



A targeted spring flora survey of New Island Bay, Cape Le Grand National Park

*A report to Tourism Branch, Department of Environment and
Conservation, Kensington*

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Executive Summary

A targeted flora survey for species of conservation significance was undertaken in the New Island Bay area, in Cape Le Grand National Park, Western Australia. This survey consisted of walking transects in the Project Area over six days between October and November, 2011. Twenty two species of significance were found by this survey.

Thirteen species with listed conservation status were located within the Project Area. This includes a new population of the threatened (DRF) species, *Lambertia echinata* subsp. *echinata*, which is also listed under the Environment Protection and Biodiversity Conservation Act 1999. Twelve species were listed by the Department of Environment and Conservation as having priority status; including one Priority 1 taxon (*Commersonia apella*), five Priority 2 taxa (*Lasiopetalum maxwellii*, *Lepyrodia fortunata*, *Goodenia quadrilocularis*, *Leucopogon multiflorus*, *Patersonia inaequalis*), four Priority 3 taxa (*Eucalyptus semiglobosa*, *Leucopogon rotundifolius*, *Melaleuca incana* subsp. *tenella*, *Persoonia scabra*) and two Priority 4 taxa (*Eucalyptus aquilina*, *Eucalyptus ligulata* subsp. *ligulata*).

In addition to these 13 species, the putative new taxon (*Lasiopetalum* aff. *parvuliflorum*) has affinities to a priority 3 listed taxon and is likely to gain priority status listing when its taxonomic identity is resolved (either as a new taxon or confirmed as *Lasiopetalum parvuliflorum*).

Eight notable species were located in within or adjacent to the New Island Bay Project Area. This includes two priority listed species located adjacent to the Project Area (*Dampiera decurrens*, *Acacia incanicarpa*). Newly located populations of three species were significant range extensions (>200 km). Two taxa were undescribed, putatively new species (*Opercularia* aff. *ovata*, *Acrotriche* aff. *cordata*), both of which have a limited distribution along the coast east of Esperance. One taxon (*Commersonia grandiflora*) has been recommended to have conservation listing. Populations of two species which had not been collected in the Cape Le Grand region since the Flinders Expedition in 1802 were located in New Island Bay (*Persoonia scabra*, *Banksia plumosa* subsp. *plumosa*), which is a significant find within the context of verifying the original type locations for these taxa.

The vegetation of New Island Bay was found to be relatively intact, weed-free and in very-good to excellent condition, although regenerating from a hot summer fire at the time of survey. There is a need to assess for the presence of *Phytophthora* spp. and the risk of its spread around the Project Area.

1. Introduction

New Island Bay (34.007057°S, 122.142376°E) is a relatively small, isolated bay located between two granitic headlands in the Cape Le Grand National Park (reserve number 22795), c. 30 km ESE of Esperance (Figure 1). As part of the Naturebank programme (a partnership between The Western Australia Tourism Commission (Tourism WA) and the Western Australia Department of Environment and Conservation (DEC)), this bay has been identified as a potential site for tourism development. As part of this assessment, a targeted priority flora survey was undertaken within proposed development envelope (the Project Area) in the bay and adjacent area flanking Mt Le Grand. This Project Area consisted of the proposed Naturebank Site in a proportion of New Island Bay, and a proposed access road from the site to Hellfire Bay Road. This survey will assist in the decision to determine if further environmental assessment is required.

1.1 Physical Environment

The Cape Le Grand National Park experiences a Temperate Mediterranean climate, with warm, dry summers, cool, wet winters and an annual rainfall of 619 mm (as measured at the nearest meteorological station, Esperance) (Beard 1973, Bureau of Meteorology 1908-).

The study site is located at southern edge of Yilgarn craton, in the Proterozoic Albany-Fraser orogen of Yilgarn craton province, where the coastal granite hills and outcrops at Cape Le Grand are significant geomorphological features of the region (Comer et al. 2001). New Island Bay is bounded by massive coastal granite headlands including those associated with Mount Le Grand, which is the highest peak near the Project Area (345 m AMSL), but most of the survey area itself is below 50 m elevation and consists of gently undulating dunes, while the proposed access road climbs over rocky ridges of between 50 and 70m.

Much of the Project Area is dominated by coastal dune hills of Quaternary sands heaps on coastal hills of Proterozoic granite and gneiss (Morgan & Peers 1973). Further inland towards Hellfire Bay Road (in the northeast of the survey area) the terrain becomes an undulating upland of lateritic ridges (from weathered granites) and deeper grey sands among granite outcrops and hills.

Water draining off the surrounding granite headlands is channelled into numerous creeklines and swampy areas in New Island bay, several of which features intersect the Project Area. Two of these significant creeklines are crossed by the proposed road, and there are several seepage areas and lowland swamps which host wetland vegetation communities. Wet depressions also occur in some of the deeper in dune troughs. Swampy terrain forms at the base of the Mt Le Grand granites, which then drains into a meandering creek through the dunes to eventually drain into the beach in the south-east corner of the bay (Figure 1).

1.2 Vegetation and Flora

New Island Bay is located in the Recherche subregion of the Esperance Plains IBRA bioregion (Comer et al. 2001; Department of Sustainability, Environment Water,

Population and Communities 2011). The most recent vegetation maps for the Cape Le Grand National Park are inclusive within the broadscale 1:250 000 scale maps of Beard (1973), where the vegetation units are a combination of mixed Proteaceae – Myrtaceae scrub heath and granite outcrops. Beard mapped New Island Bay within part of the Fanny's Cove System, which encompasses littoral/coastal communities. Closer to the coast are relatively recent dunes with *Eucalyptus angulosa*, *Acacia*, *Melaleuca* and *Banksia* dominated mallee heath and heath, and ridges covered in scrub heath, swampy hollows between ridges covered in *Nuytsia* heath with sedges and rushes. Around granite hills are lakes, tea tree swamps, heathy swamps and sand heath, and further inland are extensive belt of sand ridges, swamps and heaths (Beard 1973). A more limited but also more detailed transect survey has been conducted at nearby Mount Le Grand and Hellfire Bay (Tauss 2005), which both border New Island Bay.

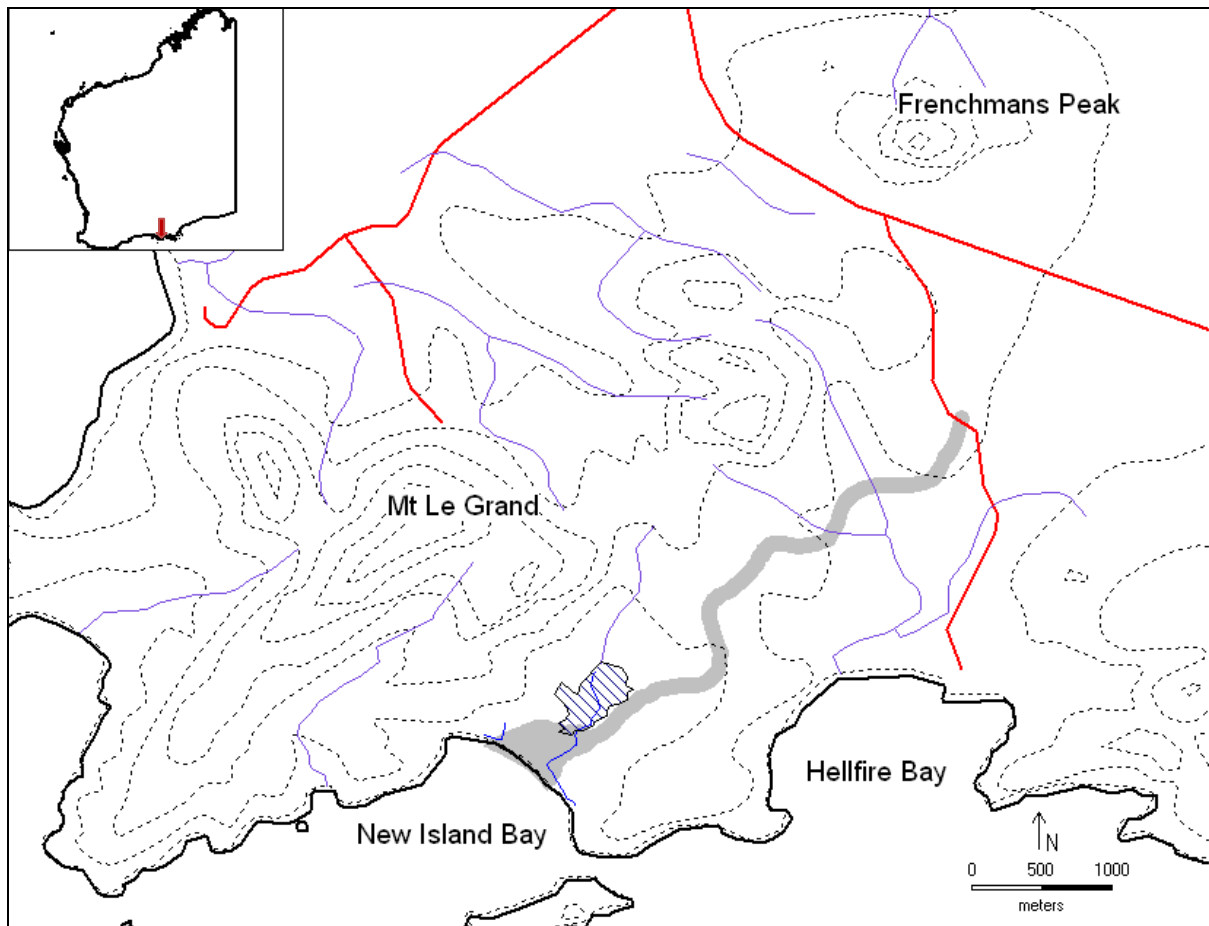


Figure 1: Map of New Island Bay Project Area flora survey (arrowed on inset map). Contours (broken black lines) are given at 50m intervals, and the major landmarks are labelled. The Project Area is shaded grey. Drainage lines are indicated by blue lines and swampy area in the Project Area is indicated by an outlined, hatched polygon.

The Project Area runs along a transect from the beach of New Island Bay inland c. 3.5 km in a northeast direction (Figure 1). The vegetation varies along this environmental gradient from coastal heath on foredunes to vegetated secondary dunes dominated by mixed mallee shrubland / heath and mixed Proteaceous and Myrtaceous shrubland / heath on sand over laterite and granites. These vegetation associations and the vegetation associated with creeklines and peaty swampland are described in Appendix 1. Most of the vegetation had been burnt in the summer of 2008/2009, so these site descriptions are based on regenerating vegetation.

1.3 Flora Identification Survey

This targeted survey for threatened flora is part of a larger scoping survey for threatened flora and fauna for a proposed development at New Island Bay, in Cape Le Grand National Park. This site is currently being assessed for its suitability for a potential tourism development, including an evaluation of the risks for impacts on biodiversity. This is a review of and search for native plant species of conservation significance occurring within the Project Area. This includes species that are listed as rare or potentially endangered, those endemic to the Cape Le Grand National Park and immediate surrounds, species with a limited distribution and outlying populations of species significantly disjunct from their main range.

2. Methods

2.1 Preliminary assessment

A preliminary desktop assessment was carried out prior to the field survey in order to identify conservation listed priority flora and endemic species which either actually or may potentially occur in the proposed Project Area. Species were drawn from both the Le Grand National Park and the surrounding Esperance district. This included querying the Department of Environment and Conservation (DEC) threatened flora database (DEFL), NatureMap (Department of Environment and Conservation 2007-), and Florabase for conservation listings and online herbarium records for Western Australia (Western Australian Herbarium 1998-), and the Australian Virtual Herbarium (2010) for national herbarium records.

These desktop survey results were used to generate a list of targeted flora (Table 1). Further species information was also obtained from Craig and Coates (2001). State and national conservation listings were checked using Florabase (Western Australian Herbarium 1998-, Smith 2010) and the EPBC Act list of threatened flora (Department of Sustainability, Environment, Water, Population and Communities 2009a-). Information from all these sources was used to generate a targeted species list for the field assessment (Table 1) and field information sheets.

Not all species from the wider Esperance area were likely to occur at New Island Bay due to the lack of suitable habitats in the bay (such as *Atriplex muellerii*), but species from coastal, sandplain, laterite and granite habitats in the wider area were considered for this survey. Species were selected on the basis of being endemic to

the Cape Le Grand National Park and immediate surrounds and / or listed as having conservation status under either state listing under the Western Australian *Wildlife Conservation Act 1950* or federal listings under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Both state (Department of Environment and Conservation 2010, 2011) and national listings (Department of Sustainability, Environment, Water, Population and Communities 2009b-) for threatened ecological communities were checked for the Cape Le Grand National Park.

2.2 Field Assessment

The field survey aimed to locate flora of conservation significance (actual and potentially occurring in Project Area). Two three-day field trips were conducted in the proposed development envelope in mid-late spring. The New Island Bay was surveyed between October 20th and 23rd 2011, and the proposed access road between Hellfire Bay Road and New Island Bay was traversed between the 24th and 26th November 2011 (Figure 2).

Using the waypoints provided by the Tourism Branch (DEC), both the New Island Bay development footprint boundary and the proposed access road were initially marked with flagging tape. The Project Area was then extensively traversed by foot by the pair of observers walking a series of zig-zag lines within the bay footprint and within 50m either side of the proposed road line (Figure 1). Both tracks and waypoints were taken using a GPS receiver (Garmin 76) at points of interest – namely site photos, collection points, locations of targeted taxa and a site references for field notes.

Because of the availability of volunteers, the field survey was divided into two fieldtrips. A different volunteer was taken on each trip, both of whom were experienced in flora survey and plant identification and either had worked or were currently working as technical officers at DEC (Science Division). A series of information sheets made prior to the survey were taken into the field to assist with recognition of priority taxa.

Field collections of putative priority flora, unknown and unusual species were pressed and identified at the Western Australian Herbarium. Some of the collections were referred to DEC or Western Australian Herbarium (WAH) staff with expertise in particular taxonomic groups, with the Malvaceae being seen by Carol Wilkins (WAH), *Sphaerolobium* being confirmed by Ryonen Butcher, *Opercularia* being confirmed by Greg Keighery (DEC) and *Leucopogon* and *Acrotriche* (Ericaceae) being seen by Mike Hislop (WAH).

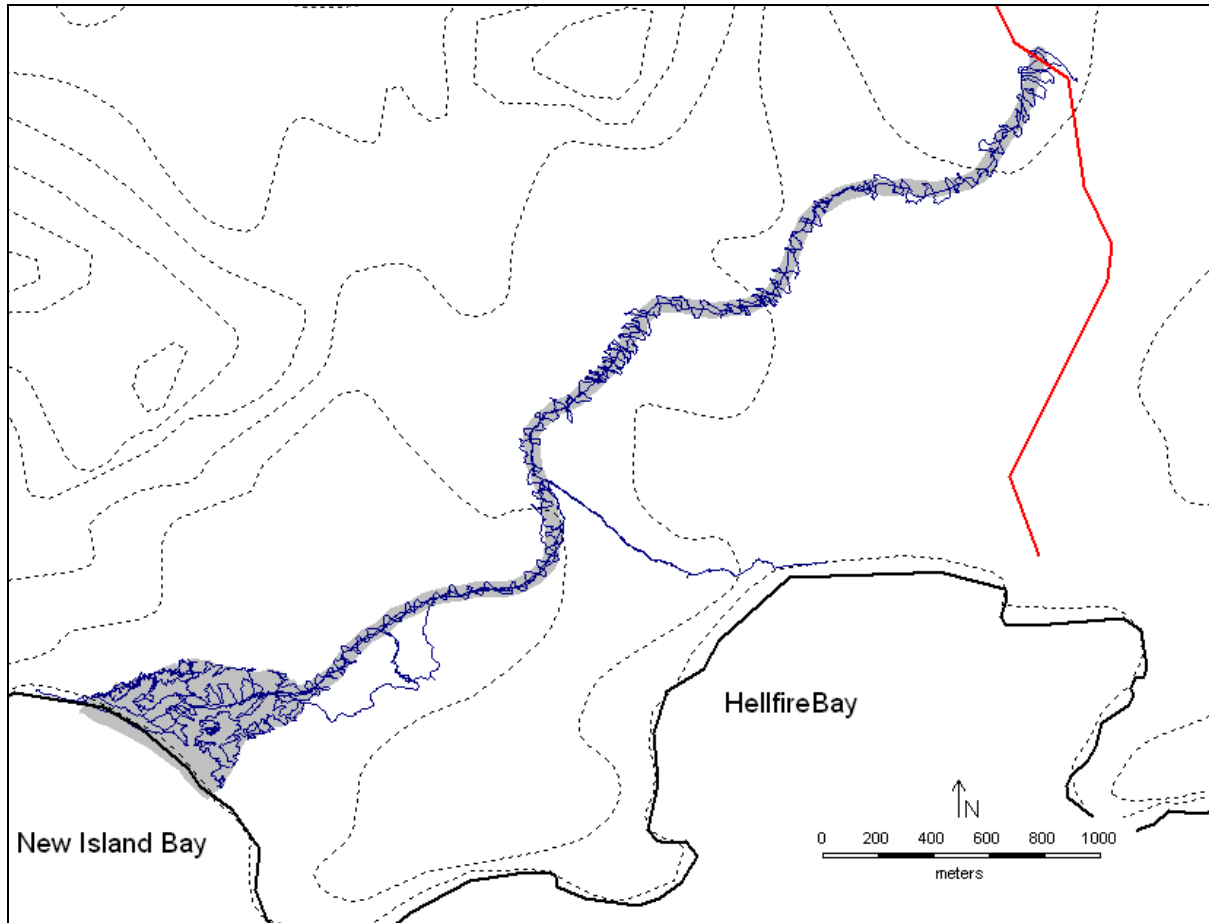


Figure 2: Map of New Island Bay Project Area flora survey. Contours (broken black lines) are given at 50m intervals. The Project Area is shaded grey, transects (tracks) walked during the survey are indicated by blue solid lines and roads indicated by red lines.

3. Preliminary assessment

Prior to this fieldwork, no priority flora were recorded as occurring within the survey boundary and no plant communities currently listed as either a PEC or TEC were found to occur within the proposed development envelope – although the heath and mallee community descriptions match those included in the Esperance Plains PEC listing. Previous exploratory work in August 2011 by Emma Adams (pers. comm.) found a single site each of *Lasiopetalum maxwellii* and *Leucopogon multiflorus* within the development envelope, and additional priority taxa just outside the Project Area (including *Eucalyptus aquilina* and *Eucalyptus semiglobosa*). The list of targeted taxa generated from this preliminary assessment consisted of 44 species. (Table 1)

Table 1: Targeted Taxa for Flora Survey of New Island Bay Project Area. Conservation status is according to state and national (EPBC) listings. T – Threatened (DRF – extant). CR – critical. VU – vulnerable. EN – Endangered. State flora priority conservation codes are defined by the DEC (<http://www.dec.wa.gov.au/content/view/852/1556/1/1/>). Endemic taxa are those restricted in distribution to Cape Le Grand National Park.

Species	WA status / rank	EPBC rank	endemic
<i>Acacia incanica</i>	P2		✓
<i>Acacia nitidula</i>	P2		
<i>Aldrovanda vesiculosa</i>	P2		
<i>Anigozanthos bicolor</i> subsp. <i>minor</i>	T / VU	EN	
<i>Astartea</i> sp. eastern swamps (A.G. Gunness 2434)	none		✓
<i>Banksia prolata</i> subsp. <i>prolata</i>	P3		
<i>Boronia scabra</i> subsp. <i>attenuata</i>	P3		
<i>Comesperma lanceolatum</i>	P2		
<i>Dampiera decurrens</i>	P2		
<i>Daviesia pauciflora</i>	P2		
<i>Eucalyptus aquilina</i>	P4		✓
<i>Eucalyptus balanopelex</i>	P1		
<i>Eucalyptus cornuta</i> x <i>utilis</i>	none		✓
<i>Eucalyptus famelica</i>	P3		
<i>Eucalyptus insularis</i>	T / EN	EN	
<i>Eucalyptus ligulata</i> subsp. <i>ligulata</i>	P4		
<i>Eucalyptus semiglobosa</i>	P3		
<i>Gonocarpus simplex</i>	P4		
<i>Goodenia quadrilocularis</i>	P2		
<i>Hibbertia hamata</i>	P3		
<i>Lambertia echinata</i> subsp. <i>echinata</i>	T / CR	EN	✓
<i>Lasiopetalum maxwellii</i>	P2		
<i>Lepyrodia fortunata</i>	P2		✓
<i>Leucopogon apiculatus</i>	P3		
<i>Leucopogon interruptus</i>	P2		
<i>Leucopogon multiflorus</i>	P2		
<i>Leucopogon rotundifolius</i>	P3		
<i>Melaleuca incana</i> subsp. <i>tenella</i>	P3		
<i>Myoporum velutinum</i>	T / EN		
<i>Opercularia hirsuta</i>	P2		
<i>Patersonia inaequalis</i>	P2		
<i>Persoonia scabra</i>	P3		
<i>Poa billardi</i>	P3		
<i>Ricinocarpos pilifer</i>	P2		✓
<i>Scaevola paludosa</i>	P2		✓
<i>Sphaerolobium pubescens</i>	P3		
<i>Stylidium beaugleholei</i>	P3		
<i>Stylidium glandulosum</i>	P3		
<i>Thysanotus brachiatus</i>	P2		
<i>Thysanotus parviflorus</i>	P4		
<i>Trachymene anisocarpa</i> var. <i>trichocarpa</i>	P3		
<i>Utricularia helix</i>	P2		✓
<i>Utricularia westonii</i>	P2		✓
<i>Verticordia verticordina</i>	P3		

4. Field Investigation

4.1.1 Priority taxa in New Island Bay Project Area

Fourteen taxa of conservation significance were located within the Project Area (Table 2, Figure 3). Thirteen of these were listed as having conservation status, one being a new population of threatened flora (declared rare flora - extant) (*Lambertia echinata* subsp. *echinata*). The remaining taxon (*Lasiopetalum* aff. *parvuliflorum*) was a putative new entity with affinities to a species already listed as having conservation status.

Table 2: Flora of conservation significance located in New Island Bay Project Area. Conservation status current as of February 2012.

Species	WA Conservation Status
<i>Commersonia apella</i>	P1
<i>Eucalyptus aquilina</i>	P4
<i>Eucalyptus ligulata</i> subsp. <i>ligulata</i>	P4
<i>Eucalyptus semiglobosa</i>	P3
<i>Goodenia quadrilocularis</i>	P2
<i>Lambertia echinata</i> subsp. <i>echinata</i>	T (CR)
<i>Lasiopetalum</i> aff. <i>parvuliflorum</i>	sp nov? closest taxon is P3
<i>Lasiopetalum maxwellii</i>	P2
<i>Lepyrodia fortunata</i>	P2
<i>Leucopogon multiflorus</i>	P2
<i>Leucopogon rotundifolius</i>	P3
<i>Melaleuca incana</i> subsp. <i>tenella</i>	P3
<i>Persoonia scabra</i>	P3
<i>Paterstonia inaequalis</i>	P2

Commersonia apella

Commersonia apella was located in the far north-western corner of the Project Area in New Island Bay (Figure 4), in the dense mallee regrowth in humic sandy soils in the creekline behind the foredunes (Appendix 1 C). Several tall shrubs (1.5 – 2.0 m) were spotted, but the dense vegetation precluded any more precise estimates of abundance, and this species was not immediately recognised as being of significance the field and did not receive closer attention.

Commersonia apella is a new species recently described by Wilkins & Whitlock (2011). It is currently known from several localities between Pemberton, Walpole and Denmark, but recent searches at these locations have failed to find live plants (including one post fire survey) (C. Wilkins, per. comm.). It was not expected to be located at New Island Bay, which is c. 445 km east of the nearest known populations at Denmark. Wilkins and Whitlock (2011) recommended that this species be nominated for threatened species (DRF) status because of the limited number of known populations and concerns about observed declines within those populations. At the time of publication of their description, Wilkins and Whitlock (2011) noted that the only known living plants of *Commersonia apella* were grown from cuttings and

located at the Australian National Botanic Gardens in Canberra, where they form the basis of a species conservation project.

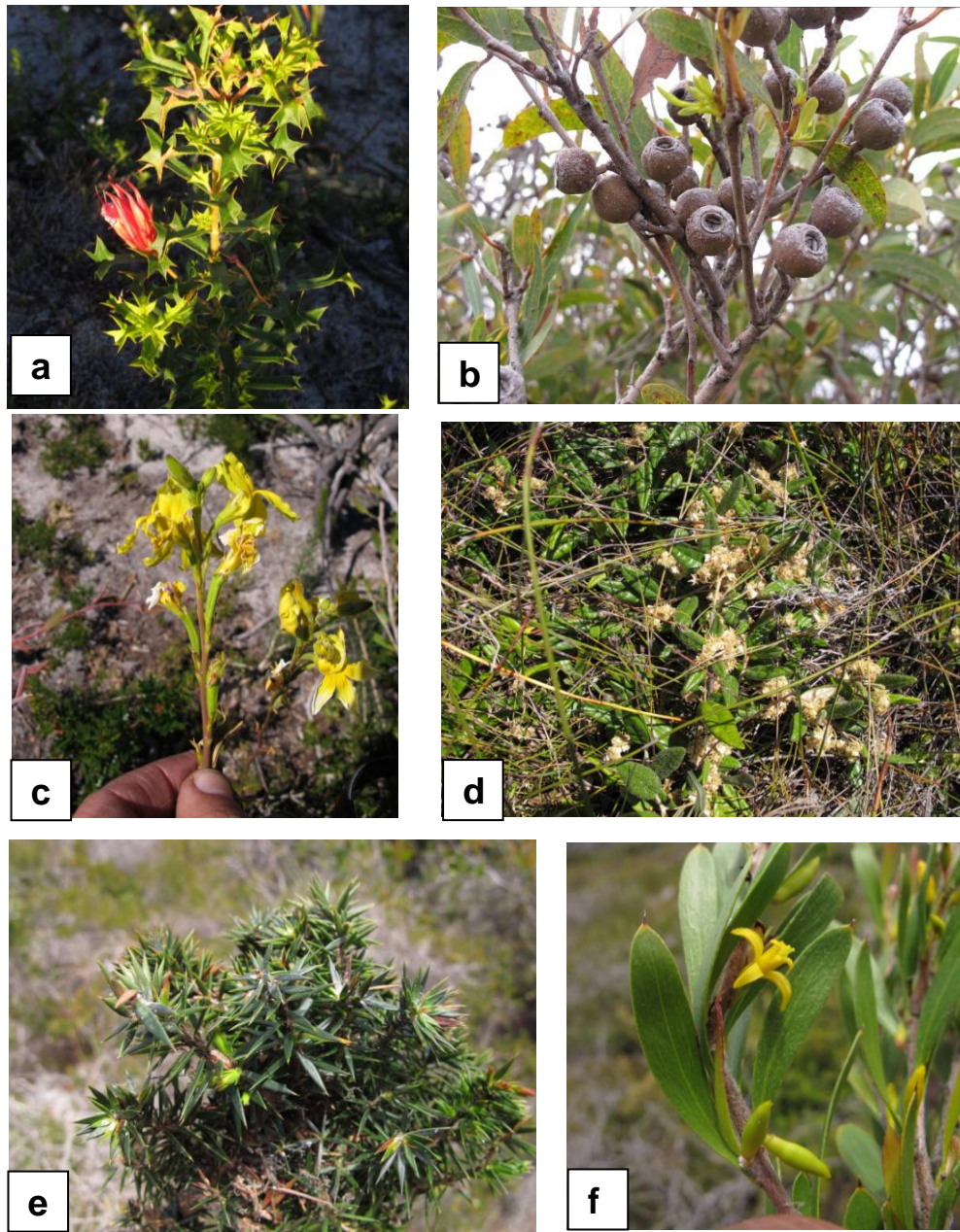


Figure 3 a: *Lambertia echinata* subsp. *echinata*., b: *Eucalyptus ligulata* subsp. *ligulata*, c: *Goodenia quadrilocularis*, d: *Lasiopetalum maxwellii*, e: *Leucopogon multiflorus*, f: *Persoonia scabra*.

Eucalyptus aquilina

Eucalyptus aquilina has a restricted distribution around Cape Le Grand National Park and the Recherche Archipelago, where it occurs in association with sandy soils over granite. This is a dominant species in stands of mallee, and was located on the northern edge of New Island Bay and in a major creekline (Figure 4, Appendix 1 I).

While *Eucalyptus aquilina* is listed as Priority 4 and is locally abundant in the Cape Le Grande region, it is a local endemic and has a relatively limited distribution.

Eucalyptus ligulata* subsp. *ligulata

Eucalyptus ligulata subsp. *ligulata* was found to be relatively abundant in the New Island Bay and along the parts of the proposed road, as part of the mallee heaths found on the deeper sandy soils and sands over laterites and granites (Figures 3 and 4, Appendix 1 G). *Eucalyptus ligulata* subsp. *ligulata* occurs in Cape Le Grand and Cape Arid National Parks, where it is a locally abundant mallee on deep grey sands over laterite and granite and on shallower grey sands on laterite ridges.

Eucalyptus semiglobosa

Eucalyptus semiglobosa is found between Bremer Bay and Cape Arid, with the type locality occurring between Mt Le Grand and Frenchmans Peak. *Eucalyptus semiglobosa* was found as a component of the mallee shrubland in New Island Bay, co-occurring with the very similar-looking *Eucalyptus goniantha* subsp. *notactities* (Figure 5, Appendix 1 E). This close similarity is not surprising, considering that *Eucalyptus semiglobosa* was formerly recognised as a subspecies of *Eucalyptus goniantha* (Hill & Johnson 1992). The two species were not expected to be so closely associated (Figure 5), and only sightings verified by collections could be considered conclusive.

Goodenia quadrilocularis

Goodenia quadrilocularis was found at several locations within and adjacent to the Project Area (Figure 6). It was found as small patches consisting of two - several plants on deeper white-grey sandy soils near drainage lines and on shallow sands over granites (Figure 3). It was only found in burnt vegetation and to be a fire opportunist. *Goodenia quadrilocularis* is known from several of locations around the Project Area. Most records in the WAH for *Goodenia quadrilocularis* are from Cape Le Grand and Cape Arid National Parks, with one record from the Porongurup Range. In these sites, this species is noted to occur in sandy soil pockets and in association with drainage lines on granite outcrops and hills (Craig & Coates 2001; Western Australian Herbarium 1998-).

Lambertia echinata* subsp. *echinata

A population of *Lambertia echinata* subsp. *echinata* was located within New Island Bay, within the Project Area (Figure 6, Appendix 1 E). This previously unrecorded population is a new find for this endangered species. This adds to the three known populations, all of which are restricted to Cape Le Grand National Park (Craig & Coates 2001; Monks *et al.* 2001; Threatened Species Scientific Committee, 2008), Western Australian Herbarium 1998-). It was estimated that there were 150-200 individuals at the time of survey. A few plants appeared to be 2-3 years old (estimated from both counting annual growth nodes and height (0.3-1m)), which were flowering in October 2011 (Figure 3). The majority (c. 150 - 180) were smaller plants (seedlings to c. 15 cm tall) which were estimated to be <2 years old and yet to flower. This population is coming back from seed after the hot summer 2008/ 2009 fire, and no adult plants were located in the burnt and adjacent unburnt vegetation. The profusion of seedlings within a in small area suggests that dispersal is limited.

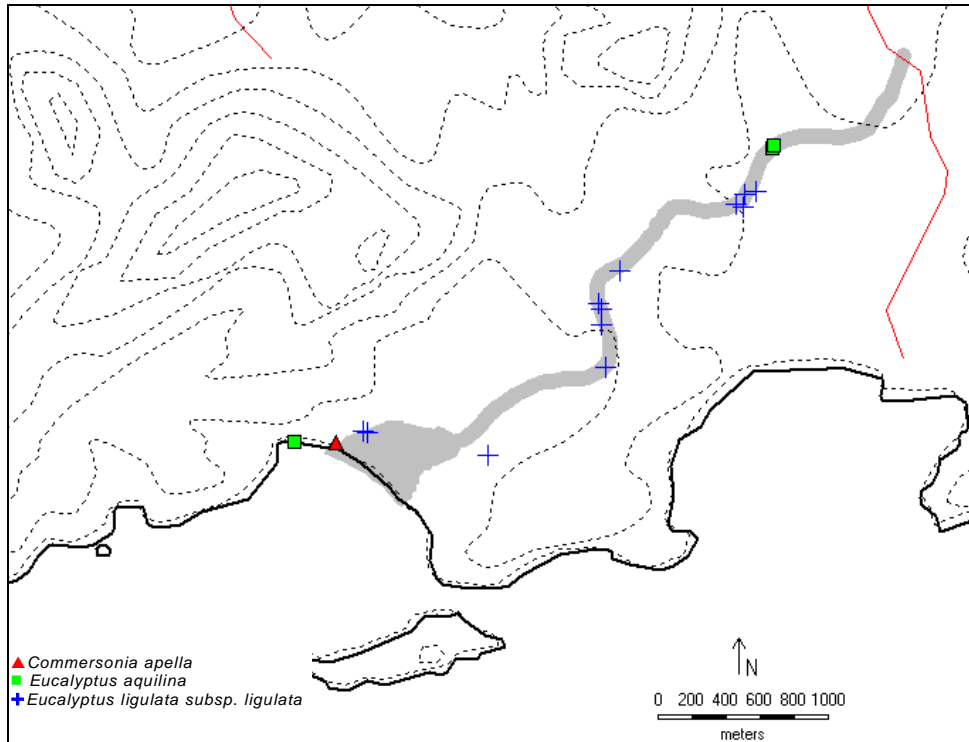


Figure 4: Distribution map of *Commersonia apella*, *Eucalyptus aquilina* and *Eucalyptus ligulata* subsp. *ligulata* within the proposed New Island Bay Project Area (grey shaded area).

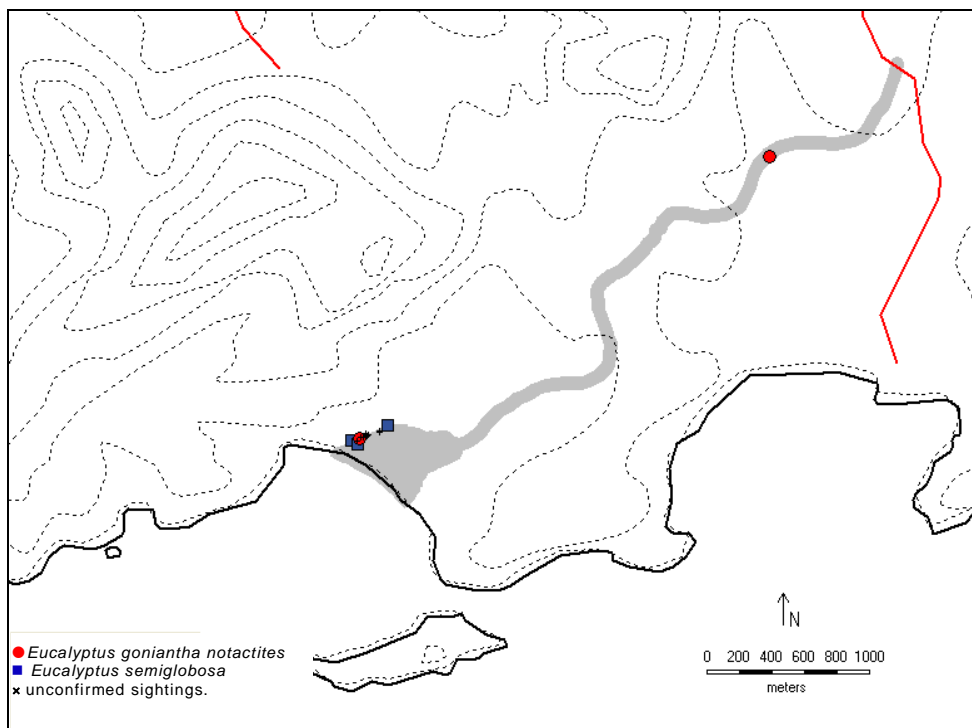


Figure 5: Distribution map of *Eucalyptus semiglobosa*, *Eucalyptus goniantha* subsp. *notactites* and unconfirmed sightings of either taxa within the proposed New Island Bay Project Area (grey shaded area). Species identity was only confirmed with collected material.

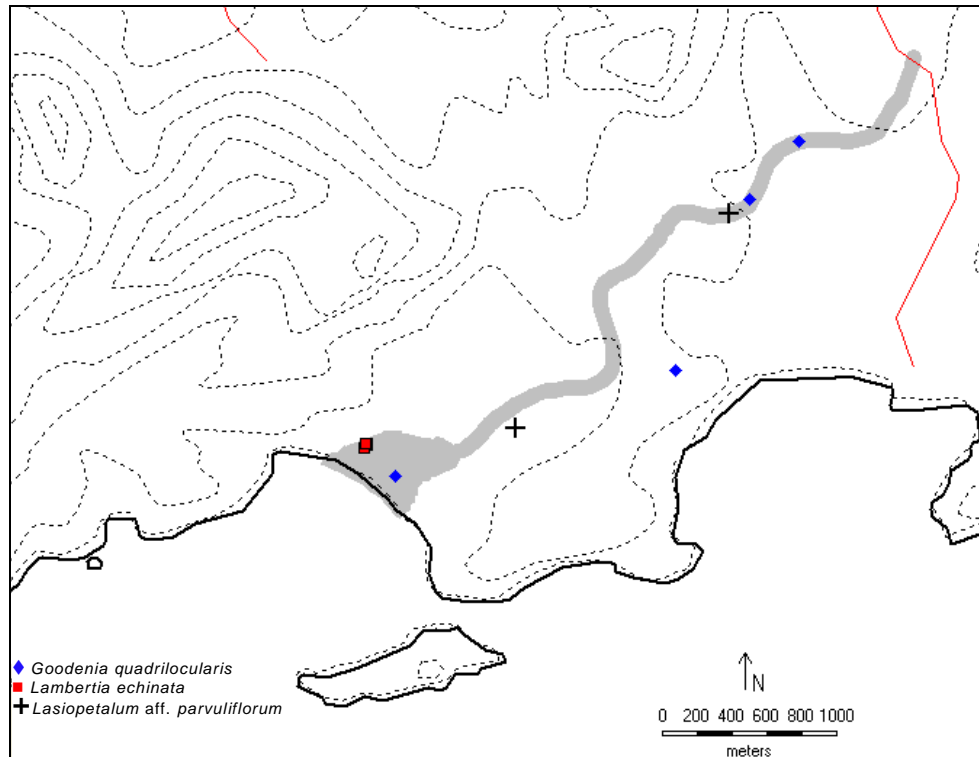


Figure 6: Distribution map of *Goodenia quadrilocularis*, *Lambertia echinata* subsp. *echinata* and *Lasiopetalum* aff. *parvuliflorum* within the proposed New Island Bay Project Area (grey shaded area) and along the walking track into Hellfire Bay.

***Lasiopetalum* aff. *parvuliflorum* (sp nov?)**

Lasiopetalum aff. *parvuliflorum* was collected in two localities within the Project Area (Figure 6 < Appendix 1 F), where it was found to be uncommon. This low subshrub was noted by C. Wilson (pers. comm.) to be unusual in that the glands and hairs on the outer calyx surface were denser and larger than observed in other similar *Lasiopetalum* species. It was noted to have affinities to *L. parvuliflorum*, which is a P3 listed species. Material will be lodged at WAH so that further taxonomic work can proceed on this entity.

Lasiopetalum parvuliflorum is located at scattered locations between Stirling range NP, Bremer Bay and Point Malcolm – Cape Arid. Work would be required on this taxa and the entity collected in New Island Bay. Craig & Coates (2001) note that a population of *Lasiopetalum parvuliflorum* occurs in Cape Le Grand NP but no collections exists in the WAH, which means collections from this population haven't been seen by an expert taxonomist.

Lasiopetalum maxwellii

Lasiopetalum maxwellii was the most commonly encountered target species (Figures 3 and 6). It was found to be very abundant (estimates number in the hundreds of individuals) in the bay, occurring across wide range of habitats on deeper sandy soils and on adjacent granites. Most plants were seedlings growing in the burnt vegetation, having germinated post-fire. It should be noted that this is a fire response, and this

density of plants is likely to decline as the vegetation regenerates after fire and the plants mature and succumb to attrition (C. Wilkins, pers. comm.). Most herbarium records for *Lasiopetalum maxwellii* are from Cape Le Grand National Park (Thistle Cove, Lucky Bay, Hellfire Bay) with a few records from Cape Arid National Park and Bald Island, near Albany.

Leucopogon multiflorus

Leucopogon multiflorus was located twice within the Project Area (Figure 7), suggesting that it was an uncommon or occasional shrub in coastal heath on deeper sands (Figure 3, Appendix 1 E,F). *Leucopogon multiflorus* occurs from near Albany and Mt Barren eastward to the Cape Le Grand and Cape Arid National Parks, where it is recorded usually as occasional in coastal heath on granite slopes (Craig & Coates 2001; Western Australian Herbarium 1998-).

Leucopogon rotundifolius

Leucopogon rotundifolius was located at one location within the bay (Figure 8), in the secondary dunes (Appendix 1 B). This species typically grows in sandy soils around coastal granite outcrops and in coastal scrub and heaths (Craig & Coates 2001). *Leucopogon rotundifolius* has been recorded in coastal regions between Esperance and Israelite Bay, and further inland at Condingup and Scadden. At Cape Le Grand National Park, *L. rotundifolius* is known from a wide number of locations and reported by Craig & Coates (2001) to be very common and occurring on most granite outcrops.

Lepyrodia fortunata

Lepyrodia fortunata is a currently unpublished manuscript name (Meney & Pate 1999) for a medium-tall rush which grows in seasonally inundated freshwater wetlands on peaty sand (Craig & Coates 2001, Western Australian Herbarium 1998-). It is restricted to the Cape Le Grand National Park, where it is known from five locations, including this new record for the species in New Island Bay (Figure 7). The nearest known population is north of Mt Le Grand, near Le Grand beach and 3.5 km from the New Island Bay population. Because this species was found growing among a dense stand of sedges and rushes in a thicket of burnt *Melaleuca* (Appendix 1 H), it was difficult to assess the size and extent of the population.

Melaleuca incana* subsp. *tenella

Melaleuca incana subsp. *tenella* was located once in a significant swampy creekline in the Project Area (Figure 8, Appendix 1 H), and was identified from a very few plants which had escaped being burnt. Most of this area had been burnt and the creekline vegetation regrowth difficult to move through, so an assessment of abundance and distribution could not be made. It appeared (from burnt branches), that both *Melaleuca incana* subsp. *tenella* and *Melaleuca globifera* dominated a wetland thicket in this section of the drainage line.

This tall shrub occurs predominantly around Esperance district in swampy habitats, from Esperance to Cape Le Grand NP, Condingup Peak, Coolinup Nature Reserve and Cape Arid NP, with an outlying record from Albany (Craig & Coates 2001; Western Australian Herbarium 1998-).

Patersonia inaequalis

This is a small, superficially sedge-like, tufted plant which flowers mainly in winter, so the single plant encountered in New Island Bay (Figure 8) was found to be in late-fruit. It is likely that there were a few more plants in the vicinity which were overlooked because they were past-fruiting or were sterile and growing in association with sedges and rushes in sands over laterite (Appendix 1 G). A better time for survey would be in August-September, when their distinctive white flowers are more conspicuous. Craig & Coates (2001) note that this species grows as scattered, widely spaced individuals with only a few plants growing in together.

This distinctive perennial herb is restricted to the Esperance district, with most populations known from Cape Le Grand National Park (Frenchmans Peak, Lucky Bay, Mt Le Grand), with one population on the adjacent Mondrain Island and two outlying populations at Gibson and Coomalbidgup Swamp (Western Australian Herbarium 1998-). It is a relatively poorly collected species, with 11 records in the WAH, and a further 7 records (including duplicates) in other Australian herbaria.

Persoonia scabra

Persoonia scabra was found throughout the development envelope (Figure 8) in New Island Bay. This species was found to be relatively common and scattered in the low heath on the stabilised secondary dunes and deep white sands in the bay, having resprouted from rootstock after the fire A(ppendix 1 D). Plants were found to be flowering well in October and late November (Figure 3).

This species is poorly collected, with only 11 records in the WAH and a further 12 collections (including duplicates) in other Australian herbaria. There are only two (including this new record at New Island Bay) populations along the coastline east of Esperance. Populations of *Persoonia scabra* are scattered from Lake King to Kau Rocks, south at Dunns Beach (Cape Le Grand National Park) and eastwards to Mount Ragged (Cape Arid National Park). The type locality for *Persoonia scabra* is at Lucky Bay, where it was collected by Robert Brown collected in 1802 ('Bay 1') (Chapman et al. 2001) but this population has not been collected from since. The type locality hasn't been in doubt, since *Persoonia scabra* is known from the Esperance region, but this collection from New Island Bay does confirm Lucky Bay as the type locality.

Care was taken to confirm the identity of this *Persoonia*, since *Persoonia scabra* and *Persoonia spathulata* (an uncommon species) are superficially similar species whose ranges overlap. The former species is characterised by a lack of glandular hairs on the outer perianth lobes.

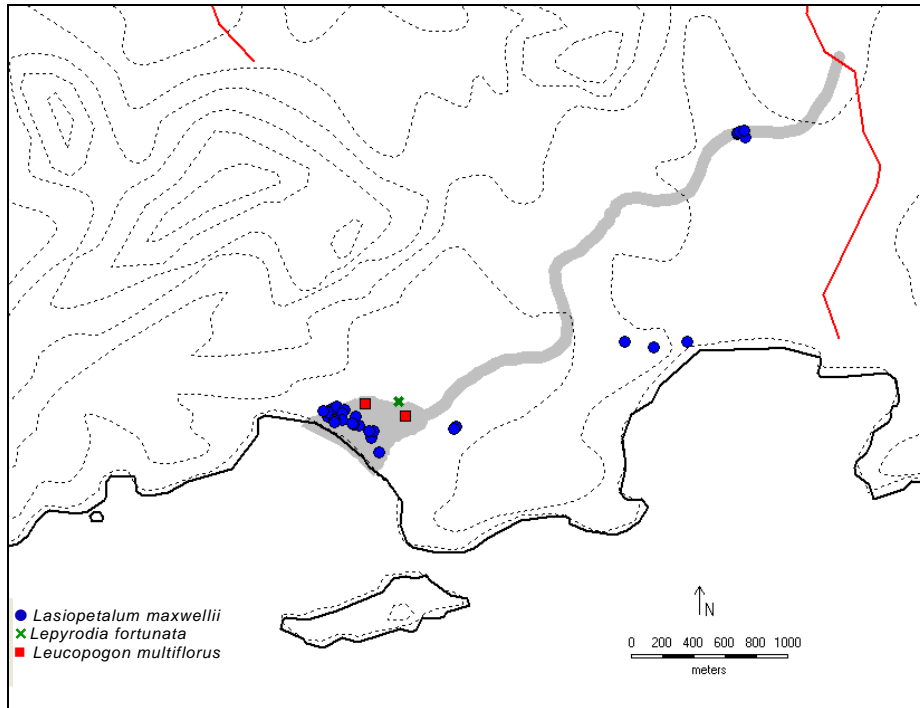


Figure 7: Distribution map of *Lasiopetalum maxwellii*, *Lepyrodia fortunata* and *Leucopogon multiflorus* within the proposed New Island Bay Project Area (grey shaded area) and along the walking track into Hellfire Bay.

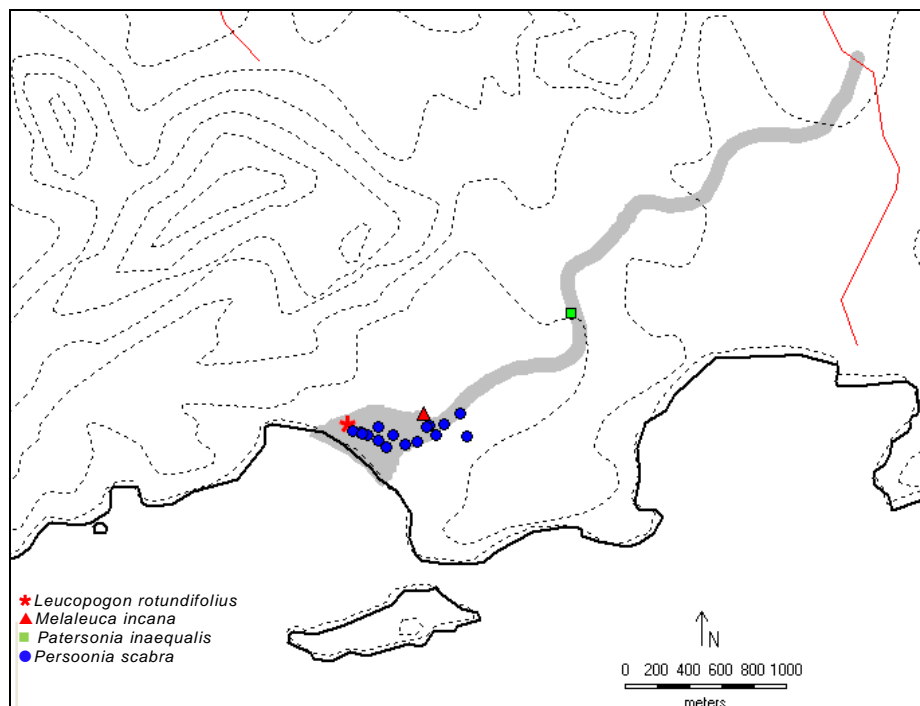


Figure 8: Distribution map of *Leucopogon rotundifolius*, *Melaleuca incana* subsp. *tenella*, *Patersonia inaequalis* and *Persoonia scabra* within the proposed New Island Bay Project Area (grey shaded area).

4.1.2 Other Significant flora in New Island Bay

Eight species of interest were located and identified from the New Island Bay survey. Two of these are priority listed species located outside of the Project Area and along the Hellfire Bay – Mt Le Grand walk trail. Three species are of geographical significance – these being significant range extensions and/or new species records for the park. Two taxa are putative new species, both with a limited distribution to coastal regions east of Esperance.

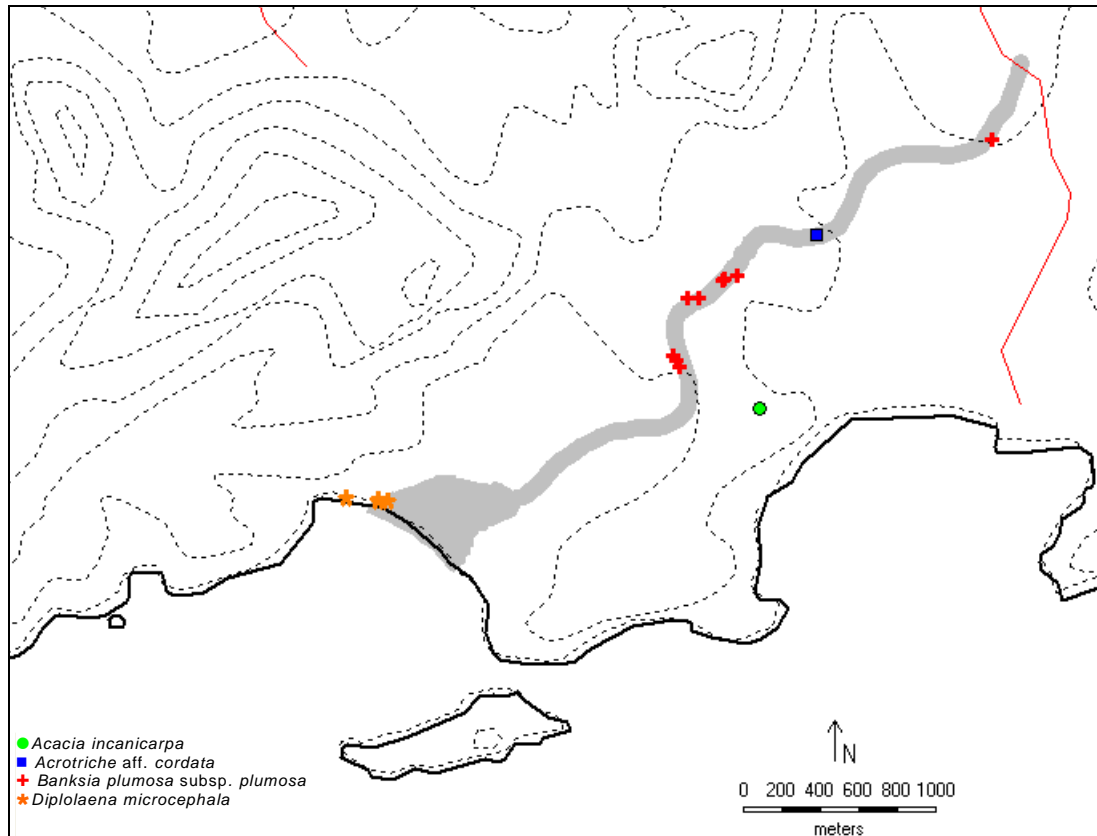


Figure 9: Distribution map of *Acacia incanycarpa*, *Acrotriche* aff. *cordata*, *Banksia plumosa* subsp. *plumosa* and *Diplolaena microcephala* within the proposed New Island Bay Project Area (grey shaded area) and along the walking track into Hellfire Bay.

Acacia incanycarpa

The conservation listed species, *Acacia incanycarpa* was located adjacent to the Project Area on the Le Grand - Hellfire Bay track (Figure 9). This was a small patch of c. 10 plants on the granite outcrop. *Acacia incanycarpa* is restricted to Cape Le Grand National Park, where it is known from several granite hills between Frenchmans Peak, Cape Le Grand and Thistle Cove, but not from this part of Hellfire Bay (Craig & Coates 2001, Western Australian Herbarium 1998-).

Acrotriche* aff. *cordata

Acrotriche aff. *cordata* is a distinctive, narrow-leaved variant of *Acrotriche cordata* which is a new record for Cape Le Grand National Park, where two plants were found in one location on a burnt, rocky lateritic slope (Figure 9, Appendix 1 G). This is an undescribed taxon in the *Acrotriche cordata* species complex, which is currently being investigated by Mike Hislop (WAH) and who advises that there is sufficient morphological evidence for this new to be separated from *Acrotriche cordata* and recognised as a new taxon. Specimens known from three locations – at Cape Le Grand and Cape Arid and a location between two parks on southeast coastline. This entity is sympatric with the typical variant of *Acrotriche cordata*, which has also been collected from Cape Le Grand National Park.

Banksia plumosa* subsp. *plumosa

A population of *Banksia plumosa* subsp. *plumosa* was found growing on stony lateritic ridges (Figures 8 and 10, Appendix 1 G). This is the first time in 200 years that this species has been collected at Cape Le Grand since Robert Brown visited the area. In his description of *Banksia plumosa*, Robert Brown (1810) noted that the type specimen was originally collected from 'Bay 1' (i.e. Lucky Bay) in January 1802, making Lucky Bay the type location. Over the following two centuries, more collections of this species have been made in an area from the Stirling Ranges and Albany eastwards to the Fitzgerald River. However, *Banksia plumosa* was not recorded again from any area east of Bremer Bay (c. 270 km west of Cape Le Grand). George (1999) concluded that the type locality was in error, and that the more likely type location was in the Albany district (King George Sound) where Brown collected from December to early January in 1801-1802 (Vallance et al. 1993). The discovery of this New Island Bay population, approximately six kilometres west of Lucky Bay, confirms that *Banksia plumosa* was originally collected at Lucky Bay. This is a significant find in terms of confirming Cape Le Grand National Park as the eastern limit of this species and as the type locality for this species.

Commersonia grandiflora

Commersonia grandiflora is a small subshrub that was located in New Island bay (Figure 9) under *Melaleuca globifera*/*Callitris preissii* tall shrubland in dune troughs in the secondary dunes of New Island Bay (Appendix 1 C). Although not currently listed as having conservation status, Wilkins and Whitlock (2011) recommended a review of this species because populations at each of the c. 15 known localities consist of only a few plants.

Diplolaena microcephala

Diplolaena microcephala was located in foredune vegetation, on the crests and in association with the coastal mallee (Figure 9, Appendix 1 C). This is a new record of this species and genus in the Le Grand National Park, and this newly discovered population is an outlier between two eastern populations at Boyatup Hill and near Leda Nature Reserve (c. 110 east and 100 km northeast of New Island Bay) and the main distribution west of Hopetoun (200 km west of New Island Bay). The species is

characterised by a rust-coloured indumentum on the inflorescence bracts, but this character isn't so obvious on specimens collected from New Island Bay (Figure 11), Boyatup Hill and on a collection from Cape Riche.

Dampiera decurrens

Dampiera decurrens is a P2 priority listed species which was not located within the survey area, but encountered on the Le Grand - Hellfire Bay track just outside the survey area (Figure 10), on skeletal sandy loams on granites on the western side of Hellfire Bay (Figure 11). This species was growing well and in abundance following the recent fire. This is a new locality for this species, which is found on granite outcrops and headlands in numerous locations within Cape Le Grand National Park (Craig & Coates 2001; Western Australian Herbarium 1998-).

Opercularia aff. ovata

Opercularia aff. ovata is an undescribed taxon. *Opercularia ovata* is not currently recognised as occurring in Western Australia, but an entity collected from the south coast and within the Project Area has some affinities to this eastern states taxon (G. Keighery, pers. comm). *Opercularia aff. ovata* was collected on the foredunes within the bay, and on granites adjacent to Hellfire Bay (Figure 10), and was growing vigorously after the fire (Figure 11).

Opercularia is a relatively neglected genus in WA requiring some revision, particularly in regards to recognising *Opercularia aff. ovata* and distinguishing this entity from *Opercularia hispidula* and *Opercularia hirsuta*. An examination of herbarium specimens clearly shows that these entities are being confused, and work is required to redefine taxonomic characters which distinguish these taxa. This will determine the range and conservation status of *Opercularia aff. ovata*, which currently appears to be restricted to the southern coastline. It is likely that *Opercularia aff. ovata* will be phrase-named during the early stages of this taxonomic work.

Opercularia echinocephala

Opercularia echinocephala was found to be a common subshrub found widely from the foredunes in the bay back to on the deeper sands over laterite and granite (Figures 9 and 10). It was growing in abundance in the burnt vegetation, and is a fire opportunist. This species has only been collected previous on three occasions in the Esperance district. Two sterile collections of what appeared to be this species had been made near Esperance (near Barker Inlet) and lodged in WAH, but could not be verified as belonging to this taxon. According to a single South Australian Herbarium record, a second population was located in 1968 at Condingup Peak. Ample collections of fertile material from New Island Bay confirms that *Opercularia echinocephala* does occur in the Esperance district, and it was found to be abundant with New Island Bay and a post fire opportunist. These Cape Le Grand populations are c. 530 km east of the main distribution of the species in the northern Jarrah forest and Swan Coastal Plain. Such greatly disjunct eastern populations require further detailed work to determine how different they are from the main species range.

Thelymitra fuscolutea

Collections and photographs were made of *Thelymitra fuscolutea*, whose identity was confirmed by Andrew Brown (DEC) (Figure 11). This species record extends the

known range of this species east by c. 330 kilometers. A closely related and very similar species, *Thelymitra benthamiana* is known from Cape Le Grand National Park, but this is first record for *Thelymitra fuscolutea* in the Esperance district (Figure 10). Plants were found growing on sand on the laterite ridges, apparently flowering in response to the fire.

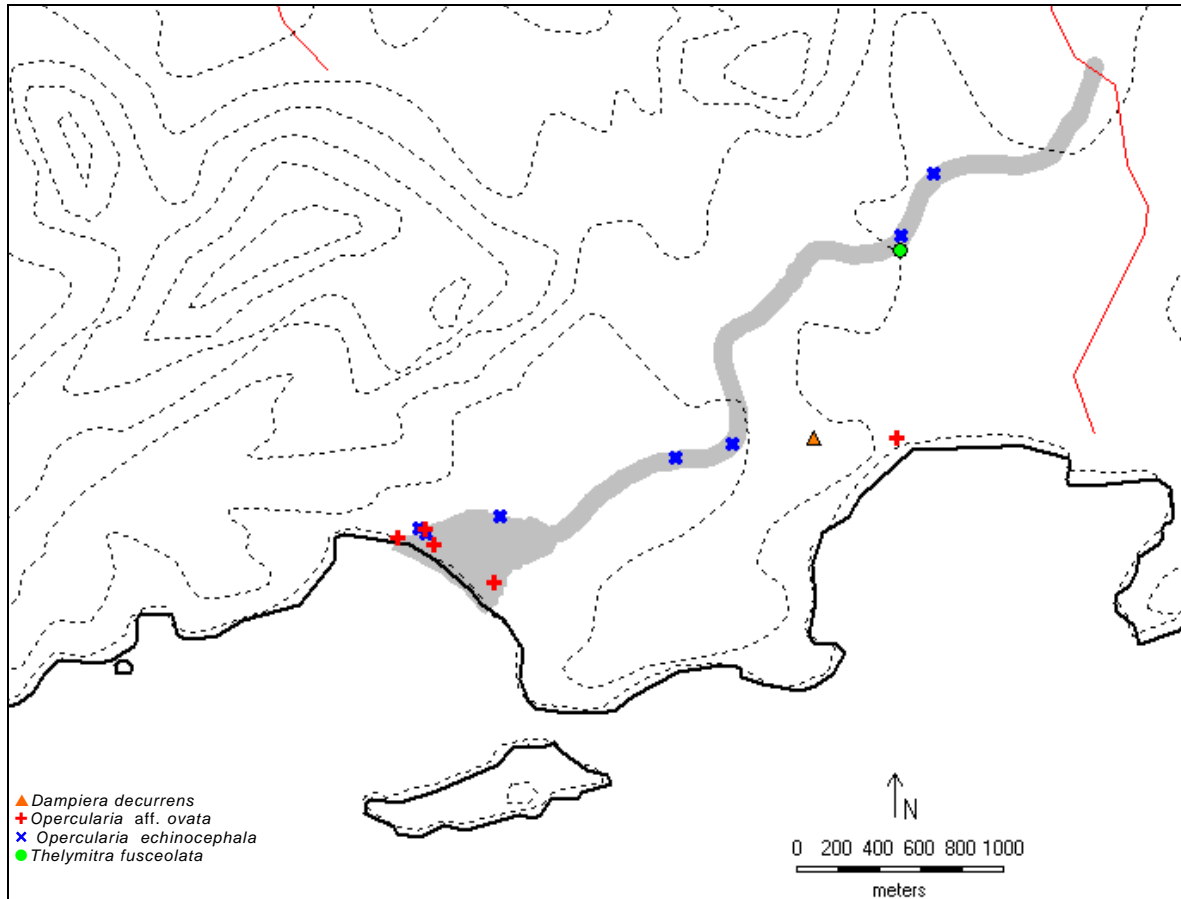


Figure 10: Distribution map of *Dampiera decurrens*, *Opercularia aff. ovata*, *Opercularia echinocephala* and *Thelymitra fuscolutea* within the proposed New Island Bay Project Area (grey shaded area) and along the walking track into Hellfire Bay.

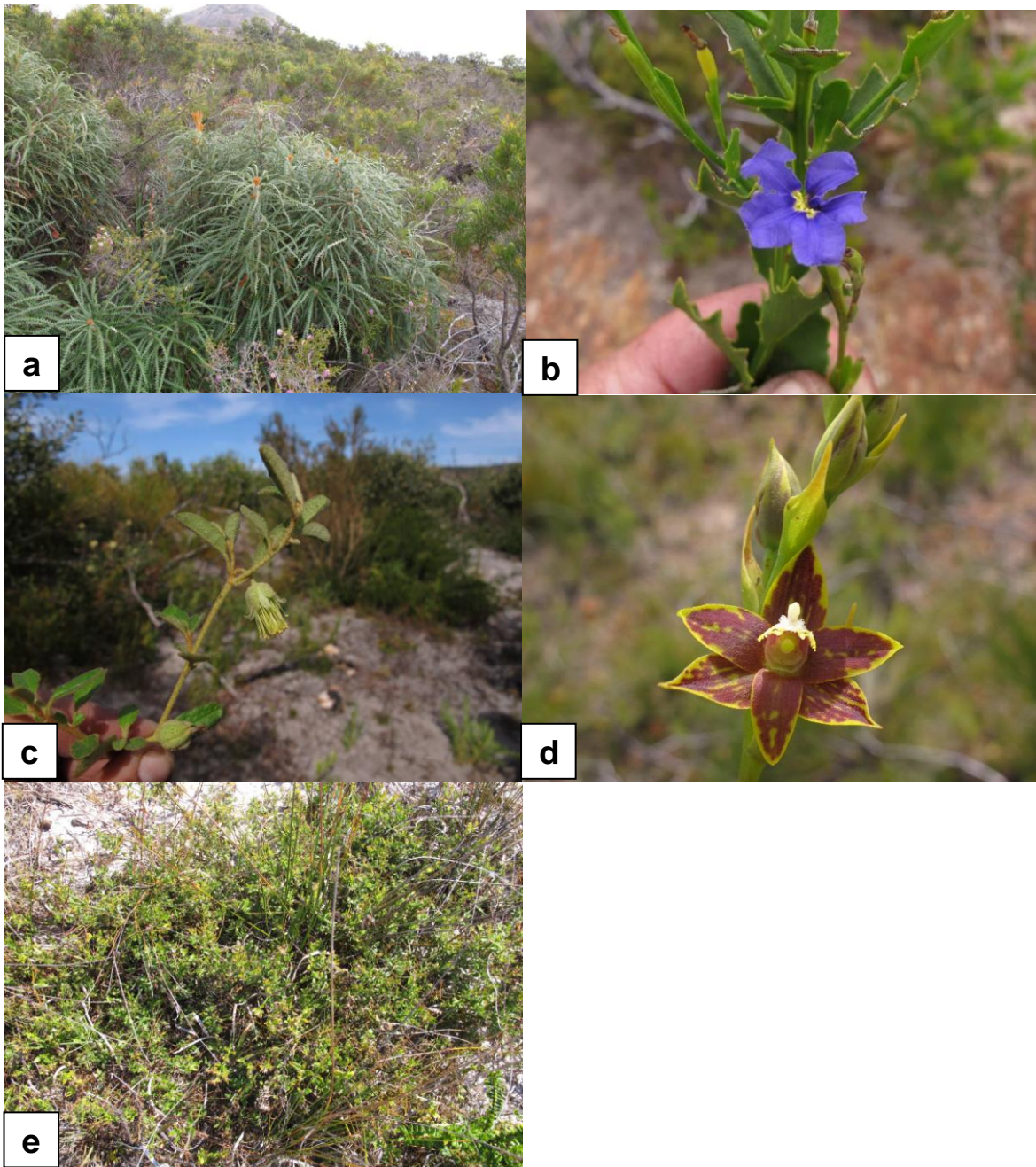


Figure 11: a: *Banksia plumosa* subsp. *plumosa*, b: *Dampiera decurrens*, c: *Diplolaena microcephala*, d: *Thelymitra fuscolutea*, e: *Opercularia* aff. *ovata*,

4.1.3 Weeds, vegetation condition and threatening processes

The area was found to be relatively free from invasive non-native plants, and no weeds of national significance were found. The most noticeable sites for non-native weeds were the on foredunes in New Island Bay, which had scattered individuals of *Peplidium paralias*, *Cakile maritima* and *Avena barbata*. The beachfront was observed to be free from marram grass (*Ammophila arenaria*), rose pelargonium (*Pelargonium capitatum*), beach evening primrose (*Oenothera drummondii*) and dune daisy (*Arctotheca populifolia*), all of which are common coastal weeds in the Esperance district and occur in Cape Le Grand National Park (including in the

adjacent Hellfire Bay). Should marram grass become established in New Island Bay, it could spread up through the dunes, changing dune structure and vegetation community composition and changing the environmental values of the beachfront.

Since much of the Project Area was recovering from the recent hot summer fire, it was difficult to assess the vegetation condition. The vegetation condition within the Project Area was judged to be in very good to excellent condition (Keighery 1994), based on the high diversity of native species, the low numbers and low abundance of weed species, and from the absence of clearing, roads, grazing and mechanical disturbance. Only one track currently traverses the Project Area, which is the Hellfire Bay – Le Grand Beach walking track which is situated far from the bay.

Dieback (*Phytophthora* spp.) spread into the Project Area poses a very significant threat to the vegetation of New Island Bay. Many of the species in the bay would be adversely affected by this disease, including the dieback sensitive *Lambertia echinata* subsp. *echinata* (Monks et al. 2001; Threatened Species Scientific Committee 2008). Current information on dieback distribution in the Project Area and between Mt Le Grand and Hellfire Bay isn't available and the recent fire has made it difficult to interpret the presence of dieback. However, it is likely that dieback is present in the area (G. Freebury, pers. comm.). Patches of dead shrubs on some of the upland sites on the lateritic ridges and near the granites could indicate the presence of dieback, but soil / tissue sampling is required to confirm its presence.

5. Discussion

This targeted flora survey in the New Island Bay area located thirteen species of listed conservation status, one species likely to be listed, and a further eight species of significance. A further two species of priority status occur adjacent to the Project Area, outside of the area of potential immediate impact. The vegetation communities were observed to be relatively intact, undisturbed and weed-free. Based on these values, the area is of high conservation significance.

The newly located population of the threatened species, *Lambertia echinata* subsp. *echinata* was found to be a large, with >150 seedlings estimated to have emerged after the fire. This is a significant population which will be included in recovery operations for this species, and monitoring and detailed mapping of this population has already commenced (David Coates (DEC), per. comm.). Development in the vicinity of this population will require assessment for risks of negative impacts to this population, including clearing and disturbance associated with infrastructure construction, public access to and the potential for the spread of dieback (*Phytophthora*) disease (Monks et al. 2001, Threatened Species Scientific Committee 2008).

Of the priority-listed species, *Commersonia apella* has been recommended to be nominated for threatened flora listing (Wilkins & Whitlock 2011). This new population is the only known population currently with plants known to be alive and flowering. Priority should be given to estimating the size of this population in New Island Bay, for seed collection for propagation efforts and for further survey in Cape Le Grand National Park for more populations.

Opportunistic collections conducted during this targeted survey found new and unexpected species records for the park, species' range extensions, records of historical significance and undescribed and potentially new species. This suggests that a further, more detailed survey is required to document the total vascular flora.

There are some limitations on this limited targeted flora scoping survey. Some priority species that are small and inconspicuous could have been overlooked, including *Gonocarpos simplex* (in peaty sandy soils in swampy area). Other species potentially missed are those which reappear in the later successional stages of post-fire vegetation recovery and those that flower outside of spring.

Future planning for conservation, management and infrastructure would benefit from the survey and mapping of vegetation communities, as this information is not currently available at a fine scale. The Cape Le Grand National Park vegetation was most intensively surveyed in 1971 by Arthur Weston (Kitchener et al. 1975), and a number of collections from those surveys have been lodged in the Western Australian Herbarium, but the associated final report was not completed.

6. Conclusions and Recommendations

A total of 22 species of significant flora were located in the New Island Bay Project Area. Proposed developments should be planned to not impact adversely or minimise disturbance on these populations.

Further detailed ground work is required to accurately map distributions and boundaries of populations of targeted species (especially *Lambertia echinata* and *Commersonia apella*) within the Project Area and locate new populations in adjoining areas, since this detail was not possible on the initial scoping trips.

Some species that are small and inconspicuous or absent soon after fire could have been overlooked by this scoping survey. Further surveys should consider the possibility that species such as *Patersonia inaequalis* may have been under-reported or less conspicuous priority listed species, such as *Lepyrodia fortunata* and *Gonocarpus simplex*, may occur in the wetlands in the Project Area.

A number of significant range extensions, new records for the area and a putative new species (undescribed taxa) were located in this survey, which was essentially a survey concerned with locating conservation listed species. This demonstrates that there is a need for a more exhaustive survey to compile an inventory of all vascular plant species. A comprehensive park-wide flora survey will determine the level of biological diversity found in New Island Bay and in the Cape Le Grand National Park

Vegetation community descriptions and mapping have not been undertaken in the Project Area and Cape Le Grand National Park, so no conclusion can be made on the significance of the plant communities found in the Project Area.

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9. Appendices

9.1 Appendix 1: Vegetation associations of the New Island Bay Project Area. Descriptions are based on field notes and describe vegetation which is generally post-fire regrowth.



A: Steep coastal foredunes: Low shrubland dominated by *Olearia axillaris*, *Acacia nigricans*, *Leucophyta brownii*, *Adenanthos cuneatus*, *Pimelea ferruginea*, *Bossiaea dentata*, *Ricinocarpos megalocarpus*, *Rhagodia baccata*. *Leucopogon obovatus*, *Poa poiformis*, *Sporobolus virginicus*, *Ficinia nodosa*, *Senecio pinnatifida* subsp. *maritima* and *Dampiera fasciculata*.



B: Secondary dunes: Shrubland dominated by *Ricinocarpos megalocarpa*, *Melaleuca globifera*, *Bossiaea dentata*, *Olax phyllanthi*, *Gyrostemon sheathii*, *Acacia nigricans*. Prior to the fire, tall thickets of *Melaleuca globifera* and *Callitris preissii* would have stood in the dune troughs / depressions.



C: Secondary dunes: Coastal mallee adjacent to creeklines and dune troughs – Dense mallee (*Eucalyptus uncinata*, *Eucalyptus angulosa*, *Eucalyptus conferruminata* and *Eucalyptus cornuta*), *Melaleuca globifera* and *Hakea drupacea*, over moderately dense mixed shrub layer of *Acacia myrtifolia*, *Acacia nigricans*, *Gyrostemon sheathii*, *Olax phyllanthi*. *Phyllanthus scaber*, *Bossiaea dentata* and *Diplolaena microcephala*.



D: Mixed Proteaceae and Myrtaceae Low shrubland on consolidated dunes – *Xanthorrhoea platyphylla*, *Banksia repens*, *Melaleuca globifera*, *Melaleuca thymoides*, *Melaleuca striata*, *Adenanthos cuneatus*, *Calytrix decandra*, *Logania serpyllifolia*, *Anarthria scabra*, *Banksia nivea*, sedges, rushes (including *Lepidosperma* spp. and *Lepyrodia* sp), *Lechenaultia tubiflora* and *Persoonia, scabra*. *Banksia speciosa* was not observed in this community, although it occurs in similar foredune heath in Hellfire Bay.



E: Mallee shrubland - Proteaceous heath on deep grey sand adjacent to granites – Mixed *Eucalyptus* mallee heath (*Eucalyptus goniantha* subsp *noctactites*, *Eucalyptus semiglobosa*, *Eucalyptus ligulata* subsp. *ligulata*, *Eucalyptus uncinata*, *Eucalyptus angulosa*, *Eucalyptus conferruminata* and *Eucalyptus cornuta* *Acacia myrtoides*, *Melaleuca globifera*, *Calothamnus quadrifidus*, *Gyrostemon sheathii*, *Acacia nigricans* *Lasiopetalum maxwellii*, *Xanthorrhoea platyphylla*, *Calothmanus villosus*, *Taxandria spathulata*, *Banksia nivea* and *Banksia armata*.



F: Heath dominated on deep grey sand adjacent to granites - dominated by mixed Proteaceae and Myrtaceae - *Melaleuca scabra*, *Hakea trifurcata*, *Banksia armata*, *Calothamnus villosus*, *Calothamnus quadrifidus*, *Melaleuca globifera*, *Taxandria spathulata*, over sedges and rushes (*Lepidosperma* spp., *Mesomelaena stygia* and *Mesomelaena tetragona*) and *Gastrolobium latifolium*.



G: Open heath and Mallee heath on laterite ridges and on deeper sands in gulleys. *Nuytsia floribunda* and *Eucalyptus* mallees (*E. ligulata* subsp. *ligulata*, *E. doratoxylon*, *E. extrica*) over mixed Proteaceous and Myrtaceous heath including *Lambertia inermis*, *Banksia obovata*, *Hakea trifurcata*, *Adenanthos sericeus*, *Allocasuarina humilis*, *Taxandria spathulata*, *Xanthorrhoea platyphylla*, *Beaufortia schaueri*, *Beaufortia*

empetrifolia, *Adenanthos cuneata*, *Banksia nivea* and *Lepidosperma* spp.



H: Riparian vegetation:

Freshwater creek behind foredunes and winter-wet depressions between consolidated dunes and adjacent to freshwater creek. Creekbed dominated by sedges and rushes, *Astartea astarteoides*, *Dampiera leptoclada*, and *Comesperma virgata*. Fringing vegetation grades into shrubland dominated by *Taxandria callistachys*, *Melaleuca globifera* and *Acacia nigricans*.



Tall shrubland / sedgeland of *Gahnia decomposita*, *Viminaria juncea*, *Taxandria callistachys*, *Melaleuca incana* subsp. *tenella*, *Melaleuca globifera*, *Acacia nigricans* and *Acacia myrtifolia* over *Dampiera leptoclada*, *Boronia denticata*, mixed sedges and rushes.



I: Major creekline running from Mount Le Grand into Hellfire Bay -

Eucalyptus (including *E. aquilina*) mallee thicket over dense thicket of *Acacia nigricans* *Acacia myrtifolia* and *Pteridium esculentum*, over moderately dense herbs of *Dampiera leptoclada*, *Lindsaea linearis* and *Thysanotus dichotomus*.

9.2 Appendix 2: Locations of Significant Flora Species. Only confirmed records (not field sightings) of *Eucalyptus semiglobosa* are listed.

WAYPOINT	SPECIES	LATITUDE	LONGITUDE	Abundance Estimate
WP176	<i>Acacia incanearpa</i>	-34.002604	122.157262	c. 10 plants
WP195	<i>Acrotriche aff cordata</i>	-33.994308	122.160009	1 plant
WP197	<i>Acrotriche aff cordata</i>	-33.994270	122.160005	1 plant
WP183	<i>Banksia plumosa</i> subsp. <i>plumosa</i>	-33.996479	122.155517	c. 10 plants – seedlings and senesced/dead adults
WP184	<i>Banksia plumosa</i> subsp. <i>plumosa</i>	-33.996386	122.155611	c. 10 plants – seedlings
WP188	<i>Banksia plumosa</i> subsp. <i>plumosa</i>	-33.996185	122.156218	c. 2 adults plants,
WP230	<i>Banksia plumosa</i> subsp. <i>plumosa</i>	-33.989712	122.168409	seedlings, c. 10 plants
WP239	<i>Banksia plumosa</i> subsp. <i>plumosa</i>	-33.997281	122.154405	1 plant
WP242	<i>Banksia plumosa</i> subsp. <i>plumosa</i>	-33.997272	122.153848	occasional, c. 2 plants
WP247	<i>Banksia plumosa</i> subsp. <i>plumosa</i>	-34.000085	122.153170	saplings, occasional
WP248	<i>Banksia plumosa</i> subsp. <i>plumosa</i>	-34.000299	122.153296	saplings, occasional
WP249	<i>Banksia plumosa</i> subsp. <i>plumosa</i>	-34.000554	122.153413	saplings, occasional
WP152	<i>Commersonia apella</i>	-34.006920	122.139085	few plants c. 2
WP176	<i>Dampiera decurrens</i>	-34.002604	122.157262	common
WP176	<i>Dampiera decurrens</i>	-34.002604	122.157262	common
WP003	<i>Diplolaena microcephala</i>	-34.006988	122.139139	occasional
WP152	<i>Diplolaena microcephala</i>	-34.006920	122.139085	occasional
WP153	<i>Diplolaena microcephala</i>	-34.007061	122.139604	occasional
WP164	<i>Diplolaena microcephala</i>	-34.007061	122.139604	occasional
WPPIT	<i>Diplolaena microcephala</i>	-34.006847	122.137572	common
CAMPSITE	<i>Eucalyptus aquilina</i>	-34.006919	122.136856	common, dominant
WP212	<i>Eucalyptus aquilina</i>	-33.991115	122.162721	common, dominant
WP213	<i>Eucalyptus aquilina</i>	-33.990930	122.162822	common, dominant
WP157	<i>Eucalyptus semiglobosa</i>	-34.006725	122.139682	Scattered, co-occurring with <i>E. goniantha</i>
WP148	<i>Eucalyptus semiglobosa</i>	-34.005906	122.141723	Scattered, co-occurring with <i>E. goniantha</i>
WP155	<i>Eucalyptus semiglobosa</i>	-34.006891	122.140027	Scattered, co-occurring with <i>E. goniantha</i>
WP112	<i>Eucalyptus ligulata</i> subsp. <i>ligulata</i>	-34.006342	122.140561	occasional
WP113	<i>Eucalyptus ligulata</i> subsp. <i>ligulata</i>	-34.006386	122.140793	occasional
WP199	<i>Eucalyptus ligulata</i> subsp. <i>ligulata</i>	-33.994102	122.160728	occasional

WAYPOINT	SPECIES	LATITUDE	LONGITUDE	Abundance Estimate
WP200	<i>Eucalyptus ligulata</i> subsp. <i>ligulata</i>	-33.994216	122.161090	occasional
WP204	<i>Eucalyptus ligulata</i> subsp. <i>ligulata</i>	-33.993525	122.161169	occasional
WP207	<i>Eucalyptus ligulata</i> subsp. <i>ligulata</i>	-33.993356	122.161806	occasional
WP240	<i>Eucalyptus ligulata</i> subsp. <i>ligulata</i>	-33.997671	122.154425	occasional
WP245	<i>Eucalyptus ligulata</i> subsp. <i>ligulata</i>	-33.999428	122.153258	occasional
WP246	<i>Eucalyptus ligulata</i> subsp. <i>ligulata</i>	-33.999706	122.153452	occasional
WP249	<i>Eucalyptus ligulata</i> subsp. <i>ligulata</i>	-34.000554	122.153413	occasional
WP252	<i>Eucalyptus ligulata</i> subsp. <i>ligulata</i>	-34.002882	122.153645	occasional
WP265	<i>Eucalyptus ligulata</i> subsp. <i>ligulata</i>	-34.007668	122.147322	occasional
WP122	<i>Goodenia quadrilocularis</i>	-34.006470	122.140948	one plant
WP127	<i>Goodenia quadrilocularis</i>	-34.008183	122.142490	c. 10 plants
WP176	<i>Goodenia quadrilocularis</i>	-34.002604	122.157262	common
WP204	<i>Goodenia quadrilocularis</i>	-33.993525	122.161169	few plants
WP219	<i>Goodenia quadrilocularis</i>	-33.990468	122.163824	few plants
WP121	<i>Lambertia echinata</i> subsp. <i>echinata</i>	-34.006554	122.140923	c. 200 individuals, mostly seedlings 1-2 years old.
WP122	<i>Lambertia echinata</i> subsp. <i>echinata</i>	-34.006470	122.140948	common seedlings
WP123	<i>Lambertia echinata</i> subsp. <i>echinata</i>	-34.006735	122.140803	common seedlings
WP160	<i>Lambertia echinata</i> subsp. <i>echinata</i>	-34.006463	122.140853	common seedlings
WP197	<i>Lasiopetalum</i> aff. <i>parviflorum</i>	-33.994270	122.160005	1 plant
WP257	<i>Lasiopetalum</i> aff. <i>parviflorum</i>	-34.005614	122.148771	1 plant
adjWP221	<i>Lasiopetalum maxwellii</i>	-33.990422	122.163860	common
WP009	<i>Lasiopetalum maxwellii</i>	-34.006612	122.139728	few plants
WP100	<i>Lasiopetalum maxwellii</i>	-34.006549	122.140122	common seedling
WP105	<i>Lasiopetalum maxwellii</i>	-34.006502	122.140206	common seedlings
WP106	<i>Lasiopetalum maxwellii</i>	-34.006617	122.140338	1 adult
WP107	<i>Lasiopetalum maxwellii</i>	-34.006654	122.140267	very common > 50 seedlings and several adults
WP111	<i>Lasiopetalum maxwellii</i>	-34.006404	122.140501	common
WP121	<i>Lasiopetalum maxwellii</i>	-34.006554	122.140923	common
WP123	<i>Lasiopetalum maxwellii</i>	-34.006735	122.140830	common
WP124	<i>Lasiopetalum maxwellii</i>	-34.006887	122.140734	common
WP126	<i>Lasiopetalum maxwellii</i>	-34.009044	122.142992	1 adult
WP127	<i>Lasiopetalum maxwellii</i>	-34.008183	122.142490	common
WP133	<i>Lasiopetalum maxwellii</i>	-34.007811	122.142615	common
WP134	<i>Lasiopetalum maxwellii</i>	-34.007802	122.142400	common

WAYPOINT	SPECIES	LATITUDE	LONGITUDE	Abundance Estimate
WP149	<i>Lasiopetalum maxwellii</i>	-34.006932	122.141633	common
WP150	<i>Lasiopetalum maxwellii</i>	-34.007480	122.141816	common
WP151	<i>Lasiopetalum maxwellii</i>	-34.007369	122.141413	common
WP154	<i>Lasiopetalum maxwellii</i>	-34.006943	122.139959	common, > 20 plants
WP156	<i>Lasiopetalum maxwellii</i>	-34.006681	122.139963	common
WP161	<i>Lasiopetalum maxwellii</i>	-34.006755	122.140797	very common, abundant
WP162	<i>Lasiopetalum maxwellii</i>	-34.007160	122.140818	common
WP163	<i>Lasiopetalum maxwellii</i>	-34.007164	122.140380	common
WP164	<i>Lasiopetalum maxwellii</i>	-34.007307	122.140373	common
WP173	<i>Lasiopetalum maxwellii</i>	-34.007405	122.141483	common
WP176	<i>Lasiopetalum maxwellii</i>	-34.002604	122.157262	common
WP177	<i>Lasiopetalum maxwellii</i>	-34.002898	122.159003	common
WP178	<i>Lasiopetalum maxwellii</i>	-34.002616	122.160933	common
WP219	<i>Lasiopetalum maxwellii</i>	-33.990468	122.163824	scattered c. 20 plants
WP221	<i>Lasiopetalum maxwellii</i>	-33.990422	122.163860	common, seedlings
WP222	<i>Lasiopetalum maxwellii</i>	-33.990350	122.164007	common
WP222	<i>Lasiopetalum maxwellii</i>	-33.990350	122.164007	common
WP223	<i>Lasiopetalum maxwellii</i>	-33.990288	122.164215	common
WP225	<i>Lasiopetalum maxwellii</i>	-33.990695	122.164308	scattered
WP265	<i>Lasiopetalum maxwellii</i>	-34.007668	122.147322	occasional
WP266	<i>Lasiopetalum maxwellii</i>	-34.007569	122.147456	5 plants, occasional
WP144	<i>Lepyrodia fortunata</i>	-34.006119	122.144166	In dense sedgeland
WP147	<i>Leucopogon multiflorus</i>	-34.006248	122.142169	1 plant
WP261	<i>Leucopogon multiflorus</i>	-34.006947	122.144561	1 plant
WP124	<i>Leucopogon rotundifolius</i>	-34.006887	122.140734	1 plant
WP141	<i>Melaleuca incana</i> subsp. <i>tenella</i>	-34.006285	122.145023	common ? burnt
WP001	<i>Opercularia</i> aff. <i>ovata</i>	-34.007034	122.138712	occasional
WP126	<i>Opercularia</i> aff. <i>ovata</i>	-34.009044	122.142992	occasional
WP156	<i>Opercularia</i> aff. <i>ovata</i>	-34.006681	122.139963	occasional
WP164	<i>Opercularia</i> aff. <i>ovata</i>	-34.007307	122.140373	occasional
WP164	<i>Opercularia</i> aff. <i>ovata</i>	-34.007307	122.140373	occasional
WP178	<i>Opercularia</i> aff. <i>ovata</i>	-34.002616	122.160933	common
WP009	<i>Opercularia echinocephala</i>	-34.006612	122.139728	common
WP113	<i>Opercularia echinocephala</i>	-34.006386	122.140793	common

WAYPOINT	SPECIES	LATITUDE	LONGITUDE	Abundance Estimate
WP145	<i>Opercularia echinocephala</i>	-34.006110	122.143320	common
WP155	<i>Opercularia echinocephala</i>	-34.006891	122.140027	common
WP203	<i>Opercularia echinocephala</i>	-33.993616	122.161168	common
WP214	<i>Opercularia echinocephala</i>	-33.990885	122.162647	common
WP252	<i>Opercularia echinocephala</i>	-34.002882	122.153645	common
WP255	<i>Opercularia echinocephala</i>	-34.003496	122.151128	common
WP249	<i>Patersonia inaequalis</i>	-34.000554	122.153413	1 plant
POI 19	<i>Persoonia scabra</i>	-34.006972	122.145338	1 plant
WP132	<i>Persoonia scabra</i>	-34.008160	122.142867	1 plant
WP134	<i>Persoonia scabra</i>	-34.007802	122.14240	4 plants and 2 seedlings
WP135	<i>Persoonia scabra</i>	-34.007505	122.143271	1 plant
WP137	<i>Persoonia scabra</i>	-34.008059	122.143971	2 plants
WP138	<i>Persoonia scabra</i>	-34.007905	122.144595	1 plant
WP139	<i>Persoonia scabra</i>	-34.007465	122.145722	occasional
WP150	<i>Persoonia scabra</i>	-34.007480	122.141816	1 plant
WP151	<i>Persoonia scabra</i>	-34.007369	122.141413	1 plant
WP165	<i>Persoonia scabra</i>	-34.007245	122.140955	1 plant
WP166	<i>Persoonia scabra</i>	-34.007057	122.142376	3 plants
WP173	<i>Persoonia scabra</i>	-34.007405	122.141483	1 plant
WP259	<i>Persoonia scabra</i>	-34.006271	122.147069	1 plant
WP260	<i>Persoonia scabra</i>	-34.006884	122.146163	1 plant
WP263	<i>Persoonia scabra</i>	-34.006990	122.145181	1 plant
WP266	<i>Persoonia scabra</i>	-34.007569	122.147456	1 plant
WP200	<i>Thelymitra fuscolutea</i>	-33.994216	122.161090	c. 10 plants