



Pearl Beach Arboretum – Ecological Report

Prepared for Pearl Beach Arboretum | 2024



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1. Introduction

1.1 Purpose

The purpose of this report is to present the findings of desktop searches and field surveillance to deliver an Ecological Report for Council owned lands within The Crommelin Native Arboretum to assist in the ongoing management of the site to support and enhance restoration of native vegetation composition, structure and overall ecosystem function.

1.2 Background

“The Crommelin Native Arboretum at Pearl Beach (the Arboretum) – known locally as the Pearl Beach Arboretum (PBA) – is situated on 5.5 acres of land owned by Central Coast Council in the southwest corner of the village of Pearl Beach adjacent to the Brisbane Water National Park (Figure 1). An arboretum is defined by the Oxford Dictionary as “a garden where many different types of trees are grown, for people to look at or for scientific study”. The Arboretum at Pearl Beach is restricted to Australian native trees and other flora, with a particular emphasis on plants endemic to the region”

Crommelin Native Arboretum Pearl Beach Draft Management Plan 2022.

1.3 Location and Precincts

The Arboretum is located adjacent to Brisbane Water National Park within the southwest corner of Pearl Beach, with access gained from Crystal Avenue, Opal Close and the public carpark adjacent to the Tennis Courts in the north (Figure 1).

Adjusted precincts of the Arboretum are outlined below and in Figure 2.

- Parking and Entrances
- The Open / Entrance Area (including the Wedding Tree)
- Pearl Beach Sand Forest
- The Riparian Zone (including the Palm Grove)
- The Pleasance
- The Wetland Area
- The Wildlife Corridor (including the Flowering Shrub Area)

Table 1: Site/Parcel Survey Details

Site Name	Address	Lot	DP	Tenure	Zoning	Total Size of Site (Ha)
Pearl Beach Arboretum	73B Crystal Ave, PEARL BEACH, NSW, 2256	540	DP1043338	Council owned community land	SP1 Conservation, Research Station	~5.2
	69 Amethyst Ave, PEARL BEACH, NSW, 2256	215	DP755251			
		216	DP755251			

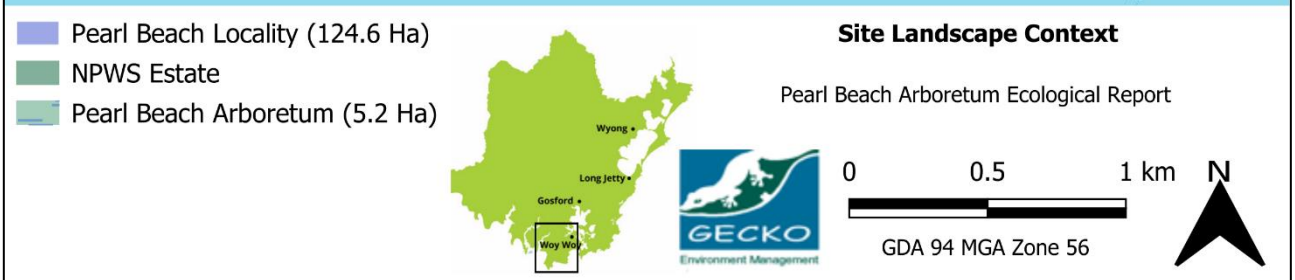
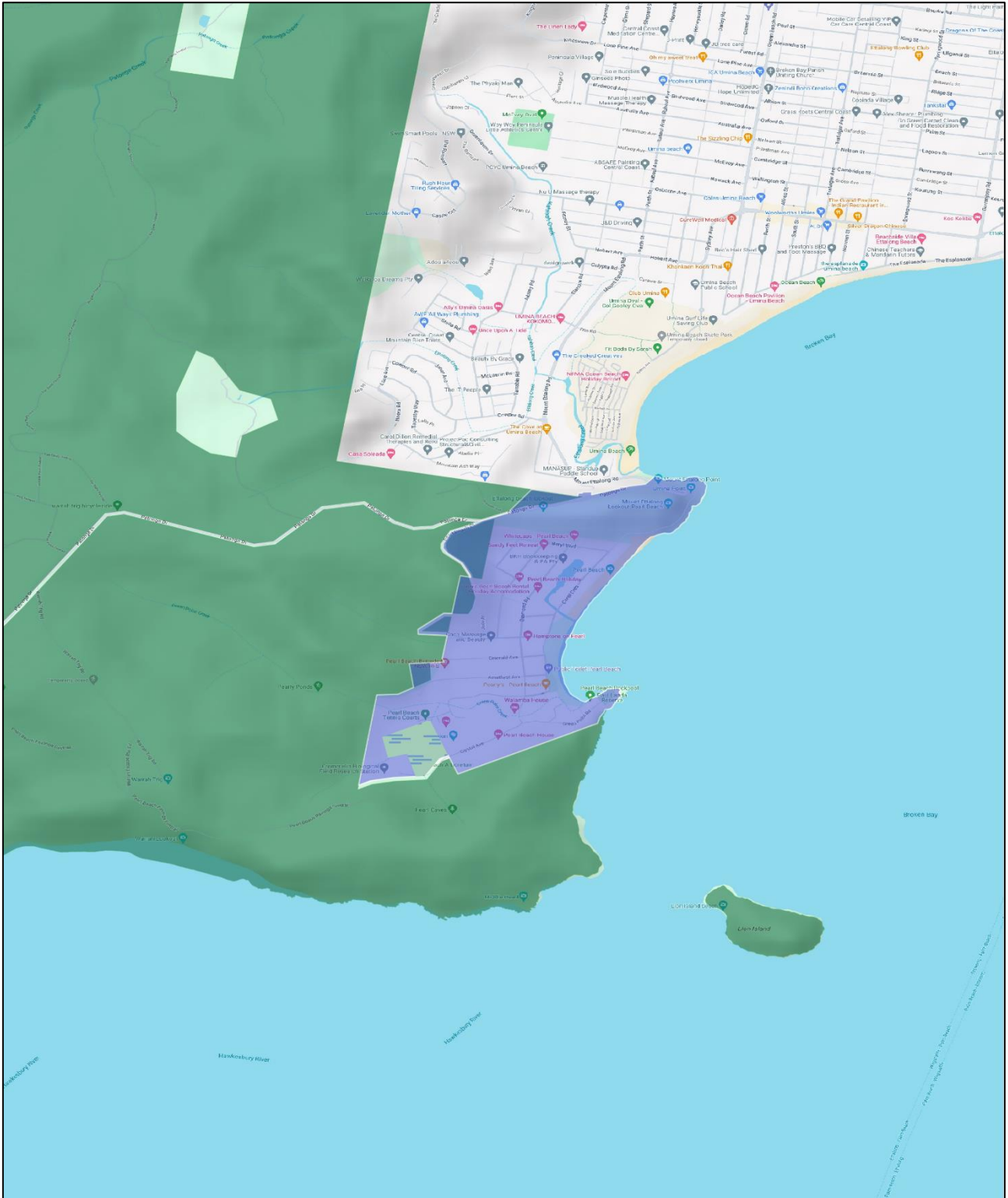


Figure 1: Site location within the surrounding landscape context showing bushland connectivity and urban influences.

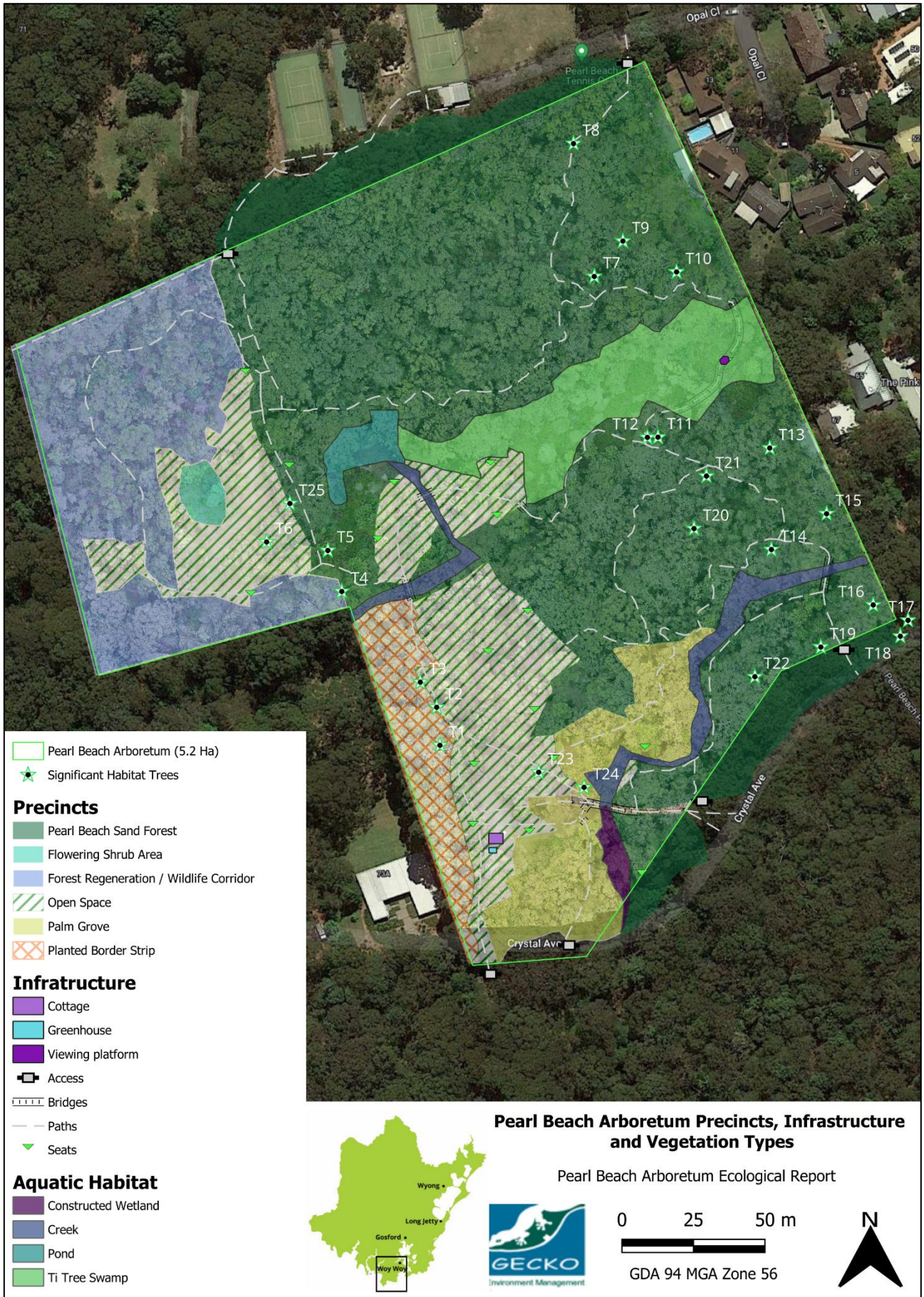


Figure 2: Pearl Beach Arboretum precincts, updated vegetation types and locations of infrastructure

2. Methodology

2.1 Desktop review

Gecko Environment Management (GEM) has undertaken a review of the following databases to identify threatened flora and fauna species records within a 10km radius of Pearl Beach Arboretum (PBA):

- NSW Department of Planning, Industry and Environment (DPIE) BioNet, Atlas of NSW Wildlife (DPIE 2023).
- Department of Agriculture, Water and the Environment (DAWE) EPBC Act Protected Matters Tool (DAWE 2023).

Literature review has also been relied upon to comment on soils, site history and fauna sightings, all outside the scope of fieldwork, for the purposes of this report vegetation communities on site were established both with the aid of

- Literature review
- Aerial photo interpretation to establish obvious zonation in vegetation cover on site
- Random meander ground truthing survey of the site by two ecologists with the aid of Garmin 62 ST and Avenza GPS
- Two representative 10m x 10m Floristic Quadrats.
- Field application of the Specht Method of Vegetation Classification (Specht, 1970)

The Specht method defines the structure of a plant community via determining Foliage Projective Cover (FPC) and height as well as life form of the tallest strata.

The vegetation of the site was surveyed and reviewed in reference to the literature during a random meander survey throughout the entire site. Both key indigenous and introduced plants have been recorded in species lists provided.

2.2 Field survey

Field surveys were conducted on 29th of January & 1st of February 2024 by two field ecologists to assess, map and ground truth significant habitat values, extant native vegetation communities and the density and distribution of key weed species and other disturbances on council owned lands through a targeted, systematic approach. Average weather conditions were fine and sunny, 26-33 C and light winds. Field survey was executed over the study area of ~5.2 hectares via two complimentary survey methods.

- 1) Aerial
- 2) Ground

2.2.1 Aerial

The entire site was surveyed by acquiring high resolution, remote sensed photogrammetry obtained from an Unmanned Aerial Vehicle (UAV) or drone. Areas of disturbance and lacking vegetated canopy can provide increased mapping accuracy when the aerial view is unobstructed or terrain difficult to access on foot.

2.2.2 Ground

Systematic random meander on foot was used to map the site, focussing on areas where the aerial view would be obstructed by canopy or dense vegetation, to ground-truth any acquired vegetation data and confirm the presence or absence of any potential threatened species. Emphasis was placed on significant habitat values, weed plumes, their severity and assessing native vegetation.

2.3 Floristic Survey

Two representative 10m x 10m Floristic Quadrats were installed in areas of remnant vegetation where the vegetation was observed to be most representative of the community. Photo Monitoring (Appendix 5) was conducted at the centroid of each quadrat capturing a 360-degree view by taking photos 1-2m from the centre point of the plot facing each cardinal point (N, E, S, and W).

2.3.1 Quadrats

Two (2) 10m x 10m quadrats were established using the methods outlined in section 7.2.2 of (Barker, 2001) to capture all floristic and habitat data to inform vegetation classification and provide useful diagnostic attributes. Floristic and habitat data has been modified from section 4 of (Biodiversity Conservation Trust, 2021).

Data included:

Location

- Latitude
- Longitude

Identification of monitoring point

Date

Assessor

Native Species

- Structure – Overall native PFC for each stratum (Canopy, mid strata, understorey)
- Scientific name
- Lifeform
- Stratum – where species occurs (Canopy, mid strata, understorey)
- Abundance/Species composition – Relative measure of the number of individuals

1,2,3,4,5,6,7,8,9,10,20,50,100,500,1000 or >1000. (Numbers >20 are estimates only).

- Projected Foliage Cover (PFC) - Braun-Blanquet score: <5% cover, 5-25% cover, 25-50% cover, 50-75% cover, >75% cover.

Exotic vegetation

- Structure – Overall exotic PFC for each stratum (Canopy, mid strata, understorey)
- Scientific name
- Stratum – where species occurs (Canopy, mid strata, understorey)
- Projected Foliage Cover (PFC) - Braun-Blanquet score: <5% cover, 5-25% cover, 25-50% cover, 50-75% cover, >75% cover.

Habitat

- Hollow bearing trees (number)
- Fallen logs (>100mm diameter) in metres
- Leaf litter depth (mm)
- Cover % of key features
 - Rocky outcrops
 - Grasses
 - Grass like
 - Forbs
 - Ferns
 - Litter
 - Fallen logs
 - Soaks
 - Riparian zone

2.4 Image Acquisition

We collected 182 UAV orthophotos (JPEG) from 16th of January 2024 using a DJI Mavic 2 Zoom with a 12 MP, 1/2.3-inch CMOS RGB sensor (DJI, Shenzhen, Guangdong, China). To retain consistency, limit shadowing and image blur all flights were conducted between 09:30 and 14:00 EDST with winds < 10 knots. Based on previous studies efficacy and methodology (O'Connell et al., 2022) and (Oddi et al., 2021), our own qualitative evaluation of orthomosaics created from test flights at ~30, 60 and 90m AGL and site topographical constraints we chose to fly the UAV ~60 m above ground level (AGL) resulting in a ground-sampling distance (GSD) of about 2cm. We automated flights using DroneDeploy software (DroneDeploy, San Francisco, CA, USA) with 75% front overlap, 70% sidelap, an average speed of 4m/s, and NADIR (90°) gimbal angle. Flight plans were generated automatically by DroneDeploy using a pre-determined bounding polygon input limiting flights to public lands and the above parameters. Flight paths were adjusted as necessary, and Terrain Assist was activated to retain the correct AGL distance over undulating terrain and to account for any potential flight hazards.

2.5 Photogrammetric Data Processing

JPG files were uploaded to DroneDeploy for processing and the resultant GEOTIFF outputs were downloaded in High Resolution (HR) 1.8 cm outputs (Figure 3).

All subsequent processing of vector, raster and ground truth data was done in QGIS 3.22.16 (QGIS, 2022). We merged the outputs of the separate rasters into a single orthomosaic map by resampling to the highest resolution using the Nearest Neighbour algorithm and projected to EPSG:4326 – WGS84. A Virtual Raster File (VRT) of the study area was then rendered usable after overviews were built at varying resolutions (Figure 5).



Figure 3: Same portion of a study area at different spatial resolutions (per pixel) comparing UAV vs Satellite imagery: UAV-1.8cm (a) and Google Satellite- >1m (b).

2.6 Ground Truth

Using handheld GPS (Garmin ; ± 3 m positional accuracy), we marked the locations of significant habitat trees and any weed species distribution and density on foot via random meander. Species included Giant Bird of Paradise (*Strelitzia nicolai*), Camphor laurel (*Cinnamomum camphora*), Lantana (*Lantana camara*), Fishbone Fern (*Nephrolepis cordifolia*), Green Cestrum (*Cestrum parqui*) and Ochna (*Ochna serrulata*).

A total of 64 ground truth grid reference points were collected for key native and exotic floristics and used for image analysis, aerial interpretation training and accuracy assessment.

Identification of native and exotic flora utilised the resources of *Weeds of South Eastern Australia* (Richardson, 2006), PlantNet (PlantNET, 2019), NSW DPI Weedwise (WeedWise, 2019) and samples taken for further botanical analysis.

2.7 Image Analysis and Mapping

Image analysis was carried out using visual photo- interpretation of the HR GEOTIFF outputs by a user expert on the study area.

Photo-interpretation (PI) was manually carried out in QGIS 3.22.16 (QGIS, 2022) by an operator interpreting the images according to their knowledge of the vegetation in the area and ground truth data. Manipulation of different Red-1, Green-2, Blue-3 (RGB) spectral bands assisted interpretation of differing species due to their reflective characteristics (Figure 4).

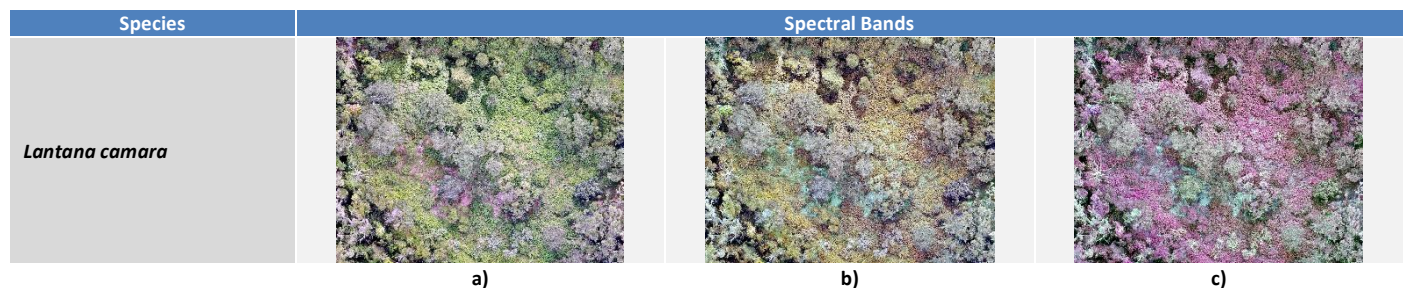


Figure 4: UAV acquired imagery showing an example of different reflectance characteristics of the weed species *Lantana camara* in spectral bands : 1-2-3 (a), 2-1-3 (b) and 2-3-1 (c) used to assist in manual classification.

Vector layers were created for key weed species distribution, overall weed density and other disturbances across the study area utilising analysed imagery, collected ground reference data and included:

- Polygons developed with assessment of % weed density and distribution
- Weed list for the site, including identification of Priority Weeds
- Disturbance types and management issues
- Relevant ecological data
- Locations of any management issues

Mapped Weed Density categories were in keeping with Central Coast Councils current assessment method:

- Sparse 0-1%
- Low 1-10%
- Medium 11-40%

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Figure 5: UAV acquired imagery processed into a high resolution orthomosaic GEOTIFF raster of the study area.

3. Results

3.1 Threatened Flora & Fauna Search Results

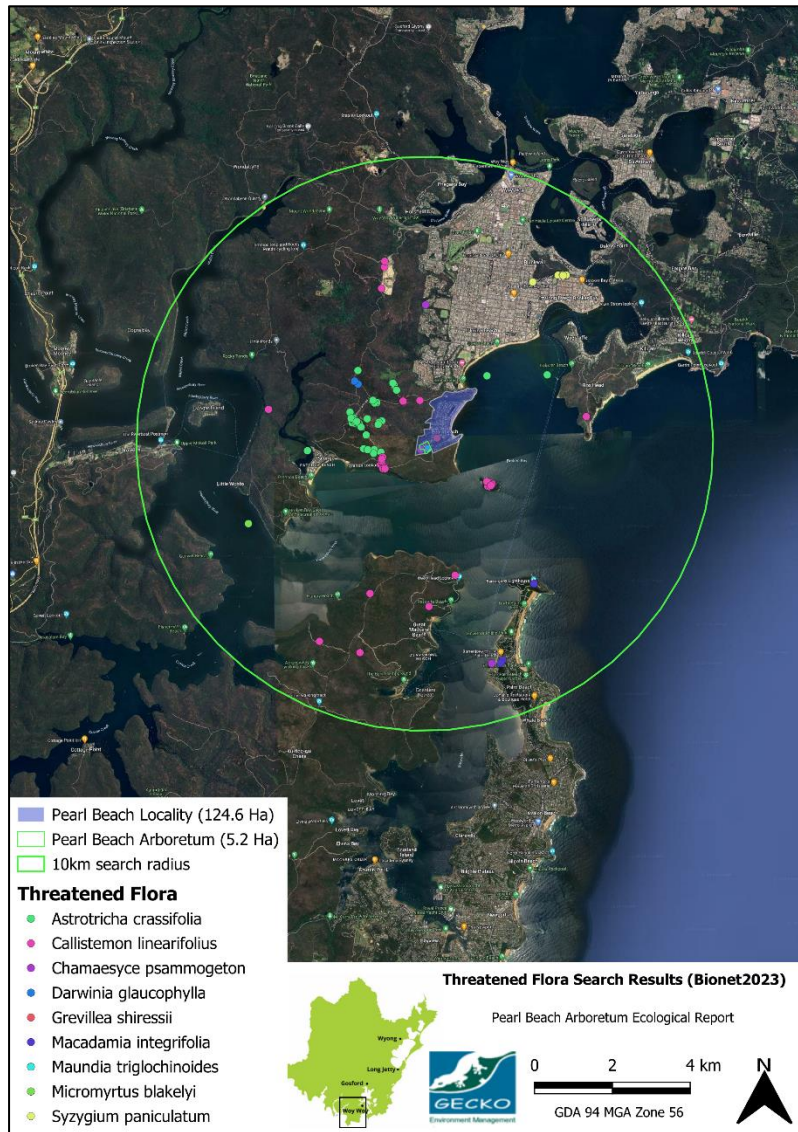


Figure 6: Threatened flora occurring within a 10km2 search radius surrounding the site

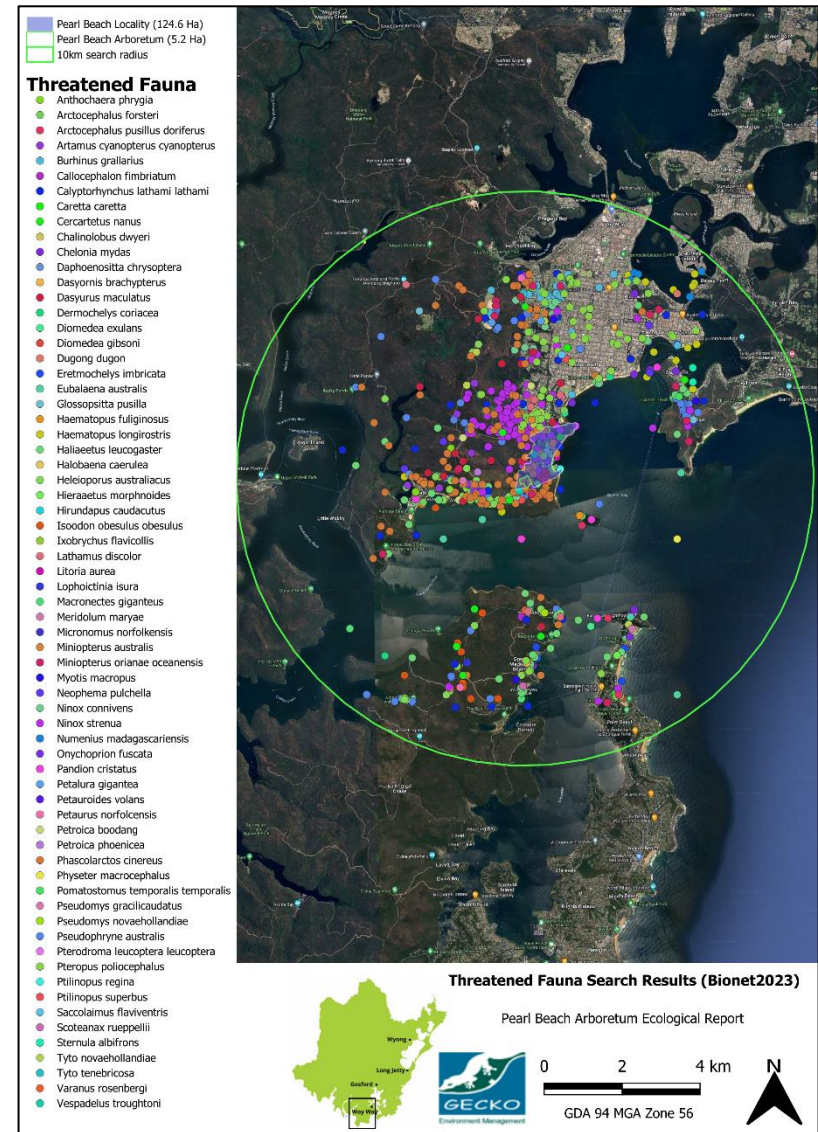


Figure 7: Threatened fauna occurring within a 10km2 search radius surrounding the site

3.1.1 Flora

Nine threatened flora species listed under the NSW Biodiversity Conservation Act 2016 (BC Act) have been recorded within a 10km radius (Figure 6) of the site (DPIE 2023) and twenty-six threatened flora species listed under the Commonwealth Environment Protection and Biodiversity Act 1999 (EPBC Act) were identified as having the potential to occur (DAWE 2023). Four threatened ecological community (TEC) have been identified with the potential to occur (DAWE 2023):

- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community
- Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland
- River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria
- Coastal Upland Swamps in the Sydney Basin Bioregion

No threatened flora species were located by G.E.M. survey within the site.

3.1.2 Fauna

Fifty-three threatened fauna species listed under the BC Act have been recorded within a 10km radius (Figure 7) of the site (DPIE 2023) with thirty-five threatened fauna species listed under the EPBC Act were identified as having the potential to occur (DAWE 2022), including:

- 21 Bird (7 Migratory species)
- 3 Frog
- 10 Mammal
- 1 Reptile

No threatened fauna species were located by G.E.M. opportunistically during surveys. Detailed field fauna studies were beyond the scope of this study.

The 10km radius encompasses significant National Parks and Wildlife estate, which the majority of the threatened flora and fauna species recordings were made. Pearl Beach Arboretum is an extension of the broader connective bushland and potentially provides suitable habitat and refugia for a number of these threatened species.

Search results of threatened flora and fauna species is provided in Appendices 1-4.

3.2 Endangered Ecological Communities (EECs)

No mapped vegetation communities or their respective PCT equivalence have a likely association as an EEC. However, due to the limited distribution and restricted nature of the extant vegetation communities found within PBA, all are deemed as Regionally Significant Vegetation.

3.3 Native Vegetation

Table 2 and Figures 8 and 9 outline the native Vegetation Communities, Plant Community Type (PCT) equivalence and legislative context within the study area. The vegetation communities occurring within the site as described by Bell (2019) include E33I - Pearl Beach Sand Forest; E37ei - Coastal Sand Swamp Forest and Xr - Disturbed - Canopy Only.

Table 2: Native Vegetation Communities (Bell 2019)

Vegetation Unit	Vegetation Community Name	BC Act Equivalent	EPBC Equivalent	PCT Equivalent	PCT Name
E33I	Pearl Beach Sand Forest	not currently listed	not currently listed	PCT3587	Pearl Beach Sand Forest
E37ei	Coastal Sand Swamp Forest	not currently listed	not currently listed	PCT4004	Northern Melaleuca quinquenervia Swamp Forest
Not Classified		not currently listed	not currently listed	PCT4006	Northern Paperbark-Swamp Mahogany Saw-sedge Forest
Xr	Disturbed - Canopy Only	not currently listed	not currently listed		

E33I – Pearl Beach Sand Forest

Plate 1: E33I – Pearl Beach Sand Forest



Vegetation formation	Dry Sclerophyll Forests (Shrubby sub-formation)
Vegetation class	Sydney Coastal Dry Sclerophyll Forests
PCT	3587 Pearl Beach Sand Forest
Extent within survey area	> 3 hectares
Condition	Vegetation within this community was considered good (Plate 1) throughout the core of its distribution, representative both structurally and floristically. Some evidence of disturbance and weed ingress was encountered with proximity to edge effects and weed ingress
Description (Bell 2019)	Pearl Beach Sand Forest is a restricted vegetation community occurring at a few locations around Pearl Beach, and as far north as Point Clare. It is found on gully-fill sand deposits at the foot of the Hawkesbury Sandstone escarpment, and is characterised by a canopy of <i>Angophora costata</i> , <i>Corymbia gummifera</i> , <i>Allocasuarina torulosa</i> , <i>Banksia serrata</i> , <i>Eucalyptus piperita</i> and <i>Syncarpis glomulifera</i> . Understorey species commonly present include <i>Elaeocarpus reticulatus</i> , <i>Xanthorrhoea arborea</i> , <i>Ceratopetalum gummifera</i> , <i>Synoum glandulosum</i> , <i>Leptospermum polygalifolium</i> , <i>Monotoca elliptica</i> , <i>Podocarpus spinulosus</i> , <i>Pteridium esculentum</i> , <i>Macrozamia communis</i> and <i>Lomandra longifolia</i> . Pearl Beach Sand Forest is closely related to the Umina Coastal Sandplain Woodland and shares many similar species. Analysis of plot data collected from both communities support the recognition of two communities (unpubl. data).
Description (DPE 2022)	<p>A tall, occasionally very tall, dry shrubby sclerophyll open forest with mesic elements found on low-lying fluviially deposited quartz sand mainly at Pearl Beach, Central Coast.</p> <p>The tree canopy almost always includes a sparse cover of <i>Corymbia gummifera</i> in association with a higher cover of <i>Angophora costata</i> or less frequently <i>Syncarpia glomulifera</i> and <i>Eucalyptus piperita</i>. Rarely local stands of <i>Eucalyptus paniculata</i> occur near the base of the escarpment on colluvial sands.</p> <p>Mesic elements in the mid-stratum are almost always present including <i>Livistona australis</i>, <i>Elaeocarpus reticulatus</i> and less frequently <i>Synoum glandulosum</i> subsp. <i>glandulosum</i>. The distinctive <i>Podocarpus spinulosus</i> is also very frequent amongst other sclerophyll shrubs including <i>Platylobium formosum</i>, <i>Leptospermum polygalifolium</i> and <i>Banksia serrata</i>.</p> <p>The ground layer includes a mid-dense cover of <i>Macrozamia communis</i>, <i>Xanthorrhoea arborea</i> with <i>Pteridium esculentum</i> and small climbers such as <i>Pandorea pandorana</i> subsp. <i>Pandorana</i> and <i>Smilax glycyphylla</i>.</p> <p>The distribution of this PCT is very restricted, situated on the gentle gradients behind Pearl Beach, and a single northern outlier on sand at West Gosford. This PCT shares some compositional attributes with PCT 3592 however can be distinguished readily by the substrate and elevation.</p>

E37ei - Coastal Sand Swamp Forest

Plate 2: E37ei - Coastal Sand Swamp Forest



Vegetation formation

Forested Wetlands

Vegetation class

Coastal Swamp Forests

PCT

4004 Northern *Melaleuca quinquenervia* Swamp Forest

Extent within survey area

Approximately 0.3 hectares

Condition

Vegetation within this community was generally considered good (Plate 2) throughout its distribution, representative both structurally and floristically. Some evidence of disturbance and weed ingress was encountered with proximity to edge effects.

Description (Bell 2019)

Coastal Sand Swamp Forest occurs in coastal areas on Quaternary Pleistocene Sand deposits, in poorly drained depressions. In most locations, Broad-leaved Paperbark (*Melaleuca quinquenervia*) dominates the tree layer, although Swamp Mahogany (*Eucalyptus robusta*) may be present in some fringing areas. Understorey components are generally wetland or mesic species such as *Gahnia clarkei*, *Phragmites australis*, *Baumea* spp, *Baloskion tetraphyllum* subsp. *meiostachyum* and *Omalanthus populifolius*, together with the ferns *Blechnum indicum*, *Blechnum camfieldii*, *Gleichenia* spp., and *Cyclosorus interruptus*. NPWS (2000) identify this form in their profile for Swamp Mahogany – Paperbark Forest, although do not apply sub-community status.

Type variant (mapped as E37ei) – dense stands of *Melaleuca quinquenervia* comprise the type variant (generally greater than 90%), with an understorey dominated by *Gahnia clarkei* and other sedges and rushes.

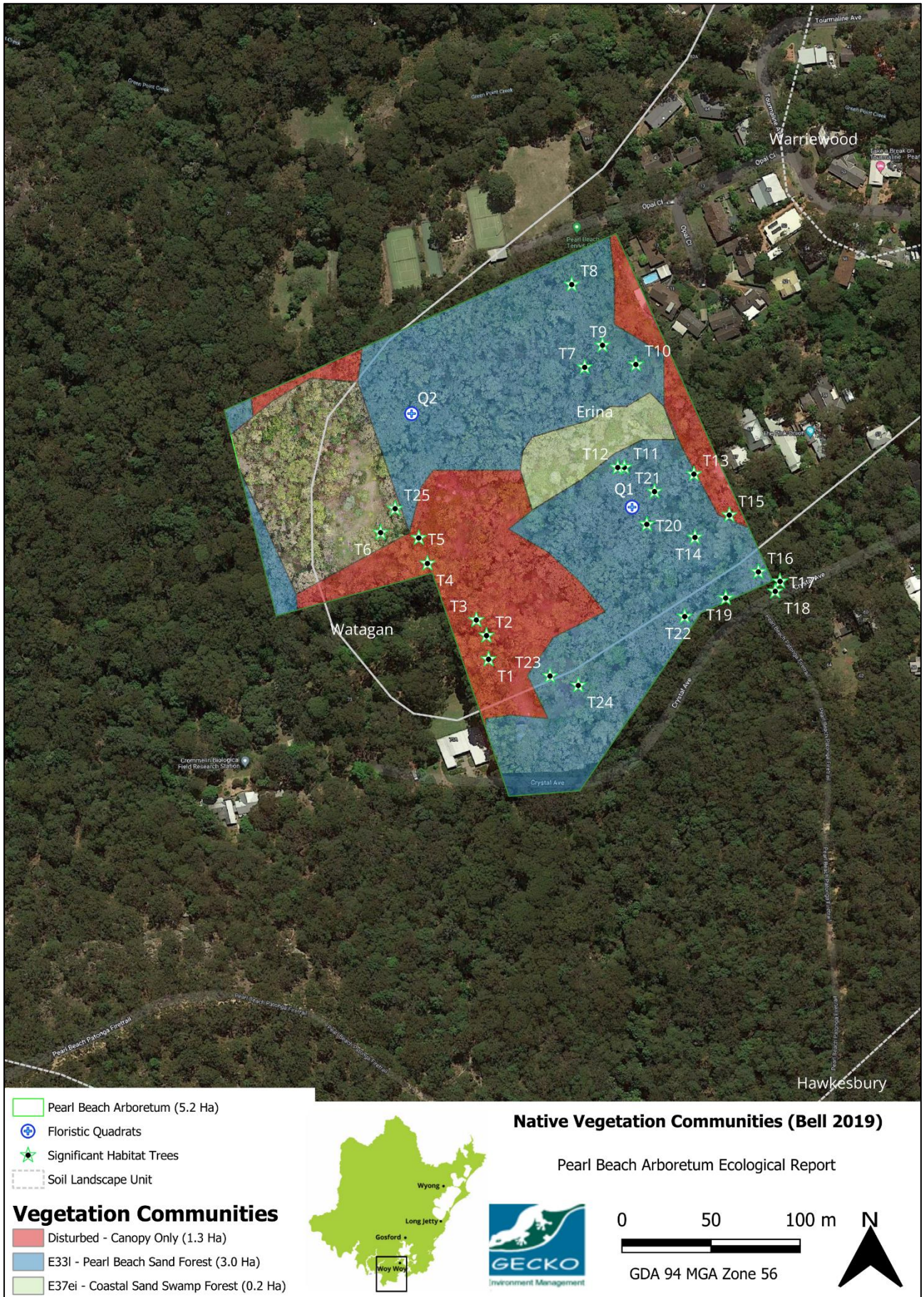


Figure 8: Extant vegetation communities of Pearl Beach Arboretum from (Bell, 2019) geological soil landscape units (Department of Planning Industry and Environment, 2020). floristic survey quadrats and significant habitat trees

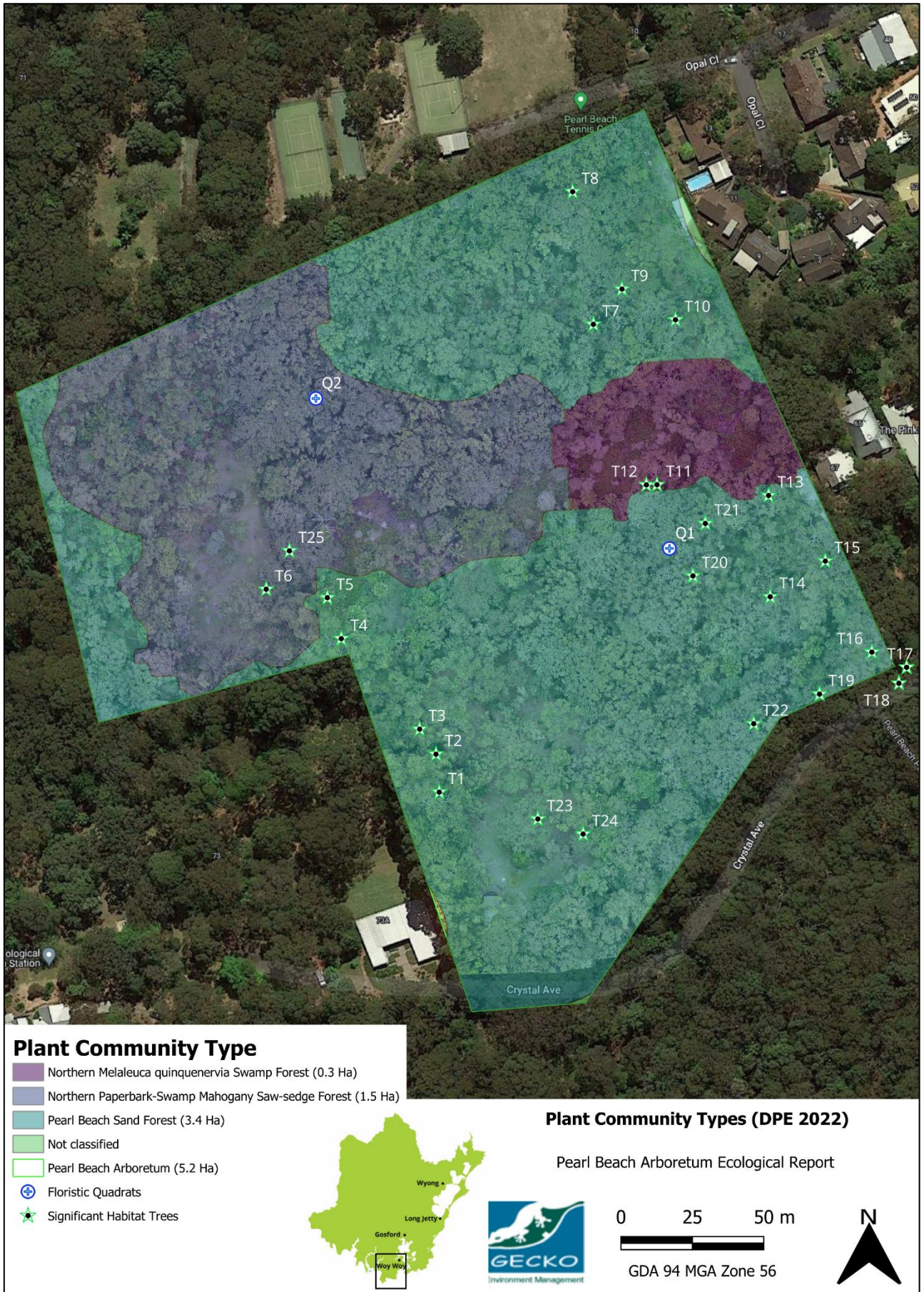


Figure 9: Extant associated Plant Community Types (PCTs) of Pearl Beach Arboretum, floristic survey quadrats and significant habitat trees.

Pearl Beach Arboretum has requested a review of vegetation communities on site. The premise was to determine if Umina Coastal Sandplain Woodland (UCSW) was represented within PBA. The Crommelin Native Arboretum Pearl Beach Draft Management Plan 2022 puts forward a classification of “Rare Burrawang Scrub” which is not scientifically or officially recognized as a legitimate vegetation community. Due to the vulnerable and critical nature of remaining UCSW remnants another complete regional floristic analysis similar to Payne et al., (2010) would be required to determine vegetation community boundary extents (which was outside of the scope of this report) and deemed to be unnecessary. Instead, analysis of data (Tables 3 & 4) derived from sampling quadrats capturing diagnostic species composition, structural elements and floristics together with geological data and literature reviews were undertaken of the vegetation in question.

After careful consideration, GEM agrees with the determined community ‘Pearl Beach Sand Forest’ due to the below factors:

The vegetation in question structurally exhibited characteristics in line with a forest classification as opposed to woodland under the (Specht, 1970) method.

The vegetation at Pearl Beach occurs on fluviially deposited Warriewood, Erina and Watagan Soil Landscape Units at an average elevation of 33m. UCSW occurs at 2m elevation on Quaternary sands of the Tuggerah and Woy Woy soil landscape units (Payne et al., 2010).

Diagnostic species and floristic assemblages encountered in each stratum were representative of and reflected Pearl Beach Sand Forest as described below:

“Pearl Beach Sand Forest is most closely related to Umina Coastal Sandplain Woodland (E33b), however there are important floristic differences. Unit E33b most commonly supports a canopy of *Eucalyptus botryoides* and *Angophora floribunda* with *Banksia integrifolia*, while *Angophora costata* and *Corymbia gummifera* occur very infrequently. *Syncarpia glomulifera*, *Eucalyptus piperita* and *Allocasuarina torulosa* have not been recorded within Umina Coastal Sandplain Woodland. Hawkesbury Peppermint-Apple Forest (E25) is also similar to E33I through a sharing of *Eucalyptus piperita* and *Angophora costata*, however that community occurs on sheltered sandstone slopes and minor gullies at higher elevations than Pearl Beach Sand Forest.”

(Bell 2009)

“A tall, occasionally very tall, dry shrubby sclerophyll open forest with mesic elements found on low-lying fluviially deposited quartz sand mainly at Pearl Beach, Central Coast.

The tree canopy almost always includes a sparse cover of *Corymbia gummifera* in association with a higher cover of *Angophora costata* or less frequently *Syncarpia glomulifera* and *Eucalyptus piperita*. Rarely local stands of *Eucalyptus paniculata* occur near the base of the escarpment on colluvial sands. Mesic elements in the mid-stratum are almost always present including *Livistona australis*, *Elaeocarpus reticulatus* and less frequently *Synoum glandulosum* subsp. *glandulosum*. The distinctive *Podocarpus spinulosus* is also very frequent amongst other sclerophyll shrubs including *Platylobium formosum*, *Leptospermum polygalifolium* and *Banksia serrata*.

The ground layer includes a mid-dense cover of *Macrozamia communis*, *Xanthorrhoea arborea* with *Pteridium esculentum* and small climbers such as *Pandorea pandorana* subsp. *Pandorana* and *Smilax glycyphylla*.

The distribution of this PCT is very restricted, situated on the gentle gradients behind Pearl Beach, and a single northern outlier on sand at West Gosford. This PCT shares some compositional attributes with PCT 3592 however can be distinguished readily by the substrate and elevation.”

(DPE 2022)

Further historical evidence of the original vegetation of the Umina Woy Woy sandplain and Pearl Beach has been provided (Figures 10 & 11) and mapped by (Department of Climate Change, 2007, Payne, 2006 & Payne et al., 2010)

confirming this vegetation community was historically mapped as Sydney Red Gum Complex Open Forest and not Umina Coastal Sandplain Woodland.

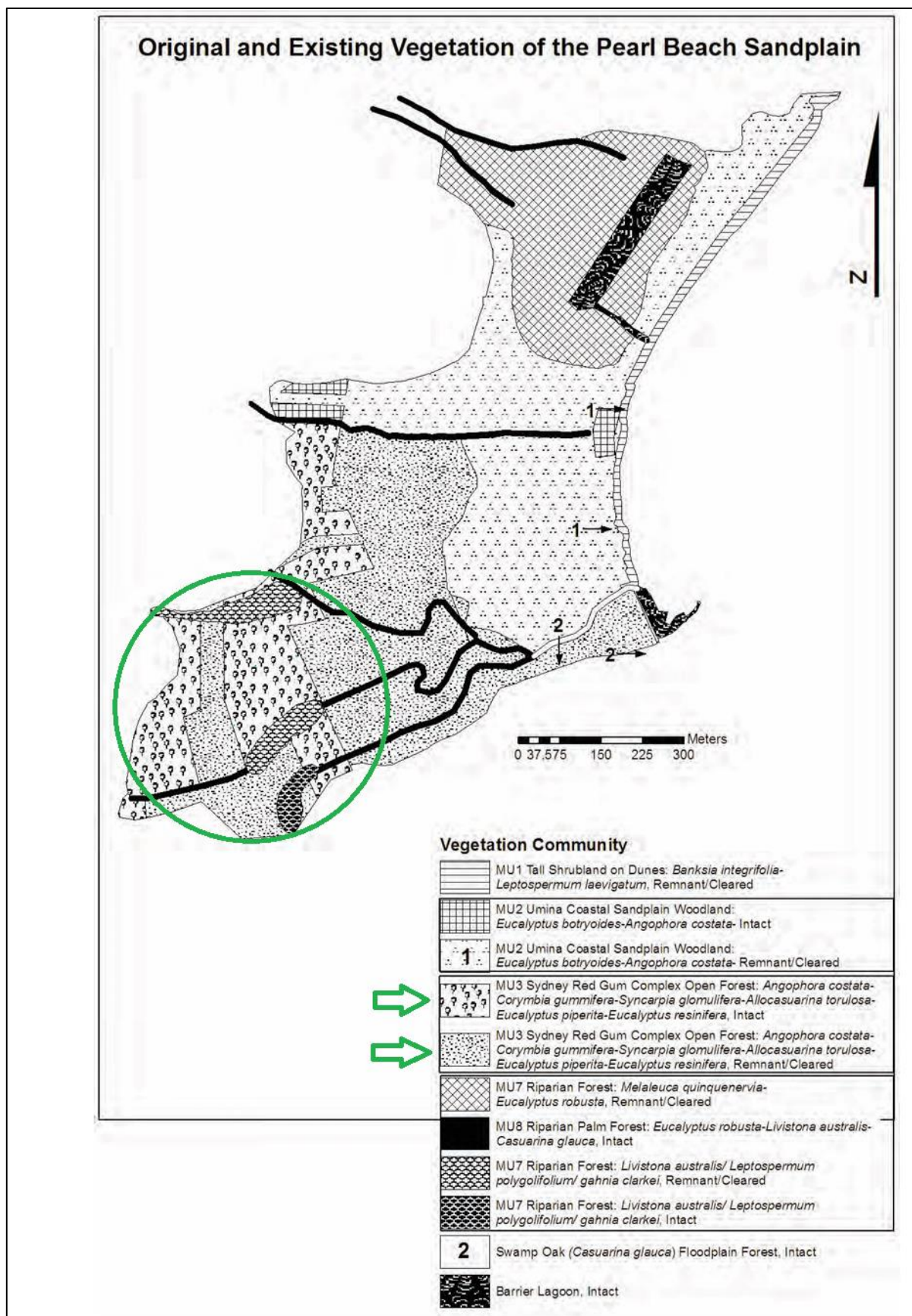


Figure 10: Map of Pearl Beach (Payne et al., 2010) showing the original and existing vegetation of the area. The vegetation has historically been mapped as “MU3 Sydney Red Gum Complex Open Forest” (Green arrows) within Pearl Beach Arboretum area (Green circle)

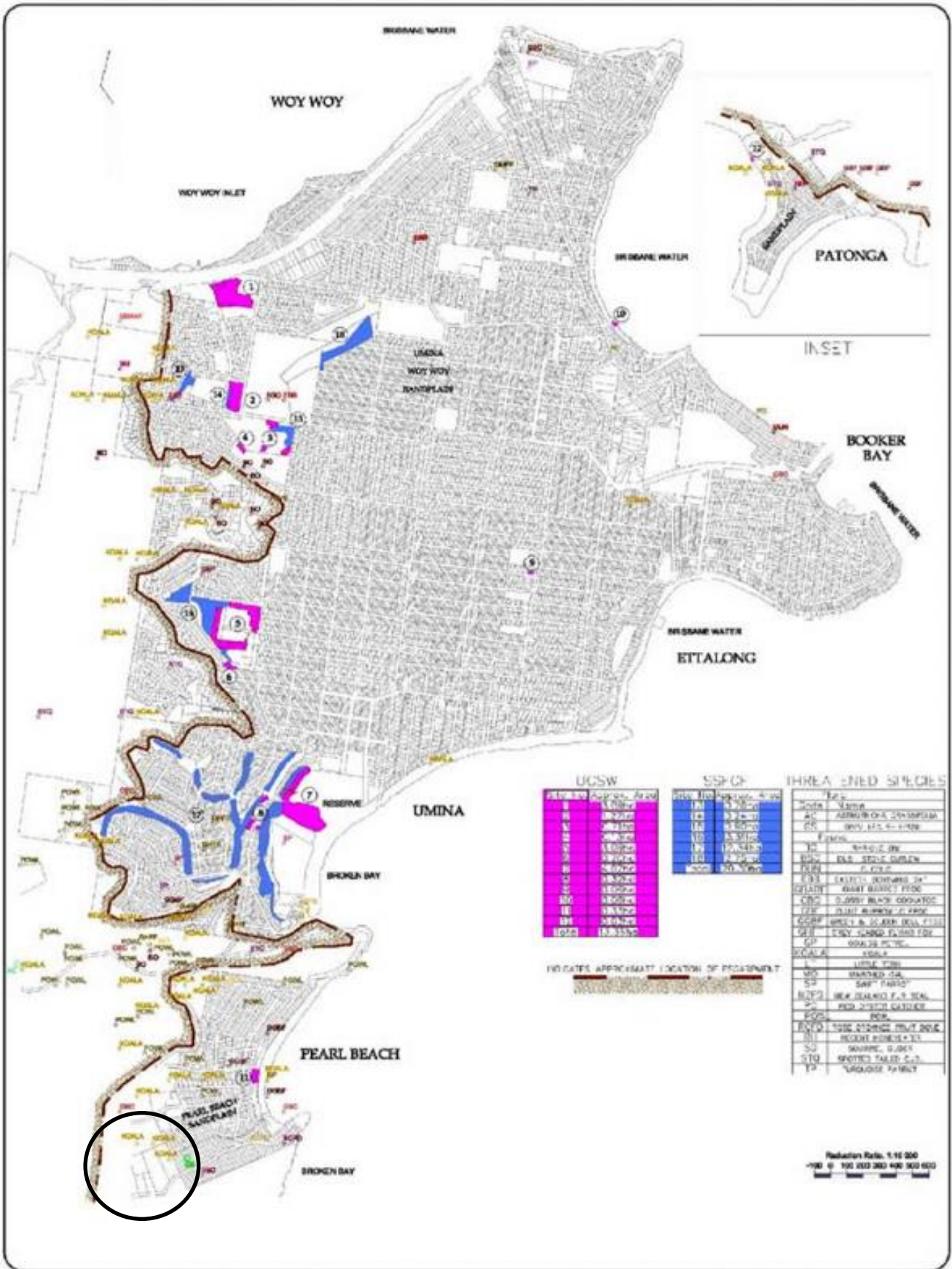


Figure 11: Historically mapped locations from Payne (2006) of the Umina Coastal Sandplain Woodland (Pink) vegetation community showing no distribution in the Pearl Beach Arboretum area (black circle).

Table 3: Quadrat 1 Floristic Data

Stratum PFC %	Scientific Name	Lifeform	Stratum	% Cover	Abundance
Canopy 50-75%	<i>Eucalyptus piperita</i>	Tree	Canopy	25-50%	2
	<i>Angophora costata</i>	Tree	Canopy	25-50%	2
	<i>Corymbia gummifera</i>	Tree	Canopy	5-25%	2
	<i>Syncarpia glomulifera</i>	Tree	Canopy	5-25%	1
Mid 50-75%	<i>Banksia serrata</i>	Tree	Mid	5-25%	4
	<i>Elaeocarpus reticulatus</i>	Small Tree	Mid	25-50%	4
	<i>Acacia maidenii</i>	Small Tree	Mid	5-25%	5
	<i>Monotoca elliptica</i>	Small Tree	Mid	<5%	1
	<i>Xylomelum pyriforme</i>	Small Tree	Mid	<5%	5
	<i>Cryptocarya microneura</i>	Small Tree	Mid	<5%	2
	<i>Leptospermum polygalifolium</i>	Small Tree	Mid	<5%	3
	<i>Synoum glandulosum</i>	Small Tree	Mid	<5%	5
	<i>Eustrephus latifolius</i>	Climber	Mid	<5%	1
	<i>Smilax glycyphylla</i>	Climber	Mid	<5%	2
	<i>Pandorea pandorana</i>	Climber	Mid	<5%	1
	<i>Parsonsia straminea</i>	Climber	Mid	<5%	2
Understorey >75%	<i>Xanthorrhoea arborea</i>	Graminoid	Understorey	25-50%	20
	<i>Cordyline stricta</i>	Herb	Understorey	<5%	1
	<i>Macrozamia communis</i>	Cycads	Understorey	25-50%	20
	<i>Hibbertia dentata</i>	Climber	Understorey	<5%	1
	<i>Pteridium esculentum</i>	Fern	Understorey	<5%	10
	<i>Podocarpus spinulosus</i>	Shrub	Understorey	25-50%	50
	<i>Eustrephus latifolius</i>	Climber	Understorey	<5%	6
	<i>Smilax glycyphylla</i>	Climber	Understorey	<5%	3
	<i>Pandorea pandorana</i>	Climber	Understorey	<5%	5
	<i>Cryptostylis erecta</i>	Orchids	Understorey	<5%	1
	<i>Livistona australis</i>	Palm	Understorey	<5%	50
	<i>Amperea xiphioclada</i>	Herb	Understorey	<5%	1
	<i>Entolasia stricta</i>	Grass	Understorey	<5%	20
	<i>Lomandra longifolia</i>	Herb	Understorey	<5%	7
	<i>Dianella caerulea</i>	Herb	Understorey	<5%	1
	<i>Breynia oblongifolia</i>	Small Tree	Understorey	<5%	1
	<i>Homalanthus populifolius</i>	Small Tree	Understorey	<5%	1
	<i>Elaeocarpus reticulatus</i>	Small Tree	Understorey	<5%	1
	<i>Microlaena stipoides</i>	Grass	Understorey	<5%	5
	<i>Entolasia marginata</i>	Grass	Understorey	<5%	1
<i>Stephania japonica</i>	Climber	Understorey	<5%	1	

Table 4: Quadrat 2 Floristic Data

Stratum PFC %	Scientific Name	Lifeform	Stratum	% Cover	Abundance
Canopy 50-75%	<i>Angophora costata</i>	Tree	Canopy	25-50%	4
	<i>Corymbia gummifera</i>	Tree	Canopy	5-25%	5
	<i>Syncarpia glomulifera</i>	Tree	Canopy	5-25%	1
	<i>Elaeocarpus reticulatus</i>	Small Tree	Mid	25-50%	4
Mid 50-75%	<i>Syncarpia glomulifera</i>	Tree	Mid	5-25%	1
	<i>Persoonia linearis</i>	Small Tree	Mid	<5%	1
	<i>Clerodendrum tomentosum</i>	Small Tree	Mid	<5%	1
	<i>Leptospermum polygalifolium</i>	Small Tree	Mid	<5%	1
	<i>Smilax glyciophylla</i>	Climber	Mid	<5%	1
	<i>Synoum glandulosum</i>	Small Tree	Understorey	5-25%	20
	<i>Smilax glyciophylla</i>	Climber	Understorey	<5%	10
	<i>Pandorea pandorana</i>	Climber	Understorey	<5%	3
	<i>Xanthorrhoea arborea</i>	Graminoid	Understorey	5-25%	20
	<i>Macrozamia communis</i>	Cycads	Understorey	5-25%	10
	<i>Hibbertia dentata</i>	Climber	Understorey	5-25%	1
	<i>Pteridium esculentum</i>	Fern	Understorey	5-25%	50
	Understorey >75%	<i>Podocarpus spinulosus</i>	Shrub	Understorey	50-75%
<i>Eustrephus latifolius</i>		Climber	Understorey	<5%	6
<i>Cryptostylis erecta</i>		Orchids	Understorey	<5%	20
<i>Livistona australis</i>		Palm	Understorey	<5%	10
<i>Lomandra longifolia</i>		Herb	Understorey	5-25%	50
<i>Homalanthus populifolius</i>		Small Tree	Understorey	<5%	1
<i>Elaeocarpus reticulatus</i>		Small Tree	Understorey	<5%	2
<i>Entolasia stricta</i>		Grass	Understorey	<5%	2
<i>Imperata cylindrica</i>		Grass	Understorey	<5%	1
<i>Platylobium formosum</i>		Shrub	Understorey	<5%	1
<i>Lomandra confertifolia</i>		Herb	Understorey	<5%	1
<i>Notelaea longifolia</i>		Small Tree	Understorey	<5%	1
<i>Poa affinis</i>		Grass	Understorey	<5%	1

4. Management Issues and Values

The bushland remnants held within PBA and adjacent NPWS land forms the eastern edge of important refugia habitat containing wetlands, riparian zones and bushland parcels, extending the functional habitat into an otherwise hostile urban matrix to the north and east.

These areas provide some greater connectivity to a surrounding network of National Parks, Natural Areas and COSS Reserves. Brisbane Water National Park to the west provides an expanse of protected flora and fauna that connects through other vegetation remnants to the north, south and east including PBA. These infiltrate the surrounding urbanised areas of Umina, Woy Woy and Ettalong effectively reducing fragmentation distances.

Fragmentation of bushland threatens both area limited species and dispersal limited species, the most vulnerable groups include the arboreal marsupials, medium sized reptiles, ground mammals and small sedentary birds (Smith, 2002). In planning for ecological connectivity on the NSW Central Coast, previous studies have relied on indicator species such as the Squirrel glider, chosen to establish priority linkages meeting minimum corridor width, minimum gap width and type, minimum fragment size (Smith & Murray, 2003).

Remnant vegetation found within PBA and the local area is important in maintaining already similar open space corridor parameters and increased connectivity within the surrounding landscape.

Management issues within the reserves applying to biodiversity values and community amenity are discussed below and presented in Figure 12.

4.1 Exotic Flora and Non-Endemic Native Flora

The most significant threat impacting the extant native vegetation onsite is from invasive exotic flora. Previous land clearing practices and proximity to urban impacts have allowed some light to moderate weed infestation, particularly attributed to edge effects (Figure 12) caused from:

- Historical land use
- Urban development
- Vegetation clearing
- Informal Asset Protection Zone (APZ)

And ongoing disturbances posed by:

- Rural maintenance
- Recreational use
- Tracks
- Green waste dumping

A weeds list of exotic flora encountered onsite and duties under the *Biosecurity Act 2015* are listed in Table 5.

A moderate (11-40%) band of Fishbone Fern (*Nephrolepis cordifolia*) and Buffalo Grass (*Stenotaphrum secundatum*) has spread under native canopy from the adjoining tennis courts and recreational area along the northern boundary impacting native vegetation here.

Areas along the northern and eastern property boundary and southern road alignment generally exhibited Low (1-10%) weed density with only light, scattered Camphor laurel (*Cinnamomum camphora*), Mickey Mouse Plant (*Ochna serrulata*) Lantana (*Lantana camara*), Giant Bird of Paradise (*Strelitzia Nicolai*) and Cocos Palm (*Syagrus romanzoffiana*).

Small infestations of exotic grasses Guinea Grass / Green Panic (*Megathyrsus maximum var. maximum*) and Whisky grass (*Andropogon virginicus*) occur in open disturbed areas and along track edges posing an ongoing management challenge.

Of note, is the occurrence of Green Cestrum (*Cestrum parqui*), a priority weed and considered essential to eradicate. Further, the proliferation of Giant Bird of Paradise (*Strelitzia Nicolai*) across the entire site is of concern but easily managed.

PBA by nature has many interesting and attractive non-endemic native plantings, many of which pose no real risk or issues to the surrounding or onsite native flora. However, we recommend managing and monitoring some problem native species outlined in Table 6. These species have the potential to become invasive to surrounding bushland and can become difficult to manage if ignored (Plates 3 & 4).

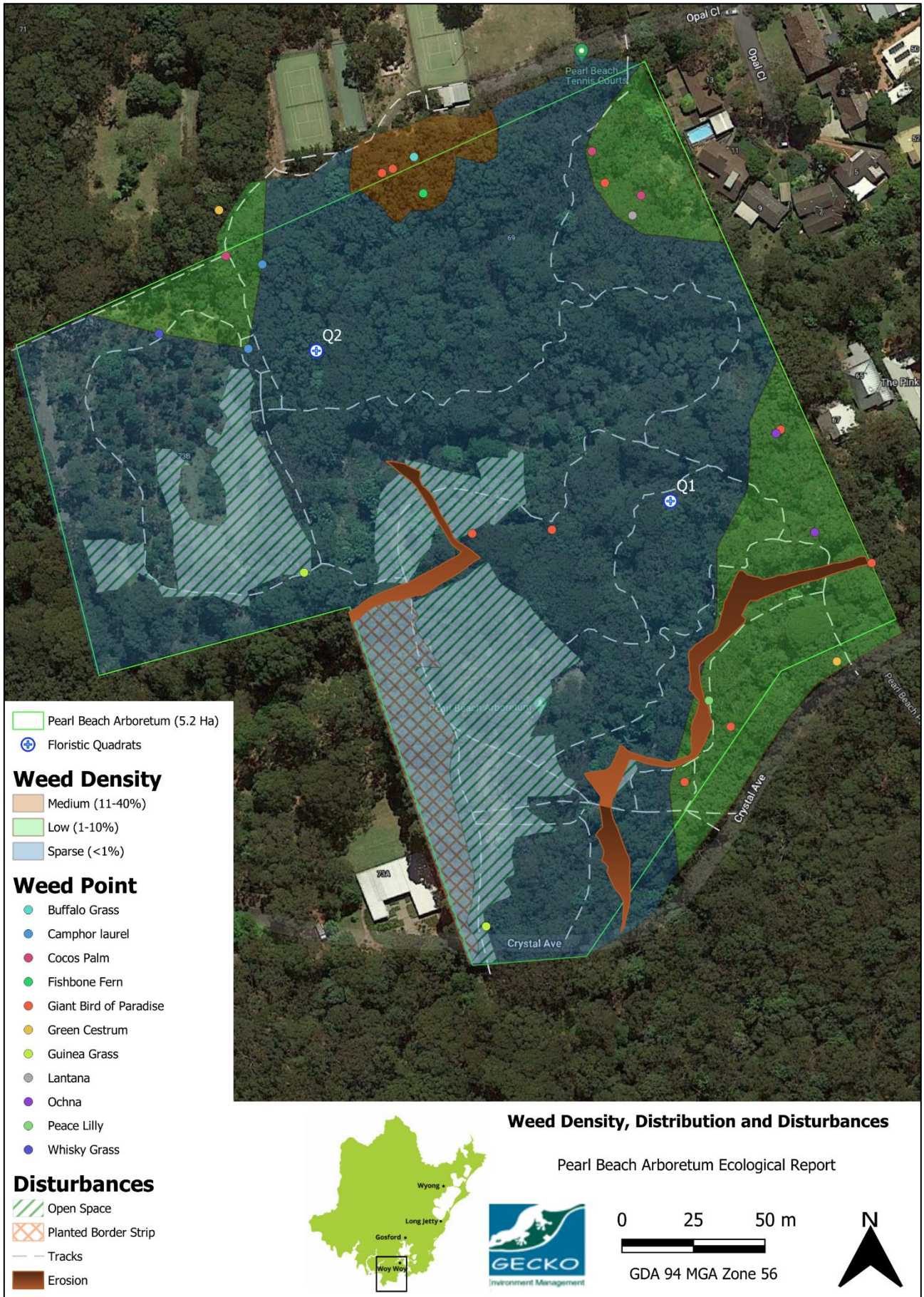


Figure 12: Weed density, distribution and disturbance mapping of Pearl Beach Arboretum

4.1.1 Weed Species List

Exotic weed species found to occur within the site and obligations under the *Biosecurity Act 2015* and *Local Land Services (LLS) Greater Sydney Regional Strategic Weed Management Plan* (NSW Local Land Services, 2017-2022) have been outlined below in Table 5.

Table 5: Weed species list

Growth Form	Common Name	Scientific Name	Regional Weed Management Category	Biosecurity Act 2015	Priority Weed Status
Fern	Fishbone Fern	<i>Nephrolepis cordifolia</i> *	Asset Protection	General Biosecurity Duty (GBD)	
Grass	Whisky grass	<i>Andropogon virginicus</i> *	Asset Protection	General Biosecurity Duty (GBD)	
Grass	Guinea Grass / Green Panic	<i>Megathyrsus maximum var. maximum</i> *	Asset Protection	General Biosecurity Duty (GBD)	
Grass	Buffalo Grass	<i>Stenotaphrum secundatum</i> *	Asset Protection	General Biosecurity Duty (GBD)	
Herb	Peace Lilly	<i>Spathiphyllum sp.</i> *	Asset Protection	General Biosecurity Duty (GBD)	
Herb	Giant Bird of Paradise	<i>Strelitzia nicolai</i> *	Asset Protection	General Biosecurity Duty (GBD)	
Palm	Cocos Palm	<i>Syagrus romanzoffiana</i>	Asset Protection	General Biosecurity Duty (GBD)	
Shrub	Green Cestrum	<i>Cestrum parqui</i> *	Asset Protection	General Biosecurity Duty (GBD)	Regional
Shrub	Lantana	<i>Lantana camara</i> *	Asset Protection	General Biosecurity Duty (GBD)	
Shrub	Mickey Mouse Plant	<i>Ochna serrulata</i> *	Asset Protection	General Biosecurity Duty (GBD)	
Tree	Camphor Laurel	<i>Cinnamomum camphora</i> *	Asset Protection	General Biosecurity Duty (GBD)	

Table 6: Non-endemic problem species list

Family	Common Name	Scientific Name	Management Recommendation
Araucariaceae	Queensland Kauri	<i>Agathis robusta</i>	Monitor Remove new recruitment and smaller specimens
Araucariaceae	Bunya Pine	<i>Araucaria bidwillii</i>	Monitor Remove new recruitment and smaller specimens
Malvaceae	Illawarra Flame Tree	<i>Brachychiton acerifolius</i>	Monitor Remove new recruitment and smaller specimens
Proteaceae	Brown Silky Oak	<i>Darlingia darlingiana</i>	Monitor Remove new recruitment and smaller specimens
Myrtaceae	Tallowood	<i>Eucalyptus microcorys</i>	Monitor Remove new recruitment and smaller specimens
Proteaceae	Silky Oak	<i>Grevillea robusta</i>	Monitor Remove new recruitment and smaller specimens
Myrtaceae	Brush Box	<i>Lophostemon confertus</i>	Monitor Remove new recruitment and smaller specimens



Plate 3: *Darlingia darlingiana* prolific seedling recruitment under mature planted specimen



Plate 4: *Brachychiton acerifolius* recruiting and establishing within PBA

4.2 Threatened Species

No evidence of endemic threatened species was encountered by GEM survey.

Several recent records for *Ninox connivens* (Barking Owl), *Calyptorhynchus lathami latham* (South-eastern Glossy Black-Cockatoo) and *Pseudophryne australis* (Red-crowned Toadlet) have been made within and in close proximity of the site. Unfortunately, no records of *Phascolarctos cinereus* (Koala) have been made since 2002. It is reasonable to assume these species may be transiently present within the site, considering their large home ranges and mobile nature to utilise seasonal nectar, prey resources or habitat values. Many records are recorded in the surrounding Brisbane Water National Park, where biodiversity levels may be higher.

4.3 Significant Habitat

Many vertebrate and invertebrate species rely on hollows as shelter sites, rearing young, feeding, thermoregulation and to facilitate dispersal and ranging behaviour. Generally small hollows with narrow entrances (2-5cm) are suitable for small animals such as Antechinus, feather-tail and sugar glider species and can take upwards of 100 years to form. Medium sized hollows (6-10cm) suitable for larger mammal species (Common ringtail possum, Greater and Yellow-bellied glider) and parrot species can take around 200 years to form. Larger and deeper hollows occupied by Cockatoo and Owl species can take significantly longer with trees requiring at least 220 years of age to produce hollows of this nature. For many of these species hollow use is obligate, and no other habitat resource can be feasibly substituted (Gibbons and Lindenmayer 2002; NPWS 1999).

The probability of a tree containing hollows can be associated with several factors:

- Tree diameter
- Tree form
- Tree species
- Tree age
- Presence of fire scar

Tree age and diameter are correlated and a positive relationship between the presence of hollows and diameter in eucalypts has been reported in many studies – the proportion of trees with hollows increases significantly with diameter (Gibbons, P. and Lindenmayer, D. 2002).

Understanding the current and future hollow tree resource on site is critical in determining any ongoing management actions.

Twenty-five trees of significance, displaying high habitat value were located within PBA (Figures 8 & 9). These trees all have large (>80cm) Diameter at Breast Height (DBH) measurements. As a result, this age class provides essential hollow resources of various size classes and heights facilitating a diverse range of fauna requirements. A summary is provided below in Table 5.

Table 7: Hollow Bearing Trees

Tree ID	Tree Species	Height (m)	Trunk DBH (cm)	Age Class	Current Vigour	Current Form	Tree Origin	Habitat Value	No. Hollows	Type Hollow	H entrance size class (cm)	Height Hollow (m)	Fauna Observed
HBT1	Eucalyptus grandis	32	113	Mature	Excellent	Good	Native	2 Moderate					
HBT2	Eucalyptus grandis	30	103	Mature	Excellent	Good	Native	2 Moderate					
HBT3	Eucalyptus grandis	28	87	Mature	Good	Good	Native	2 Moderate					
HBT4	Eucalyptus grandis	28	93	Mature	Excellent	Good	Native	2 Moderate					
HBT5	Eucalyptus grandis	30	91	Mature	Excellent	Good	Native	2 Moderate					
HBT6	Eucalyptus grandis	30	107	Mature	Good	Good	Native	2 Moderate					
HBT7	Angophora costata	25	99	Mature	Normal	Good	Endemic	3 High	3	Branch End	>20cm Extra large	15	European Honey Bee
HBT8	Angophora costata	28	92	Mature	Good	Good	Endemic	3 High	3	Bayonet	6-10 cm Medium	15	
HBT9	Angophora costata	25	96	Mature	Fair	Average	Endemic	2 Moderate	several	Branch End	2-5 cm Small		
HBT10	Angophora costata	28	104	Mature	Good	Good	Endemic	3 High	several	Branch End	2-5 cm Small		
HBT11	Angophora costata	25	96	Mature	Good	Good	Endemic	2 Moderate					
HBT12	Angophora costata	30	104	Mature	Good	Good	Endemic	3 High	1	Branch Middle	6-10 cm Medium		

HBT13	Eucalyptus piperita	30	135	Mature	Excellent	Good	Endemic	3 High	several	Branch End	2-5 cm Small		
HBT14	Eucalyptus piperita	25	118	Mature	Fair	Average	Endemic	3 High	3	Branch Middle	6-10 cm Medium		
HBT15	Eucalyptus piperita	25	121	Mature	Good	Average	Endemic	3 High	4	Branch End	10-20 cm Large		
HBT16	Eucalyptus piperita	28	141	Mature	Good	Good	Endemic	3 High	3	Branch End	>20cm Extra large	10	
HBT17	Eucalyptus piperita	28	112	Mature	Fair	Average	Endemic	3 High	2	Branch End	>20cm Extra large	12	
HBT18	Eucalyptus piperita	25	91	Mature	Fair	Average	Endemic	3 High	several	Branch End	2-5 cm Small		
HBT19	Eucalyptus piperita	28	105	Mature	Normal	Good	Endemic	2 Moderate					
HBT20	Standing Dead Tree	10	76	Senescent	Dead	Poor	Endemic	3 High	1	Trunk Top	>20cm Extra large	10	
HBT21	Standing Dead Tree	20	107	Senescent	Dead	Poor	Endemic	3 High	3	Branch End	>20cm Extra large	15	
HBT22	Angophora costata	30	132	Mature	Excellent	Good	Endemic	3 High	several	Branch End	10-20 cm Large	15	
HBT23	Angophora costata	28	99	Mature	Excellent	Good	Endemic	3 High	several	Branch End	2-5 cm Small		
HBT24	Standing Dead Tree	30	110	Senescent	Good	Good	Endemic	2 Moderate					
HBT25	Angophora costata	25	184	Mature	Excellent	Good	Endemic	3 High	several	Branch End	2-5 cm Small		

4.4 Dieback / BMAD / Plant diseases

4.5 Encroachment/Dumping

Some small encroachments have been made along the eastern urban interface boundary of the site (Figure 11). These are generally clearing vegetation in the form of rural maintenance and eastern boundary APZ.

Dumping of green waste along the eastern perimeter has previously occurred. Many of the edge effects, weed incursions and exotic species encountered onsite may be attributed to this practice whilst consistently increasing the risk of invasive species and persistently degrading natural assets and community amenity.

4.6 Erosion

Severe erosion has developed within the ephemeral drainage lines (Figure 11) within the site, undermining bank stability and importing significant sediment loads into the creek and discharges below. Evidence of streambank armouring and erosion control is apparent. Recommendations and any remediation works should be in keeping with Section 4.4 Creeks and Wetlands Management Policy - Crommelin Native Arboretum Pearl Beach Draft Management Plan 2022.

4.7 Vertebrate Pests

No vertebrate pests or evidence thereof were opportunistically observed in field survey. However, due to urban proximity the likelihood of some of the following species occurring within the proximity of the site would be considered high.

- Feral dog - *Canis familiaris*
- Black Rat - *Rattus rattus*
- House Mouse - *Mus musculus*
- European Red Fox - *Vulpes vulpes*
- Feral Cat - *Felis catus*.

A targeted survey may need to be employed to accurately determine the presence of any vertebrate pest species.

4.8 Key Weed Species Control Recommendations

Pearl Beach Arboretum occurs within proximity to waterways and sensitive habitat. Contractors must select herbicides that are currently approved by the Australian Pesticide and Veterinary Medicines Authority (APVMA). The application of herbicides must be done in strict accordance with current CCC policy, the herbicide label and Safety Data Sheet (SDS) and any permit pertaining to herbicide application.

Table 8: Key Weed Species Control Recommendations

As recommended by [NSW Department of Primary Industries \(DPI\)](#) under off label PERMIT 9907 and herbicide options current at time of writing.

Scientific Name	Common Name	Physical Methods	Chemical Methods	Herbicide Options
<i>Cestrum parqui</i>	Green cestrum	<p>All parts of this green cestrum are poisonous. Wear gloves and other protective clothing when handling the plant.</p> <p>To tackle green cestrum: treat mature plants in early spring, before they flower</p> <ul style="list-style-type: none"> control regrowth from treated plants look for and kill new seedlings in autumn use mulches and revegetate to suppress seedlings keep checking for new seedlings for many years because seeds can lie dormant. <p>Early detection Destroy new infestations before they flower and produce berries.</p> <p>Competition Planting and maintaining vigorous dense pasture can suppress green cestrum seedlings.</p> <p>Hand removal Small seedlings can be pulled out or dug up. Ensure all parts of the plant, including the roots, are removed.</p> <p>Mechanical removal Repeated cutting down, digging or pushing out by mechanical equipment will control green cestrum. Remove and destroy all the yellow roots to prevent regrowth.</p> <p>Disposal The roots can be burnt. In urban areas contact your local council for advice on disposal. Keep stock away from dead plant material as it remains poisonous.</p>	<p>Chemical control Treat actively growing plants. Early spring for mature plants, autumn for new seedlings. Keep stock away from treated plants until the leaf material has disintegrated. The plants are still poisonous and the treatment makes the plant more palatable so stock are more likely to eat it.</p> <p>Spraying Spray actively growing plants. Various herbicides can be used for different sized plants. See details below and label conditions.</p> <p>Basal barking Basal bark application can be used for plants with stems up to 5 cm diameter at the base. Ensure the stems are dry before treating. Liberally spray the bark around the stem from ground level to 30 cm high, wetting thoroughly to the point of runoff.</p> <p>Cut stump Liquid herbicide mix: Stems should be cut less than 15 cm above the ground. Apply herbicide mixture to the cut surface and the sides of the stem immediately.</p> <p>Gel herbicide: Cut stems horizontally preferably no higher than 10 cm above the ground. Apply a 3–5 mm layer of gel for stems less than 20 mm and 5 mm layer on stems above 20 mm .</p> <p>Cut scrape and paint. Cut the stems and scrape a thin layer of bark of the sides of the stems. Apply the herbicide mix to the cut and scraped sections within 15 seconds.</p>	<p>Glyphosate 360 g/L (Various products) Rate: 1 part glyphosate to 1.5 parts water Comments: Cut, scrape and paint. See permit for additional conditions.</p> <p>Glyphosate 360 g/L (Various products) Rate: 1 part glyphosate to 50 parts water Comments: Spot spray. See permit for additional conditions.</p> <p>Picloram 44.7 g/L + Aminopyralid 4.47 g/L (Vigilant II ®) Rate: Undiluted Comments: Cut stump application: Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm .</p>
<i>Cinnamomum camphora</i>	Camphor Laurel	<p>Physical removal When: year-round, after rain when soil is moist. Seedlings can be hand-pulled. Smaller plants are more difficult to remove as the stems are more likely to</p>	<p>Chemical control Chemical control is an effective way of controlling existing infestations. Herbicides can control trees without the need to disturb soil or other vegetation.</p>	<p>Glyphosate 360 g/L (Various products) Rate: Undiluted glyphosate Comments: Stem injection application.</p>

		break from the root system when pulled, leaving viable root segments capable of regeneration.	In areas to be cleared, prior herbicide control allows easy removal of the dead stumps and hastens the revegetation process. Effective control of camphor laurel can be achieved by using either the stem injection, basal bark or foliar spray application techniques. The method used depends on the site situation, tree size, access and personal preferences.	
<i>Lantana camara</i>	Lantana	<p>Physical removal When: year-round, after rain when soil is moist. Follow-up: within 3 to 6 months. Hand pulling can work on small infestations, isolated plants and in steep areas that machinery cannot access. The best time is after rain when the soil is moist. Wear gloves when hand pulling. Grub out roots with a mattock or hoe, then roll and haul the stems and roots away. Remove the roots and stems or the lantana will regrow.</p>	<p>Spraying Small plants less than 2 m can be sprayed at any time of the year as long as they are actively growing. Stressed plants don't take up much herbicide. Treat regrowth from burning, cutting, slashing or frost when plants are 30 cm to 1 m high. Spray mature lantana (>2 m high) between February and the first frost. Early morning or late afternoon is the best time to spray during Autumn.</p> <p>Gas or splatter-gun Splatter-guns use small amounts of highly concentrated herbicide. A five-litre bottle of mixed herbicide should cover about 0.2 hectares of lantana. The splatter gun:</p> <ul style="list-style-type: none"> works best on dense infestations at least 300 mm high limits off-target plant damage is good for hard-to-access and steep areas can be used year-round if plants are actively growing, but works best during summer is cheaper than traditional foliar spray methods. <p>Cut stump method Cut stems off at about 15 cm from the ground. Apply herbicide to the cut surface of the stump within 15 seconds. Treat every cut stem because lantana regrows vigorously from untreated stems.</p>	<p>Glyphosate 360 g/L (Various products) Rate: 1.0 L per 100 L of water Comments: Actively growing with full foliage. Avoid summer stress.</p> <p>Glyphosate 360 g/L (Various products) Rate: 1 part per 9 parts water Comments: Gas gun / Splatter gun application. Apply 2 x 2 mL doses per 0.5 m of bush height</p> <p>Glyphosate 360 g/L with Metsulfuron-methyl 600 g/kg (Various products) Rate: 10 g metsulfuron-methyl plus 200 mL glyphosate per 100 L of water Comments: Apply to bushes up to 2 m high. Thoroughly wet all foliage and stems. Add organosilicone penetrant.</p>
<i>Nephrolepis cordifolia</i>	Fishbone fern	<p>Control Fishbone fern is a native plant. Control may not be appropriate in some areas with native vegetation.</p> <p>If control is required it can be hand pulled, dug up or sprayed with herbicides.</p> <p>Control can be difficult and time consuming because:</p>	<p>Chemical control Fishbone fern can be spot sprayed. Plants are often hard to kill with herbicides so follow up with inspections and re-treat if necessary.</p>	<p>Glyphosate 360 g/L with Metsulfuron-methyl 600 g/kg (Various products) Rate: 200 mL glyphosate plus 1.5 g metsulfuron-methyl per 10 L of water Comments: Knapsack spot spray.</p>

it has a hardy root system
plants don't respond well to herbicides.
Sites should be revisited and several control attempts
may be needed.

Physical removal

Manual removal of isolated, small seedlings can be
attempted by hand pulling or digging them up. This is
only practical for a small number of plants.

**It is important to remove the whole root system if
possible, otherwise the plant can regrow.**

4.9 Conducting rehabilitation works in an EEC

Whilst the intention of bush regeneration works within an EEC is clearly to improve and not harm the community, such works create the potential for accidental harm to occur. To minimise risk of harm to a threatened species or EEC or their habitat, a site-specific environmental assessment will be prepared in accordance with Part 5 of the Environmental Planning and Assessment Act. All parties undertaking works on site must be briefed on the assessment and implement required mitigation measures. Parties undertaking works on site must ensure compliance with all relevant legislation and licensing obligations. All works should be carried out after first ensuring compliance with the issues raised within the *Checklist For Bush Regeneration Activities In The Habitat Of Threatened Species, Endangered Populations And Endangered Ecological Communities* available from the DECCW website (Appendix 5).

5. Monitoring

5.1 Contractor monitoring

Effective monitoring of contractor works, and resultant site conditions are important for many reasons. Progress of rehabilitation works can be slow, staff within council and contractors can change and memories of initial site conditions may be inaccurate. Monitoring can also assist in:

- Adaptive management
- Determining the effectiveness of chosen techniques,
- Responding to unforeseen impacts or issues on site
- Assisting in attracting future funding
- Contributing to the scientific understanding of environmental management

Additionally, the following monitoring techniques are recommended for works within this site:

- Photo monitoring points
These have been established in conjunction with this plan and at the commencement of previous works with before and after and progress photos taken six monthly or at major milestones such as when conducting significant primary weed removal, plantings or installation of erosion controls. Locations have been recorded with a grid reference and marked in the field with a capped and tagged star picket.
- Daily site records
to record works carried out, seed collection, planting species, numbers, locations, hours worked etc.
- Records of all significant flora and fauna sightings
Threatened species should be notified to Council and PBA and records lodged with the NSW Wildlife Atlas.

References

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Appendix 1: BioNet Threatened Flora Species Search Results

Class	Scientific Name	Common Name	NSW status	Comm. status	Records
Flora	<i>Astrotricha crassifolia</i>	Thick-leaf Star-hair	V	V	64
Flora	<i>Chamaesyce psammogeton</i>	Sand Spurge	E1		2
Flora	<i>Maundia triglochinooides</i>		V		1
Flora	<i>Callistemon linearifolius</i>	Netted Bottle Brush	V,3		60
Flora	<i>Darwinia glaucophylla</i>		V		2
Flora	<i>Micromyrtus blakelyi</i>		V	V	1
Flora	<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	E1	V	7
Flora	<i>Grevillea shiressii</i>		V	V	1
Flora	<i>Macadamia integrifolia</i>	Macadamia Nut		V	3

NSW Biodiversity and Conservation Act 2016

P: Protected, P 13: Protected Native Plants, V: Vulnerable, E1: Endangered, E2: Endangered Population, E4: Extinct, E4A: Critically Endangered Species, FCE: Critically Endangered Fish Species, FE: Endangered Fish Species, FP: Protected Fish Species, FV: Vulnerable Fish Species, FX: Extinct Fish Species, FEP: Endangered Population Of Fish, FKTP: Key Threatening Process of Fish, 2: Category 2 Sensitive Species, 3: Category 3 Sensitive Species

Commonwealth Environment Protection and Biodiversity Conservation Act 1999

C: CAMBA, CD: Conservation Dependant, CE: Critically Endangered E: Endangered, J: JAMBA, K: ROKAMBA, KTP: Key Threatening Process, V: Vulnerable, X: Extinct, XW: Extinct in the Wild

Sensitivity Class

Denatured records will be flagged with:

^^ - coordinates rounded to 0.01°

^ - coordinates rounded to 0.1°

Appendix 2: BioNet Threatened Fauna Species Search Results

Class	Scientific Name	Common Name	NSW status	Comm. status	Records
Amphibia	<i>Pseudophryne australis</i>	Red-crowned Toadlet	V,P		119
Amphibia	<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V,P	V	98
Amphibia	<i>Litoria aurea</i>	Green and Golden Bell Frog	E1,P	V	4
Reptilia	<i>Varanus rosenbergi</i>	Rosenberg's Goanna	V,P		1
Aves	<i>Ptilinopus regina</i>	Rose-crowned Fruit-Dove	V,P		1
Aves	<i>Ptilinopus superbis</i>	Superb Fruit-Dove	V,P		5
Aves	<i>Hirundapus caudacutus</i>	White-throated Needletail	P	V,C,J,K	9
Aves	<i>Ixobrychus flavicollis</i>	Black Bittern	V,P		1
Aves	<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	V,P		83
Aves	<i>Hieraetus morphnoides</i>	Little Eagle	V,P		3
Aves	<i>Lophoictinia isura</i>	Square-tailed Kite	V,P,3		2
Aves	<i>Pandion cristatus</i>	Eastern Osprey	V,P,3		9
Aves	<i>Burhinus grallarius</i>	Bush Stone-curlew	E1,P		178
Aves	<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	V,P		1
Aves	<i>Haematopus longirostris</i>	Pied Oystercatcher	E1,P		31
Aves	<i>Numenius madagascariensis</i>	Eastern Curlew	P	CE,C,J,K	9
Aves	<i>Onychoprion fuscatus</i>	Sooty Tern	V,P		2
Aves	<i>Sternula albifrons</i>	Little Tern	E1,P	C,J,K	3
Aves	<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V,P,3	E	1
Aves	<i>^Calyptorhynchus lathami lathami</i>	South-eastern Glossy Black-Cockatoo	V,P,2	V	144
Aves	<i>Glossopsitta pusilla</i>	Little Lorikeet	V,P		6
Aves	<i>Lathamus discolor</i>	Swift Parrot	E1,P	CE	13
Aves	<i>Neophema pulchella</i>	Turquoise Parrot	V,P,3		10
Aves	<i>Ninox connivens</i>	Barking Owl	V,P,3		32
Aves	<i>Ninox strenua</i>	Powerful Owl	V,P,3		188
Aves	<i>Tyto novaehollandiae</i>	Masked Owl	V,P,3		12
Aves	<i>Tyto tenebricosa</i>	Sooty Owl	V,P,3		2
Aves	<i>^Dasyornis brachypterus</i>	Eastern Bristlebird	E1,P,2	E	1
Aves	<i>^Anthochaera phrygia</i>	Regent Honeyeater	E4A,P,2	CE	4
Aves	<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)	V,P		1
Aves	<i>Daphoenositta chrysoptera</i>	Varied Sittella	V,P		5
Aves	<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	V,P		22
Aves	<i>Petroica boodang</i>	Scarlet Robin	V,P		6
Aves	<i>Petroica phoenicea</i>	Flame Robin	V,P		2
Mammalia	<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V,P	E	24
Mammalia	<i>Isoodon obesulus obesulus</i>	Southern Brown Bandicoot (eastern)	E1,P	E	24

Mammalia	<i>Phascolarctos cinereus</i>	Koala	E1,P	E	138
Mammalia	<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V,P		12
Mammalia	<i>Petaurus norfolcensis</i>	Squirrel Glider	V,P		2
Mammalia	<i>Petauroides volans</i>	Southern Greater Glider	E1,P	E	1
Mammalia	<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V,P	V	127
Mammalia	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V,P		3
Mammalia	<i>Micronomus norfolkensis</i>	Eastern Coastal Free-tailed Bat	V,P		6
Mammalia	<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V,P	V	3
Mammalia	<i>Myotis macropus</i>	Southern Myotis	V,P		6
Mammalia	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V,P		5
Mammalia	<i>Vespadelus trougtoni</i>	Eastern Cave Bat	V,P		4
Mammalia	<i>Miniopterus australis</i>	Little Bent-winged Bat	V,P		10
Mammalia	<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat	V,P		17
Mammalia	<i>Pseudomys gracilicaudatus</i>	Eastern Chestnut Mouse	V,P		2
Mammalia	<i>Pseudomys novaehollandiae</i>	New Holland Mouse	P	V	1
Insecta	<i>Petalura gigantea</i>	Giant Dragonfly	E1		2
Gastropoda	<i>Meridolum maryae</i>	Maroubra Woodland Snail	E1		1

NSW Biodiversity and Conservation Act 2016

P: Protected, P 13: Protected Native Plants, V: Vulnerable, E1: Endangered, E2: Endangered Population, E4: Extinct, E4A: Critically Endangered Species, FCE: Critically Endangered Fish Species, FE: Endangered Fish Species, FP: Protected Fish Species, FV: Vulnerable Fish Species, FX: Extinct Fish Species, FEP: Endangered Population Of Fish, FKTP: Key Threatening Process of Fish, 2: Category 2 Sensitive Species, 3: Category 3 Sensitive Species

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Sensitivity Class

Denatured records will be flagged with:

^^ - coordinates rounded to 0.01°

^ - coordinates rounded to 0.1°

Appendix 3: Protected Matters Threatened Species Search Results

Scientific Name	Common Name	Class	Simple Presence	Presence Text	Threatened Category	Migratory Category
<i>Lathamus discolor</i>	Swift Parrot	Bird	Known	Species or species habitat known to occur within area	Critically Endangered	
<i>Calidris ferruginea</i>	Curlew Sandpiper	Bird	Known	Species or species habitat known to occur within area	Critically Endangered	Migratory Wetlands Species
<i>Anthochaera phrygia</i>	Regent Honeyeater	Bird	Known	Species or species habitat known to occur within area	Critically Endangered	
<i>Numenius madagascariensis</i>	Eastern Curlew, Far Eastern Curlew	Bird	Likely	Species or species habitat likely to occur within area	Critically Endangered	Migratory Wetlands Species
<i>Rostratula australis</i>	Australian Painted Snipe	Bird	Likely	Species or species habitat likely to occur within area	Endangered	
<i>Botaurus poiciloptilus</i>	Australasian Bittern	Bird	Known	Species or species habitat known to occur within area	Endangered	
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	Bird	Likely	Species or species habitat likely to occur within area	Endangered	
<i>Calidris canutus</i>	Red Knot, Knot	Bird	May	Species or species habitat may occur within area	Endangered	Migratory Wetlands Species
<i>Hirundapus caudacutus</i>	White-throated Needletail	Bird	Known	Species or species habitat known to occur within area	Vulnerable	Migratory Terrestrial Species
<i>Grantiella picta</i>	Painted Honeyeater	Bird	Likely	Species or species habitat likely to occur within area	Vulnerable	
<i>Pycnoptilus floccosus</i>	Pilotbird	Bird	May	Species or species habitat may occur within area	Vulnerable	
<i>Limosa lapponica baueri</i>	Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit	Bird	Known	Species or species habitat known to occur within area	Vulnerable	
<i>Sternula nereis nereis</i>	Australian Fairy Tern	Bird	May	Species or species habitat may occur within area	Vulnerable	
<i>Charadrius leschenaultii</i>	Greater Sand Plover, Large Sand Plover	Bird	Likely	Species or species habitat likely to occur within area	Vulnerable	Migratory Wetlands Species
<i>Erythrotriorchis radiatus</i>	Red Goshawk	Bird	May	Species or species habitat may occur within area	Vulnerable	
<i>Falco hypoleucos</i>	Grey Falcon	Bird	May	Species or species habitat may occur within area	Vulnerable	
<i>Calyptorhynchus lathami lathami</i>	South-eastern Glossy Black-Cockatoo	Bird	Known	Species or species habitat known to occur within area	Vulnerable	
<i>Macquaria australasica</i>	Macquarie Perch	Fish	May	Species or species habitat may occur within area	Endangered	
<i>Prototroctes maraena</i>	Australian Grayling	Fish	May	Species or species habitat may occur within area	Vulnerable	
<i>Mixophyes iteratus</i>	Giant Barred Frog, Southern Barred Frog	Frog	Likely	Species or species habitat likely to occur within area	Vulnerable	
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	Frog	Likely	Species or species habitat likely to occur within area	Vulnerable	
<i>Mixophyes balbus</i>	Stuttering Frog, Southern Barred Frog (in Victoria)	Frog	Likely	Species or species habitat likely to occur within area	Vulnerable	
<i>Litoria aurea</i>	Green and Golden Bell Frog	Frog	Likely	Species or species habitat likely to occur within area	Vulnerable	
<i>Dasyurus maculatus maculatus (SE mainland population)</i>	Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population)	Mammal	Known	Species or species habitat known to occur within area	Endangered	
<i>Petauroides volans</i>	Greater Glider (southern and central)	Mammal	Known	Species or species habitat known to occur within area	Endangered	
<i>Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)</i>	Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory)	Mammal	Known	Species or species habitat known to occur within area	Endangered	

<i>Potorous tridactylus tridactylus</i>	Long-nosed Potoroo (northern)	Mammal	Likely	Species or species habitat likely to occur within area	Vulnerable
<i>Notamacropus parma</i>	Parma Wallaby	Mammal	Likely	Species or species habitat likely to occur within area	Vulnerable
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	Mammal	Known	Foraging, feeding or related behaviour known to occur within area	Vulnerable
<i>Petaurus australis australis</i>	Yellow-bellied Glider (south-eastern)	Mammal	Known	Species or species habitat known to occur within area	Vulnerable
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat, Large Pied Bat	Mammal	Likely	Species or species habitat likely to occur within area	Vulnerable
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	Mammal	May	Species or species habitat may occur within area	Vulnerable
<i>Pseudomys novaehollandiae</i>	New Holland Mouse, Pookila	Mammal	Likely	Species or species habitat likely to occur within area	Vulnerable
<i>Rhodamnia rubescens</i>	Scrub Turpentine, Brown Malletwood	Plant	Known	Species or species habitat known to occur within area	Critically Endangered
<i>Rhodomyrtus psidioides</i>	Native Guava	Plant	Known	Species or species habitat known to occur within area	Critically Endangered
<i>Prostanthera askania</i>	Tranquillity Mintbush, Tranquillity Mintbush	Plant	May	Species or species habitat may occur within area	Endangered
<i>Rhizanthella slateri</i>	Eastern Underground Orchid	Plant	May	Species or species habitat may occur within area	Endangered
<i>Cynanchum elegans</i>	White-flowered Wax Plant	Plant	Likely	Species or species habitat likely to occur within area	Endangered
<i>Genoplesium baueri</i>	Yellow Gnat-orchid, Bauer's Midge Orchid, Brittle Midge Orchid	Plant	Likely	Species or species habitat likely to occur within area	Endangered
<i>Rutidosia heterogama</i>	Heath Wrinklewort	Plant	May	Species or species habitat may occur within area	Vulnerable
<i>Eucalyptus camfieldii</i>	Camfield's Stringybark	Plant	Likely	Species or species habitat likely to occur within area	Vulnerable
<i>Tetradlea juncea</i>	Black-eyed Susan	Plant	Known	Species or species habitat known to occur within area	Vulnerable
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry	Plant	Likely	Species or species habitat likely to occur within area	Vulnerable
<i>Cryptostylis hunteriana</i>	Leafless Tongue-orchid	Plant	Likely	Species or species habitat likely to occur within area	Vulnerable
<i>Diuris praecox</i>	Newcastle Doubletail	Plant	Likely	Species or species habitat likely to occur within area	Vulnerable
<i>Melaleuca deanei</i>	Deane's Melaleuca	Plant	May	Species or species habitat may occur within area	Vulnerable
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	Plant	Known	Species or species habitat known to occur within area	Vulnerable
<i>Caladenia tessellata</i>	Thick-lipped Spider-orchid, Daddy Long-legs	Plant	Likely	Species or species habitat likely to occur within area	Vulnerable
<i>Acacia bynoeana</i>	Bynoe's Wattle, Tiny Wattle	Plant	May	Species or species habitat may occur within area	Vulnerable
<i>Thesium australe</i>	Austral Toadflax, Toadflax	Plant	Likely	Species or species habitat likely to occur within area	Vulnerable
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	Reptile	May	Species or species habitat may occur within area	Vulnerable

Appendix 4: Protected Matters Threatened Ecological Community Search Results

Community Name	Threatened Category	Presence Rank
Coastal Swamp Oak (<i>Casuarina glauca</i>) Forest of New South Wales and South East Queensland ecological community	Endangered	Community may occur within area
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	Critically Endangered	Community likely to occur within area
Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland	Endangered	Community likely to occur within area

Appendix 5: Floristic Quadrat Indicative Vegetation

ID	North	East	South	West
Q1				
Q2				

Appendix 6: NPWS Checklist For Bush Regeneration In Threatened Species Habitat or a Threatened Ecological Community

Please Note:

- 1) The checklist is provided to facilitate licence applications and to draw attention to NPWS issues of concern.
- 2) There is no requirement to use the checklist when applying for a licence. You may alternatively choose to provide details of your project and an explanation of how you will ensure there will not be a significant impact on threatened species, their habitat or on endangered ecological communities.
- 3) If you provide a negative answer using the checklist this does not necessarily mean your application will be unsuccessful. You will however need to provide a satisfactory explanation as to why you do not wish to comply with the guideline and how you will ensure there is unlikely to be a significant impact on threatened species, their habitat or on endangered ecological communities.
- 4) You may wish your licence application to cover the collection of Voucher Herbarium Specimens and Plant Material for Identification. Guidelines to cover those activities are also attached.

Management Planning:	yes	no	more info attached
The proposed activities will be in accordance with a management plan or site plan (map). <i>Please attach the plan or relevant sections of the plan or strategy to the licence application.</i>			
The project has been discussed with the relevant Landcare coordinator. <i>If not, provide details of any other professional advice you have sought, e.g. from a qualified bush regenerator.</i>			
A NPWS Wildlife Atlas database search of a 5km radius of the site has been undertaken to identify threatened flora/fauna species known or likely to occur on the site. <i>The Wildlife Atlas is accessible on the NPWS Web Site www.nationalparks.nsw.gov.au.</i>			
Prior to commencing any works on site, a permit or permission will be obtained from the relevant landowner(s) or land manager(s).			
Training and supervision:			
All workers carrying out bush regeneration and associated works will be supervised by a trained and experienced co-ordinator who has completed a recognised bush regeneration course (e.g. the Certificate of Bushland Regeneration) or a minimum of 2 years bush regeneration experience. <i>If 'yes', please provide below the name and qualifications of the co-ordinator.</i> Name: Qualifications/experience:.....			
Other members of the group that have bush regeneration training or experience. Name: Qualifications/experience: Name: Qualifications/experience:..... Name: Qualifications/experience:..... Name: Qualifications/experience:..... Name: Qualifications/experience:.....			
All activities by workers will be regularly checked and approved by the co-ordinator.			
All workers will be informed of any threatened species or endangered ecological communities known from the area or which may occur in the area and the potential impacts of activities on these species/communities. <i>e.g. vines on the edge of a littoral rainforest remnant may protect the remnant from salt-bearing winds.</i>			
All workers have adequate weed and native plant identification skills. <i>i.e. all workers can identify and differentiate between weeds and native plants that occur on the site.</i>			

	yes	no	more info attached
Workers will be familiar with the identifying features of threatened flora that are known or likely to occur in the project area. Where threatened species known from the area are similar to weed species, the distinguishing features between these will be understood prior to commencing the work.			
Access to sites			
All vehicular access to sites will be restricted to formed roads.			
Unnecessary damage to sites will be avoided. <i>e.g. avoid working in wet weather to lessen soil compaction.</i>			
To reduce the possibility of introducing plant diseases and weeds the following measures will be applied: 1. Secateurs will be sharp and cleaned with methylated spirits. 2. Footwear will be cleaned of loose soil and preferably treated with bleach between sites.			
Impacts on flora:			
Prior to any works being undertaken, the presence or absence of threatened flora will be determined by a thorough walking search of the area.			
All threatened flora will be tagged with highly visible flagging tape before work commences. If a number of individuals occur in a clump, the area should be marked out with flagging tape.			
Cutting or damaging of threatened flora will be avoided.			
All plants will be positively identified before they are removed (pulled, cut, poisoned etc).			
Weed removal within 2m of a threatened species will be undertaken by hand.			
Impacts on fauna:			
All workers will be aware of any threatened fauna that are known or likely to occur on site, and the potential impacts of the proposed activities on those species.			
The habitat and refuge potential of weeds and rubbish will be considered prior to removal. <i>e.g. Lantana can provide cover for threatened fauna such as the Bush-hen. Dead Lantana and poisoned Camphor Laurels should, where possible, be left in situ.</i>			
Weeds will be removed gradually in areas where an infestation is extensive. <i>Ideally, 50% of weeds that may provide habitat should be left until native plant species have re-established and provide alternative refuge.</i>			
Disturbance to, and removal of rocks, logs and other potential refuge sites will be avoided.			
A herbicide registered for use near waterways will be used within 5m of waterways.			
Herbicide spraying will be restricted to a distance greater than 5 metres from watercourses where threatened frogs are known or likely to occur and within a 10m radius of records of threatened frogs.			
A buffer of 1m along other watercourses will be maintained in which no herbicide will be sprayed.			
Care will be taken to minimise disturbance to shy or cryptic species. <i>e.g. the Marbled Frogmouth roosts in vine 'curtains'.</i>			
Care will be taken to minimise disturbance to the leaf litter layer.			
Reconstruction through revegetation: This section does <i>not</i> address propagation or planting of threatened species – this activity would need to be separately addressed.			
Seed collection or cuttings will be from species, populations or ecological communities other than those listed as threatened (unless licensed by NPWS).			
Prior to collecting any seed or cuttings permission will be obtained from the relevant landholder or manager of the site. <i>eg a licence is required to collect native plants on National Parks estate.</i>			
Seed collection from any one species will be limited to less than 10% of the available crop at that site.			
Seed collection from any individual plant will be limited to less than 10% of the available crop.			

	yes	no	more info attached
If your seed source is used by other seed collectors, has consideration been given to minimising any cumulative impacts to the source plants? <i>Some individual plants are known as a reliable seed source and their seed is collected extensively. This may result in – (i) a reduction in genetic diversity); (ii) an impediment to the individual's natural ability to regenerate.</i>			
When collecting propagation material from a wild population, collection will be random from as many individuals as possible across the population to ensure a representative range of genetic material is collected. Collectors will avoid selection of propagation material on the basis of physical attributes. <i>e.g. tallest, most attractive, greatest amount of seed or flowers.</i>			
Plantings will be sourced from stock of local provenance.*			
Will propagated material collected only be used at the subject site? <i>i.e. excess material will only be used at other sites if it meets the provenance criteria.</i>			
A buffer of 5 metres will be maintained around all threatened plant specimens. Planting will only be undertaken outside this buffer. <i>This requirement is intended to protect the roots of the threatened plant from damage or introduction of disease.</i>			
Care will be taken to ensure that mulch does not introduce weeds or impede natural regeneration at the site.			
Care will be taken to ensure that weeds and/or phytophthora are not introduced to a site from pots of cultivated plants.			
Consideration will be given to the possible impacts of plantings on the ecological requirements of threatened species at the site <i>e.g. reduced light, competition, etc.</i>			
Species will be planted within their natural habitat and range. Plantings will be guided by the plants' local habitat preferences. <i>e.g. the species used for plantings along watercourses should be those that naturally occur in that habitat in your local area.</i>			
Herbicide use: <i>A permit from the National Registration Authority for Agricultural and Veterinary Chemicals PO Box E240, Kingston ACT 2604 may be required for herbicide use that is not consistent with conditions specified on the label.</i>			
A buffer of 2m will be maintained around all threatened plant specimens. Herbicide use will only be undertaken outside this buffer.			
Herbicide use will cease where there are any signs of threatened species being affected by herbicide. <i>e.g. browning off, wilting, deformed growth.</i>			
All herbicide spray operators will be capable of undertaking precise and effective weed control.			
Spray will be directed away from threatened flora.			
Herbicide will only be sprayed in suitable weather conditions when the impact of spray drift (windy) or run-off (wet) on threatened flora is minimised.			
Marker dyes <i>e.g. white field marker</i> will be mixed with herbicide before use. <i>Marker dye enables the worker to see where the spray is landing.</i>			
Reporting and data records:			
Any new records of threatened species will be provided within three months to NPWS. These records will be in a format appropriate for entry into the Wildlife Atlas, once identification of a threatened species is confirmed by a recognised authority. <i>Wildlife Atlas cards available on request.</i>			

*Local provenance species should be regarded as those species propagated from material that has been collected from a natural wild population as close as possible to a site. For example, within the local catchment – which may be based on a local creek.

