Appendix B: Fauna and Flora Surveys (including fauna and flora of conservation significance)

AUTHOR - Epacris Environmental Consultants[1]

Fauna Survey

Existing Records

Several threatened fauna species have previously been recorded at this site. They are:

Species	TSC Act (1995)	EPBC Act (1999)
Powerful Owl *(Ninox strenua)*	Vulnerable	-
Grey-headed Flying Fox *(Pteropus poliocephalus)*	Vulnerable	Vulnerable
Eastern Bentwing Bat *(Miniopterus schreibersii oceanensis)*	Vulnerable	-
Spotted-tailed Quoll *(Dasyurus maculatus)*	Vulnerable	Endangered
Superb Fruit Dove *(Ptilinopus superbus)*	Vulnerable	-

In addition several threatened fauna species have been recorded within a few kilometres of the site, and may occur on site. These include:

Species	TSC Act (1995)	EPBC Act (1999)
Koala (*Phascolartcos cinereus*)	Vulnerable	-
Red-crowned Toadlet (*Pseudophryne australis)*	Vulnerable	-
Rosenberg's Goanna (*Varanus rosenbergi)*	Vulnerable	-
Glossy Black Cockatoo *(Calyptorhynchus lathami)*	Vulnerable	-
Scarlet Robin *(Petroica boodang) (species)*	Vulnerable	-

Survey

A comprehensive fauna survey was undertaken along the proposed track route at this site. This fauna survey followed guidelines outlined within the *Threatened Species Survey and Assessment: Guidelines for developments and activities (DEC, 2004).* Multiple survey techniques reflecting the species targeted, were utilized during this survey. As much as possible, all survey techniques and sites were designed so as to be repeatable in any future surveys. Full details of survey techniques used are included.

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No survey, unless carried out over many seasons and years, will detect all the species located within an area, therefore there is potential for other threatened fauna species to be present within the area that was not picked up during this survey.

Where re-routing around significant fauna species or habitats was required, alternate route surveys were conducted to ensure the suitability of new track alignments.

Fauna Survey Results

The fauna survey detected along the proposed track route, a total of 35 or 36, check bird species, 18 Mammal species (5 feral sp.) and 13 reptile and amphibian species. These are all listed below:

Common Name	Scientific Name	TSC Act	EPBC Act
Brush Turkey	*Alectura lathami*	P	
Masked Lapwing	*Vanellus miles*	P	
Little Eagle	*Hieraaetus morphnoides*	P	
Collared Sparrowhawk	*Accipiter cirrocephalus*	P	
Nankeen Kestrel	*Falco cenchroides*	P	
Yellow-tailed Black Cockatoo	*Calyptorhynchus funereus*	P	
Sulphur-crested Cockatoo	*Cacatua galerita*	P	
Rainbow lorikeet	*Trichoglossus haematodus*	P	
Fantail Cuckoo	*Cacomantis flabelliformis*	P	
Shining Bronze Cuckoo	*Chalcites lucidus*	P	
Boobook Owl	*Ninox novaeseelandiae*	P	
White-throated Nightjar	*Eurostopodus mystacalis*	P	
Laughing Kookaburra	*Dacelo novaeguineae*	P	
Sacred Kingfisher	*Todiramphus sanctus*	P	
White-throated Treecreeper	*Cormobates leucophaea*	P	
Spotted Pardalote	*Pardalotus punctatus*	P	
White-browed Scrubwren	*Sericornis frontalis*	P	
Chestnut-rumped Heathwren	*Calamanthus pyrrhopygius*	P	
Brown Gerygone	*Gerygone mouki*	P	
Brown Thornbill	*Acanthiza pusilla*	P	
Striated Thornbill	*Acanthiza lineata*	P	
Red Wattlebird	*Anthochaera carunculata*	P	
White-cheeked honeyeater	*Phylidonyris niger*	P	
New Holland Honeyeater	*Phylidonyris novaehollandiae*	P	
Eastern Spinebill	*Acanthorhynchus tenuirostris*	P	
Eastern Whipbird	*Psophodes olivaceus*	P	
Crested Shrike-tit	*Falcunculus frontatus*	P	
Grey Shrike-thrush	*Colluricincla harmonica*	P	
Golden Whistler	*Pachycephala pectoralis*	P	
Grey Fantail	*Rhipidura albiscapa*	P	

Black-faced Monarch	*Monarcha melanopsis*	P	
Magpie	*Gymnorhina tibicen*	P	
Pied Currawong	*Strepera graculina*	P	
Australian Raven	*Corvus coronoides*	P	
Red-browed Finch	*Neochmia temporalis*	P	
Silvereye	*Zosterops lateralis*	P	

Mammals

Common Name	Scientific Name	TSC Act	EPBC Act
Swamp wallaby	*Wallabia bicolor*	P	
Sugar Glider	*Petaurus breviceps*	P	
Long-nosed Bandicoot	*Peremeles nasuta*	P	
Ringtail Possum	*Pseudocheirus peregrinus*	P	
Brown antechinus	*Antechinus stuartii*	P	
Bush Rat	*Rattus fuscipes*	P	
Echidna	*Tachyglossus aculeatus*	P	
Grey-headed Flying Fox	*Pteropus poliocephalus*	V	V
White-striped Freetailed bat	*Tadarida australis*	P	
Little Forest Bat	*Vespadelus vulturnus*	P	
Large Forest Bat	*Vespadelus darlingtoni*	P	
Gould's Wattled Bat	*Chalinolobus gouldii*	P	
Chocolate Wattled Bat	*Chalinolbus morio*	P	
Feral Cat	*Felis cattus*		
Feral dog	*Canis lupus*		
Fox	*Vulpes vulpes*		
House Mouse	*Mus musculus*		
Black Rat	*Rattus rattus*		

Reptiles and Amphibians

Common Name	Scientific Name	TSC Act	EPBC Act
Red-bellied Black Snake	*Pseudechis porphyriacus*	P	
Lace Monitor	*Varanus varius*	P	
Eastern Water Dragon	*Physignathus lesueurii*	P	
Cunningham Skink	*Egernia cunninghami*	P	
Eastern Water-skink	*Eulamprus quoyi*	P	
Copper-tailed Skink	*Ctenotus taeniolatus*	P	
Dark-flecked Garden Sunskink	*Lampropholis delicata*	P	
Dark-flecked Garden Sunskink	*Lampropholis delicata*	P	
Cream-striped Shining-skink	*Cryptoblepharus virgatus*	P	
Red-crowned Toadlet	*Pseudophryne australis*	V	
Peron's Tree Frog	*Litoria peroni*	P	
Common Eastern Froglet	*Crinia signifera*	P	
Brown-striped Frog	*Lymnodynastes peroni*	P	

Threatened Species

Two threatened species were recorded during the fauna survey. These were the Grey-headed Flying Fox (*Pteropus poliocephalus*) and the Red-crowned Toadlet (*Pseudophryne australis*)

The Grey-headed Flying Fox (*Pteropus poliocephalus*) is a highly mobile species, only one individual was heard during the survey, possibly feeding on flowering plant species within the Reserve. This part of the reserve is not home to a colony of this species. The nearest Flying Fox colony is The Gordon Bat Colony located approx 7 km to the north-west. Flying Foxes are nectar and fruit eating bats that travel large distances at night to areas where trees are flowering.

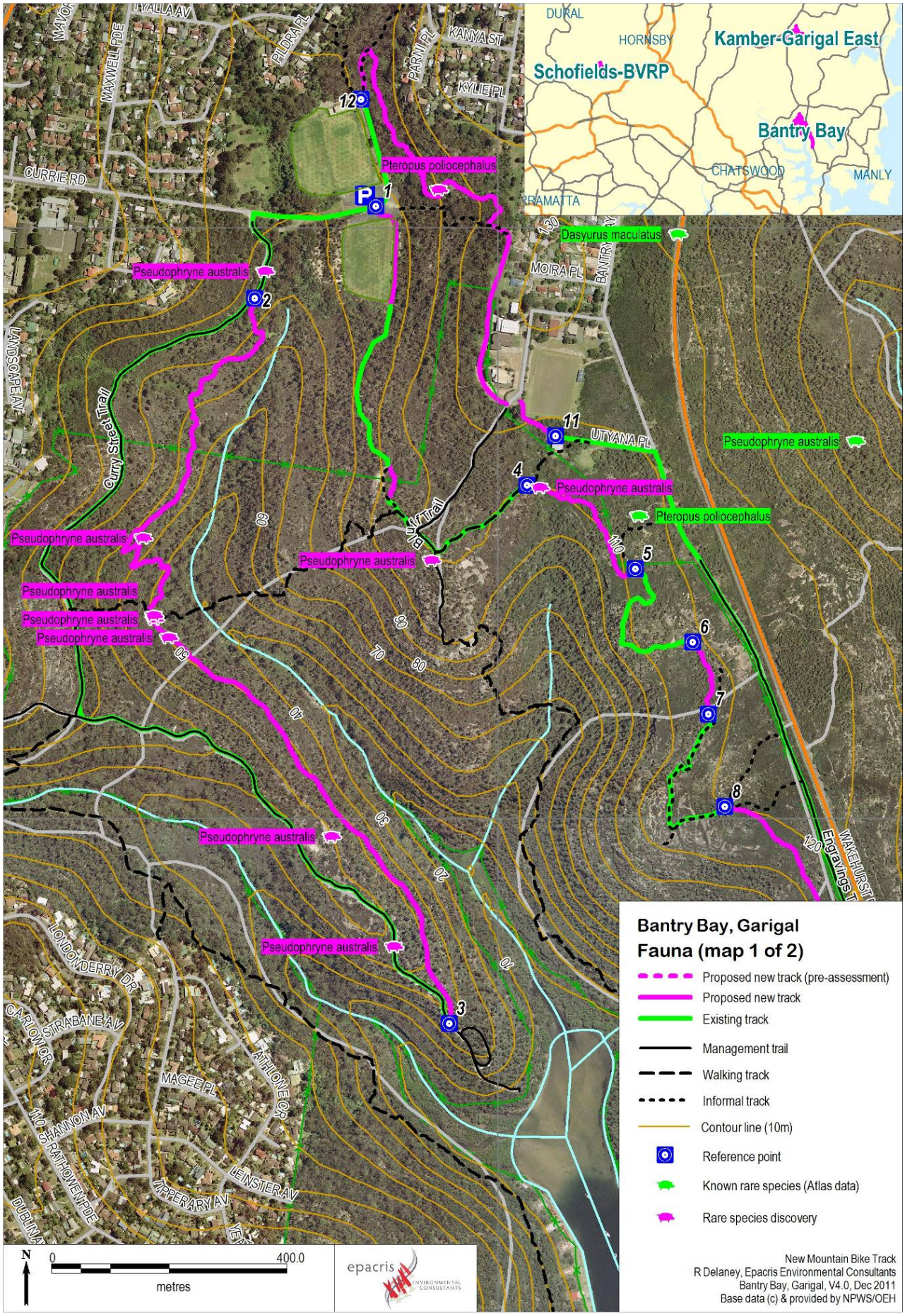
The Red-crowned Toadlet usually lives in the vicinity of permanently moist soaks or areas of dense ground vegetation or leaf litter along or near head-water stream beds. They prefer first or second order ephemeral drainage lines draining ridges and rock benches. These watercourses are often dry or reduced to ponded areas for much of the year and only sustain flow for short periods. This species was found in a quite a few areas throughout this section of the reserve. Protecting water quality is a prime factor in protecting this species and its habitat.

Threatened species found during survey

Species
Grey-headed Flying Fox (*Pteropus poliocephalus*)
Red-crowned Toadlet (*Pseudophryne australis*)

Feral Species

Five feral species were detected during the fauna survey. These were the Feral cat (*Felis cattus*), Feral dog (*Canis lupus*), Fox (*Vulpes vulpes*), House Mouse (*Mus musculus*) and the Black Rat (*Rattus rattus).* The long history of use of this area in addition to the surrounding urban areas, make the presence of these feral species inevitable. Feral species such as these do predate upon native fauna species, such as possums, birds, reptiles and amphibians. Tracks are commonly used by feral species to travel through areas of bush, and the construction of new tracks is likely to advantage the travel of these species into new areas of bushland.


DURAL
HORNSBY
Kamber-Garigal East
Schofields-BVRP
Bantry Bay
CHATSWOOD
MANLY
Pteropus poliocephalus
Dasyurus maculatus
Pseudophryne australis
Curry Street Trail
Cliff Trail
UTYANA PL
MOIRA PL
BANTRY
CURRIE RD
MAXWELL PDE
PILORA PL
PARNI PL
KANYA ST
KYLIE PL
LANDSCAPE AV
WAKEHURST
Engravings
LONDONDERRY DR
CARLOW CR
STRABANE AV
MAGEE PL
ATHLONE CR
SHANNON AV
BEETHOVEN PDE
LEINSTER AV
TIPPERARY AV
DUBLIN AV
Bantry Bay, Garigal
Fauna (map 1 of 2)
Proposed new track (pre-assessment)
Proposed new track
Existing track
Management trail
Walking track
Informal track
Contour line (10m)
Reference point
Known rare species (Atlas data)
Rare species discovery
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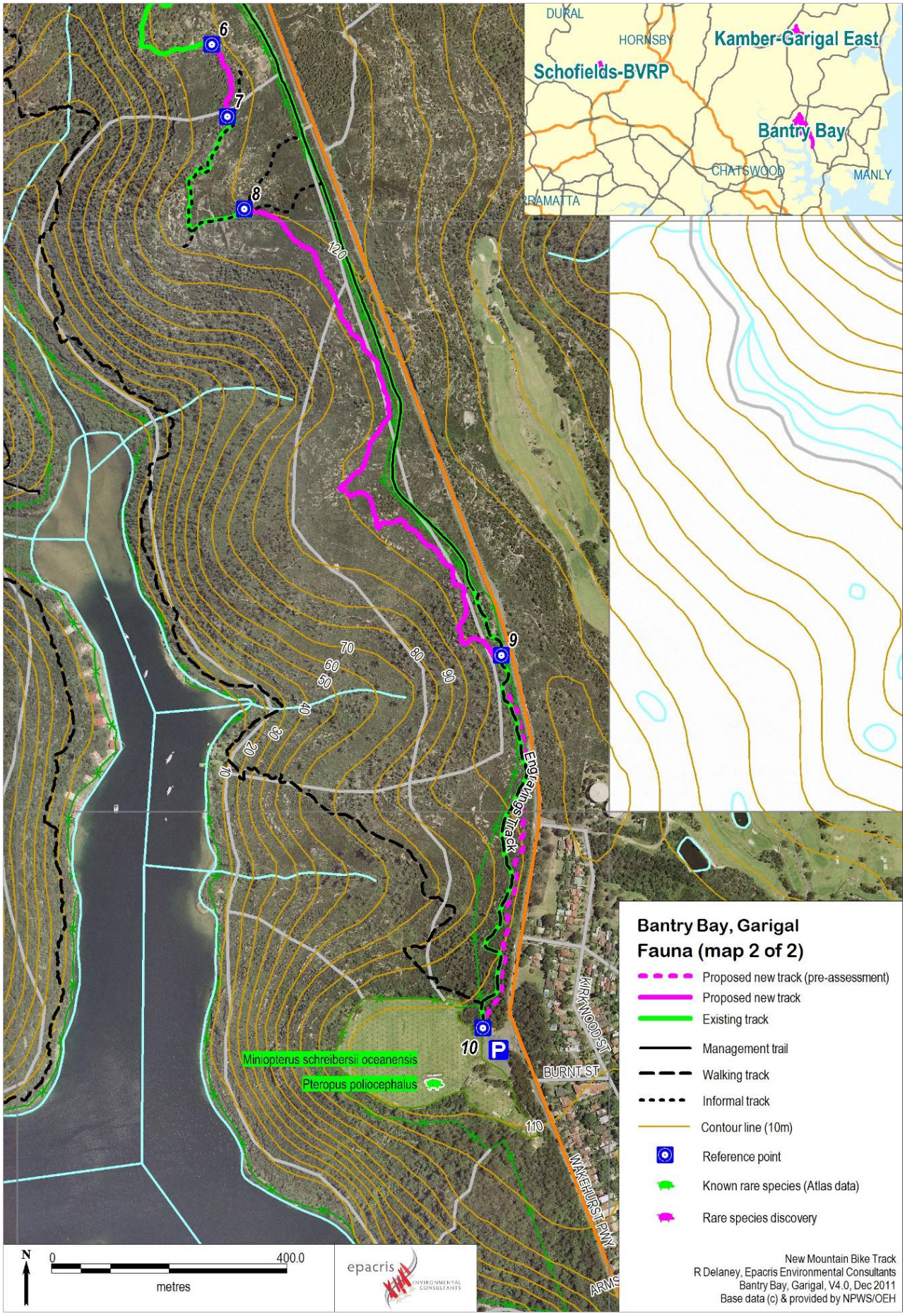
ENVIRONMENTAL CONSULTANTS
New Mountain Bike Track
R Delaney, Epacris Environmental Consultants
Bantry Bay, Garigal, V4.0, Dec 2011
Base data (c) & provided by NPWS/OEH


DURAL
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Schofields-BVRP
Bantry Bay
CHATSWOOD
MANLY
PARRAMATTA
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70
60
50
40
30
20
10
80
90
Engelbays Track
KIRKWOOD ST
BURNT ST
110
WAKEHURST PWY
Miniopterus schreibersii oceanensis
Pteropus poliocephalus
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metres
epacris
ENVIRONMENTAL CONSULTANTS
Bantry Bay, Garigal
Fauna (map 2 of 2)
Proposed new track (pre-assessment)
Proposed new track
Existing track
Management trail
Walking track
Informal track
Contour line (10m)
Reference point
Known rare species (Atlas data)
Rare species discovery
New Mountain Bike Track
R Delaney, Epacris Environmental Consultants
Bantry Bay, Garigal, V4.0, Dec 2011
Base data (c) & provided by NPWS/OEH

Habitat Values

Bantry Bay has good habitat values. The area has a long history of use, which has impacted upon the diversity of species that are now present. The area has few large trees with large hollows, which minimises habitat value for the large owls and arboreal mammals. The dense understorey, however provides excellent habitat for Long-nosed Bandicoot which was trapped and observed during the survey. The many small drainage lines and seepages offer excellent habitat for frog species, especially the red-crowned toadlet, which was also found in the area.

Recommendations for Track Alignment

The new track proposed in native bushland totals approximately 4,142 lineal metres. The total extent of vegetation removal is unable to be provided as a quantitative amount, as the vegetation communities change along the route from grassland to forest, and the vegetation to be removed can only assessed during the track construction.

The proposed track alignment will not necessitate the removal of any trees, other than small saplings in a few locations. Trees and shrubs with a DBH of 50mm or greater are to be left in place however this may be increased to 100mm where absolutely necessary. Existing canopy to remain intact and interlocking, removal of vegetation to be restricted to a height of 5 metres. Where possible, existing tracks are to be used to minimise additional track infrastructure and habitat fragmentation.

The records of the Grey-headed Flying-fox do not require any track modifications, as this species are highly mobile and the track construction is not expected to impact on them or any of their potential habitat.

The red-crowned Toadlet sightings in small ephemeral drainage lines have necessitated the track to be re-routed where it was possible. Where alternate routes were unavailable or would be more environmentally detrimental, the track will be constructed on bedrock, so no deterioration of water quality from sedimentation will occur. In one section of track, which parallels the engravings track, the proposed track crosses a small section of hanging swamp. A raised section of track, such as a boardwalk is required in this area to protect swamp vegetation and to maintain current water flows and quality.

In areas close to recorded Red-crowned Toadlet habitat, care must be taken when constructing or repairing tracks that water flows and water quality are not impacted.

Habitat features such as large trees with hollows, dense vegetation and rock piles have been avoided wherever possible. Track construction is only to be carried out between the hours of 7am and 7pm to avoid disturbance to nocturnal animals and must utilise minimal disturbance construction methods. Movement of surface water should be considered as a priority with track design/construction using the following principles:

- A maximum average track grade of 10%
- A maximum track grade of half of the cross slope (ie 10% cross slope -> 5% track)
- Track tread to be finished with a 5% outslope
- Existing tracks are to be used wherever possible (meeting criteria above)

There is potential that increased track usage will impact not only on the threatened fauna species present, but also other species in the area and could disrupt fauna movements through the area, as well as breeding, nesting or foraging behaviours. A regular monitoring program including a bi-yearly fauna survey should be implemented to monitor any potential impacts of fauna and vegetation.

Fauna Survey Methodology

This fauna survey will follow the guidelines outlined within the *Threatened Species Survey and Assessment: Guidelines for developments and activities (DEC, 2004).* Multiple survey techniques reflecting the species targeted, will be utilized during this survey. As much as is possible, all survey techniques and sites will be designed so as to be repeatable in any future surveys.

Surveys to be carried out in early to mid September and should aim to target habitat types within as may vegetation types present on the sites as possible. Timing of surveys is always problematic, with some species only being present during certain times of the year (migratory species) or only being observed during very hot days (such as Rosenberg's goanna) or wet days (such as red-crowned toadlets).

The fauna survey will entail an initial walk of the track noting potential habitat types and identifying suitable locations for traps and survey transects. As some areas are quite close to the urban interface, it is up to the surveyor to determine the safest and most practical locations for both traps, hair tubes and Anabat equipment.

Fauna survey methods to be used include:

Mammals

- Hair tubes
- Cage traps
- Elliott Traps
- Sign searches, including scat collection
- spotlighting
- Anabat recording for microbats

Avifauna

- bird census,
- nocturnal call playback

Reptiles

- herpetofauna searches.
-

These are discussed in more detail below:

Habitat Description

Initial identification of 'priority fauna habitats' such as riparian areas, rock outcrops, wetlands etc. to be carried out along the survey route. Habitat tree assessment along proposed route to be carried out. A description of the habitat at each survey location to be documented. This will include the vegetation community classification as described on accompanying maps. The presence or absence of standing water, species of plants in flower and fruit, presence of hollows, as well as other site attributes.

Anabat recording

In order to navigate and hunt for food, micro-bats use high frequency sounds that are above the audible range of the human ear. Through specialised equipment (Anabat) these calls can be recorded and then later analysed to indicate the species that were calling at the survey site. The advantages of this system are that, when used in conjunction with harp traps, there is a greater chance of detecting different species at the survey site, targeting bats that fly too high for the trap or those that do not follow flyways.

Echolocation call survey is particularly effective for recording those bat species that have strong calls. These species generally correspond with those which feed at or above the forest canopy and which are not readily captured in harp traps.

The location of the Detector sites will be assessed during the initial proposed track inspection, and will target corridors through vegetation, water bodies and near large rock crevices. Calls are interpreted using frequency and call structure characteristics. Call references used included "Bat Calls of NSW : Region based guide to the echolocation calls of Microchiropteran bats," and bat call libraries.

Bird Survey

The species and number of all birds seen or heard within each fauna survey site during a 30-minute time period are to be recorded. Each bird census is to be conducted during the early morning and late afternoon. Each site is to be surveyed three times, on separate days. Opportunistic bird sightings also to be recorded.

Diurnal Herpetofauna Search

Active searching of potential herpetofauna microhabitats for 30 minutes is to be undertaken in suitable habitat. This should be done three times during the survey period; twice soon after dark when it is still warm, and once early in the day. Ideally a search will be conducted during a wet period to enhance detection of Red-crowned Toadlets and Giant Burrowing Frog.

The technique will involve observation and active searching of fallen logs, litter, decorticating and fallen bark, rock outcrops and other likely substrates. Logs and rocks are to be replaced to their original position to minimise the impact on habitat. Animals are to be identified, recorded and where necessary, captured to verify their identification and then released.

The use of cage traps and remote cameras together at the same sites is proposed to target Rosenberg's Goanna. Searches around rocky areas and at night to be carried out for Broad-headed snake.

Spotlight by Foot

At each site, spotlighting for one person-hour is to be conducted twice using 50-watt bulbs along a 500m transect in each habitat type. This method is to be used to detect arboreal and ground mammals, frogs, birds and reptiles. Spotlight transects to be tracked with a GPS.

Cage and Elliott Traps

Cage and Elliott traps will be utilised to target small to medium-sized mammals. Southern brown bandicoot may be detected by the use of cage traps as well as predator scat collection, remote cameras and hair tubes,

Hair Tubes

Large diameter hair tubes will be used to detect mammals greater than 500g body weight. Pygmy Possums can potentially be detected with hair tubes, in addition to predator scat collection. Tubes will be baited with a mixture found to be successful in small mammal surveys. Hair tube tapes will be sent to Barbara Triggs for identification.

Nocturnal Call Playback

A standard set of pre-recorded calls of nocturnal species are to be played for a set period. For each species four 1 minute call periods are to be separated by two minutes.

Prior to the commencement of playback, and after all species have been broadcast, surveyors must listen for ten minutes, and then search the immediate area with a spotlight after the final listening period. Playback is to be conducted after the spotlighting habitat search has been completed or on a different evening. Playback location to be recorded with GPS.

Scats and Signs Search

All predator scats are to be collected and delivered to Marg Turton to be sent away for analysis. Scat locations to be recorded with GPS. Scats and identifiable signs of animals on sites are also to be recorded opportunistically throughout the survey period.

Opportunistic Site Records

All species seen during the entire survey period will be recorded. Tracks and signs of animal activity will also be recorded throughout the survey. All off-site fauna observations will be recorded.

Survey sites should be preferably positioned primarily on or close to access trails to facilitate conduct of spotlighting and harp trapping surveys and to maximise the number of sites that can be accessed during the limited survey period. Traps will also need to be accessed quickly each morning to release trapped animals.

The survey is to provide a baseline, replicable survey to enable monitoring of any potential impacts into the future.

Flora Survey

The vegetation of the proposed bike routes was examined as follows:

1. The survey was conducted over a period of several days in September and October 2011 to target the flowering times of threatened plant species known to occur in the area.

2. The route was walked and an area 5 metres on either side of the track centreline was searched for the presence of Rare and Endangered species. Those found were marked by tape, their numbers and area extent recorded, and the GPS co-ordinates recorded. This information was used to relocate the centreline of the route, which was then re-plotted on the GPS and marked in the field. Any other relevant environmental factors which might affect the plants as a result of the proximity of the track were also noted.

3. The vegetation types which the route traverses is shown in Appendix 2. The distance traversed through each type was determined from the GIS maps. Recent aerial imagery was used to confirm the boundaries of the vegetation types supplied on the maps.

4. The vegetation types and boundaries were noted during the rare plant search along the proposed route. Any differences of the observed vegetation types with the mapped vegetation types were noted.

5. A total of six 10x10m vegetation quadrats (Appendix 1) were carried out a short distance from the proposed route. The quadrats are located beyond the 5 metre search area for the Rare and Endangered Species, and in sites which were selected to be representative of the vegetation along the route, but which would not be affected by track construction. In each of these 6 quadrats, the vegetation was described by the standard modified Braun-Blaquet procedure for determining cover classes. Vegetation communities were classified on the basis of the Structural Formation Classes according to the NVIS Scheme shown in the table located in Appendix 3.

6. Where re-routing around significant plant species was required, alternate route surveys were conducted to ensure the suitability of new track alignments.

Flora Survey Results:

Rare and Endangered Species occurring along the proposed mountain bike route Bantry Bay.

There was one occurrence of *Melaleuca deanei* found along the route. This plant is located on the eastern side near the ridge crest of the park and has a single plant. The site details are:

Easting	Northing	Species and Details
N/A	N/A	*Melaleuca deanei* one plant approximately 2m high, in the middle of a drainage line and marshy area. It was on the centreline of the initial proposed route, within the *Corymbia gummifera* Open Woodland. Track line has now been diverted around this plant.

Track diversions have been put into place to avoid this species along track route.

Melaleuca deanei habitat

Melaleuca deanei habitat

Vegetation Communities along the proposed route:

The vegetation communities of the area have been mapped most recently by the DECCW (2009) in Department of Environment, Climate Change and Water (DECCW) (2009a) in *The Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area*. Department of Environment and Climate Change NSW, Hurstville.

The route passes through 7 native vegetation communities and one weed dominated community. These are:

- Coastal Enriched Sandstone Sheltered Forest
- Coastal Sandstone Riparian Forest
- Coastal Sandstone Sheltered Peppermint-Apple Forest
- Sandstone exposed Bloodwood Woodland
- Hornsby Sandstone Heath-Woodland
- Sydney Ironstone Bloodwood-Silvertop Ash Forest
- Coastal Upland Damp Heath Swamp
- Weeds and exotics

Of the native communities the route passes through a small area comprising the Endangered Ecological Community known as Duffys Forest Ecological Community. The existing walking track also passes through this community, and the upslope portion of the vegetation adjoins the Wakehurst Parkway and is affected by introduced species and weeds.

Of the six remaining communities affected by the route, the most widespread one is the Hornsby Sandstone Heath-Woodland (BBQ1, BBQ2). This community demonstrates considerable variability. Its occurrence on the west facing slopes is affected by changes in density of the major tree components. Where trees are absent it takes the form of a tall shrubland dominated by *Allocasuarina distyla*, in which condition it has a low plant diversity, and a moderately heavy fuel load. By contrast, at lower altitudes and on the eastern aspect, this community contains more shrub and herb species, taller trees and an open forest structure. It is possible that some of the area of this community is incorrectly mapped. However in this context the current mapping has not been varied.

Another community which appears to be incorrectly mapped is the Coastal Sandstone Riparian Forest (Quadrats BBQ3, BBQ5). The small occurrences of this type along the eastern ridge line (BBQ3) are distinctly different from that on the western side of the Bay (BBQ5) where the understory is dominated by *Xanthorrhoea* and *Dodonaea*.

Threats to Vegetation Communities

Weeds

The area has an extensive urban interface, which inevitably leads to weed invasion from the urban areas into the surrounding bushland. Weed propagules travel via wind, water and are carried by both animals and people. Disturbed soil is more likely to become susceptible to weed invasion, as there is no competition from other plants.

Clearings, tracks and creeks are also avenues for weed transportation. The core of the area is predominantly weed free and in excellent condition, however reserve edges, tracks, powerline easements and creeklines have weed infestations.

Care must be taken during track construction to prevent carrying weed material and propagules into bushland. All materials used, workers clothing, and tools should be checked for soil and weed seed and cleaned before work commences. Track construction should aim to prevent water flows downslope from built up areas.

Phytophthora

Phytophthora cinnamomi is a microscopic soilborne organism, invisible to the naked eye, which causes root rot of a wide variety of plant species including many native and introduced plants. Infection often results in the death of the plant, with early symptoms including wilting, yellowing and retention of dried foliage and darkening of young feeder roots and occasionally the larger roots. *Phytophthora* requires moist soil conditions and warm temperatures to be active, but damage is most evident in summer when plants are also prone to drought stress.

There is no way of visually telling if the pathogen is present in the soil at any one site, however laboratory analysis of soil can determine if the organism is present. A plant infected by *Phytophthora* suffers destruction of root tissue which renders the plant unable to absorb water and nutrients, and the plant may subsequently die. The spores are easily transported in stormwater, drainage water, contaminated soil and on tools, footwear and vehicles. *Phytophthora* is able to survive in dead plant tissue and in the soil for extended periods.

Currently there is no one method for controlling *Phytophthora cinnamomi*. A combination of hygiene protocols, good horticultural management, selective use of some fungicides and the addition of organic matter to soils can be used to retard the activity of *Phytophthora*. Hygiene protocols should be implemented to prevent the spread of *Phytophthora*, even if the organism has not been identified in the reserve.

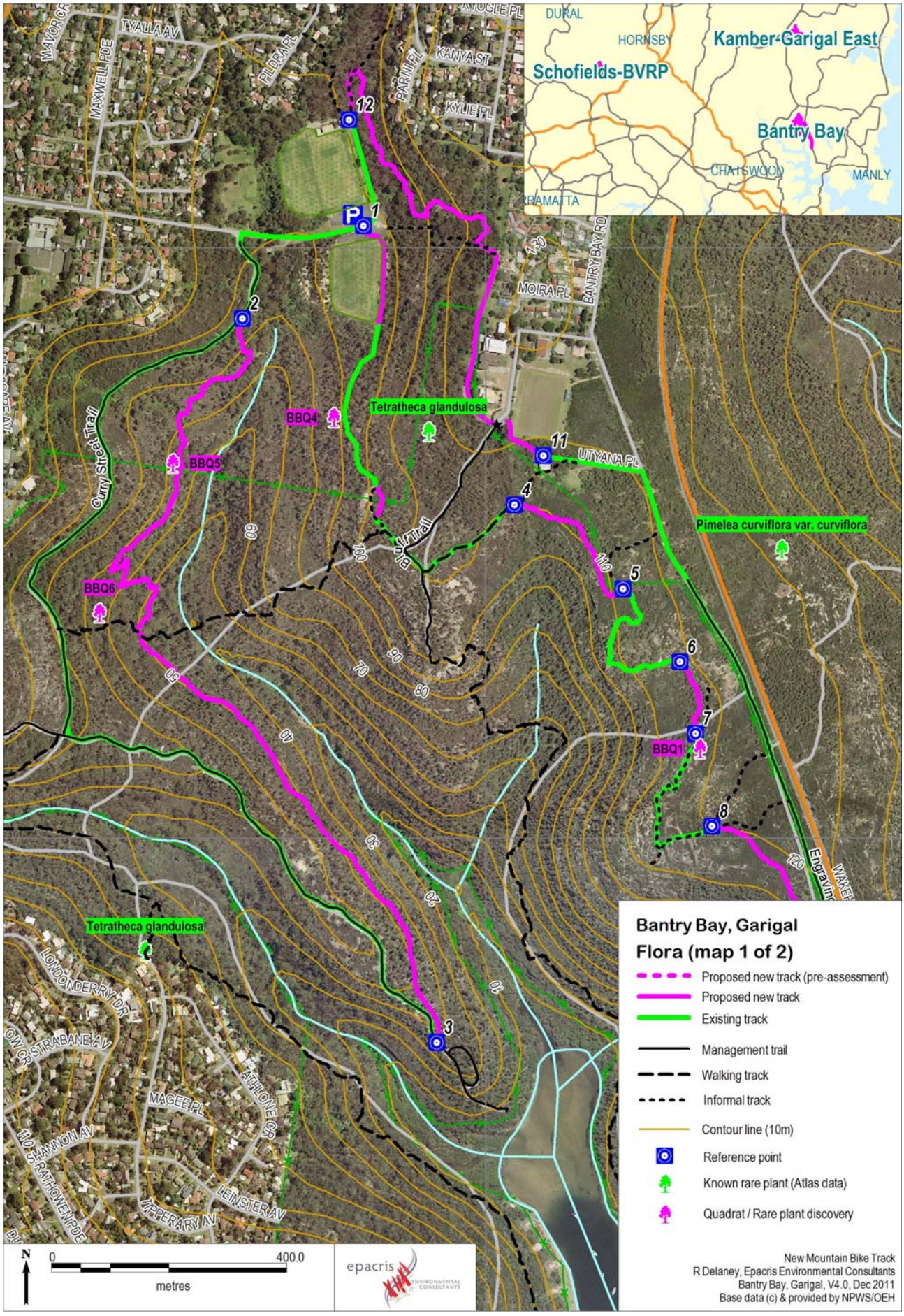
Myrtle Rust

Myrtle rust (*Puccinia psidii s.l.*) is a newly described fungus that is closely related to the Eucalyptus/Guava rusts. These rusts are serious pathogens which affect plants belonging to the family Myrtaceae including Australian natives like bottle brush (*Callistemon* spp.), tea tree (*Melaleuca* spp.) and eucalypts (*Eucalyptus* spp.).

Myrtle rust is distinctive in that it produces masses of powdery bright yellow or orange-yellow spores on infected plant parts. It infects leaves of susceptible plants producing spore-filled lesions on young actively growing leaves, shoots, flower buds and fruits. Leaves may become buckled or twisted and may die as a result of infection. Sometimes these infected

spots are surrounded by a purple ring. Older lesions may contain dark brown spores. Infection on highly susceptible plants may result in plant death.

New infestations of Myrtle Rust should be reported to the Dept. of Primary Industries, however it is now accepted that the spread of Myrtle Rust is unable to be controlled on the eastern seaboard of NSW.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MAXWELL PDE
PILDRA PL
KANYA ST
KYLIE PL
MOIRA PL
BANTRY BAY RD
UTYANA PL
Curry Street Trail
Blue Trail
Tetratheca glandulosa
Pimelea curviflora var. curviflora
BBQ1
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MAGEE PL
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SHANNON AV
LEINSTER AV
TIPPERARY AV
Bantry Bay, Garigal
Flora (map 1 of 2)
Proposed new track (pre-assessment)
Proposed new track
Existing track
Management trail
Walking track
Informal track
Contour line (10m)
Reference point
Known rare plant (Atlas data)
Quadrat / Rare plant discovery
N
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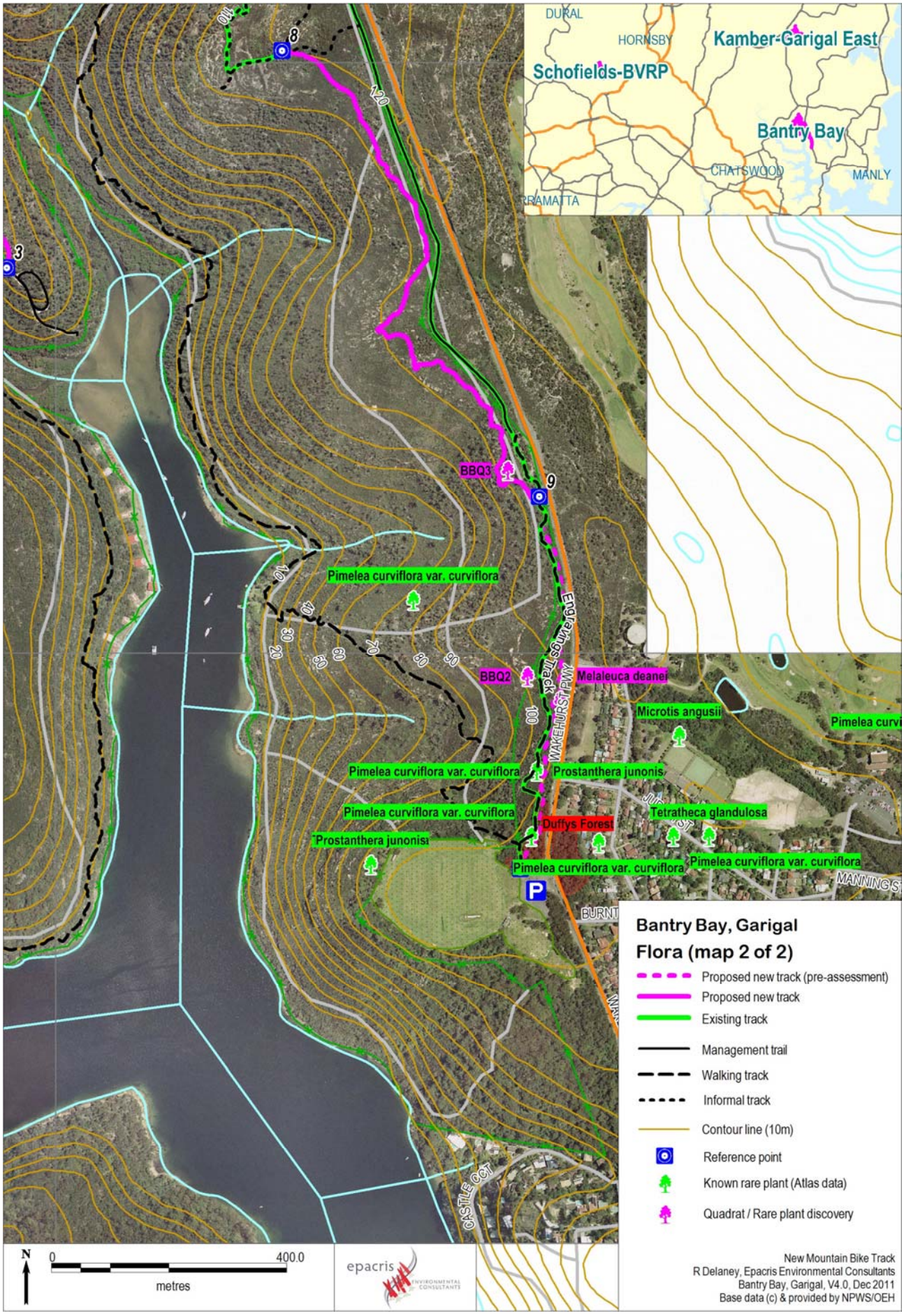
ENVIRONMENTAL CONSULTANTS
New Mountain Bike Track
R Delaney, Epacris Environmental Consultants
Bantry Bay, Garigal, V4.0, Dec 2011
Base data (c) & provided by NPWS/OEH


DURAL
HORNSBY
Kamber-Garigal East
Schofields-BVRP
Bantry Bay
CHATSWOOD
MANLY
PARRAMATTA
8
9
3
BBQ3
BBQ2
Pimelea curviflora var. curviflora
Melaleuca deanei
Microtis angusii
Prostanthera junonis
Tetratheca glandulosa
Duffys Forest
Pimelea curviflora var. curviflora
Pimelea curviflora var. curviflora
Pimelea curviflora var. curviflora
Prostanthera junonisa
Pimelea curviflora var. curviflora
Pimelea curvi
Jennings Track
WAKEHURST PWY
MANNINGS
BURNT
CASTLE CCT
P
Bantry Bay, Garigal
Flora (map 2 of 2)
Proposed new track (pre-assessment)
Proposed new track
Existing track
Management trail
Walking track
Informal track
Contour line (10m)
Reference point
Known rare plant (Atlas data)
Quadrat / Rare plant discovery
N
0
400.0
metres
epacris
ENVIRONMENTAL CONSULTANTS
New Mountain Bike Track
R Delaney, Epacris Environmental Consultants
Bantry Bay, Garigal, V4.0, Dec 2011
Base data (c) & provided by NPWS/OEH

Appendix 1: QUADRATS

SITE NAME: BANTRY BAY – GARIGAL NATIONAL PARK
QUADRAT NO: BBQ1 SIZE: 10X10m DATE: 21/09/2011
QUADRAT LOCATION GPS: 6262152 3363627 (GDA 94)
VEGETATION TYPE: Closed Scrubland (NVIS Terminology) SURVEYOR: Wyn Jones
OVERALL CONDITION (Qualitative): Poor (Species depauperate) GROWTH STAGE: Senescent-x Mature Regeneration

PHYSICAL CHARACTERISTICS:
ASPECT: 270˚ SLOPE: 4˚
SOIL TYPE: Sand loam SOIL DEPTH (ESTIMATED): 10cm
GROUND COVER%: BARE:<5 LITTER DEPTH cm: 1 LITTER COVER: 95
ROCK: <5 DEAD STICKS AND LOGS: <1

COMMUNITY STRUCTURE – Dominant species

Canopy	**Form**	**Height range (m)**	**% Cover**	**Species 1**	**Species 2**	**Species 3**
C	T	2-3.5	<5	*Eucalyptus haemastoma*		
SC	SH	2-2.5	95	*Allocasuarina distyla*		
SH	SH	1.5-2.5	<5	*Banksia ericifolia*	*Grevillea speciosa*	
GC	SH	0.2-1.0	<5	*Cyathochaeta diandra*	*Lepidosperma limicola*	

Species Composition by Cover/Abundance Values

SPECIES	**COVER**	**SPECIES**	**COVER**
Eucalyptus haemastoma	2		
Allocasuarina distyla	6		
Angophora hispidula	2		
Leptospermum squarrosum	2		
Banksia ericifolia	4b		
Banksia spinulosa	3		
Phebalium squamulosum	3		
Melaleuca linearis	2		
Grevillea speciosa	2		
Monotoca scoparia	4b		
LepidoSperma neesii	3		
Lepidosperma limicola	3		
Cyathochaeta diandra	4b		
Entolasia stricta	4b		
Xanthosia tridentata	4b		
Epacris microphylla	3		

SITE NAME: BANTRY BAY – GARIGAL NATIONAL PARK
QUADRAT NO: BBQ2 SIZE: 10X10m DATE: 03/10/2011
QUADRAT LOCATION GPS: 6260961 3367979 (GDA 94)
VEGETATION TYPE: Closed Scrub – *Allocasuarina distyla* SURVEYOR: Wyn Jones
OVERALL CONDITION (Qualitative): GOOD GROWTH STAGE: Senescent-t Mature-x Regeneration-a

PHYSICAL CHARACTERISTICS:
ASPECT: 235˚ SLOPE: 15˚
SOIL TYPE: Sandy loam SOIL DEPTH (ESTIMATED): 10
GROUND COVER%: BARE: LITTER DEPTH cm: LITTER COVER:
ROCK: DEAD STICKS AND LOGS:
COMMUNITY STRUCTURE – Dominant species

Canopy	**Form**	**Height range (m)**	**% Cover**	**Species 1**	**Species 2**	**Species 3**
C#	T	3-5	<5	*Angophora costata*	*Allocasuarina distyla*	
C	SH	2-4	>90	*Allocasuarina distyla*	*Banksia ericifolia*	
SH		0.5-1.5	60	*Leptospermum polygalifolium*	*Xanthorrhoea media*	
GC						

# Indicates the tree canopy is a minor emergent above the dominant vegetation formation

Species Composition by Cover/Abundance Values

SPECIES	**COVER**	**SPECIES**	**COVER**
Allocasuarina distyla	7	*Pimelea linifolia*	1
Angophora costata	5	*Caustis flexuosa*	1
Pteridium esculentum	2		
Leptospermum polygalifolium	2		
Acacia terminalis	1		
Epacris longifolia	4b		
Acacia ulicifolia	1		
Banksia ericifolia	4b		
Platysace linearifolia	4b		
Xanthosia pilosa	4b		
Woollsia pungens	1		
Dianella caerulea var. producta	1		
Erisotemon australasius spp australasius	1		
Dillwynia retorta	1		
Hakea dactyloides	1		
Gompholobium latifolium	1		
Entolosia stricta	1		
Lepidosperma laterale	1		
Darwinia fascicularis	1		
Hibbertia spp.	1		

SITE NAME: BANTRY BAY – GARIGAL NATIONAL PARK
QUADRAT NO: BBQ3 SIZE: 10X10m DATE: 03/10/2011
QUADRAT LOCATION GPS: 6261310 3367649 (GDA 94)
VEGETATION TYPE: Open Forest SURVEYOR: Wyn Jones
OVERALL CONDITION (Qualitative): AVERAGE GROWTH STAGE: Senescent-t Mature-x Regeneration-t

PHYSICAL CHARACTERISTICS:
ASPECT: 300˚ SLOPE: 3˚
SOIL TYPE: Sandy loam SOIL DEPTH (ESTIMATED): 0.5
GROUND COVER%: BARE: <5 LITTER DEPTH cm: 3 LITTER COVER: 95
ROCK: <1 DEAD STICKS AND LOGS: 20

COMMUNITY STRUCTURE – Dominant species

Canopy	**Form**	**Height range (m)**	**% Cover**	**Species 1**	**Species 2**	**Species 3**
C	T	8-12	65	*Corymbia gummifera*		
SC	SH	3-6	50	*Allocasuarina distyla*	*Hakea dactyloides*	
SH	SH	1-2.5	60	*Dodonaea triquetra*	*Allocasuarina distyla*	
GC	SH	0-0.6	20	*Lomandra spp*		

Species Composition by Cover/Abundance Values

SPECIES	**COVER**	**SPECIES**	**COVER**
Corymbia gummifera	6	*Phyllanthus hirtellus*	2
Allocasuarina distyla	6	*Bossiaea scolopendria*	2
Dodonaea triquetra	6		
Pultenaea stipulifera	1		
Xanthorrhoea media	1		
Lomatia silaifolia	1		
Banksia serrata	3		
Hakea dactyloides	5		
Lambertia formosa	2		
Entolasia marginata	3		
Lomandra obliqua	2		
Hibbertia rufa	2		
Lomandra brevis	2		
Acacia ulicifolia	2		
Acacia terminalis	2		
Pandorea pandorana	2		
Billardiera scandens	2		
Caustis flexuosa	2		
Hakea propinqua	2		
Leptospermum trinervium	2		

SITE NAME: BANTRY BAY – GARIGAL NATIONAL PARK

QUADRAT NO: BBQ4 SIZE: 10X10m DATE: 03/10/2011
QUADRAT LOCATION GPS: 6262713 3357434 (GDA 94)
VEGETATION TYPE: Open Forest SURVEYOR: Wyn Jones
OVERALL CONDITION (Qualitative): GOOD GROWTH STAGE: Senescent-t Mature-x Regeneration-s

PHYSICAL CHARACTERISTICS:
ASPECT: 290˚ SLOPE: 8˚
SOIL TYPE: SOIL DEPTH (ESTIMATED): 0.4
GROUND COVER%: BARE: 0 LITTER DEPTH cm: 2 LITTER COVER: 85
ROCK: 0 DEAD STICKS AND LOGS: 5

COMMUNITY STRUCTURE – Dominant species

Canopy	**Form**	**Height range (m)**	**% Cover**	**Species 1**	**Species 2**	**Species 3**
C	T	8-12	60	*Angophora costata*	*Eucalyptus oblonga*	*Corymbia gummifera*
SC	T SH	3-5	30	*Banksia serrata*	*Corymbia gummifera*	
SH	SH	1-2	20	*Lambertia formosa*	*Caustis flexuosa*	*Leptospermum trinervium*
GC	SH H	0-0.4	10	*Lomandra glauca*		

Species Composition by Cover/Abundance Values

SPECIES	**COVER**	**SPECIES**	**COVER**
Angophora costata	6	*Eriostemon australasius var australasius*	2
Corymbia gummifera	5	*Hibbertia rufa*	1
Eucalyptus oblonga	5	*Grevillea buxifolia*	1
Banksia serrata	6	*Lomandra glauca*	4b
Leptospermum trinervium	5	*Bossiaea heterophylla*	1
Anisopogon avenaceus	4b	*Platysace linearifolia*	4b
Caustis flexuosa	5	*Phyllota phylicoides*	1
Pultenaea stipularis	4b	*Boronia pinnata*	1
Pimelea linifolia	3	*Persoonia levis*	2
Pteridium esculentum	1	*Patersonia sericea*	2
Dillwynia retorta	1	*Xanthosia pilosa*	1
Cryptostylis sp.	1	*Billardiera scandens*	1
Banksia ericifolia	1	*Lambertia formosa*	5
Hakea gibbosa	1		
Xanthorrhoea media	1		
Dampiera stricta	1		
Woollsia pungens	4b		
Lepidosperma laterale	5		
Dianella caerulea spp. producta	5		

SITE NAME: BANTRY BAY – GARIGAL NATIONAL PARK

QUADRAT NO: BBQ5 SIZE: 10X10m DATE: 03/10/2011
QUADRAT LOCATION GPS: 6262636 3354712 (GDA 94)
VEGETATION TYPE: Open Forest SURVEYOR: Wyn Jones
OVERALL CONDITION (Qualitative): GOOD GROWTH STAGE: Senescent-a Mature-s Regeneration-d

PHYSICAL CHARACTERISTICS:
ASPECT: 65˚ SLOPE: 10˚
SOIL TYPE: Sandy Loam SOIL DEPTH (ESTIMATED): 0.5m
GROUND COVER%: BARE: <1 LITTER DEPTH cm: 3 LITTER COVER: 70
ROCK: 15 DEAD STICKS AND LOGS: 20

COMMUNITY STRUCTURE – Dominant species

Canopy	**Form**	**Height range (m)**	**% Cover**	**Species 1**	**Species 2**	**Species 3**
C	T	7-14	30	*Corymbia gummifera*	*Angophora costata*	*Eucalyptus piperita*
SC	T SH	2.5-5	20	*Banksia serrata*	*Banksia ericifolia*	
SH	SH	0.5-2	30	*Caustis flexuosa*	*Woollsia pungens*	
GC	SH	<0.5	5	*Entolasia stricta*	*Entolasia marginata*	

Species Composition by Cover/Abundance Values

SPECIES	**COVER**	**SPECIES**	**COVER**
Corymbia gummifera	4b	*Caustis flexuosa*	4b
Angophora costata	4b	*Ceratopetalum gummiferum*	4b
Banksia serrata	1	*Entolasia marginata*	4b
Eucalyptus piperita	4b	*Dampiera stricta*	2
Banksia ericifolia	4b	*Lomandra obliqua*	1
Acacia linifolia	4b	*Lepidosperma laterale*	3
Platysace linearifolia	5	*Patersonia sericea*	4b
Woollsia pungens	4b	*Lomatia silaifolia*	1
Epacris longiflora	3	*Leptospermum squarrosum*	1
Pteridium esculentum	1	*Pultenaea daphnoides*	3
Lindsaea linearis	2	*Cassytha glabella*	1
Eustrephus latifolius	1	*Xanthosia pilosa*	2
Gahnia sieberiana	1	*Dianella revoluta var. revoluta*	1
Grevillea buxifolia	1	*Banksia marginata*	1
Pimelea linifolia	1		
Hibbertia aspera	1		
Dianella caerulea spp. producta	1		
Hibbertia scandens	2		
Entolasia stricta	4b		

SITE NAME: BANTRY BAY – GARIGAL NATIONAL PARK

QUADRAT NO: BBQ6 SIZE: 10X10m DATE: 03/10/2011
QUADRAT LOCATION GPS: 6262382 335347 (GDA 94)
VEGETATION TYPE: Open Forest SURVEYOR: Wyn Jones
OVERALL CONDITION (Qualitative): GOOD GROWTH STAGE: Senescent-t Mature-d Regeneration-s

PHYSICAL CHARACTERISTICS:
ASPECT: 30˚ SLOPE: 12˚
SOIL TYPE: SOIL DEPTH (ESTIMATED): 0.75
GROUND COVER%: BARE: <1 LITTER DEPTH cm: 3 LITTER COVER: 80
ROCK: 10 DEAD STICKS AND LOGS: 10

COMMUNITY STRUCTURE – Dominant species

Canopy	**Form**	**Height range (m)**	**% Cover**	**Species 1**	**Species 2**	**Species 3**
C	T	15-20	60	*Angophora costata*	*Eucalyptus piperita*	
SC	T	3-8	10	*Angophora costata*	*Eucalyptus piperita*	
SH	SH	2-3	30	*Grevillea linearis*	*Dodonaea triquetra*	*Dillwynia retorta*
GC	S H	0-0.3	10	*Dodonaea triquetra*	*Caustis flexuosa*	

Species Composition by Cover/Abundance Values

SPECIES	**COVER**	**SPECIES**	**COVER**
Angophora costata	5	*Grevillea buxifolia*	4b
Eucalyptus piperita	4b	*Epacris longifolia*	1
Dodonaea triquetra	4b	*Caustis flexuosa*	4b
Pteridium esculentum	4b	*Stylidium productum*	1
Leptospermum polygalifolium	2	*Acacia terminalis*	1
Xanthorrhoea arborea	2	*Xanthosia pilosa*	1
Gahnia sieberiana	2		
Elaeocarpus reticulatus	1		
Smilax glyciphylla	1		
Pimelea linifolia	3		
Xanthorhoea media	1		
Entolasia marginata	2		
Acacia linifolia	4b		
Platysace linearifolia	2		
Pultenaea stipularis	2		
Dianella caerulea var, producta	2		
Lomandra longifolia	1		
Lepidosperma urophorum	1		
Hibbertia scandens	2		

Appendix 2: Bantry Bay – Garigal National Park Vegetation Communities along proposed route. Source - CMA vegetation mapping

Map Unit	*Map Colour*	*Quadrat Code This Survey*	*Vegetation Community*	*EEC*	*Length of Route through Vegetation (m)*
S_DSF04		**BBQ6**	**Coastal Enriched Sandstone Sheltered Forest**		**381**
S_DSF08		**BBQ3 BBQ5**	**Coastal Sandstone Riparian Forest**		**381**
S_DSF09		**BBQ4**	**Coastal Sandstone Sheltered Peppermint-Apple Forest**		**515**
S_DSF11	**YELLOW**		**Sandstone Exposed - Bloodwood Woodland**		**139**

Map Unit	*Map Colour*	*Quadrat Code This Survey*	*Vegetation Community*	*EEC*	*Length of Route through Vegetation (m)*
S_DSF12		**BBQ2 BBQ2**	**Hornsby Sandstone Heath-Woodland**		**2619**
S_DSF14			**Sydney Ironstone Bloodwood-Silvertop Ash Forest**	**Duffys Forest Ecological Community**	**537**
S_FrW01			**Coastal Upland Damp Heath Swamp**		**60**
Weed_Ex			**Weeds and Exotics**		**n/a**

Appendix 3: NVIS Structural Formation Terminology used in quadrats

	Cover Characteristics							
	Foliage cover *	70-100	30-70	10-30	<10	» 0	0-5	unknown
	Crown cover **	>80	50-80	20-50	0.25-20	<0.25	0-5	unknown
	% Cover ***	>80	50-80	20-50	0.25-20	<0.25	0-5	unknown
	Cover code	d	c	i	r	bi	bc	unknown
Growth Form	**Height Ranges (m)**	**Structural Formation Classes**						
tree, palm	<10,10-30, >30	closed forest	open forest	woodland	open woodland	isolated trees	isolated clumps of trees	trees
tree mallee	<3, <10, 10-30	closed mallee forest	open mallee forest	mallee woodland	open mallee woodland	isolated mallee trees	isolated clumps of mallee trees	mallee trees
shrub, cycad,grass-tree, tree-fern	<1,1-2,>2	closed shrubland	shrubland	open shrubland	sparse shrubland	isolated shrubs	isolated clumps of shrubs	shrubs
mallee shrub	<3, <10, 10-30	closed mallee shrubland	mallee shrubland	open mallee shrubland	sparse mallee shrubland	isolated mallee shrubs	isolated clumps of mallee shrubs	mallee shrubs

Growth Form	Height Ranges (m)	Structural Formation Classes						
heath shrub	<1,1-2,>2	closed heathland	heathland	open heathland	sparse heathland	isolated heath shrubs	isolated clumps of heath shrubs	heath shrubs
chenopod shrub	<1,1-2,>2	closed chenopod shrubland	chenopod shrubland	open chenopod shrubland	sparse chenopod shrubland	isolated chenopod shrubs	isolated clumps of chenopod shrubs	chenopod shrubs
samphire shrub	<0.5,>0.5	closed samphire shrubland	samphire shrubland	open samphire shrubland	sparse samphire shrubland	isolated samphire shrubs	isolated clumps of samphire shrubs	samphire shrubs
hummock grass	<2,>2	closed hummock grassland	hummock grassland	open hummock grassland	sparse hummock grassland	isolated hummock grasses	isolated clumps of hummock grasses	hummock grasses
tussock grass	<0.5,>0.5	closed tussock grassland	tussock grassland	open tussock grassland	sparse tussock grassland	isolated tussock grasses	isolated clumps of tussock grasses	tussock grasses
other grass	<0.5,>0.5	closed grassland	grassland	open grassland	sparse grassland	isolated grasses	isolated clumps of grasses	other grasses
sedge	<0.5,>0.5	closed sedgeland	sedgeland	open sedgeland	sparse sedgeland	isolated sedges	isolated clumps of sedges	sedges
rush	<0.5,>0.5	closed rushland	rushland	open rushland	sparse rushland	isolated rushes	isolated clumps of rushes	rushes

Growth Form	Height Ranges (m)	Structural Formation Classes						
forb	<0.5,>0.5	closed forbland	forbland	open forbland	sparse forbland	isolated forbs	isolated clumps of forbs	forbs
fern	<1,1-2,>2	closed fernland	fernland	open fernland	sparse fernland	isolated ferns	isolated clumps of ferns	ferns
bryophyte	<0.5	closed bryophyteland	bryophyteland	open bryophyteland	sparse bryophyteland	isolated bryophytes	isolated clumps of bryophytes	bryophytes
lichen	<0.5	closed lichenland	lichenland	open lichenland	sparse lichenland	isolated lichens	isolated clumps of lichens	lichens
vine	<10,10-30, >30	closed vineland	vineland	open vineland	sparse vineland	isolated vines	isolated clumps of vines	vines
aquatic	0-0.5,<1	closed aquatic bed	aquatic bed	open aquatic bed	sparse aquatics	isolated aquatics	isolated clumps of aquatics	aquatics
seagrass	0-0.5,<1	closed seagrass bed	seagrassbed	open seagrassbed	sparse seagrassbed	isolated seagrasses	isolated clumps of seagrasses	seagrasses