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Working Paper

Vegetation Survey

VEGETATION SURVEY OF THE PREFERRED ROUTE FOR THE UPGRADE OF THE PACIFIC HIGHWAY BETWEEN SAPPHIRE AND WOOLGOOLGA

Prepared for

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1.0 INTRODUCTION

1.1 Scope

Ecos Environmental Pty Ltd has been engaged by Connell Wagner Pty Ltd to undertake a vegetation survey of the preferred route for the Sapphire to Woolgoolga upgrade of the Pacific Highway.

The specific objectives of the vegetation survey were to: -

- document the plant species identified within the study area, highlighting any species listed on the TSC Act and/or EPBC Act, and/or the ROTAP register;
- compile a list of threatened species recorded, and considered likely to occur, in the study area
- map the location and extent of distribution of threatened species and endangered ecological communities throughout the study area;
- identify and map the plant communities found along the corridor, highlighting any TSC Act and/or EPBC Act, endangered communities:
- identify constraints posed by native vegetation, particularly threatened species and endangered ecological communities; and
- recommend appropriate measures for mitigating the impacts of the proposed road on native flora, particularly Threatened species and Endangered Ecological Communities.

The remaining sub-headings of this introduction describe the location and physical environment of the study area. Section 2 explains the methodology used to survey the flora, classify and map plant communities and assess findings. Section 3 describes the results of the vegetation survey and identifies the conservation significance of recorded flora and vegetation communities with reference to State and Federal environmental legislation. Section 4 discusses the conservation significance of Threatened and significant plant species and Endangered Ecological Communities recorded during the survey and Section 5 considers options to ameliorate the potential impact of the highway corridor on these values.

1.2 Survey Area

The survey area is located in the Coffs Harbour Local Government Area on the Mid North Coast of NSW. The preferred route for the Sapphire to Woolgoolga upgrade of the Pacific Highway extends from Sapphire Beach on the northern outskirts of Coffs Harbour to Arrawarra Creek north of Woolgoolga, a distance of approximately 25 km. The area examined during the vegetation survey was confined to the projected road footprint and 20-50 metres on either side. The southern two-thirds of the proposed route closely follows the existing highway and the area surveyed consisted of the present road reserve and the edges of adjoining properties. The northern third of the proposed route veers west of Woolgoolga in an arc crossing privately owned forest and cleared land, banana plantations and sections of Wedding Bells State Forest before rejoining the present Pacific Highway at the Arrawarra turn-off.

1.3 Physical Environment

The study area encompasses the narrow coastal plain between Arrawarra and Moonee Beach and the foothills of the Coast Range, which meet the sea at Sapphire Beach.

Maximum elevation is approximately 100m west of Woolgoolga. The study area has a humid subtropical climate with a mean annual rainfall of 1600mm. Geologically, the study area forms part of the Coffs Harbour Block comprising Paleozoic metasediments (hardened sedimentary rocks) (Fisher *et al* . 1996).

1.4 Existing Vegetation Information

The following databases and studies provided existing information on the flora and plant communities of the study area:

- DECC Wildlife Atlas (records within 10km of the study area)
- EPBC Act Protected Matters Search Tool
- Australia's Virtual Herbarium
- Fischer et al. (1996) The Vegetation of the Coffs Harbour City Council LGA
- Binns, D. (1994). Flora Survey of the Dorrigo 3-Year EIS Area. State Forests of NSW.
- Moore, D. M. and Floyd, A.G. (1994). A Description of the Flora and an Assessment of Impacts of the Proposed Forestry Operations in the Grafton Management Area.
- Forest Ecosystem Classifications for Upper and Lower North East CRA Regions (NPWS 1999).

2.0 METHODOLOGY

2.1 Flora Survey

2.1.1 Survey Design

The objective of the flora survey was to search for Threatened and other rare or significant plant species, while also recording vegetation communities and variation in the overall flora. The survey was implemented by the meander traverse method (DEC 2004), which enabled searching of a wide area within the 24 km long corridor (much greater than if the survey had been quadrat-based). The vegetation survey was stratified by dividing the study area into corridor sections, each containing a predominant broad vegetation type (e.g. wet sclerophyll/rainforest, moist/dry open forest and swamp sclerophyll) and allocating one meander traverse to each section. Preliminary vegetation maps prepared by Connell Wagner were used as an initial source of information on broad vegetation type. An indicative list of Threatened and rare plant species for the Coffs Harbour-Woolgoolga area (Table 1) was derived from the DECC Wildlife Atlas database and other existing information (see above).

Vegetation data were collected from 14 traverses varying in length from 1-4 km over a total of 15 days (see Appendices 1a & 1b). Twelve days survey work was undertaken in March, June and July 2005. An additional 3 days survey work was carried out in December 2005 to examine remaining unsurveyed properties and to conduct a targeted search of potential habitat for Threatened summer flowering herbs. Survey work was spread throughout the year, thereby minimising the possibility of species being overlooked due to seasonality of growth and flowering.

On each traverse all species sighted were recorded and any unknown plants collected for later identification. Changes in vegetation communities within a traverse were recorded, including changes in the dominant overstorey and understorey species. After each traverse, species were scored for overall abundance as either: -
1 – rare (few individuals seen or only seen at one or a few points on the traverse);
2 – occasional (of patchy distribution, widespread on the traverse but not common);
3 - common (widespread and regularly observed along the traverse, dominant or sub-dominant within any vegetation layer – canopy, understorey or ground layer);
4 - very common (widespread and very abundant within any vegetation layer).

These classes indicated the overall abundance of species on a subjectively assessed, semi-quantitative scale.

The road footprint was located in the field using a colour aerial photograph of the study area overlaid with the road footprint and cadastral boundaries, and with the assistance of survey markers where installed. In addition to the meander traverses, point inspections of vegetation were made at many locations, particularly where the type and condition of vegetation indicated that Threatened species could be present, or to fill gaps in the traverse coverage. During spot inspections searches were made for Threatened flora and notes recorded on dominant species and vegetation type.

The locations of threatened and rare plant species were recorded with a eTrex GPS in GDA (MGA 1994 Zone 56) datum format and marked on a 1:25,000 topographic map. Each significant flora occurrence was given a unique identification number

between 80001 and 80100. This was written on flagging tape and attached to a closely adjoining plant, to enable surveyors to re-locate each occurrence and record its coordinates to sub-metre accuracy. Where an 'individual' plant could not be determined, the plant number referred to a clump or a cluster of plants.

Where Threatened species or Endangered Ecological Communities were encountered, more detailed sampling was carried out following the guidelines in DEC (2004). This sampling consisted of a 20m x 20m quadrat in which species composition, vegetation structure and site characteristics were recorded. Species abundance was measured as cover-abundance (the horizontal projection of foliage crown extent), estimated visually in terms of Braun Blanquet cover-abundance classes (Mueller-Dombois and Ellenberg 1974; NPWS 1995), as follows:-

1 sparse, <5% crown-cover
2 any number, <5% crown-cover
3 5 - 25%
4 25 - 50%
5 50 - 75%
6 75 - 100%

Plant taxonomy and nomenclature followed the Flora of NSW (Harden 1992, 1993, 2000, 2002). Any species that could not be identified were sent to the Royal Botanic Gardens, Sydney for identification. Dr Andrew Benwell carried out botanical fieldwork.

Table 1: Indicative list of Threatened plant species potentially present in the survey area based on records derived from the DECC Wildlife Atlas records within 10km of the survey area and other sources. TSC Act Conservation Status is shown as E – Endangered and V- Vulnerable.

Species	**Cons. Status**	**Habitat**
Possible		
Amorphospermum whitei Rusty Plum	V	Wet sclerophyll forest and rainforest
Arthraxon hispidus A Grass	V	Seepage swamps at the base of hillslopes
Boronia umbellata A Shrub	V	Shrubby, moist open forest on sedimentary geology
Eleocharis tetraquetra Square-stemmed Spike Rush	E	Coastal swamp and streamside seepage
Lindsaea incisa A Fern	E	Swamp sclerophyll forest/open forest ecotone
Parsonsia dorrigoensis A vine	V	Wet sclerophyll forest and rainforest
Phaius australis Swamp Orchid	E	Swamp sclerophyll forest margins with rainforest elements
Quassia sp. B Narrow-leaved Quassia	E	Shrubby dry sclerophyll forest usually on sedimentary geology
Sarcochilus fitzgeraldii Ravine Orchid	V	Rock outcrops in wet sclerophyll forest and rainforest

Typhonium sp. *aff. brownii* Stinky Lily	E	Rainforest and wet sclerophyll close to drainage lines
Unlikely		
Allocasuarina defungens Dwarf Heath Sheoak	E	Heath on sand or sedimentary geology
Acronychia littoralis Scented Acronychia	E	Coastal dune littoral rainforest and edges
Angophora robur Large-fruited Angophora	V	Dry sclerophyll forest on sandstone
Thesium australe Austral Toadflax	E	Grassy headlands.
Zieria prostrata Headland Zieria	E	Grassy headlands

2.1.2 Conservation Significance of Plant Species

The conservation significance of plant species was determined with reference to:

- Schedules and Preliminary Listings of the NSW Threatened Species Conservation Act 1995;
- Schedules of the Commonwealth Environment Protection and Biodiversity Conservation Act 1999;
- ROTAP (Briggs and Leigh 1995) for nationally rare species;
- Sheringham and Westaway (1995) and NPWS (1998) for regionally significant plants; and

2.2 Vegetation Classification and Mapping

2.2.1 Existing Data

The scope of this study did not include the preparation of a vegetation map from raw data, as detailed vegetation mapping already existed for the study area. The approach was to use the existing vegetation data supplied by DECC (via Connell Wagner) as an initial reference for the vegetation classification and mapping, then to ground-check the mapping and classification during fieldwork and modify where any errors or inconsistencies were apparent.

The origin of the mapping was indicated on the data files as being a combination of Research Note 17 Forest Types (FCNSW 1989), CRAFTI (Comprehensive Regional Assessment Forest Type Inventory), Coffs Harbour City Council Vegetation Mapping (Fischer *et al.* 1996) and ANC. There was no field for Forest Ecosystems (NPWS 1999) in the mapping data supplied. The CRAFTI units were the types mapped by the air photo interpreters on the CRAFTI project, which was essentially an adaptation of the Forest Type system to broad-scale air photo vegetation mapping with limited ground-truthing (see Appendix 2).

2.2.2 Validating the Existing Mapping

Validation of the initial vegetation mapping, which displayed a combination of RN17 Forest Types, Coffs Harbour City Council mapping units and CRAFTI units, was carried out during flora traverses and spot inspections. This consisted of field checking the dominant species, typing of vegetation and boundaries of map polygons. Field notes were annotated on map printouts to record the main canopy species and vegetation type.

2.2.3 Classification

The basic unit of vegetation classification and mapping used for the Sapphire to Woolgoolga survey was the 'association', which is defined as a plant community having the same or similar vegetation structure and dominant species in the upper/canopy vegetation layer (Beadle 1981). Appendix 2 provides some background information on the systems of classification used in previous vegetation mapping of the study area (e.g. Forest Types and CRAFTI).

An examination of the initial mapping indicated that a number of Forest Type (RN17), CRAFTI and Coffs Harbour City Council vegetation mapping units were equivalent floristically and the units in these classifications were at the same level as 'associations'. A simplified classification was therefore proposed in which floristically related units would be merged to produce a smaller number of vegetation map units, based on an assessment of floristic similarities (associations) and vegetation-terrain relationships observed during fieldwork.

As well as the problem of 'duplicate' vegetation types in the initial data, it was also apparent that some areas were wrongly classified in terms of vegetation type. These polygons were re-classified to the best fitting community in the merged classification, or new associations were created on the basis of the dominant species observed during fieldwork.

The final classification reduced the initial classes down to 12 associations, as listed in Table 2 and mapped in Figures 1 and 2.

(Classification of vegetation in terms of Forest Ecosystems (NPWS 1999) was considered at the start of this vegetation survey, however, the Forest Ecosystems indicated as being present in the study area in data supplied by DECC, were found to be difficult to identify in the field. Several had overlapping understorey floristic descriptions without useful indicator species (e.g. FE 153, 155, 157) and there was little information in NPWS (1999) on environmental relationships or distribution that would assist is assessing the most appropriate Forest Ecosystems for the study area.)

2.2.4 Mapping

The delineation of vegetation polygons on the initial map was retained or modified where found to be incorrect. The majority of the line work was expected to be accurate in general outline as it derived from detailed vegetation mapping by the Forestry Commission, National Parks and Wildlife Service and Coffs Harbour City Council. The final map was created by merging initial mapped vegetation units falling within each association, or altering boundaries, as indicated by fieldwork.

2.2.5 Assessment of Community Conservation Status

The conservation significance of plant communities was determined according to:

- Schedules and Preliminary Listings of the NSW Threatened Species Conservation Act 1995;

- Schedules of the Commonwealth Environment Protection and Biodiversity Conservation Act 1999;

- Hager and Benson (1994) for plant communities.

Vegetation associations recorded in the survey corridor were compared with the descriptions of Endangered Ecological Communities (TSC Act) in the relevant Final Determinations by the Scientific Committee (DECC website) to assess whether any of the associations were equivalent to an Endangered Ecological Community. This assessment was also carried out with reference to the Commonwealth EPBC Act.

Two other references may be used in assessing the conservation status of forest plant communities in northeast NSW. The first of these is Hager and Benson (1994) which gives an inventory of the region's forest plant communities listed as associations equated with Forest Types (FCNSW 1989). Conservation status is rated as 'poorly reserved', 'inadequately reserved' and 'adequately reserved' based on the number and size of samples in conservation reserves in the lower, central and upper northeast. Rainforests in Hager and Benson (1994) are classified and assessed after Floyd (1990).

The second is the Forest Ecosystems study from the North East NSW CRA (NPWS 1999). Forest Ecosystems (NPWS 1999) are a modification of the Forest Type classification (FCNSW 1989) derived by multivariate analysis of floristic data collected across the range of Forest Types. During the NSW Comprehensive Regional Assessment, the conservation status of Forest Ecosystems was assessed on the basis of the area required to be reserved to achieve 15% of the predicted pre-European distribution. However, data on the areas of EEC's reserved and target level achieved are not given in NPWS (1999), only the estimated pre-1750 area and the extent of clearing, so it is only possible to use this reference indirectly as an indicator of plant community conservation status.

3.0 RESULTS

3.1 General Floristics and Vegetation Description

A total of 479 plant species were recorded during the survey, which included 68 naturalized or exotic species. Families exhibiting the highest diversity of species were: - Poaceae (48 species), Myrtaceae (44), Cyperaceae (31), Fabaceae (21) Asteraceae (21), Mimosaceae (15), Orchidaceae (14), Euphorbiaceae (13), Lauraceae (12), Proteaceae and Sapindaceae (9) and Rutaceae (8).

The two main broad vegetation types in the survey area were Coastal Hills Moist Open Forest (comprising five associations) and Coastal Floodplain Forest (four associations). Coastal Hills Moist Open Forest occurred throughout the corridor on hilly terrain adjoining the coastal floodplain. The five associations comprising this broad type form a complex mosaic, responding to subtle changes in topography and lithic substrate. Coastal Floodplain Forest consisting mainly of Broad-leaved Paperbark swamp forest was the predominant vegetation type in the low-lying central part of the corridor on the coastal floodplain between the Bucca Road and Double Crossing Creek south of Woolgoolga. The corridor intersects one very small area of Estuarine Complex in the central section. Small stands of Littoral Rainforest occur in a few protected gullies at Sapphire Beach and two small stands of Lowland Rainforest on Floodplain occur at Woolgoolga Creek and a stream crossed by Newmans Road.

3.2 Modifications to the Initial Vegetation Data

The following modifications were made to the initial mapping data supplied by DECC to produce the vegetation map of the survey corridor shown in Figures 1 and 2: -

- Equivalent RN17 (Forest Type), CRAFTI and Coffs Harbour City vegetation units were merged. For example Paperbark in State Forest (Forest Type 31) and Paperbark mapped by Coffs Harbour City Council were merged into a single association.

- Units with Blackbutt as an indicator species were merged into a single Blackbutt association.

- Some 'Narrow-leaved White Mahogany' polygons were changed to 'Grey Gum - Grey Ironbark' in the northern half of the survey corridor, as Grey Gum (*E. propinqua*) was judged to be a commoner canopy species than Narrow-leaved White Mahogany (*E. acmenoides*) in these areas.

- One polygon of Forest Red Gum mapped by Coffs Harbour City Council was merged into the Grey Gum-Ironbark association. (This polygon of Forest Red Gum was very localised, also contained Ironbark and Blackbutt and was not on a floodplain.)

- A Red Mahogany association was differentiated from the initial data at one location.

- A Smooth-barked Apple association was differentiated from the initial data at one location.

- Lowland Rainforest on Floodplain was differentiated from the initial data at two locations.

- Two areas of Sedgeland/Swamp mapped by Coffs Harbour City Council were found to be Paperbark (generally with a low to mid-high woodland to open woodland structure).

- Minor adjustments were made to polygon boundaries.

3.3 Description of Vegetation Associations

3.3.1 Introduction

Species abundances in the tabular descriptions below are reported qualitatively and semi-quantitatively. This was requested by fauna ecologists with Connell Wagner for modeling habitat variables and assessing impacts on fauna. Semi-quantitative abundance (numbers to the right of the qualitative abundance) is according to Braun-Blanquet scale (see Section 2.1.1).

The associations falling within listed Endangered Ecological Communities are indicated in Table 2. Equivalent Forest Types (FCNSW 1989) for the associations are also provided in the assessments below. The conservation ratings according to Hager and Benson (1994) are indicative only, as significant additions have been made to the reserve system since 1994.

There were no plant communities protected under the Federal EPBC Act in the study area

The structural terminology used below (e.g. open forest to woodland, tall to very tall etc.) follows Walker and Hopkins (1990).

Table 2: Vegetation associations of the Sapphire to Woolgoolga survey area grouped under broad ecological vegetation types and indicating equivalent Endangered Ecological Communities (TSC Act).

No.	**Associations** (1-12) (indicator species dominant or co-dominant)	**Endangered Ecological Communities**
	Rainforest	
1	Brush Box - Guioa - Native Olive	Littoral Rainforest
2	Native Olive - Strangler Fig - Brush Cherry	Lowland Rainforest on Floodplain
	Coastal Hills Moist Open Forest	
3	Blackbutt	
4	Flooded Gum	
5	Grey Gum – Ironbark	
6	Spotted Gum	
7	Narrow-leaved White Mahogany	
	Coastal Floodplain Forest	
8	Red Mahogany	Swamp Sclerophyll Forest on Floodplain
9	Smooth-barked Apple	Swamp Sclerophyll Forest on Floodplain
10	Paperbark	Swamp Sclerophyll Forest on Floodplain
11	Swamp Oak	Swamp Oak Floodplain Forest
	Estuarine Complex	
12	Swamp Oak – Saltwater Couch	Coastal Saltmarsh

3.3.2 Littoral Rainforest

Association: Brush Box (*Lophostemon confertus*) - Guioa (*Guioa semiglauca*) - Native Olive (*Olea paniculata*)

Structure: Tall to very tall (18-25m) open to closed forest.

Distribution: Restricted to a few gullies at the southern end of the corridor at Sapphire Beach within the Coffs Harbour urban area.

Habitat: Lower slopes of southeast aspect within 0.5km of the sea. Soils are red-yellow podzolics on metasediment.

Main Species: (* introduced species)

Stratum	Common Name	Botanical Name	Abundance
Upper	Brush Box	*Lophostemon confertus*	common (3)
	Native Olive	*Olea paniculata*	common (3)
	Guioa	*Guioa semiglauca*	common (3)
	Water Vine	*Cissus antarctica*	common (3)
	Five-leaf Water Vine	*Cissus hypoglauca*	common (3)
	Scrub Bloodwood	*Baloghia inophylla*	occasional (2)
	Pepperberry Tree	*Cryptocarya obovata*	occasional (2)
	Cheese Tree	*Glochidion ferdinandii*	occasional (2)
Mid	Sandpaper Fig	*Ficus coronata*	common (3)
	Common Lilly Pilly	*Acmena smithii*	common (3)
	*Lantana	*Lantana camara*	common (3)
	Burny Vine	*Trophis scandens*	common (3)
	Veiny Wilkea	*Wilkea huegeliana*	common (3)
	Red Bean	*Dysoxylum muelleri*	common (2)
	Barb-wire Vine	*Smilax australis*	common (2)
Lower	Rasp Fern	*Doodia aspera*	common (3)
	A Grass	*Oplismenus imbecilis*	common (3)
	Rainforest Lomandra	*Lomandra spicata*	common (3)
	Morinda	*Morinda jasminoides*	common (3)
	Giant Maidenhair Fern	*Adiantum formosum*	common (2)

Condition: Small remnants close to housing or banana farms were generally in fair condition without large weed infestations although incipient populations of a wide range of environmental weeds were present.

Assessment: This rainforest community is equivalent to the Endangered Ecological Community 'Littoral Rainforest'. The stands adjacent to the existing Pacific Highway at Sapphire Beach are among the few remaining examples in the Coffs Harbour urban area.

3.3.3 Lowland Rainforest on Floodplain

Association: Strangler Fig (*Ficus watkinsiana*) - Native Olive (*Olea paniculata*)

Structure: Tall (16-25m) open to closed forest.

Distribution: Small stands occur along a stream crossed by the footprint at Newmans Road northwest of Woolgoolga township and on the floodplain of Woolgoolga Creek close to the projected road reserve.

Habitat: Floodplain alluvium derived from metasedimentary rocks.

Main Species: (* introduced species)

Stratum	Common Name	Botanical Name	Abundance
Upper	Red Bean	*Dysoxylum muelleri*	common (3)
	Native Olive	*Olea paniculata*	common (3)
	Brush Cherry	*Syzygium australe*	common (3)
	Brush Box	*Lophostemon confertus*	common (3)
	Black Booyong	*Heritiera actinophylla*	common (3)
	Hard Quandong	*Elaeocarpus obovatus*	common (2)
	Cheese Tree	*Glochidion ferdinandii*	common (2)
	Brush Bloodwood	*Baloghia inophylla*	common (2)
	Strangler Fig	*Ficus watkinsiana*	occasional (2)
Mid	Guioa	*Guioa semiglauca*	common (3)
	Burny Vine	*Trophis scandens*	common (3)
	Water Vine	*Cissus antarctica*	common (3)
	White Bolly Gum	*Neolitsea dealbata*	common (2)
	Veiny Wilkea	*Wilkea huegeliana*	common (3)
	Cleistanthus	*Cleistanthus cunninghamii*	common (2)
	*Lantana	*Lantana camara*	common (2)
	Common Lilly Pilly	*Acmena smithii*	common (2)
	Wait-a-while	*Calamus muelleri*	common (2)
	Red Bean	*Dysoxylum muelleri*	common (2)
Lower	Rasp Fern	*Doodia aspera*	common (3)
	Brush Lomandra	*Lomandra spicata*	common (3)
	Morinda	*Morinda jasminoides*	common (3)
	Giant Maidenhair Fern	*Adiantum formosum*	common (3)

Condition: Rainforest at Newmans Road was in good to excellent condition with only minor weed invasion. The rainforest at Woolgoolga Creek Road on the edge of cleared land was also in good condition. Exotics were largely absent although Climbing Asparagus Fern was invading from the rainforest edge.

Assessment: This rainforest community is equivalent to the Endangered Ecological Community 'Lowland Rainforest on Floodplain'. Few examples of Lowland Rainforest on Floodplain' remain near the town of Woolgoolga.

3.3.4 Blackbutt Coastal Hills Moist Open Forest

Association: Coastal Blackbutt (*Eucalyptus pilularis*)

Structure: Tall to very tall (20-30m) open forest with a grass, shrub and small tree understorey. A few areas had a greater abundance of sclerophyll shrubs and sedges in the understorey.

Distribution: Common in both the northern and southern halves of the survey area.

Habitat: Undulating hills, lower to upper slopes; yellow clay soils formed on metasediment. Soils are generally of medium fertility, which imparts a 'moist' species composition to the understorey of this association.

Main Species: (* introduced species)

Stratum	Common Name	Botanical Name	Abundance
Upper	Blackbutt	*Eucalyptus pilularis*	v. common (4-5)
	Tallowwood	*E. microcorys*	common (3)
	Grey Gum	*E. propinqua*	common (3)
	Pink Bloodwood	*Corymbia intermedia*	occasional (3)
	White Mahogany	*E. acmenoides*	occasional (2)
Mid	Blackwood Wattle	*Acacia melanoxylon*	common (3)
	Turpentine	*Syncarpia glomulifera*	common (3)
	White Bottlebrush	*Callistemon salignus*	common (3)
	*Lantana	*Lantana camara*	common (3)
	Cheese Tree	*Glochidion ferdandii*	common (2)
	Common Tea Tree	*Leptospermum polygalifolium subsp. polygalifolium*	common (3)
Lower	Forest Wire Grass	*Entolasia stricta*	common (3-4)
	Blady Grass	*Imperata cylindrica*	common (3)
	Bracken Fern	*Pteridium esculentum*	common (3)
	Common Mat Rush	*Lomandra longifolia*	common (3)
	Trailing Goodenia	*Goodenia rotundifolia*	common (2)
	Barb Wire Grass	*Cymbopogon refractus*	common (2)
	Kangaroo Grass	*Themeda australis*	common (2)

Condition: Generally in good condition with few environmental weeds apart from Lantana.

Assessment: Not listed as an endangered community under the TSC Act.

Generally equivalent to Forest Type 36 (Moist Blackbutt). The associations representing this forest type in the survey area were considered adequately conserved in the central zone of NE NSW by Hager and Benson (1994).

3.3.5 Flooded Gum Coastal Hills Moist Open Forest

Association: Flooded Gum (*Eucalyptus grandis*)

Structure: Tall to extremely tall (20–40m) open forest.

Distribution: Scattered, small areas in the north (e.g. Arrawarra Creek and Woolgoolga Creek) and south (e.g. Sugar Mill Creek) of the survey area.

Habitat: The floodplain of larger drainage lines, sometimes extending to adjacent lower hillslopes.

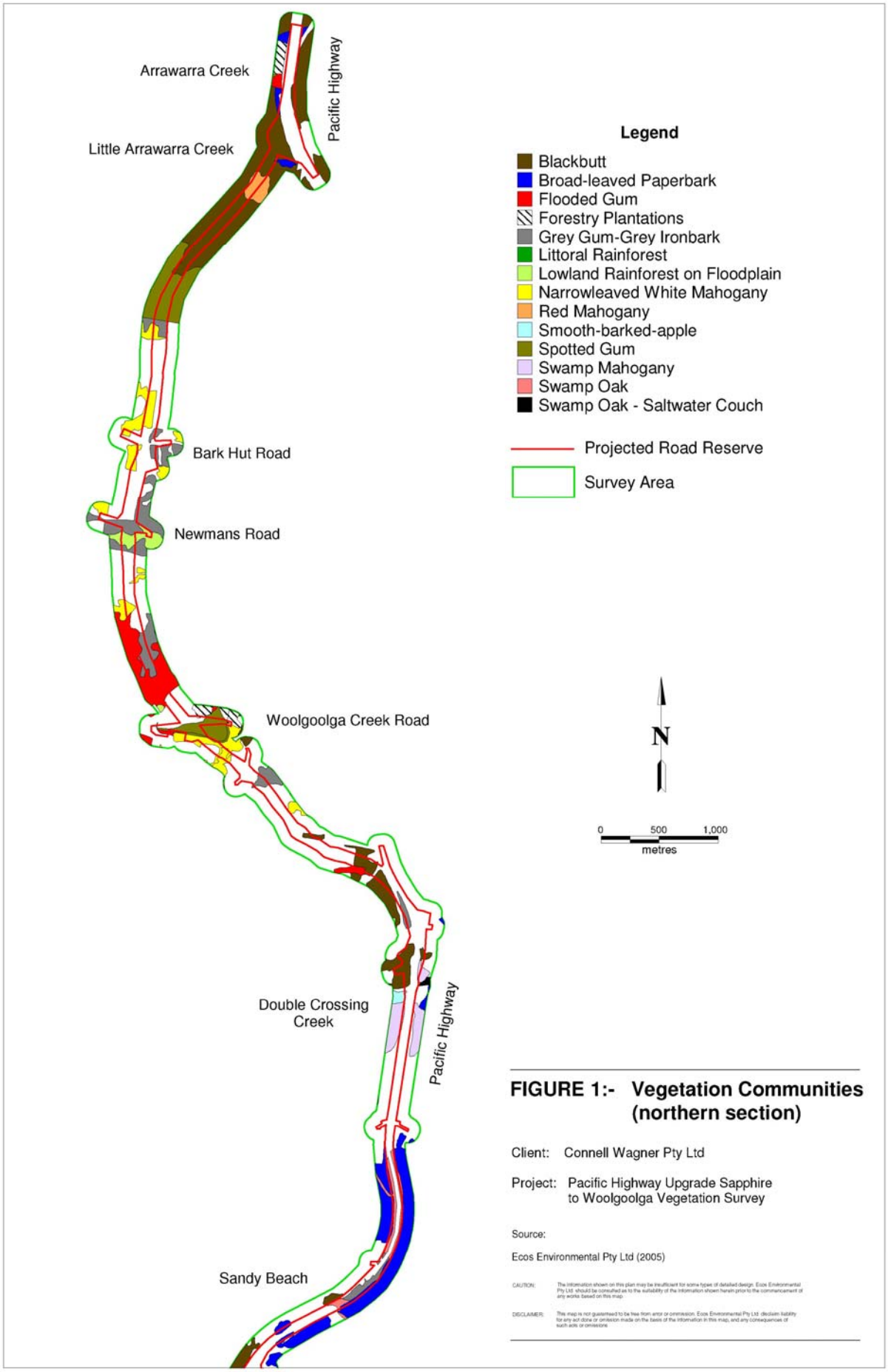
Main Species: (* introduced species)

Stratum	Common Name	Botanical Name	Abundance	
Upper	Flooded Gum	*Eucalyptus grandis*	common	(4-5)
	Brush Box	*Lophostemon confertus*	occasional	(2)
	Broad-leaved Ironbark	*Eucalyptus siderophloia*	occasional	(2)
	Tallowwood	*Eucalyptus microcorys*	occasional	(2)
Mid	Murrogun	*Cryptocarya microneura*	common	(3)
	Morinda	*Morinda jasminoides*	common	(3)
	Common Mock Olive	*Notelaea longifolia*	common	(3)
	Narrow-leaf Palm Lily	*Cordyline stricta*	common	(3)
	*Lantana	*Lantana camara*	common	(3)
	Barb-wire Vine	*Smilax australis*	common	(3)
	* Thorny Poinciana	*Caesalpinia decapitala*	common	(3)
	Veiny Wilkea	*Wilkea huegeliana*	occasional	(2)
	Common Lilly Pilly	*Acmena smithii*	occasional	(2)
	*Winter Senna	*Senna pendula*	occasional	(2)
Lower	Gristle Fern	*Blechnum cartilagineum*	common	(3)
	Ottochloa Grass	*Ottochloa gracillima*	common	(3)
	Rasp Fern	*Doodia aspera*	common	(3)
	Settlers Flax	*Gymnostachys anceps*	occasional	(2)
	Maidenhair Fern	*Adiantum formosus*	occasional	(2)

Condition: Moderately high levels of environmental weeds in some areas.

Assessment: Not listed as an endangered community under the TSC Act.

Equivalent to Forest Type 48 (Flooded Gum). This community was considered inadequately conserved in the central zone of NE NSW by Hager and Benson (1994).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Pacific Highway
Little Arrawarra Creek
Bark Hut Road
Newmans Road
Woolgoolga Creek Road
Double Crossing Creek
Pacific Highway
Sandy Beach
Legend
Blackbutt
Broad-leaved Paperbark
Flooded Gum
Forestry Plantations
Grey Gum-Grey Ironbark
Littoral Rainforest
Lowland Rainforest on Floodplain
Narrowleaved White Mahogany
Red Mahogany
Smooth-barked-apple
Spotted Gum
Swamp Mahogany
Swamp Oak
Swamp Oak - Saltwater Couch
Projected Road Reserve
Survey Area
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0
500
1,000
metres
FIGURE 1:- Vegetation Communities (northern section)
Client: Connell Wagner Pty Ltd
Project: Pacific Highway Upgrade Sapphire to Woolgoolga Vegetation Survey
Source:
Ecos Environmental Pty Ltd (2005)
CAUTION:
DISCLAIMER:

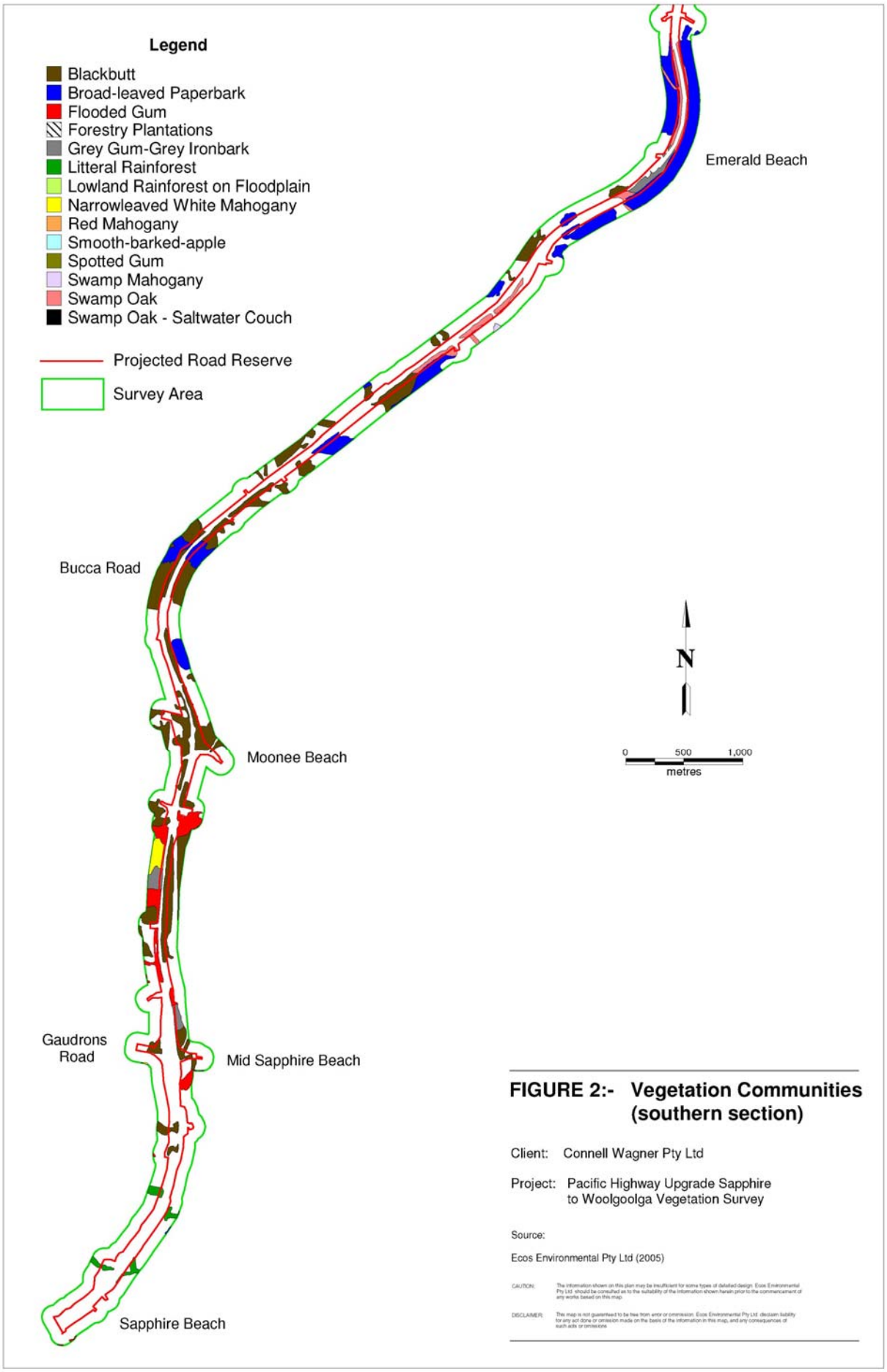

FIGURE 2:- Vegetation Communities (southern section)

Client: Connell Wagner Pty Ltd

Project: Pacific Highway Upgrade Sapphire to Woolgoolga Vegetation Survey

Source:

Ecos Environmental Pty Ltd (2005)

CAUTION: The information shown on this plan may be insufficient for some types of detailed design. Ecos Environmental Pty Ltd should be consulted as to the suitability of the information shown herein prior to the commencement of any works based on this map.

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3.3.6 Grey Gum-Grey Ironbark-White Mahogany Coastal Hills Moist Open Forest

Association: Grey Gum (*Eucalyptus propinqua*) – Grey Ironbark (*Eucalyptus siderophloia*) – White Mahogany (*Eucalyptus acmenoides*)

Structure: Tall open forest (15-28m) with a mid-dense mid stratum of small trees and shrubs and dense grass-herb understorey.

Distribution: The northern half of the survey area, mainly north of Woolgoolga Creek.

Habitat: Generally mid to upper hill slopes; red-yellow podzolic soil formed on metasediment.

Main Species: (* introduced species)

Stratum	Common Name	Botanical Name	Abundance
Upper	Grey Gum	*Eucalyptus propinqua*	common (3)
	Broad-leaved Ironbark	*Eucalyptus siderophloia*	common (3)
	Tallowwood	*Eucalyptus microcorys*	common (3)
	Pink Bloodwood	*Corymbia intermedia*	occasional (3)
	Spotted Gum	*Corymbia variegata*	occasional (3)
Mid	Turpentine	*Syncarpia glomulifera*	common (3)
	*Lantana	*Lantana camara*	common (3)
	Blackwood Wattle	*Acacia melanoxylon*	common (3)
	Forest Oak	*Allocasuarina torulosa*	common (3)
	Cheese Tree	*Glochidion ferdandii*	common (2)
Lower	Blady Grass	*Imperata cylindrica*	common (3)
	Bracken Fern	*Pteridium esculentum*	common (3)
	Common Mat Rush	*Lomandra longifolia*	common (3)
	Poison Pratia	*Pratia purpurascens*	common (3)
	Kangaroo Grass	*Themeda australis*	common (3)
	Rusty Desmodium	*Desmodium rhytidophyllum*	occasional (2)

Condition: Generally in good condition with few weeds, apart from Lantana.

Assessment: Not listed as an endangered community under the TSC Act.

Equivalent to Forest Type 62 (Grey Gum – Grey Ironbark-White Mahogany), which was considered adequately conserved in the central zone of NE NSW by Hager and Benson (1994).

3.3.7 Spotted Gum Coastal Hills Moist Open Forest

Association: Spotted Gum (*Corymbia variegata*)

Structure: Tall open forest (20-30m) with a grassy understorey.

Distribution: The northern half of the survey area at Woolgoolga Creek Road and Wedding Bells State Forest north of Bark Hut Road.

Habitat: Upper hill slopes; shallow, yellow podzolic soil formed on metasediment.

Main Species: (* introduced species)

Stratum	Common Name	Botanical Name	Abundance
Upper	Spotted Gum	*Corymbia variegata*	common (3-4)
	Grey Gum	*Eucalyptus propinqua*	common (3)
	Broad-leaved Ironbark	*Eucalyptus siderophloia*	common (3)
	Pink Bloodwood	*Corymbia intermedia*	occasional (2)
Mid	*Lantana	*Lantana camara*	common (3)
	Blackwood Wattle	*Acacia melanoxylon*	common (3)
	Forest Oak	*Allocasuarina torulosa*	common (3)
	Cheese Tree	*Glochidion ferdandii*	common (2)
Lower	Blady Grass	*Imperata cylindrica*	common (3-4)
	Bracken Fern	*Pteridium esculentum*	common (3)
	Common Mat Rush	*Lomandra longifolia*	common (3)
	Poison Pratia	*Pratia purpurascens*	common (3)
	Kangaroo Grass	*Themeda australis*	common (3)
	Rusty Desmodium	*Desmodium rhytidophyllum*	common (2)

Condition: Generally in good condition with few weeds.

Assessment: Not listed as an endangered community under the TSC Act.

Equivalent to Forest Type 74 (Spotted Gum – Ironbark/Grey Gum). The association representing this forest type in the survey area was considered poorly conserved in the central zone of NE NSW by Hager and Benson (1994).

3.3.8 White Mahogany Coastal Hills Moist Open Forest

Association: White Mahogany (*Eucalyptus acmenoides*)

Structure: Tall open forest (15-28m) with a grassy understorey.

Distribution: The northern half of the survey area, mainly north of Woolgoolga Creek Road.

Habitat: Mostly on mid to upper hill slopes of protected aspect; red-yellow podzolic soil formed on metasediment.

Main Species: (* introduced species)

Stratum	Common Name	Botanical Name	Abundance		
Upper	White Mahogany	*Eucalyptus acmenoides*	common	(3)	
	Grey Gum	*Eucalyptus propinqua*	common	(3)	
	Broad-leaved Ironbark	*Eucalyptus siderophloia*	common	(3)	
	Tallowwood	*Eucalyptus microcorys*	common	(3)	
	Brush Box	*Lophostemon confertus*	occasional	(3)	
Mid	Forest Oak	*Allocasuarina torulosa*	common	(3)	
	Native Guava	*Euphomatia laurina*	common	(3)	
	*Lantana	*Lantana camara*	common	(3)	
	Morinda	*Morinda jasminoides*	common	(3)	
	Forest Phyllanthus	*Phyllanthus gastroemii*	occasional		(2)
	Cheese Tree	*Glochidion ferdandii*	common	(2)	
Lower	Gristle Fern	*Blechnum cartilagineum*	common	(3)	
	Ottochloa Grass	*Ottochloa gracillima*	common	(3)	
	Rasp Fern	*Doodia aspera*	common	(3)	
	Common Mat Rush	*Lomandra longifolia*	common	(3)	
	Barbed Wire Vine	*Smilax australis*	common	(3)	
	Pastel Flower	*Pseuderanthemum variable*	occasional	(2)	

Condition: Generally in good condition with few weeds.

Assessment: Not listed as an endangered community under the TSC Act.

Equivalent to Forest Type 60 (Narrow-leaved White Mahogany-Red Mahogany-Grey Ironbark – Grey Gum). The plant communities representing this forest type in the survey area were considered inadequately conserved in northeast NSW by Hager and Benson (1994).

3.3.9 Red Mahogany Swamp Sclerophyll Forest

Association: Red Mahogany (*Eucalyptus resinifera*)

Structure: Mid-high to tall (8-15m) woodland with a dense tall shrub/small tree mid stratum and a sedge dominated ground layer.

Distribution: One small area occurs in the valley of Little Arrawarra Creek at the northern end of the survey corridor.

Habitat: Valley flat on heavy clay soil, possibly an old stream terrace.

Main Species: (* introduced species)

Stratum	Common Name	Botanical Name	Abundance
Upper	Red Mahogany	*Eucalyptus resinifera*	common (3)
Mid	White Paperbark	*Melaleuca sieberi*	common (3)
	Prickly Paperbark	*Melaleuca nodosa*	common (3)
	Heath Banksia	*Banksia oblongifolia*	common (3)
	Black Sheoak	*Allocasuarina littoralis*	common (3)
Lower	A Sedge	*Ptilothrix deusta*	common (4)
	Wire Grass	*Entolasia marginata*	common (3)
	Kangaroo Grass	*Themeda australis*	common (3)
	Bracken Fern	*Pteridium esculentum*	common (3)
	A Hibbertia	*Hibbertia vestita*	common (3)

Condition: In good condition with no weeds.

Assessment: Equivalent to the Endangered Ecological Community 'Swamp Sclerophyll Forest on Floodplain'. Typically the latter ecosystem is dominated by Broad-leaved Paperbark (*Melaleuca quinquenervia*) or Swamp Mahogany (*Eucalyptus robusta*), however, the Scientific Committee's final determination for Swamp Sclerophyll Forest on Floodplain specifies that Red Mahogany (*Eucalyptus resinifera*) may be locally dominant at some sites. The associated understorey species fit well with the description of Swamp Sclerophyll Forest on Floodplain. The terrain also matches in terms of elevation and landform (point one of the final determination).

Equivalent to Forest Type 68 (Red Mahogany) which was considered poorly conserved in north east NSW by Hager and Benson (1994).

3.3.10 Smooth-barked Apple Swamp Sclerophyll Forest

Association: Smooth-barked Apple (*Angophora leiocarpa*)

Structure: Mid-high to tall (8-15m) woodland with a predominantly grassy ground layer.

Distribution: One small area occurs in the northern half of the survey area on the western side of the highway south of Double Crossing Creek.

Habitat: Valley flat on heavy clay soil derived from metasediments.

Main Species: (* introduced species)

Stratum	Common Name	Botanical Name	Abundance
Upper	Smooth-barked Apple	*Angophora leiocarpa*	common (4)
	Swamp Mahogany	*Eucalyptus robusta*	common (3)
	Broad-leaved Paperbark	*Melaleuca quinquenervia*	common (3)
	Swamp Box	*Lophostemon suaveolens*	occasional (3)
Mid	White Paperbark	*Melaleuca sieberi*	common (3)
	Prickly Paperbark	*Melaleuca nodosa*	common (3)
	Heath Banksia	*Banksia oblongifolia*	occasional (3)
	Prickly Tea Tree	*Leptospermum juniperinum*	occasional (3)
Lower	A Sedge	*Ptilothrix deusta*	common (4)
	Wire Grass	*Entolasia marginata*	common (3)
	Kangaroo Grass	*Themeda australis*	common (3)
	A Hibbertia	*Hibbertia vestita*	common (3)
	A Grass	*Ischaemum australe*	common (3)

Condition: Generally in good condition with few weeds.

Assessment: In terms of terrain and associated flora this community equates with 'Swamp Sclerophyll Forest on Coastal Floodplains', an Endangered Ecological Community, however, the dominant species, *Angophora leiocarpa*, was not mentioned in the final determination. The similarity of terrain and associated flora with Swamp Sclerophyll Forest warrants a pre-cautionary approach to classification, so that for the purposes of this study, the association is considered equivalent to Swamp Sclerophyll Forest on Coastal Floodplains.

Equivalent to Forest Type 105 (Smooth-barked Apples). Considered poorly conserved in the central zone of NE NSW by Hager and Benson (1994).

3.3.11 Broad-leaved Paperbark Swamp Sclerophyll Forest

Association: Broad-leaved Paperbark (*Melaleuca quinquenervia*)

Structure: Mid-high to tall (10-15m) open forest.

Distribution: Common along the low-lying central part of the corridor between the Bucca Road and Double Crossing Creek south of Woolgoolga, but also in narrow bands along swampy drainage lines in the north and south of the survey area (some of these were too narrow to be mapped).

Habitat: Seasonally waterlogged floodplain or swampy creek lines at the edge of coastal hills and the floodplain.

Main Species: (* introduced species)

Stratum	Common Name	Botanical Name	Abundance
Upper	Paperbark	*Melaleuca quinquenervia*	common (4-5)
	Swamp Oak	*Casuarina glauca*	occasional (2)
	Swamp Box	*Lophostemon suaveolens*	occasional (2)
	Swamp Mahogany	*Eucalyptus robusta*	occasional (2)
Mid	Broad-leaf Paperbark	*Melaleuca quinquenervia*	common (4)
	Swamp Oak	*Casuarina glauca*	occasional (2)
	Giant Silkpod Vine	*Parsonsia straminea*	occasional (2)
Lower	Swamp Ground Fern	*Hypolepis muelleri*	common (3)
	A sedge	*Schoenus brevifolius*	common (3)
	*Broad-leaf Paspalum	*Paspalum wettsteinii**	common (3)
	Swamp Panic	*Entolasia marginata*	common (3)
	*Billygoat Weed	*Ageratum houstonianum*	common (3)
	Native Violet	*Viola hederacea*	common (2)
	A sedge	*Carex maculata*	occasional (2)

Condition: Generally in good condition with mature structure and few environmental weeds.

Assessment: Equivalent to the Endangered Ecological Community 'Swamp Sclerophyll Forest on Floodplain'.

3.3.12 Swamp Oak Swamp Sclerophyll Forest

Association: Swamp Oak (*Casuarina glauca*) grassy forest

Structure: Mid-high to tall (8-15m) woodland and open forest.

Distribution: Limited to the road reserve between the Emerald Beach turn-off to Stony Creek Road.

Habitat: Disturbed/previously cleared areas in the road reserve adjacent to Broad-leaved Paperbark forest. These sites appear to be dominated by Swamp Oak rather than Paperbark, because Swamp Oak is a better coloniser of cleared and disturbed ground.

Main Species: (* introduced species)

Stratum	Common Name	Botanical Name	Abundance
Upper	Swamp Oak	*Casuarina glauca*	common (4)
	Paperbark	*Melaleuca quinquenervia*	common (3)
Lower	*Broad-leaf Paspalum	*Paspalum wettsteinii*	common (3)
	*Billygoat Weed	*Ageratum houstonianum*	common (3)
	*Vasey Grass	*Paspalum urvillei*	common (2)
	Swamp Ground Fern	*Hypolepis muelleri*	common (3)
	*Carpet Grass	*Axonopus affine*	common (3)

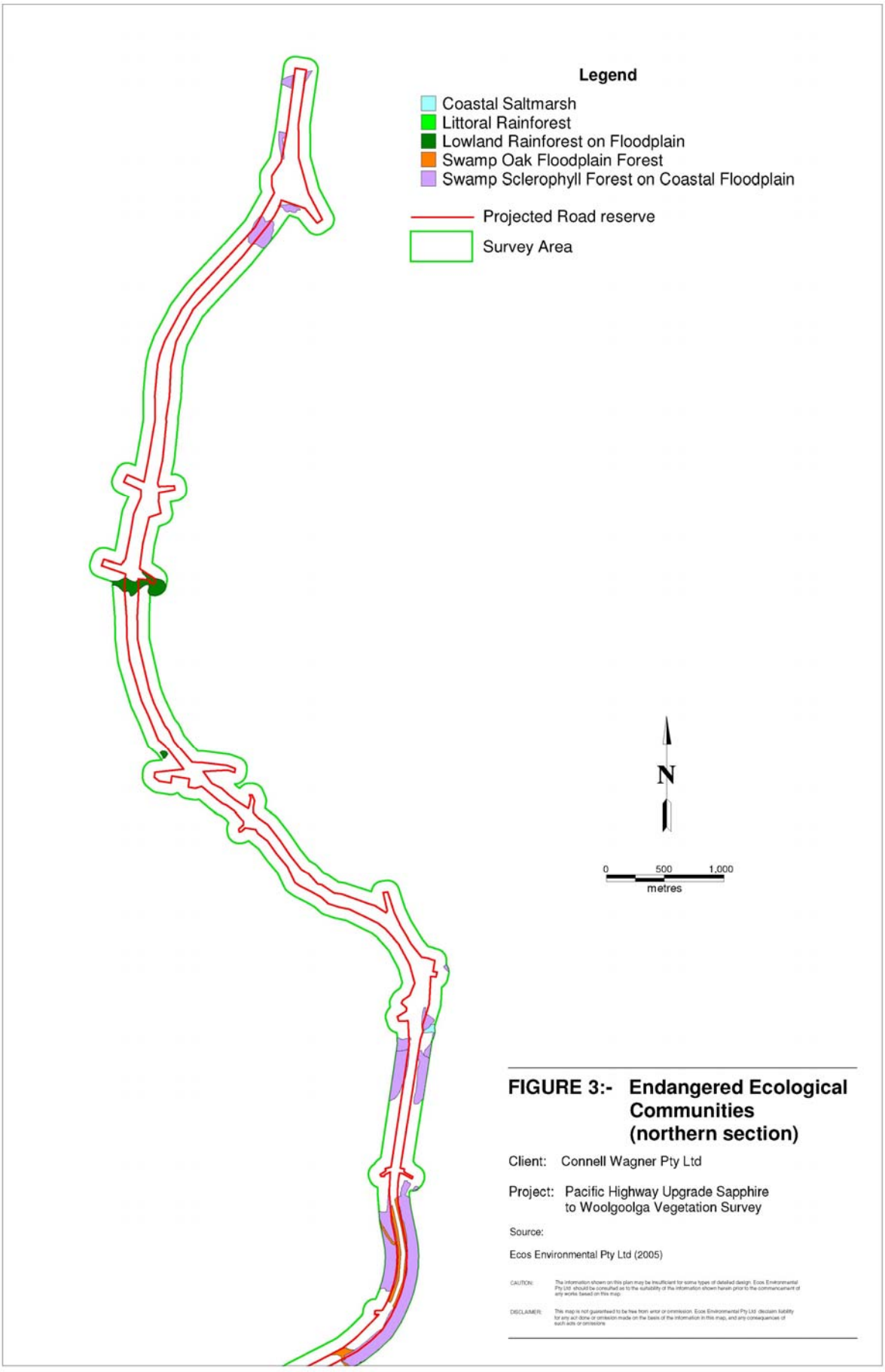
Condition: Poor condition.

Assessment: Equivalent to the Endangered Ecological Community (TSC Act) Swamp Oak Floodplain Forest.

3.3.13 Estuarine Complex

One very small area of estuarine vegetation was intersected by the projected footprint in the tidal zone of Double Crossing Creek south of Woolgoolga. Dominant species present included Saltwater Couch (*Sporobolus virginicus*) and Swamp Oak (*Casuarina glauca*).

This vegetation type is equivalent to Coastal Saltmarsh, an Endangered Ecological Community.


Legend
Coastal Saltmarsh
Littoral Rainforest
Lowland Rainforest on Floodplain
Swamp Oak Floodplain Forest
Swamp Sclerophyll Forest on Coastal Floodplain
Projected Road reserve
Survey Area
N
0
500
1,000
metres
FIGURE 3:- Endangered Ecological Communities (northern section)
Client: Connell Wagner Pty Ltd
Project: Pacific Highway Upgrade Sapphire to Woolgoolga Vegetation Survey
Source:
Ecos Environmental Pty Ltd (2005)
CAUTION:
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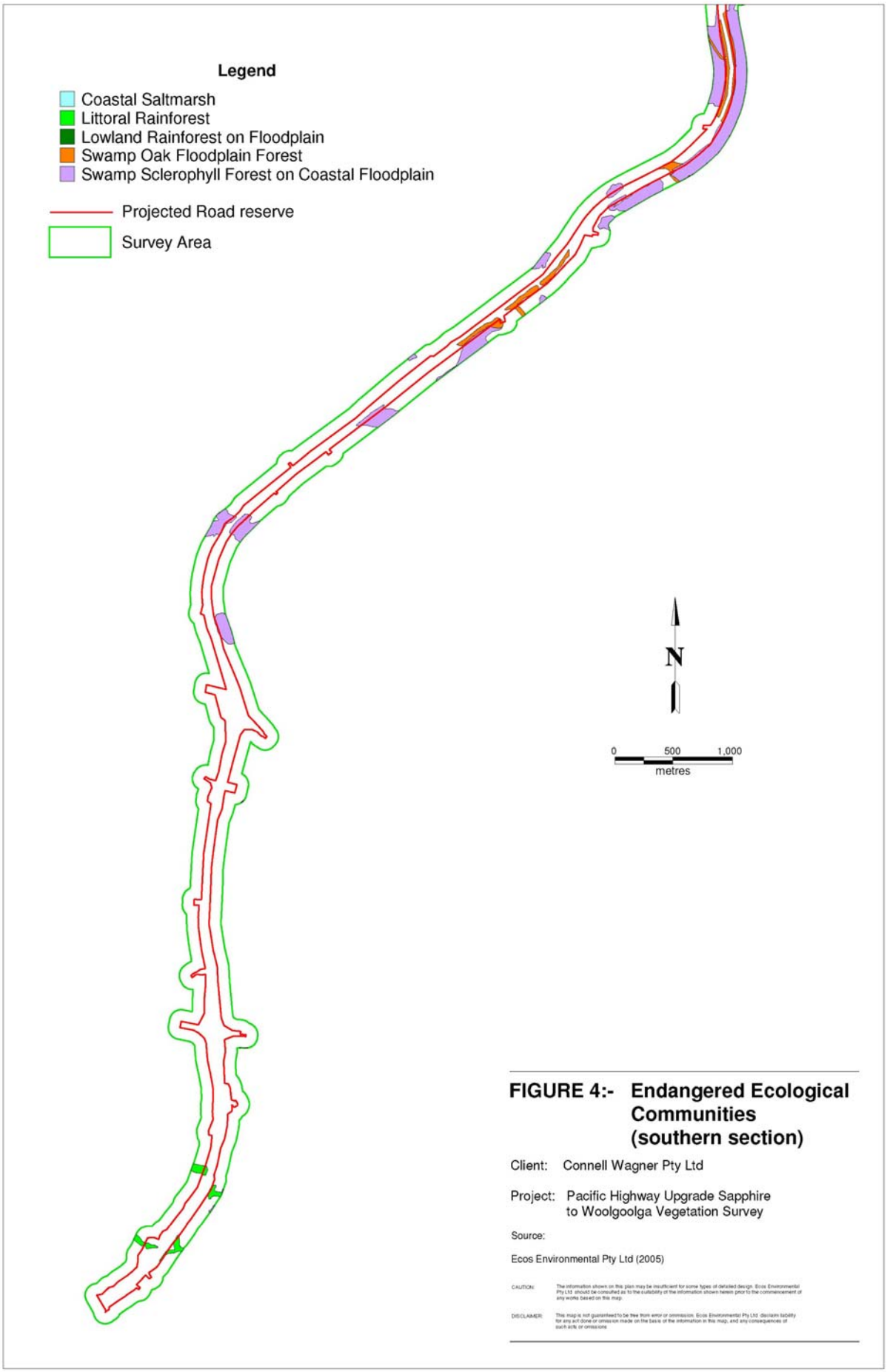

FIGURE 4:- Endangered Ecological Communities (southern section)

Client: Connell Wagner Pty Ltd

Project: Pacific Highway Upgrade Sapphire to Woolgoolga Vegetation Survey

Source:

Ecos Environmental Pty Ltd (2005)

CAUTION: The information shown on this plan may be insufficient for some types of detailed design. Ecos Environmental Pty Ltd should be consulted as to the suitability of the information shown herein prior to the commencement of any works based on this map.

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3.4 Threatened Plant Species

3.4.1 Summary

Four Threatened (TSC Act) plant species were recorded within or closely adjoining the projected footprint. Three are listed as Endangered (*Marsdenia longiloba*, *Lindsaea incisa* and *Quassia sp.* B) and one as Vulnerable (*Amorphospermum whitei*). Two of these are also listed under the EPBC Act. Descriptions of recorded Threatened species, including their regional distribution, local occurrence and habitat are provided below. Threatened and rare plant species occurrences in the vicinity of the proposed route are detailed in Table 3.

3.4.2 Slender Marsdenia (*Marsdenia longiloba*)

Conservation Status: *Marsdenia longiloba* is listed as Endangered under the NSW TSC Act and as Vulnerable under the Commonwealth EPBC Act.

Description: A slender vine to 5m in height, leaves opposite, ovate to lanceolate, glabrous, pale green above, lighter on the underside, 3-10cm long and 1-5cm wide, with minute cluster glands at the base of lamina. The flowers are arranged in umbels, each flower is 7-9mm in diameter and whitish. This species is distinguished from other members of the genus by leaf colour and shape and the clear latex (rather than opaque or milky) that exudes from the leaf stalks.

Flowering has rarely been observed in this species and the fruits (follicles) have never been recorded (Harden 1992). The flowering period is reported as November to January in Quinn *et al.* (1995). The plants at Gaudrons Road were recorded with new flower buds at the end of July 2005 and one fruit (follicle) 10cm long was collected in December 2005.

Regional Distribution: This species occurs north of the Hastings River at widely scattered localities from the coast inland to the Great Escarpment ranges and extends into southeast Qld. Recorded localities include the Tweed River, Woodenbong, Byron Bay, Alstonville district, Billilimbra SF, Upper Copmanhurst, Coffs Harbour, Macleay River, Hastings River, Mt Boss (Quinn *et al.*1995), Billinudgel and the Burringbar Range (pers.obs.).

Habitat: Moist open forest with a fern-grass understorey and occasional small rainforest trees, often on hillslopes adjacent to gully rainforest. It appears to prefer soils of medium fertility formed on substrates such as metasediment.

Local Occurrence: A small population was recorded at one location approximately 15 metres to the east of the existing highway in the road reserve just north of Gaudrons Road, Mid Sapphire Beach. The population at this site extends for a distance of approximately 50 metres parallel with the Pacific Highway and contains 20-30 plants growing amongst the ground layer vegetation or climbing 1-4 m into the understorey. Habitat consists of moist open forest dominated by Grey Gum (*E. propinqua*), Tallowwood (*E. microcorys*) and Grey Ironbark (*E. siderophloia*), which is in good condition with mature structure and few weeds present.

There are no proposed works in the immediate vicinity of the population, as the existing highway at this location would form a local access road and the closest construction activity would be at Gaudrons Road, approximately 220 metres to the south. As such, none of these individuals would be removed as a result of construction of the Proposal and there would be no long-term decrease in the size of the present population at this location.

Similar forest habitat to the Gaudrons Road site was present on several sections of the survey corridor but no other plants were recorded. This species appears to be very sparsely distributed in the greater Coffs Harbour area. Apart from the single herbarium (RBG) record for Coffs Harbour dated 1903 (Quinn *et al.*1995), this species was also recorded 1km east of the survey corridor on Woolgoolga Creek during earlier botanical survey work (Benwell 2002) and is reported to occur on another property near Coffs Harbour (D. Binns pers.comm.).

Plate 1: Slender Marsdenia (Marsdenia longiloba) at Gaudrons Road, Mid Sapphire, and fruit collected in December 2005 (The Flora of NSW states that the fruit of this species has not been recorded.)

Table 3: Threatened (TSC Act) and rare plant species occurrences recorded on the preferred route of the proposed Sapphire to Woolgoolga Upgrade of the Pacific Highway.

No.	Plant name	Conservation Status (TSC Act)	No.	Growth Form	Easting GDA	Northing GDA	Location Description
80001a	Rusty Plum *Amorphospermum whitei*	Vulnerable	1	tree (6m)	514081	6654676	property no. 176 west side of existing highway opposite Sebel Resort bottom of rock embankment
80001b	Rusty Plum *Amorphospermum whitei*	Vulnerable	1	tree (7m)	514081	6654676	within 2m of 80001a
80001c	Rusty Plum *Amorphospermum whitei*	Vulnerable	1	tree (5m)	514097	6654691	upslope to the north of 80001a and 8000b, closer to bananas, behind large fig
80002	Rusty Plum *Amorphospermum whitei*	Vulnerable	1	tree (6m)	514109	6654590	east side of highway, 100m sth of Sebel Resort in rainforest patch on same creek as 80001, one tree on private property
80003	*Marsdenia longiloba*	Endangered	few plants	small vine (<2m)	514209	6656264	east side of highway in road reserve, tall open forest of Grey Gum, Ironbark and Turpentine, north of Gaudrons Rd.
80004	*Marsdenia longiloba*	Endangered	few plants	small vine (<2m)	514204	6656231	20m south of 80003 - plants scattered between these two points
80005	*Marsdenia longiloba*	Endangered	few plants	small vine (<2m)	514198	6656260	near 80004 - closer to existing road
80006	*Marsdenia longiloba*	Endangered	few plants	small vine (<2m)	514204	6656227	near 80005 - further south
80007	*Marsdenia longiloba*	Endangered	few plants	small vine (<2m)	514191	6656215	near 80006 - further south
80008	*Marsdenia longiloba*	Endangered	few plants	small vine (<2m)	514204	6656180	near 80007 - further south, 15 from existing road
80009	Red Bopple Nut *Hicksbeachia pinnatifolia*	Vulnerable	1	small tree - juvenile 0.6m high	516876	6668470	at old forestry station Woolgoolga Ck road, about 80 metres north of road across grassed area to edge of plantation, just inside the footprint
80010	Long-leaved Tuckeroo *Cupaniopsis newmanii*	ROTAP	1	small tree-2m high	516789	6668048	opposite old forestry station Woolgoolga Ck road,on southern side of road 10 metres from edge of existing

							road, in the road reserve
80011	Rough-shelled Bush Nut *Macadamia tetraphylla*	Vulnerable	1	juvenile 0.2m high	516249	6670925	property no.241, in gully below driveway
80013	Rusty Plum *Amorphospermum whitei*	Vulnerable	1	small tree (8m)			on property no. 364 (no-go) identified with binoculars 20m south of property no.222 at 516242 666908, on creek
80014	Rusty Plum *Amorphospermum whitei*	Vulnerable	1	small tree (4m)	516202	6669179	on property no. 222 near creek
80020	Rusty Plum *Amorphospermum whitei*	Vulnerable	2	small trees (8.5m & 4m)	516504	6668674	on property no. 131, top of northern bank of Woolgoolga Ck
80021	Rusty Plum *Amorphospermum whitei*	Vulnerable	1	small tree (6m)	516523	6668667	on property no. 131, top of northern bank of Woolgoolga Ck 4m from 80020
80022	Rusty Plum *Amorphospermum whitei*	Vulnerable	1	small tree (8m)	516479	6668698	on property no. 131, top of northern bank of Woolgoolga Ck
80023	Rusty Plum *Amorphospermum whitei*	Vulnerable	1	small tree (7m)	516473	6668680	on property no. 131, top of northern bank of Woolgoolga Ck
80024	Rusty Plum *Amorphospermum whitei*	Vulnerable	1	small tree (2m)	516504	6668674	on property no. 131, top of northern bank of Woolgoolga Ck close to 80020
80025	Rusty Plum *Amorphospermum whitei*	Vulnerable	1	small tree (4.5m)	516528	6668521	on State Forest or property no. 131? in small rainforest remnant
80026-28	Long-leaved Tuckeroo *Cupaniopsis newmanii*	ROTAP	1	small tree and two juveniles	516870	6668367	Opposite old forestry station Woolgoolga Ck road,on southern side of road 2-6 metres from edge of existing road, in the road reserve
80029	*Lindsaea incisa*	Endangered	patch	small ground fern	514029	6659846	Wedding Bells SF 20m from property no. 351 and 30m from existing highway; patch about 8m long and 2m wide
80030	Rough-shelled Bush Nut *Macadamia tetraphylla*	Vulnerable	1	small tree 6m tall	516828	6668451	Woolgoolga Creek Road, Wedding Bells State Forest, ground of old forestry station.

80031	Narrow-leaved Quassia *Quassia sp.* B	Endangered	few plants	spindly shrub 0.5-1m tall	514026	6657385	In road reserve north of Wakefield Road, northern side of drainage line.
80032	Narrow-leaved Quassia *Quassia sp.* B	Endangered	few plants	spindly shrub 0.5-1m tall	514023	6657388	Private property north of Wakefield Road, northern side of drainage line; 2m from road res.
80033	Narrow-leaved Quassia *Quassia sp.* B	Endangered	few plants	spindly shrub 0.5-1m tall	514020	6657378	Private property north of Wakefield Road, northern side of drainage line; 10m from road res.
80034	Narrow-leaved Quassia *Quassia sp.* B	Endangered	few plants	spindly shrub 0.5-1m tall	513864	6657420	Private property north of Wakefield Road, northern side of drainage line; 150m from rd. res.
80035	An Orchid *Cymbidium maddidum*	Reg. Signif.	1 clump	epiphyte, pseudobulbs	516377	6670914	Property no.241 (Bark Hut Rd west of Woolgoolga) 10m south of fence line bottom of slope
80090	Koala Bells *Artanema fimbriatum* A Daisy *Acmella grandiflora*	Rare Regionally Significant	8 plants several plants	herbs	514160	6660318	State Forest on the corner of Pacific Hwy and Bucca Road
80091	Koala Bells *Artanema fimbriatum* A Daisy *Acmella grandiflora*	Rare Regionally Significant	1 plant several plants	herbs	514213	6660307	State Forest on the corner of Pacific Hwy and Bucca Road
80092	Koala Bells *Artanema fimbriatum* A Daisy *Acmella grandiflora*	Rare Regionally Significant	1 plant several plants	herbs	514191	6660292	State Forest on the corner of Pacific Hwy and Bucca Road
80093	An Orchid *Cymbidium maddidum*	Regionally Significant	1 clump	epiphyte, pseudobulbs	516183	6669946	Property no.99 (Newmans Rd west of Woolgoolga), growing on tall stump 20m from creek
80094	An Orchid *Cymbidium maddidum*	Regionally Significant	1 clump	epiphyte, pseudobulbs	516098	6670062	Property no.99 (Newmans Rd west of Woolgoolga), growing on log across creek
80095	*Typhonium sp.* Possibly *Typhonium sp. aff brownii*	Endangered	several plants	rhizomatous herb	516301	6669947	Property no.99 (Newmans Rd west of Woolgoolga), growing on creek banks in strip of riparian rainforest. Plants scattered along creek for 20 metres east from the recorded location.

3.4.3 *Lindsaea incisa*

Conservation Status: *Lindsaea incisa* is listed as Endangered under the NSW TSC Act.

Description: A small ground fern with pale green, slender, erect fronds, 1-3cm wide and 10-20cm long. The paired leaves are deeply divided and form whorls of 3-4 leaflets spaced out along the stems. The fronds occur in small, often dense patches, which arise from a rhizomatous root system.

Regional Distribution: This species is distributed in central eastern Australia between Fraser Island and Coffs Harbour (Australia's Virtual Herbarium website). In NSW the species is known from scattered localities between the lower Clarence River and the Coffs Harbour district. Recorded localities include Corindi, Barcoongere State Forest, Wells Crossing, Bundjalung National Park, Waihou Flora Reserve and Copmanhurst (Sheringham and Westaway 1995; pers.obs.).

Habitat: Heathy open forest grading into swamp sclerophyll forest on seasonally waterlogged or poorly drained sites, usually along the base of hillslopes or adjacent creeks in sandstone terrain. The great majority of sites are on sedimentary geology (sandstone or siltstone) or derived alluvium (NPWS 2002; pers. obs.).

Local Occurrence: *Lindsaea incisa* was recorded at a single location in Orara East State Forest approximately 30m from the existing Pacific Highway at Yellow Water Holes. The site is at the base of hillslope on the edge of open forest and a narrow remnant of swamp sclerophyll woodland. Plants at this location occurred in a single patch about 8 m long and 2 m wide consisting of 200-300 stems. The nearest known populations to the Yellow Water Holes site are in Waihou Flora Reserve, 15 km to the northwest, and near Corindi,15 km to the north.

Plate2: *Lindsaea incisa* in Wedding Bells SF adjacent to the existing Pacific Hwy.

In the vicinity of the population a proposed service road would be located on the western side of the existing highway. The toe of the batter slope would be located approximately 10 metres from the area of *Lindsaea incisa.* Construction of the proposed service road to the east of the patch of *Lindsaea incisa* would require measures to ensure that construction machinery and personnel are excluded from the area containing the threatened species.

3.4.4 Rusty Plum (*Amorphospermum whitei*)

Conservation Status: *Amorphospermum whitei* is listed as Vulnerable under the NSW TSC Act.

Description: Medium sized rainforest tree to 20 m in height with pale rough bark and a fluted trunk in larger trees. Leaves are alternate and prominently veined, with a smooth upper surface and rusty hairy beneath. New shoots are rusty brown (Floyd 1989).

Regional Distribution: The Macleay River to upper Tallebudgera Creek in far southern Queensland (Floyd 1989). Also reported from the Port Macquarie district (Harden 2000), the species' southern limit. Recorded localities include Nulla Nulla Creek, Warrell Creek, Oakes S.F., Bellinger River S.F., Tuckers Knob, Orara West S.F., Bruxner Park F.R., Coramba, Mt Coramba, Orara East S.F., Lower Bucca S.F., Woolgoolga Creek F.R., Waihou F.R., Sherwood N.R., Copmanhurst, Whian Whian S.F., Minyon Falls F.R., Broken Head N.R., Couchy Creek, Numinbah N.R. and Mt Cougal (Floyd 1989), Brunswick Heads N.R. (Briggs and Leigh 1996) and Mt Jerusalem (BSC 1999).

Habitat: Typical habitat consists of gully rainforest or wet sclerophyll with a well-developed rainforest understorey. Soil of medium fertility formed on metasediment or rhyolite. The altitude range of this species is from near sea level to 600 m (Floyd 1989).

Local Occurrence: Rusty Plum was recorded at several locations during the earlier route options survey (Benwell 2002). A large number of trees were seen in the upper catchment of Woolgoolga Creek adjacent to Gentle Annie Road and this population probably extends downstream to Woolgoolga Creek Nature Reserve where it is also reported (Floyd 1989), a distance of 2-3km. Other populations were recorded at Slaters Crossing Road, Bark Hut Creek, Moonee Creek and an unnamed creek on Sherwood Road near the junction with Nana Glen Road (all in Wedding Bells State Forest) and on Woolgoolga Creek between the survey area and Woolgoolga township on private property. Other occurrences are reported from Orara East SF in Sheringham and Westaway (1995). Eight out of 13 individuals in the vicinity of the Proposal would need to be removed.

Overall, flora survey work indicated that Rusty Plum is fairly widespread in rainforest and wet sclerophyll forest surrounding the study area. This species has become rare in the more cleared and developed zone surrounding coastal towns.

Plate 3: Rusty Plum *(Amorphospermum whitei)* growing on the footprint of the preferred route at Woolgoolga Creek

3.4.5 Narrow-leaved Quassia (*Quassia sp.* B)

Conservation Status: *Quassia sp.* B is listed as Endangered under both the NSW TSC Act and the EPBC Act.

Description: Shrub from 0.5 to 2 metres high, leaves narrow elliptical to oblanceolate, 4-12mm wide, glabrescent, paler underneath and with distinct secondary and intramarginal veins (Harden 2002). The population on the survey corridor had leaves matching this description, however, plants in the hinterland observed during previous fieldwork had leaves up to 20mm wide, or closer to the second *Quassia* taxon in NSW (*Quassia* sp. A).

Regional Distribution: *Quassia* sp. B is endemic to the area between Moonee Beach and Glenreagh north of Coffs Harbour and north east of Grafton. Recorded from Pine Brush State Forest, McCraes Knob (via Tucabia), Flaggy Creek (near Glenreagh), Timbertop (Kangaroo River State Forest), Wedding Bells State Forest, Conglomerate State Forest and Orara East State Forest (Quinn *et al.* 1995).

Habitat: Wet sclerophyll forest and heathy dry sclerophyll forest on sandstone and metasediment. Some records are from heathy open forest dominated by *E. planchoniana* and *E. pyrocarpa* on poor sandstone soils, while others are from wet sclerophyll forest. A. Floyd regards *Quassia* sp. 1 as a forest edge species (Quinn *et al.* 1995). The majority of locations appear to be in the ecotone between wet and dry sclerophyll forest.

Local Occurrence: A single occurrence was recorded on the southern half of the survey corridor north of Wakefield Road (Mid Sapphire). This population extended from the road reserve on the western side of the highway west (at right angles to the highway) for approximately 150 metres and contained approximately 70 plants, 4 within the present road reserve. Four of these individuals are located within the present road reserve approximately 15 metres from the construction footprint (but would not be required to be removed for construction of the Proposal), with the majority of the individuals located well outside the construction footprint. As such, none of these individuals would be removed as a result of construction of the Proposal and there would be no long-term decrease in the size of the present population at this location.

During the earlier route options vegetation survey (Benwell 2002) this species was recorded in the catchment of upper Woolgoolga Creek south of the junction of Bark Hut Road and Gentle Annie Road in Wedding Bells State Forest.

Overall, the Narrow-leaved Quassia appears to be uncommon and widely scattered in coastal foothill and range country north of Coffs Harbour. The occurrence in study area appears to be the most easterly and lowest elevation population of the species.

3.4.6 Koala Bells (*Artanema fimbriatum*)

Conservation Status: *Artanema fimbriatum* is not a legislatively protected species but was given a C2 ranking (threatened or potentially threatened) in the Upper North East Comprehensive Regional Assessment (NPWS 1998). *Artanema fimbriatum* was

included in a recent precautionary listing of potentially threatened plant species by the Royal Botanic Gardens Sydney (correspondence from B. Makinson, RBG, 23/7/04).

Description: A herb in the foxglove family growing to 50cm high with opposite, toothed leaves and 3-4cm long, blue tubular flowers (Plate 4).

Habitat: Koala Bells occurs mainly in coastal grassy floodplain forest and the edges of swamp sclerophyll forest but also in open forest on bedrock soils of medium to high fertility.

Regional Distribution: The southern limit of Koala Bells is the Macleay River valley near Kempsey (Wildlife Atlas; Australia's Virtual Herbarium). It extends northwards in small, widely scattered populations to the Qld border, in near coastal forests. The species is reported to be rare in southeast Qld (T. Bean, Qld Herb, pers.comm.).

Local Occurrence: An occurrence was recorded in swamp sclerophyll forest adjacent to the Pacific Highway and Bucca Road in Orara East State Forest. A total of ten plants were recorded at three points within a radius of approximately 30 metres. Two of the plants are located approximately 25 metres west of the Proposal footprint with the remaining eight plants located further west, approximately 75 metres from the Proposal footprint.

3.4.7 Stinky Lily (*Typhonium* sp. *aff. brownii*)

Note: a Typhonium species without flowers was recorded in December 2005. This could be either *Typhonium brownii*, a relatively common species, or the Endangered species *Typhonium* sp. *aff. brownii*. Until an identification can be made, the population will be treated as possibly the Endangered species.

Conservation Status: *Typhonium* sp. *aff. brownii.* is listed as Endangered under the TSC Act. This taxon has recently been recognised as a distinct species *Typhonium clemeshaii* (NPWS 2002).

Description: A rhizomatous herb to 20cm tall with glabrous, hastate to deeply two lobed leaves. The flowers consist of a floral spathe with a central stigma and are coloured green and purplish brown (NPWS 2002). The species is distinguished by the shape and length of the central flower stigma, which is intermediate between *T. brownii* and *T. eliosurum.*

Habitat: Stinky Lily occurs on fairly fertile soils, in moist eucalypt forest and its margins with subtropical rainforest (NPWS 2002).

Regional Distribution: This species is restricted to the ranges between Coffs Harbour and Woolgoolga and west to Glenreagh

Local Occurrence: The undetermined Typhonium species was recorded in the lowland subtropical rainforest at Newmans Road growing on the stream channel in moist alluvial soil. Several plants were scattered along a 20 metres stretch of creek bank, the closest located approximately 12 metres to the east of the proposed road footprint. Measures to protect these plants during construction would be implemented unless subsequent surveys identify them as the common *Typhonium brownii* species.

3.5 Threatened and ROTAP Species Not Native to the Study Area

In addition to the three naturally occurring Threatened species described above, two non-indigenous (not native to the study area) Threatened and one ROTAP species were recorded during the survey, as described below: -

- Rough-shelled Bush Nut (Macadamia tetraphylla)

Macadamia tetraphylla is listed as a Threatened species under the TSC Act and the EPBC Act (Vulnerable). This species is a small tree indigenous to the Richmond-Tweed region where it occurs in lowland rainforest on basalt, metasediment or alluvial substrates (Floyd 1989).

One planted tree was recorded in the grounds of the old forestry station on Woolgoolga Creek Road approximately 50 metres north of the road footprint. One wild growing juvenile was recorded in a wet sclerophyll gully near Bark Hut Road (Woolgoolga district), approximately 140 metres west of the proposed footprint.

- Red Bopple Nut (*Hicksbeachia pinnatifolia*)

A single Red Bopple Nut juvenile was recorded at the old forestry station on Woolgoolga Creek Rd (Plate 5) in an area of planted rainforest that included other non-indigenous natives (e.g. *Callitris macleayana*) and appeared to be 20 – 40 years old. The Red Bopple Nut was much smaller (0.6m) than other planted trees suggesting that it could have resulted from natural seed dispersal, however, there was no evidence that Red Bopple Nut occurs in the Woolgoolga district, although it does occur in the Dorrigo-Bellinger River area south of Coffs Harbour. This plant occurs approximately 50 metres north of the proposed footprint at Woolgoolga Creek Road.

- Long-leaved Tuckeroo (*Cupaniopsis newmanii*)

Cupaniopsis newmanii is a small tree with long pinnate leaves indigenous to the Richmond-Tweed region where it occurs in rainforest and adjoining wet sclerophyll forest (Floyd 1989). This species is listed in ROTAP (Briggs and Leigh 1995) as nationally rare.

Four plants were recorded 10 to 15 metres from the projected footprint in Wedding Bells State Forest near the old forestry station on Woolgoolga Creek Rd (Plate 6) and would not be required to be removed by the Proposal. The plants are 5-10 m from the existing road in moist open forest and appear to have grown from introduced (deliberately or accidentally?) seed or planted seedlings. Two individuals were producing flower buds in July during the survey. A few more mature trees were seen in State Forest adjoining Sanctuary Road in the same general locality.

3.6 Regionally Significant Species

Cymbidium maddidum

The Flora of NSW Vol.4 (Harden 1993) gives the southern limit of *Cymbidium maddidum* as the Clarence River. Occurrences were recorded in wet sclerophyll forest and rainforest near Bark Hut Road and Newmans Road west of Woolgoolga, or

approximately 100km south of the Clarence River. These represent an extension of range and the extreme southern limit of the species distribution. The occurrence at Newmans Road (two point records) is approximately 20 metres west of the proposed road footprint, while the occurrences at Bark Hut Road were approximately 20 metres west and 50 metres south of the projected footprint.

Acmella grandiflora

The Flora of NSW Vol.3 (Harden 1992) gives the southern limit of *Acmella grandiflora,* as Lismore, however, the Virtual Herbarium website shows the species occurring as far south as the Clarence River. The records from the present survey next to the existing highway in Orara East State Forest between Coffs Harbour and Woolgoolga appears to be at the extreme southern end of its geographical range. Several plants were located approximately 25 metres and 75 metres west of the Proposal footprint and would not be impacted by the Proposal.

Plate 4: *Artanema fimbriatum* (Koala Bells)

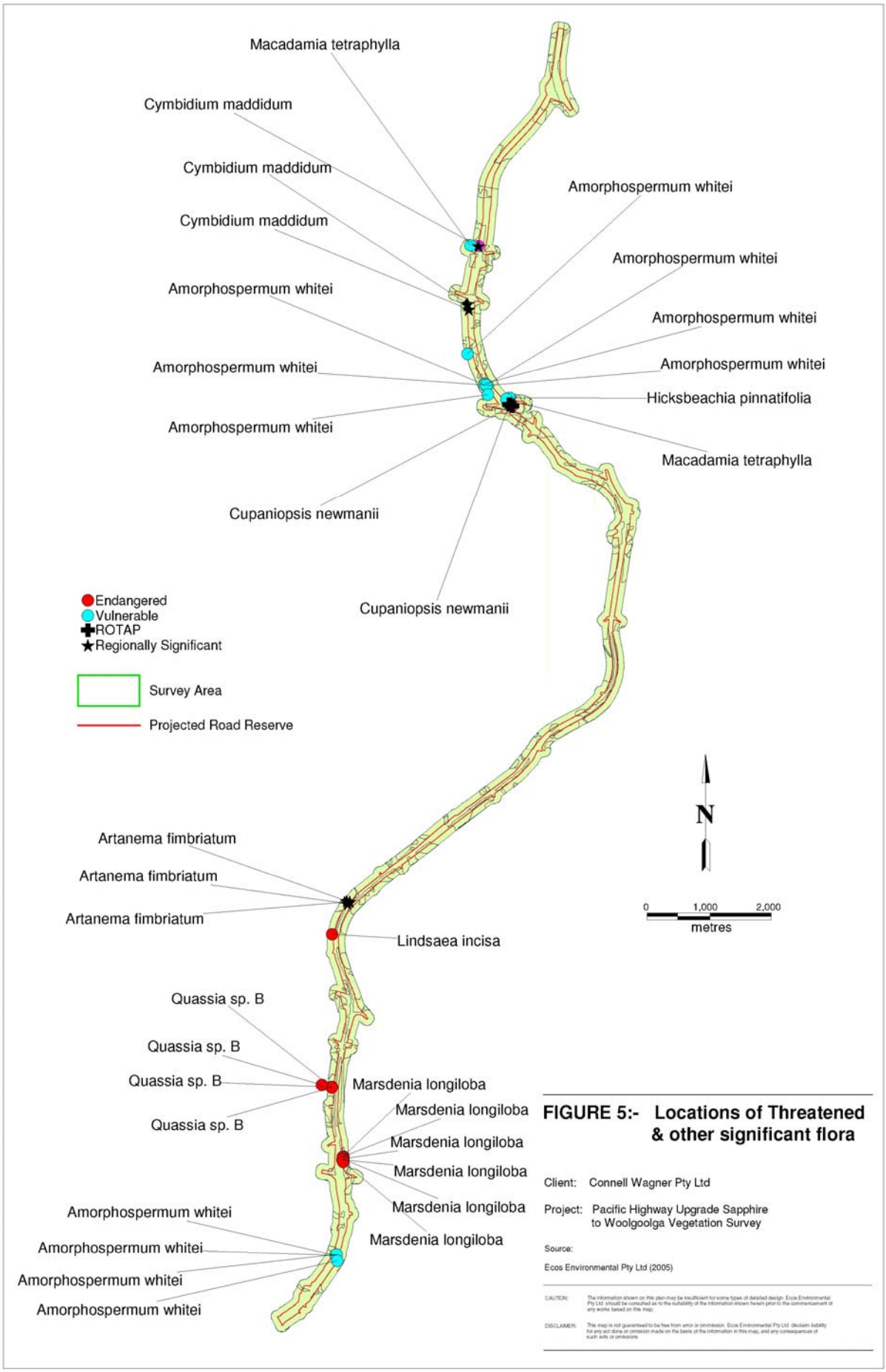
Macadamia tetraphylla
Cymbidium maddidum
Cymbidium maddidum
Cymbidium maddidum
Amorphospermum whitei
Amorphospermum whitei
Amorphospermum whitei
Amorphospermum whitei
Amorphospermum whitei
Amorphospermum whitei
Hicksbeachia pinnatifolia
Macadamia tetraphylla
Cupaniopsis newmanii
Cupaniopsis newmanii
Endangered
Vulnerable
ROTAP
Regionally Significant
Survey Area
Projected Road Reserve
N
0
1,000
2,000
metres
Artanema fimbriatum
Artanema fimbriatum
Artanema fimbriatum
Lindsaea incisa
Quassia sp. B
Quassia sp. B
Quassia sp. B
Quassia sp. B
Marsdenia longiloba
Marsdenia longiloba
Marsdenia longiloba
Marsdenia longiloba
Marsdenia longiloba
Marsdenia longiloba
Amorphospermum whitei
Amorphospermum whitei
Amorphospermum whitei
Amorphospermum whitei
FIGURE 5:- Locations of Threatened & other significant flora
Client: Connell Wagner Pty Ltd
Project: Pacific Highway Upgrade Sapphire to Woolgoolga Vegetation Survey
Source:
Ecos Environmental Pty Ltd (2005)
CAUTION: The information shown on this plan may be insufficient for some types of detailed design. Ecos Environmental Pty Ltd should be consulted as to the suitability of the information shown herein prior to the commencement of any works based on this map.
DISCLAIMER: This map is not guaranteed to be free from error or ommission. Ecos Environmental Pty Ltd disclaim liability for any act done or omission made on the basis of the information in this map, and any consequences of such acts or omissions

Plate 5: Red Bopple Nut (*Hickesbeachia pinnatifolia*). Juvenile plant in a planted area at the old forestry station in Wedding Bells SF, Woolgoolga Creek Road.

Plate 6: Long-leaved Tuckeroo (*Cupaniopsis newmanii*) in Wedding Bells SF near the edge of Woolgoolga Creek Road.

3.7 Endangered Ecological Communities

Five Endangered Ecological Communities (TSC Act) were recorded on or closely adjoining the proposed road footprint (Figure 3 and 4): -

- Swamp Sclerophyll Forest on Coastal Floodplains of the North Coast Bioregion
- Swamp Oak Floodplain Forest in the North Coast Bioregion
- Lowland Rainforest on Floodplain in the North Coast Bioregion
- Littoral Rainforest in the North Coast Bioregion
- Coastal Saltmarsh in the North Coast Bioregion

Swamp Sclerophyll Forest (SSF) is common in the central part of the proposed road corridor between Double Crossing Creek (near Sandy Beach) and Yellow Water Holes (near Moonee Beach). The proposed corridor through this central section is located largely within the present road reserve but also extends into the margin of adjoining properties along most of its length. Much of the Swamp Sclerophyll Forest in the road reserve is young regrowth with moderate to high levels of common exotic grasses and herbs in the understorey. Approximately 7.6 hectares of this community (excluding the Arrawarra interchange area) would be required to be removed for the Proposal.

Regrowth in the road reserve was often dominated by Swamp Oak even though adjoining swamp forest outside the road reserve was dominated by Broad-leaved Paperbark (SSF). This is apparently because Swamp Oak is a better coloniser of disturbed ground, a phenomenon commonly seen along roadsides where these two species co-occur. This change in species composition could create problems in classifying the vegetation, however, since both Swamp Sclerophyll Forest (Broad-leaved Paperbark) and Swamp Oak are EECs, it would not affect assessment of the conservation status of this general type of swamp forest vegetation. Approximately 5.3 hectares of Swamp Oak Floodplain Forest (excluding the Arrawarra interchange area) would be required to be removed for the Proposal In effect, all swamp forest vegetation along the corridor falls within either Swamp Oak or Swamp Sclerophyll Forest, which are both EECs.

Small areas of three other EECs occur within or closely adjacent to the survey corridor. Firstly, areas of rainforest on the floodplain of Woolgoolga Creek (alongside the proposed footprint at the proposed Woolgoolga interchange) and at a small stream crossed by Newmans Road are equivalent to the EEC ‘Lowland Rainforest on Floodplain in the North Coast Bioregion’. Approximately 1.0 hectare of this community (excluding the Arrawarra interchange area) would be required to be removed for the Proposal. Small areas of a second rainforest EEC, ‘Littoral Rainforest’ occur at Sapphire Beach adjoining the existing highway on the eastern and western side. Approximately 1.1 hectares of this community (excluding the Arrawarra interchange area) would be required to be removed for the Proposal. The other EEC is a very small area of Coastal Saltmarsh located downstream of where the projected footprint crosses Double Crossing Creek south of Woolgoolga. This community would not be impacted by the Proposal.

No examples of the EEC Lowland Rainforest, which has preliminary listing status under the TSC Act, were found in the study area. (The EEC Lowland Rainforest encompasses all areas of rainforest below 600m elevation excluding 'Lowland Rainforest on Floodplain' and 'Littoral Rainforest'.)

4.0 DISCUSSION

4.1 Threatened Plants

The Slender Marsdenia (*Marsdenia longiloba*) population located just north of Gaudrons Road at Mid Sapphire has probably the highest level of botanical constraint on the highway design. This species is listed as Endangered under the TSC Act (also as Vulnerable under the EPBC Act) and is extremely rare. Only ten records are listed in Quinn *et al.* (1995) and seven of these are from the early 1900s or late 1800s. The remaining three records are from Woodenbong, Dalmorton and Mt Boss, which are all more than 100km apart. This species also occurs in the Brunswick-Tweed district where two populations are known to the author. One of these populations was impacted by the Yelgun to Chinderah Highway Upgrade. Transplanting and cutting propagation carried out in an attempt to translocate the species during the latter project were unsuccessful (Benwell 2003).

The Endangered ground fern *Lindsaea incisa* is considered to have the next highest level of constraint on the highway design. This species is known from a total of only seven locations in NSW between the lower Clarence River and just north of Coffs Harbour. Although the plan of the highway footprint indicates it will not be directly impacted, the population is located approximately 30m from the present road and any widening in its direction would encroach into this 30m buffer zone, which is considered a minimum buffer to protect an Endangered species (Bali 2000; NPWS 1996). This species appears to have specific habitat requirements (see Section 3.4.3), which would be difficult to replicate at a site if the population was translocated.

The Endangered Narrow-leaved Quassia (Quassia sp. B) has a high level of constraint on the highway design but lower than the two above species. Although this species has a very restricted distribution, reasonable sized populations occur in State Forest in the hinterland ranges (e.g. Wedding Bells, Orara East and Conglomerate State Forests) where they are relatively secure. Also, the population recorded during the survey was found to extend from the road reserve west for 150 metres and contained approximately 70 mature plants, 4 of which were in the road reserve. The occurrence in the survey area is of particular interest as it represents the lowest elevation population of the species. No individuals of this species would be required to be removed for the construction of the Proposal.

The Rusty Plum (*Amorphospermum whitei*) is considered to have a lower level of botanical constraint than the other three Threatened species. Although this rainforest tree is rare close to the coast due to clearing and development, it is reasonably common in the hinterland (Section 3.4.4). Eight out of 13 individuals in the vicinity of the Proposal would need to be removed. A translocation plan should be prepared according to guidelines in ANPC (2004) to relocate impacted individuals to land with appropriate habitat and security of tenure nearby.

4.2 Threatened and ROTAP Species Not Native to the Study Area

The survey recorded three Threatened and ROTAP plant species non-indigenous to the Coffs Harbour-Woolgoolga area (see Section 3.5). These may have been accidentally or deliberately introduced. DECC advises that planted or introduced individuals of Threatened species have the same level of protection as wild growing

ones. This apparently applies to an area where the species is unlikely to have occurred historically or in recent geological time.

Potential habitat may exist for a plant species beyond its current or natural distribution due to climate change and past shrinkage in distribution caused by glacial-interglacial climatic oscillations (Myers and Giller 1988). The predicted green-house effect could also create new potential habitat and changes in species distributions.

The Red Bopple Nut occurs naturally in two metapopulations, one in the Coffs Harbour-Dorrigo district where the species is rare and the other in the Richmond-Tweed district 200km to the north where it is more common (NPWS 1998). If the lone individual is of planted origin, which seems likely, it may have been propagated from seed collected in the northern metapopulation. Some plant conservation biologists may consider it undesirable to introduce (putative) genetic variation from the north into the southern metapopulation.

A similar situation applies to the Rough-shelled Bush Nut and Long-leaved Tuckeroo except that a *species* has been introduced to a region (the Mid North Coast) where it did not occur historically, although suitable potential habitat appears to exist, as evidenced by the healthy, wild-growing individuals of Long-leaved Tuckeroo at the Woolgoolga Creek Road site. These plants may be considered to have conservation significance as populations of Threatened or nationally rare species that are extending their range in the wild as a consequence human activity and therefore should be actively protected, by either *in situ* protection or translocation.

4.3 Regionally Significant Species

Two regionally significant species were recorded in the study area, the epiphytic orchid *Cymbidium maddidum* and the perennial herb *Acmella grandiflora*. The occurrences of *Cymbidium maddidum* near Bark Hut Road and Newmans Road west of Woolgoolga and of *Acmella grandiflora* at the Bucca Road turn-off are apparently at the extreme southern limit of their distribution. Appropriate protective measures such as a marking protocol and barrier mesh fencing during highway construction are recommended to protect these species and their habitat.

4.4 Endangered Ecological Communities

Five Endangered Ecological Communities were recorded along the proposed road corridor: -

- Swamp Sclerophyll Forest on Coastal Floodplains of the North Coast Bioregion;
- Swamp Oak Floodplain Forest in the North Coast Bioregion;
- Lowland Rainforest on Floodplain in the North Coast Bioregion;
- Littoral Rainforest in the North Coast Bioregion; and
- Coastal Saltmarsh in the North Coast Bioregion

The EECs most affected by the proposed road footprint are Swamp Sclerophyll Forest on Coastal Floodplains and Swamp Oak Floodplain Forest. These two communities are fairly widespread in remnant vegetation on the coastal floodplain adjacent to the proposed corridor, although at a regional scale their extent has been greatly reduced by land clearing. Restricting the highway upgrade largely within the present road reserve in the central and southern sections of the corridor minimises the impact on these EECs. Generally, the examples of the two EECs within the proposed corridor consist of regrowth in poorer condition than the examples found on adjoining private property, Coffs Harbour Council and State Forest land.

Lowland Rainforest on Floodplain occurs in two areas within the bypass section of the Proposal. A small area on the floodplain of Woolgoolga Creek would not be impacted by the Proposal, with a larger area of the community present where the Proposal crosses Newmans Road. At this location the dual carriageways and associated batters would require the removal of approximately one hectare of this community.

Littoral Rainforest would be impacted by the Proposal (on the western side of the existing highway) at Sapphire Beach. Some areas of this community are degraded due to the adjacent cleared land and surrounding residential areas.

No examples of the EEC Lowland Rainforest (as distinct from Lowland Rainforest on Floodplain and Littoral Rainforest), which has preliminary listing status under the TSC Act, were found in the study area.

A very small area of Coastal Saltmarsh is present on the eastern side of the existing highway at Double Crossing Creek south of Woolgoolga. There would be no direct impact on this community.

5.0 RECOMMENDED AMELIORATIVE MEASURES

5.1 Threatened and Rare Plant Species

5.1.2 Slender Marsdenia (*Marsdenia longiloba*)

- The occurrence of this species is to be treated as having a very high level of significance. If there are any reasons why the population of Slender Marsdenia located to the east of the existing Pacific Highway immediately north of Gaudrons Road cannot be adequately protected during construction, then the feasibility of translocation should be investigated. Translocation would be undertaken in consultation with DECC.

- Employ protective measures such as barrier mesh fencing during vegetation clearing and highway construction.

5.1.2 *Lindsaea incisa*

- The occurrence of this species is to be treated as having a very high level of significance. The population of *Lindsaea incisa* is located in Orara East State Forest close to the boundary with the existing Pacific Highway road reserve. It is located approximately 30 metres to the west of the existing highway, however, the service road to connect Moonee Beach to Heritage Park would be located approximately 10 from the population of *Lindsaea incisa*.

- Employ protective measures such as barrier mesh fencing during vegetation clearing and highway construction.

5.1.3 Rusty Plum (*Amorphospermum whitei*)

- Eight out of 13 individuals in the vicinity of the Proposal would be impacted. Flora survey work has indicated that Rusty Plum is fairly widespread in rainforest and wet sclerophyll forest in the study area, with the species seen in the upper catchment of Woolgoolga Creek where it is though to extend downstream to Woolgoolga Creek Nature Reserve where it is also recorded.

- Investigate the feasibility of translocation of impacted individuals. Translocation would be undertaken in consultation with DECC.

5.1.4 Narrow-leaved Quassia (*Quassia* sp. B)

- No individuals of this species would be required to be removed for the construction of the Proposal, however protective measures such as barrier mesh fencing would be employed during vegetation clearing and highway construction.

5.1.5 Koala Bells (*Artanema fimbriatum*)

- Koala Bells were located in one location on the western side of the existing highway south of the Bucca Road turn off, outside of the area to be impacted by the highway and proposed service road. Employ protective measures such as barrier fencing during vegetation clearing and highway construction.

5.1.6 Stinky Lily (*Typhonium sp. aff. brownii*) To be confirmed.

- The (potential) occurrence of this species is to be treated as having a very high level of significance. Despite surveys during the appropriate season, no plants were flowering, therefore it could not be determined whether they were the relatively common species or the endangered species. Surveys should be conducted during summer of 2006-07 to check for flowering so that this species can be accurately determined.

- If the species is determined to be the endangered species, then investigate the feasibility of translocation. Translocation would be undertaken in consultation with DECC.

- Employ protective measures such as barrier fencing during vegetation clearing and highway construction.

5.1.7 Other Significant Flora

- Employ protective measures such as barrier fencing during vegetation clearing and highway construction.

- Where a species will be directly impacted, investigate the feasibility of translocation. Translocation would be undertaken in consultation with DECC.

5.2 Translocation

Where it is not possible to modify the highway design to avoid directly impacting species of conservation significance, because of engineering, economic or social factors, a translocation strategy should be developed for the subject plants, in accordance with ANPC (2004), “Guidelines for the Translocation of Threatened Plants in Australia”. The translocation strategy would be developed in consultation with DECC. Translocation, which is defined as the "deliberate transfer of plants or regenerative plant material from one place to another, including existing or new sites or those where the taxon is now extinct" (ANPC 2004), may entail a range of measures including transplanting, seed/cutting propagation and reintroduction, and habitat rehabilitation.

The aim of translocation is not simply to undertake the salvage and removal of individuals to a new location, but to promote the establishment of reproductive and sustainable stands of the subject species, to compensate for losses to population numbers and habitat incurred during development of the highway upgrade. This requires consideration of genetic, demographic and ecological issues, as well as a follow-up maintenance commitment to ensure the population is given a reasonable chance of becoming established, reproductive and self-sustaining.

5.3 Endangered Ecological Communities

Clearing of Endangered Ecological Communities should be minimised wherever possible and the spread of weed species to these ecosystems as a consequence of road

construction should be addressed in the Environmental Management Plan for the highway upgrade.

5.4 Weed Control and Topsoil Re-use

Earthworks during road construction have the potential to spread seed of noxious and environmental weeds already present in soil along the highway corridor and into adjoining plant communities. A weed management strategy that addresses vegetation clearing and topsoil stockpiling and re-use should be formulated to mitigate these potential effects. This strategy should be integrated with revegetation and landscape planning for the project.

Vegetation cleared from sections of the highway corridor with high levels of noxious or invasive environmental weeds (Plate 7) should be mulched and disposed of under the edges of fill batters or sites appropriate from a road engineering perspective. Where topsoil stripping is required in any cut section with high levels of exotic or pest plants, the topsoil from these sections should also be disposed of by burial.

Generally the strategy would aim to prevent the spread of pest plants by salvaging topsoil from sections of the corridor with low levels of exotic plants, for storage and re-spreading on the highway batters after construction. Previous experience with topsoil salvage and re-use by the RTA should be carefully considered in developing improved strategies of topsoil re-use in highway revegetation.

The native soil seedbank present in largely weed-free topsoil should be utilised for revegetation, although problems with timing and method of soil storage are still being resolved (J. O'Donnell, RTA, pers.com.).

5.5 Seed Collection and Revegetation

Seed collection to be undertaken prior to and during vegetation clearing from a range of hardy native species suitable for tubestock propagation or hydro-seeding of the highway verges. For revegetation, primary reliance to be on re-use of the topsoil seedbank, which would be salvaged from parts of the corridor with low levels of weeds and directed to appropriate habitat. Tubestock propagation or hydro-seeding from locally collected seed would be used to augment revegetation results achieved by topsoil re-use, for example, by the addition of non-soil seedbank species (e.g. *Eucalyptus, Melaleuca, Casuarina*) where required.

Plate 7: Impenetrable thicket of exotic Prickly Poinciana (*Caealpinea decapitala*) and Coral Tree (*Erythrina crista-galli*) (red flowers) along Woolgoolga Creek next to Wedding Bells SF. During clearing of heavily weed-infested vegetation, cleared material should be mulched and buried together with the topsoil to prevent spread to new areas during highway construction.

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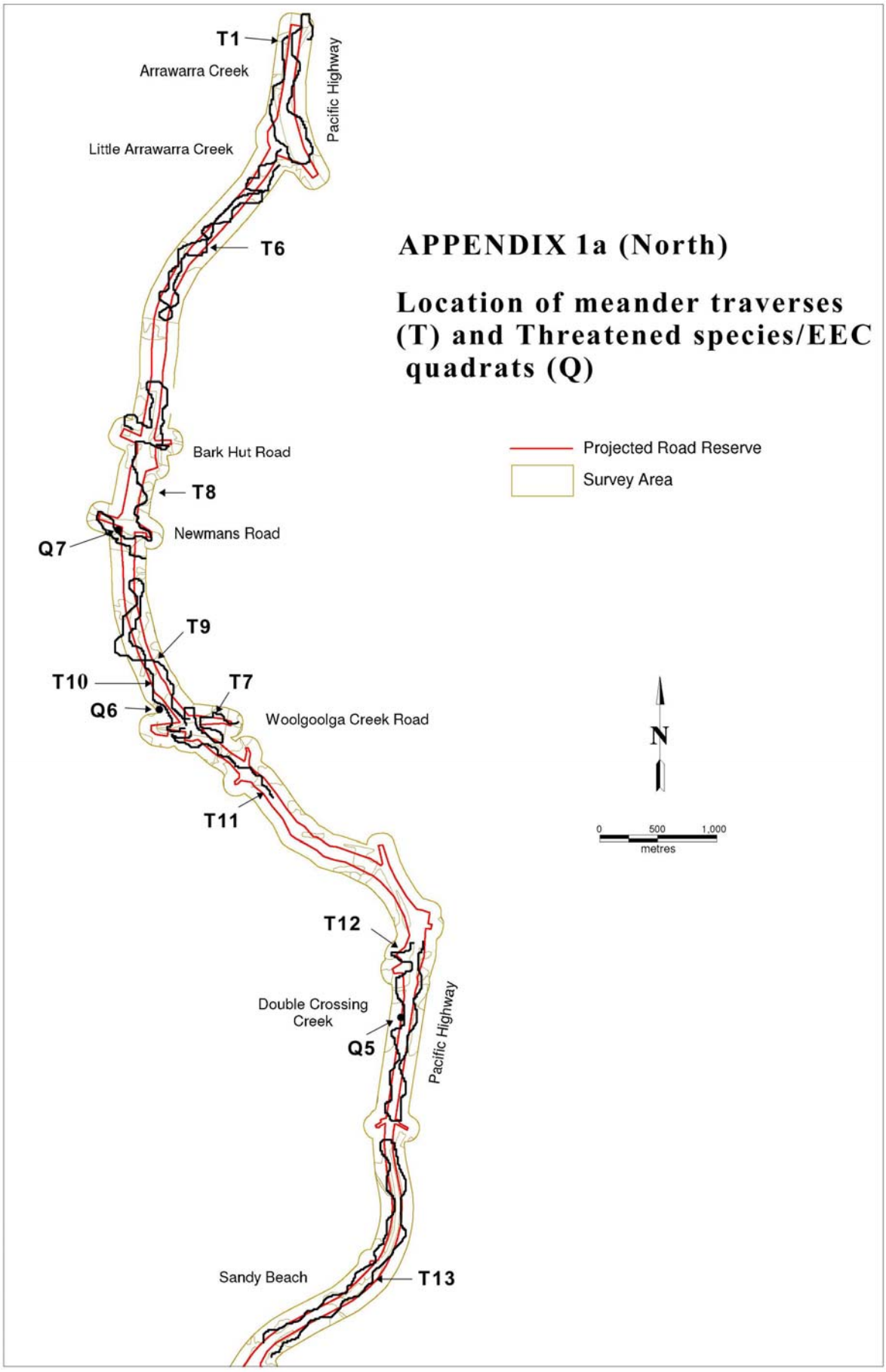
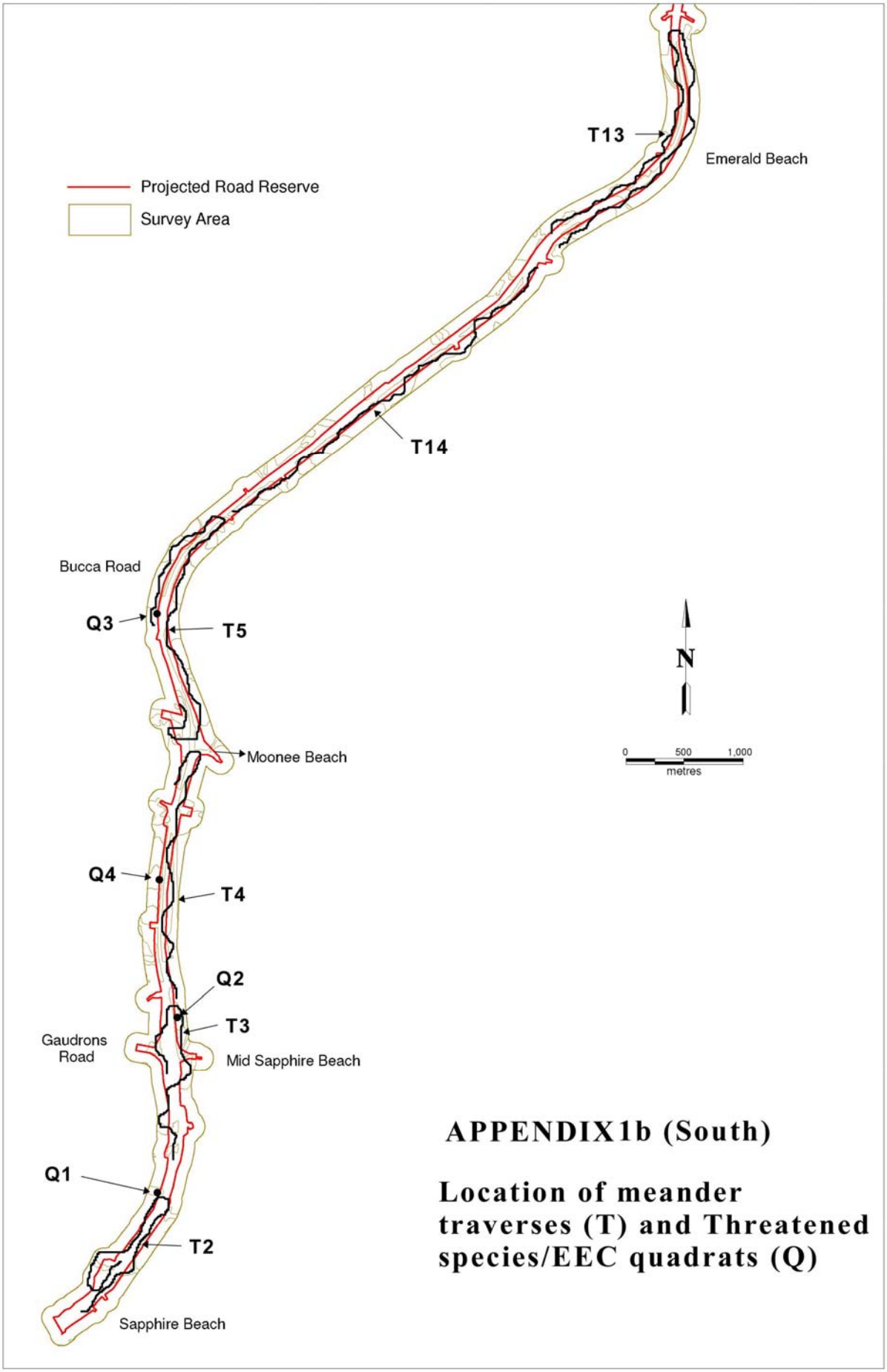

APPENDIX 1a (North)
Location of meander traverses (T) and Threatened species/EEC quadrats (Q)
Projected Road Reserve
Survey Area
T1
Arrawarra Creek
Little Arrawarra Creek
Pacific Highway
T6
Bark Hut Road
T8
Newmans Road
Q7
T9
T10
T7
Q6
Woolgoolga Creek Road
T11
T12
Double Crossing Creek
Q5
Pacific Highway
Sandy Beach
T13
N
0
500
1,000
metres


Projected Road Reserve
Survey Area
T13
Emerald Beach
T14
Bucca Road
Q3
T5
Moonee Beach
N
0
500
1,000
metres
Q4
T4
Q2
T3
Gaudrons
Road
Mid Sapphire Beach
Q1
T2
Sapphire Beach
APPENDIX1b (South)
Location of meander traverses (T) and Threatened species/EEC quadrats (Q)

APPENDIX 2:

Background on Vegetation Classification Schemes used in North East NSW

There are many different schemes for classifying vegetation communities. Existing vegetation maps of the study area use four different plant community schemes - Forest Types (FCNSW 1989), 'vegetation communities' (Fischer *et al.* 1996), Forest Ecosystems (NPWS 1999) and CRAFTI (NPWS 1999). Forest Types, vegetation communities and CRAFTI identify closely corresponding or similar vegetation entities and these three classification frameworks are derived by same traditional methods of classification based on the 'association' concept and mapping based on aerial photograph interpretation and ground-truthing. Forest Ecosystems differ from Forest Types/vegetation communities/associations in being derived from quadrat data by a complex process of multivariate statistical analysis (see below).

The use of different systems of classification to describe and map plant communities is confusing for specialists and non-specialist alike. Since vegetation classification frameworks form the basis of assessments of plant community conservation status, further information is provided below on systems of classification (ie. associations, Forest Types, vegetation communities, Forest Ecosystems).

Associations

The association has traditionally been the basic unit of vegetation classification and mapping in Australia. An association is defined as a unit of vegetation having the same overall structure and dominant species in the overstorey (Beadle and Costin 1952; Beadle 1981), and the same dominant species in the understorey (Neldner 1993). 'Structure' refers to the life form, height and crown cover of the upper vegetation stratum (Specht 1970). Associations as the primary vegetation unit can be grouped together into broader units (e.g. forest types, broad ecological vegetation types), which may be more appropriate for coarse scale vegetation mapping, for example, at a regional or State level.

Forest Types

The Forest Type system of vegetation classification and mapping was developed by G.N. Bauer and other plant ecologists with the Forestry Commission of NSW (now State Forests of NSW) over several decades. A Forest Type is defined as any group of tree-dominated stands that possess general similarity in composition and character (FCNSW 1989). The similarity of Forest Types with associations is evident. Some Forest Types are equivalent to associations while others are broader or include several floristically related associations.

Forest Types is a prescribed system of classification comprising over 200 types, which vegetation is mapped or fitted to, although the system also make provision for recognition of new Forest Types. A total of 87 Forest Types (excluding rainforest, non-forest and cleared/artificial types) are recognised in upper north eastern NSW (NPWS 1996). These are described in Research Note No.17 (FCNSW 1989). The system was developed primarily for mapping forest vegetation but includes classes for general types of non-forest land cover.

The Forest Type classification is designed for mapping forest vegetation at a scale of 1:25,000, a relatively high resolution which may delineate forest stands as small as 2 hectares in area or 50 metres in width. Some forest types are floristically and ecologically relatively uniform, while others are more heterogeneous (NPWS 1996). The classification is based primarily on overstorey floristics although some forest types have the same overstorey indicators but differ in understorey floristics (e.g. moist and dry Blackbutt - Forests Types 36 and 37).

CRAFTI

CRAFTI was the CRA Aerial Photograph Interpretation Project (NPWS 1999), an acronym for Comprehensive Regional Assessment Forest Type Inventory. The CRAFTI project was primarily focused on mapping vegetation on non-Crown Lands. The vegetation classification adopted for the CRAFTI project was based on existing Forest Type and association classification frameworks, adapted to broad-scale vegetation mapping by aerial photograph interpretation.

Coffs Harbour City Council LGA Mapping

Fisher *et al.* (1996) described the vegetation of the Coffs Harbour Local Government Area in terms of 'vegetation communities'. These units were described as being of similar floristic and ecological resolution to 'forest types', 'associations' and 'floristic groups'.

Associations were originally defined as plant species assemblages having similar canopy species composition and structure (Beadle 1981). Fisher *et al.* (1996) used the term association in a broader, api-based sense. "Communities of similar structure but varying floristic composition are difficult to map from aerial photography and may be grouped as an association." (p. 13).

'Floristic groups' are numerically derived vegetation units produced by cluster analysis of floristic data collected from vegetation survey plots. Fisher *et al.* (1996) aimed to make the classification of vegetation in the Coffs Harbour area consistent with floristic groups derived by the numerical method in the regional NRAC study (NPWS 1995).

Forest Ecosystems

The Forest Ecosystem classification is a derivation of the Forest Type classification, which represents an attempt to arrive at a floristically and ecologically more comprehensive and balanced classification of forest vegetation in northeast NSW than the Forest Type system. NPWS (1999) developed a classification of 157 Forest Ecosystems for northeast NSW (16 non-eucalypt types). Of these, 43 represented unmodified Forest Types and 98 were derived by splitting and amalgamating Forest Types using multivariate data analysis tools.

According to NPWS (1999), Forest Ecosystems were mapped predictively over crown lands with existing fine scale vegetation mapping (e.g. Forest Type mapping in State Forest) but were not extrapolated to private lands, apparently because of the potential for mis-classification of vegetation and inaccurate spatial boundaries. For non-crown lands, modeling was used to predict the *proportions* of Forest Ecosystems in areas of

natural vegetation (NPWS 1999) but modeling of their actual distribution was not carried out, or reported. Instead, indicative maps were produced of probable Forest Ecosystem distribution, which displayed vegetation as a random mosaic of square grid units where more than one Forest Ecosystem was predicted to occur in an area of vegetation (the number of grid units of each FE proportional to its probability). This form of vegetation map has limited application in environmental planning at the scale of LGA's where the boundaries of actual vegetation communities are required.

APPENDIX 3: Threatened Species and Endangered Ecological Community Quadrats

Quadrat 1 *Amorphospermum whitei* (Rusty Plum) – TSC Act Vulnerable

Location: Western side of Pacific Highway opposite Sebels Resort, bottom of steep rock fill embankment, in gully (GDA 0514081 6654676).
Vegetation Type: Lowland subtropical rainforest, tall closed forest.
Substrate: red-yellow podzol on metasediment
Slope Aspect: southwest
Slope Angle: 10-25^{o}
Disturbance history: no evidence of recent fire
Quadrat Size: 20m x 20m

Stratum	**Height (m)**	**Crown Cover (%)**	**Species 1**	**Species 2**	**Species 3**
Upper	12-18	70	*Olea paniculata*	*Ficus watkinsiana*	*Lophostemon confertus*
Mid	1-6	80	*Ficus coronata*	*Lantana camara*	*Dysoxylum muelleri*
Lower	0-1	40	*Oplismenus imbecilis*	*Ageratum adenophorum*	*Doodia aspera*

Species (* exotic species)	**Habit**	**Cover-abundance Class**
Acmena smithii	*T*	1
Alphitonia excelsa	*T*	2
Alpinea caerulea	*H*	2
Amorphospermum whitei	*T*	1
Aphanopetalum resinosum	*V*	1
Archontophoenix cunninghamiana	*P*	2
Arytera divaricata	*T*	2
Baloghia inophylla	*T*	2
Beilschmedia elliptica	*T*	1
Calamus muelleri	*V*	3
Cissus antarctica	*V*	3
Cissus hypoglauca	*V*	3
Cleistanthus cunninghamii	*S*	2
Cordyline stricta	*S*	2
Cyathea leichhardtiana	*S*	1
Diospyros pentamera	*T*	2
Doodia aspera	*F*	3
Drypetes australasica	*T*	1
Dysoxylum muelleri	*T*	2
Ficus coronata	*T*	2
Ficus fraseri	*T*	2
Ficus watkinsiana	*T*	3
Flagellaria indica	*V*	2

Guoia semiglauca	*T*	2
Legnephora moorei	*V*	2
Lomandra spicata	*H*	2
Lophostemon confertus	*T*	3
Maclura cochinchinensis	*V*	2
Melodinus australis	*V*	2
Olea paniculata	*T*	3
Oplismenus imbecillus	*G*	3
Ripogonum album	*V*	2
Ripogonum ellseyanum	*V*	2
Smilax australis	*V*	2
Syzygium oleosum	*T*	1
Wilkea hugeliana	*S*	2
**Ageratum adenophorum*	*H*	2
**Anredera cordifolia*	*V*	1
**Araujia hortorum*	*V*	1
**Ochna serrulata*	*S*	1
**Schefflera actinophylla*	*T*	2
**Senna pendula*	*S*	2

Quadrat 2 *Marsdenia longiloboa* (Slender Marsdenia) – TSC Act Endangered

Location: Eastern side of the Pacific Highway in road reserve 100-200 metres north of Gaudrons Road. (GDA 0514221 6656202).
Vegetation Type: Grey Gum – Tallowwood – Ironbark, tall to very tall open forest.
Substrate: red podzol on metasediment
Slope Aspect: flat
Slope Angle: 2^{o}
Disturbance history: No evidence of recent fire, probably unburnt for 20 years or more. No recent logging or other disturbance.
Quadrat Size: 20m x 20m

Stratum	**Height (m)**	**Crown Cover (%)**	**Species 1**	**Species 2**	**Species 3**
Upper	20-28	70	*Eucalyptus propinqua*	*Eucalyptus microcorys*	*Eucalyptus siderophloia*
Mid	3-6	60	*Syncarpia glomulifera*	*Elaeocarpus obovatus*	*Lophostemon confertus*
Lower	0-1	80	*Ottochloa gracillima*	*Blechnum cartilagineum*	*Imperata cylindrica*

Species (* exotic species)	**Habit**	**Cover-abundance Class**
Blechnum cartilagineum	*F*	3
Cissus antarctica	*V*	1
Cordyline stricta	*S*	2
Cryptocarya triplinervis	*T*	1
Cupaniopsis anacardioides	*T*	2
Cyclophyllum coprosmoides	*T*	1
Desmodium gunnii	*H*	2
Desmodium rhytidophyllum	*H*	2
Dianella caerulea	*G*	2
Digitaria parviflora	*G*	1
Dioscorea transversa	*V*	2
Elaeocarpus obovatus	*T*	3
Entolasia stricta	*G*	2
Eucalyptus microcorys	*T*	4
Eucalyptus pilularis	*T*	2
Eucalyptus propinqua	*T*	3
Eucalyptus siderophloia	*T*	2
Ficus platypoda	*T*	1
Geitonoplesium cymosum	*V*	2
Glycine clandestina	*H*	2
Imperata cylindrica	*G*	4
Jagera pseudorhus	*T*	1
**Lantana camara*	*S*	2
Lomandra laxa	*G*	2
Lomandra longifolia	*G*	1

Lophostemon confertus	*T*	2
Maclura cochinchinensis	*V*	2
Marsdenia longiloba	*V*	2
Maytennus bilocularis	*S*	1
Maytennus silvestris	*S*	2
Notelaea longifolia	*T*	2
Ottochloa gracillima	*G*	4
Pittosporum undulatum	*T*	2
Pseuderanthemum variable	*H*	2
Pteridium escultentum	*F*	1
Rapanea varibilis	*T*	2
Rhodamnia rubescens	*T*	1
**Senna pendula*	*S*	2
Smilax australis	*V*	2
Syncarpia glomulifera	*T*	3
Wikstroemia indica	*S*	1

Quadrat 3 *Lindsaea incisa* (A Fern) – TSC Act Endangered

Location: Western side of the Pacific Highway, 30 metres from road edge near boundary of Orara East State Forest and clear private property (GDA 0514029 6659846).
Vegetation Type: Heathy dry sclerophyll/swamp sclerophyll ecotone.
Substrate: heavy grey clay
Slope Aspect: flat
Slope Angle: 2^{o}
Disturbance history: No evidence of recent fire, probably unburnt for 10 years or more. No recent logging or other disturbance.
Quadrat Size: 20m x 20m

Stratum	Height (m)	Crown Cover (%)	Species 1	Species 2	Species 3
Upper	15-22	60	*Eucalyptus resinifera*	*Eucalyptus planchoniana*	*Angophora leiocarpa*
Mid	2-6	40	*Leptospermum polygalifolium*	*Leucopogon pimelioides*	*Syncarpia glomulifera*
Lower	0-1	100	*Ptilothrix deusta*	*Dampieria stricta*	*Banksia spinulosa subsp. collina*

Species	Habit	Cover-abundance Class
Acacia myrtifolia	*S*	1
Allocasuarina littoralis	*T*	1
Angophora costata	*T*	3
Banksia spinulosa subsp. collina	*S*	3
Billardieria scandens	*V*	1
Comesperma ericinum	*S*	1
Dampieria stricta	*H*	3
Dianella caerulea	*G*	1
Entolasia marginata	*G*	3
Entolasia stricta	*G*	2
Entolasia stricta	*G*	2
Eucalyptus planchoniana	*T*	3
Eucalyptus resinifera	*T*	3
Eucalyptus tindaliae	*T*	1
Goodenia heterophylla	*H*	1
Hibbertia aspera	*S*	2
Hibbertia vestita	*S*	3
Leptospermum juniperinum	*S*	2
Leptospermum polygalifolium	*S*	3
Leucopogon pimelioides	*S*	2
Lindsaea incisa	*F*	2
Lindsaea linearis	*F*	1
Melaleuca sieberi	*T*	2
Notelaea ovata	*S*	1

Patersonia glabrata	*H*	2
Persoonia stradbrokensis	*T*	1
Ptilothrix deusta	*H*	4
Pultenaea retusa	*S*	2
Smilax glyciphylla	*V*	1
Syncarpia glomulifera	*T*	3
Themeda australis	*G*	2
Xanthorrhoea fulva	*S*	2

Quadrat 4 *Quassia sp.* B (Narrow-leaved Quassia) – TSC Act Endangered

Location: North of Wakefield Road western side of highway, northern side of drainage line. (GDA 514026 6657385).
Vegetation Type: Grey Gum – Grey Ironbark grading into Flooded Gum along a drainage line.
Substrate: yellow podzol on metasediment
Slope Aspect: south-east
Slope Angle: 10^{o}
Disturbance history: Burnt 5-10 years ago. Habitat logged in the past.
Quadrat Size: 20m x 20m

Stratum	**Height (m)**	**Crown Cover (%)**	**Species 1**	**Species 2**	**Species 3**
Upper	20-28	70	*Eucalyptus propinqua*	*Eucalyptus siderophloia*	*Eucalyptus pilularis*
Mid	4-12	60	*Syncarpia glomulifera*	*Notelaea longifolia*	*Cryptocarya microneura*
Lower	0-1	60			

Species (* exotic species)	**Habit**	**Cover-abundance Class**
**Lantana camara*	*S*	1
**Passiflora edulis*	*V*	1
**Senna pendula*	*S*	1
Acmena smithii	*T*	2
Acronychia oblongifolia	*T*	2
Adiantum formosum	*F*	1
Angophora leiocarpa	*T*	1
Blechnum cartilagineum	*F*	3
Breynia oblongifolia	*S*	2
Calochlaena dubia	*F*	1
Clematis glycinoides	*V*	1
Cordyline stricta	*S*	2
Corymbia intermedia	*T*	2
Croton verrauxii	*S*	2
Cryptocarya microneura	*T*	3
Dioscorea transversa	*V*	2
Elaeocarpus obovatus	*T*	1

Endiandra discolor	*T*	1
Eucalyptus grandis	*T*	2
Eucalyptus pilularis	*T*	3
Eucalyptus propinqua	*T*	4
Eucalyptus siderophloia	*T*	3
Eucalyptus umbra	*T*	2
Eustrephus latifolius	*V*	1
Guioa semiglauca	*T*	1
Gymnostachys anceps	*H*	2
Lomandra longifolia	*G*	1
Lophostemon confertus	*T*	2
Maytennus silvestris	*S*	1
Morinda jasminoides	*V*	2
Notelaea longifolia	*T*	3
Ottochloa gracillima	*G*	3
Parsonsia straminea	*V*	2
Pseuderanthemum variable	*H*	2
Rapanea variabilis	*T*	1
Rhodamnia rubescens	*T*	2
Scolopia braunii	*S*	2
Smilax australis	*V*	2
Smilax glyciphylla	*V*	1
Stephania japonica	*V*	1
Syncarpia glomulifera	*T*	3
Tripladenia cunninghamii	*H*	2
Zieria smithii	*S*	1

Quadrat 5 Endangered Ecological Community (TSC Act) – Swamp Sclerophyll Forest on Coastal Floodplains

Location: Western side of the Pacific Highway, 200m south of Double Crossing Creek, in road reserve (GDA 0518559 6665428).
Vegetation Type: Swamp sclerophyll forest regrowth
Substrate: Heavy grey clay, flooded.
Slope Aspect: nil
Slope Angle: nil
Disturbance history: cleared in the past
Quadrat Size: 20m x 20m.

Stratum	**Height (m)**	**Crown Cover (%)**	**Species 1**	**Species 2**	**Species 3**
Upper	6-10	70	*Melaleuca quinquenervia*	*Casuarina glauca*	
Mid	1-5	50	*Melaleuca sieberi*	*Melaleuca quinquenervia*	
Lower	0-1	90	*Baumea teretifolia*	*Baumea sp.*	*Schoenus brevifolius*

Species	Habit	Cover-abundance Class
Melaleuca quinquenervia	*T*	5
Baumea teretifolia	*H*	4
Lophostemon suaveolens	*T*	3
Melaleuca sieberi	*T*	3
Schoenus brevifolius	*H*	3
Baumea sp.	*H*	2
Callistemon pachyphyllus	*S*	2
Casuarina glauca	*T*	2
Gonocarpus tetragynus	*H*	2
Ischaemum australe	*G*	2
Leptospermum juniperinum	*S*	2
Viola betonicifolia	*H*	2
Eucalyptus robusta	*T*	1
Fimbrystylis nutans	*H*	1
Melaleuca thymifolia	*S*	1
Philydrum lanuginosum	*H*	1
Pultenaea retusa	*S*	1
Themeda australis	*G*	1

Quadrat 6 Endangered Ecological Community (TSC Act) – Lowland Rainforest on Floodplain

Location: Northwest corner of the old forestry station block of Wedding Bells State Forest on Woolgoolga Creek Rd (GDA 0516528 6668521).
Vegetation Type: Lowland subtropical rainforest on the floodplain of Woolgoolga Creek, tall closed forest.
Substrate: alluvium.
Slope Aspect: flat
Slope Angle: level
Disturbance history: been logged and grazed in the past.
Quadrat Size: 20m x 20m

Stratum	**Height (m)**	**Crown Cover (%)**	**Species 1**	**Species 2**	**Species 3**
Upper	12-18	70	*Olea paniculata*	*Alphitonia excelsa*	*Ficus watkinsiana*
Mid	1-6	80	*Guioa semiglauca*	*Trophis scandens*	*Neolitsea dealbata*
Lower	0-1	40	*Morinda jasminoides*	*Doodia aspera*	*Adiantum formosum*

Species (* exotic species)	**Growth Habit**	**Cover-abundance Class**
Acmena smithii	T	2
Acronychia oblongifolia	T	1
Adiantum formosum	F	2
Alectryon subcinereus	T	2
Alphitonia excelsa	T	3
Alpinea caerulea	H	1
Amorphospermum whitei	T	2
Aphananthe philipensis	T	2
Archontophoenix cunninghamiana	P	1
Blechnum cartilagineum	F	2
Brachychiton acerifolius	T	1
Cordyline stricta	S	1
Croton verrauxii	S	2
Cryptocarya obovata	T	2
Decaspermum humile	T	2
Diospyros australis	S	1
Diospyros pentamera	T	1
Diploglottis australis	T	1
Doodia aspera	F	3
Dysoxylum muelleri	T	2
Elaeocarpus obovatus	T	1
Euodia micrococca	T	1
Ficus coronata	T	1
Ficus watkinsiana	T	3
Glochidion ferdinandii	T	2

Guilfoylia monostylis	T	1
Guoia semiglauca	T	2
Hippocratea barbata	V	2
Litsea reticulata	T	1
Lomandra spicata	H	2
Morinda jasminoides	V	3
Neolitsea dealbata	T	2
Notelaea longifolia	T	3
Olea paniculata	T	4
Rhodamnania rubescens	T	2
Rhodomyrtus psidioides	T	1
Rubus moorei	V	2
Synoum glandulosum	T	1
Syzygium australe	T	2
Trophis scandens	V	3
Wilkea huegeliana	S	1
**Ochna serrulata*	S	2
**Protoasparagus plumosus*	V	2

Quadrat 7 Endangered Ecological Community (TSC Act) – Lowland Rainforest on Floodplain

Location: Newmans Rd northwest of Woolgoolga township, small stream western side of road. (GDA 516188 6669966).
Vegetation Type: Lowland subtropical rainforest on narrow floodplain with recently deposited flood debris showing extent of inundation.
Substrate: alluvium.
Slope Aspect: flat
Slope Angle: level
Disturbance history: been logged and grazed in the past.
Quadrat Size: 20m x 20m

Stratum	Height (m)	Crown Cover (%)	Species 1	Species 2	Species 3
Upper	18-30	70	*Heritiera actinophylla*	*Lophostemon confertus*	*Dysoxylum muelleri*
Mid 1	8-18	70	*Hodgkinsonia ovatifolia*	*Cissus antarctica*	*Baloghia inophylla*
Mid 2	1-8	50	*Calamus muelleri*	*Cleistanthus cunninghamii*	*Neolitsea dealbata*
Lower	0-1	60	*Arachnoides aristata*	*Doodia aspera*	*Lomandra spicata*

Species (* exotic species)	Growth Habit	Cover-abundance Class
Actephila lindleyi	S	2
Adiantum formosum	F	2
Alangium villosum	T	1

Alchornea ilicifolia	S	2
Alphitonia excelsa	T	2
Arachnoides aristata	F	3
Archontophoenix cunninghamiana	P	2
Backhousia myrtifolia	T	2
Backhousia sciadophora	T	2
Baloghia inophylla	T	2
Calamus muelleri	V	3
Cissus antarctica	V	3
Claoxylon australe	T	1
Cleistanthus cunninghamii	S	3
Clerodendron tomentosum	S	1
Cordyline petiolaris	S	2
Cymbidium maddidum	E	1
Daphnandra sp. A	S	1
Derris involuta	V	2
Diospyros australis	S	1
Diospyros pentamera	T	2
Doodia aspera	F	4
Dysoxylum muelleri	T	3
Endiandra muelleri subsp. *muelleri*	T	2
Ficus coronata	T	2
Ficus watkinsiana	T	3
Gymnostachys anceps	H	2
Heritiera actinophylla	T	3
Hodgkinsonia ovatifolia	T	3
Ixora beckleri	S	2
Lastreopsis decomposita	F	2
Legnephora moorei	V	2
Lomandra spicata	H	2
Lophostemon confertus	T	3
Mallotus philippensis	T	2
Melia azedarach	T	1
Neolitsea dealbata	T	2
Olea paniculata	T	3
**Passiflora suberosa*	V	2
Pellaea paradoxa	F	1
Pouteria australis	T	1
Psychotria loniceroides	S	1
Rauwenhoffia leichhardtiana	V	3
Sarcomelicope simplicifolia	T	2
Smilax australis	V	2
Syzygium francisii	T	2
Tabernaemontana pandaqui	S	1
Tetrastigma nitens	V	2
Trophis scandens	V	2
Wilkea huegeliana	S	2

APPENDIX 4: Species lists from 14 flora traverses recorded during the vegetation survey of the Sapphire Beach to Woolgoolga Highway Corridor. Species abundances are given as r – rare; o – occasional; c – common and vc – very common. 'O' opportunistic

Botanical Name	**Common Name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**O**
Acacia aulacocarpa	A wattle															x
*Acacia baileyana	Cootamundra wattle													r		
Acacia binervata	Two-veined wattle									o		o				
Acacia concurrens	Curracabah	o														
Acacia falcata		r	r												o	
Acacia fimbriata	Qld golden wattle	o	r				o									
Acacia floribunda			r			o										
Acacia irrorata	Black wattle					r				o	o					
Acacia longifolia		r														
Acacia longissima	Narrow-leaved wattle				r	r										
Acacia melanoxylon	Sally wattle	o		c	c	o		o	o		o	o				
Acacia myrtifolia		r	r			o							r		r	
Acacia o'shanesii		o					o									
Acacia sophorae	Coast wattle												r	r		
Acalypha nemorum			r													
Acmella grandiflora						r										
Acmena hemilampra	Lilly pilly		r													
Acmena smithii	Common lilly pilly	r			r		o				o					
Acronychia imperforata	Beach acronychia			r												
Acronychia oblongifolia	Common actronychia			r	o			r			o	o				
Actephila lindleyi	Actephila								r							
Adiantum aethiopicum	Maidenhair fern	r					o		o			r				
Adiantum formosum	Black-stem maidenhair fern			r						o	o	r				
Adiantum hispidulum			r				r				o					
*Ageratina adenophorum	Crofton weed		r		r										o	
*Ageratum houstonianum	Blue goat weed	o				o							c			

Agrostis avenacea						r										
Alangium villosum	Alangium								r							
Alchornea ilicifolia	Native holly								o							
Alectryon subcinereus										o	r					
Alocasia brisbanensis	Cunjevoi lily										r					
Allocasuarina littoralis	Black sheoak						o						o	o		
Allocasuarina torulosa	Black sheoak	o	r		o	o		o	o	o						
Alphitonia excelsa	Red ash	r	r		o			r	o		r	r				
Alpinia caerulea	Native ginger							r	o	o	o	r				
Amorphospermum whitei	Rusty plum		r								r					
Amyema cambagei	Casuarina mistletoe															x
Amyema pendula		r														
*Andropogon virginicus	Whiskey grass					r							r			
Aneilema acuminatum								r				r				
Angophora leiocarpa	Smooth-barked apple				r	o							o			
*Anredera cordifolia	Anredera		r													
Aphananthe philipensis											r					
Aphanopetalum resinosum		r									o					
Arachnoides aristata									o							
*Araujia hortorum	Moth vine		r													
Archidendron grandiflorum								r		o	o					
Archirhodomyrtus beckleri							r			o						
Archontophoenix cunninghamii	Bangalow palm				r			r	r	r	r	r				
Aristida benthamii	A grass															x
Aristida ramosa subsp. speciosa						r										
Aristida vagans	A grass	o				o	o								o	
Arytera divaricata	Coogera								r							
Asterotricha latifolia															r	
Austrostephania aculeata		r						r		r		r				
Ambrosia artemisiifolia	Annual ragweed	o			o											
Araucaria cunninghamii	Hoop pine		o													

Artanema fimbriatum	Koala bells					r										
Arthrochilus prolixus	Hammer orchid															x
Arytera divaricata			r					r								
Asclepias curassavica*	A herb	o														
*Aster subulatus															r	
Austrodanthonia tenuior	A wallaby grass														r	
Austrosteenisia blacki	Bloodvine		r													
Astrotricha latifolia			r													
*Axonopus compressus	Carpet grass	r														
Babingtonia angusta					o											
*Baccharis halimifolia	Groundsel bush		r	r	r						r		r	o		
Backhousia myrtifolia	Grey myrtle	o					o	o	o	r						
Backhousia sciadophora	Shatterwood								r							
Bacopa monnieri													r			
Baloghia inophylla	Brush bloodwood		r						o							
Banksia integrifolia	Coast banksia		c											r		
Banksia oblongifolia	Heath banksia	r					r						o			
Banksia spinulosa var. collina	Hairpin banksia				r	r	r						r			
Baumea articulata														r		
Baumea juncea		r				o							c			
Baumea rubiginosa	A sedge					r									o	
Baumea teretifolia													vc			
Beilschmedia elliptica										r						
*Bidens pilosa	Farmers friends										o					
Billardieria scandens		o		o			o							r		
Blandfordia grandiflora	Christmas bells					r										
Blechnum cartilagineum	Gristle fern		o	o			o	c	r	o	c					
Blechnum indicum	Bungwal fern											c				
Boronia parviflora	Small boronia														o	
Bothriochloa macra	Red-leg grass		r	r												
Botrychium australe	Parsley fern				r										r	

Brachychiton acerifolium											r					
Breynia oblongifolia	Coffee bush	o	o		o	r	o	o	o		o	o			o	
Brunoniella australis	A herb												r			
*Caesalpinia decapitala	Thorny poinciana							r			o					
Caldcluvia paniculosa	Caldcluvia										r	r				
Callistemon pachyphyllus	Wallum bottlebrush												o			
Callistemon salignus	Willow bottlebrush	o			c	o	o								o	
Callitris macleyanus (p)	Brush cypress pine							r								
Calamus muelleri	Southern lawyer vine		r						o	o						
Calochlaena dubia	Soft ground fern	r						o	o	o				r	o	
Calystegia marginata	A herb	o			r		o								c	
Capillipedium spicegerum	Scented-top grass	o	o	o		r				r			o	o		
Carex appressa					r											
Carex breviculmis									o							
Carex maculata	A sedge				r		o							o		
Cassine australe			r								r					
Casuarina glauca	Swamp oak												c	c		
Caytratia clematidea	A vine							r								
Centaurium spicatum						r										
Centella asiatica	Arthritis plant	c												o		
*Chamaecrista mimosoides	Sensitive plant	r														
Chamaecysce drummondii	Caustic weed				o											
Cheilanthes sieberi	A fern													r		
Chiloglottis sp.	An orchid											r				
*Chloris gayana		o	c	o	c									o		
Choricarpia leptopetala	Brown myrtle						r	r			o	r				
Chorizandra cymbaria														o		
Chorizema parviflora	A pea															x
Christella dentata			r								o					
*Chrysanthemoides monilifera		r					r						r	c	c	
Chrysocephalum apiculatum	Yellow buttons															x

*Cinnamomum camphora	Camphor laurel	r	o	o				r	r					r	r	
Cissus antarctica	Water vine		o	r				o	o	c	c	o			r	
Cissus hypoglauca	Five-leaf water vine		o					r	o			o				
Cissus sterculifolia				r					r							
Citriobatus pauciflorus										r						
*Citrus limonia	Lemon tree							r				r				
Claoxylon australe									r							
Cleistantus cunninghamii	Cleistanthus		r						o							
Clematis glycinoides	Clematis								r	o						
Clerodendron floribundum	Smooth clerodendron								r							
Clerodendron tomentosum	Hairy clerodendron							r	r	r						
*Commelina benghalensis	A herb			o				r								
Comesperma defoliatum						r										
Comesperma ericinum	Matchheads					r										
*Conyza bonnariensis	Fleabane					r										
Cordyline petiolaris	Long-leaf palm lily		r						o		o					
Cordyline stricta	Narrow-leaved palm lily	r	r	o	r		o	o	o	o	o	o				
Corymbia gummifera	Red bloodwood						o									
Corymbia intermedia	Pink bloodwood	o	r	o	o		o		c			o		o	o	
Corymbia variegata	Spotted gum						o		c		c	o				
*Corymbia torreliana	Cadaghi														r	
*Cotoneaster lactea			r													
*Crassocephalum crepidoides	Thickheads			o												
*Crotalaria lanceolata	A pea	r	o	c		o										
Crotalaria montana	A pea	r				r										
Croton verrauxii					r		r	o		c	o	o				
Cryptocarya microneura	Murrogun			o			o	o	o	r	o	o				
Cryptocarya obovata	Pigeonberry tree								r		o	r				
Cryptocarya rigida	Forest maple		r	o			r	o		o		o				
Cryptocarya triplinervis	Three-veined laurel		o	r										r		
Cryptostylis sp.	An orchid				r		r									

Cupaniopsis anacardioides	Tuckeroo		o	o	r			r	r							
Cupaniopsis newmanii	Long-leaf tuckeroo							r				r				
Cyclophyllum coprosmoides	Coast canthium			r				o				o			r	
Cymbidium maddidum									r							
Cymbopogon refractus	Barb wire grass	r		r	r	o	o		o	r			o	o		
Cyathea australis	Rough treefern							r					r			
Cyathea cooperi	Straw treefern		r	r												
Cyathea leichhardtiana	Prickly treefern		r													
Cynodon dactylon	Couch grass															x
Cyperus difformis	A sedge															x
Cyperus enervis									r							
Cyperus eragrostis				r												
Cyperus haspan subsp.juncoides	A sedge															x
Cyperus pilosus	A sedge			r		r										
Dampieria stricta	A dampieria	r			r	o	o						o			
Daphnandra sp. A									r		r					
Davidsonia puriens (p)									r							
Davesia ulicifolia	A pea	r					o									
Davesia umbellata														r		
Decaspermum humile	Silky myrtle										r					
Denhamia celastroides				r				r		r						
Derris involuta	Derris vine								o							
Desmodium rhytidophyllum	Rusty desmodium	c	r	o		o	o	r	o	o	o					
*Desmodium uncinatum	Silver-leaf desmodium		o													
Desmodium gunnii				r	r		o		o		o					
Dianella caerulea	Blue flax lily	o		o					o		o	o	o			
Dianella revoluta		o														
Dichantheum sericeum	Queensland bluegrass		r	r												
Dichelachne rara	Narrow plume grass														r	
Dichondra repens	Kidney leaf				r		r		o							
Digitaria parviflora									r							

Digitaria ramularis	A grass	r		o			o							r		
Digitaria scrobiculatum		o														
Dioscorea transversa				o				o			o	o				
Diospyros australis									r		r	r				
Diospyros pentamera	Grey ebony		r					r	r		r					
Diploglottis australis								r			r					
Dodonaea triquetra	A hop bush	r		r	r	o	c			r	o					
Doodia aspera	Rasp fern		r	o			o	c	c	o	o	o				
Drypetes australascica	Yellow tulip		r													
Duboisia myoporoides	Soft corkwood				r									r		
Dysoxylum muelleri	Red bean		o						o	o	o					
*Echinochloa crus-galli	Barnyard grass			r												
Echinopogon caespitosus		o		o											o	
Eclipta prostrata	White eclipta															
Elaeocarpus obovatus	Hard quandong			r				r			o	r				
Elaeocarpus reticulatus	Blue berry ash				r	r						o			o	
Eleocharis acuta	A sedge					r										
Embelia australiana	Embelia								o	o	o	r				
Endiandra discolor	Domatia tree			r				r			r					
Endiandra muelleri ssp muelleri	Domatia tree								o		o					
Endiandra sieberi	Hard corkwood															
Entolasia marginata	A grass	c												c		
Entolasia stricta	A grass	o		r	c	c	vc	o			o	c	c	o		
Epacris pulchella		r				r										
Eragrostis benthamii		r														
Eragrostis brownii	A grass	o				o							c			
Eragrostis sororia	A grass	o													o	
*Eriobotrya japonica	Loquat							r								
*Erythrina crista-galli	Coral tree							r			o					
Eucalyptus acmenoides								c	c			o				
Eucalyptus carnea							o								r	

Eucalyptus eugenoides	White stringybark					r										
Eucalyptus grandis	Flooded gum	r		o				o			c	c				
Eucalyptus microcorys	Tallowwood	r		o	o		o	c	o	c	o	o				
Eucalyptus pilularis	Coastal blackbutt	c	o	c	c	vc	vc					r	o		c	
Eucalyptus planchoniana	Needlebark stringybark					r										
Eucaltyptus propinqua	Grey gum			o			o	c	c	c	c	c				
Eucalyptus resinifera	Red mahogany	o					o								r	
Eucalyptus robusta	Swamp mahogany												o		o	
Eucalyptus siderophloia	Broad-leaved ironbark	r	r	o		o	o	r	o	o	o			r	o	
Eucalyptus tereticornis	Forest red gum	o	r	o										o		
Euphomatia bennettiana												r				
Euphomatia laurina		r		r			o		o	c	o	o				
Euroschinus falcata										r					r	
Eustrephus latifolius	A vine		r				o	o								
Exocarpus cupressiformis	Cherry ballart	r														
Ficus coronata	Sandpaper fig	r			r		o	o	o	o	c	o				
Ficus fraseri	Sandpaper fig		r													
Ficus platypoda	Rusty fig/rock fig			r												
Ficus watkinsiana	Strangler fig		r						r		r					
Fimbrystylis nutans	A sedge												o			
Flagellaria indica	Whip vine		r													
Flindersia schottiana	Cudgerie tree		r		r							r				
Gahnia aspera		r					r	r			o	o		o		
Gahnia clarkei					o	r	r									
Gahnia sieberana	Red-fruit saw sedge				r		o						r			
Geitonoplesium cymosum	A vine	o		o	o			o	o	o					o	
Gleichenia dicarpa	Coral fern														o	
Glochidion ferdinandi	Cheese tree	o		c	o	o	c	o			o	o	r		r	
Glycine clandestina	A pea	o	o			o			c							
Gompholobium pinnatum	A pea					r										
Gomphocarpus fruticosus	Cotton bush			o												

Gonocarpus humilis		o														
Gonocarpus tetragynus							o						c			
Goodenia paniculata	A goodenia	r				r	r									
Goodenia rotundifolia	A goodenia	c				c	c						o	o		
Grevillea robusta (p)	Silky oak														r	
Guilfoylia monostylis									r		r					
Guioa semiglauca		r	o	o	o		r	c	r	o	c	o			o	
Gymnostachys anceps	Settlers flax			r				r	o		o	o				
Haemodorum planifolium	Bloodroot lily															x
Hakea florulenta	A hakea	o					r						r			
Hardenbergia violacea		r		r							r					
Harpullia pendula (p)	Tulipwood							r								
Heritiera actinophylla	Black booyong								o							
Hibbertia aspera		c	r	o	o	c	c		r		o		c			
Hibbertia dentata				r							r					
Hibbertia scandens	Trailing guinea flower	r				r					r			r		
Hibbertia vestita	An hibbertia	c				c	c						c	o	o	
Hibiscus diversifolius														r		
Hibiscus heterophyllus		r					r				r					
Hickesbeachia pinnatifolia	Red bopple nut							r								
Hippocratea barbata											r					
Hodgkinsoniae ovatifolia			r						o							
Hovea acutifolia			r		r	r										
Hybanthus enneaspermus	A herb	o														
Hydrocotyle peduncularis		r												o		
Hymenosporum flavum	Native frangipanni									r						
*Hypoestes sanguinolenta	Polka dot plant							r								
Hypolepis muelleri	Harsh ground fern													c	r	
Hypoxis hygrometrica		o													r	
Imperata cylindrica	Blady grass	vc	c	c	c	c	c		c		c			o	c	
*Ipomoea cairica	Five-leaf morning glory			r	o											

*Ipomoea purpurea	Common morning glory	r				r										
Isachne globosa	Swamp millet					o									o	
Ischaemum austale	A grass	r											c			
Ixora beckleri	Ixora								o							
*Jacaranda mimosifolia	Jacaranda								r							
Jacksonia scoparia	Native broom	r	o	o		o	r						r	r		
Jagera pseudorhus	Foambark tree		r	r				r	r		o	r				
Juncus prismatocarpus	A rush														o	
*Lantana camara	Lantana	o			c	o	c	c	c	c	c	c		o	c	
Lastreopsis decompisita	Trim shield fern								o		o					
Legnephora moorei	Round-leave vine			r					r							
Lepidosperma laterale	Common sword sedge					r	c			r				o		
Lepidosperma quadrangulata	Rectangular sedge													r		
Leptospermum juniperinum	Prickly teatree															x
Leptospermum polygalifolium subsp. polygalifolium	Common teatree	o				r	c									
Leucopogon juniperinus							r						c			
Leucopogon lanceolatus							o									
Leucopogon pimelioides		r			r	o							r	r		
*Lilium formosanum		r	r		o								r		r	
Lindsaea linearis	A fern						o						r			
Linospadix monostachys	Walking stick palm								r							
Litsea australis	Brown bolly gum			r												
Litsea reticulata	Bolly gum									r						
Livistonia australis							r									
Lobelia alata		r											r			
Lobelia armstrongii	A herb					r									o	
Lobelia dentata						r										
Lobelia trigonocaulis																x
Lomandra laxa											o					
Lomandra longifolia	Long-leaf lomandra	c		o	o	o	c	c	c	c	o	c	c	c	c	

Lomandra multiflora	A lomandra															
Lomandra spicata		r					o		o		o					
Lomatia silaifolia	Crinklebush												r			
Lonicera japonica	Japanese honeysuckle				r											
Lophostemon confertus	Brush box		r	o	o		o	o	o	r	o					
Lophostemon suaveolens	Swamp box	c				c	o						c	c		
Macadamia integrifolia (p)	Smooth-shelled bush nut											r				
Macadamia tetraphylla (p)	Rough-shelled bush nut							r	r							
Macadamia tetraphylla (s)	Rough-shelled bush nut								r							
Macaranga tanarius	Macaranga											r				
Maclura cochinchinensis	Cockspur		r	r				o			o	o				
*Macroptilium atropurpureum	Siratro	o	o		c											
Mallotus discolor										r	r					
Mallotus philipinensis	Red kamala							r	o		o					
Marsdenia flavescens											o					
Marsdenia longiloba				r												
Marsdenia rostrata	Common milk vine		o	r	o			o			o	o		r		
Maytennus bilocularis				r												
Maytennus silvestris				r			o		r		r					
Melaleuca nodosa		r														
Melaleuca quinquenervia	Broad-leaved paperbark	o			r	o	o						vc	vc		
Melaleuca sieberi	A paperbark	o				r	o						c			
Melaleuca stypheloides															r	
Melaleuca thymifolia													r		r	
Melia azedarach	White cedar							r	r							
Melicope elleryana	Pink euodia													r		
Melicope micrococca											r					
*Melinus minutiflora	Molassus grass		o	o												
*Melinus repens			r													
Melodinus australis			o									r				
Microlaena stipoides	A grass	r				r								r		

*Modiola caroliniana	Red-flowered mallow		r		o											
Morinda jasminoides		r	r	c	o		c	c	o	c	c	c			o	
Murdania gramineum	A herb	r													r	
Neolitsea dealbata	White bolly gum		r					r	o	o	o					
Nephrolepis cordifolia	Fishbone fern			o												
*Nerium oleander					r											
Notelaea longifolia	Mock olive	o	r	o	o		o	c	o	o	c	o		r		
Notelaea ovata	Mock olive					o	r						o			
*Nymphaea capensis	Introduced waterlily					r									r	
*Ochna serrulata	Ochna		r		r			r				r				
Olea paniculata	Native olive		o	o				o	o		c	r				
Oplismenus aemulus	A grass	o		c										o		
Oplismenus imbecilis									o							
Ottochloa gracillima	A grass	c		o	o		o	o	c			c		c		
Oxalis chnoodes	A herb															
Ozothamnus diosmifolium						o	r				o					
Pandorea pandorana						r		r	r			r				
Panicum simile	A grass			r		o										
Parsonsia straminea	Giant silkpod vine	o		o				o	r	o	o	o				
Paspalidium distans	A grass				r											
Paspalum scrobiculatum	A grass					r			r							
*Paspalum urvillei	Vasy grass	o			o											
*Paspalum wettsteinii					c	o		o	o	c	c	c	vc		c	
*Passiflora edulis				r				r								
*Passiflora suberosa	Corky passionfruit							r	o			o				
*Passiflora subpeltata	White passionfruit			o				r	o			r				
Patersonia glabrata	A native iris	r					o									
Patersonia sericea	A native iris												o		r	
Pellaea paradoxa	Sickle fern								r							
Persicaria dichotoma	A herb												r			
Persicaria strigosa	A herb			r												

Persoonia adenanthera		o					o	o				o				
Persoonia stradbrokensis														o		
Philydrum lanuginosum	A herb					r							r			
Phragmites communis	Common reed					r							o			
Phyllanthus gastroemii				r				r	o			r				
Phyllanthus virgatus	A herb	r														
*Phyllostachys aurea	Fishpole bamboo											r				
*Physalis peruviana				r									o			
*Phytolacca octandra	Pokeroot															
Picris henricorum-carolorum				r												
Pilidiostigma glabrum											r					
Pimelea latifolia subsp. altior				r												
Pimelea linifolia	A herb	o											c			
*Pinus elliottii	Slash pine		c	c											r	
Pittosporum undulatum	Sweet pittosporum		o	o	r	r		o				o			r	
Pittosporum revolutum	Rusty pittosporum			o				o		r		o			r	
*Pityrogramma austroamericana	Gold fern		r													
Platycerium bifurcatum															r	
Poa labillardieri	Tussock poa		r						r							
Poa sieberiana										o						
Podocarpus elatus (p)	Brown pine															
Polygala paniculata*		o			o	o							o	o		
Polyscias elegans							r									
Polyscias sambucifolius		r		o	c		o	o	o	r			r		o	
Pouteria australis	Black apple								r							
Pratia purpurascens	Poison pratia	c			r		o									
*Protoasparagus aethiopicus	Sprengeri fern	r							r							
*Protoasparagus plumosus										r						
Pseuderanthemum variabile	Pastel flower	r		r	o		o	c	c		o					
Psidium guajava	Guava		r													
Psychotria loniceroides	Hairy psychotria		r	r	r		r		o			r				

Pteridium esculentum	Bracken fern	c	o	c	c	c	vc	o			o					
Pterostylis nutans														r		
Ptilothrix deusta	A sedge	r					c						c		r	
Pultenaea petiolaris	A bushpea															
Pultenaea retusa	A bushpea	o	r	o		r	r		r				c	o		
Pultenaea villosa	A bushpea				r		r						o			
Pyrrosia rupestris				r												
Rapanea howittiana	Brush muttonwood	r					r				r		r			
Rapanea variabilis	Muttonwood	r	r		r			r	r	r						
Rauwenhoffia leichhardtiana			o						o							
Rhodamnia rubescens				r				o		o	o					
Rhodomyrtus psidioides	Native guava	r									r	r		r	r	
*Richardia brasiliensis						r										
Ripogonum album	White supplejack		r													
Ripogonum ellseyanum										r						
Rostellularia adscendens	A herb										o					
*Rubus fruticosus	Blackberry					r										
Rubus hillii	A bramble				r						r					
Rubus moorei										r	o					
Rubus parviflorus	Small-leaf bramble		o												r	
Rubus rosifolius							r									
Sacciolepis indica	Indian cup grass			r												
*Sansevieria trifasciata	Mother-in-law’s tongue			r												
Sarcomelicope simplicifolia	Bauerella								r							
Sarcopetalum harveyanum								r			r					
*Schefflera actinophylla	Umbrella tree		o	o				r	o			r				
*Schinus terebinthifolia			o													
Schizomeria ovata										o	r					
Scolopia braunii	Flintwood		r						r			r				
Schoenus apogon	A sedge														o	
Schoenus brevifolius	A sedge												c			

*Senna X floribunda	A cassia	r					r									
*Senna pendula	Winter senna		o	o	o			o	r					o	o	
*Setaria palmifolia															r	
*Setaria sphacelata	Pigeon grass	r		r												
*Sida rhombifolia	Paddy's lucerne		o	o	o		r									
Sloanea woollsii										r	r					
Smilax australis	Barb-wire vine	o	o	o	o		o	c	c	o				r	o	
Smilax glyciphylla				r	o			r	r			o	r			
Solanum densivestitum				r	r											
*Solanum mauritianum	Tobacco weed					r										
Sorghum leiocladum	Native sorghum		r													
*Sporobolus indicus	Parramatta grass	r	o	o					c				o		o	
Sporobolus virginicus	Saltwater couch												r			
Stackhousia viminea						r										
Stephania japonica	Snake vine			o	o	r		o	o	o				o		
Sticherus lobatus	Fan fern		r													
*Strezlitzea reginae	Bird of paradise flower														r	
*Syagrus romanzoffiana	Queen palm								r							
Syncarpia glomulifera	Turpentine	o		o	c	c	vc		o	c	o	o			r	
Synoum glandulosum				o	r			c	o	c	o	o			r	
Syzygium australe	Brush cherry						o				o					
Syzygium francisii	Giant water gum								r							
Syzygium oleosum	Blue lily pilly		r									r				
Tabernaemontana pandacaqui	Banana bush			r			r	r	o	o	o	o				
*Tagetes minuta														o		
Tetrastigma nitens				r					o							
Themeda australis	Kangaroo grass	vc	o		o	c	c		c	o	o		c	c		
Tragia novae-hollandiae										o						
Trema aspera	Poison peach				r											
*Tephrosia grandiflora																x
Tricoryne elatior	A herb					r										

Triglochin procerum s. lat.	Waterribbons						r								r	
Tripladenia cunninghamii				o					c							
Tristaniopisis laurina							r								r	
Trochocarpa laurina				r			o	o	o	c		o				
Trophis scandens	Burny vine							r			o					
Toona ciliata											r					
Tylophora paniculata									o			o				
Typha orientalis	Bullrush					r							r			
Typhonium sp.	Stinky lily								r							
Velleia paradoxa	A herb	r											o			
Vernonia cinerea	A herb	o					o									
Villarsia exaltata						r										
Viola betonicifolia		r					r						o			
Viola hederacea	Native violet	o												o		
Wikstroemia indica	A shrub			r												
Wilkea huegliana	Veiny wilkea		o	o				c	o	o	c	o			r	
Xanthorrhoea latifolia							o									
Xanthorrhoea macronema	Bottlebrush grass tree				o		r								r	
Zieria smithii	Sandfly bush				o		r			o		o	r			
*Zingiber officinale	Ginger							r								