Priority Ecological Community (PEC)

MAPPING AND CONDITION ASSESSMENT:

***"Relict dune system dominated by extensive stands of Mangarr* (Minyjuru)**
Sersalisia (*formerly *Pouteria) sericea "

March 2015

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SAVING THE NATURE OF THE KIMBERLEY

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*The waypoints, shapefiles, and GIS datasets that inform this report have been provided to the Department of Parks and Wildlife (DPaW) and can be accessed by contacting the Species and Communities Branch, Department of Parks and Wildlife, Locked Bag 104, Bentley Delivery Centre WA 6983 communities.data@dpaw.wa.gov.au

** The report has been provided to the Shire of Broome, Nyamba Buru Yawuru Land and Sea Management Unit, Kimberley Ports Authority, Northwest Property Consultants and is also available for free download at: www.environskimberley.org.au through the Projects/BBS/SKIPA/ tabs.

Parties interested in obtaining shapefiles and datasets of this Priority 1 community and remnant trees should first contact:

Species and Communities Branch
Department of Parks and Wildlife
Locked Bag 104
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Cover Photo: Minyjuru or Mangarr *(Sersalisia sericea)* in flower and fruit at Quadrat S2, south side of Kavite Road, near Nun's block. Note the silky hairs on the leaves, which give rise to the Latin name '*sericea*'. Photo: 27th November 2013, Willing.

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Executive Summary

The *Sersalisia sericea* (Priority 1) Priority Ecological Community (PEC) on inland-trending dunes at Broome has been well-defined, based on ecological mapping and description by Trudgen (1988), description and mapping by Beames, Dureau and Docherty (2011) and subsequent mapping for the nomination to DEC (now DPAW) for listing as a PEC (Beames, 2012). As a local species, *S. sericea* also occurs in the Endangered, Threatened Ecological Community (TEC) Monsoon Vine Thicket and as a scattered element in Pindan communities. The species has high cultural value to many Kimberley Indigenous groups, including Dampier Peninsula groups. It is known that the Broome-based ecological community, with its dense stands of *S. sericea* providing shade, sweet tasty fruit and material resources were of high cultural significance to Yawuru people.

In deference to the Yawuru people of Broome, where this PEC occurs, the official name of this PEC needs to be changed to remove **Mangarr**, a Bardi language name and replace with **Minyjuru***,* the Yawuru language name for *Sersalisia* (formerly *Pouteria*) *sericea.* The official registered name for the PEC would then become: "Relict dune system dominated by extensive stands of Minyjuru *Sersalisia* (formerly *Pouteria*) *sericea."*

Due to the high visual contrast of the ecological community with the surrounding vegetation, the location of populations of *S. sericea* on inland dunes were easily established from aerial photography and Google Earth Professional mapping software. All newly identified and known inland dune locations were visited and the *S. sericea* populations mapped using a hand-held GPS. The only exceptions were two small populations near the Port of Broome, previously surveyed and lodged with the DEC (now DPAW) by Beames, Dureau and Docherty (2011) and Beames (2012). Unlike the surveys conducted for this report, not all *S. sericea* specimens in each dune cluster were GPS located in the 2011 and 2012 surveys and the total extent of these communities was estimated from a combination of aerial mapping and ground-truthing. In the current survey, some additional populations on inland dune ridges at low densities were also noted NE of the town and briefly examined, as well as other groves east of Lawrence Road at Coconut Wells.

Four 50 x 50 m flora quadrats (S1-S4) were located at representative sites on inland dunes, where the PEC was clearly identified to be present, to gain a detailed understanding of its associated soils and flora species and assess overall condition and identified threats. Weeds were identified as one of the greatest threats – particularly the invasive Neem Tree *(Azadirachta indica)* which establishes readily under its shady canopy. In the northern townsite, particularly near the Broome Tip, the relentless spread of Bellyache Bush (*Jatropha gossypifolia*) a Weed of National Significance, poses an additional insidious threat.

Inclusive of a 50m buffer starting from the outer-most *S. sericea* specimens running along the relict dune ridges, the total area of this PEC within the Broome townsite is estimated at 231.73ha, comprised of 15 community groupings of *S. sericea* on relict dunes. Of this, 196.33ha (85%) was preliminarily assessed as VERY GOOD according to the Bush Forever Score. The total area (including a number of small patches and clusters on the outskirts of town) is estimated at 261.46ha, with 84% being preliminarily assessed as VERY GOOD according to the Bush Forever Score.

The presence of remnant large old *S. sericea* trees dotted throughout the now developed residential area known as "Pearlers Hill", means that it is probable that since the foundation of the town, the ecological community has suffered a significant decline in extent across the Broome peninsula. Using

remnant trees as a guide, we can estimate that the community covered at least an additional 10ha if not more, given that many remnant tree indicators have likely been removed.

The Yawuru Conservation Park (YCP) currently only protects less than 58ha or 22% of the total Minyjuru PEC area with nearly 78% remaining exposed to development pressure as the town expands. No patch is protected in its entirety, excepting M8 (3.87ha) of which 99.5% is within the YCP. Of the remaining 18 patches; 8 remain completely unprotected, including the largest patch M11 (42.2ha), 2 patches have less than 5% within the YCP, including M1 (11.9ha) of which unprotected areas have already been subjected to approved clearing, less than 35% of M3 (11.1ha) and M16 (3.34ha) is protected and only 6 patches have more than 50% within the Yawuru Conservation Park.

There is at least 139.83ha of Very Good quality Minyjuru PEC within the township and outside of the YCP that remains exposed to partial or complete destruction as a result of development pressures, including the southern-most occurrences of *S. sericea* and the ecological community. However, further detailed discussions need to take place to resolve the developers desire to reduce the density of associated understorey shrubs in the PEC to locate proposed eco-tents.

Immediate development concerns include the area of this PEC identified at the proposed Wilderness Retreat (NE side of the Broome Turf Club), previously identified by Willing (2013) as 2.75ha (See Map 1.42). The calculated % of total PEC area within the townsite to be impacted within this proposed development was 1.19%, or 1.32% of similarly assessed VERY GOOD Minyjuru habitat within the township. The developer has made a verbal commitment to conserve 90% of the *S. sericea* community present within the land parcel and it is recommended that planners work with the Department of Environment Regulation (DER) to identify development plans that first avoid, then minimise the clearance of any areas identified as *S. sericea* community.

During the compilation of this report a further 2.43ha of M1 was cleared near the Broome Port under the Permit no. CPS 3104/5. This clearing occurred in October 2014 and was within vegetation preliminarily assessed as being VERY GOOD under the Bush Forever score.

Additionally, a small area of M13 (on the east side of Buckley Road) was cleared for a Shire Recycling Depot, following the 2014 survey. The cleared area was a total of 10.5ha of which 0.4ha was within previously the surveyed M13 PEC patch. The total PEC area within the townsite has now been reduced to 228.9ha.

Previously the 2.75ha proposed to be impacted by the Turf club was calculated as 1.19% of the total PEC, or 1.32% of similarly assessed VERY GOOD Minyjuru habitat within the township (Willing, 2014). Due to the permitted clearing of Minyjuru habitat, these figures now need to be updated to reflect the loss of habitat to 1.2% of the total PEC or 1.42% of similarly assessed VERY GOOD Minyjuru habitat within the township.

1.0 Introduction

This survey and condition report was commenced in response to a request from the Department of Environment Regulation (DER) to the developer (North West Property Consultants) to identify the extent and condition of the *S. sericea* community throughout the Broome townsite as there is potential for up to 2.75ha to be impacted in the proposed development. Prior to this survey, the community was only known from four restricted locations on the Broome Peninsula, covering a total area less than 65ha. This precautionary approach has enabled a greater understanding of the ecology, condition, threats and extent of the ecosystem throughout the Broome peninsula.

The survey has been in-part commissioned by North West Property Consultants and an Interim report was produced by Tim in June 2014 for North West Property Services entitled " Interim summary of Priority Ecological Community (PEC) mapping and condition assessment. "Relict dune system dominated by extensive stands of Mangarr (Sersalisia sericea)". However the majority of the survey work has been undertaken voluntarily by Tim Willing, with some volunteer input from SKIPA, and with Louise Beames from Environs Kimberley working to produce maps and this extensive final report.

2.0 Background

The "Relict dune system dominated by extensive stands of Mangarr (Minyjuru) *Sersalisia* (formerly *Pouteria*) *sericea"* was listed as a Priority 1 Ecological Community by the Western Australian Threatened Ecological Community Scientific Committee (TECSC) on 27th March 2012. The description of the ecosystem is as follows:

> "Contains frequent mature (100 years +) *Sersalisia* (formerly *Pouteria*) *sericea* or otherwise known as Mangarr. Mangarr is a culturally important and renowned local bushtucker species and does not occur in such frequency and longevity in other locations. The community is recorded as a *Eucalyptus*, *Sersalisia* low woodland unit that occurs on parallel dunes in the area south east of Gantheaume Point. The community also contains numerous woodland species such as: *Erythrophleum chlorostachys* (ironwood), *Eucalyptus* (*Corymbia*) *zygophylla* (Broome bloodwood), *Hakea macrocarpa* and *Corynotheca micrantha* (zig-zag Lily). Some species are more reminiscent of desert and aridland country including: *Solanum cunninghamii* (bush tomato), *Scaevola parvifolia*, *Goodenia sepalosa, Senna costata*, *Gyrostemon tepperi* and *Triodia* sp. (spinifex). The extensive stands of Mangarr occur in association with species more often found within the nearby Threatened Ecological Community (TEC)-Monsoon Vine Thicket.
>
> Threats: weed invasion, grazing, inappropriate fire regime, proposed developments."

The Mangarr Priority Ecological Community (PEC) was approximated to occur over less than 65ha as mapped by Beames, Dureau and Docherty (2011) and Beames (2012).

Prior to this, Trudgen (1988, 1990) described the floristic composition of the community and identified it as “Inland dunes” occurring as a group of parallel dunes that run roughly WSW-ENE in the area south east of Gantheaume Point.

The body of work conducted throughout 2013-14 and contained within this 2015 report has vastly improved the understanding of the ecology, extent and vulnerability of the priority ecosystem.

Pic. 1.0 View from within the Minyjuru on relict dunes PEC across to the nearby Broome Port industrial area. Photo: 2011, Beames

2.1 Dominant Tree - *Sersalisia sericea*

Sersalisia is a monotypic endemic Australian genus in the Sapotaceae family, which includes tropical fruit trees such as Sapodilla *(Manilkara zapota)* and Star Apple *(Chrysophyllum cainito).* The name *Sersalisia* was first used by the British botanist Robert Brown in 1810. Another member of the Sapotaceae is Mamajen or Joongon *(Mimusops elengi),* an important tree in the monsoon vine thickets of the Dampier Peninsula, but not native in the Broome townsite. Members of the Sapotaceae characteristically have a milky sap, bear fleshy fruits – many of which are edible - and are relatively slow-growing.

For many years *Sersalisia sericea* was known as ***Pouteria sericea*** (Aiton) Baehni and appears under this name in both Wheeler (1992) and Kenneally *et al.* (1996). Two other *Pouteria* species are native to the Kimberley: the closely-related *P. arnhemica* and *P. pohlmaniana,* both occurring in sandstone country, north of the King Leopold Ranges.

Apart from its Kimberley distribution, *Sersalisia sericea* is also found in the Top End of the Northern Territory, in Queensland on Cape York Peninsula, and as far south as Rockhampton.

In Broome, *S. sericea* is called **Minyjuru** by the Yawuru people. However, the Bardi name **Mangarr** also has its followers, as well as the name "Wild Prune".

In consideration of the location of this Priority Ecological Community being within Yawuru country, *S. sericea* will be referred to as *Minyjuru* throughout this report.

On the Dampier Peninsula, Minyjuru (Mangarr) is known to grow in close proximity to *Biidin* (fresh water under the ground) but can also survive well in dryer areas (Bardi Jawi Oorany Rangers, 2011).

The plant is notoriously slow growing, with larger specimens expected to be in the order of hundreds of years old (Beames, Docherty and Dureau, 2011) . New seedlings characteristically require the shade and moist leaf litter of the parent plant or other large old trees to germinate and survive. Cultivation of this species is relatively easy with ripe seeds best removed of flesh before sowing, or using older dropped seeds found at the base of the tree amongst the leaf litter. However, the slow growth rate of the plants deters many people from making such efforts.

Pic. 1.1 Mass germination and abundant Minyjuru seedling growth within the leaf litter and under the shady canopy a parent Minyjuru tree. Photo: Willing.

2.2 Cultural Value

Blanchot & Grouset (2004, p.19-20) noted Minyjuru's high value as a shade tree and fruit provider to the Yawuru people. Yawuru man Micklo Corpus has described the fruit as Mayi, an important traditional food (Vivian, 2013). Yawuru woman, Mujadee Susan Edgar described Minyjuru as a "lovely sweet juicy fruit" which was used by travellers in the wet season to stimulate saliva flow, as "when you are walking a long way and you have that fruit, it gives you a sweetness" (Vivian, 2013).

Blanchot & Grouset (2004, p.19-20) noted that beehives [source of 'sugarbag'] of the stingless native bee (*Trigona* sp.) can often be found in the trunks. Furthermore, "this tree is said to cover your tracks when you are followed". This may be because leaf litter is usually dense under the trees, tracks of an individual cannot be easily be followed once they reach a grove of trees.

Minyjuru, known as Mangarr in Bardi country, in the north of the Dampier Peninsula, has been recorded as wood used to make spears (Irrol) and axe-handles and the ashes used to mix with chewing tobacco (Bardi Jawi Oorany Rangers, 2011).

Miklo Corpus has described the (Minyjuru) area as previously being subject to traditional burning practices involving cool and spot burning every five years (Vivian, 2013).

Other than the small pieces of information above, there is little published information regarding the significance of Minyjuru or the Minyjuru areas to Yawuru people, nor has there been much exploration into their Traditional use and management.

Pic. 1.2 The sweet tasty fruit of the Minyjuru tree are well regarded by many Aboriginal groups throughout the Kimberley. Minyjuru trees within the Broome PEC were a much coveted fruiting tree and places of cultural importance for Yawuru people. Photo: Beames

2.3 Minyjuru Habitat on the Broome Peninsula

The Broome Peninsula is the southern limit of this species in Western Australia (Florabase). In the Broome townsite, *Sersalisia sericea* or Minyjuru essentially occurs in the following habitats:

- **Monsoon Vine Thicket (MVT)**, which is closely associated with coastal sand dunes. This community is listed as Endangered under the Federal EPBC Act (1999).These populations, which are notably abundant in Minyirr Park and along the coastal edge of the peninsula, have not been mapped in this exercise, though most patches are registered within the DPaW TEC database. This community is almost always well defined and does not directly link to Inland Dune Ridges. The sole exception is the MVT located between the east side of Lullfitz Drive and the Water Authority Tank, which merges gradually just south of the Tank into a WSW-ENE trending Inland Dune Ridge community. This patch, and potentially other MVT in the southern Broome Peninsula has yet to be mapped and registered with the DPaW database, though some preliminary survey and negotiations to are underway between Environs Kimberley, Society for Kimberley Indigenous Plants and Animals, Department of Parks and Wildlife, Nyamba Buru Yawuru and Cultural Law Bosses for that area. Some recommendations have been made at the end of this report to finalise the mapping of this Endangered community within the town-site (See page 59.)

- **Inland (relict) Dune Ridges**:

One of the Inland Dune Ridges, now built over, is actually so-called “Pearler’s Hill” in Old Broome. This runs approximately E-W, between and parallel with Anne and Louis Streets. A few vulnerable Minyjuru survivors can still be found: in the grounds of the Uniting Church (corner of Anne & Robinson Sts) and on the southern verge of Anne Street. (Pic 1.4) Old residents lament the demise (c. 2008) of the tree outside the Bowling Club on Herbert Street, beloved by generations of schoolkids for its tasty fruit (Lands, 1997). Using the mapped remnant Minyjuru trees, the local topography and old aerial maps as a guide, it is probable that this community once occupied an additional 10ha of what is now "Old Broome" residential area.

- **Pindan** - as occasional scattered trees. However, due to the current fire-frequency in many areas, damage to canopies, trunk and bark is often evident. Recruitment of new Minyjuru plants is increasingly restricted by fire. A handful of individual pindan-located trees were GPS-located during the course of this survey.

Pic. 1.3 Remnant Minyjuru tree (Wpt 597) on the southern verge of Anne Street in the area previously referred to as "Pearlers Hill." The specimen is overwhelmed by the weed *Merremia*

***dissecta* which is smothering its crown. The tree bears scars and holes and is estimated to be greater than 100 years old (Martin Huber, Broome Botanical Society, pers. com).**

Photo: 23rd Dec 2013, Willing

2.4 Previous Mapping

In his report to the State Planning Commission of WA, Trudgen (1988) first described and mapped the "*Sersalisia sericea* on relict dunes community" on two parallel sand ridges trending roughly WSW-ENE, or transversely along Kavite Road. Trudgen again made reference to and partially mapped this ecosystem extending from Kavite Road in the Cable Beach/Riddell Point Broome Development Concept Plan (Trudgen, 1990).

In a more recent mapping exercise for the Port of Broome, Woodman Environmental Consulting (2008) disturbingly failed to identify either the relict inland dunes or its *S. sericea* associated plant community. This occurred despite Woodman quoting Trudgen's pioneering study at length on p.9 of their report! It seems that the Woodman approach to mapping chose to ignore geomorphology and by using a highly statistical sampling method, effectively sunk or "homogenized" this plant community into the broad-scale open pindan woodland communities they described as FCT 4 and FCT 5.

More recently Environs Kimberley and SKIPA reported on surveys, species associations and threats (Beames, Dureau and Docherty (2011) and provided subsequent maps showing additional sand ridges between Kavite Road and the Broome Racecourse as part of a nomination to DEC (now DPAW) for listing as a Priority Ecological Community (Beames, 2012). These were also used by Jan Lewis (2013) to publish bird population data for the community.

3.0 Survey

This survey was conducted by Tim Willing with some assistance from Christine Howe-Piening from November 2013 to March 2014 for the purposes of identifying the extent and condition of the *Sersalisia sericea* or Minyjuru on relict dunes community (PEC) throughout the Broome Peninsula.

3.1 Methodology

The survey team first identified likely Minyjuru community occurrences throughout the peninsula using a combination of previous mapping, aerial photographic maps and local knowledge. The dense foliage of the Minyjuru tree is in stark contrast to the surrounding vegetation so that clusters of Minyjuru are easily identified from aerial maps, particularly where the photographs have been taken in the dry season and much of the vegetation, excepting the dark evergreen to Minyjuru, has dried off.

Each individual Minyjuru specimen was GPS located using a hand-held GPS (Garmin GPS 60C or Garmin Oregon 550 device) with accuracies of at least 7m. In addition, written notes were made

about the condition of each specimen, including weeds present, fire scars, animal tracks or any other observations.

A total of 889 Minyjuru trees were logged in the Broome Peninsula with a further 48 trees outside the town boundary. Known locations of remnant aged Minyjuru specimens were also GPS-located within the township.

Historical aerial maps were obtained from Landgate, and by cross referencing with the remnant aged Minyjuru locations, local knowledge and local topography, a cautious estimate has been developed that identifies the historical location of one dune ridge Minyjuru community along Anne Street prior to the development of the township.

In March 2014, the surveyor took a helicopter flight over the Broome peninsula to check for any additional relict dune locations and cross-check the extent of those surveyed.

Four 50 x 50 m flora quadrats (S1-S4) were located at representative sites on inland dunes in November-December 2013, where the PEC was clearly identified to be present, to gain a detailed understanding of its associated soils and flora species and assess overall condition and identified threats (See 4.2). These four representative sites are Minyjuru 1, 4B, 8 and 12 and are identifiable on the maps as blue squares. Christine Howe-Piening assisted the surveyor with all quadrat surveys.

The collected data was uploaded from the hand-held GPS to Google Earth Pro and cross-checked with written notes.

In order to identify the area and extent of each of the distinct Minyjuru groupings around relict dune ridges, an arbitrary 50m buffer was plotted from the outer-most Minyjuru specimens.

Pic. 1.4 A number of high resolution images obtained from Landgate (from 1943, 1961 and 1966) allow identification of historical (and current) Minyjuru areas. This photo is from 1961 and has been cropped, reduced in size and compressed for the purposes of this report. The Minyjuru areas in the southern Broome Peninsula can clearly be seen in these images. Actual images are available from Landgate. Source: Landgate, by request.

3.2 Limitations

The survey was severely limited by the amount of paid time available to the consultant to undertake the mapping across the town-site. As a result, much of the work has been undertaken on a volunteer basis and has relied upon the commitment of the surveyor to undertaking a thorough and professional survey, with the unpaid assistance of volunteers from community groups SKIPA and Environs Kimberley. Despite this huge undertaking, the maps developed for the ecological community within the townsite are considered by the authors to be 90% complete and 99% accurate, excepting those patches (M1 and M2) which have not been further ground-truthed in the 2013/14 survey and remain estimated from aerial maps and limited ground-truthing.

Despite the survey work occurring in 2013/14, the compilation of the report was delayed due to the sheer volume of datapoints and information that needed to be compiled during a time when one of the primary authors (Louise) was having her second child (in two years).

The survey was restricted to one Mankala season (Dec-March), whereas, surveys over variable seasons and multiple years would doubtless provide additional data about the floristic and faunal composition of the ecosystem.

The local Yawuru people recognise six seasons:

Mankala	(December - March)	Wet season with north-westerly winds
Marul	(April)	Hot period with high humidity and light winds
Wirralburu	(May)	South-east winds and cool nights start
Barrgana	(June-August)	South-east winds blow with cold nights
Wirlburu	(September)	Westerly winds return with warmer nights
Larja	(October-November)	Winds strengthen to north-west, thunderstorms begin

In some instances (notably in Minyjuru 10, 11, 12 and 13) the eco-tone between the dune ridges and the surrounding pindan woodland are not clearly identifiable and there is some merging of the two ecosystems. An arbitrary 50m buffer has been developed around the outermost Minyjuru tree of each cluster of Minyjuru tree to define each individual patch. However it may be the case that the ecosystem, and its floristic associations sometimes continue beyond this area. The superimposition of detailed contour mapping, unavailable to the authors at the time of compiling the report would help resolve such issues. Compounding factors include the potential of frequent fire in certain areas of Minyjuru community which may have destroyed aged Minyjuru stands and inhibited germination, leading to these areas being considered "outside" the Minyjuru community, where, in the absence of frequent and hot fires, the community would be naturally occurring.

One helicopter flight was taken during the wet season when much of the vegetation was green and dense. Such a survey would have been better undertaken during the late dry season (eg. Sept-Oct) , when much of the vegetation had dried, excepting the evergreen and dense Minyjuru community.

4.0 Results

A total of 889 individual Minyjuru trees were recorded across 15 discrete Minyjuru community groupings (patches) within the township and a further 49 trees in four patches (Minyjuru 14,15, 16 and 17), inclusive of two small clusters were mapped outside the township. Using a 50m buffer plotted from the outer-most Minyjuru specimens of each community grouping (patch) to determine the shape file of each discrete PEC patch, the total area of this PEC within the Broome townsite is estimated at 231.73ha with an additional 29.73ha found outside the town boundary. This area includes the two patches; Minyjuru 1 and Minyjuru 2 which have an area of 11.9ha and 13.4ha respectively. These areas were estimated from aerial maps and partial ground-truthing in Beames (2012) rather than the detailed ground-truthing undertaken for the remaining patches.

Table 1.0 provides a quick glance summary of each of the Minyjuru patches, survey dates and details including area, land tenure, condition assessment, weeds, threats and recommendations by the authors.

Within the townsite, 196.33ha (85%) was preliminarily assessed as VERY GOOD and 15% as GOOD according to the Bush Forever Score. Across the entire range, 84% was preliminarily assessed as VERY GOOD, 14% as GOOD and 2% as POOR under the Bush Forever Score.

The town-site patches were labelled Minyjuru 1-13 (inclusive of 4B and 5B) and the area of each site, condition assessment and other details are examinable in Table 1.0. Additional individual Minyjuru trees would certainly be located in Minyjuru 1 and 2 that were reported on in Beames (2012) and not subject to the exhaustive 2013/14 survey.

The historical occurrence of Minyjuru within the townsite appears to have been confined to the dune ridge known as "Pearlers Hill" between Anne Street and Louis St. Conservatively estimated as once covering 10ha, the patch is now only present as a few remnant trees scattered throughout the residential area.

Following the survey work and during the compilation of the report, in October 2014, further clearing of 2.43ha occurred within M1 (under the Permit no. CPS 3104/5). This vegetation had been preliminarily assessed as being VERY GOOD under the Bush Forever Score. The total PEC area within the townsite has now been reduced to 229.3ha.

Using the conservative estimate of historical loss of 10ha and the recent clearing of M1, the original range of Minyjuru PEC has been reduced by 6.2%. Further loss by the proposed Wilderness Retreat NE of the Turf Club, will increase this loss to 7.3%

The shape files for the Yawuru Conservation Park have been overlayed on the shape files for the Minyjuru PEC patches. Unfortunately, only a small percentage (22%) of the Minyjuru PEC area is protected within the Yawuru Conservation Park. Only 57.57 ha is currently protected, leaving nearly 78% exposed to development pressure as the town expands. No patch is protected in its entirety, excepting M8 (3.87ha) of which 99.5% is within the YCP. Of the remaining 18 patches: 8 remain completely unprotected, including the largest patch M11 (42.2ha), 2 patches have less than 5%

within the YCP, including M1 (11.9ha) of which unprotected areas have already been subjected to approved clearing, less than 35% of M3 (11.1ha) and M16 (3.34ha) is protected and only 6 patches have more than 50% within the Yawuru Conservation Park.

There is at least 139.83 ha (now 137ha following clearing) of VERY GOOD quality Minyjuru PEC within the township and outside of the YCP that remains exposed to partial or complete destruction as a result of development pressures, including the southern-most occurrences of *S. sericea* and the ecological community. **Table 1.1** displays the areas of each patch within the Yawuru Conservation Park, % calculations and relationships to preliminary quality assessment.

Due to historical clearing and degradation of vegetation as a result of development, weeds and fire, as well as climatic changes over time, a number of remnant Minyjuru trees exist outside of defined patches, or occur as outlier trees as a component within surrounding ecosystems. Twenty Minyjuru remnant trees were recorded and described and recommendations have been made with regards to their management and protection. These can be found in **Table 1.2.**

The data that informs this report has been sent to the Department of Parks and Wildlife, Species and Communities Branch as the following three kmz files that open into Google Earth.

File no.1 Minyjuru shape files and labels

Minyjuru shape files and labels ALL.kmz

File no.2 Minyjuru waypoints ALL TREES

Minyjuru waypoints ALL TREES.kmz

File no.3 Minyjuru PEC Mapping - Complete dataset is found within this document inclusive of quadrats, 50m buffer lines, shapefiles, tree waypoints, clearance areas etc.

Minjurru PEC Mapping.kmz

The results have been collated into the following maps.

Map 1.0 shows the location and extent of Sites 1-13 within the township. The shapefile for all Minyjuru patches within and outside town is below.

Map 1.10 shows the data points for each Minyjuru specimen mapped within the township, within patches 1-13 and as remnant trees.

Map 1.11 shows a closer view of the data points for Minyjuru trees mapped within the township within Minyjuru patches M1- 9and outlier remnant trees.

Map 1.12 shows a closer view of the data points for Minyjuru trees mapped within the township, within Minyjuru patches M10-14 and outlier remnant trees.

Maps 1.20 show the location and extent of Minyjuru patches M14-17 outside the township

Map 1.21 shows a closer view of the data points for Minyjuru trees mapped outside the township, within Minyjuru patches M14- 17 and outlier remnant trees.

Map 1.30 shows the location of mapped remnant trees in the Pearlers Hill area and the likely historical location of Minyjuru community throughout the developed township.

Map 1.40 shows the location of the recent clearing undertaken as part of Permit no. CPS 3104/5 and the incursion that has been made into M1.

Map 1.41 shows the location of the recent clearing undertaken near the Broome Tip and the incursion that has occurred into M13. Two older Minyjuru trees were damaged as part of the clearing. It is evident that further survey work would have increased the boundary of M12 and/or M13 Minyjuru patches.

Map 1.42 shows the location of the Minyjuru trees within the proposed Wilderness Retreat (outlined in red). These Minyjuru trees are currently proposed for retention as shade trees within the development.

Map 1.50 shows the locations of sampling Quadrats S1,S2 and S4

Map 1.51 shows the locations of sampling Quadrat S1

Table 1.0 provides a quick glance summary of each of the Minyjuru patches, survey dates and details including area, land tenure, condition assessment, weeds, threats and recommendations by the authors.

Minyjuru Patch No.	Surveyed	Hectares	Land tenure	Quality Assessment	Threats	Weeds	Notes	Recommendations
1	2011/12 (identified as Mangarr 1) some estimation	11.9 ha estimated Now 9.47ha due to permitted clearing CPS 3104/5	Environmental & Cultural Corridor Reserve (LPS6) Port Zone Bottom corner in Conservation Reserve (Nyamba Buru Yawuru?) Special Control Area (SCA 4) – flood levels <10.5m AHD	Would qualify as VERY GOOD under Bush Forever scoring	Industrial development. Weeds invading into the northern section. Two sections have since been cleared under clearing permit CPS 3104/5 in October 2014 0.81ha + 1.62ha = 2.43ha	*Passiflora foetida* *Azadirachta indica* *Merremia dissecta,* *Macroptilium atropurpureum* *Cenchrus setiger* *Hyptis suaveolens* *Tridax procumbens* (Weeds present behind the Industrial Area on the firebreak not within most of the patch)	Weed hotspot behind industrial blocks in adjacent CP9 Contains S1 Quadrat in the southern section. No *Corynotheca micrantha var. gracilis* Lily present No recent burn 15 mature Minyjuru trees clear-felled and pulped in October 2014	Needs additional survey and ground-truthing to determine all remnant tree locations and correct boundary of ecosystem - may run east-west and connect with Minyjuru 2. Need to determine total loss to Minyjuru habitat proposed by impending development and offset appropriately - including measures that protect other patches and contribute to their improved management.
2	2011/12 (identified as Mangarr 2) some estimation	13.4 ha estimated	Environmental & Cultural Corridor Reserve Special Control Area (SCA 6) – Drainage Aquifer Recharge Area	Would qualify as VERY GOOD under Bush Forever scoring	Industrial development. Some tracks and rubbish. Illegal camping facilitating weeds and rubbish.	*Passiflora foetida*	Flattened off dune ridge. Suspect that there are midden sites throughout. *Corynotheca micrantha var. gracilis* Lily present within this patch (Southern section) No recent burn	Needs additional survey and ground-truthing to determine all remnant tree locations and correct boundary of ecosystem - may in fact run east-west and connect with Minyjuru 1. Manage weeds. Rationalise tracks and discourage dumping of rubbish and garden waste. Discourage illegal camping.

Minyjuru Patch No.	Surveyed	Hectares	Land tenure	Quality Assessment	Threats	Weeds	Notes	Recommendations
3	Dec 2013 Ground-truthed	11.1ha	Environmental & Cultural Corridor Reserve Part in Yawuru Conservation Park Special Control Area (SCA 6) – Drainage Aquifer Recharge Area	Would qualify as VERY GOOD under Bush Forever scoring	Industrial development. Garden rubbish, Industrial rubbish	One Neem *Azadirachta indica* (752) *Hyptis suaveolens* on track near 753 *Passiflora foetida*	Half in and half out of the Yawuru Conservation Park. Low density of old Minyjuru. Individuals with 5-6m crown height. Intersected by numerous tracks No *Corynotheca micrantha var. gracilis* Lily present within this patch. No recent burn	Investigate the possibility of Yawuru Conservation Park expanding at least to the track to take in more of Minyjuru 3. Shire de-gazettes ecologically inappropriate (c.1970) subdivision and YCP is brought to the edge of Kavite Road and is contiguous with the Yawuru Conservation Park encompassing 4B. Rationalise tracks and discourage dumping of rubbish and garden waste. *Grevillea refracta* in between the sand ridges requires a cool burn to regenerate. This is an important nectar tree for birds and is becoming senescent in these areas causing a decline in bird populations (J. Lewis pers. com)
4	2011/12 (identified as Mangarr 3) some estimation Ground-truthed Dec 2013	23.3ha estimated 27.4ha	Environmental & Cultural Corridor Reserve Part in Yawuru Conservation Park Special Control Area (SCA 6) – Drainage Aquifer Recharge Area Patch bisected by local road corridor – Kavite Road Development Zone (adjacent to Kavite Road)	Would qualify as VERY GOOD under Bush Forever scoring	Possible Kavite Road subdivision?, Fire, weeds	*Passiflora foetida*	High density of Minyjuru trees. High quality area with crown height from 3-4 metres and some up to 5-6m (WP 793 - 794) Dense Minyjuru at western end have not been subject to complete mapping (outside defining edge was the focus). *Corynotheca micrantha var. gracilis* Lily present within this patch, running along the dune crest. A single track traverses the patch (N-S) Has the only known population of weeping tree *Psydrax pendulina* in Broome (WP 733 with 4B).	Shire de-gazettes ecologically inappropriate (c.1970) subdivision and Yawuru Conservation Park is brought to the edge of Kavite road and is contiguous with the Yawuru Conservation Park encompassing 4B. Undertake further survey effort for weeping tree *Psydrax pendulina* and implement measures to protect this solitary population. (SKIPA/Yawuru/EK/DPaW) *Grevillea refracta* in between the sand ridges requires a cool burn to regenerate. This is an important nectar tree for birds and is becoming senescent in these areas causing a decline in bird populations (J. Lewis pers. com)

Minyjuru Patch No.	Surveyed	Hectares	Land tenure	Quality Assessment	Threats	Weeds	Notes	Recommendations
4 cont							Important agile wallaby habitat. No recent fire.	
4B	2011/12 (identified as part of Mangarr 3) some estimation Dec 2013 Ground-truthed	3.78ha	Coastal Reserve (LPS6) Conservation Reserve (Nyamba Buru Yawuru?) (Minyirr Park?) Patch bisected by local road corridor – Kavite Road	Would qualify as VERY GOOD under Bush Forever scoring	Fire, weeds, long term coastal cliff erosion.	*Passiflora foetida*	Contains the S2 quadrat at the western end Dense wind-pruned Minyjuru at western end - completely mapped. Canopy height varies from 3m (Seaward side) to 5m (Kavite Rd side). High quality area Contains aboriginal midden. Has the only known population of weeping tree *Psydrax pendulina* in Broome (with 4) Important agile wallaby habitat. *Corynotheca micrantha var. gracilis* Lily present within this patch, running along the dune crest. No recent fire. Termite damaged trees noted at WP 666, 667, 669 and 682.	Register Aboriginal Middens Undertake further survey effort for weeping tree *Psydrax pendulina* and implement measures to protect this solitary population. (SKIPA/Yawuru/EK/DPaW) *Grevillea refracta* in between the sand ridges requires a cool burn to regenerate. This is an important nectar tree for birds and is becoming senescent in these areas causing a decline in bird populations (J. Lewis pers. com)

Minyjuru Patch No.	Surveyed	Hectares	Land tenure	Quality Assessment	Threats	Weeds	Notes	Recommendations
5	Ground-truthed Dec 2013	16.4 ha	Environmental & Cultural Corridor Reserve Part in Yawuru Conservation Park Special Control Area (SCA 6) – Drainage Aquifer Recharge Area Patch truncated by local road corridor (Kavite Rd) Major portion in Development Zone adjacent to Kavite Rd)	Would qualify as VERY GOOD under Bush Forever scoring	Rubbish; cement, old tyres in the camping area. Spread of weeds by campers and horses. inc. Khaki weed and caltrop Road widening	*Passiflora foetida*	No Corynotheca micrantha var. gracilis Lily present within this patch. Large unofficial camping area (in the western end) particularly during the racing season. A number of unofficial tracks Eastern survey area away from the camping is in prime condition. Minyjuru is dense throughout this patch. Crown height averages 3.5 - 4m No recent burn	Shire de-gazettes ecologically inappropriate (c.1970) subdivision and Yawuru Conservation Park is brought to the edge of Kavite Road and is contiguous with the Yawuru Conservation Park encompassing 5B. *Grevillea refracta* in between the sand ridges requires a cool burn to regenerate. This is an important nectar tree for birds and is becoming senescent in these areas causing a decline in bird populations (J. Lewis pers. com) Register trees along the roadside to prevent clearing of significant mature trees. Discourage/manage camping and remove rubbish/provide rubbish solutions.
5B	Ground-truthed Dec 2013	1.1ha	Broome Shire Reserve 22648 leased to Turf Club	Would qualify as GOOD under Bush Forever scoring	Road widening	*Passiflora foetida*	Meets with *Paractia* grouping (CP15) Low density Minyjuru with 4m crown height. No *Corynotheca micrantha var. gracilis* Lily present within this patch. Patch bisected by local road corridor – Kavite Road No recent burn	Register trees along the roadside to prevent clearing of significant mature trees. Investigate the possibility of Yawuru Conservation Park expanding to include Minyjuru 5B (and CP 15)
6	Ground-truthed March 2014	5.65 ha	Environmental & Cultural Corridor Reserve Part in Yawuru Conservation Park	Would qualify as VERY GOOD under Bush Forever scoring	Future industrial development Abandoned car body and other industrial rubbish eg. concrete pipes, (near to the	*Hyptis suaveolens (*southern area) *Passiflora foetida*	Small dune ridge patch north west of power station and in close proximity to Minyjuru 4. Low density Minyjuru with 4-5m crown heights. Outlier waypoint 764 suggests that Minyjuru 4 and 6 were once one	Apart from the rubbish and *Hyptis,* the patch is in good condition and could recover well if subject to restoration activities including weed control and rubbish removal.

Minyjuru Patch No.	Surveyed	Hectares	Land tenure	Quality Assessment	Threats	Weeds	Notes	Recommendations
6 cont			Special Control Area (SCA 6) – Drainage Aquifer Recharge Area		power station - at the southern end)		patch, now divided by the power station. A significant loss has occurred previously No *Corynotheca micrantha var. gracilis* Lily present No recent burn	Investigate the possibility of Yawuru Conservation Park expanding to include Minyjuru 6 as most is right outside the current boundary.
7	2011/12 (identified as Mangarr 4) some estimation Ground-truthed March 2014	15.3ha estimated 25.9 ha (ground-truthed)	Environmental & Cultural Corridor Reserve Part in Yawuru Conservation Park Special Control Area (SCA 6) – Drainage Aquifer Recharge Area Low density western portion is in Development Zone = Broome Shire Reserve 22648 (leased to Turf Club)	Would qualify as VERY GOOD under Bush Forever scoring	Impending eco-tourism development (Wilderness Retreat) and potential development outside of the Yawuru Conservation Park Rubbish	*Passiflora foetida* *Stylosanthes hamata* (confined to the track)	High density of Minyjuru trees with crown height 3-4.5m High quality throughout with some degradation in the turf club lease area (western edge) Intersected by two North- south tracks inside the proposed Wilderness Retreat. Some weeds along the track and some rubbish within the turf club lease areas (as a result of past camping) including old mowers etc. No *Corynotheca micrantha var. gracilis* Lily present No recent burn	Investigate the possibility of Yawuru Conservation Park expanding at least to the track and up to the turf club lease area, incorporating as much of Minyjuru as possible. *Grevillea refracta* in between the sand ridges requires a cool burn to regenerate. This is an important nectar tree for birds and is becoming senescent in these areas causing a decline in bird populations (J. Lewis pers. com) Turf Club takes responsibility for the removal of dumped rubbish on the western section. Dumping of rubbish and garden waste is discouraged/controlled.
8	Ground-truthed Dec 2013	3.87ha	Environmental & Cultural Corridor Reserve Almost all within the Yawuru Conservation Park Special Control Area (SCA 6) – Drainage Aquifer Recharge Area	Would qualify as VERY GOOD under Bush Forever scoring	Rubbish, fire, expanding trail bike tracks	*Passiflora foetida*	Contains Quadrat sampling - S4 Low density of Minyjuru trees on dune ridge throughout, with 3-4.5m crown height. No *Corynotheca micrantha var. gracilis* Lily present	Remove rubbish and old car bodies. Nyamba Buru Yawuru and Broome Shire explore possibility of relocating trail bike circuit to a more appropriate location and rehabilitate track.

Minyjuru Patch No.	Surveyed	Hectares	Land tenure	Quality Assessment	Threats	Weeds	Notes	Recommendations
8 cont							Informal trail bike circuit. Some old car bodies and tyres present. No recent burn	
9	Ground-truthed Dec 2013	1.19ha	Environmental & Cultural Corridor Reserve Part in Yawuru Conservation Park Special Control Area (SCA 6) – Drainage Aquifer Recharge Area	Would qualify as VERY GOOD under Bush Forever scoring	Road-widening Roadside fire, fire breaks clearing vegetation and assisting weed spread	*Passiflora foetida*	Not present on an obvious sand dune. Substrate more like pindan. Minyjuru crown height 3-4.5m Overlaps with CP37 Close proximity to sensitive cultural area (rare sandstone outcrops) Fire track runs parallel to Gubinge Road and through this patch. No recent burn	Register trees along the roadside and in proximity to firebreak to prevent clearing of significant mature trees.
10	2013/14 Ground-truthed	24ha	Development Zone (LPS6) Outside of Yawuru Conservation Park	Zones within this patch would qualify as GOOD (approx 40% ~ 9.6ha) or VERY GOOD (60%~14.4ha) under Bush Forever scoring	*Jatropha* infestation is beginning to invade the sand dune on the southern side. Expansion of Broome North - potential for residential and light industrial development.	Minor weeds mostly within the SW section due to historical use as cattle feedlot. *Passiflora foetida* *Jatropha gossypifolia* *Hyptis suaveolens* *Stylosanthes scabra* *Azadirachta indica* *Ziziphus mauritiana*	Minyjuru crown height 3.5-5m A number of informal camps Numerous tracks intersect. Contiguous with unregistered MVT on the north western end. Minyjuru continues throughout the MVT. No *Corynotheca micrantha var. gracilis* Lily present Close to extensive *Jatropha* infestation on the southern side. No recent burn	Review the extent of Minyjuru 10 as the SE hook appears to merge from dune ridge to pindan. Use contour data as it becomes available. Contiguous MVT needs to be subject to survey, condition assessment and registered with DPaW and the Federal Department of Environment. (SKIPA/EK/Yawuru/DPaW) Review planning for Broome North and adjust locations for conservation reserves/Public open space to align with this PEC. Identify quality zones throughout. Manage weeds, particularly *Jatropha* patch which is spreading quickly from the established source population (South west of patch - on the intersection of the two tracks WE -NS).

Minyjuru Patch No.	Surveyed	Hectares	Land tenure	Quality Assessment	Threats	Weeds	Notes	Recommendations
								Register trees along the track between Broome North and Fairway Drive to prevent clearing of significant mature trees during road construction
11	Ground-truthed Dec 2013	42.2ha	Outside of Yawuru Conservation Park Northern portion – Some conflict in mapping here: Rural Residential (LPS6)? Development Zone ?(southern portion) Landcorp/Broome North extension ?	Would qualify as VERY GOOD under Bush Forever scoring (Approx 85% ~35.87ha) Some differentiation in quality in the Northern area- may qualify as GOOD (approx 15% ~ 6.33ha) under the Bush Forever scoring	Urban expansion, rubbish dumping, weeds, potential sand mining, fire	Northern section: *Azadirachta indica* *Cryptostegia madagascariensis* (WONS) *Passiflora foetida* *Jatropha gossypifolia* (WONS) - northern boundary only *Sansevieria trifasciata* (garden escapee at WP 421) on Northern boundary Feral European Bees have hives in trees at WP 528 and 536	Mapping was to determine outer boundary of the patch only. The dense middle section requires more extensive mapping. High density of Agile Wallabies. Old campsites in the southern end using drain as access point. Rubbish dumping in the North. Car bodies in the north-west. Neems, *Jatropha* and *Hyptis* invading from road verges. Highest density of Minyjuru trees in the central northern section on high ground. High density of *Gyrocarpus* trees (culturally important). Most degraded zone is within the conservation area, while the higher quality area (southern area) is outside the conservation area (marked for future stages of Broome North) No *Corynotheca micrantha var. gracilis* Lily present No recent fire	Use contour data, as it becomes available, to more accurately define the patch where dune field ridges merge into pindan. Seek to protect the large population of Agile Wallabies (potentially the largest population left in town) by re-drawing the conservation park boundary to accommodate the central and southern portion of Minyjuru 11 and 12 which is both of high quality and density for Minyjuru and Agile Wallabies. Register trees along the roadside between to prevent clearing of significant mature trees if the road is widened. Manage weeds, particularly *Jatropha*, *Azadirachta indica* and remove the one *Cryptostegia madagascariensis.* Remove rubbish. Actively discourage dumping and camping in this area. Review planning for Broome North and adjust locations for conservation reserves/Public open space to align with this PEC.
12	2013/14	34.3ha	Majority of patch in Environmental &	Would qualify as VERY GOOD	Weeds	*Passiflora foetida*	Minyjuru crown heights at 4-7m	Needs more mapping in the central area - mapping was undertaken to determine the extent

Minyjuru Patch No.	Surveyed	Hectares	Land tenure	Quality Assessment	Threats	Weeds	Notes	Recommendations
12 cont	Ground-truthed		Cultural Corridor Reserve (LPS6) Outside of Yawuru Conservation Park Southern portion in Development Zone Landcorp/Broome North extension ?	under Bush Forever scoring (approx 80% ~27.44) Some differentiation in quality in the eastern section which may only qualify as GOOD (approx 20% ~ 6.86ha) under the Bush Forever scoring	Sandmining proposal? Rubbish dumping, Fire Urban expansion	Weeds in the eastern section: *Azadirachta indica* *Stylosanthes scabra* *Aerva javanica* *Merremia dissecta* *Ziziphus mauritiana* Along Buckleys road verge: *Hyptis suaveolens*	Highest density of Minyjuru is in the proximity of the quadrat S3 (located on the dune summit) in the western section. Shire Recycling Depot has recently been located to the south of this patch and compromised two large old Minyjuru trees Some historic rubbish and older weed infestations, particularly *Hyptis* on the eastern side of the track. Neem weeds are becoming a problem. Central area needs to be subject to more survey and mapping - current mapping to determine boundaries only. No *Corynotheca micrantha var. gracilis* Lily present. No recent fire	of the outer boundaries. Contour data would assist better definition of this patch. Seek to protect the large population of Agile Wallabies (potentially the largest population left in town) by re-drawing the conservation park to accommodate the southern portion of Minyjuru 11 and 12. Register trees along the roadside between to prevent clearing of significant mature trees if the road is widened. Remove rubbish. Actively discourage dumping and camping in this area. Review planning for Broome North and adjust locations for conservation reserves/Public open space to align with this PEC. Manage high threat weeds.
13	Ground-truthed Dec 2013	9.54ha estimated from some survey points	Development Zone (LPS6) - Landcorp/Broome North extension ? Outside of Yawuru Conservation Park	Would qualify as VERY GOOD under Bush Forever scoring	Urban expansion, Weeds Fire Rubbish dumping	*Passiflora foetida* *Azadirachta indica* (seedlings and saplings at 458)	Minyjuru crowns 4.5-6m height. Likely to have a moderate to high Agile Wallaby population. A 10.5ha clearance for the new Shire Recycling Depot has occurred in May 2014 just north of this patch and including a small section north west of the identified patch.	Requires urgent survey of the eastern area. Minyjuru observed from the air, not sufficient time within this survey to complete mapping for this patch. Use contour data, as it becomes available, to more accurately define the patch. More ground-truth mapping required at eastern end.

Minyjuru Patch No.	Surveyed	Hectares	Land tenure	Quality Assessment	Threats	Weeds	Notes	Recommendations
							No *Corynotheca micrantha var. gracilis* Lily present. No recent fire	Review planning for Broome North and adjust locations for conservation reserves/Public Open Space to align with this PEC.
OUTSIDE TOWN BOUNDARY								
14	Ground-truthed Dec 2013	5.25ha	Cultural & Natural Resource Use (LPS6) ? Sand mining lease west of Broome Tip Outside of Yawuru Conservation Park	Would qualify as POOR under Bush Forever scoring	Illegal rubbish filling and digging activities Further sandmining Weeds	*Merremia dissecta* *Ziziphus mauritiana* *Passiflora foetida* *Azadirachta indica* *Jatropha gossypifolia* *Cenchrus cilliaris*	Minyjuru crowns 4-5m height No *Corynotheca micrantha var. gracilis* Lily present within this patch. No recent fire Has already been massively impacted by digging and illegal rubbish-filling activities by Broomecrete	Draw attention of EPA to illegal dumping. Manage weeds Require current sand mine leasee (Broomecrete) to manage weeds on their lease and prevent further spread.
15	Ground-truthed Dec 2013	16.9ha	Major portion in Industrial Zone (south of Broome Road) and the Savannah Way layby Public Purposes – Airport (LPS6) Outside of Yawuru Conservation Park	Would qualify as VERY GOOD under Bush Forever scoring	Future industrial development or future airport expansion.	*Passiflora foetida* *Azadirachta indica* (several seedlings)	Low density of scattered Minyjuru trees with 4.5-5m crowns. This ridge may continue east. Explosives storage depot has been built to the North-east and also a batching plant has been built to the South west. Both of these were potentially on top of the dune system and possibly Minyjuru habitat. *Corynotheca micrantha var. gracilis* Lily present within this patch, running along the linear sand dune.	Survey additional sand ridges parallel with this patch (to the north of Broome Highway in Water Authority Reserve.) (SKIPA/EK/Yawuru/DPaW) Use contour data to more accurately define the patch. More ground-truth mapping required. Subject to more intensive survey. New industrial/other developments undertake flora assessment, avoiding first and then minimising any clearance of the *Minyjuru* ecosystem. Any losses should be offset appropriately, including; conserving other at risk patches and contributing to management.

Minyjuru Patch No.	Surveyed	Hectares	Land tenure	Quality Assessment	Threats	Weeds	Notes	Recommendations
							No recent fire	
16 (cluster)	Ground-truthed Dec 2013	3.34ha	Public Purposes -Water Supply Special Control Area (SCA2) – Future Broome International Airport Environs Part in Yawuru Conservation Park	Would qualify as VERY GOOD under Bush Forever scoring	Inappropriate fire.	*Passiflora foetida*	Minyjuru trees with 3.5-8m crown height. Has been damaged by recent fire. Regular hot fire is common in this area. *Corynotheca micrantha var. gracilis* Lily present Elevated pindan area with dune ridges ill defined, south side of McGuigan Road.	Cool burn undertaken by Yawuru Rangers to prevent regular wildfire.
17 (cluster)	Ground-truthed Dec 2013	4.24ha	Cultural & Natural Resource Use Outside of Yawuru Conservation Park	Would qualify as VERY GOOD under Bush Forever scoring	Inappropriate fire. Weeds	*Passiflora foetida* *Hyptis suaveolens* (400- close to road verge)	Minyjuru trees with canopies 4-6m in height. Further ridges extending east from Coconut Wells need to be mapped. Unusual topography - extensive gravel and some sand mix - does not appear to be located on a typical sand ridge and may not fit the classification for this PEC. Numerous Agile Wallaby scrapes observed. No *Corynotheca micrantha var. gracilis* Lily present. No recent fire	Survey additional ridges parallel with this patch (to the north east and south east toward the Waterbank Homestead road) (SKIPA/EK/Yawuru/DPaW) Remove *Hyptis* incursion.

Table 1.1 Area of each patch within the Yawuru Conservation Park, % calculations and relationships to preliminary quality assessment.

Managarr Patch	Total Area (ha)	Area within YCP	% in Yawuru Conservation Park	Rating	Cleared area	
						2015 area
Inside town Boundary						
M1	11.9	0.42	3.53%	VG	2.43	9.47
M2	13.4	0	0.00%	VG		
M3	11.1	3.45	31.08%	VG		
M4	27.4	19.69	71.86%	VG		
M4B	3.78	2.86	75.66%	VG		
M5	16.4	8.42	51.34%	VG		
M5B	1.1	0.03	2.73%	G		
M6	5.65	3.17	56.11%	VG		
M7	25.9	13.85	53.47%	VG		
M8	3.87	3.85	99.48%	VG		
M9	1.19	0.79	66.39%	VG		
M10	24	0	0.00%	VG		
M11	42.2	0	0.00%	VG		
M12	34.3	0	0.00%	G		
M13	9.54	0	0.00%	VG	0.4	9.14
Within town totals	231.73	56.53	24.39%			
		VG	24.38%			
Within town totals inc cleared area	228.9	56.53	25%		**% Condition within town area**	
VG	196.33	56.5	28.78%	**VG**	85%	
G	35.4	0.03	0.08%	**G**	15%	
VG	193.5	56.5	29.2%		85%	
G	35.4	0.03	0.08%		15%	
Outside town boundary						
M14	5.25	0	0.00%	Poor		
M15	16.9	0	0.00%	VG		
M16	3.34	1.04	31.14%	VG		
M17	4.24	0	0.00%	VG		
Outside town totals	29.73	1.04	3.50%		**% Condition outside town area**	
VG	24.48	1.04	4.25%	**VG**	82%	
POOR	5.25	0	0.00%	**POOR**	18%	
Grand total						
Total	**261.46**	**57.57**	**22.02%**		**% Condition overall**	
VG	**220.81**	**57.54**	**22.01%**	**VG**	**84%**	
G	**35.4**	**0.03**	**0.01%**	**G**	**14%**	
POOR	**5.25**	**0**	**0.00%**	**POOR**	**2%**	
After clearing totals						
Total	258.63	57.57	22.26%		**% Condition overall**	
VG	217.98	57.54	26.40%		84%	
G	35.4	0.03	0.08%		14%	
POOR	5.25	0	0.00%		2%	

Table 1.2 Twenty Minyjuru remnant trees were recorded and described and recommendations have been made with regards to their management and protection.

Remnant Tree No.	Latitude	Longtitude	Closest Patches	Notes	Recommendations - which are in YCP?
00001	-17.970642°	122.223534°	NA	Within LIA at the back of Clementson Street address. Not within Yawuru Conservation Park.	Add to Shire Significant Tree Register to avoid un-witting clearance of this significant tree. Inform resident/tenant.
351	-17.908011°	122.235379°	Minyjuru 11	Outlier from Minyjuru 11 patch. Situated along west side of Buckleys Road. 4.5m healthy tree. Not within Yawuru Conservation Park.	Add to Shire Significant Tree Register to avoid un-witting clearance of this significant tree in the process of road-widening/grading.
365	-17.985562°	122.208318°	Minyjuru 3	Along Port Drive at the front of the NW Shedmasters, west side of Port Drive. Healthy 6m tree within the lawn area. Once connected to Minyjuru patches at the rear of the development which has cleared and fragmented Minyjuru extent. Not within Yawuru Conservation Park.	Add to Shire Significant Tree Register to avoid un-witting clearance of this significant tree. Inform resident/tenant.
366	-17.989100°	122.207656°	Minyjuru 1	Between Pistol Club and old Shire Tip, on dune track to Father Emo's old camp opposite Colin Wilkinson. Within identified *Corymbia paractia* patch CP17 and within Yawuru Conservation Park. 6m healthy old tree. Within Yawuru Conservation Park.	Protect and manage as part CP17, within the YCP including weed and fire management.
390	-17.863789°	122.274296°	Minyjuru 16	4 Minyjuru trees to a 4m height in a cluster of three with 390, 391 and 392 along Cape Leveque Road. Separated from 392 by road. Once contiguous with Minyjuru 16 but fragmented through frequent fire. *Corynotheca micrantha var. gracilis Lily present* Not within Yawuru Conservation Park.	Add to Shire Significant Tree Register to avoid un-witting clearance of this significant tree in the process of road-widening/grading.
391	-17.863312°	122.273884°	Minyjuru 16	In a cluster of three with 390, 391 and 392 along Cape Leveque Road. Separated from 392 by road. Once contiguous with Minyjuru 16 but fragmented through frequent fire. 4m multi-trunked tree. Not within Yawuru Conservation Park.	Add to Shire Significant Tree Register to avoid un-witting clearance of this significant tree in the process of road-widening/grading.
392	-17.863917°	122.275428°	Minyjuru 16	In a cluster of three with 390, 391 and 392 along Cape Leveque Road. Separated from 391 and 390 by road. Once contiguous with Minyjuru 16 but fragmented through frequent fire. 3.5m fire damaged tree. Not within Yawuru Conservation Park.	Add to Shire Significant Tree Register to avoid un-witting clearance of this significant tree in the process of road-widening/grading.

398	-17.836123°	122.220572°	Minyjuru 17	Fire damaged Minyjuru to 4m in dense *Acacia monticola* patch. On the edge of Yawuru Conservation Park, on roadside. At risk of clearance through road widening.	Further survey to the east required. This may be part of or an outlier of a patch not yet surveyed. Coconut Wells patches appear to be significantly different to in town patches as they are on gravelly soil and have different associates and further work will be required to define and distinguish these patches.
580	-17.920650°	122.235082°	Minyjuru 10	Could be considered continuous with Minyjuru 10 however separated by vehicle track extending parallel with Magabala Road. Grove of 3 Minyjuru to 4.5m height. Not within Yawuru Conservation Park.	Protect and conserve in next stage of Broome North.
583	-17.922149°	122.234661°	Minyjuru 10	Could be considered continuous with Minyjuru 10 however separated by vehicle track extending parallel with Magabala Road. Grove of 3 Minyjuru to 4.5m height. Not within Yawuru Conservation Park.	Protect and conserve in next stage of Broome North
584	-17.922241°	122.233890°	Minyjuru 10	Could be considered continuous with Minyjuru 10 however separated by vehicle track extending from Lulfitz Drive to Magabala Road. Grove of 3 Minyjuru to 3.5m height. Not within Yawuru Conservation Park.	Protect and conserve in next stage of Broome North
608	-17.899765°	122.234142°	Minyjuru 14	Could be considered a part of Minyjuru 14, however large entrance track into Broomecrete sandpit has fragmented this tree from the larger patch. 5m Minyjuru with Y trunk. Not within Yawuru Conservation Park.	Add to Shire Significant Tree Register to avoid un-witting clearance of this significant tree in the track widening and further illegal sand mining operations.
609	-17.899763°	122.234256°	Minyjuru 14	Could be considered a part of Minyjuru 14, however large entrance track into Broomecrete sandpit has fragmented this tree from the larger patch. Single trunk 5m Minyjuru tree. Not within Yawuru Conservation Park.	Add to Shire Significant Tree Register to avoid un-witting clearance of this significant tree in the track widening and further illegal sand mining operations.
627	-17.899733°	122.234840°	Minyjuru 14	Could be considered a part of Minyjuru 14, however large entrance track into Broomecrete sandpit has fragmented this tree from the larger patch. Skinny 3m Minyjuru tree.	Add to Shire Significant Tree Register to avoid un-witting clearance of this significant tree in

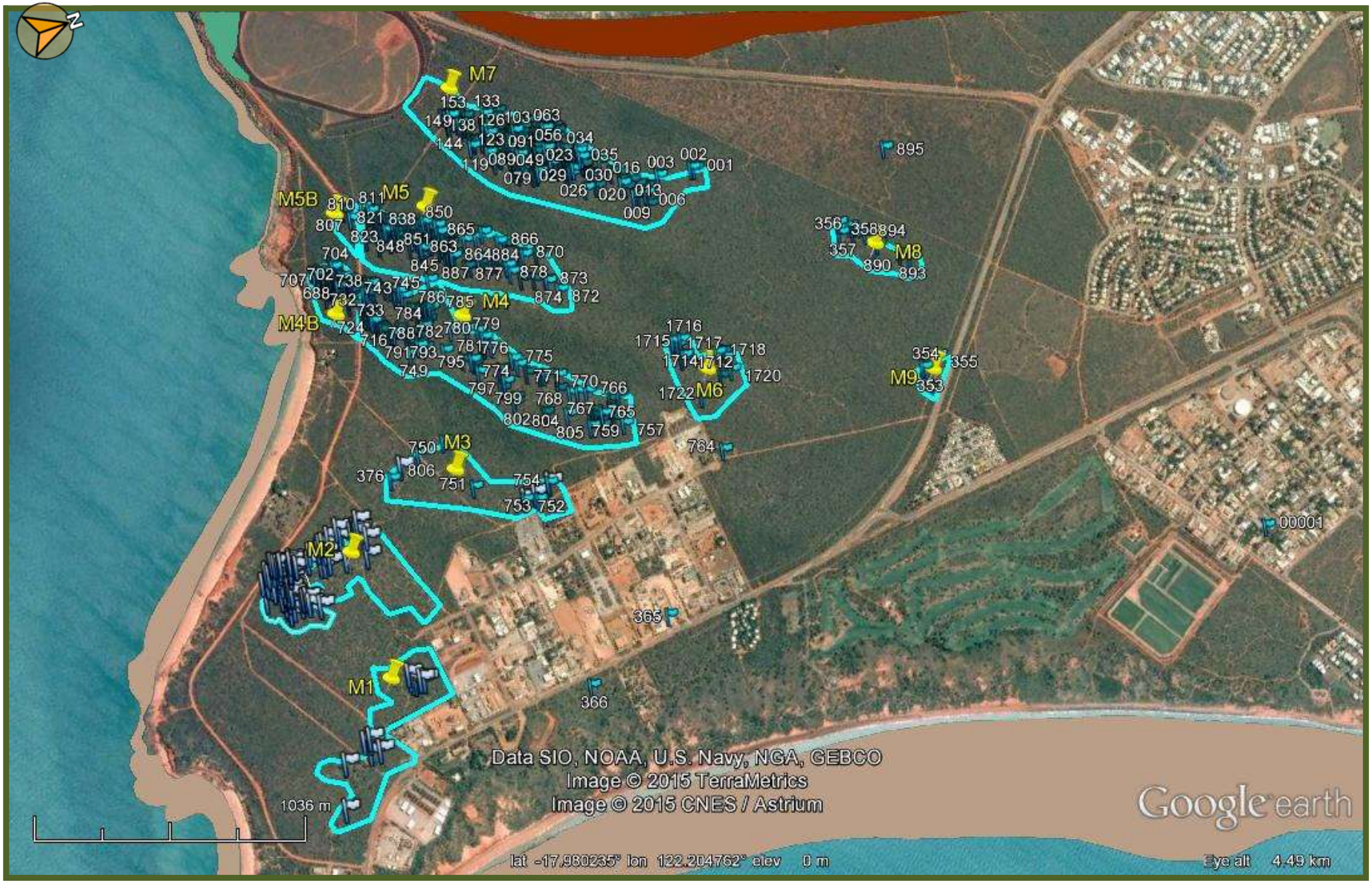
				Not within Yawuru Conservation Park.	the track widening and further illegal sand mining operations.
764	-17.979903°	122.206268°	Minyjuru 6	Old 5m Minyjuru tree at the front of old power station in the LIA at the track starting from the end of McDaniels Road. Once part of Minyjuru 6 Not within Yawuru Conservation Park.	Add to Shire Significant Tree Register to avoid un-witting clearance of this significant tree through informal track widening.
895	-17.968306°	122.204257°	Minyjuru 8	Between Gantheume Point Road and Gubinge Road alongside informal track. Two Minyjuru to 3.5m height. Within Yawuru Conservation Park.	Register location within the Yawuru conservation park. Ensure that management such as fire and weed management seeks to protect this specimen.
896	-17.963872°	122.233519°	NA	Remnant from the old Pearlers Hill patch. Suspected large loss of Minyjuru patch prior to this area being developed for residential living. Aerial photographs obtained from photomapping services suggest that this occurred prior to 1943. Along Herbert St between Louis St and Guy St in the Bowling Club carpark Tree, around 5m high and large dbh suggesting significant age, was much loved by Broome locals for its tasty fruits (Lands, 2007). It died around 2007 - suspected herbicide poisoning.	Planting new Minyjuru plants on road reserves and street verges within this area would re-establish a significant *Mayi* (bush fruit) tree that has been lost from the local area and go some way toward rectifying the loss of this significant ecosystem from this part of Old Broome.
897	-17.961620°	122.234659°	NA	5m tree remnant from the Old Pearlers Hill patch. Suspected large loss of Minyjuru patch prior to this area being developed for residential living. Aerial photographs obtained from photomapping services suggest that this occurred prior to 1943. Within Anne St residential area between Herbert and Walcott St.	Add to Shire Significant Tree Register to avoid un-witting clearance of this significant tree. Inform resident/tenant. Remove weed *Merremia dissecta* smothering crown.
898	-17.962245°	122.236758°	NA	Twin-trunked 5m tree remnant of the old Pearlers Hill patch. Suspected large loss of Minyjuru patch prior to this area being developed for residential living. Aerial photographs obtained from photomapping services suggest that this occurred prior to 1943. Uniting Chruch grounds on the corner of Anne and Robinson St.	Add to Shire Significant Tree Register to avoid un-witting clearance of this significant tree. Inform resident/tenant.

Total Remnant Tree waypoints	**19**			

Map 1.0 Minyjuru patches M1-13 (in blue) within the township. M14 is also shown.

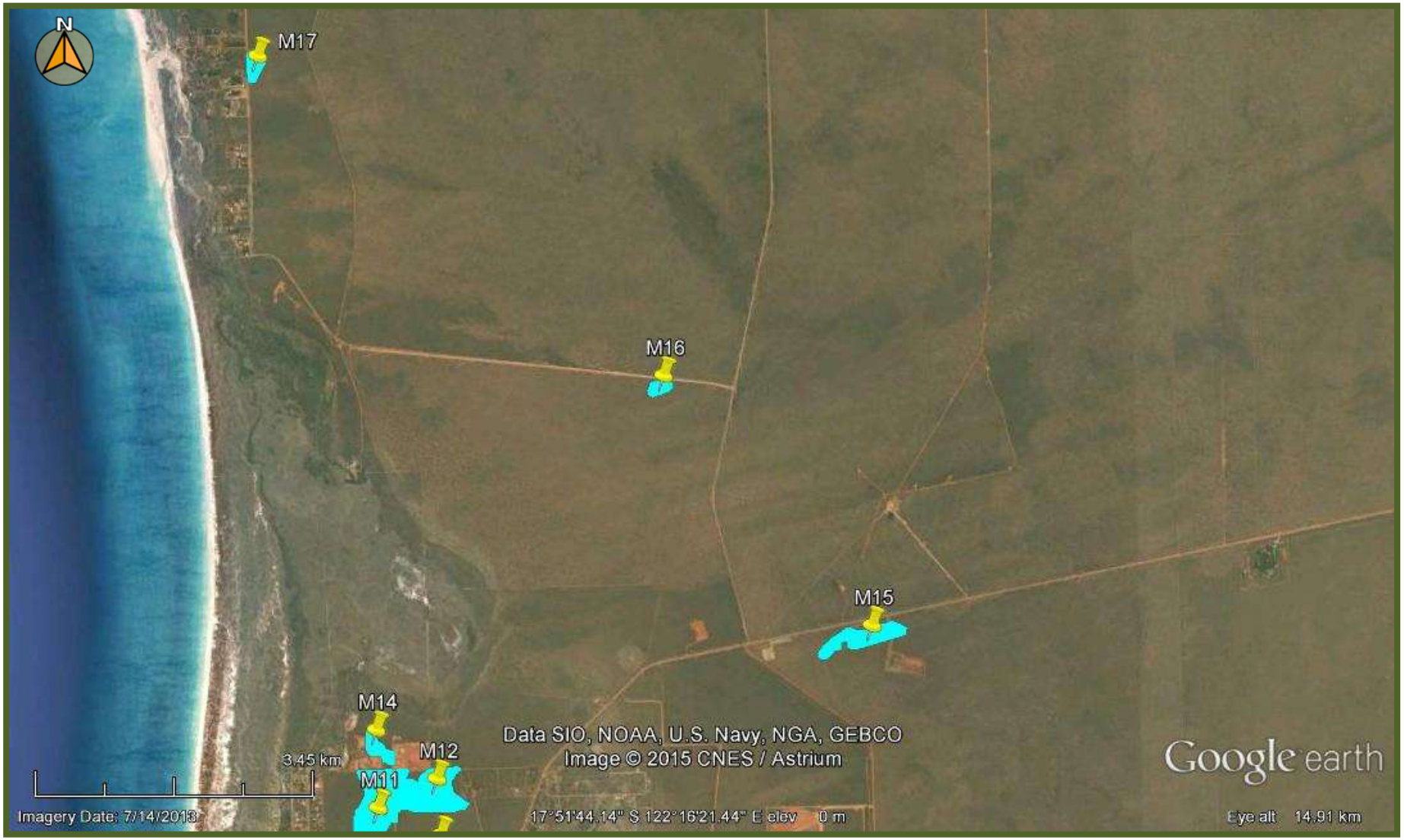
Map 1.10 Data points for Minyjuru trees mapped within the township including those within Minyjuru patches M1-13 (outlined in blue) and outlier remnant trees shown outside of patches.

Map 1.11 **Data points for Minyjuru trees mapped within the township, within Minyjuru patches M1- 9 (outlined in blue) and outlier remnant trees, outside of defined patches.**

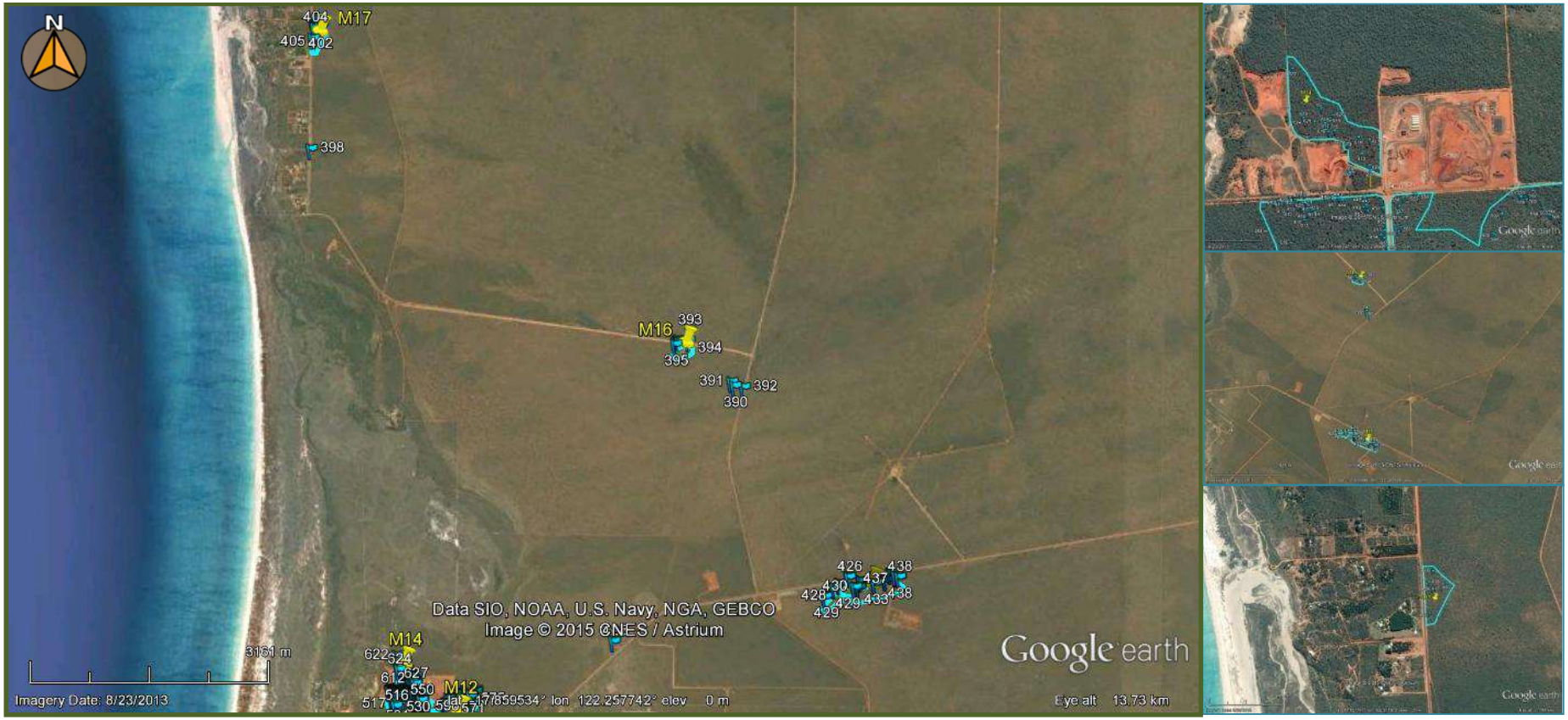


Map 1.12 Data points for Minyjuru trees mapped within the township, within Minyjuru patches M10-14 (outlined in blue) and outlier remnant trees, outside of defined patches.

Map 1.20 Minyjuru patches M14-17 (in blue) outside the township

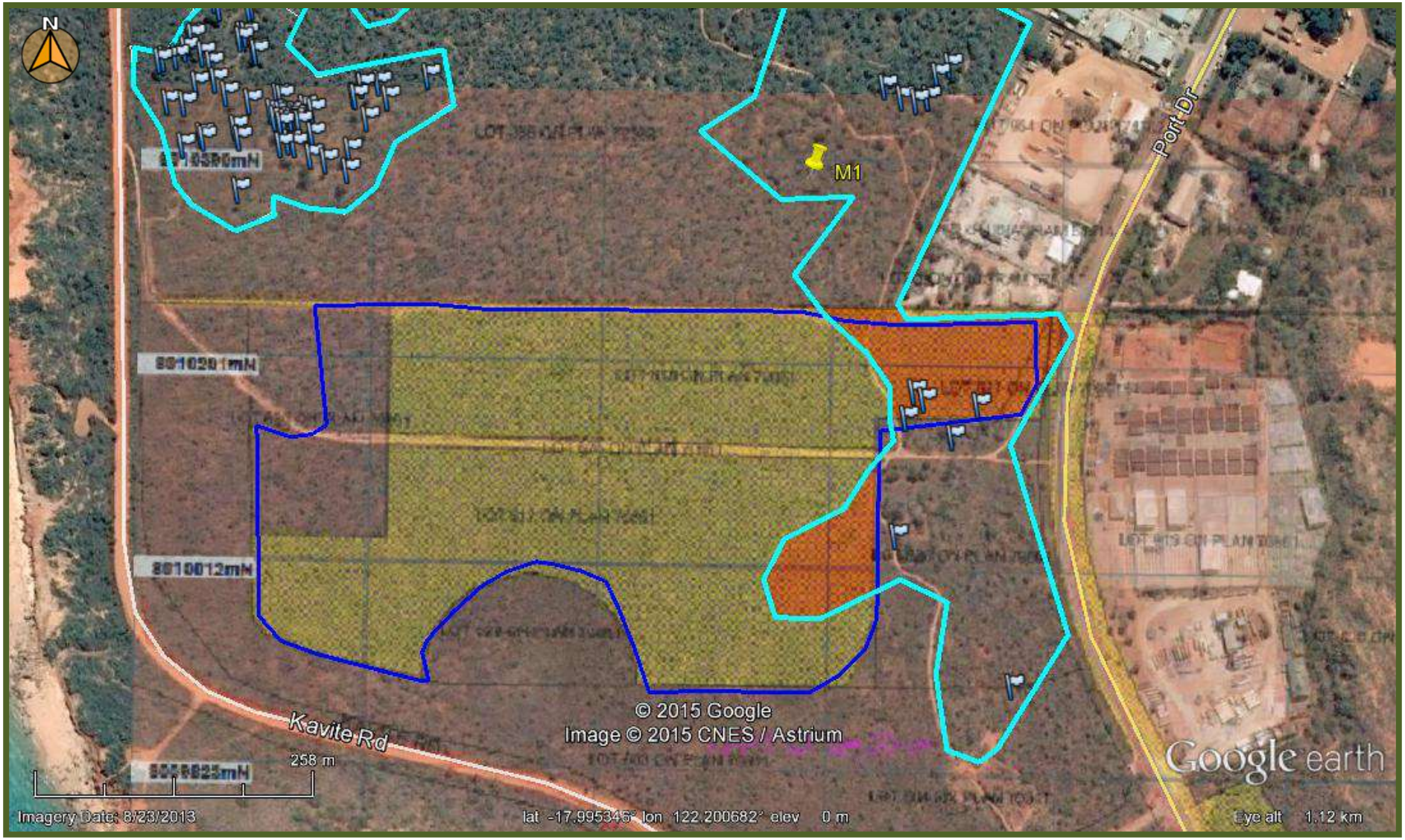


Map 1.21 Data points for Minyjuru trees mapped outside the township, within Minyjuru patches M14- 17 (outlined in blue) and outlier remnant trees, outside of defined patches.

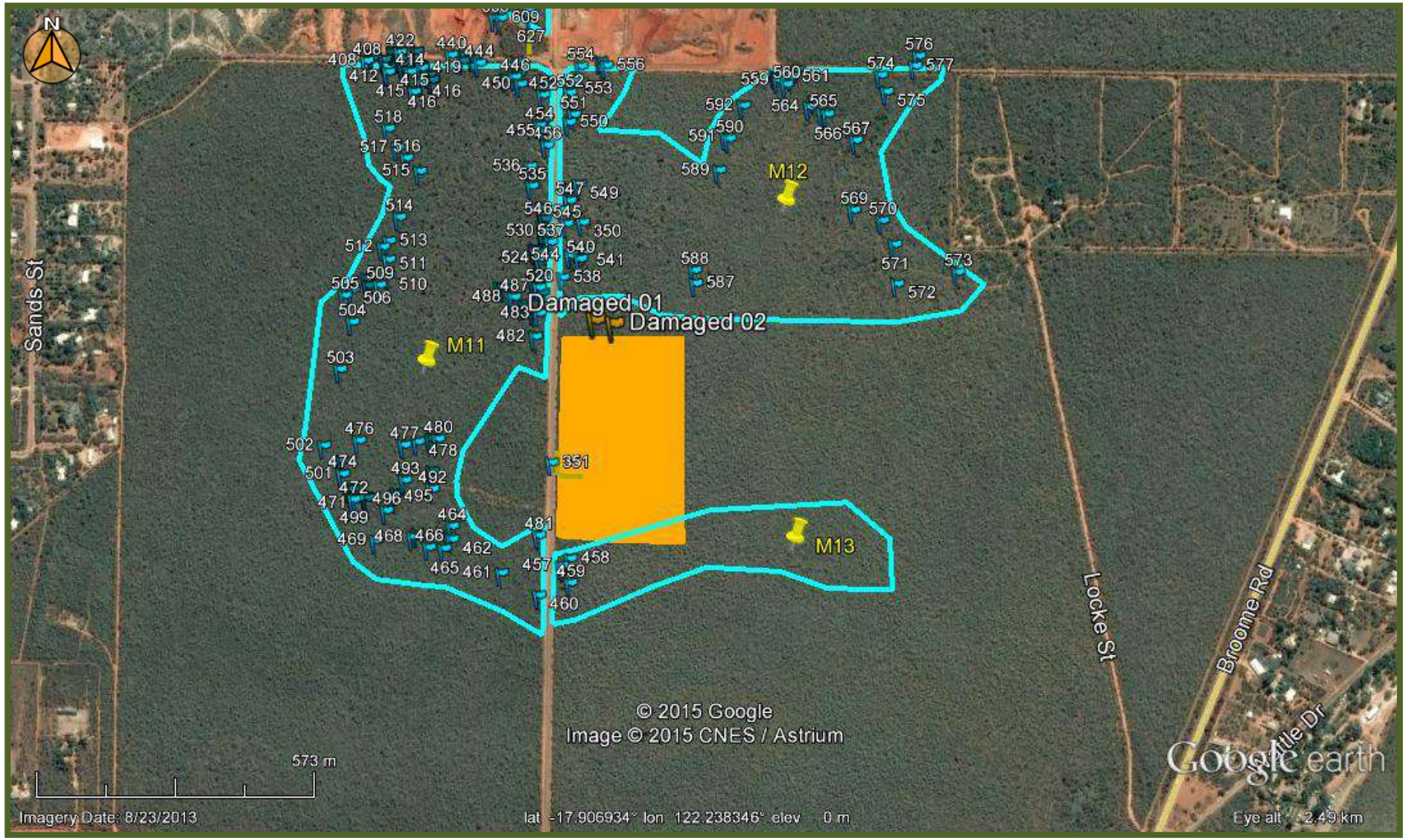


Map 1.30 Remnant trees in the Pearlers Hill area (896, 897, 898) and the likely historical location of Minyjuru community throughout the developed township (in olive green). An additional tree 00001, is found in the area now part of the Light Industrial Area and could be an indicator of an additional Minyjuru patch once existing in that area.

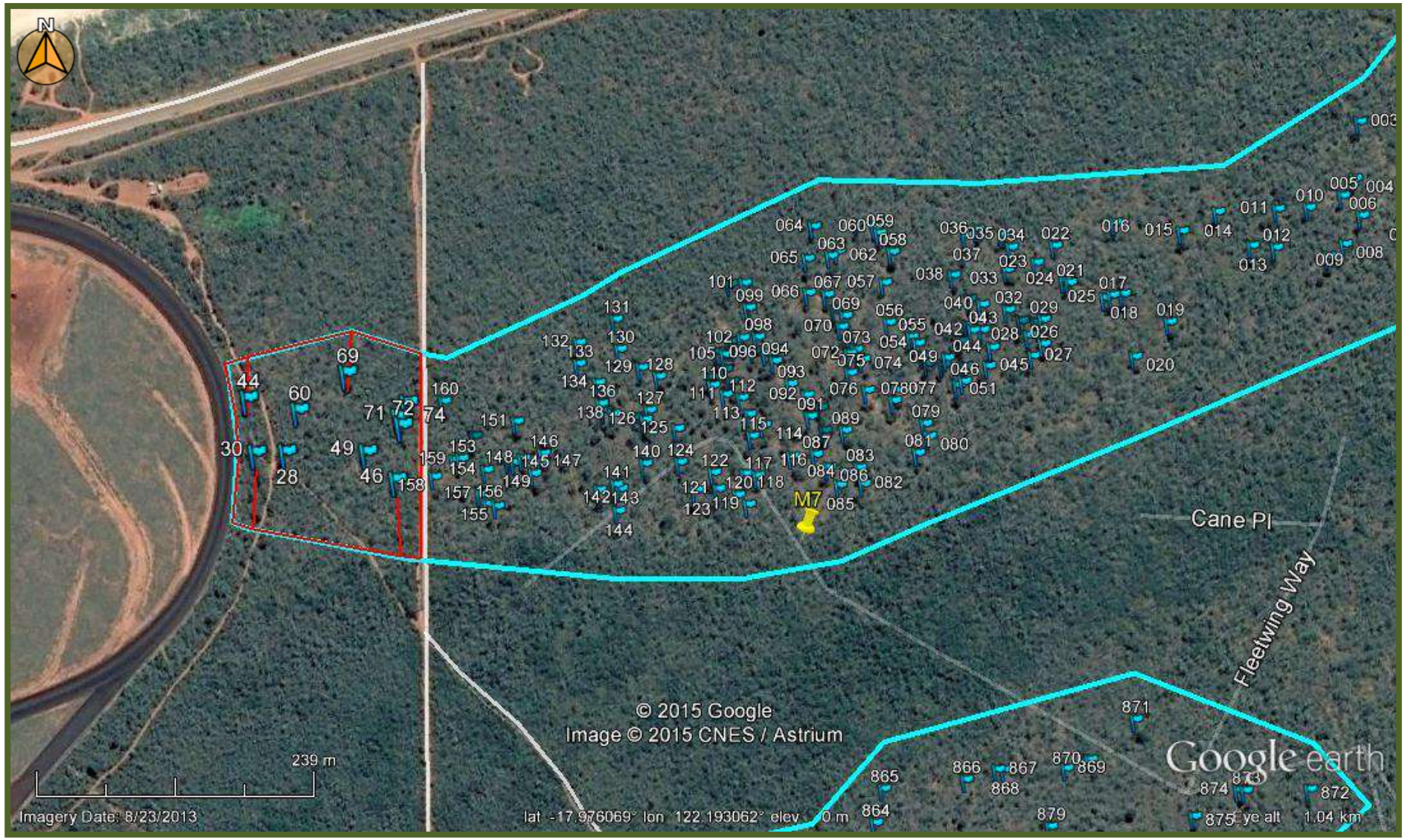
Map 1.40 Location of the recent clearing (in dark blue) undertaken as part of Permit no. CPS 3104/5 (in green and orange) and the incursions that have been made into M1 (in light blue). Around 15 mature Minyjuru trees were cleared (see external source maps in Appendix 2). Please note that M1 was not surveyed as extensively as the 2013/14 data and trees are/were present in addition to those shown below. Also, to the west, areas outside of the permitted clearance area have been cleared.



Map 1.41 Location of the recent clearing (in orange) undertaken near the Broome Tip for the Shire Recycling Depot and the incursion that has occurred into M13 (in blue). Two older Minyjuru trees (brown flags as labelled) were damaged as part of the clearing. Further survey work would have increased the boundary of M12 and/or M13 Minyjuru patches and so additional Minyjuru PEC may have been cleared .



Map 1.42 Location of the Minyjuru trees within the proposed Wilderness Retreat (outlined in red). Minyjuru trees located there (30, 28, 44, 60, 69, 71, 72, 46,49, 158) form the western end of the M7 patch and abut the racetrack. These Minyjuru trees are currently proposed for retention as shade trees within the development.

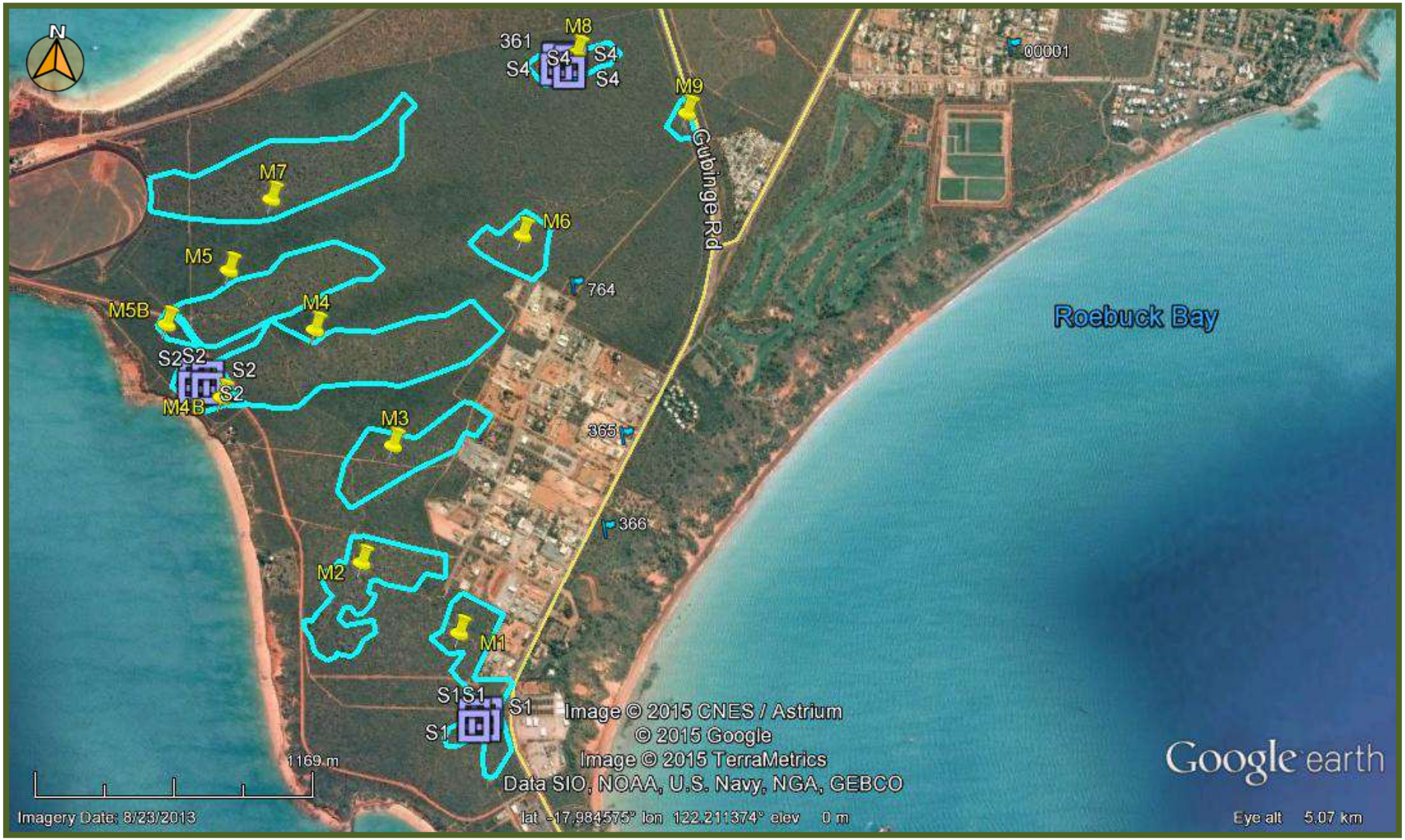


4.1 Quadrat Data

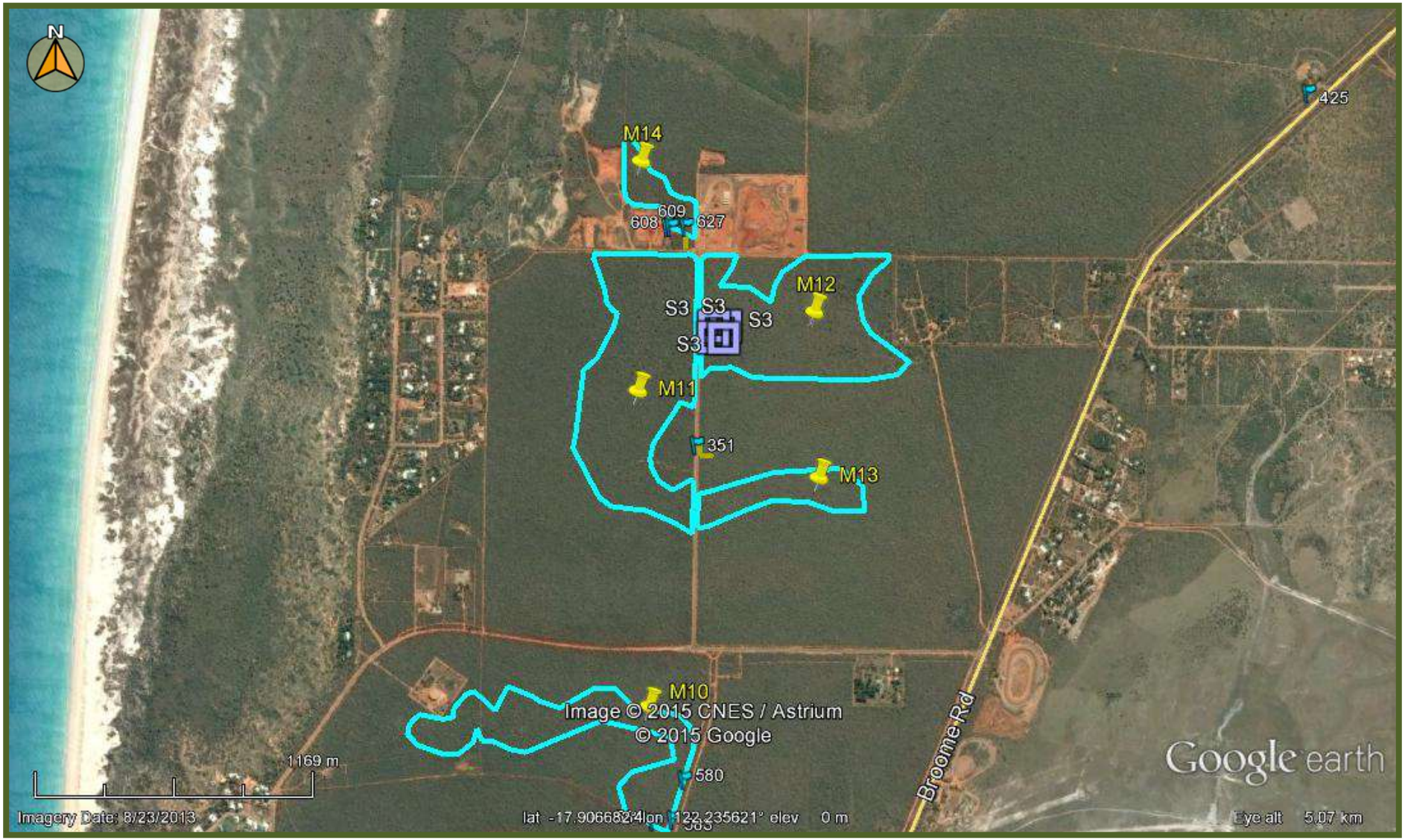
To assess the variation of the habitat, 4 localities were subject to a detailed quadrat sampling effort. Below is a quick view comparison of the four 50m x50m quadrats sampled within Minyjuru habitat within the Broome townsite. Maps 1.50 and 1.51 show the location of the sampling quadrats. The raw data collected is provided in Appendix 1. See section 5.2 for the discussion of the results.

Quadrat No.	Minyjuru patch overlap	Bush Forever Score	Fauna observed	Indige-nous species	Dominant native species cover	Weed species	Time since last fire	Threats	Notes
S1	1	Very Good	Agile Wallaby, Birds nest (*Gyrocarpus* and *Bauhinia*) Kookaburras, Termite mound	37	*Triodia schinzii (30%)* *Corymbia zygophylla (4%)* Minyjuru *(3%)* *Gyrocarpus americanus (2%)*	1 *Passiflora foetida*	No sign of recent fire	Weeds, rubbish, fire, clearing for laydown yards	Near Port Drive
S2	4	Very Good	Agile Wallaby with joey, goanna holes Low dome termite mounds	50	*Triodia schinzii (40%)* *Corynotheca micrantha (10%)* Minyjuru *(8%)* *Acacia colei (5%)*	1 *Passiflora foetida*	No sign of recent fire	Fire, weeds, long term coastal cliff erosion	Near Reddell Beach, Aboriginal midden with oyster shells
S3	12	Good	Agile Wallaby, Grey crowned babblers, Red-collared Lorikeets No termite mounds	40	*Chrysopogon fallax (12%)* *Waltheria indica (15%)* *Acacia eripoda (8%)* Minyjuru *(4%)*	2 *Acacia auriculiformis* *Azadirachta indica*	No sign of recent fire	Weeds Neem and, close proximity of *Hyptis*, rubbish dumping, fire and sand mining	Close to the tip
S4	8	Good	Agile Wallaby, Silver crowned friar bird Grey crowned babbler Black faced cuckoo shrike Singing honeyeater Rufous whistler	48	*Triodia schinzii (30%)* *Aristida hygrometrica (10%)* *Atalaya hemiglauca (3%)* *Gyrocarpus americanus (3%)* *Corymbia zygophylla (3%)*	1 *Passiflora foetida*	Very long un-burnt	Weeds, rubbish including car bodies, fire, Trail bikes	Trail bike circuit

Map 1.50 **Locations of sampling Quadrats S1,S2 and S4 (purple squares as labelled). Minyjuru patches are outlined in blue.**



Map 1.51 **Location of sampling quadrat S3 (purple squares as labelled). Minyjuru patches are outlined in blue.**



4.2 Other TECs and PECs

The Broome Peninsula is a wealth of diversity, rarity, ecological and cultural value. On the Peninsula exists one federally (EPBC Act, 1999) Endangered ecosystem, the Monsoon Vine Thickets of the Dampier Peninsula at their southern-most extent; the federally Vulnerable (EPBC Act, 1999) species-rich faunal community of the intertidal mudflats of Roebuck Bay; three state-listed (Priority 1) Priority Ecological Communities: Dwarf Pindan Heath, Mangarr on Relict Dunes and *Corymbia paractia* dominated community on dunes. None of the PEC's had been extensively surveyed prior to this and the concurrent *Corymbia paractia* survey work. The extent of the Dwarf Pindan Heath remains only partially known, while there are still some Monsoon Vine Thicket areas to be surveyed and mapped.

One Critically Endangered plant, *Keraudrenia exastia* has been extensively mapped in the Broome Peninsula, and is found within and south of M1. Other Declared Rare and Priority Flora and Fauna have also been found in the region, though not subject to extensive mapping. These data points can be accessed through the Department of Parks and Wildlife. Maps in Appendix 2 show the location of the Keraudrenia population.

Map 1.60 shows the Minyjuru patches M1-M10, the mapped and registered locations of Dwarf Pindan Heath PEC and Monsoon Vine Thicket TEC (filled in purple). The map also shows the locations of remnant trees and the estimated historical location of Minyjuru PEC in the Pearlers Hill area (filled in olive green).

Map 1.61 shows the Minyjuru patches M10-M17 and the mapped and registered locations of Monsoon Vine Thicket TEC, as well as unmapped locations of Monsoon Vine Thicket TEC and Paractia PEC. The map also shows the locations of remnant trees.

Map 1.62 shows the location and overlap of the Yawuru Conservation Park (in green) across the identified Minyjuru PEC patches (M1-M9), the Dwarf Pindan Heath PEC and the Monsoon Vine Thicket TEC patches identified in the previous maps.

Map 1.63 shows the location and overlap of the Yawuru Conservation Park across the identified Minyjuru PEC patches (M7 - M17), remnant Minyjuru trees, registered and unmapped Monsoon Vine Thicket TEC patches and unmapped Paractia PEC patches.

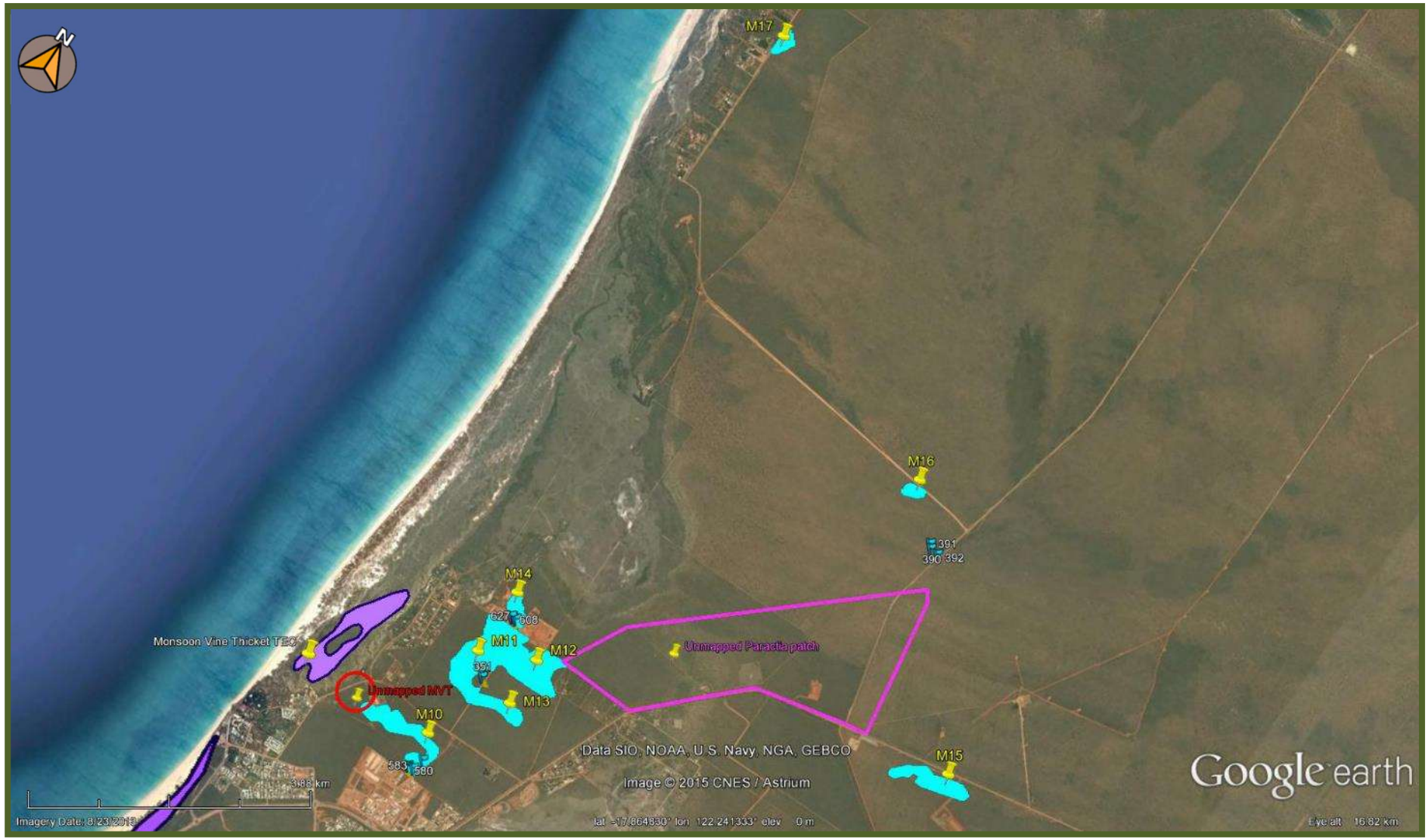
Map 1.64 shows a closer view of M10-M14 and the location of Monsoon Vine Thicket that currently connects with M10 which has not yet been mapped or registered as a TEC, as well as existing registered Monsoon Vine Thicket TEC.

Map 1.65 shows the location of mapped *Corymbia paractia* PEC patches (which have been detailed in a separate report) in relation to the mapped Minyjuru PEC patches (M1-M10) and the Monsoon Vine Thicket TEC and Dwarf Pindan Heath PEC patches identified in previous maps.

Map 1.66 shows the location of mapped *Corymbia paractia* PEC patches (which have been detailed in a separate report) in relation to the mapped Minyjuru PEC patches (M10-M17), as well as Monsoon Vine Thicket TEC and unmapped *Corymbia paractia* PEC identified in previous maps.

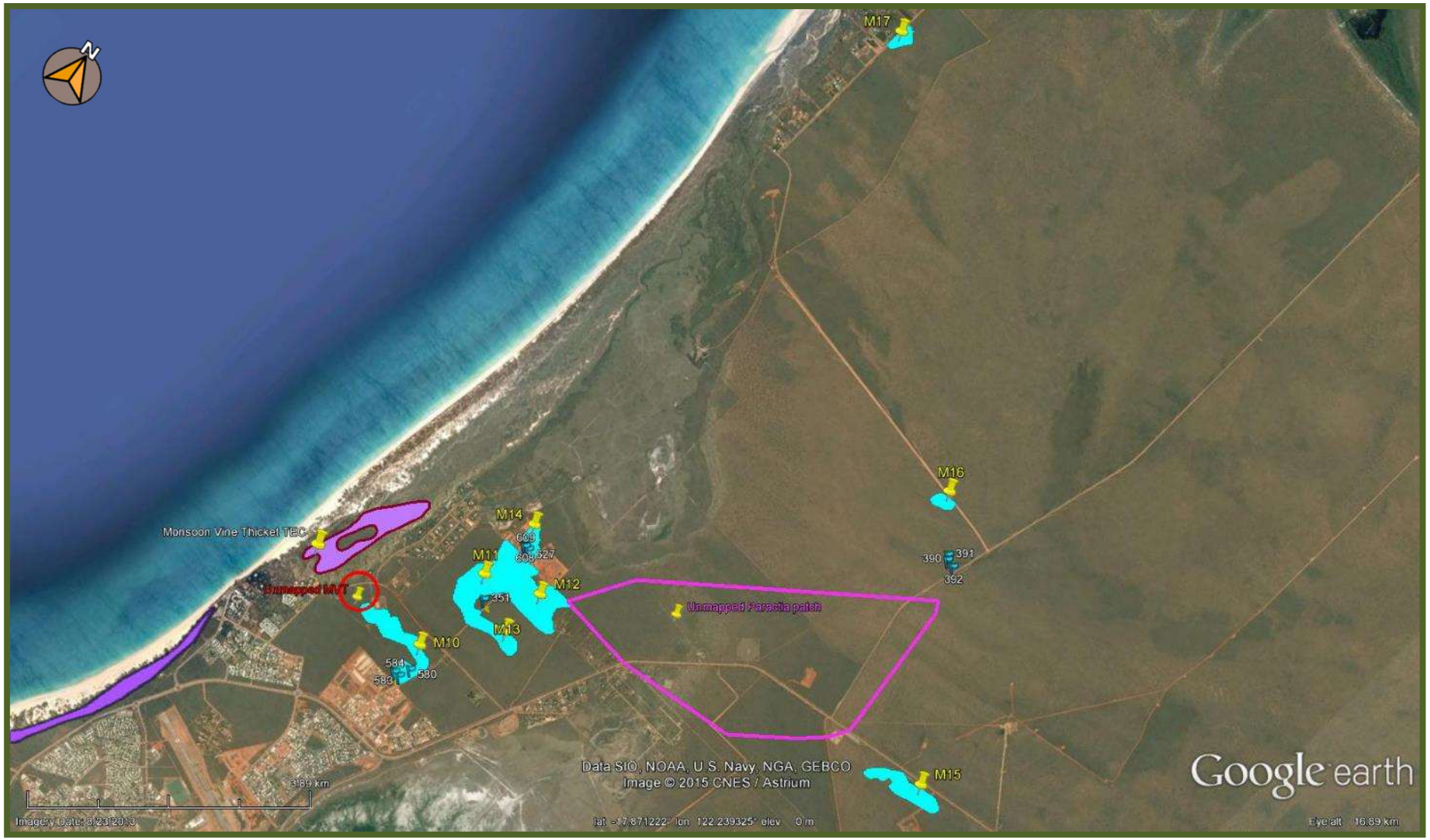
Map 1.60 Minyjuru patches M1-M10 (in blue) and the mapped and registered locations of Dwarf Pindan Heath PEC (filled in green), Monsoon Vine Thicket TEC (filled in purple) and recent mapping of Monsoon Vine Thicket TEC (outlined in purple), most of which has been registered with the DPaW Species and Communities branch. The map shows areas of Dwarf Pindan Heath PEC (outlined in green) and Monsoon Vine Thicket TEC (outlined in red) that remain unsurveyed. The map also shows the locations of remnant trees and the estimated historical location of Minyjuru PEC in the Pearlers Hill area (filled in olive green). Remnant outlier Minyjuru trees are also shown as numbered blue flags.

Map 1.61 Minyjuru patches M10-M17 (in blue) and the mapped and registered locations of Monsoon Vine Thicket TEC (filled in purple). The map also shows the locations of remnant Minyjuru trees as numbered blue flags, and unmapped Monsoon Vine Thicket TEC (outlined in red) and unmapped Paractia PEC (outlined in pink).

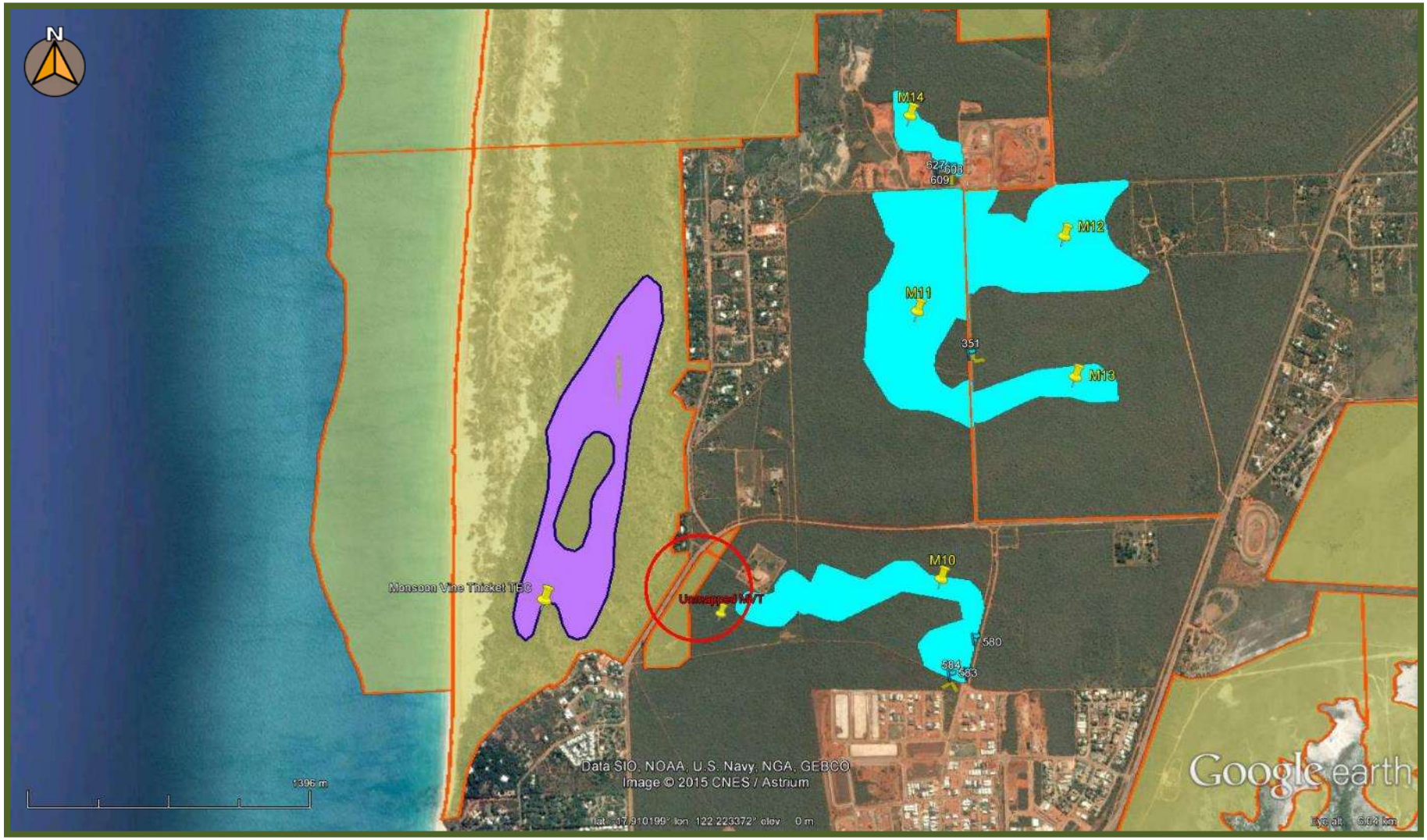


Map 1.62 Location and overlap of the Yawuru Conservation Park (Orange border filled yellow) across the identified Minyjuru PEC patches (M1-M10), historic Minyjuru patch (filled in olive green), registered (filled in lime green) and unmapped (outlined in lime green) Dwarf Pindan Heath PEC, unmapped (outlined in red) and registered Monsoon Vine Thicket TEC patches(purple) as identified in the previous maps. Remnant Minyjuru trees are shown as numbered blue flags. Note: The Yawuru Conservation Park boundaries do not completely contain any TEC or PEC.

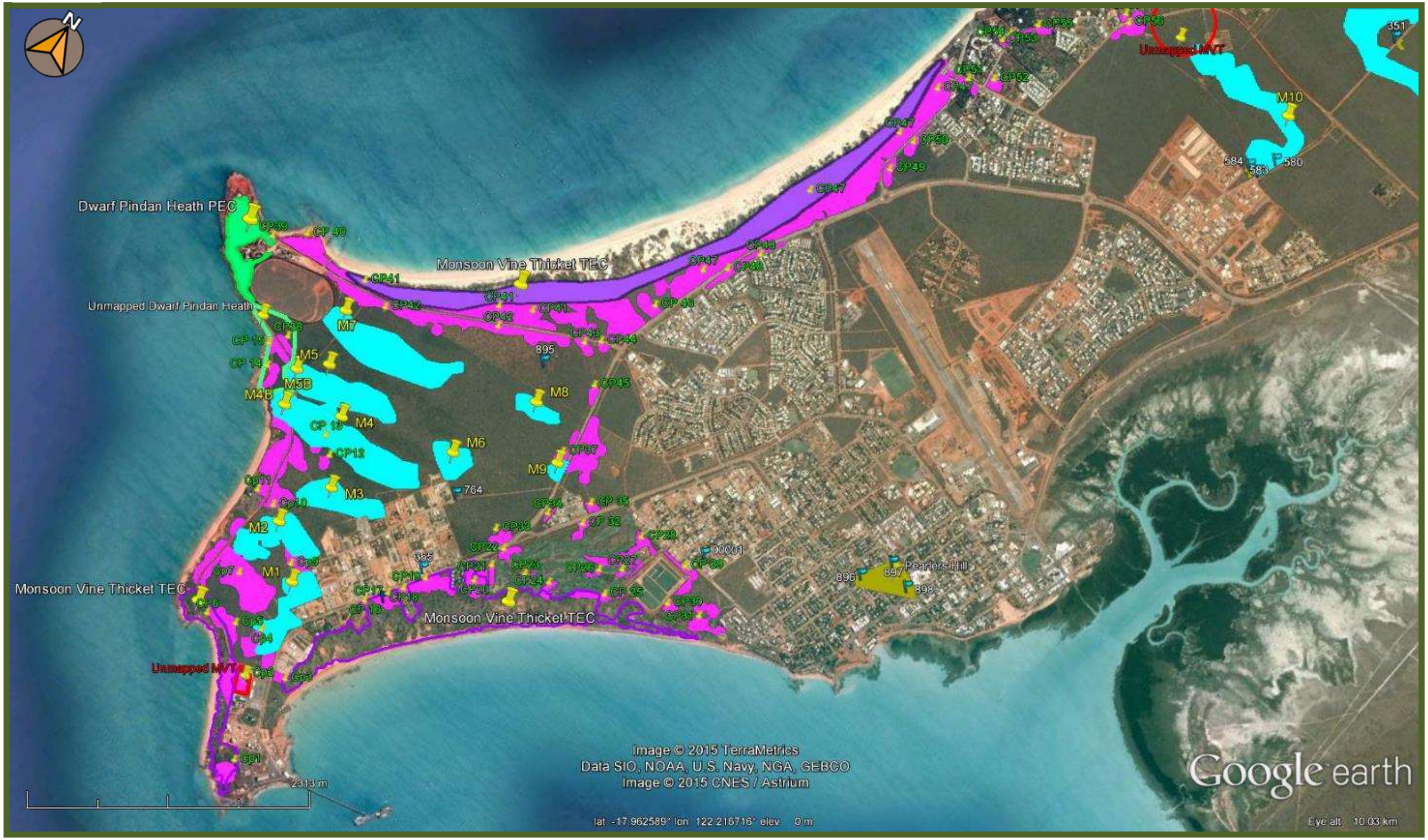
Map 1.63 Location and overlap of the Yawuru Conservation Park (Orange border filled yellow) across the identified Minyjuru PEC patches (M10-M17)., Unmapped (outlined in red) and registered Monsoon Vine Thicket TEC patches(purple) and unmapped Paractia PEC (outlined in pink). Remnant Minyjuru trees are shown as numbered blue flags. Note: The Yawuru Conservation Park boundaries contain very little of the Minyjuru patches outside the town area.



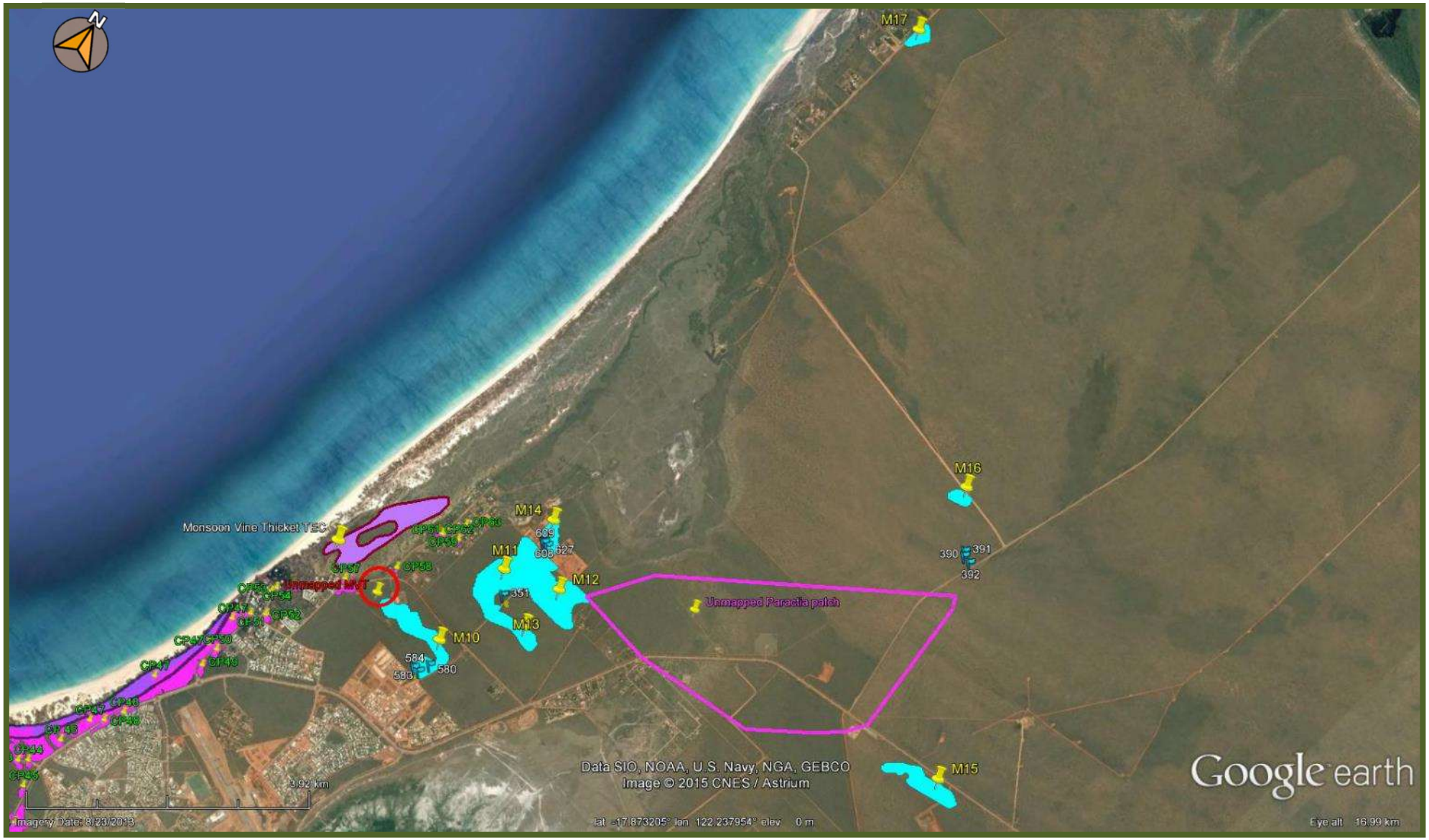
Map 1.64 Closer view of M10 - M14 and location (in red) of unsurveyed and unregistered Monsoon Vine Thicket that currently connects with M10. Existing registered Monsoon Vine Thicket mapped here in purple. The Yawuru Conservation Park boundaries are shown here in yellow (bordered in orange)



Map 1.65 Location (numbered CP, and filled and outlined in pink) of mapped *Corymbia paractia* PEC patches (which have been detailed in a separate report) in relation to the mapped Minyjuru PEC patches (M1-M10, in blue) and the Monsoon Vine Thicket TEC (purple) and Dwarf Pindan Heath PEC patches (green) identified in previous maps.



Map 1.66 Location (numbered as CP, in pink) of mapped *Corymbia paractia* PEC patches (which have been detailed in a separate report) in relation to the mapped Minyjuru PEC patches (M10-M17, in blue) and mapped (purple) and unmapped (red) Monsoon Vine Thicket TEC patches. The unfilled pink polygon is an area that contains *Corymbia paractia* PEC but has yet to be surveyed in any detail.



5.0 Observations and Discussions

This section examines some of the observations of fauna and flora made within the Minyjuru PEC during the survey work. It also briefly discusses the ecological role of the PEC in the wider landscape.

5.1 Fauna

Agile Wallabies *Macropus agilis*

The vast majority of individual trees surveyed displayed evidence of "resting" or "siesta scrapes", dug out by this species for shade during periods of mid - day heat. Scats were often present. Dave Dureau (pers.com) believes that this species is a significant consumer of fallen Minyjuru fruit, excreting the seeds intact in dung. On this basis, it is probable that agile wallabies are a significant dispersal agent.

Pic 1.5 Typical resting or siesta scrapes made by Agile Wallabies *(Macropus agilis)* under shady *Sersalisia sericea* tree. Quadrat S3, East side of Buckleys Road. Photo: 29 November 2013, Willing.

Northern Brushtail Possum *Trichosaurus arnhemensis*

There is anecdotal and cultural evidence that this arboreal species is also a significant consumer of Minyjuru fruits and sometimes lives in hollows in old trees. The species is believed to be in decline in the Broome townsite.

Flying Foxes *Pteropus alecto & P. scapulatus*

It seems likely that both the Black Flying Fox (*P. alecto*) and the little Red Flying Foxes (*P. scapulatus*) consume ripe Minyjuru fruits during nocturnal foraging. Both species are present in the large colony in *Rhizophora* mangroves just east from Chinatown.

Gilberts Dragon *Amphibolurus gilberti*

Locally known as Gunada or Ta-Ta Lizard, this common species has been observed eating fruits from the ground when they fall from the tree.

Blue-Tongue Lizards *Tiliqua scincoides & multifasciata*

Both species are significant consumers of fruits, as well as arthropods, so are a likely dispersal agent for Minyjuru. They may also be observed in its leaf litter, foraging for food.

Snakes including *Pseudechis australis*

A 2m King Brown snake was observed living in a large basal hole on the NE side of a Minyjuru tree at WP 494, west of Buckley Road on 13 December 2013. The surveyor narrowly avoided standing on it early in the morning!

Noury and Lombard, (2005) also mention that the hollows often found within Minyjuru are known to house insects, lizards and snakes.

Birds

During the course of this survey, the most frequent bird nesting in Minyjuru crowns was the Grey-crowned Babbler *Pomatostoimus temporalis*, known for their unusual communal nesting behaviour. Pic 1.6 shows one of their nests in a Minyjuru tree which was observed during the survey.

Birds that have been recorded as utilising the flowers or fruits of this species include: Yellow White-eye *Zosterops luteus*, Great Bowerbird *Chlamydera nuchalis*, Red-winged Parrot *Aprosmictus erYthropterus,* Rainbow Lorikeet *Trichoglossus haematodus* and Little Friarbird *Philemon citreogularis* (Bardi Jawi Oorany Rangers, 2011). Similarly, Lewis (2013) recorded up to 53 bird species utilising the suite of plant species abundant throughout *S. sericea* habitat. Lewis identified that the Minyjuru habitat provides important year-round and seasonal resources for many of these species, including shade, roosts, nests, nectar, fruits and insects and may in fact act as a refuge for desert species such as the Grey-headed Honeyeater *Lichenostomus keartlandi*, White-fronted Honeyeater *Purnella albifrons,* Black Honeyeater *Certhionyx niger,* Painted Finch *Emblema pictum* and Zebra Finch *Taeniopygia guttata* during harsh seasons.

Pic. 1.6 Nest of the Grey-crowned babbler within Minyjuru tree and Minyjuru PEC on the Broome peninsula. Photo: 2012, Beames

Bees

Minyjuru is an important tree culturally for its association with native bees *Trigona spp.* These are stingless, small black bees which produce "sugarbag" or native honey, much prized by Indigenous peoples.

Large colonies of feral European bees *Apis melifera,* were observed at Minyjuru trees near the Broome rubbish tip (WP528,WP536) in Minyjuru 11 on the west side of Buckley road on the 13th December 2013. This species is regarded as a threat to native bees *Trigona spp.*

Both species evidently value the cool canopy microclimate of Minyjuru trees.

Termites

Mature Minyjuru trees are often observed to have hollowed-out trunks attributable to the Giant termite *Mastotermes darwinensis*. On occasion, trees may be killed by them.

Lichens

Kenneally et al. (1996, p 242) recorded that *Trypethalium sp.* occurred on the bark of Minyjuru trees at Broome. It is thought that abundant lichen growth observed on the branches of trees inland of Reddell beach is connected to the frequency of early morning fogs in this area, as well as regular episodes of condensation in the dry season.

5.2 Flora

The general description of the characteristic plant species associated with this PEC (Page 5 this report, as based on Trudgen (1988) is supported by the fieldwork. However *Gyrocarpus americanus* should not be added to the tree list as it seems to be a universal associate.

Quadrat data (4.1) shows the dominant associated grass at the southern near coastal sites was always *Triodia schinzii*. However at the sole northern site (S3) the dominant grass was *Chrysopogon fallax.* The pindan wattle *Acacia eripoda,* as well as the sub shrub *Waltheria indica*, are characteristically abundant at all the Minyjuru communities in the northern townsite (M10, M11, M12, M13), probably reflecting their more inland location and possibly less alkaline soils. Another important difference is that the interconnected M11, M12, M13, and M14 occupy a complex elevated dunefield rather that the typically linear and often parallel dune ridges in the southern townsite (eg. M4, M4B, M5, M5B, M6 and M7).

M10 is somewhat intermediate in that it is a linear dune ridge in the west, becomes a dunefield in the east and merges into pindan at its south east hook.

Quadrat data indicates the Minyjuru community supports an average of 43 native species over an area of 50m^2. The southern near coastal communities typically had 5 tree species (inc. Minyjuru), 13-19 shrubs, 2-3 grasses, one sedge (*Cyperus conicus*), 5-10 climbers and 10-22 herbs. The northern inland community (sampled at S3) had by contrast 9 tree species (inc. Minyjuru), 18 shrubs, 4 grasses, one sedge (*Cyperus conicus*), only 2 climbers and 8 herbs.

In general weed abundance is low (1-3 species) in the southern townsite communities. However a localised weed hotspot was detected at M1 behind the industrial area (7 species). In contrast, the northern townsite communities generally had 5-7 weeds species. Only M13 had 2 weed species. Proximity to the Broome Tip is considered significant in explaining this.

Zig-Zag Lily ***Corynotheca micrantha var. gracilis***

The type locality for this subspecies is Riddell Beach, Broome, collected by Kevin Kenneally in June 1984 (K.F.Kenneally 9025). This remarkable species is an "erect divaricately branched, tangled, glabrous subshrub to 1m" (Kenneally et al., 1996, p.200 & 243). Its narrow linear leaves are soon shed giving the plants a very distinct appearance. Little is known about its biology. The species occurs from Port Hedland to Kununurra with a mainly southern Kimberley distribution.

In the southern townsite, this species is often present, defining the crests of Pleistocene sand dune ridges in the Minyjuru communities 2, 4 and 4B. It is also present in the Minyjuru community 15, outside the township. The reasons for such a patchy distribution are unclear. How this species copes with fire is not known.

Pic. 1.7 Zig-Zag Lily (*Corynotheca micrantha var. gracilis*) often defines the crests of Pleistocene sand ridges, associated with the Minyjuru PEC. Viewed here at WP 781 in Minyjuru 4 community. Photo: 21 December 2013, Willing.

Interdunal swales East of Reddell Beach

The remarkable series of parallel Pleistocene dune ridges trending SW to NE between Reddell Beach and the Port Drive industrial zone (containing M3, M4, M4B, M5 and M7) supports a distinctive interdunal flora. The dominant species is often *Acacia monticola* (Scratchy wattle, Minniritchi, or Warraka in Yawuru) suggesting that the swales overlie subsoil deposits of laterite. Associated species include *Grevillea refracta, Dodonaea hispidula, Gardenia pyriformis, Acacia adoxa, Breynia cernva* and *Santalum lanceolatum. G. refracta* was noted by Jan Lewis (2013) as an especially important source of nectar to bird populations. As it is a pioneer species, its value as a food source may be diminishing as populations senesce and die out in the long absence of fire in this area.

5.3 Monsoon Vine Thicket Elements

The heavy shade provided by mature Minyjuru trees together with leaf litter and soil moisture retention creates a "mini Monsoon Vine Thicket" effect under many trees. The effect is doubtless enhanced by avian frugivores favouring the crowns to eat seeds and fruits sourced from the Monsoon Vine Thicket (MVT) in adjacent Minyirr Park.

Typical MVT elements found in the Minyjuru PEC include the following:

Vines	*Abrus precatorius*	Frequent	(See Pic 1.8)
	Jasminum didymum	Frequent	
	Tylophora cinerascens	Occasional	
Shrubs	*Breynia cernua*	Occasional	
	Grewia breviflora	Frequent	
	Pavetta kimberleyana	Frequent	
	Premna acuminata	Frequent	
	Terminalia petiolaris	Occasional	

If the species Minyjuru is regarded as an "advance guard" of MVT expansion, it may play a critical role in the coming decades. Global warming is driving increased rainfall across the Kimberley region. On this basis, Minyjuru could arguably expand its range.

However this same niche is also ideal for establishment of invasive weeds, notably Neem *Azadirachta indica* whose seeds are dispersed by birds (See Pic 1.9).

Pic. 1.8 Colourful seeds of the crab eye bean *Abrus precatorius* in Minyjuru PEC Photo: Willing

6.0 THREATS

Principal threats identified in the Priority 1 Ecological Community listing include: weed invasion, grazing, inappropriate fire regime and proposed developments. In undertaking the survey and condition assessment and through the process of identifying the area and extent of the community the following threats have been identified in order of priority. Grazing is no longer assessed as a significant threat.

6.1 Urban expansion/Clearing

Clearing for urban expansion and industrial development is among the greatest past, future and current threats to Minyjuru on relict dunes. This ecological community remained largely un-noticed or surveyed between the Trudgen report (1988) and the 2011/12 survey work conducted by Environs Kimberley and SKIPA. Remnant trees dotted throughout the town stand testament to the unwitting development that has reduced the extent of this community within the Broome Peninsula by a conservative estimate of at least 10hectares. Phil Docherty (SKIPA/Broome Botanical Society) has described how despite SKIPA mapping and consulting with Landcorp to retain large trees in situ as habitat trees, at least three 100+year old Minyjuru and two 20+ year old Minyjuru trees were needlessly cleared in the recent development of Broome North. One in particular, was situated within the vicinity of the Broome Botanical Park and was removed to make way for a drainage reserve that should have been slightly realigned to enable the retention of the Minyjuru within the park (Phil Docherty, pers.com March, 2015). At least five Minyjuru have been retained within the development but there needs to be a formal register to ensure their protection.

In the process of undertaking this survey work and report, two clearing permits have impinged on Minyjuru PEC area, clearing approximately 2.83ha, while an additional 2.75ha will be impacted by the proposed Wilderness Retreat. Pic 1.9 shows Minyjuru from the M1 patch, of which areas were cleared in October 2014, reshooting from the cut stumps in February 2015.

Smaller developments such as road-widening, changes to nature strips, housing redevelopment, urban weed infestations etc. contribute to a slow attrition of aged remnant Minyjuru trees. At least one aged Minyjuru tree has been damaged by roadside works in 2013 on Gubinge Road (see Pic 1.10). It is important that local government and state government departments, as well as Nyamba Buru Yawuru work together and use the collected data to eliminate unnecessary loss and damage to Minyjuru patches and remnant Minyjuru trees.

As almost 70% of the identified Minyjuru community within the township lies outside of designated conservation reserves, ongoing development will have a considerable impact on the extent, connectivity and ecological processes within and surrounding the community if efforts are not made to avoid and minimise clearing of this community.

Pic. 1.9 **Minyjuru cleared in M1 in October 2014 is reshooting from the cut stump.**

Photo: Willing

Pics. 1.10 **Minyjuru cleared in M1 in October 2014 is reshooting from the cut stump.**

Photo: Beames

6.2 Weeds

The spread of Neem *Azadirachta indica,* is among the greatest weed threat, with seeds spread by birds germinating and establishing readily under shady Minyjuru canopy (Pic 1.11). Weed invasion and dominance of species such as *Merremia aegyptia*, *Passiflora foetida* and Buffel Grass *Cenchrus ciliaris* is occurring in areas that have been subject to historical disturbance or where the dumping of garden or other rubbish has occurred.

Likewise, the steady spread of Bellyache Bush *Jatropha gossypifolia,* around the Broome Tip on Buckley Road poses a major long-term risk to the integrity of the Minyjuru community of the northern townsite (Pic 1.12).

Additionally, there are many uncontrolled and unmanaged tracks running throughout the area. These unmanaged tracks continue to expand, increasing fragmentation and the "edge effect" and enabling more people and vehicles to transverse the areas. Such tracks accelerate damaging activities such as garden refuse dumps, bushfires, illegal camping and weed spread.

Pic. 1.11 Neem (*Azadirachta indica)* seedling growing amongst the heavy leaf litter within Minyjuru PEC (left, Photo: Willing). Neem is a serious invasive weed that can quickly dominate the understory and canopy of many natural areas (right, Photo: Beames).

Pic 1.12 **Bellyache Bush (*Jatropha gossypifolia*) is a Weed of National Significance (WONS), which poses a significant threat to Minyjuru communities 10, 11, 12 & 14 in the northern sector of the Broome townsite.** **Photo: Willing**

Pic 1.13 **A magnificent old Minyjuru next to an ad hoc track, where builder's waste has been dumped. WP 818 in Minyjuru 5, SE from Racecourse.**

Photo: Willing 22 December 2013.

6.3 Fire

Minyjuru (Mangarr) trees are sensitive to fire, and can take considerable time to recover (Bardi Jawi Oorany Rangers, 2011). Fire damage remains a risk, especially as the communities lie close to built up areas and illegal camping spots which are scattered throughout the area. Arson and too frequent late season burning continue to be major threats to Broome bushland.

However, the extent to which the Minyjuru dune ridges are vulnerable to fire may be debatable. For one thing, fuel loads along the crest often appear to be low with *Triodia schinzii* Spinifex and/or *Corynotheca* present at relatively low densities. Trees growing on dune flanks appear more vulnerable. More field observations of fire impacts on the PEC are needed to clarify to what extent fire is a threat.

Pic 1.14 *Sersalisia sericea* showing fire damage to trunk and canopy in *Acacia eriopoda* – dominated Pindan, south side of McGuigan Road, Coconut Well, north of Broome (WP 393).

Photo: 6 December 2013, Willing

6.4 Hydrological Changes

Changes to the hydrology pose a significant risk to the community. The Minyjuru community is present on the well-drained higher level dunes and rarely extends into pindan areas that can become seasonally inundated. Changes to the natural hydrology of areas local to each site, as a result of development, roads and other sealed surfaces, can potentially compromise the health and viability of the local site and broader community.

7.0 Recommendations

1) The PEC is currently known and listed as "Relict dune system dominated by extensive stands of Mangarr *Sersalisia* (formerly *Pouteria*) *sericea*." While *S. sericea* is known by Bardi people as Mangarr, as this ecological community is found only within Yawuru country, it is more appropriate that the listing incorporate the Yawuru name for the dominant species. The authors recommend that the listed PEC name be adjusted accordingly to "Relict dune system dominated by extensive stands of Minyjuru *Sersalisia* (formerly *Pouteria*) *sericea*."

2) It is important that ecologists work with Nyamba Buru Yawuru Land and Sea Unit and the Yawuru Language Centre, in addition to senior Yawuru people to identify important cultural knowledge regarding Minyjuru, significant Minyjuru Mayi and other cultural areas, and better understand the Traditional management of these areas. This will aid management of areas within conservation areas and better guide planning and development so that important cultural areas are appropriately valued and not inadvertently lost through careless planning.

3) Data gathered through the process of this survey work, and any additional work with Traditional owners should form the basis of an application for the ecosystem to be upgraded from a Priority one Priority Ecological Community, which describes a poorly-known ecological community to a Threatened Ecological Community. The authors recommend that the Minyjuru community should be considered for assessment within the **Vulnerable** criterion, given that it has been adequately surveyed and that more than 75% of the area is outside of conservation areas, leaving it vulnerable to threats: including development, weed invasion and unmanaged fire. The loss of a number of hectares of Minyjuru PEC during the compilation of this report, and applications for more clearing already underway suggests that the acceleration of development in the Broome area will likely put many more hectares of this restricted community at risk.

4) New maps created for the PECs (Minyjuru and concurrent work with the Priority 1 *Corymbia paractia* community) need to be forwarded for use by local agencies; most importantly, those undertaking extensive planning and development where the communities occur, i.e.: Broome Shire, Broome Port Authority and Nyamba Buru Yawuru, and those responsible for managing conservation and fire management; inclusive of those previously listed, as well as the Department of Fire and Emergency Services.

5) Recommendations in Table 1.0 for each Minyjuru patch should be considered by the relevant authorities including where small changes to development zones, conservation areas and management plans can considerably alter the % and quality of Minyjuru PEC that can be protected and managed effectively.

6) Condition assessments need to be undertaken and management plans developed for Minyjuru community that occurs within designated conservation reserves, including the Yawuru Conservation Park, shire reserves outside the park, and the impending Yawuru Indigenous Protected Area. These need to be incorporated into larger reserve plans to enable rangers and on-ground managers to address identified threats, such as weeds and fire and improve conservation management.

7) In the process of undertaking the survey, two locations of unmapped and unregistered occurrences of the Endangered Monsoon Vine Thicket community have been identified. It is recommended that mapping and condition assessment of remaining MVT within the Broome townsite be completed in order to improve sustainable development planning, avoid erroneous clearing and expensive non-compliance with the EPBC Act (1999). Map 1.6 0-1.66 show the location of the areas that are yet to be mapped. Environs Kimberley, with Society for Kimberley Indigenous Plants have begun preliminary negotiations and survey with Nyamba Buru Yawuru and appropriate Cultural law bosses for this significant area.

8) In the process of undertaking the survey at least one unmapped occurrence of the Priority 1 ecological community Dwarf Pindan Heath was identified. This area is shown in Maps 1.60 -1.66 and is approximately 14.5ha in size. It is recommended that mapping and condition assessment of this and other remaining unmapped PEC's within the Broome townsite be completed in order to improve sustainable development planning, avoid erroneous clearing and expensive non-compliance with the Wildlife Act (1950).

9) Remnant Minyjuru trees that have been mapped need to become part of the Broome Shire Tree Register, and if not active, part of a local tree register managed by Broome's Department of Parks and Wildlife. Local government and state government departments, as well as Nyamba Buru Yawuru, Landcorp etc. should cooperate to utilise the collected data to eliminate unnecessary loss and damage to remnant Minyjuru trees through local developmental processes.

10) Any new development areas that contain aged Minyjuru PEC should first seek to retain the integrity of the patch by placing a buffered protection zone around the patch and avoid clearing. If development is permitted to proceed where a Minyjuru patch occurs, it should only do so under strict conditions that the as many aged Minyjuru specimens as possible are retained as remnant trees within the development.

11) Detailed contour maps need to be sourced and overlayed with current mapping of the Minyjuru PEC and used, along with historic and current aerial maps, to better define current and pre-township Minyjuru communities. In particular it would assist with better definition of the M10-M13 patch boundaries.

11) Additional survey work needs to be undertake at Coconut Wells and within the Water Authority Reserve East of Broome. The Coconut Wells area appears to contain Minyjuru trees with unusual associate species such as *Cyanstegia cyanocalyx* on parallel ridges over lateritic gravel instead of relict dunes and may constitute a different ecological community. Similarly, Water Authority Reserve contains a low density of Minyjuru running along parallel dune ridges merging into pindan and requires further investigation as to whether it constitutes additional Minyjuru on Relict Dune PEC.

8.0 Acknowledgements

Tim Willing, co-author of the report, acknowledges the financial support of North West Property Consultants in commencing this survey. However survey completion necessitated a labour intensive volunteer contribution toward better understanding of this Priority ecosystem and improving planning and management.

Louise Beames (Environs Kimberley) uploaded and collated the data, produced the maps and co-authored the report.

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Phil Docherty (SKIPA/BBS) for reviewing report and advising on Minyjuru loss within the Broome Port

Steve Reynolds (Environs Kimberley) assisted with sourcing historical maps and identifying the land tenure of each of the Minyjuru patches.

Jo Caloundra (Broome Helicopter Services) skilfully piloted a Robinson 44 helicopter on 12 March 2014, from which aerial photographs were taken by Richard Meister and Tim Willing.

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APPENDIX 1

S1 -S4 Quadrat Data Sheets

S1 - Port Drive

S2 - Kavite Road

S3 - Buckleys Road

S4 - Trail bike Circuit

S1 -S4 Pictures

Quadrat S1

Broome Flora Quadrat **SERSALISIA PEC SURVEY**

Project No.		Project Name:	
Survey Area	Sersalisia Quadrat	Date	28 November 2013 7- 9.30am
Site No. :	S1	Recorders:	Tim Willing & Chris Howe-Piening
Location:	off Port Drive Broome		
Photo:	View N/ View ex NW to SE/NE - IMG 2139 - 2146		
Datum and Zon	51K	Site staked?:	Yes / No Peg No.s
Peg 1 (NW):	_0415562	Peg 2 (NE)	_0415612
WP341	8010099	WP342	8010104
Peg 4 (SW)	_0415561	Peg 3 (SE)	_0415603
WP340	8010050	WP343	8010056

Habitat: Pleistocene dune crest

Soil: Dry- reddish brown sand

Rock type: Broome Sandstone (not exposed)

Termite Mound Height: Shape: Colour:

Vegetation: Low open woodland of Sersalisia sericea, Corymbia zygophylla & Gyrocarpus americanus with tall very open shrubland of Erythrophleum chlorostachys over Triodia schinzii hummock grassland

Veg condition (disturbance)	Excellent minor *Passiflora foetida	Very good	Good	Poor	Very Poor	completely degraded
Fire Age Burnt	<1 year ago	1-2 yrs ago	3-5 Yrs ago	no sign of recent fire	very long unburnt	

Notes:

Agile wallaby scrapes under trees

Family of blue-winged Kookaburras seen

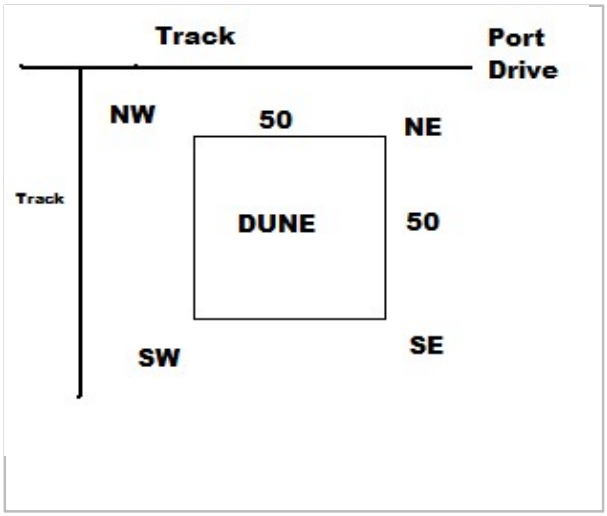
Birds nests in Gyrocarpus & Bauhinia

1 x old low dome-shaped red termite mound

Threats : weeds, rubbish, fire

Nb: Clearing of area West and NS of track took place in October 2014 with loss of 15 mature Minyjuru trees.

Sketch of quadrat layout (include N Points, tracks, quadrat corners numbered clockwise from from NW), stakes,s/g landform features)



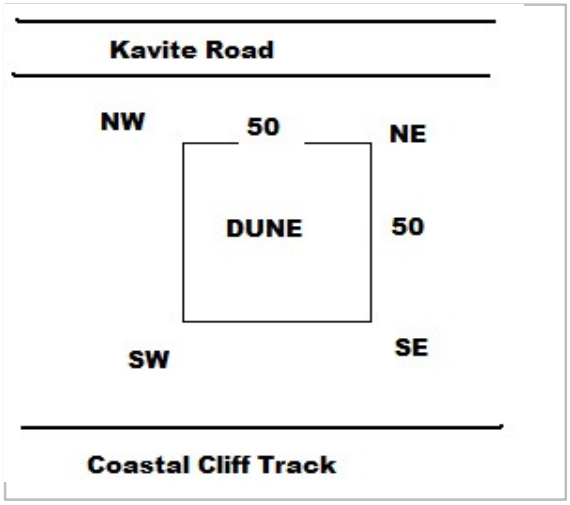
Quadrat S1

Site No.: S1	SERSALISIA PEC SURVEY		
Trees	**Height**	**Cover**	**Notes**
Sersalisia sericea	6	3%	Co-dominant
Corymbia zygophylla	7	4%	Co-dominant
Gyrocarpus americanus	6	2%	Co-dominant
Ehretia saligna	6		occasional
Ventilago viminalis	5		clump (5) on dune crest
SHRUBS			
Erythrophleum chlorostachys	3.5	2.50%	Dominant
Bauhinia cunninghamii	3.5		scattered
Corymbia greeniana	4		occasional NE
Grewia breviflora	4		one in E
Psydrax attenuata var. tenella	4		scattered - infl
Breynia cernua	3		suckering clump
Acacia colei	2		scarce (1)
Persoonia falcata	1.5		scarce (1)
Pavetta kimberleyana	1.5		under Sersalisia (2)
Dolichandrone heterophylla	1.5		big patch in SW
Carissa lanceolata	1.5		in flower
Premna acuminata	1.5		under Sersalisia
Flueggea virosa	1.5		scarce (1)
Gardenia pyriformis	1		scarce (2)
GRASSES			
Triodia schinzii	0.4	30%	Dominant
Triodia acutispicula	0.4		scattered patches
Panicum decompositum	1		patch in N
SEDGES			
Cyperus conicus	0.4		patch in NW
CLIMBERS			
*Passiflora foetida			under Sersalisia (4)
Jasminum didymum			under Sersalisia
Tylophora cinerascens			scattered (3)
Abrus precatorius			under Sersalisia
Cassytha filiformis			under Sersalisia
HERBS			
Polycarpaea longiflora	0.5		scattered - dune crest
Waltheria indica	0.4		scattered
Sauropus trachyspermus	0.4		scarce (2)
Crotalaria medicaginea	0.4		scattered
Tephrosia rosea	0.4		frequent
Corchorus pumilio	0.3		frequent
Achyranthes aspera	0.3		under Sersalisias
Spermacoce occidentalis	0.3		abundant on dune crest
Sida rohlenae	0.3		occasional (2)
Sida sp B Kimb. Flora	0.3		occasional NW
TOTAL (38)			

Quadrat S2

Broome Flora Quadrat				**SERSALISIA PEC SURVEY**			
Project No.			Project Name:				
Survey Area	Sersalisia Quadrat		Date	27 November 2013 8-11am			
Site No. :	S2		Recorders:	Tim Willing & Chris Howe-Piening			
Location:	N of Nun's House, Kavite Road						
Photo:	View N from SE/Vies from NW/Velleia - IMG 2115-2135						
Datum and Zon	51K		Site staked?:	Yes / No	Peg No.s		
Peg 1 (NW):	_0414356			Peg 2 (NE)	_0414411		
WP335	8011494			WP338	8011489		
Peg 4 (SW)	_0414355			Peg 3 (SE)	_0414404		
WP336	8011446			WP337	8011442		
Habitat:	Pleistocene dune ridge						
Soil:	Dry- reddish brown sand						
Rock type:	Broome Sandstone (not exposed)						
Termite Mound	Height:		Shape:		Colour:		
Vegetation:	Low open woodland of Sersalisia sericea, over Acacia colei						
	very open shrubland over Corynotheca micrantha var gracilis [Zig Zag Lily]						
	over Triodia schinzii hummock grassland						
Veg condition	Excellent	Very good	Good	Poor	Very Poor	completely degraded	
(disturbance)	minor *Passiflora foetida						
Fire Age Burnt	<1 year ago	1-2 yrs ago	3-5 Yrs ago	no sign of recent fire	very long unburnt		
Notes:							
Female Agile Wallaby with joey seen running							
Scattered goanna holes							
Aboriginal midden with oyster shells							
Occasional low done-shaped termite mounds							
Threats: fire, weeds & long-term coastal cliff erosion.							

Sketch of quadrat layout (include N Points, tracks, quadrat corners numbered clockwise from from NW), stakes,s/g landform features)



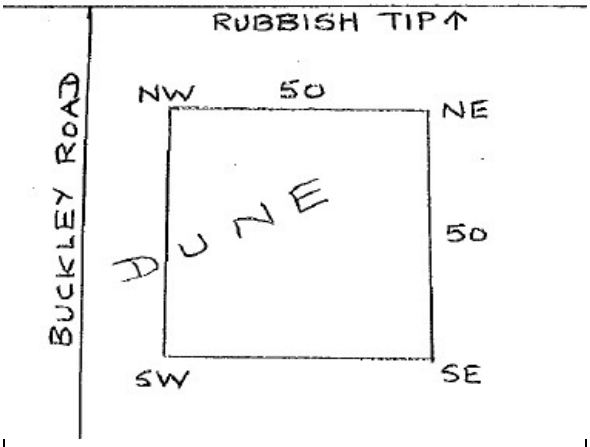
Sersalisia sericea	4.5	8%	dominant	
Corymbia greeniana	5		occasional (2)	
Gyrocarpus americanus	5.5		three in patch	
Corymbia zygophylla	4.5		mallee-like (1)	
Grewia breviflora	4.5		occasional with Sersalisia	
SHRUBS				
Acacia colei	4	5%	dominant	
Premna acuminata	3.5		occasional	
Psydrax pendulina	3.5		patch of three in NW	
Brachychiton diversifolius	3		scarce (1)	
Acacia tumida var kulparn	2		occasional	
Erythrophleum chlorostachys	2.5		scattered	
Terminalia ferdinandiana	2		scarce (1)	
Hakea macrocarpa	1.5		scarce (1)	
Persoonia falcata	1.5		scattered	
Santalum lanceolatum	1.5		patch of three	
Carissa lanceolata	1		scattered	
Senna costata	1		occasional under Sersalisia	
Velleia panduriformis	1		patch on W side	
GRASSES				
Triodia schinzii	0.8	40%	dominant	
Aristida sp. probably hygrometrica	0.6		not identifiable - frequent	
LILIES				
Corynotheca micrantha var gracilis	0.7	10%	dominant sp.	
CLIMBERS				
*Passiflora foetida			occasional (2)	
Tylophora cinerascens			with Sersalisia	
Tinospora smilacina			with Sersalisia	
Jasminum didymum			one patch	
Abrus precatorius			under Sersalisias	
Cassytha filiformis			frequent	
Cucumis maderaspatanus			occasional	
SEDGES				
Cyperus conicus	0.4		scattered	
HERBS				
Phyllanthus aridus	0.6		occasional	
Dodonaea hispidula	0.5		three in W and NW	
Gyrostemon tepperi	0.5		occasional	
Grewia retusifolia	0.5		occasional under Sersalisias	
Ehretia saligna	0.5		scattered	
Tephrosia rosea	0.5		scattered, mauve flowers	
Gardenia pyriformis	0.4		scarce (2)	
Crotalaria medicaginea	0.4		occasional	
Corchorus pumilio	0.3		scattered	
HERBS cont				
Solanum cunninghamii	0.3		occasional	
Tephrosia crocea	0.3		scattered	
Waltheria indica	0.3		abundant	
Abutilon otocarpum	0.3		abundant	
Breynia cernua	0.3		occasional	
Achyranthes aspera	0.3		one patch under Sersalisia	
Rulingia loxophylla	0.3		occasional	
Scaevola parvifolia	0.3		occasional	
Goodenia linifolia	0.3		scarce	
Evolvulus alsinoides	0.2		occasional	
Heliotropium leptaleum	0.2		occasional	
Cajanus marmoratus	0.2		occasional (N)	
Melhania oblongifolia	0.2		occasional	
TOTAL (51)				

Quadrat S3

Broome Flora Quadrat							
Project No.			Project Name:				
Survey Area	Sersalisia Quadrat		Date	29-Nov-13	7-10 am		
Site No. :	S3		Recorders:	Tim Willing & Chris Howe-Piening			
Location:	East side of Buckley Rd						
Photo:	Image 2147-2155						
Datum and Zon	51K		Site staked?:	No	Peg No.s		
Peg 1 (NW):	0:419072			Peg 2 (NE)	0:419121		
WP 345	8020368			WP 346	8020370		
Peg 4 (SW)	0:419070			Peg 3 (SE)	0:419114		
WP 344	8020318			WP 348	80020320		
Habitat:	Pleistocene dune crest						
Soil:	Reddish sandy pindan						
Rock type:	N/A						
Vegetation:	Acacia eriopoda and Sersalisia serciea low woodland over Waltheria indica low shrubland over Chrysopogon fallax bunch grassland.						
Veg condition	Excellent	Very good	Good	Poor	Very Poor	completely degraded	
(disturbance)	Azadirachta indica (Neem)						
Fire Age Burnt	<1 year ago	1-2 yrs ago	3-5 Yrs ago	no sign of recent fire	very long unburnt		

Notes: Numerous Agile Wallaby scrapes under Sersalisias with holes dug to eat Chrysopogon rhizomes. No termite mounds. Grey Crowned babblers. Red collared lorikeets. Threats: Weeds*, Rubbish, Fire (* nb Hyptis on Buckley Rd)

Sketch of quadrat layout *(include N point, tracks, quadrat corners (numbered clockwise from NW), stakes, sig landform features)*



Quadrat S3 Species list

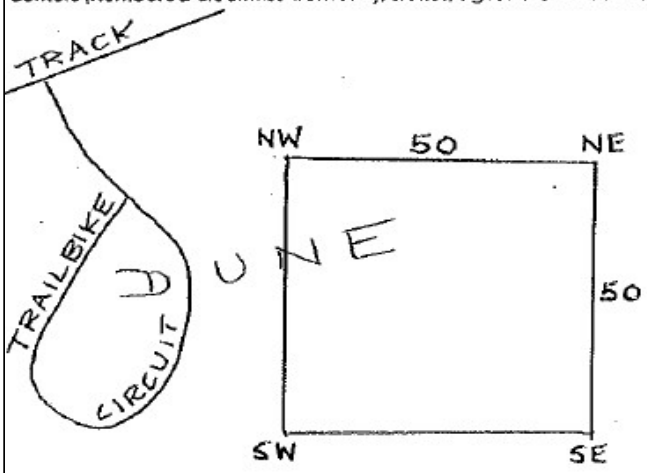
Site No.: S3 SERSALISIA PEC			
Species	**Height**	**Cover**	**Notes**
TREES			
Acacia eriopoda	7	8%	Co-dominant
Gyrocarpus americanus	7		scattered
Sersalisia sericea	6	4%	Co-dominant
Ventilago viminalis	5.5		frequent
Bauhinia cunninghamii	5.5		scattered
Hakea macrocarpa	5.5		frequent
*Azadirachta indica	5		under Sersalisia
Corymbia greeniana	5		occasional (2)
Brachychiton diversifolius	4		scattered
SHRUBS			
Corymbia zygophylla	3.5		occasional (1)
Grewia breviflora	3		under Sersalisia
Dolichandrone heterophylla	2.5		scarce (1)
Persoonia falcata	2.5		occasional
Flueggea virosa	2.5		occasional
Carissa lanceolata	2		abundant
Acacia colei	2		occasional
Pavetta kimberleyana	2		occasional under Sersalisia
Clerodendrum tomentosum	2		scarce (1)
Ehretia saligna	2		occasional
Psydrax attenuata var tenella	2		occasional (3)
*Acacia auriculiformis	2		garden escape under Sersalisia
Exocarpus latifolius	1.5		under Sersalisia
Grewia retusifolia	1.5		scattered
Bridelia tomentosa	1.5		scattered
Breynia cernua	1		clump in SW
Crotalaria medicaginea	1		scattered
Waltheria indica	1	15%	Dominant shrub
GRASSES			
Chrysopogon fallax	0.5	12%	Dominant grass
Aristida sp. Probably hygrometrica	0.6		frequent
Triodia acutisepala	0.4		one patch in N
Panicum decompositum	0.6		scarce (1)
SEDGES			
Cyperus conicus	0.3		one patch
CLIMBERS			
Capparis lasiantha			scarce (1)
Tylophora cinerascens			2 seen
HERBS			
Ptilotus poystachyus var. polystachyus	0.6		in patches
Mallotus nesophilus	0.5		serveral under Sersalisia
Myoporum tenuifolium	0.5		under Gyropcarpus (1)
Terminalia petiolaris	0.5		under Sersalisia (1)
Solanum cunninghamii	0.4		occasional
HERBS cont			
Achyranthes aspera	0.4		under Sersalisia
Melhania oblongifolia	0.4		abundant
Corchorus pumilio	0.3		scattered
TOTAL (42)			

Quadrat S4

Broome Flora Quadrat							
Project No.			Project Name:				
Survey Area	Sersalisia Quadrat		Date	2-Dec-13	7-10am		
Site No. :	S4		Recorders:	Tim Willing & Chris Howe-Piening			
Location:	Trailbike Circuit						
Photo:	IMG 2264-2277						
Datum and Zon	51K		Site staked?:	No	Peg No.s		
Peg 1 (NW):	0:4158698			Peg 2 (NE)	0:415917		
WP 362	8012851			WP 363	8012840		
Peg 4 (SW)	0:415857			Peg 3 (SE)	0:415911		
WP 360	8012804			WP 364	8012792		
Habitat:	Pleistocene dune crest						
Soil:	Dry reddish brown sand						
Rock type:	N/A						
Vegetation:	Gyrocarpus americanus and Corymbia zygophylla. Low open woodland over Atalya hemiglauca. Low shrubland over Triodia schinzii hummock grassland and Aristida open bunch grassland.						
Veg condition	Excellent	Very good	Good	Poor	Very Poor	completely degraded	
(disturbance)	*Passiflora foetida						
Fire Age Burnt	<1 year ago	1-2 yrs ago	3-5 Yrs ago	no sign of recent fire	very long unburnt		

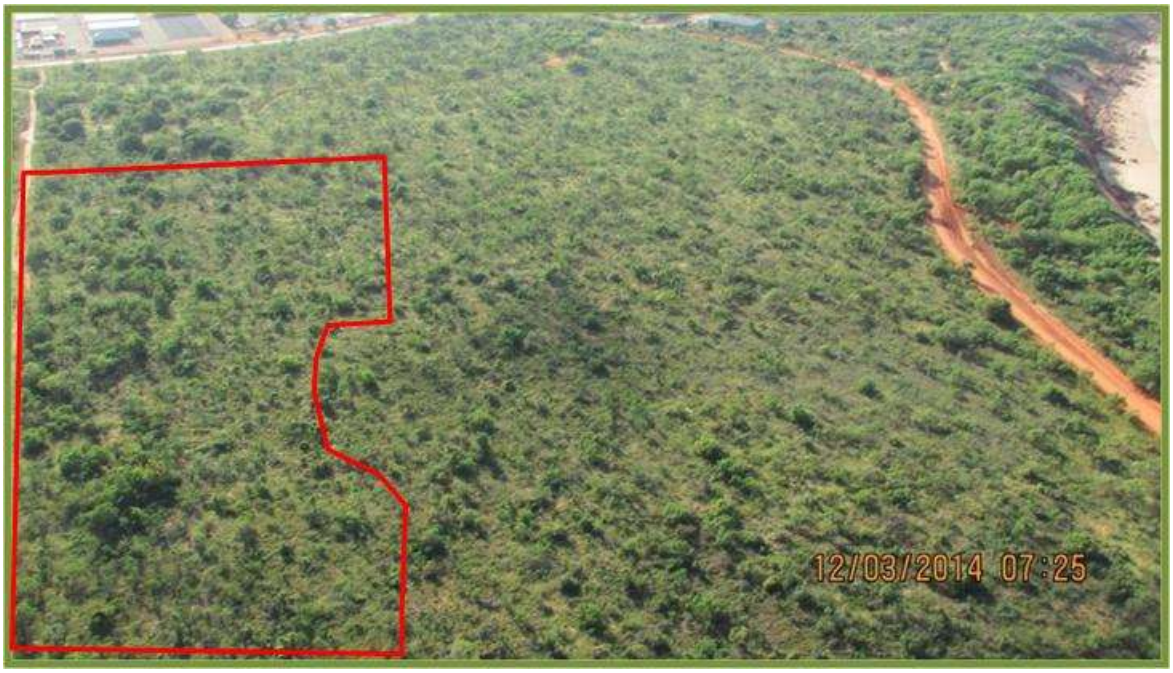
Notes: Some Agile Wallaby scrapes on S. boundary. No termite mounds. Silver-crowned friarbird, Grey-crowned babbler, Black-faced cuckoo shrike, Singing Honeyeater Rufous whistler sighted, Threats: Weeds, Rubbish^, Fire (^Car bodies on Trailbike Circuit)

Sketch of quadrat layout *(include N point, tracks, quadrat corners (numbered clockwise from NW), stakes, sig landform features)*



SERSALISIA PEC Site No. S4			
Species	**Height**	**Cover**	**Notes**
TREES			
Gyrocarpus americanus	5	3%	Co-dominant
Corymbia zygophylla	5	3%	Co-dominant
Sersalisia sericea	4		scattered
Brachychiton diversifolius	4		2 in South
Acacia colei	4		scattered
SHRUBS			
Atalaya hemiglauca	3.5	3%	dominant
Acacia eriopoda	3		occasional
Bauhinia cunninghamii	3		scarce (1)
Ehretia saligna	3		frequent
Grewia breviflora	3		occasional
Hakea macrocarpa	3		patch in N (3)
Psydrax attenuata var. tenella	3		scarce (1)
Ventilago viminalis	3		scattered
Dolichandrone heterophylla	2.5		patch in N
Premna acuminata	2.5		scarce (2)
Santalum lanceolatum	2.5		frequent
Carissa lanceolata	2		scattered
Ficus aculeata	2		2 under Gyrocarpus
Fluggea virosa	2		frequent
Grewia retusifolia	2		under Corymbia
Persoonia falcata	2		occasional
Bridelia tomentosa	1.5		under Gyrocarpus
Senna costata	1.5		one patch
Trichodesma zeylanica	1.5		in SW
GRASSES			
Triodia schinzii	0.5	30%	Co-dominant
Aristida hygrometrica	0.4	10%	Co-dominant
SEDGES			
Cyperus conicus	0.3		patches on W & S
CLIMBERS			
Abrus precatorius			under Sersalisia
Cassytha filiformis			in Triodia in NE
Cucumis maderaspatanus			in Triodia in NE
Cajanus marmoratus			on Triodia
Ipomoea muelleri			in SW
Jacquemontia paniculata			scattered
Jasminium didymum			frequent
*Passiflora foetida			in Corymbia
Tylophora cinerascens			on Acacia
Tinospora smilacina			on Gyropcarpus
MISTLETOES			
Lysiana spathulata			on Acacia colei & Santalum
HERBS			
Crotalaria medicageinea	0.8		frequent
Waltheria indica	0.8		frequent
Abutilon otocarpum	0.5		occasional in NE
Gyrostemon teppperi	0.5		scarce (1) in NE
Corchorus pumilio	0.4		frequent
Melhania oblongifolia	0.4		occasional NW
Solunum cunninghamii	0.4		occasional NE
Tephrosia rosea	0.4		frequent
Gomphrena sp.	0.3		occassional
Spermacoce occidentalis	0.3		scattered
Zornia prostrata	0.2		occasional NE
TOTAL (49)			

Quadrat S1 -West side of Port Drive

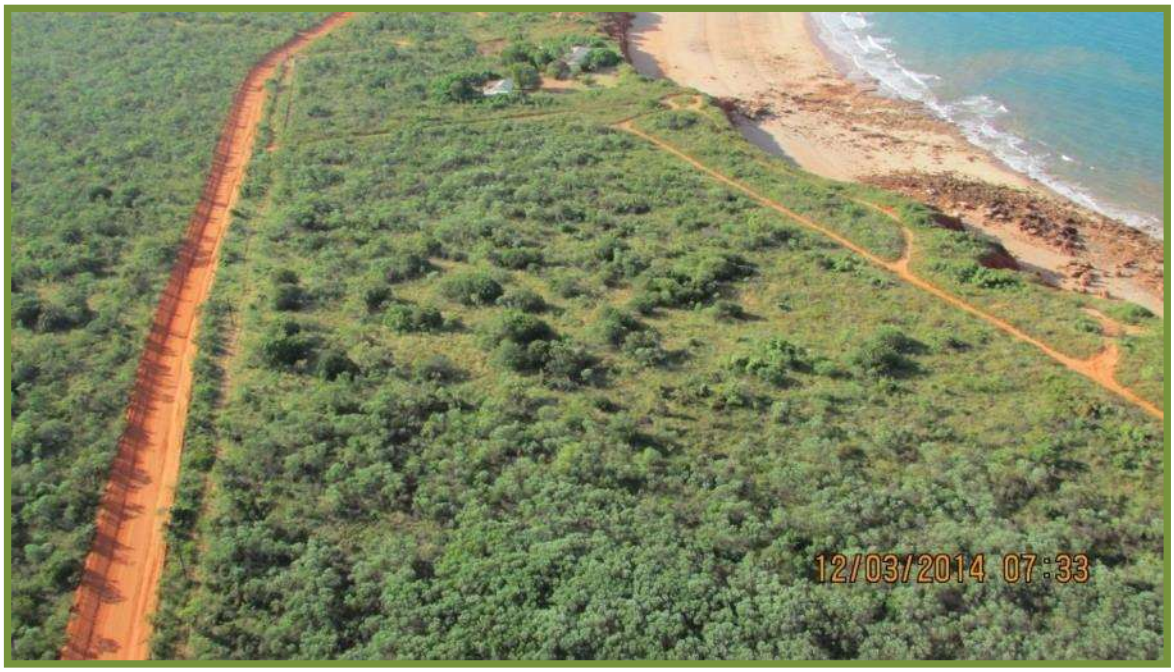


Quadrat S1a: In foreground reserve area with *Keraudrenia exastia* (DRF). Kavite Road is at right. Port Drive in background and Inpex laydown yard at far left. The approximate area cleared is shown in red. The *Sersalisia sericea* PEC is the tree grove in the top left corner, where the quadrat was located on the sand ridge. View looking south-east. Picture: Willing

Quadrat S1b: Dune ridge with sparse cover of Spinifex *(Triodia schinzii).* Helicopter Trees *(Gyrocarpus americanus)* with lime-green new foliage are at centre and left. Photo: 28 November 2013, Willing

Quadrat S1c: ***Psydrax attenuata*** **var.** ***tenella,*** **with fragrant vanilla-scented flowers, favours the sand ridge habitat and is a frequent associated species in the** ***Sersalisia sericea*** **PEC. Photo: 28 November 2013, Willing.**

Quadrat S2 -South side of Kavite Road, near Reddell Beach house



Quadrat S2a: In centre, grove of *Sersalisia sericea* on sand ridge, where quadrat was located. View is south-east with Kavite Road at left, Reddell Beach at right and Reddell Beach house in background. The foreground is dense Soap Bush *(Acacia colei)* showing as bluish-grey tall shrubs. Picture: Willing

Quadrat S2b: Quadrat area viewed from cliff-top track, looking north-east. *Acacia tumida* var. *kulparn* is growing in centre as semi-prostrate shrubs with much *Cassytha filiformis,* smothering Spinifex *(Triodia schinzii)*. Nb: The foreground is unmapped Dwarf Pindan Heath.
Photo: 27 November 2013, Willing.

Quadrat S2c: *Sersalisia sericea* with Helicopter Trees *(Gyrocarpus americanus)* in fresh lime-green leaf in background. Soap Wattle *(Acacia colei)* is at far right. Mixed Spinifex *(Triodia schinzii)* with Zig-Zag Lily *(Corynotheca micrantha* var. *gracilis)* comprises the foreground. This is the type locality for the latter species. Photo: 27 November 2013, Willing.

Quadrat S3 - East side of Buckleys Road, just south of Rubbish Tip

Quadrat S3a: Groves of *Sersalisia sericea,* showing as dark trees, flanking Buckleys Road in late dry season on a broad sand ridge. Broome Rubbish Tip at right. View looking north with the quadrat located at right centre. Some of the area to the right foreground (approximated with the red line), including some Minyjuru trees, has since been cleared for a Shire Recycling Depot. Photo: 16 September 2013, Willing.

Quadrat S3b: View north on quadrat with *Acacia eriopoda* at left and centre over sparse Ribbon Grass *(Chrysopogon fallax). Sersalisia sericea* tree at far right. Photo: 29 November 2013, Willing.

Quadrat S3c: A fine specimen of Boomerang Tree *(Hakea macrocarpa),* surrounded by *Acacia eriopoda* over sparse grassland of *Aristida* sp. Photo: 29 November 2013, Willing.

Quadrat S4 - Trail bike Circuit, south of Gantheaume Point Road

Quadrat S4a: ***Sersalisia sericea*** **PEC community on dune ridge at Trail bike Circuit. View looking north-east to Gubinge Road in background with Vacation Village at extreme right. Picture: Willing.**

Quadrat S4b: View looking north on quadrat with ***Sersalisia sericea*** **as dark-foliaged background tree; Helicopter Tree** ***(Gyrocarpus americanus)*** **at left background with bird's nest in crown. In the foreground are**

slender Whitewood *(Atalaya hemiglauca*) saplings over Spinifex *(Triodia schinzii).* Photo: 2 December 2013, Willing.

Quadrat S4c: View south on quadrat towards *Sersalisia sericea* trees in background. Soap Bush *(Acacia colei)* is at top right with Medicine Bark *(Ventilago viminalis)* at lower right over Spinifex *(Triodia schinzii)*. Photo: 2 December 2013, Willing.

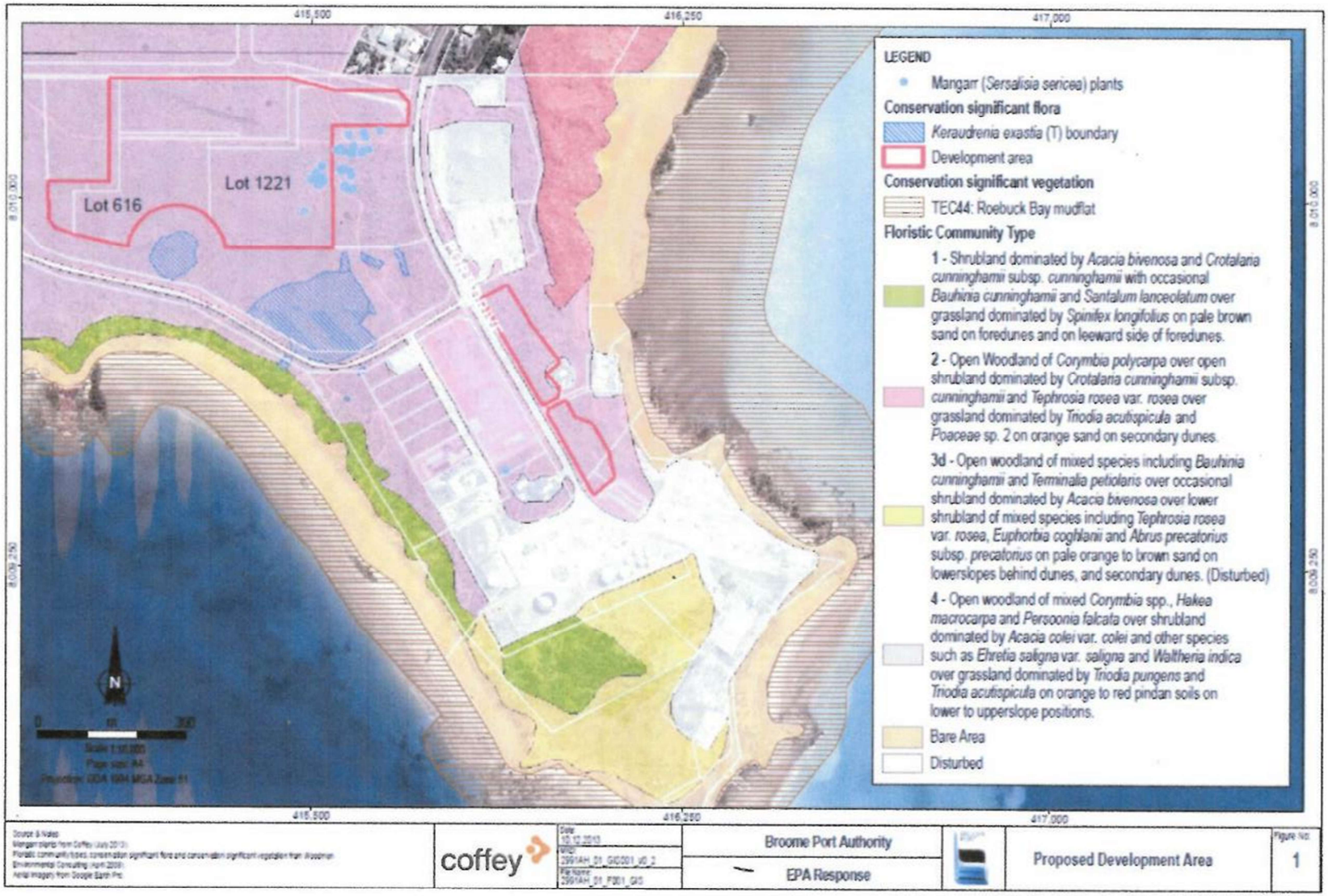
APPENDIX 2

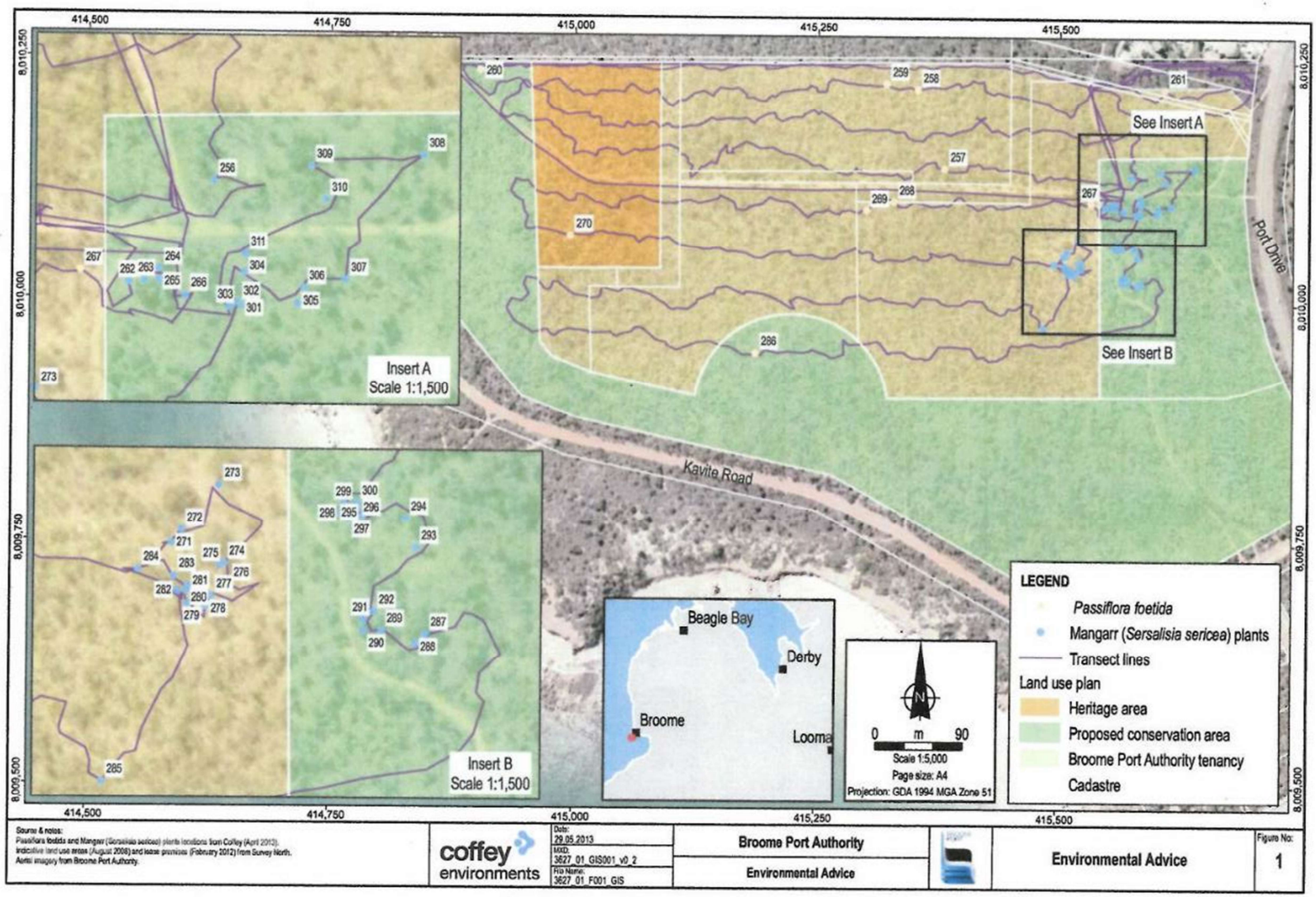
Maps sourced from Coffey Natural Systems Pty Ltd

showing:

15 Mangarr (Minyjuru) plants to be cleared as part of Lot 616 and Lot 1221 (Permit no. CPS 3104/5) as well as the locations of the Critically Endangered *Keraudrenia exasita* in the Broome Peninsula.

Maps sourced from Coffey Natural Systems showing the location of Mangarr (Minyjuru) plants *(S. sericea)* and *Keraudrina exastia* in relation to the Development area. At least 15 Mangarr (Minyjuru) large old trees have been cleared according to this and the following map. Sources are as indicated.




414,500
414,750
415,000
415,250
415,500
8,010,250
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8,009,500
Insert A
Scale 1:1,500
Insert B
Scale 1:1,500
See Insert A
See Insert B
Kavite Road
Port Drive
Beagle Bay
Derby
Broome
Looma
0 m 90
Scale 1:5,000
Page size: A4
Projection: GDA 1994 MGA Zone 51
LEGEND
Passiflora foetida
Mangarr (Sersalisia sericea) plants
Transect lines
Land use plan
Heritage area
Proposed conservation area
Broome Port Authority tenancy
Cadastre
Sources & notes:
Passiflora foetida and Mangarr (Sersalisia sericea) plants locations from Coffey (April 2013).
Indicative land use areas (August 2008) and lease premises (February 2012) from Survey North.
Aerial imagery from Broome Port Authority.
coffey environments
Date: 29.05.2013
MXD: 3627_01_GIS001_v0_2
File Name: 3627_01_F001_GIS
Broome Port Authority
Environmental Advice
Environmental Advice
Figure No: 1

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