# **3** Results

The findings of the desktop and field surveys are presented and discussed below.

# 3.1 Landscape, topography and geology

The project area is located on a peninsula of land terminating at Gunn Point, and bounded by Shoal Bay and the Howard River estuary to the west and south-west, and Adam Bay and the Adelaide River estuary to the east. The southern approach to the 'Gunn Point peninsula' is bounded by the Howard River catchment in the south and south-west, and the extensive Adelaide River floodplain to the south-east. The project area itself is located in the Howard River catchment (after crossing the Howard River at Howard Springs, the Gunn Point Rd follows the approximate watershed with the Adelaide River catchment).

The Gunn Point peninsula is largely comprised of four main land forms, all of which are represented on the project site –

- Lateritic plain a generally level to very gently sloping upper plain below 40 m elevation called the Koolpinyah surface, comprised of a laterised surface formed in the Tertiary (the Kay land system).
- Run-off slopes an eroding slope and associated drainage lines around the edge of the Koolpinyah surface and dissecting it in places, comprised of remnants of the lateritic Koolpinyah surface with exposed Cretaceous claystones and mudstones closer to sea level (encompassing the Keefers Hut, Krans and Knifehandle land systems).
- Depositional landforms Quaternary alluvial landscapes comprising coastal plains fringing either estuarine waterways or the sea, and internal freshwater drainage depressions (encompassing the Krokane and Littoral land systems).
- Coastal sand plain a 12 km long broad sandy beach combined with a narrow dune and swale system (generally comprised of a low fore-dune with a shallow swale), restricted to the south-western coastline, adjacent to the project site (encompassed in the Littoral land system) (Doyle, 2001; Wood *et al*, 1985).

# 3.2 Vegetation communities

In total, 11 vegetation communities were observed in or adjacent to the project area— these communities are summarised in Table 1, fully delineated in Appendix B, and mapped in Figure 4. No threatened ecological communities listed under the EPBC Act were predicted to occur within the project site and none were recorded.

Approximately 60% of the project site is dominated by the one community, *Eucalyptus tetrodonta* woodland to low woodland on the lateritic plain. This community also contains the highest concentration of the only threatened species found during the survey, the vulnerable cycad *Cycas armstrongii* (see Section 3.3). Woodland dominated or co-dominated by *E. tetrodonta*, often with *Eucalyptus miniata*, is analogous with community nine in Wilson *et al.* (1990). This community is one of the most common in the NT with over 1.2 million ha mapped by Wilson *et al.* (1990) (Department of Natural Resources, Environment and the Arts, 2004).

Another 18% of the site is occupied by deciduous mixed species low woodland. This community occurs on lower run-off slopes, and occupies most of the ground between the Koolpinyah plateau (dominated by *E. tetrodonta* woodland), and the coastal plain (which has a mixture of vegetation types). It is characterised by a mixture of sclerophyllous and non-sclerophyllous species including *Melaleuca viridiflora, Corymbia polysciada, Gardenia megasperma, Xanthostemon paradoxus, Terminalia ferdinandiana* and, in places, *Lophostemon lactifluus*. It contains a population of *C. armstrongii*, but in much lower densities that those found in *E. tetrodonta* woodland.

It is not closely analogous to any of the communities delineated by Wilson *et al.* (1990) but fits best within community 51 (*M. viridiflora/Eucalyptus* spp. low open woodland), which is mapped over 526, 000 ha of the NT (Department of Natural Resources, Environment and the Arts, 2004).

The next most common vegetation community on the project site is low woodland dominated by *Eucalyptus tectifica* and *C. polysciada*. It occupies the run-off slope formed by the eroding Koolpinyah plateau, and occurs slightly down slope of the *E. tetrodonta* woodland which dominates that surface. This community also contains *C. armstrongii*, but as with mixed deciduous species woodland, the population density is relatively low. Low *E. tectifica* and *C. polysciada* woodland comprises approximately 11% of the project site, and forms a mosaic with deciduous mixed species low woodland. It is analogous with Wilson *et al.* unit 15 (1990), which is mapped over almost five million hectares of the NT.

The remainder of communities present on site have a representation in relation to the project area of less than 3% each. Of these, *M. viridiflora* low open forest dominates a broad drainage line and shallow depression in the south west of the project site, and woodland of *Corymbia polycarpa* and *Erythrophleum chlorostachys* occupies the fringe of a closed depression wetland located just off the south east corner. The remainder of the site is comprised of four communities that occupy the narrow coastal sand plain. None of these communities contain *C. armstrongii* populations.

Two vegetation communities, monsoon vine thicket and mangrove low closed forest, are considered to be sensitive vegetation types under the *Land Clearing Guidelines* (Department of Natural Resources, Environment, the Arts and Sport, 2010). In addition, four mapped vegetation communities are considered to be drainage areas under these guidelines:

- M. viridiflora low open forest/woodland,
- Xerochloa imberbis grassland,
- Melaleuca dealbata open woodland (this community is not located within the project area),
- Mangrove low closed forest (this community is not located within the project area).

One community meets the wetland definition under the *Land Clearing Guidelines* (Department of Natural Resources, Environment, the Arts and Sport, 2010), *M. viridiflora* and *Melaleuca cajuputi* low closed forest (note – this community is not located within the project area – see Figure 4).

In general, all communities except those on the coastal sand plain were in an intact, essentially unmodified ecological condition, using the VAST assessment framework (see Appendix C). The coastal sand plain area is heavily utilised by visitors for camping, beach fishing, and trail-bike riding, with the inevitable signs of heavy human use – litter is abundant, ranging from plastic and bottles to large sheets of corrugated iron, open (unburied) latrine sites were not uncommon, soil compaction is evident, and impromptu clearing has occurred.

In addition, weeds, which are not present over most of the site (where present they are restricted to the immediate edge of tracks), are abundant on the coastal sand plain, and it is possible that fire frequency is increased (this latter impact affects the entire site, not just the coastal sand plain). These latter impacts (weeds and increased fire frequency) may also be attributable to heavy human use.

### Table 1 Vegetation community summary

Community	Defining species	VAST condition <sup>1</sup>	Values
Lateritic level to gently und	ulating plains (the Koolpinyah surface)		
1. Eucalyptus tetrodonta woodland to low woodland on the lateritic	Upper: Eucalyptus tetrodonta, Eucalyptus miniata, Corymbia confertiflora, Erythrophleum chlorostachys Mid: Cycas armstronaji, Livistona humilis, Pandanus spiralis, Buchanania	Type I – Residual	Contains high densities of the vulnerable species <i>Cycas armstrongii</i> , over 1000 plants/ha in some places.
(~112 ha on project site)	obovata Ground: Heteropogon triticeus, Sorghum intrans, Chrysopogon latifolius, Hibbertia juncea		The western edge of this community may provide habitat for the vulnerable aroid <i>Typhonium praetermissum</i> .
Undulating to rolling plains	<ul> <li>run-off slopes forming the erosive face to the Koolpinyah surface</li> </ul>		
2. Eucalyptus tectifica & Corymbia polysciada low woodland on gentle run- off slopes	Upper: Eucalyptus tectifica, Corymbia polysciada, Erythrophleum chlorostachys Mid: Melaleuca viridiflora, Acacia dimidiata, Calytrix exstipulata	Type I - Residual	Contains relatively low densities of the vulnerable species <i>Cycas armstrongii</i> – between 0 and 225 plants/ha.
(~19.5 ha on project site)	Ground: Heteropogon triticeus, Sorghum intrans, Sorghum plumosum		May provide habitat for the vulnerable aroid <i>Typhonium praetermissum</i> .
3. Deciduous mixed species low woodland/ low open woodland on lower run-off slopes	Upper: Corymbia polysciada, Melaleuca viridiflora, Erythrophleum chlorostachys, Xanthostemon paradoxus, Gardenia megasperma, Lophostemon lactifluus	Type I – Residual	Contains relatively low densities of the vulnerable species <i>Cycas armstrongii</i> – between 0 and 175 plants/ha.
(~33.5 ha on project site)	Mid: Melaleuca viridiflora, Planchonia careya, Grevillea pteridifolia Ground: Heteropogon triticeus, Sorghum intrans, Themeda triandra		May provide habitat for the vulnerable aroid <i>Typhonium praetermissum</i> .
4. Corymbia polycarpa and Erythrophleum chlorostachys open woodland fringing internal depressions	Upper: Corymbia polycarpa, Erythrophleum chlorostachys, Melaleuca viridiflora Mid: Melaleuca viridiflora, Grevillea pteridifolia, Pandanus spiralis	Type I - Residual	Forms a buffer for an adjacent <i>M. viridiflora</i> and <i>M. cajuputi</i> ephemeral wetland.
(~3 ha on project site)	Ground: Absent (due to fire) except for dense clusters of <i>M. viridiflora</i> seedlings		

Community	Defining species	VAST condition <sup>1</sup>	Values
Depositional surfaces – ope	n and closed depressions		
5. <i>Melaleuca viridiflora</i> low open forest/ woodland on broad shallow drainage lines and localised depressions (~3 ha on project site)	Upper: Melaleuca viridiflora, Lophostemon lactifluus, Pandanus spiralis, Corymbia polysciada Mid: absent Ground: Eriachne burkittii, Heteropogon triticeus, Sorghum plumosum, Eriachne agrostidea	Type I - Residual	It may provide habitat for small trigger plants ( <i>Stylidium</i> spp.), including the endangered <i>S. ensatum</i> (although it is considered unlikely to occur on this site). Meets the definition of a drainage area under the Land Clearing Guideline <sup>2</sup> .
6. Xerochloa imberbis grassland on the coastal plain (not present on project site)	Upper: Pandanus spiralis Mid: absent Ground: Xerochloa imberbis, Cyperus alopecuroides, Sporobolus virginicus, Cyperus javanicus	Type I - Residual	<ul> <li>This community provides habitat for the near threatened mangrove Avicennia integra (nearest record is 4 km south of the project site).</li> <li>It is located immediately adjacent to the project site in the south west corner.</li> <li>Meets the definition of a drainage area under the Land Clearing Guideline<sup>2</sup>.</li> </ul>
7. <i>Melaleuca viridiflora</i> and <i>M. cajuputi</i> low closed forest on internal depressions (not present on project site)	<ul> <li>Upper 1 (emergent): Corymbia polycarpa, Melaleuca leucadendra</li> <li>Upper 2: Melaleuca viridiflora, Melaleuca cajuputi, Melaleuca</li> <li>leucadendra, Pandanus spiralis</li> <li>Mid: absent</li> <li>Ground: The ground layer had been almost entirely removed by a recent</li> <li>fire – no species were identifiable beyond sometimes dense clusters of</li> <li>Melaleuca viridiflora seedlings, and Nymphaea violacea in a shallow pool.</li> </ul>	Type I - Residual	This community may provide habitat for the data deficient trigger plant <i>Stylidium</i> <i>tenerrimum</i> . It is located immediately adjacent to the project site in the south east corner. Meets the definition of a wetland under the Land Clearing Guideline <sup>2</sup> .

Community	Defining species	VAST condition <sup>1</sup>	Values
Coastal sand plain – a low d	une and shallow swale system occupying the narrow finger of land between	the beach and the ru	n-off plain
8. <i>Melaleuca dealbata</i> open woodland on the coastal sand plain (~6 ha on project site)	Upper: Melaleuca dealbata, Corymbia polysciada Mid: Pandanus spiralis, Hibiscus tiliaceus, Ficus aculeata Ground: Imperata cylindrica, Flagellaria indica, Cyperus javanicus, Cenchrus polystachyios*	Type II - Modified	It may provide habitat for the near threatened species <i>Operculina turpethum,</i> a vine recorded from directly adjacent to this community, within the project site. May provide habitat for the vulnerable aroid <i>Typhonium praetermissum</i> . Meets the definition of a drainage area under the Land Clearing Guideline <sup>2</sup> .
<ul> <li>9. Foredune grassland/ forbland on the coastal sand plain</li> <li>(~3 ha on project site)</li> </ul>	Upper: Hibiscus tiliaceus, Ficus aculeata Mid: absent Ground: Spinifex longifolius, Ipomoea pes-caprae, Cenchrus polystachyios*, Imperata cylindrica	Type II - Modified	It may provide habitat for the near threatened species <i>Operculina turpethum</i> , a vine recorded from directly adjacent to this community, within the project site.
<ul> <li>10. Monsoon vine thicket on the coastal sand plain</li> <li>(~3.5 ha on project site, in a mosaic with community</li> <li>11)</li> </ul>	Upper (emergent): Schefflera actinophylla Upper 2: Millettia pinnata, Hibiscus tiliaceus, Thespesia populnea, Acacia auriculiformis, Trema tomentosa, Flagellaria indica, Flueggea virosa, Cathormion umbellatum, Clerodendrum floribundum, Abrus precatorius, Manoon australe, Pisonia aculeata, Ficus aculeata Ground: Cenchrus polystachyios*, Cenchrus echinatus*, Sida acuta*	Type II - Modified	It may provide habitat for the near threatened species <i>Pittosporum</i> <i>moluccanum</i> (a small tree recorded from monsoon vine thicket within two kilometres of the project site) and <i>Operculina turpethum</i> (a vine recorded from within a few hundred metres of monsoon vine thicket on the project site). This community is considered a sensitive vegetation type under the Land Clearing Guidelines <sup>2</sup> .

Community	Defining species	VAST condition <sup>1</sup>	Values	
11. Mangrove low closed	Upper: Avicennia marina, Lumnitzera racemosa, Rhizophora stylosa,	Type II - Modified	Due to its narrow width (usually no more	
forest on the coastal sand	Thespesia populnea, Hibiscus tiliaceus		than 20 m) and close co-occurrence with	
plain			monsoon vine thicket, it has been	
	Mid: absent		mapped together with that community.	
(~3.5 ha on project site, in				
a mosaic with community	Ground: Sporobolus virginicus, Ipomoea pes-caprae		This community is considered a sensitive	
10)			vegetation type and a drainage area	
			under the Land Clearing Guidelines <sup>2</sup> .	
1				
<sup>1</sup> VASI = Vegetation Assets, States and Transitions (Thackway and Lesslie, 2005);				
<sup>2</sup> Department of Natural Resources, Environment, the Arts and Sport, 2010.				





# 3.3 Species of conservation significance

Species of conservation significance recorded within a 15 km radius of the project site are outlined in Table 2. Of these, one is endangered, four are vulnerable, four are near threatened, and three are listed as data deficient under the TPWC Act. One is listed as endangered under the EPBC Act. Only one of these species was found on site – the vulnerable cycad *C. armstrongii*. In addition, one vulnerable species and three near threatened species have been assessed as possibly present:

- *Typhonium praetermissum* (vulnerable)
- Desmodium tiwiense (Melville Island Desmodium) (near threatened)
- Operculina turpethum (near threatened)
- Pittosporum moluccanum (near threatened).

#### These are discussed below.

However, it should be noted there are some limitations associated with the survey. In the month prior to the July survey, one or more fires had occurred over approximately 95% of the project site and adjoining areas (some were still burning at the time of the survey). These fires had removed almost the entire ground layer, and some of the shrub layer, in the areas it had burnt. Of the vegetation communities present on the project site, only monsoon vine thicket, mangrove low closed forest and *M. viridiflora* low open forest/woodland were entirely or mostly unaffected by this fire.

Therefore, it is not possible to say with certainty that *Operculina turpethum, Desmodium tiwiense* and *Stylidium tenerrimum* are not present, despite their not being recorded (although *S. tenerrimum* has been assessed as unlikely to be present). In particular, the location in which *O. turpethum* had been previously collected had experienced a hot burn and was largely ash at survey time.

In addition, surveys for *T. praetermissum*, a cryptic terrestrial aroid not visible above ground for most of the year, should be conducted from late December to February. Potential habitat for this species has been mapped over sections of the eastern third of the project site (see Figure 5).

### 3.3.1 Cycas armstrongii

*Cycas armstrongii* is an NT endemic cycad growing to six metres and restricted to the Tiwi Islands, the western tip of the Coburg Peninsula, and the mainland south and east of Darwin for approximately 90 km. It is described as locally abundant, but has been listed as vulnerable because it has less than one percent of its population in the protected area estate, and is prevalent in areas subject to ongoing residential and industrial development.

The major threatening processes affecting this species are clearing associated with urban development, and a predicted increase in fire intensity associated with the invasion of exotic grasses - primarily Gamba grass (*Andropogon gayanus*) and mission grass (*Cenchrus polystachyios*). Increases in fire intensity have the potential to kill cycads and reduce seed viability (Kerrigan *et al.*, 2006).

Population surveys based on 75 100 m<sup>2</sup> plots conducted for this species (the method is outlined in Section 2.3.3, and the areas surveyed are mapped in Figure 3) recorded an average of 887 individual *C. armstrongii* per ha in *E. tetrodonta* woodland on the site, of which approximately 46% are likely to be adults (adult is defined as having a stem height of greater than 50 cm). Population density mapping is presented in Figure 6.

Across the 90 ha of this habitat type, this suggests there may be approximately 79, 830 individuals present just within the *E. tetrodonta* woodland, of which 36, 700 are likely to be adults. Numbers within the 75 100 m<sup>2</sup> plots surveyed varied from zero cycads (recorded in 13 plots) to 45 (recorded in one plot). Most 100 m<sup>2</sup> plots (52%) recorded six cycads or less, and 75% of the plots had 14 cycads or less. Only 16% of the 100 m<sup>2</sup> plots had 20 or more cycads, and only one plot had more than 29.

Individuals of *C. armstrongii* were also found in *E. tectifica* and *C. polysciada* low woodland and deciduous mixed species low woodland, but in much lower densities – an average of 30 individuals per hectare was recorded based on absolute counts of all cycads present within four plots totalling 10.5 ha. The average percentage of adults as a proportion of the population was higher in these communities than for the *E. tetrodonta* woodland – 72%.

This suggests that the total population of *C. armstrongii* within these habitats may be 670, including approximately 480 adults. However, clusters of cycads are sometimes present in relatively small areas (eg half a hectare) with densities of up to 240 individuals per hectare. For instance, within area 1 (see Figure 3), located in deciduous mixed species low woodland, 54 cycads were counted within a 0.2 ha area, but only nine were recorded in the remaining 0.8 ha.

However, it should be noted that the population numbers from the sites in the eastern half of the proposed project site (within *E. tetrodonta* woodland) have been calculated based on averages (ie not absolute counts), and cycad distribution on site was often observed to be characterised by dense clumps separated by areas with relatively few or no cycads. Therefore, a large number of survey plots would need to be completed to eliminate any bias in average counts that may result from large outliers.

As a result, the total population of *C. armstrongii* on the project site (which this survey suggests, based on average densities surveyed, could be approximately 80, 000 individuals) may have been overestimated due to chance factors based on the random assignment of plots.

## 3.3.2 Typhonium praetermissum

*Typhonium praetermissum* is a perennial geophyte, that is, a herb with above-ground parts (leaves and flowers/fruits) present for a short period, rendering the plant difficult to detect for most of the year. It belongs to the 'lily' family (Araceae), and is listed as a vulnerable species in the NT. It is known to occur in *Eucalyptus miniata* woodland on red-brown clays and shallow or gravelly lateritic soils, often on plateau edges. It is considered to be endemic to the Darwin-Litchfield area, although due to its cryptic nature and the period it flowers (early wet season, around Christmas) it has a negative collection bias and may be more widespread than current records suggest (Northern Territory Herbarium, 2015; Westaway & Cowie, 2012).

A flora survey of the Litchfield Municipality conducted by the Northern Territory Herbarium in 2016 recorded a number of *T. praetermissum* from the Gunn Point area, including 23 new records from

five to eight kilometres north of the project site. Consequently, potential habitat mapping produced for Litchfield has identified an area in the east of the project site that may be suitable for this species, along the plateau edge (see Figure 5). When present, this species generally has a patchy density – absent from large areas of suitable habitat then present in low densities (10-50 plants) over small areas (1000-2500 m<sup>2</sup>) (N. Cuff, NT Herbarium, *pers. comm.*).

The July survey undertaken for this report was not conducted in a suitable season to detect this species and preclearing surveys are recommended - the appropriate season to conduct surveys for this species is the period late December to March (Green & Cuff, 2016b, Westaway & Cowie, 2012). If present, it is likely to be impacted by the project only if located within the disturbance footprint. Operational activities such as hazard reduction burns are not likely to directly impact on it, if they are conducted in the early dry season (ie low intensity) (N. Cuff, NT Herbarium, *pers. comm.*). Given it is a lily-like herb that dies back to a small tuber each year, transplantation to a suitable nearby location should be possible if it is found in the disturbance footprint.

#### 3.3.3 Desmodium tiwiense

*Desmodium tiwiense* is a near threatened trailing ground herb with annual stems belonging to the pea family (Fabaceae). It has been recorded in 'eucalypt savannah' and open forest, primarily from the Tiwi Islands but with three records from the mainland, including one from 1.7 km east of the project site (AVH, 2017; Northern Territory Herbarium, 2015). Given the broad habitat description (which encompasses habitat that covers the eastern two thirds of the project site), and a previous record from within two kilometres of the project site, it has been assessed as possibly present.

This species was not observed in the July survey, however a fire had burnt out almost all of the ground layer at that time. Therefore, a preclearing survey is recommended of the entire project footprint in a suitable season, probably in the late wet season when flowers and pods are most likely to be present (it is recorded as flowering from October to May and fruiting from April to May) (Northern Territory Herbarium, 2015).

If it is present within the disturbance footprint, it is likely to be impacted primarily by clearing the disturbance footprint. Operational activities are unlikely to impact on this species – given its preferred habitat (eucalypt woodland/open forest) it is likely to be adapted to regular fire (provided they are low intensity, early dry season fires). If present within the disturbance footprint, it is likely to respond well to being moved to suitable nearby habitat, either through transplantation and/or the collection of seed for growing on or broadcasting.

### 3.3.4 Operculina turpethum

*Operculina turpethum* is a near threatened trailing vine growing to four metres and belonging to the morning glory family (Convolvulaceae). It has been recorded from a number of locations in the NT, including in coastal areas from behind mangroves, in vine thicket, and in swampy locations beside rivers. One record from 2000 is located in the foredune forbland to the west of the project site (see Figure 5). Within the NT, it has been recorded flowering in April, May and July (AVH, 2017).

The previous record for this species is not located within the project site, and it was not observed in the July survey. However, at the time of the survey a fire had burnt out almost all of the ground layer and much of the shrub layer in the foredune forbland where it had been previously found, so it is not possible to say conclusively that it is no longer present. If it is still present, it is not likely to be impacted by the project, except indirectly (possibly from fire).

Therefore, it is recommended that the location of this record and the foredune forbland habitat in general be checked during the late wet season preclearing survey (as recommended above), and if *O. turpethum* is present, it should be noted, mapped and monitored into the future (to ensure it is not impacted by fire or other project activities). If this species is present in the vine thicket, it is unlikely to be impacted (provided the vine thicket is buffered from fire impacts).

### 3.3.5 Pittosporum moluccanum

*Pittosporum moluccanum* is a small tree to seven metres tall listed as near threatened in the NT. It is found in vine thicket, and has been recorded twice within two kilometres of the project site (to the north and to the south) (AVH, 2017; Northern Territory Government 2015). However, it was not recorded on vine thicket located immediately to the west of the site during the July 2017 survey. Therefore, it has been listed as possibly present (but only within vine thicket, which will not be impacted by the project). Given its only likely location is within a dense vegetation community that will not be impacted by the project, no further action in relation to this species is considered to be necessary.

### 3.4 Weeds

In general, weeds are restricted to the areas being utilised by the public for recreation – outside of these areas, exotic species were almost completely absent (with the exception of hyptis - *Hyptis suaveolens\**). Impacts from weeds are most serious on the foredune and swale area – here, perennial mission grass (*Cenchrus polystachyios\**), Mossman River grass (*Cenchrus echinatus\**) and spiny-headed sida (*Sida acuta\**) are all prevalent (as observed in the wet season visit – these areas were thoroughly burnt at the time of the dry season survey). All are declared Class B and C weeds in the NT. Low densities of hyptis (Class B/C) are also present in low woodland on the run-off slopes.

Of particular concern is the presence of gamba grass (*Andropogon gayanus*\*) in isolated clumps on the immediate edge of tracks in the centre/centre-west of the project site, and fringing the main Gunn Point road to the north of the project site (see Figure 7). Gamba grass has been recorded in the area since at least 2001 according to NT government weed mapping (Department of Environment and Natural Resources, 2007), and clump locations seem to be stable, which suggests the infestation is not actively expanding.

Declared weeds recorded on site are listed below and mapped in Figure 7.

#### **Gamba grass**

Gamba grass is an African grass growing to four metres tall and capable of thriving in northern Australian savannah habitats. It is highly productive, developing a dense leaf canopy that greatly increases the fuel load available to fires when compared to fuel loads from native grasses. As a result, fires become hotter than the surrounding woodland are adapted to, and can kill woodland trees and other savannah components This alters the ecosystem over time (woodland becomes tall Gamba grass grassland) and severely decreases biodiversity (ie it is an increaser grass – it increases habitat suitability for itself as it becomes established). It also poses a threat to neighbouring infrastructure and persons.

Gamba grass is a class B and C declared weed at Gunn Point (Northern Territory government, 2017a). Within the project site, gamba grass is only found in isolated clumps beside the main track to Tree Point Conservation Park. It is recommended that this species be a high priority for eradication and control early in the construction phase, and that monitoring continue to be conducted throughout the life of the project.

#### Goat's head burr

Goat's head burr (*Acanthospermum hispidulum*) is an erect annual herb to one metre tall. It is primarily a weed of disturbed areas – road sides and human settlements. It is known to invade crops and its spiny burr will degrade wool and cause a nuisance to recreational uses of bushland. It will also outcompete native species in open country (Smith, 2002). Goat's head burr is a class B and C declared weed in the NT, but was only occasionally present on the project site.

#### **Hyptis**

Hyptis is an upright annual or perennial herb capable of growing to two metres tall. It is declared as a class B and C weed in the NT. It is primarily a weed of disturbed areas, being found beside roads and other areas of regular human disturbance. It is also a sure sign of overgrazing, becoming dominant as stock will not eat it (Northern Territory government, 2017a). It has the capacity to severely decrease biodiversity, particularly in the ground layer. At Gunn Point, hyptis is found on the coastal sand plain, where it is associated with areas of high human visitation/use, and in adjoining areas of low woodland on the run-off plain.

#### **Mossman River grass**

Mossman River grass is a short grass growing to approximately 50 cm tall. It has an exceptionally spiny seed head that is not easily forgotten by any who have had the misfortune to encounter it – its spines will penetrate clothes and force the unfortunate bearer to take rapid action. It will foul wool and cause injuries to sheep – elsewhere, its main impact will be to deny areas of infestation to recreational users. It is commonly found in sandy soils, particularly beside beaches. At Gunn Point, it is present on the foredune and associated swale, in foredune grassland/forbland, along the edges of monsoon vine thicket, and in the *M. dealbata* open woodland. Mossman River grass is a declared Class B and C weed in the NT.

#### **Perennial mission grass**

Perennial mission grass is an African grass growing to three metres tall, present in the Darwin area since the 1970s. As with gamba grass, it is an increaser species that is encouraged by regular burning. It reduces native biodiversity and occupies disturbed areas. Perennial mission grass is a Class B and C declared weed in the NT (Northern Territory government, 2017a). At Gunn Point, perennial mission grass is present, together with its non-declared but weedy relative *Cenchrus pedicellatus* (annual mission grass) on the coastal sand plain and beside the track leading to the Tree Point Conservation Park. It is particularly prevalent in foredune grassland/forbland and in the *M. dealbata* open woodland.

### Spiny-headed sida and flannel weed

Spiny-headed sida and the closely related flannel weed (*Sida cordifolia*) are herbs growing to one metre or slightly more. They are weeds of disturbed areas, becoming established in areas that are used heavily by humans or stock – in particular, around camp grounds and near water troughs and other places where humans or animals gather and degrade the landscape. They have awned capsules that attach to clothing, vehicles and animals, and so are easily spread (Smith, 2002).

Both species are declared Class B and C weeds in the NT. At Gunn Point, they were recorded in the swale on the coastal sand plain, beside vehicle tracks used to access the beach, and in areas used for camping beside the monsoon vine thicket and mangrove low closed forest.