internationally important under Ramsar; or
- The site supports at least 0.1% of the flyway population of a single migratory shorebird species; or
- At least 2000 migratory shorebirds; or
- At least 15 shorebird species.

In the context of the definition provided by DEWHA (2009), a “site” includes the entire area of contiguous habitat used by the same group of migratory shorebirds, which may include multiple roots and feeding areas, and may extend beyond the boundaries of a property or project area (EMS, 2011).

The study area meets the DEWHA (2009) criteria for important migratory shorebird habitat, in that:

- Five migratory shorebird species have been recorded within the study area at numbers greater than the 0.1% threshold of the flyway population , including Lesser Sand Plover (*Charadrius mongolus)* (Figure 16-6), Greater Sand Plover *(Charadrius leschenaultii)*, Far Eastern Curlew

(Numenius madagascariensis), Terek Sandpiper *(Xenus cinereus)* and Sharp-tailed Sandpiper (*Calidris acuminate)* (Figure 16-7). These are marked with a tick in Table 16-11.

- Twenty-two migratory shorebird species have been recorded within the study area, exceeding the significance threshold of 15 species. These are listed in Table 16-11.

Source: EMS, 2011

Figure 16-6 Lesser Sand Plover (*Charadrius mongolus*) Pond D EAW

Source: EMS, 2011

Figure 16-7 Sharp-tailed Sandpiper (*Calidris acuminate*) Pond D EAW

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Table 16-10 Migratory Shorebird Threshold Criteria Indicating Site Significance Based on Count Data

Common Name	Scientific Name	EPBC Migratory Wetland/ Marine Species	EAW Max Single Count	Estbergs 2011 EAW Max Count Northern Staging April 2010	Bamford *et al.* 2008			Delany & Scott 2006		DEWHA 2009	EAW Max Count Exceeds EPBC Draft Sig Impact Guidelines 0.1% Threshold
					Flyway Estimate	1% of the Flyway Estimate	Staging 0.25% of the flyway estimate	WPE4 Population Estimate	WPE4 1% Threshold	EPBC Draft Sig Impact Guidelines 0.1% Threshold	
Grey Plover	*Pluvialis squatarola*	X	17		125 000	1250	313	125 000	1300	125	
Pacific Golden Plover	*Pluvialis fulva*	X	12		100 000-1 000 000	1000	250	100 000	1 000	100	
Oriental Plover	*Charadrius veredus*	X	1		70 000	7000	175	70 000	7 000	700	
Lesser Sand Plover	*Charadrius mongolus*	X	302		140 000	1400	350	40 000	400	40	3
Greater Sand Plover	*Charadrius leschenaultii*	X	210		110 000	1100	275	100 000	1 000	100	3
Black-tailed Godwit	*Limosa limosa*	X	23	7	160 000	1600	400	160 000	1 600	160	
Bar-tailed Godwit	*Limosa lapponica*	X	21	1	325 000	3250	813	325 000	3 250	325	
Little Curlew	*Numenius minutus*	X	4		180 000	1800	450	180 000	1 800	180	
Whimbrel	*Numenius phaeopus*	X	45		100 000	1000	250	55 000	550	55	
Far Eastern Curlew	*Numenius madagascariensis*	X	120	1	38 000	380	95	38 000	380	38	3
Common Greenshank	*Tringa nebularia*	X	31	5	60 000	600	150	100 000	1 000	100	
Marsh Sandpiper	*Tringa stagnatilis*	X	263	1	100 000-1 000 000	1000	250		10 000	1 000	
Wood Sandpiper	*Tringa glareola*	X	1		100 000-1 000 000	1000	250	100 000	1 000	100	
Terek Sandpiper	*Xenus cinereus*	X	52		60 000	600	150	50 000	500	50	3
Common Sandpiper	*Actitis hypoleucos*	X	23	1	25 000-100 000	250	63	50 000	500	50	
Grey-tailed Tattler	*Tringa brevipes*	X	24		50 000	500	125	40 000	400	40	

Source: EMS, 2011

16.2.6 Habitat Significance

Habitat Connectivity

Assessment of the 2009 aerial photography found that the mangrove vegetation in Area 1 is connected to larger tracts of remnant mangrove habitat to the north, and in particular the Charles Darwin National Park (EMS, 2011).

There are four separate areas of terrestrial vegetation in Area 1; they are relatively small and demonstrate varying degrees of ecological condition. Three of these are isolated from other areas of terrestrial vegetation. The small section of open woodland near Berrimah Road is connected to the north; however this area is increasingly being disturbed and fragmented by road construction works. The EAW precinct development and construction of road and rail easements has severed ecological corridors to the south and east of the study area (EMS, 2011).

The remaining areas of terrestrial and mangrove vegetation in Area 4 are essentially isolated from any other larger tracts of remnant habitat. Roads and land clearing for development have severed viable native vegetation corridors and the overall terrestrial vegetation assessed within Area 4 is limited to approximately 20 ha (EMS, 2011).

Significance of Vegetation Communities

None of the vegetation communities mapped in the study area are listed as threatened under the *EPBC ACT 1999*. However several vegetation community types recorded in the study area are regarded as sensitive or significant vegetation according to the *NT Land Clearing Guidelines* (NRETAS, 2010b). These include mangrove communities as well as the small area of MVF (Community 1, in Area 1) (EMS, 2011).

Monsoon Vine Forest Habitat

The study area supports a small area of remnant disturbed MVF covering approximately 0.632 ha within Area 1 (EMS, 2011). This is likely to be a small remnant of an extensive band of MVF that formerly occurred on the northern margin of Quarantine Island prior to the original East Arm development (Acer Vaughan, 1993).

The remnant MVF is floristically simplified (Thomas, 2011) and has been disturbed by the works associated with filling and clearing for the adjacent railway line. It is also impacted from edge effects associated with the close proximity of the rail line and yards. It is possible that this is a remnant of a habitat that formerly more extensive in the local area. However it is not currently providing significant habitat for wildlife, it is not an ecologically outstanding vegetation community and it is not a particularly good example of the habitat type (EMS, 2011).

The canopy is dominated by one species (*Peltophorum pterocarpum*) and it is generally species-poor when compared to representative examples of this habitat. There were thirty one native plant species recorded at this site; Bowman and Dunlop (1986) recorded in excess of fifty-five species in a pure thicket and mixed thicket. The overall area is very small and the community is bordered by the existing railway facilities (EMS, 2011).

Mixed Open Woodland Habitat

The Area 1 component of the project area supports a small area of remnant disturbed mixed open woodland covering approximately 0.295 ha. This vegetation is mixed with the regrowth and disturbed areas that are more widespread within Area 1. Open woodland habitats have been disturbed by the works associated with filling and clearing for the adjacent railway line and impacted from edge effects associated with the close proximity of the railway line and yards.

These habitats are not currently providing significant habitat for wildlife, are not an ecologically outstanding vegetation community and are not a particularly good example of the habitat type (EMS, 2011).

Within Area 4 a more extensive area of better quality open woodland habitat is present. This area also supports an NT TPWC Act 2000 vulnerable plant species (*Cycas armstrongii*) (EMS, 2011).

Mangrove/Saline Wetland Habitats

Mangrove and salt marsh/saline wetland habitats within and surrounding the study area support a number of listed migratory marine birds and shorebirds. Under EPBC significance criteria (DEWHA, 2009) these areas qualify as important habitat for migratory species listed under the *EPBC Act 1999*. These areas also support a range of other mangrove specialist fauna species (EMS, 2011).

A significant proportion of the proposed rail spur within Area 1 is an easement (<200 m) that is located directly adjacent to the existing railway line. For much of its length the corridor does not penetrate core areas of important mangrove or saline wetland. The impacts on terrestrial vegetation are likely to be lessened because of this, as it is likely that core areas of mangrove forest already removed from the existing development were likely to have been of greater significance for wildlife (EMS, 2011).

The mangrove habitats directly adjacent to the existing facility are already impacted to some degree by edge effects associated with the existing facility, including drainage, sedimentation, noise and artificial light. Despite these impacts, the area continues to support a suite of mangrove and wetland specialist fauna species, including small numbers of listed migratory shorebirds.

Higher quality and more extensive mangrove and saline wetland habitat will be intersected by the proposal at the western end of the corridor within Area 1. This area supports aggregations of listed migratory birds and some of these birds are using this area for high tide roosting and foraging. Mudflats at the western end of Area 1 and on the margins of Area 4 are used as a feeding area by migratory shorebirds at low tide (EMS, 2011).

Small areas of mangrove habitat also occur within Area 2/3. While these areas are relatively small in area, they are used by small numbers of birds, including listed migratory/marine species (EMS, 2011).

Mangrove and saline wetland habitats are the most significant habitats for wildlife within the study area. Mangrove and marine habitats surrounding the study area are generally good representations of their type and support specialist bird and marine species, including listed migratory species. Mangrove habitats away from the immediate edge of the existing facility are generally undisturbed and appear to be in good ecological condition. The mangrove forests surrounding the existing East Arm facility represent a significant area of relatively intact mangrove and saline wetland vegetation (EMS, 2011).

Fauna Significance of Dredge Spoil Ponds

Dredge spoil ponds are highly disturbed artificial wetlands created by infilling areas with dredge spoil material within bunds (Figure 16-8). These areas have become locally significant habitat for migratory and wetland birds, and represent the most significant high tide roost for migratory shorebirds in the East Arm area (EMS, 2011). These areas will ultimately be filled and developed as hardstand areas and the roost sites will be lost. It is not known where birds will subsequently roost during high tides; however there may be alternative sites on offshore islands or adjacent areas (EMS, 2011).

Source: EMS, 2011

Figure 16-8 Pond D East Arm Wharf

16.2.7 Declared Weeds and Other Naturalised Species

Eleven naturalised flora species were recorded in the study area (EMS, 2011). Five of these species are declared weeds listed in the *Weeds Management Act 2001* (NT) (EMS, 2011). These species are presented in Table 16-12.

Table 16-12 Weed Species rECORDED in the Study Area and their Classification under the Weeds Management Act 2001 (NT)

Weed Species	Classification
Andropogon gayanus (Gamba Grass)	Class A (to be eradicated) and Class C (not to be introduced to the NT)
Jatropha gossypiifolia (Bellyache Bush)	Class A (to be eradicated) and Class C (not to be introduced to the NT)
Pennisetum polystachion (Mission Grass)	Class B (spread to be controlled) and Class C (not to be introduced to the NT)
Lantana camara (Common Lantana)	Class B (spread to be controlled) and Class C (not to be introduced to the NT)
Sida cordifolia (Flannel Weed)	Class B (spread to be controlled) and Class C (not to be introduced to the NT)

Source: EMS, 2011

It is noted that DPC's EMP includes as one of its objectives to keep EAW free of declared noxious weeds. Programs are in place to adequately manage weeds, including regular weed spraying (Coffey, 2010).

16.3 Potential Impacts

DPC has an existing Flora and Fauna Management Plan as part of its EMP. A key objective of this plan is to ensure that the EAW does not have an adverse impact on native flora and fauna and is kept free of declared noxious weeds and that feral plant species and animal species are controlled. This plan identifies potential impacts on the surrounding environment and lists management strategies to address these impacts (Coffey, 2010).

The following potential impacts have been identified in the current DPC EMP Plan and as a result of the survey undertaken to advise this assessment (EMS, 2011 and Coffey, 2010):

- Loss of habitat and habitat degradation or fragmentation due to clearing of areas for the development of infrastructure and access tracks.
- Generation of air quality emissions and noise and vibration through use of heavy machinery and equipment.
- Decreased surface and groundwater quality or altered flow as a result of construction and operational activities.
- Impacts on surrounding habitats due to sediment deposition.
- Contamination of environment (air, water and land) and habitat. (It is noted that debris from the marine environment was observed to be scattered through the mangrove vegetation).
- Potential introducing pest flora and fauna species through the presence of international shipping vessels and use of vehicles and machinery on site (e.g. cane toad or exotic pests via shipping activities).
- Disruption to visual amenity.

Disturbance Areas

The proposed development of EAW will result in clearing of approximately 13.18 ha of terrestrial vegetation, of which 12.25 ha (93%) is classified as disturbed areas with regrowth. The development will also result in the disturbance/clearing of an additional 88.23 ha of combined mangrove and saltpan area (EMS, 2011). Areas of disturbance are listed in Table 16-13.

Table 16-11 Areas of Clearing and Disturbance

Vegetation Community	Area 1 (ha)	Area 2/3 (ha)	Total (ha)
Community 1: Monsoon Vine Forest	0.632	-	0.632
Community 2: Low to Mid High, Mixed Species Open Woodland to Woodland	0.295	-	0.295
Community 3: Disturbed Areas with Regrowth	12.25	-	12.25
Total Terrestrial Vegetation	13.18	-	13.18
Combined Mangroves/Saltpan	87.21	1.02	88.23
Total Vegetation	100.387	1.02	101.407
Total Area	469	36.4	505.4
Marine Component	368	35.38	403.38

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Impact Assessment Summary

Section 16.2.6 describes the significance of the habitat in the project area, and notes the existing disturbance and condition of the vegetation. The significance and impacts are summarised below.

The MVF Community is recognised as significant vegetation under the *NT Land Clearing Guidelines* (NRETAS, 2010b). It is not listed as significant or threatened under the *EPBC Act 1999*. None of the other vegetation communities were identified as significant under the *NT Land Clearing Guidelines* (NRETAS, 2010b) or were listed under the *EPBC Act 1999* (EMS, 2011).

The remnant MVF is floristically simplified (Thomas 2011) and has been disturbed by the works associated with filling and clearing for the adjacent railway line. It is also impacted from edge effects associated with the close proximity of the rail line and yards. It is not currently providing significant habitat for wildlife, it is not an ecologically outstanding vegetation community and it is not a particularly good example of the habitat type (EMS, 2011).

Open woodland habitats are mixed with regrowth and disturbed areas and have been disturbed by the works associated with filling and clearing for the adjacent railway line and impacted from edge effects associated with the close proximity of the railway line and yards. These habitats are not currently providing significant habitat for wildlife, are not ecologically outstanding vegetation communities and are not a particularly good examples of the habitat type (EMS, 2011).

Species listed in the threatened species schedules of the *EPBC ACT 1999* and the *TPWC Act 2000* were not observed in these communities with the exception of *Cycas armstrongii*, a species listed as vulnerable in the *TPWC Act 2000*. This species was found to be common in the narrow strip of remnant vegetation along the edge of Hamaura Road within Area 4. Although development of this area was included in the original NOI to support this DEIS and the survey, the development of this area is not now included as part of this EIS process (EMS, 2011).

Mangrove and salt marsh/saline wetland habitats within and surrounding the study area support a number of listed migratory marine birds and shorebirds. Under EPBC significance criteria (DEWHA 2009) these areas qualify as important habitat for migratory species listed under the EPBC Act 1999. These areas also support a range of other mangrove specialist fauna species.

Mangrove communities are recognised as sensitive or significant vegetation under the *Northern Territory Land Clearing Guidelines* (NRETAS, 2010b). They are not listed as threatened under the *EPBC Act 1999*. Species listed in the threatened species schedules of the *EPBC ACT 1999* and the *TPWC Act 2000* were not observed in this community (EMS, 2011).

The mangrove habitats directly adjacent to the existing facility are already impacted to some degree by edge effects associated with the existing facility, including drainage, sedimentation, noise and artificial light. Despite these impacts the area continues to support a suite of mangrove and wetland specialist fauna species, including small numbers of listed migratory shorebirds (EMS, 2011).

Higher quality and more extensive mangrove and saline wetland habitat will be intersected by the proposal at the western end of the corridor within Area 1. This area supports aggregations of listed migratory birds and some of these birds are using this area for high tide roosting and foraging. Mudflats at the western end of Area 1 and on the margins of Area 4 are used as a feeding area by migratory shorebirds at low tide.

Threatening processes for migratory shorebirds include habitat loss, habitat degradation and disturbance (e.g. night lighting, noise, human access, dogs etc.). It is noted that mangrove vegetation

in Area 1 is connected to larger tracts of remnant mangrove habitat to the north and in particular the Charles Darwin National Park (EMS, 2011).

The *NT Land Clearing Guidelines* (NRETAS, 2010b) state that applications to clear in coastal areas or in areas subject to tidal influence (e.g. floodplain systems associated with tidal rivers and creeks, coastal monsoon vine thickets and mangroves) must be supported by additional information, which may include (EMS, 2011):

- A plan for acid sulphate management where the area is considered a moderate to high acid sulphate soil risk.
- Potential or expected impacts of the land clearing on sensitive or fragile coastal landscapes and the steps taken to reduce and manage risks.

16.4 Management of Impacts

16.4.1 Objectives and Standards

As discussed earlier, DPC has an existing Flora and Fauna Management Plan. A key object of this plan is to ensure that EAW does not have an adverse impact on native flora and fauna and is kept free of declared noxious weeds, and that feral plant species and animal species are controlled. This plan identifies potential impacts on the surrounding environment and lists management strategies to address these impacts (Coffey, 2010).

The *NT Land Clearing Guidelines* (NRETAS, 2010b) will be followed for proposed clearing of mangrove and MVF communities. Applications to clear land will provide additional specific information regarding the 'potential or expected impacts of the land clearing on the habitats of the area and the steps to be taken to reduce and manage risks (EMS, 2011).

Although not found within the footprint of the proposed development it is noted that *Cycas armstrongii* was reported in adjacent habitats during field surveys undertaken to advise this assessment. The management of the local population of *Cycas armstrongii* will consider the management program for Cycads in the NT (Liddle, 2009). Under the *TPWC Act 2000* a permit is required by individuals to take Protected Wildlife or their parts for non-commercial purposes. Any proposed clearing of *Cycas armstrongii* habitat within will be conducted with reference to provisions and requirements of the Act. Where possible, habitats supporting known populations of *Cycas armstrongii* will be retained (EMS, 2011).

Relevant legislation includes:

- *EPBC ACT 1999* (Comm)
- *TPWC Act 2000* (NT)
- *Weeds Management Act 2001* (NT)
- *Soil Conservation and Land Utilisation Act 2009* (NT)
- *Biological Control Act 1995* (NT)

16.4.2 Management Requirements

A Land Clearing Application will need to be made in line with the requirements of the *NT Land Clearing Guidelines* (NRETAS, 2010b) for proposed clearing of mangrove and MVF communities (EMS, 2011).

Although not found in the footprint of proposed disturbance it is noted that *Cycas armstrongii* was found in areas adjacent to the proposed EAW expansion. Management of the local populations of *Cycas armstrongii* will consider the requirements of the *TPWC Act 2000* (NT) and the management program for Cycads in the NT (Liddle, 2009). A permit will be obtained to take Protected Wildlife for non-commercial purposes.

Measures will be taken to minimise potential impacts on migratory shorebirds and their habitats. These measures are described below (EMS, 2011):

- Minimising the area of mangrove, salt pan/saline flats and tidal mudflat areas disturbed for any works or reclamation.
- Including buffer zones to significant mangrove and marine habitats, as well as any other habitats that support aggregations of listed migratory/marine species where possible.
- Strict controls on sedimentation or other impacts that may impact shorebird feeding sites.
- Protection of high tide roost sites and provision of additional high tide roost sites where possible.
- Controls on activities or facilities that might disturb feeding and roosting birds (e.g. noise, nocturnal lighting).
- Undertaking significant works in the vicinity of areas where migratory shorebirds in the dry season when most northern hemisphere migrants are absent (May – August).
- Implementing measures to minimise the potential import and / or spread of weeds during construction.
- Putting in place controls to ensure that no cane toad breeding habitats are created during or following construction (e.g. small, still ponded freshwater or brackish areas). Controls on creation of these habitats will also assist in minimising creation of recruitment sites for mosquitoes (refer to Section 20 Biting Insects).
- Continued restricted access to the public and animals (dogs) to areas where migratory shorebirds roost and feed.
- Control and management of Feral Cats would be included in management programs for feral species.
- The ongoing monitoring of shorebirds and expansion of the existing program would include the western component of Area 1.

In regard to the above controls, the following points are relevant in regard to roosting sites and weed management:

- It is noted that dredge spoil ponds have become locally significant habitat for migratory and wetland birds, and represent the most significant high tide roost for migratory shorebirds in the East Arm area. However, as part of the development, these areas will ultimately be filled and developed as hardstand areas and the roost sites will be lost.

- It is noted that DPC has a current weeds management program that involves regular weed spraying. An assessment of the weed risks in the project area will be undertaken to prioritise the management responses in DPC's current program. This may include developing and refining particular measures for inspection, identification and control of weeds, to improve the effectiveness of the program.

Areas that are disturbed during construction activities, or no longer required, will be progressively rehabilitated with due consideration of the requirements of fauna species that will potentially recolonise these areas (EMS, 2011). Where possible clearing operations will include:

- Stockpiling of top-soil to conserve the soil seed bank (where relevant and appropriate given the level of previous disturbance).
- Stockpiling of deadwood and woody debris, for later return to the rehabilitation area to provide fauna microhabitat and increase the rate of faunal return (EMS, 2011).

16.4.3 Monitoring and Reporting

The DPC EMP (Coffey, 2010) includes the following management principles:

- Implement a regular program of inspections to identify pest species present in the EAW management area.
- Support the marine pest surveys undertaken by the Aquatic Biosecurity section of the Department of Resources (Fisheries) and ensure the results are used in the review of flora and fauna management measures.
- Reporting all environmental incidents (including pest incursions).
- Regular review of the efficiency of flora and fauna management measures to ensure implementation of continuous improvement.

These principles would be applied to managing the proposed expansion area as appropriate.

DPC currently monitors shorebirds and wetland birds within the EAW, mainly at the dredge spoil ponds (David McMaster, Darwin Port Corporation pers. comm. 2011). This monitoring program would be continued and expanded to include the saline flats/tidal mudflats within Area 1 and Area 3/4, in order to assess any changes in flora and fauna species composition and abundance over time (EMS, 2011).

16.5 Commitments

- *Minimise areas of disturbance, particularly areas of mangrove and MVF communities.*
- *Clearing of vegetation for construction and operational activities associated with the proposed expansion of EAW will be undertaken in accordance with the NRETAS Land Clearing Guidelines (NRETAS, 2010b). Wherever possible, DLP will seek to identify opportunities to rehabilitate previously disturbed areas as part of the proposed development.*
- *Management of the local populations of Cycas armstrongii will consider the requirements of the NT TPWC Act 2000 and the management program for Cycads in the Northern Territory (Liddle, 2009), and be in accordance with requirements of the NT TPWC Act 2000.*
- *Measures will be taken to minimise potential impacts on migratory shorebirds and their habitats, such as:*

  - minimise the area of mangrove, salt pan/saline flats and tidal mudflat areas disturbed for any works or reclamation
  - inclusion of buffer zones to significant habitats
  - controls on sedimentation or other impacts that may impact shorebird feeding sites
  - controls on activities or facilities that might disturb feeding and roosting birds (e.g. noise, nocturnal lighting)
  - undertake significant works in the vicinity of areas where migratory shorebirds inhabit in the dry season when most northern hemisphere migrants are absent (May – August).

- *Protection of high tide roost sites and the provision of additional high tide roost sites where possible.*
- *Restrict access to public and animals (dogs) and controlling feral animals (cats, cane toads) and weeds in the vicinity of areas where migratory shorebirds roost and feed.*
- *Ensure that areas that are disturbed during construction activities or no longer required will be progressively rehabilitated with due consideration of the requirements of fauna species that will potentially recolonise these areas. (In relation to this commitment it is noted that dredge spoil ponds have become locally significant habitat for migratory and wetland birds, and represent the most significant high tide roost for migratory shorebirds in the East Arm area.*
- *Continued monitoring of shorebirds, and expansion of the existing program to include the western component of Area* 1.
- *Implement controls to ensure that no cane toad breeding habitats are created during or following construction (e.g. small, still ponded freshwater or brackish areas).*

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