

Appendix F Vegetation

association floristics

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Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

1 Iluka Road - Woodburn					
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Stringybark-Ironbark-Pink Bloodwood	Dry Sclerophyll open forest	Red Mahogany open forest of the coastal lowlands of the North Coast	Nil	Mid to lower slopes of low undulating rises on Clarence-Morton Bay sediments in the southern half of the study area
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
	<i>Eucalyptus tindaliae</i>		<i>Syncarpia glomulifera</i>		<i>Imperata cylindrica</i>
	<i>Corymbia intermedia</i>		<i>Acacia concurrens</i>		<i>Themeda australis</i>
	<i>Eucalyptus siderophloia</i>		<i>Acacia disparrima</i>		<i>Eragrostis brownii</i>
			<i>Allocasuarina torulosa</i>		<i>Pteridium esculentum</i>
			<i>Pultenaea retusa</i>		<i>Hibbertia aspera</i>
	Associated upper stratum species		<i>Pultenaea euchila</i>		<i>Gonocarpus tetragynus</i>
	<i>Eucalyptus signata</i>				<i>Lomandra confertifolia</i> ssp. <i>pallida</i>
	<i>Angophora woodsiana</i>				<i>Lomandra longifolia</i> subsp. <i>longifolia</i>
2 Iluka Road - Woodburn					
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Ironbark-Tallowood-Grey Gum-Bloodwood-Red Gum	Dry Sclerophyll open forest	Narrow-leaved Red Gum woodlands of the lowlands of the North Coast	Nil	Low hills at the northern end of the study area. Soils were formed on sedimentary rocks again, but probably differ in soils texture and fertility due to different sedimentary strata intersecting the surface. This is indicated by differences in the overstorey species composition, although dominant understorey species tend to be much the same.
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
	<i>Eucalyptus siderophloia</i>		<i>Acacia disparrima</i>		<i>Ottochloa gracillima</i>
	<i>Eucalyptus microcorys</i>		<i>Acacia melanoxylon</i>		<i>Imperata cylindrica</i>
	<i>Corymbia intermedia</i>		<i>Allocasuarina torulosa</i>		<i>Themeda australis</i>
	<i>Eucalyptus propinqua</i>				<i>Axonopus affinis</i>
					<i>Microlaena stipoides</i> var. <i>stipoides</i>
	Associated upper stratum species				<i>Hibbertia scandens</i>
	<i>Eucalyptus tereticornis</i>				<i>Centella asiatica</i>
	<i>Eucalyptus carnea</i>				<i>Desmodium rhytidophyllum</i>

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3 Iluka Road - Woodburn					
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Spotted Gum	Dry Sclerophyll open forest	Spotted Gum-Grey Ironbark-Pink Bloodwood open forest of the Clarence Valley lowlands of the North Coast	Nil	Crests of low undulating hills on sedimentary geology. Soils poorly drained and of heavy clay texture, formed where fine-grained sedimentary strata intersect the surface
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
	<i>Corymbia henryi</i>		<i>Acacia concurrens</i>		<i>Entolasia stricta</i>
	<i>Eucalyptus siderophloia</i>		<i>Acacia disparrima</i>		<i>Imperata cylindrica</i>
	<i>Eucalyptus pilularis</i>		<i>Pultenaea villosa</i>		<i>Themeda australis</i>
			<i>Pultenaea spinosa</i>		<i>Eragrostis brownii</i>
					<i>Pteridium esculentum</i>
	Associated upper stratum species				<i>Lomandra longifolia subsp. longifolia</i>
	<i>Eucalyptus signata</i>				<i>Cymbopogon refractus</i>
	<i>Eucalyptus tindaliae</i>				<i>Desmodium rhytidophyllum</i>
4 Iluka Road - Woodburn					
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Needlebark Stringybark	Dry Sclerophyll open forest	Needlebark Stringybark-Red Bloodwood heathy woodland on sandstones of the lower Clarence of the North Coast	Nil	Upper slope of low undulating hills on sedimentary geology in the central section of the study area
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
	<i>Eucalyptus planchoniana</i>		<i>Banksia spinulosa var. collina</i>		<i>Entolasia stricta</i>
	<i>Eucalyptus resinifera</i>		<i>Acacia concurrens</i>		<i>Themeda australis</i>
	<i>Eucalyptus umbra</i>		<i>Pultenaea retusa</i>		<i>Pteridium esculentum</i>
			<i>Pultenaea euchila</i>		<i>Hibbertia aspera</i>
	Associated upper stratum species				<i>Lomandra longifolia subsp. longifolia</i>
	<i>Corymbia intermedia</i>				
	<i>Angophora woodsiana</i>				

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5 Iluka Road - Woodburn					
Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat	
Narrow-leaved Red Gum	Wet Sclerophyll open forest	Narrow-leaved Red Gum woodlands of the lowlands of the North Coast	Subtropical Coastal Floodplain Forest	Low lying floodplain areas with heavy clay soils formed on alluvium and colluvium derived from mainly fine-grained sedimentary rocks.	
Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species	
<i>Eucalyptus seeana</i>		<i>Lophostemon suaveolens</i>		<i>Imperata cylindrica</i>	
<i>Lophostemon suaveolens</i>		<i>Acacia concurrens</i>		<i>Lepidosperma laterale</i>	
<i>Melaleuca quinquenervia</i>		<i>Melaleuca nodosa</i>		<i>Eragrostis brownii</i>	
		<i>Glochidion ferdinandi</i>		<i>Oplismenus aemulus</i>	
		<i>Banksia spinulosa var. collina</i>		<i>Panicum simile</i>	
Associated upper stratum species				<i>Pteridium esculentum</i>	
<i>Eucalyptus resinifera</i>					
<i>Eucalyptus siderophloia</i>					
<i>Eucalyptus tereticornis</i>					
6 Iluka Road - Woodburn					
Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat	
Forest Red Gum Forest	Wet Sclerophyll open forest & woodland	Forest Red Gum-Swamp Box of the Clarence Valley lowlands of the north Coast	Subtropical Coastal Floodplain Forest	Low lying floodplain areas with heavy clay soils formed on alluvium and colluvium derived from mainly fine-grained sedimentary rocks.	
Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species	
<i>Eucalyptus tereticornis</i>		<i>Lophostemon suaveolens</i>		<i>Imperata cylindrica</i>	
<i>Lophostemon suaveolens</i>		<i>Acacia concurrens</i>		<i>Lepidosperma laterale</i>	
<i>Melaleuca quinquenervia</i>		<i>Acacia disparrima</i>		<i>Eragrostis brownii</i>	
<i>Corymbia intermedia</i>		<i>Melaleuca nodosa</i>		<i>Oplismenus aemulus</i>	
		<i>Glochidion ferdinandi</i>		<i>Panicum simile</i>	
Associated upper stratum species				<i>Pteridium esculentum</i>	
<i>Eucalyptus siderophloia</i>					

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7 Iluka Road - Woodburn					
Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat	
Paperbark-Swamp Box	Swamp Sclerophyll closed forest, open forest & woodland	Swamp Mahogany Swamp Forest of the Coastal Lowlands of the North Coast	Swamp Sclerophyll Forest on Coastal Floodplain	Seasonally waterlogged floodplain with heavy grey clay soil derived from alluvium and colluvium	
Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species	
<i>Melaleuca quinquenervia</i>		<i>Lophostemon suaveolens</i>		<i>Hypolepis muelleri</i>	
<i>Lophostemon suaveolens</i>		<i>Melaleuca sieberi</i>		<i>Carex maculata</i>	
		<i>Melaleuca quinquenervia</i>		<i>Lepidosperma laterale</i>	
		<i>Melaleuca alternifolia</i>		<i>Eragrostis brownii</i>	
		<i>Glochidion ferdinandi</i>		<i>Oplismenus aemulus</i>	
Associated upper stratum species				<i>Panicum simile</i>	
<i>Eucalyptus robusta</i>				<i>Pteridium esculentum</i>	
<i>Eucalyptus siderophloia</i>					
<i>Eucalyptus tereticornis</i>					
<i>Casuarina glauca</i>					
8 Iluka Road - Woodburn					
Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat	
Swamp Oak	Swamp Sclerophyll open forest & woodland	Swamp Oak Swamp Forest of the Coastal Lowlands of the North Coast	Swamp Oak Floodplain Forest	Limited to a few small areas at the northern end of the study area with heavy clay alluvial soil	
Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species	
<i>Casuarina glauca</i>		<i>Parsonsia straminea</i>		<i>Hypolepis muelleri</i>	
		<i>Callistemon salignus</i>		<i>Ottochloa gracillima</i>	
				<i>Paspalum mandiocanum</i>	
Associated upper stratum species					
<i>Melaleuca quinquenervia</i>					

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9 Iluka Road - Woodburn					
Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat	
Red Mahogany	Swamp Sclerophyll woodland to open woodland	Swamp Mahogany Swamp Forest of the Coastal Lowlands of the North Coast	Swamp Oak Floodplain Forest	Flat footslopes grading into valley bottom with heavy clay, alluvial/colluvial soil derived from sedimentary rocks. The ground surface often has gilgai micro-relief and is probably inundated after heavy rain	
Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species	
<i>Eucalyptus resinifera</i>		<i>Melaleuca nodosa</i>		<i>Entolasia marginata</i>	
		<i>Banksia oblongifolia</i>		<i>Themeda australis</i>	
		<i>Melaleuca sieberi</i>		<i>Pteridium esculentum</i>	
				<i>Hibbertia vestita</i>	
Associated upper stratum species				<i>Ptilothrix deusta</i>	
<i>Corymbia gummifera</i>					
10 Iluka Road - Woodburn					
Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat	
Bungwahl Fern-Lepironia-Common Reed	Freshwater Wetland	Coastal floodplain sedgeland, rushlands and forblands	Freshwater Wetlands on Coastal Floodplains	Limited to a few small areas of low lying depressions at the northern end of the corridor. Peat soils are permanently inundated or waterlogged	
Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species	
<i>Lepironia articulata</i>				<i>Blechnum indicum</i>	
<i>Phragmites communis</i>				<i>Persicaria strigosa</i>	
<i>Baumea articulata</i>				<i>Leersia hexandra</i>	
<i>Baumea rubiginosa</i>				<i>Hypolepis muelleri</i>	
<i>Persicaria lapathifolia</i>				<i>Triglochin procerum sens. st.</i>	
Associated upper stratum species					
11 Woolgoolga - Wells Crossing					

Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Swamp Mahogany/Forest Red Gum Swamp Forest	Swamp Sclerophyll Forest	Swamp Mahogany Swamp Forest of the Coastal Lowlands of the North Coast	Swamp Sclerophyll Forest on Coastal Floodplain	Low lying permanently wet depressions with poor drainage, near or on floodplains of creeks with permanent water or fringes of dams
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
	<i>Melaleuca quinquenervia</i>		<i>Melaleuca linariifolia</i>		<i>Blechnum indicum</i>
	<i>Casuarina glauca</i>		<i>Melaleuca styphelioides</i>		<i>Pteridium esculentum</i>
	<i>Eucalyptus robusta</i>		<i>Melaleuca sieberi</i>		<i>Blechnum cartilagineum</i>
	<i>Eucalyptus tereticornis</i>		<i>Melaleuca nodosa</i>		<i>Calochlaena dubia</i>
	<i>Eucalyptus resinifera</i>		<i>Callistemon salignus</i>		<i>Gahnia clarkei</i>
			<i>Callistemon citrinus</i>		<i>Baumea articulata</i>
			<i>Callistemon pachyphyllus</i>		<i>Baumea rubiginosa</i>
			<i>Glochidion ferdinandi</i>		<i>Baumea teretifolia</i>
			<i>Banksia oblongifolia</i>		<i>Eleocharis gracilis</i>
			<i>Acacia elongata</i> var. <i>elongata</i>		<i>Schoenoplectus validus</i>
	Associated upper stratum species		<i>Baccharis halimifolia</i>		<i>Leptocarpus tenax</i>
			<i>Acacia longifolia</i>		<i>Imperata cylindrica</i>
			<i>Parsonsia straminea</i>		<i>Persicaria strigosa</i>
			<i>Stephania japonica</i>		<i>Phragmites australis</i>
			<i>Eustrephus latifolius</i>		<i>Oplismenus aemulus</i>
			<i>Geitonoplesium cymosum</i>		<i>Lomandra longifolia</i> subsp. <i>longifolia</i>
					<i>Baloskion tetraphyllum</i> subsp. <i>meiostachyum</i>
					<i>Chorizandra cymbaria</i>
					<i>Lepidosperma filiforme</i>
					<i>Adiantum aethiopicum</i>
					<i>Goodenia bellidifolia</i>
					<i>Xyris juncea</i>
					<i>Viola hederacea</i>
					<i>Melaleuca thymifolia</i>
					<i>Dichondra repens</i>
					<i>Isachne globosa</i>
					<i>Drosera spathulata</i>
					<i>Philydrum lanuginosum</i>
					<i>Villarsia exaltata</i>
					<i>Lobelia anceps</i>

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					<i>Carex appressa</i>
					<i>Hydrocotyle peduncularis</i>
					<i>Hydrocotyle laxiflora</i>
					<i>Centella asiatica</i>
					<i>Schoenus brevifolius</i>
					<i>Selaginella uliginosa</i>
					<i>Juncus usitatus</i>
					<i>Juncus prismatocarpus</i>
12	Woolgoolga - Wells Crossing				
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Swamp Oak Forest	Swamp Sclerophyll Forest	Swamp Oak Swamp Forest of the Coastal Lowlands of the North Coast	Swamp Oak Floodplain Forest	Low lying permanently wet depressions with poor drainage on floodplains, with some saline influence near the coast
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
	<i>Casuarina glauca</i>		<i>Lantana camara</i> <i>Baccharis halimifolia</i>		<i>Baumea articulata</i> <i>Baumea teretifolia</i> <i>Schoenoplectus mucronatus</i> <i>Leptocarpus tenax</i> <i>Imperata cylindrica</i> <i>Phragmites australis</i> <i>Viola hederacea</i> <i>Philydrum lanuginosum</i> <i>Schoenus apogon</i> <i>Ageratina adenophora</i> <i>Fimbristylis dichotoma</i>
	Associated upper stratum species				
	<i>Eucalyptus sp</i> <i>Melaleuca sp</i>				
13	Woolgoolga - Wells Crossing				

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	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Moist Floodplain Eucalypt Forest	Wet Sclerophyll Forest or Open Forest	Blackbutt grassy open forest of the lower Clarence Valley of the North Coast	Nil	Low-lying flat floodplain areas, usually dry but subject to occasional flooding
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
			<i>Eucalyptus pilularis</i>	<i>Lophostemon suaveolens</i>	<i>Themeda australis</i>
			<i>Eucalyptus microcorys</i>	<i>Melaleuca quinquenervia</i>	<i>Cymbopogon refractus</i>
			<i>Eucalyptus signata</i>	<i>Melaleuca sieberi</i>	<i>Leucopogon lanceolatus</i> sp
			<i>Eucalyptus acmenoides</i>	<i>Allocasuarina torulosa</i>	<i>Ptilothrix deusta</i>
			<i>Eucalyptus siderophloia</i>	<i>Casuarina glauca</i>	<i>Imperata cylindrica</i>
			<i>Eucalyptus globoidea</i>	<i>Banksia spinulosa</i> var. <i>collina</i>	<i>Hibbertia riparia</i>
			<i>Angophora costata</i>	<i>Banksia oblongifolia</i>	<i>Hibbertia aspera</i>
			<i>Corymbia gummifera</i>	<i>Dodonaea triquetra</i>	<i>Dampiera stricta</i>
			<i>Syncarpia glomulifera</i>	<i>Melaleuca nodosa</i>	<i>Dianella caerulea</i> var. <i>caerulea</i>
				<i>Glochidion ferdinandi</i>	<i>Breynia oblongifolia</i>
	Associated upper stratum species		<i>Leptospermum polygalifolium</i>		<i>Gonocarpus teucroides</i>
			<i>Leptospermum trinervium</i>		<i>Epacris pulchella</i>
			<i>Persoonia stradbokensis</i>		<i>Zieria smithii</i>
			<i>Drypetes deplanchei</i>		<i>Pteridium esculentum</i>
			<i>Cupaniopsis anacardioides</i>		<i>Xanthorrhoea macronema</i>
			<i>Alphitonia excelsa</i>		<i>Lomandra longifolia</i> subsp. <i>longifolia</i>
			<i>Pultenaea retusa</i>		<i>Lomandra multiflora</i> subsp. <i>multiflora</i>
			<i>Pultenaea villosa</i>		<i>Calochlaena dubia</i>
			<i>Acacia floribunda</i>		<i>Vernonia cinerea</i> var. <i>cinerea</i>
			<i>Acacia falcata</i>		<i>Pseuderanthemum variable</i>
			<i>Acacia longifolia</i>		<i>Lindsaea microphylla</i>
			<i>Acacia myrtifolia</i>		<i>Comesperma ericinum</i>
			<i>Trema aspera</i>		<i>Lomatia silaifolia</i>
					<i>Gahnia sieberiana</i>
					<i>Calochlaena dubia</i>
					<i>Lomatia silaifolia</i>
14	Woolgoolga - Wells Crossing				

Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Needlebark Stringybark/Scribbly Gum Forest	Dry Sclerophyll Open Forest	Scribbly Gum-Needlebark Stringybark heathy open forest of coastal lowlands of the northern North Coast	Nil	Sandstone ridgetops and upper slopes with areas of sandstone outcrops or slightly elevated flat plains above and adjoining floodplains
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
		<i>Eucalyptus planchoniana</i>	<i>Phyllota grandiflora</i>		<i>Themeda australis</i>
		<i>Eucalyptus signata</i>	<i>Lambertia formosa</i>		<i>Dichelachne micrantha</i>
		<i>Eucalyptus pilularis</i>	<i>Acacia terminalis</i>		<i>Panicum simile</i>
		<i>Eucalyptus acmenoides</i>	<i>Acacia suaveolens</i>		<i>Andropogon avenaceus</i>
		<i>Angophora floribunda</i>	<i>Acacia longifolia</i>		<i>Ptilothrix deusta</i>
		<i>Corymbia gummifera</i>	<i>Acacia myrtifolia</i>		<i>Acacia brownei</i>
			<i>Pultenaea ferruginea</i>		<i>Epacris pulchella</i>
			<i>Pultenaea euchila</i>		<i>Daviesia umbellulata</i>
			<i>Pultenaea robusta</i>		<i>Pomax umbellata</i>
			<i>Petrophile pulchella</i>		<i>Dianella caerulea</i> var. <i>caerulea</i>
	Associated upper stratum species		<i>Hakea sericea</i>		<i>Hakea dactyloides</i>
			<i>Banksia spinulosa</i> var. <i>collina</i>		<i>Phyllota grandiflora</i>
			<i>Banksia oblongifolia</i>		<i>Hibbertia obtusifolia</i>
			<i>Leptospermum trinervium</i>		<i>Caustis flexuosa</i>
			<i>Leptospermum polygalifolium</i>		<i>Caustis pentandra</i>
			<i>Bossiaea rhombifolia</i>		<i>Drosera spathulata</i>
			<i>Leucopogon lanceolatus</i> sp		<i>Platysace ericoides</i>
			<i>Monotoca scoparia</i>		<i>Lomatia silaifolia</i>
			<i>Xanthorrhoea ? glauca</i> subsp. <i>glauca</i>		<i>Patersonia glabrata</i>
			<i>Persoonia stradbokensis</i>		<i>Lindsaea microphylla</i>
			<i>Dillwynia retorta</i>		
			<i>Notelaea longifolia</i>		
			<i>Hardenbergia violacea</i>		
			<i>Cassytha pubescens</i>		
			<i>Casuarina glauca</i>		
15	Woolgoolga - Wells Crossing				

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	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Angophora Swamp Forest/Grassy Angophora Woodland	Swamp Sclerophyll Open Forest or Open Woodland	Orange Gum (<i>Eucalyptus bancroftii</i>) open forest of the North Coast	Contains Eucalyptus tetrapleura	Flat, slightly swampy land on poorly drained sandy soil
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
			<i>Angophora woodsiana</i>	<i>Melaleuca sieberi</i>	<i>Themeda australis</i>
			<i>Eucalyptus bancroftii</i>	<i>Melaleuca nodosa</i>	<i>Lepyrodia scariosa</i>
			<i>Eucalyptus fibrosa</i>	<i>Acacia longifolia</i>	<i>Goodenia bellidifolia</i>
			<i>Eucalyptus tetrapleura</i>	<i>Allocasuarina littoralis</i>	<i>Lomandra longifolia</i> subsp. <i>longifolia</i>
			<i>Eucalyptus acmenoides</i>	<i>Acacia complanata</i>	<i>Ptilothrix deusta</i>
			<i>Corymbia gummifera</i>	<i>Hakea dactyloides</i>	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>
			<i>Corymbia maculata</i>	<i>Jacksonia scoparia</i>	<i>Dampiera stricta</i>
			<i>Lophostemon confertus</i>	<i>Banksia oblongifolia</i>	<i>Comesperma sphaerocarpum</i>
			<i>Lophostemon suaveolens</i>	<i>Monotoca scoparia</i>	<i>Pultenaea retusa</i>
				<i>Xanthorrhoea johnsonii</i>	<i>Dianella revoluta</i>
	Associated upper stratum species		<i>Persoonia sericea</i>		<i>Pultenaea robusta</i>
					<i>Pimelea linifolia</i> subsp. <i>collina</i>
					<i>Isopogon mnoraifolius</i>
					<i>Lomandra filiformis</i> subsp. <i>filiformis</i>
					<i>Burchardia umbellata</i>
					<i>Pteridium esculentum</i>
					<i>Leucopogon juniperinus</i>
					<i>Platysace ericoides</i>
					<i>Laxmannia gracilis</i>
					<i>Acacia ulicifolia</i>
					<i>Epacris pulchella</i>
16	Woolgoolga - Wells Crossing				

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	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Spotted Gum-Ironbark Open Forest	Swamp Sclerophyll Forest	Spotted Gum-Grey Box-Grey Ironbark dry open forest of the Clarence Valley lowlands of the North Coast	Contains Eucalyptus tetrapleura	Slightly elevated but generally flat land on rich soil, often with poor drainage
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
			<i>Eucalyptus propinqua</i>	<i>Acacia falcata</i>	<i>Themeda australis</i>
			<i>Eucalyptus bancroftii</i>	<i>Melaleuca nodosa</i>	<i>Imperata cylindrica</i>
			<i>Eucalyptus fibrosa</i>	<i>Acacia melanoxylon</i>	<i>Entolasia stricta</i>
			<i>Eucalyptus tetrapleura</i>	<i>Allocasuarina littoralis</i>	<i>Patersonia sericea</i> var. <i>sericea</i>
			<i>Eucalyptus acmenoides</i>	<i>Acacia longifolia</i>	<i>Austrostipa pubescens</i>
			<i>Corymbia gummifera</i>	<i>Hakea dactyloides</i>	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>
			<i>Corymbia maculata</i>	<i>Pimelea linifolia</i> subsp. <i>collina</i>	<i>Acacia ulicifolia</i>
			<i>Eucalyptus eugenioides</i>	<i>Bursaria spinosa</i>	<i>Lepidosperma laterale</i>
				<i>Monotoca scoparia</i>	<i>Aristida vagans</i>
				<i>Comesperma ericinum</i>	<i>Platysace ericoides</i>
	Associated upper stratum species		<i>Persoonia stradbokensis</i>		<i>Pultenaea robusta</i>
			<i>Hardenbergia violacea</i>		<i>Pultenaea retusa</i>
			<i>Glycine tabacina</i> agg.		<i>Hibbertia riparia</i>
			<i>Desmodium variabilis</i>		<i>Lomandra filiformis</i> subsp. <i>filiformis</i>
			<i>Cassytha glabella</i>		<i>Daviesia ulicifolia</i>
					<i>Goodenia heterophylla</i>
					<i>Daviesia genistifolia</i>
					<i>Pratia purpurascens</i>
					<i>Pteridium esculentum</i>
					<i>Ozothamnus diosmifolius</i>
					<i>Austrodanthonia fulva</i> var. <i>fulva</i>
					<i>Eragrostis leptostachya</i>
					<i>Xanthorrhoea fulva</i>
					<i>Haemodorum planifolium</i>
					<i>Ptilothrix deusta</i>
					<i>Hybanthus monopetalus</i>
					<i>Gompholobium pinnatum</i>
					<i>Gahnia aspera</i>
					<i>Thysanotus microtuberosum</i>

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					<i>Chrysocephalum apiculatum</i>
					<i>Vernonia cinerea</i> var. <i>cinerea</i>
17	Woolgoolga - Wells Crossing				
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Cleared Open Grassland/Derived Pasture with Scattered Trees	Cleared Land	Cleared - pasture	Nil	Mostly on the flat floodplain in the southern part of the study area
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
	Associated upper stratum species				
18	Woolgoolga - Wells Crossing				
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Plantation, Cropland, Market Garden, Pine Forest etc	Cleared Land	Cleared - cropland	Nil	Various, typically on flatter land
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
	Associated upper stratum species				
19	Woolgoolga - Wells Crossing				
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Totally cleared open pasture	Cleared Land	Cleared - pasture	Nil	Various, usually on flatter or more gently sloping land
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
	Associated upper stratum species				
20	Wells Crossing - Iluka Road				
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Spotted Gum-Ironbark Open	Dry Sclerophyll Forest	Spotted Gum - Grey	Contains <i>Eucalyptus</i>	Clay soils in Glenugie State Forest

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	Forest		Ironbark - Pink Bloodwood open forest of the Clarence Valley Lowlands of the North Coast	<i>tetrapleura</i>	
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
			<i>Eucalyptus tindaliae</i>		<i>Acacia falcata</i>
			<i>Eucalyptus moluccana</i>		<i>Daviesia ulicifolia</i>
			<i>Eucalyptus propinqua</i>		<i>Entolasia stricta</i>
			<i>Eucalyptus tetrapleura</i>		<i>Aristida vagans</i>
			<i>Eucalyptus siderophloia</i>		<i>Themeda australis</i>
	Associated upper stratum species				<i>Lepidosperma laterale</i>
21	Wells Crossing - Iluka Road				
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Spotted Gum-Square-fruited Ironbark Open Forest	Dry Sclerophyll Forest	Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley Lowlands of the North Coast	Contains <i>Eucalyptus tetrapleura</i>	Clay soils in Glenugie State Forest
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
			<i>Eucalyptus moluccana</i>		<i>Gahnia aspera</i>
			<i>Eucalyptus propinqua</i>		<i>Imperata cylindrica</i>
			<i>Alphitonia excelsa</i>		<i>Pratia purpurascens</i>
			<i>Acacia concurrens</i>		<i>Entolasia marginata</i>
	Associated upper stratum species				
22	Wells Crossing - Iluka Road				
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Scribbly Gum - Bloodwood Open Forest	Dry Sclerophyll Forest	Scribbly Gum - Needlebark Stringybark heathy open forest of coastal lowlands of the northern North Coast	<i>Angophora robur</i> <i>Eucalyptus psammitica</i>	Higher elevated areas with sandy soils

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	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
	<i>Eucalyptus signata</i>		<i>Eucalyptus bancroftii</i>		<i>Hibbertia vestita</i>
	<i>Corymbia gummifera</i>		<i>Eucalyptus psammitica</i>		<i>Acacia complanata</i>
	<i>Corymbia intermedia</i>		<i>Angophora robur</i>		<i>Themeda australis</i>
	<i>Lophostemon suaveolens</i>				<i>Imperata cylindrica</i>
					<i>Leucopogon lanceolatus sp</i>
	Associated upper stratum species				
23	Wells Crossing - Iluka Road				
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Needlebark - Scribbly Gum Open Forest	Dry Sclerophyll Forest	Scribbly Gum - Needlebark Stringybark heathy open forest of coastal lowlands of the northern North Coast	<i>Angophora robur</i> <i>Quassia sp. Moonee Creek</i>	Higher elevated areas with sandy soils
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
	<i>Eucalyptus planchoniana</i>		<i>Corymbia gummifera</i>		<i>Leptospermum trinervium</i>
	<i>Eucalyptus signata</i>		<i>Corymbia intermedia</i>		<i>Aristida vagans</i>
	<i>Eucalyptus tindaliae</i>		<i>Angophora robur</i>		<i>Pteridium esculentum</i>
	<i>Alphitonia excelsa</i>		<i>Allocasuarina littoralis</i>		<i>Breynia oblongifolia</i>
	<i>Glochidion ferdinandi</i>		<i>Eucalyptus psammitica</i>		<i>Imperata cylindrica</i>
					<i>Hibbertia vestita</i>
	Associated upper stratum species				
24	Wells Crossing - Iluka Road				
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Turpentine Open Forest	Dry Sclerophyll Forest	Turpentine Moist Open Forest of the coastal hills and ranges of the North Coast	<i>Grevillea quadricauda</i>	Higher elevated areas with sandy soils
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
	<i>Syncarpia glomulifera</i>		<i>Eucalyptus signata</i>		<i>Austrostipa pubescens</i>

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	<i>Eucalyptus microcorys</i>		<i>Eucalyptus planchoniana</i>		<i>Lomandra longifolia</i> subsp. <i>longifolia</i>
	<i>Allocasuarina torulosa</i>		<i>Acacia aulacocarpa</i>		<i>Imperata cylindrica</i>
	<i>Lophostemon suaveolens</i>		<i>Corymbia intermedia</i>		<i>Pteridium esculentum</i>
			<i>Corymbia gummifera</i>		<i>Hibbertia vestita</i>
	Associated upper stratum species				<i>Notelaea ovata</i>
25	Wells Crossing - Iluka Road				
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Blackbutt Open Forest	Dry Sclerophyll Forest	Blackbutt - Bloodwood dry heathy open forest on sandstones of the northern North Coast	Nil	Higher elevated areas with sandy soils
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
	<i>Eucalyptus pilularis</i>		<i>Eucalyptus signata</i>		<i>Lambertia formosa</i>
	<i>Eucalyptus microcorys</i>		<i>Angophora woodsiana</i>		<i>Pteridium esculentum</i>
	<i>Corymbia intermedia</i>				<i>Entolasia stricta</i>
					<i>Aristida vagans</i>
					<i>Aristida warburgii</i>
	Associated upper stratum species				<i>Xanthorrhoea</i> sp.
26	Wells Crossing - Iluka Road				
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Turpentine -Red Mahogany - Paperbark Open Woodland	Dry Sclerophyll Forest	Turpentine moist open forest of the coastal hills and ranges of the North Coast	Nil	Swampy areas with sandy soils
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
	<i>Syncarpia glomulifera</i>		<i>Angophora subvelutina</i>		<i>Leucopogon melaleucoides</i>
	<i>Eucalyptus resinifera</i>		<i>Petalostigma triloculare</i>		<i>Banksia oblongifolia</i>
	<i>Melaleuca sieberi</i>				<i>Gahnia clarkei</i>

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	<i>Melaleuca nodosa</i>				<i>Baloskion tetraphyllum subsp. meiostrachyum</i>
	Associated upper stratum species				
27	Wells Crossing - Iluka Road				
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Tallowwood-Mahogany Forest	Dry Sclerophyll Forest	Tallowwood dry grassy forest of the far northern ranges of the North Coast	<i>Angophora robur</i>	Higher elevated areas on sandy soils
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
	<i>Acacia aulacocarpa</i>		<i>Corymbia intermedia</i>		<i>Imperata cylindrica</i>
	<i>Eucalyptus microcorys</i>		<i>Angophora robur</i>		<i>Themeda australis</i>
	<i>Eucalyptus psammitica</i>		<i>Alphitonia excelsa</i>		<i>Hibbertia vestita</i>
					<i>Pomax umbellata</i>
					<i>Lomandra multiflora subsp. multiflora</i>
	Associated upper stratum species				
28	Wells Crossing - Iluka Road				
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Tallowwood-Ironbark Open Forest	Dry Sclerophyll Forest	Tallowwood dry grassy forest of the far northern ranges of the North Coast	<i>Angophora robur</i>	Higher elevated areas on slopes with higher fertility soils
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
	<i>Eucalyptus microcorys</i>		<i>Corymbia intermedia</i>		<i>Jacksonia scoparia</i>
	<i>Eucalyptus siderophloia</i>		<i>Acacia aulacocarpa</i>		<i>Entolasia stricta</i>
	<i>Allocasuarina torulosa</i>		<i>Lophostemon suaveolens</i>		<i>Themeda australis</i>
	<i>Callitris columellaris</i>		<i>Angophora robur</i>		<i>Lantana camara</i>
					<i>Oplismenus aemulus</i>
	Associated upper stratum species				<i>Leucopogon juniperinus</i>

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29 Wells Crossing - Iluka Road					
Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat	
Forest Red Gum Forest	Wet Sclerophyll forest	Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast	Subtropical Coastal Floodplain Forest	Floodplain areas on sandy alluvial soil	
Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species	
<i>Eucalyptus tereticornis</i>		<i>Lophostemon suaveolens</i>		<i>Dichondra repens</i>	
<i>Eucalyptus siderophloia</i>		<i>Angophora subvelutina</i>		<i>Cymbopogon refractus</i>	
<i>Eucalyptus moluccana</i>		<i>Eucalyptus propinqua</i>		<i>Lomandra longifolia</i> subsp. <i>longifolia</i>	
<i>Corymbia intermedia</i>		<i>Melaleuca alternifolia</i>		<i>Parsonsia straminea</i>	
		<i>Melaleuca nodosa</i>		<i>Acacia irrorata</i> subsp. <i>irrorata</i>	
		<i>Alphitonia excelsa</i>			
		<i>Acacia concurrens</i>			
Associated upper stratum species					
30 Wells Crossing - Iluka Road					
Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat	
Mixed Floodplain Forest	Wet Sclerophyll Forest	Narrow-leaved Red Gum woodlands of the lowlands of the North Coast	Subtropical Coastal Floodplain Forest	Floodplain areas on sandy alluvial soils	
				<i>Grevillea quadricauda</i>	
Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species	
<i>Eucalyptus tereticornis</i>		<i>Angophora subvelutina</i>		<i>Dichondra repens</i>	
<i>Lophostemon suaveolens</i>		<i>Casuarina glauca</i>		<i>Cymbopogon refractus</i>	
<i>Eucalyptus siderophloia</i>		<i>Lophostemon confertus</i>		<i>Parsonsia straminea</i>	
<i>Corymbia intermedia</i>		<i>Eucalyptus bancroftii</i>		<i>Gahnia aspera</i>	
<i>Eucalyptus seeana</i>		<i>Angophora floribunda</i>		<i>Gahnia clarkei</i>	
<i>Eucalyptus resinifera</i>		<i>Eucalyptus conferta</i>		<i>Entolasia marginata</i>	
<i>Acacia concurrens</i>		<i>Angophora woodsiana</i>		<i>Dianella caerulea</i> var. <i>caerulea</i>	

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			<i>Alphitonia excelsa</i>		<i>Imperata cylindrica</i>
			<i>Acacia aulacocarpa</i>		<i>Persoonia stradbokensis</i>
	Associated upper stratum species				<i>Aristida vagans</i>
31	Wells Crossing - Iluka Road				
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Swamp Mahogany-Paperbark Forest	Swamp Sclerophyll Forest	Swamp Mahogany swamp forest of the coastal lowlands of the North Coast	Swamp Sclerophyll Forest on Coastal Floodplain	Floodplain areas on waterlogged humic soils
				<i>Lindsaea incisa</i>	
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
	<i>Eucalyptus robusta</i>				<i>Gahnia clarkei</i>
	<i>Melaleuca quinquenervia</i>				<i>Hypolepis muelleri</i>
					<i>Blechnum indicum</i>
					<i>Baloskion tetraphyllum subsp. meiotachyum</i>
					<i>Baeckea linifolia</i>
					<i>Acacia longifolia</i>
					<i>Banksia oblongifolia</i>
	Associated upper stratum species				
	<i>Eucalyptus resinifera</i>				
32	Wells Crossing - Iluka Road				
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Swamp Oak Forest	Swamp Sclerophyll Forest	Swamp Oak swamp forest of the coastal lowlands of the north coast	Swamp Oak Floodplain Forest	Floodplain areas on alluvial soils with a saline influence
				<i>Melaleuca irbyana</i>	
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
	<i>Casuarina glauca</i>				<i>Oplismenus imbecillis</i>
	<i>Melaleuca nodosa</i>				<i>Centella asiatica</i>
					<i>Dichondra repens</i>
	Associated upper stratum species				<i>Parsonsia straminea</i>
	<i>Melaleuca alternifolia</i>				
33	Wells Crossing - Iluka Road				

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	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Lowland Rainforest	Swamp Sclerophyll Forest	Black Bean - Weeping Lilly Pilly riparian rainforest of the North Coast	Lowland Rainforest	Floodplain areas on rich alluvial soils
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
	<i>Waterhousea floribunda</i>				<i>Calochlaena dubia</i>
	<i>Guioa semiglauca</i>				<i>Opismenus aemulus</i>
					<i>Geitonoplesium cymosum</i>
	Associated upper stratum species				
	<i>Dendrocnide excelsa</i>				
	<i>Backhousia myrtifolia</i>				
	<i>Tristaniopsis laurina</i>				
	<i>Eupomatia laurina</i>				
34	Wells Crossing - Iluka Road				
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Freshwater Wetland	Freshwater Wetland	Coastal floodplain sedgeland, rushlands and forblands	Freshwater Wetlands on Coastal Floodplains	Low elevated depressions on floodplains, alluvial soils
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
	<i>Juncus usitatus</i>				
	<i>Carex appressa</i>				
	<i>Lepironia articulata</i>				
	<i>Baumea articulata</i>				
	<i>Persicaria strigosa</i>				
	<i>Eleocharis sphacelata</i>				
	Associated upper stratum species				

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	<i>Melaleuca sp</i>				
	<i>Philydrum lanuginosum</i>				
	<i>Ludwigia peploides subsp. montevidensis</i>				
	<i>Ischaemum australe var. Austral</i>				
35	Wells Crossing - Iluka Road				
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Mangrove Forest	Mangrove	Mangrove - Grey Mangrove low closed forest of the NSW Coastal Bioregion	Protected under Fisheries Management Act	Edges of estuarine rivers and creeks
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
	<i>Avicennia marina</i>				<i>Sporobolus virginicus var. minor</i>
	Associated upper stratum species				
	<i>Aegiceras corniculatum</i>				
36	Woodburn - Ballina				
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Banksia-Callitris Dry Heathy Woodlands and Heaths	Dry Sclerophyll Forest	Coast Cypress Pine shrubby open forest of the North Coast Bioregion	Coastal Cypress Pine Forest in the NSW North Coast Bioregion	Aeolian sand mass or occasionally on metasediments. Restricted to the coastal plains.
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
	<i>Banksia aemula</i>				<i>Homoranthus virgatus</i>
	<i>Banksia ericifolia</i>				<i>Melaleuca nodosa</i>
	<i>Acacia spp.</i>				<i>Acacia ulicifolia</i>
	Associated upper stratum species				
	<i>Callitris columellaris</i>				
	<i>Eucalyptus pilularis</i>				
	<i>Eucalyptus signata</i>				
	<i>Corymbia gummifera</i>				
37	Woodburn - Ballina				
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Paperbark-Swamp Mahogany Wet Heathy Woodlands and Heaths	Swamp Sclerophyll Forest	Swamp Mahogany swamp forest of the coastal lowlands of the North Coast	Swamp Sclerophyll Forest on Coastal Floodplain	Low lying areas or areas of impeded drainage on alluvium, colluvium, transferral landscapes or Aeolian sands. Generally restricted to the coastal plain.
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species

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	<i>Melaleuca quinquenervia</i>		<i>Callistemon pachyphyllus</i>		<i>Gahnia sieberiana</i>
	<i>Banksia ericifolia</i>				<i>Blechnum indicum</i>
	<i>Eucalyptus robusta</i>				<i>Pteridium esculentum</i>
					<i>Cyperus polystachyos</i>
	Associated upper stratum species				<i>Xanthorrhoea fulva</i>
	<i>Elaeocarpus reticulatus</i>				
	<i>Banksia aemula</i>				
38	Woodburn - Ballina				
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Paperbark-Blackbutt Closed Forest	Floodplain Forest	Swamp Mahogany swamp forest of the coastal lowlands of the North Coast	Subtropical Coastal Floodplain Forest	On or around creeklines in areas of low relief but occasionally on low slopes.
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
	<i>Melaleuca quinquenervia</i>		<i>Melicope elleryana</i>		
	<i>Eucalyptus pilularis</i>		<i>Livistona australis</i>		
	<i>Lophostemon confertus</i>		<i>Archontophoenix cunninghamiana</i>		
			<i>Jagera pseudorhus</i>		
			<i>Guioa semiglauc</i>		
			<i>Glochidion sumatranum</i>		
	Associated upper stratum species				
39	Woodburn - Ballina				
	Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species	Habitat
	Paperbark-Swamp Oak Swampy Forests	Swamp Sclerophyll Forest	Swamp Oak swamp forest of the coastal lowlands of the North Coast	Swamp Sclerophyll Forest on Coastal Floodplain	Areas of low relief with impeded drainage or alluvial/colluvial soils
	Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species
	<i>Melaleuca quinquenervia</i>		<i>Solanum mauritianum</i>		<i>Ottochloa gracillima</i>
	<i>Casuarina glauca</i>		<i>Solanum nigrum</i>		<i>Paspalum dilatatum</i>
			<i>Lantana camara</i>		<i>Viola hederacea</i>
			<i>Alphitonia excelsa</i>		<i>Setaria spp.</i>
			<i>Acmena smithii</i>		<i>Imperata cylindrica</i>
	Associated upper stratum species				<i>Pteridium esculentum</i>

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40 Woodburn - Ballina					
Vegetation association	Structural formation	Northern Rivers CMA vegetation type	Threatened Community or species information	Habitat	
Mangrove Closed Forest	Mangrove	Mangrove - Grey Mangrove low closed forest of the NSW Coastal Bioregion	Protected under Fisheries Management Act	Occurs as narrow fringing community to the limit of saline tidal influence	
Dominant upper stratum species		Dominant mid stratum species		Dominant lower stratum species	
<i>Avicennia marina</i>		<i>Hibiscus tiliaceus</i>			
<i>Aegiceras corniculatum</i>		<i>Lantana camara</i>			
Associated upper stratum species					

Appendix G Flora

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KEY TO ABBREVIATIONS IN APPENDIX G	
Abbreviation	Reference
e	Endangered species (listed as threatened under State and/or Commonwealth legislation)
v	Vulnerable species (listed as threatened under State and/or Commonwealth legislation)
i	Introduced (ie not indigenous to Australia)
n	Native Australian species not considered to be indigenous to the site
c	Cultivated (ie planted on the site)
spp.	Several species of the one genus (sometimes occurring as a hybrid swarm)
sp.	Unidentified species ³
sp. aff.	Unidentified species with characteristics similar to the indicated species or genus ³
?	Unconfirmed species ³
var.	Variety
subsp.	Subspecies
cv.	Cultivar (ie a anthropogenic form of the species)
agg.	An aggregate of several yet to be defined species
sensu	In the sense of (taxa has unstable circumscription)
NOTES:	
1. Recent 'synonyms' include misapplied names.	
2. A sample flora assemblage obtained from a short term survey, such as the present one, cannot be considered to be comprehensive, but rather indicative of the actual flora assemblage. It can take many years of flora surveys to record all of the plant species occurring within any area, especially species that are only apparent in some seasons.	
3. Not all species can be accurately identified in a 'snapshot' survey due to absence of flowering or fruiting material, etc.	
SCIENTIFIC NAMES & AUTHORITIES:	
Scientific names & families are those used in the Flora of New South Wales as maintained by the Royal Botanic Gardens (http://.plantnet.rbgsyd.gov.au).	
Orders and higher taxa are based on Angiosperm Phylogeny Group (2003).	
For sake of simplicity, scientific names in this list do not include authorities. These can be found in the Flora of New South Wales.	

GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections				
						1-2	3-5	6-8	9-11	
Club-mosses										
	LYCOPODIACEAE									
	<i>Lycopodiella cernua</i>	Scrambling Clubmoss				•				
	<i>Lycopodiella lateralis</i>							•		
	<i>Lycopodium cernuum</i>							•		
	SELAGINELLACEAE									
	<i>Selaginella uliginosa</i>	Selaginella				•	•	•		
Fork-ferns										
	PSILOTACEAE									
	<i>Psilotum nudum</i>	Slender Fork-fern				•	•			
Ferns										
	OSMUNDACEAE									
	<i>Todea barbara</i>	King Fern								•
	GLEICHENIACEAE									
	<i>Gleichenia dicarpa</i>	Pouched Coral fern/Tangle Fern				•	•	•	•	

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections			
						1-2	3-5	6-8	9-11
	<i>Sticherus flabellatus</i>	Umbrella Fern				•	•		
	SCHIZAEACEAE								
	<i>Lygodium microphyllum</i>	Climbing Snake Fern					•	•	
	<i>Schizaea bifida</i>	Forked Comb-fern						•	•
	<i>Schizaea dichotoma</i>	Branched Come Fern						•	
	DENNSTAEDTIACEAE								
	<i>Histiopteris incisa</i>	Bats-wing Fern					•		
	<i>Hypolepis muelleri</i>	Harsh Ground-fern				•	•	•	•
	<i>Hypolepis glandulifera</i>	Downy Ground-fern				•			
	<i>Pteridium esculentum</i>	Bracken				•	•	•	•
	DICKSONIACEAE								
	<i>Calochlaena dubia</i>	False Bracken Fern				•	•	•	
	LINDSAEACEAE								
	<i>Lindsaea incisa</i>	Slender Screw Fern		e		•	•	•	
	<i>Lindsaea linearis</i>	Screw Fern				•	•		
	<i>Lindsaea microphylla</i>	Lacy Wedge-fern				•	•		
	CYATHEACEAE								
	<i>Cyathea australis</i>	Rough Tree-fern				•			
	MARSILEACEAE								
	<i>Marsilea hirsuta</i>	Hairy Nardoo					•		
	<i>Marsilea mutica</i>	Nardoo					•	•	
	AZOLLACEAE								
	<i>Azolla pinnata</i>	Rufous Azolla						•	
	SALVINIACEAE								
	<i>Salvinia molesta</i>	Salvinia	i				•		•
	ADIANTACEAE								
	<i>Adiantum aethiopicum</i>	Maidenhair Fern				•	•	•	
	<i>Adiantum hispidulum</i>	Rough Maidenhair					•	•	•
	<i>Cheilanthes distans</i>	Bristly Cloak-fern					•		
	<i>Cheilanthes sieberi</i>	Poison Rock Fern						•	
	<i>Cheilanthes sieberi subsp. sieberi</i>	Slender Cloak-fern				•	•		
	<i>Pellaea falcata</i>					•			
	<i>Pellaea falcata var. falcata</i>	Sickle Fern					•		
	PTERIDACEAE								
	<i>Pteris vittata</i>	Chinese Brake / Ladder Brake				•			
	ASPLENIACEAE								
	<i>Asplenium australasicum</i>	Birds-nest Fern					•	•	•
	BLECHNACEAE								
	<i>Blechnum cartilagineum</i>	Gristle Fern				•	•	•	•
	<i>Blechnum indicum</i>	Swamp Water-fern				•	•	•	•
	<i>Blechnum nudum</i>	Fishbone Water-fern							•
	<i>Blechnum wattsii</i>	Hard Water Fern							•

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections				
						1-2	3-5	6-8	9-11	
	<i>Doodia aspera</i>	Prickly Rasp-fern					•	•	•	
	<i>Doodia australis</i>							•		
	<i>Doodia caudata</i>	Small Rasp-fern				•	•	•	•	
	<i>Doodia linearis</i>	Small Rasp-fern					•		•	
	DRYOPTERIDACEAE									
	<i>Arachniodes aristata</i>	Prickly Shield Fern							•	
	<i>Lastreopsis decomposita</i>	Shield-fern							•	
	<i>Lastreopsis microsora</i>	Shield-fern					•		•	
	THELYPTERIDACEAE									
	<i>Christella dentata</i>	Binung				•	•	•	•	
	DAVALLIACEAE									
	<i>Davallia solida var. pyxidata</i>	Hare's-foot Fern					•	•		
	<i>Nephrolepis cordifolia</i>	Fishbone Fern	i			•				
	ATHYRIACEAE									
	<i>Diplazium australe</i>								•	
	POLYPODIACEAE									
	<i>Platynerium bifurcatum</i>	Elk-horn Fern				•	•	•	•	
	<i>Platynerium superbum</i>							•		
	<i>Pyrosia confluens</i>	Horse shoe Felt Fern							•	
	<i>Pyrosia rupestris</i>	Rock Felt-fern					•		•	
	OPHIOGLOSSACEAE									
	<i>Botrychium australe</i>	Austral Moonwort/Parsley Fern				•		•		
	Cycads									
	ZAMIACEAE									
	<i>Lepidozamia peroffskyana</i>	Burrawang				•				
	<i>Macrozamia fawcettii</i>					•	•			
	Conifers									
	ARAUCARIACEAE									
	<i>Araucaria bidwillii</i>	Bunya Pine	i			•				
	<i>Araucaria columnaris</i>	Cooks Pine	i							
	<i>Araucaria cunninghamii</i>	Hoop Pine						•	•	
	<i>Araucaria heterophylla</i>	Norfolk Island Pine	i			•				
	CUPRESSACEAE									
	<i>Callitris columellaris</i>	Coastal Cypress Pine					•	•	•	
	<i>Callitris rhomboidea</i>	Port Jackson Pine				•				
	PINACEAE									
	<i>Pinus elliotii</i>	Slash Pine	i				•	•	•	
	<i>Pinus radiata</i>	Monterey Pine	i			•				
	PODOCARPACEAE									
	<i>Podocarpus spinulosus</i>	Shrub Plum-pine					•			
	Flowering Plants - Dicotyledons									
	CABOMBACEAE									
	<i>Brasenia schreberi</i>	Water-shield				•				
	NYMPHAEACEAE									

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections				
						1-2	3-5	6-8	9-11	
	<i>Nymphaea spp.</i>	Waterlily					•			
	<i>Nymphaea caerulea</i>	Cape Waterlily							•	
	<i>Nymphaea caerulea subsp. zanzibarensis</i>	Cape Waterlily	i			•				
	<i>Nymphaea mexicana</i>	Waterlily	i							
	EUPOMATIACEAE									
	<i>Eupomatia laurina</i>	Bolwarra					•		•	
	LAURACEAE									
	<i>Cassytha filiformis</i>							•	•	
	<i>Cassytha glabella f. glabella</i>	Devils Twine				•			•	
	<i>Cassytha pubescens</i>	Devils Twine				•	•	•	•	
	<i>Cinnamomum camphora</i>	Camphor Laurel	i			•	•	•	•	
	<i>Cinnamomum oliveri</i>	Oliver's Sassafras								
	<i>Cryptocarya foetida</i>	Stinking Cryptocarya		v	v				•	
	<i>Cryptocarya glaucescens</i>	Native Laurel					•			
	<i>Cryptocarya microneura</i>	Murrogun					•	•		
	<i>Cryptocarya obovata</i>	Pepperberry							•	
	<i>Cryptocarya rigida</i>	Brown beech					•			
	<i>Cryptocarya triplinervis</i>	Three-veined Cryptocarya							•	
	<i>Endiandra discolor</i>	Rose Walnut				•	•	•	•	
	<i>Endiandra hayesii</i>	Rusty Rose Walnut		v	v				•	
	<i>Endiandra muelleri subsp. bracteata</i>	Green-leaved Rose Walnut		e			•		•	
	<i>Endiandra pubens</i>	Hairy Walnut							•	
	<i>Endiandra sieberi</i>	Cork Wood				•	•	•		
	<i>Litsea australis</i>						•		•	
	<i>Neolitsea australiensis</i>	Green Bolly Gum							•	
	<i>Neolitsea dealbata</i>	White Bolly Gum				•			•	
	MONIMIACEAE									
	<i>Wilkiea huegeliana</i>	Wilkiea							•	
	ARISTOLOCHIACEAE									
	<i>Aristolochia littoralis</i>	Dutchmans Pipe	i				•		•	
	PEPEROMIACEAE									
	<i>Peperomia blanda var. floribunda</i>	Hairy Peperomia					•			
	MENISPERMACEAE									
	<i>Echinostephia aculeata</i>	Prickly Snake Vine				•	•	•		
	<i>Sarcopetalum harveyanum</i>	Pearl Vine							•	
	<i>Stephania japonica</i>	Snake Vine				•	•		•	
	<i>Stephania japonica var. discolor</i>	Snake Vine						•		
	RANUNCULACEAE									
	<i>Clematis aristata</i>	Toothed Clematis				•	•			
	<i>Clematis glycinoides</i>	Entire-leaf Clematis				•	•	•		
	<i>Ranunculus inundatus</i>	River Buttercup					•	•	•	

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections			
						1-2	3-5	6-8	9-11
	<i>Ranunculus lappaceus</i>	Common Buttercup							•
	<i>Ranunculus plebius</i>	Hairy Buttercup							•
	<i>Ranunculus sessiliflorus</i>					•			
	PROTEACEAE								
	<i>Banksia aemula</i>	Wallum Banksia					•	•	•
	<i>Banksia ericifolia</i>	Heath-leaved Banksia				•			•
	<i>Banksia ericifolia</i> subsp. <i>macrantha</i>	Heath-leaved Banksia						•	
	<i>Banksia integrifolia</i>	Coastal Banksia					•		•
	<i>Banksia integrifolia</i> subsp. <i>integrifolia</i>	Coastal Banksia				•		•	
	<i>Banksia marginata</i>	Silver Banksia					•		
	<i>Banksia oblongifolia</i>	Spoon-leaf Banksia				•	•	•	•
	<i>Banksia serrata</i>	Saw Banksia				•	•		•
	<i>Banksia spinulosa</i> var. <i>collina</i>	Hill Banksia				•	•	•	
	<i>Grevillea hilliana</i>	White Yiel Yiel		e					•
	<i>Grevillea linearifolia</i>	Narrow-leaf Spider-flower						•	
	<i>Grevillea quadricauda</i>			v	v		•		
	<i>Grevillea robusta</i>	Silky Oak				•	•		
	<i>Hakea actites</i>	Mulaway Needle Bush						•	
	<i>Hakea dactyloides</i>	Broad-leaved Hakea				•			
	<i>Hakea florulenta</i>	Hakea				•		•	
	<i>Hakea laevipes</i> subsp. <i>laevipes</i>						•		
	<i>Hakea salicifolia</i>	Willow Hakea					•	•	
	<i>Hakea sericea</i>	Silky Hakea				•			
	<i>Isopogon anemonifolius</i>	Broad-leaf Drumsticks				•			
	<i>Isopogon mnoraifolius</i>					•	•		
	<i>Lambertia formosa</i>	Mountain Devil					•		
	<i>Lomatia silaifolia</i>	Crinkle Bush				•	•	•	
	<i>Macadamia tetraphylla</i>	Rough-shelled Queensland Nut		v	v	•	•		•
	<i>Persoonia cornifolia</i>							•	
	<i>Persoonia lanceolata</i>	Lance-leaf Geebung				•			
	<i>Persoonia levis</i>	Broad-leaf Geebung				•			
	<i>Persoonia linearis</i>	Narrow-leaf Geebung					•		
	<i>Persoonia sericea</i>					•			•
	<i>Persoonia stradbokensis</i>					•	•	•	
	<i>Persoonia tenuifolia</i>	Fine-leaf Geebung						•	
	<i>Persoonia virgata</i>	Twiggy Geebung						•	•
	<i>Petrophile canescens</i>	Conesticks							•

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections			
						1-2	3-5	6-8	9-11
	<i>Petrophile pulchella</i>	Conesticks					•		
	<i>Stenocarpus sinuatus</i>	Firewhell Tree							•
	DILLENIACEAE								
	<i>Adrastaea salicifolia</i>								•
	<i>Hibbertia aspera</i>	Rough Guinea-flower					•	•	•
	<i>Hibbertia aspera</i> subsp. <i>aspera</i>					•			
	<i>Hibbertia dentata</i>	Twining Guinea-flower				•			
	<i>Hibbertia diffusa</i>	Prostrate Guinea-flower				•			
	<i>Hibbertia empetrifolia</i>	Trailing Guinea-flower							•
	<i>Hibbertia fasciculata</i>	Clustered Guinea-flower							•
	<i>Hibbertia linearis</i>	Narrow-leaf Guinea-flower					•	•	
	<i>Hibbertia obtusifolia</i>							•	
	<i>Hibbertia obtusifolia</i> s. <i>lat.</i>	Blunt-leaf Guinea-flower				•			
	<i>Hibbertia riparia</i>	Guinea Flower				•			•
	<i>Hibbertia scandens</i>	Climbing Guinea-flower				•		•	•
	<i>Hibbertia serpyllifolia</i>	Thyme Guinea-flower					•		
	<i>Hibbertia vestita</i>	Hairy Guinea-flower					•	•	
	<i>Hibbertia virgata</i>	Twiggy Guinea-flower							•
	AIZOACEAE								
	<i>Tetragonia tetragonioides</i>	New Zealand Spinach					•	•	•
	AMARANTHACEAE								
	<i>Alternanthera denticulata</i>	Lesser Joyweed					•	•	•
	<i>Amaranthus hybridus</i>	Slim Amaranth	i					•	
	BASELLACEAE								
	<i>Anredera cordifolia</i>	Madeira Vine	i					•	
	CARYOPHYLLACEAE								
	<i>Colobanthus affinis</i>								•
	<i>Spergula arvensis</i>	Corn Spurry	i						•
	<i>Spergularia marina</i>	Saltspurry							•
	<i>Stellaria media</i>	Common Chickweed	i					•	
	CHENOPODIACEAE								
	<i>Chenopodium ambrosioides</i>	Mexican Tea						•	•
	<i>Einadia hastata</i>	Shrubby Berry-saltbush							•
	<i>Sarcocornia quinqueflora</i>	Samphire					•		
	DROSERACEAE								
	<i>Drosera auriculata</i>	Leafless Sundew						•	

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections			
						1-2	3-5	6-8	9-11
	<i>Drosera peltata</i>	Rosette Sundew					•	•	
	<i>Drosera spatulata</i>	Common Sundew				•	•	•	•
	POLYGONACEAE								
	<i>Persicaria attenuata</i>							•	
	<i>Persicaria decipiens</i>	Slender Knotweed				•	•	•	•
	<i>Persicaria dichotoma</i>							•	•
	<i>Persicaria hydropiper</i>	Water Pepper					•	•	•
	<i>Persicaria lapathifolia</i>	Pale Knotweed						•	•
	<i>Persicaria orientalis</i>	Princes Feathers							•
	<i>Persicaria strigosa</i>	Spotted Knotweed				•	•	•	•
	<i>Rumex brownii</i>	Swamp Dock					•		•
	<i>Rumex crispus</i>	Curled Dock	i				•		
	PORTULACACEAE								
	<i>Portulaca pilosa</i>	Akulikuli	i						•
	LORANTHACEAE								
	<i>Amyema cambagei</i>	She-oak Mistletoe					•		
	<i>Amyema congener</i>						•	•	
	<i>Amyema congener subsp. congener</i>					•			
	<i>Amyema pendulum subsp. pendulum</i>	Pendulous Mistletoe				•		•	
	<i>Amylothea dictyophleba</i>	Rainforest Mistletoe					•		
	<i>Dendrophthoe vitellina</i>	Creeping Mistletoe					•		
	OLACACEAE								
	<i>Olax angulata</i>	Square-stemmed Olax				•			
	SANTALACEAE								
	<i>Choretrum candollei</i>	Snow Bush				•			
	<i>Choretrum pauciflorum</i>	Dwarf Sourbush							
	<i>Exocarpos cupressiformis</i>	Cherry Ballart				•	•	•	
	<i>Leptomeria acida</i>	Native Current				•		•	•
	VISCACEAE								
	<i>Notothixos incanus</i>							•	
	CRASSULACEAE								
	<i>Bryophyllum delagoense</i>	Mother-of-millions	i				•	•	
	<i>Bryophyllum pinnatum</i>	Live Plant	i						•
	<i>Crassula spp.</i>	Stonecrop					•		
	HALORAGACEAE								
	<i>Gonocarpus chinensis</i>							•	
	<i>Gonocarpus humilis</i>						•	•	
	<i>Gonocarpus micranthus subsp. micranthus</i>	Creeping Raspwort				•	•	•	•
	<i>Gonocarpus salsoloides</i>								•
	<i>Gonocarpus tetragynus</i>	Poverty Raspwort				•	•	•	
	<i>Gonocarpus teucroides</i>	Raspwort				•	•		

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections			
						1-2	3-5	6-8	9-11
	<i>Myriophyllum crispatum</i>							•	
	<i>Myriophyllum variifolium</i>	Water-milfoil				•			
	VITACEAE								
	<i>Cayratia clematidea</i>	Slender Grape					•	•	•
	<i>Cissus antarctica</i>	Water Vine				•	•		•
	<i>Cissus hypoglauca</i>	Five-leaf Water Vine				•	•	•	•
	<i>Cissus opaca</i>	Pepper vine					•	•	
	GERANIACEAE								
	<i>Geranium solanderi</i> var. <i>solanderi</i>	Native Cranesbill					•		
	MELASTOMATACEAE								
	<i>Melastoma affine</i>	Native Lassiandra					•	•	
	MYRTACEAE								
	<i>Acmena ingens</i>	Red Apple							•
	<i>Acmena smithii</i>	Lilly Pilly				•	•	•	•
	<i>Acmena smithii</i> (Narrow Leaf Form)							•	
	<i>Angophora bakeri</i>	Narrow-leaved Apple					•		
	<i>Angophora costata</i>	Smooth-barked Apple				•			
	<i>Angophora floribunda</i>	Rough-barked Apple				•	•		
	<i>Angophora paludosa</i>							•	
	<i>Angophora robur</i>	Sandstone Rough-barked Apple		v	v		•		
	<i>Angophora subvelutina</i>	Broad-leaved Apple				•	•	•	•
	<i>Angophora woodsiana</i>					•	•	•	
	<i>Archirhodomyrtus beckleri</i>	Rose Myrtle					•		
	<i>Austromyrtus dulcis</i>	Midgen Berry						•	•
	<i>Backhousia myrtifolia</i>	Grey Myrtle				•	•		
	<i>Baeckea frutescens</i>							•	•
	<i>Baeckea imbricata</i>								•
	<i>Baeckea linifolia</i>	Weeping / Swamp Baeckea				•			
	<i>Baeckea virgata</i>	Twiggy Heath-myrtle					•		
	<i>Callistemon citrinus</i>	Crimson Bottlebrush				•	•		
	<i>Callistemon linearis</i>	Narrow-leaved Bottlebrush					•		
	<i>Callistemon pachyphyllus</i>	Wallum Bottlebrush				•		•	•
	<i>Callistemon rigidus</i>	Stiff Bottlebrush					•		
	<i>Callistemon salignus</i>	Willow Bottlebrush				•	•	•	•
	<i>Callistemon viminalis</i>	Weeping Bottlebrush							•
	<i>Corymbia gummifera</i>	Red Bloodwood				•	•	•	•
	<i>Corymbia henryi</i>	Large-leaved Spotted Gum					•	•	
	<i>Corymbia intermedia</i>	Pink Bloodwood				•	•	•	
	<i>Corymbia maculata</i>	Spotted Gum				•			

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections			
						1-2	3-5	6-8	9-11
	<i>Eucalyptus acmenoides</i>	White Mahogany				•	•		
	<i>Eucalyptus baileyana</i>	Bailey's Stringybark				•		•	
	<i>Eucalyptus bancroftii</i>	Orange Gum				•	•		
	<i>Eucalyptus campanulata?</i>	Gum-topped Peppermint				•			
	<i>Eucalyptus capitellata</i>	Brown Stringybark						•	
	<i>Eucalyptus carnea</i>	Thick-leaved Mahogany					•		•
	<i>Eucalyptus crebra</i>	Narrow-leaf Ironbark				•			
	<i>Eucalyptus eugenioides</i>	Thin-leaved Stringybark				•		•	
	<i>Eucalyptus fibrosa</i>	Broad-leaf Ironbark				•	•	•	
	<i>Eucalyptus globoidea</i>	White Stringybark				•			
	<i>Eucalyptus grandis</i>	Flooded Gum	n			•	•	•	
	<i>Eucalyptus microcorys</i>	Tallowwood				•	•	•	
	<i>Eucalyptus moluccana</i>	Grey Box					•		
	<i>Eucalyptus pilularis</i>	Blackbutt				•	•	•	•
	<i>Eucalyptus planchoniana</i>	Bastard Tallowwood				•	•	•	
	<i>Eucalyptus propinqua</i>	Small-fruited Grey Gum				•	•	•	
	<i>Eucalyptus psammitica</i>	Bastard White Mahogany					•		
	<i>Eucalyptus resinifera</i>	Red Mahogany				•			
	<i>Eucalyptus resinifera subsp. hemilampra</i>	Red Mahogany					•	•	
	<i>Eucalyptus robusta</i>	Swamp Mahogany				•	•	•	•
	<i>Eucalyptus robusta x tereticornis</i>						•		
	<i>Eucalyptus saligna</i>	Sydney Blue Gum							•
	<i>Eucalyptus seeana</i>	Narrow-leaved Red Gum				•	•	•	•
	<i>Eucalyptus siderophloia</i>	Northern Grey Ironbark				•	•	•	•
	<i>Eucalyptus signata</i>	Northern Scribbly Gum				•	•	•	•
	<i>Eucalyptus tereticornis</i>	Forest Red Gum				•	•	•	•
	<i>Eucalyptus tetrapleura</i>	Square-fruited Ironbark		v	v	•	•		
	<i>Eucalyptus tindaliae</i>	Tindale's Stringybark				•	•	•	•
	<i>Eucalyptus umbra</i>	Bastard White Mahogany							•
	<i>Harmogia densifolia</i>						•		
	<i>Homoranthus virgatus</i>								•
	<i>Kunzea ambigua</i>	Tick Bush				•			
	<i>Kunzea capitata</i>	Pink Kunzea				•			
	<i>Leptospermum brachyandrum</i>						•	•	
	<i>Leptospermum juniperinum</i>	Prickly Teatree				•	•	•	•

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections			
						1-2	3-5	6-8	9-11
	<i>Leptospermum liversidgei</i>	Lemon-scented Tea-tree						•	•
	<i>Leptospermum microcarpum</i>						•		
	<i>Leptospermum petersonii</i>	Lemon-scented Tea-tree	n			•			
	<i>Leptospermum polygalifolium</i>	Tantoon				•	•		
	<i>Leptospermum polygalifolium subsp. polygalifolium</i>							•	
	<i>Leptospermum polygalifolium subsp. cismontanum</i>	Yellow Tea-tree						•	
	<i>Leptospermum semibaccatum</i>								•
	<i>Leptospermum speciosum</i>							•	•
	<i>Leptospermum trinervium</i>	Flaky-bark Tea-tree				•	•	•	•
	<i>Leptospermum variabile</i>								•
	<i>Lophostemon confertus</i>	Brush Box				•	•	•	•
	<i>Lophostemon suaveolens</i>	Swamp Turpentine				•	•	•	•
	<i>Melaleuca alternifolia</i>	Oil Tea-tree					•	•	•
	<i>Melaleuca armillaris subsp. armillaris</i>	Coast Paperbark				•			
	<i>Melaleuca decora</i>	White Feather Honey-myrtle				•	•		
	<i>Melaleuca irbyana</i>	Weeping Paperbark		e			•	•	
	<i>Melaleuca linariifolia</i>	Snow-in-Summer				•	•		
	<i>Melaleuca nodosa</i>	Ball Honey-myrtle				•	•	•	•
	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	n			•	•	•	•
	<i>Melaleuca sieberi</i>	Sieber's Paperbark				•	•	•	
	<i>Melaleuca squamea</i>	Swamp Honey-myrtle							•
	<i>Melaleuca styphelioides</i>	Prickly Paperbark				•	•	•	•
	<i>Melaleuca thymifolia</i>	Thyme Paperbark				•	•	•	
	<i>Ochrosperma citriodorum</i>								•
	<i>Ochrosperma lineare</i>	Cross-leaf Heath-myrtle						•	•
	<i>Rhodamnia rubescens</i>	Brush Turpentine					•	•	
	<i>Rhodomyrtus psidioides</i>	Native Guava						•	
	<i>Sannantha angusta</i>							•	
	<i>Sannantha similis</i>						•	•	
	<i>Syncarpia glomulifera</i>	Turpentine				•	•	•	•
	<i>Syzygium australe</i>	Brush Cherry					•		•
	<i>Syzygium francisii</i>	Giant Water Gum							•
	<i>Syzygium oleosum</i>	Blue Lilly Pilly					•		
	<i>Tristaniaopsis laurina</i>	Water Gum				•	•		

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections			
						1-2	3-5	6-8	9-11
	<i>Waterhousea floribunda</i>	Weeping Lilly Pilly				•	•		
	ONAGRACEAE								
	<i>Ludwigia octovalvis</i>	Willow Primrose						•	
	<i>Ludwigia peploides</i>							•	•
	<i>Ludwigia peploides</i> subsp. <i>montevidensis</i>	Water Primrose					•		
	CELASTRACEAE								
	<i>Cassine australis</i> var. <i>australis</i>	Red-fruited Olive Plum					•		
	<i>Celastrus australis</i>	Staff Vine							•
	<i>Maytenus bilocularis</i>	Orangebark					•	•	
	<i>Maytenus disperma</i>	Orangebush					•		
	<i>Maytenus silvestris</i>	Forest Maytenus						•	
	STACKHOUSIACEAE								
	<i>Stackhousia muricata</i>						•		
	<i>Stackhousia viminea</i>	Slender Stackhousia				•		•	
	CLUSIACEAE								
	<i>Hypericum gramineum</i>	Narrow-leaf St. Johns Wort				•	•	•	
	<i>Hypericum japonicum</i>	Matted St. Johns Wort					•	•	
	FLACOURTIACEAE								
	<i>Scolopia braunii</i>	Flintwood					•		
	OCHNACEAE								
	<i>Ochna serrulata</i>	Ochna	i			•	•	•	•
	PASSIFLORACEAE								
	<i>Passiflora aurantia</i> var. <i>aurantia</i>	Blunt-leaved Passion-flower						•	•
	<i>Passiflora edulis</i>	Passion-fruit	i			•	•	•	•
	<i>Passiflora herbertiana</i>	Yellow Passion-flower				•			•
	<i>Passiflora suberosa</i>	Cork Passion-flower	i					•	•
	<i>Passiflora subpeltata</i>	White Passion-flower						•	•
	PHYTOLACCACEAE						•		
	<i>Phytolacca octandra</i>	Inkweed	i					•	•
	PUTRANJIVACEAE								
	<i>Drypetes deplanchei</i>	Yellow Tulipwood				•			
	VIOLACEAE								
	<i>Hybanthus enneaspermus</i> subsp. <i>stellarioides</i>	Yellow Spade Flower					•		
	<i>Hybanthus monopetalus</i>	Slender Violet-bush				•	•	•	
	<i>Hybanthus stellarioides</i>							•	
	<i>Hybanthus vernonii</i> subsp. <i>scaber</i>						•		
	<i>Melicytus dentatus</i>	Tree Violet					•		
	<i>Viola</i> sp.							•	
	<i>Viola</i> sp. aff <i>banksii</i>							•	

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections			
						1-2	3-5	6-8	9-11
	<i>Viola banksii</i>	Wild Violet							•
	<i>Viola betonicifolia</i>	Showy Violet				•	•	•	
	<i>Viola hederacea</i>	Ivy-leaf Violet				•	•	•	•
	CUNONIACEAE								
	<i>Bauera microphylla</i>								•
	<i>Callicoma serratifolia</i>	Black Wattle					•		•
	<i>Ceratopetalum gummiferum</i>	Christmas Bush				•	•	•	
	<i>Schizomeria ovata</i>	Crab-apple					•	•	
	ELAEOCARPACEAE								
	<i>Elaeocarpus obovatus</i>	Hard Quandong					•	•	•
	<i>Elaeocarpus reticulatus</i>	Blueberry Ash				•	•	•	•
	<i>Tetradlea thymifolia</i>	Thyme-leaf Black-eyed Susan				•	•		
	OXALIDACEAE								
	<i>Oxalis chnoodes</i>							•	•
	<i>Oxalis corniculata</i>	Creeping Oxalis	i			•			
	<i>Oxalis exilis</i>	Yellow Oxalis					•		
	<i>Oxalis latifolia</i>	Pink Oxalis	i						
	<i>Oxalis perennans</i>					•	•		•
	FABACEAE								
	<i>Caesalpinia subtropica</i>							•	•
	<i>Cassia brewsteri</i>	Native Laburnum							•
	<i>Chamaecrista nomame</i> var. <i>nomame</i>						•		
	<i>Chamaecrista rotundifolia</i>		i					•	
	<i>Senna barclayana</i>	Smooth Senna							•
	<i>Senna floribunda</i>		i					•	
	<i>Senna septemtrionalis</i>	Cassia	i				•		
	<i>Senna pendula</i>		i			•			•
	<i>Senna pendula</i> var. <i>glabrata</i>	Cassia	i					•	
	<i>Aotus lanigera</i>						•	•	•
	<i>Aotus subglauca</i> var. <i>filiformis</i>							•	•
	<i>Austrosteenisia glabristyla</i>	Giant Blood Vine							•
	<i>Bossiaea heterophylla</i>	Variable Bossiaea				•	•	•	•
	<i>Bossiaea prostrata</i>						•		
	<i>Bossiaea rhombifolia</i> subsp. <i>rhombifolia</i>					•			
	<i>Callerya megasperma</i>	Native Wisteria							•
	<i>Chorizema parviflorum</i>	Eastern Flame Pea				•		•	
	<i>Crotalaria incana</i>		i					•	
	<i>Crotalaria lanceolata</i> subsp. <i>lanceolata</i>		i			•	•	•	
	<i>Crotalaria medicaginea</i> ?						•		

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections			
						1-2	3-5	6-8	9-11
	<i>Crotalaria montana</i> var. <i>angustifolia</i>					•			
	<i>Daviesia acicularis</i>								•
	<i>Daviesia genistifolia</i>	Broom Bitter Pea				•			
	<i>Daviesia ulicifolia</i>	Gorse Bitter-pea					•	•	
	<i>Daviesia ulicifolia</i> subsp. <i>ulicifolia</i>	Bitter Pea				•			
	<i>Daviesia umbellulata</i>	Bitter Pea				•	•	•	
	<i>Daviesia villifera</i>							•	
	<i>Derris involuta</i>							•	
	<i>Desmodium acanthocladum</i>	Thorny Pea		v				•	
	<i>Desmodium brachypodum</i>	Large Tick-trefoil					•		
	<i>Desmodium gunnii</i>	Slender Tick Trefoil						•	•
	<i>Desmodium nemorosum</i>						•	•	
	<i>Desmodium rhytidophyllum</i>	Rusty Tick-trefoil				•	•	•	•
	<i>Desmodium varians</i>	Slender Tick-trefoil				•	•	•	
	<i>Dillwynia retorta</i>	Prickly Parrot-pea				•	•		•
	<i>Dillwynia sieberi</i>	Prickly Parrot-pea				•			
	<i>Erythrina crista-galli</i>	Cockspur Coral Tree	i					•	
	<i>Erythrina x sykesii</i>	Coral Tree	i				•		
	<i>Galactia tenuiflora</i>								•
	<i>Glycine clandestina</i>	Love Creeper				•		•	•
	<i>Glycine clandestina</i> agg.	Twining Glycine					•		
	<i>Glycine microphylla</i>	Small-leaf Glycine				•			
	<i>Glycine tabacina</i>							•	•
	<i>Glycine tabacina</i> agg.						•		
	<i>Glycine tabacina</i> s. lat.					•			
	<i>Glycine tomentella</i>	Wooly Glycine					•	•	
	<i>Gompholobium glabratum</i>	Dainty Wedge-pea				•			
	<i>Gompholobium latifolium</i>	Broad-leaf Wedge-pea					•		
	<i>Gompholobium pinnatum</i>	Pinnate Wedge-pea				•	•	•	
	<i>Gompholobium virgatum</i>	Leafy Wedge Pea							•
	<i>Hardenbergia violacea</i>	Purple Twining-pea				•	•	•	•
	<i>Hovea acutifolia</i>						•	•	
	<i>Hovea heterophylla</i>							•	
	<i>Hovea lanceolata</i>	Lance-leaf Hovea							•
	<i>Hovea longifolia</i>	Long-leaf Hovea					•		•
	<i>Indigofera australis</i>	Native Indigo					•	•	•
	<i>Jacksonia scoparia</i>	Dogwood				•	•	•	
	<i>Kennedia rubicunda</i>	Dusky Coral Pea				•	•	•	•
	<i>Macroptilium atropurpureum</i>	Siratro	i			•	•	•	
	<i>Medicago polymorpha</i>	Burr Medic	i			•		•	

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections			
						1-2	3-5	6-8	9-11
	<i>Mirbelia rubiifolia</i>	Mirbelia					•	•	•
	<i>Mirbelia speciosa</i>								•
	<i>Oxylobium robustum</i>	Tree Shaggy-pea					•	•	•
	<i>Phyllota phylloides</i>	Common Phyllota				•			•
	<i>Platylobium formosum subsp. formosum</i>	Handsome Flat-pea						•	
	<i>Podolobium aciculiferum</i>	Spiny Shaggy-pea					•		
	<i>Podolobium scandens</i>	Netted Shaggy-pea					•	•	
	<i>Pultenaea alea</i>						•		
	<i>Pultenaea euchila</i>	Pale Bush-pea				•	•	•	
	<i>Pultenaea ferruginea?</i>	Bush Pea				•	•		
	<i>Pultenaea flexilis</i>	Graceful Bush Pea				•			
	<i>Pultenaea myrtoides</i>					•		•	
	<i>Pultenaea paleacea</i>	Narrow-leaf Bush-pea					•		
	<i>Pultenaea petiolaris</i>					•		•	
	<i>Pultenaea retusa</i>	Blunt-leaf Bush-pea				•	•	•	•
	<i>Pultenaea robusta</i>					•		•	
	<i>Pultenaea spinosa</i>	Whorled Bush-pea					•	•	
	<i>Pultenaea villosa</i>	Wallaby Tails				•	•	•	•
	<i>Swainsona galegifolia</i>	Smooth Darling-pea					•	•	
	<i>Tephrosia brachyodon</i>							•	
	<i>Trifolium repens</i>	White Clover	i			•			
	<i>Vicia sativa subsp. nigra</i>	Narrow-leaved Vetch	i					•	
	<i>Viminaria juncea</i>	Native Broom				•			
	<i>Acacia aulacocarpa</i>	Salwood					•		
	<i>Acacia baeuerlenii</i>	Wattle						•	
	<i>Acacia binervata</i>	Two-veined Hickory				•			
	<i>Acacia brownii</i>	Yellow Prickly Moses				•	•		
	<i>Acacia complanata</i>					•		•	
	<i>Acacia concurrens</i>	Curracabah					•	•	
	<i>Acacia disparrima subsp. disparrima</i>	Southern Salwood					•	•	
	<i>Acacia elongata</i>					•			•
	<i>Acacia elongata var. elongata</i>	Swamp Wattle					•		
	<i>Acacia falcata</i>	Sickle Wattle				•	•	•	
	<i>Acacia falciformis</i>	Broad-leaf Hickory							•
	<i>Acacia fimbriata</i>	Fringed Wattle				•	•	•	
	<i>Acacia floribunda</i>	Sally Wattle				•	•	•	
	<i>Acacia granitica</i>						•		
	<i>Acacia hispidula</i>					•			
	<i>Acacia implexa</i>	Hickory					•		

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						1-2	3-5	6-8	9-11	
	<i>Acacia irrorata</i> subsp. <i>irrorata</i>	Rough Green Wattle				•	•	•		
	<i>Acacia irrorata</i> subsp. <i>velutinella</i>					•				
	<i>Acacia leiocalyx</i>							•	•	
	<i>Acacia longifolia</i> subsp. <i>longifolia</i>	Sydney Golden Wattle				•			•	
	<i>Acacia longifolia</i> subsp. <i>sophorae</i>					•				
	<i>Acacia longissima</i>	Thin-leaf Wattle				•			•	
	<i>Acacia maidenii</i>	Maiden's Wattle						•	•	
	<i>Acacia melanoxylon</i>					•		•	•	
	<i>Acacia myrtifolia</i>	Myrtle Wattle				•		•		
	<i>Acacia obtusifolia</i>								•	
	<i>Acacia orites</i>	Mountain Wattle							•	
	<i>Acacia oshanesii</i>					•				
	<i>Acacia podalyriifolia</i>	Queensland Silver Wattle	i			•				
	<i>Acacia quadrilateralis</i>	Four-angled Wattle				•				
	<i>Acacia sophorae</i>	Beach Wattle							•	
	<i>Acacia suaveolens</i>	Sweet Wattle				•	•	•	•	
	<i>Acacia terminalis</i>	Sunshine Wattle						•		
	<i>Acacia terminalis</i> subsp. <i>longiaxialis</i>					•				
	<i>Acacia ulicifolia</i>	Prickly Moses				•	•	•	•	
	<i>Acacia venulosa</i>	Umbrella Wattle/Miljee				•				
	<i>Archidendron hendersonii</i>	White Lace Flower		v					•	
	<i>Pararchidendron pruinatum</i>	Snow-wood					•			
	POLYGALACEAE									
	<i>Comesperma defoliatum</i>								•	
	<i>Comesperma ericinum</i>	Heath Comesperma				•	•	•		
	<i>Comesperma retusum</i>	Swamp Comesperma				•				
	<i>Comesperma sylvestre</i>	Broom Milkwort				•				
	<i>Polygala japonica</i>	Dwarf Milkwort						•		
	<i>Polygala paniculata</i>		i					•		
	CASUARINACEAE									
	<i>Allocasuarina distyla</i>	Scrub She-oak					•			
	<i>Allocasuarina littoralis</i>	Black She-oak				•	•	•	•	
	<i>Allocasuarina torulosa</i>	Forest Oak				•	•	•	•	
	<i>Casuarina glauca</i>	Swamp Oak				•	•	•	•	
	AMYGDALACEAE									
	<i>Prunus</i> spp.						•			
	MALACEAE									
	<i>Cotoneaster glaucophyllus</i>	Cotoneaster	i				•			

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						1-2	3-5	6-8	9-11
	MORACEAE								
	<i>Ficus coronata</i>	Creek Sandpaper Fig				•	•	•	•
	<i>Ficus fraseri</i>	Frasers Sandpaper Fig					•	•	
	<i>Ficus macrophylla</i>	Moreton Bay Fig					•	•	•
	<i>Ficus obliqua</i>	Small-leaved Fig					•		
	<i>Ficus rubiginosa</i>	Port Jackson Fig					•		•
	<i>Ficus virens</i>	White Fig							•
	<i>Ficus watkinsiana</i>	Strangling Fig				•	•	•	•
	<i>Maclura cochinchinensis</i>	Cockspur Thorn					•	•	•
	<i>Morus alba</i>	White Mulberry	i			•			
	<i>Streblus brunonianus</i>	Whalebone Tree						•	•
	<i>Trophis scandens subsp. scandens</i>	Burny Vine					•		•
	RHAMNACEAE								
	<i>Alphitonia excelsa</i>	Red Ash				•	•	•	•
	<i>Pomaderris argyrophylla subsp. argyrophylla?</i>	Silvery Pomaderris				•			
	<i>Pomaderris intermedia</i>					•			
	ROSACEAE								
	<i>Rubus sp.</i>					•			
	<i>Rubus fruticosus agg.</i>	Blackberry	i				•		
	<i>Rubus hillii</i>	Broad-leaf Bramble					•	•	
	<i>Rubus moluccanus</i>	Molucca Bramble							•
	<i>Rubus parviflorus</i>	Small-leaf Bramble				•			•
	<i>Rubus rosifolius</i>	Rose-leaf Bramble					•	•	
	ULMACEAE								
	<i>Aphananthe philippinensis</i>	Native Elm					•		
	<i>Trema tomentosa var. aspera</i>	Poison Peach							•
	<i>Trema tomentosa</i>	Native Peach				•	•	•	
	URTICACEAE								
	<i>Dendrocnide excelsa</i>	Giant Stinging Tree					•		
	CORYNOCARPACEAE								
	<i>Corynocarpus rupestris</i>			v					•
	CUCURBITACEAE								
	<i>Zehneria cunninghamii</i>	Slender Cucumber							•
	CAPRIFOLIACEAE								
	<i>Lonicera japonica</i>	Honeysuckle	i			•			
	BRASSICACEAE								
	<i>Lepidium africanus</i>	Peppercress	i				•		
	<i>Lepidium pseudohyssopifolium</i>	Peppercress					•		
	<i>Rorippa nasturtium-aquaticum</i>	Watercress	i					•	
	EUPHORBIACEAE								

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections				
						1-2	3-5	6-8	9-11	
	<i>Alchornea ilicifolia</i>	Dovewood							•	
	<i>Baloghia inophylla</i>	Brush Bloodwood					•			
	<i>Breynia cernua</i>								•	
	<i>Breynia oblongifolia</i>	Breynia				•	•	•		
	<i>Bridelia exaltata</i>	Brush Ironbark							•	
	<i>Chamaesyce hyssopifolia</i>	Caustic Weed	i			•				
	<i>Chamaesyce prostrata</i>	Red Caustic Weed						•		
	<i>Croton verreauxii</i>	Green Native Cascarilla						•		
	<i>Excoecaria agallocha</i>	Milky Mangrove							•	
	<i>Glochidion ferdinandi</i>	Cheese Tree					•	•		
	<i>Glochidion ferdinandi var. ferdinandi</i>	Cheese Tree				•				
	<i>Glochidion sumatranum</i>	Umbrella Cheese Tree						•	•	
	<i>Mallotus discolor</i>	White Kamala							•	
	<i>Mallotus philippensis</i>	Red Kamala					•		•	
	<i>Homalanthus populifolius</i>	Bleeding Heart					•		•	
	<i>Petalostigma pubescens</i>	Bitter Bark					•	•		
	<i>Petalostigma triloculare</i>	Long-leaved Bitter Bark					•	•		
	<i>Phyllanthus gunnii</i>	Blunt Spurge					•			
	<i>Phyllanthus hirtellus</i>	Thyme Spurge				•	•	•		
	<i>Phyllanthus tenellus</i>	Hen and Chicken					•			
	<i>Phyllanthus virgatus</i>	Small-leaf Spurge				•		•		
	<i>Poranthera ericifolia</i>	Heath-leaf Poranthera				•				
	<i>Poranthera microphylla</i>	Small Poranthera					•	•	•	
	<i>Pseudanthus orientalis</i>								•	
	<i>Ricinocarpos pinifolius</i>	Wedding Bush				•	•		•	
	<i>Ricinus communis</i>	Castor Oil Plant	i					•		
	<i>Sauropus hirtellus</i>						•			
	MALVACEAE									
	<i>Abutilon oxycarpum</i>	Straggly Lantern-bush					•			
	<i>Abutilon leucopetalum</i>	Lantern Bush	i			•				
	<i>Hibiscus splendens</i>	Pink Hibiscus						•		
	<i>Hibiscus tiliaceus</i>	Cottonwood Hibiscus					•		•	
	<i>Hibiscus trionum</i>	Flower of a Hour							•	
	<i>Sida cordifolia</i>							•		
	<i>Sida cunninghamii</i>	Ridged Sida							•	
	<i>Sida rhombifolia</i>	Paddys Lucerne	i			•	•	•	•	
	STERCULIACEAE									
	<i>Brachychiton populneus</i>	Kurrajong					•			
	<i>Commersonia bartramia</i>	Brown Kurrajong						•	•	

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections			
						1-2	3-5	6-8	9-11
	<i>Lasiopetalum ferrugineum</i> var. <i>ferrugineum</i>	Rusty-petals				•			
	<i>Rulingia dasyphylla</i>	Kerrawang						•	
	THYMELEACEAE								
	<i>Pimelea latifolia</i> subsp. <i>altior</i>					•	•		
	<i>Pimelea linifolia</i>	Slender Rice Flower						•	•
	<i>Pimelea linifolia</i> subsp. <i>collina</i>	Swamp Rice Flower					•		
	<i>Pimelea linifolia</i> subsp. <i>linifolia</i>	Slender Rice Flower				•			
	<i>Wikstroemia indica</i>	Wikstroemia				•		•	
	MELIACEAE								
	<i>Dysoxylum fraserianum</i>	Rosewood							•
	<i>Dysoxylum mollissimum</i>	Red Bean						•	
	<i>Melia azedarach</i>	White Cedar							•
	<i>Synoum glandulosum</i> subsp. <i>glandulosum</i>	Scentless Rosewood				•			•
	<i>Toona ciliata</i>	Red Cedar					•		
	RUTACEAE								
	<i>Acronychia oblongifolia</i>	Common Acronychia				•	•	•	•
	<i>Acronychia imperforata</i>	Logan Apple							•
	<i>Acronychia littoralis</i>	Scented Acronychia		e	e				•
	<i>Acronychia wilcoxiana</i>	Silver Aspen							•
	<i>Boronia falcifolia</i>	Wallum Boronia						•	
	<i>Boronia microphylla</i>	Small-leaf Boronia							•
	<i>Boronia parviflora</i>	Swamp Boronia					•		
	<i>Boronia pinnata</i>	Pinnate Boronia							•
	<i>Boronia polygalifolia</i>	Waxy Boronia						•	
	<i>Boronia rosmarinifolia</i>					•			
	<i>Boronia safrolifera</i>							•	
	<i>Citrus australasica</i>	Finger Lime							•
	<i>Citrus limonia</i>	Lemon	i					•	
	<i>Citrus x taitensis</i>	Rough Lemon	i					•	
	<i>Flindersia bennettiana</i>	Bennett's Ash							•
	<i>Flindersia schottiana</i>	Cudgerie					•		•
	<i>Flindersia xanthoxyla</i>	Yellowwood							•
	<i>Melicope elleryana</i>	Pink-flowered Doughwood							•
	<i>Melicope micrococca</i>	White Euodia					•		
	<i>Nematolepis squamea</i> subsp. <i>squamea</i>	Satinwood						•	•
	<i>Zieria arborescens</i>	Stinkwood					•		
	<i>Zieria laxiflora</i>	Wallum Zieria							•
	<i>Zieria minutiflora</i>	Twiggy Zieria				•		•	
	<i>Zieria pilosa</i>	Hairy Zieria					•		

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections			
						1-2	3-5	6-8	9-11
	<i>Zieria smithii</i>	Sandfly Zieria					•	•	•
	SAPINDACEAE								
	<i>Alectryon subcinereus</i>	Native Quince					•		
	<i>Alectryon subdentatus</i>								•
	<i>Alectryon tomentosus</i>	Hairy Bird's Eye					•	•	
	<i>Arytera divaricata</i>	Coogera					•		•
	<i>Cardiospermum grandiflorum</i>	Balloon Vine	i				•		•
	<i>Castanopora alphandii</i>	Brown Tamarind							•
	<i>Cupaniopsis anacardioides</i>	Tuckeroo					•	•	•
	<i>Cupaniopsis flagelliformis</i>	Brown Tuckeroo							•
	<i>Cupaniopsis parvifolia</i>	Small-leaved Tuckeroo						•	
	<i>Diploglottis cunninghamii</i>	Native Tamarind					•		•
	<i>Dodonaea multijuga</i>						•		
	<i>Dodonaea triquetra</i>	Hop Bush				•	•	•	•
	<i>Guioa semiglauca</i>	Guioa					•	•	•
	<i>Harpullia hillii</i>	Blunt-leaved Tulip					•		
	<i>Jagera pseudorhus</i>	Foambark Tree					•	•	•
	<i>Sarcopteryx stipata</i>	Steelwood							•
	<i>Toechima dasyrrhache</i>	Blunt-leaved Steelwood							•
	SIMAROUBACEAE								
	<i>Ailanthus triphysa</i>	White Bean					•		
	<i>Quassia</i> sp. 'Moonee Creek'	Moonee Creek Quassia		e	e		•		
	EBENACEAE								
	<i>Diospyros fasciculosa</i>	Grey Ebony							•
	ERICACEAE								
	<i>Acrotriche aggregata</i>	Red Cluster Heath							•
	<i>Brachyloma daphnoides</i>	Daphne Heath				•			•
	<i>Epacris microphylla</i>	Small-leaf Heath							•
	<i>Epacris obtusifolia</i>	Swamp Heath					•	•	•
	<i>Epacris pulchella</i>	Coral Heath				•	•	•	
	<i>Leucopogon fraseri</i>								•
	<i>Leucopogon juniperinus</i>	Juniper Beard-heath				•	•	•	
	<i>Leucopogon lanceolatus</i>							•	•
	<i>Leucopogon lanceolatus</i> var. <i>gracilis</i>	Lance Beard Heath				•	•	•	
	<i>Leucopogon lanceolatus</i> var. <i>lanceolatus</i>	Lance Beard Heath				•	•		
	<i>Leucopogon leptospermoides</i>						•		
	<i>Leucopogon margarodes</i>							•	•
	<i>Leucopogon parvifolius</i>	Coastal Beard-heath				•			
	<i>Leucopogon rodwayi</i>								•

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections			
						1-2	3-5	6-8	9-11
	<i>Leucopogon sp. aff. setiger</i>							•	
	<i>Leucopogon virgatus</i>	Common Beard-heath							•
	<i>Melichrus procumbens</i>	Jam Tarts				•	•		
	<i>Monotoca elliptica</i>	Tree Broom-heath						•	•
	<i>Monotoca scoparia</i>	Prickly Broom-heath				•	•	•	•
	<i>Sprengelia sprengelioides</i>							•	•
	<i>Styphelia triflora</i>	Five-corners				•			
	<i>Styphelia viridis</i>	Green Five-corners							•
	<i>Trochocarpa laurina</i>	Tree Heath				•	•	•	•
	<i>Woolisia pungens</i>	Woolisia							•
	MYRSINACEAE								
	<i>Aegiceras corniculatum</i>	River Mangrove					•		•
	<i>Anagallis arvensis</i>	Pimpernel	i			•	•		
	<i>Embelia australiana</i>	Embelia						•	
	<i>Myrsine howittiana</i>	Brush Muttonwood					•	•	•
	<i>Myrsine variabilis</i>	Muttonwood				•			
	SAPOTACEAE								
	<i>Planchonella australis</i>	Black Apple					•		
	APOCYNACEAE								
	<i>Alstonia constricta</i>	Bitter Bark							•
	<i>Asclepias curassavica</i>	Blood Flower	i			•		•	
	<i>Cynanchum carnosum</i>								•
	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton Bush	i			•	•	•	
	<i>Gomphocarpus physocarpus</i>	Balloon Cotton Bush	i					•	•
	<i>Hoya australis</i>	Native Hoya							•
	<i>Marsdenia fraseri</i>	Narrow-leaved Milk Vine							•
	<i>Marsdenia longiloba</i>			e	v				•
	<i>Marsdenia rostrata</i>	Common Milk Vine					•	•	•
	<i>Melodinus australis</i>	Southern Melodinus					•		
	<i>Parsonsia longipetiolata</i>	Green-leaved Silkpod							•
	<i>Parsonsia rotata</i>	Veinless Silkpod							•
	<i>Parsonsia straminea</i>	Common Silkpod				•	•	•	•
	<i>Tabernaemontana pandacaqui</i>	Banana Bush				•	•		
	<i>Tylophora paniculata</i>	Paniculate Tylophora					•	•	•
	<i>Vinca major</i>	Greater Periwinkle	i			•			
	GENTIANACEAE								
	<i>Centaurium spicatum</i>							•	
	<i>Schenkia spicata</i>	Spiked Centaury					•		
	LOGANIACEAE								

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections				
						1-2	3-5	6-8	9-11	
	<i>Logania albiflora</i>	Logania					•			
	<i>Logania pusilla</i>							•		
	<i>Mitrasacme alsinoides</i>						•	•		
	<i>Mitrasacme paludosa</i>							•		
	<i>Mitrasacme polymorpha</i>	Mitre Weed				•	•			
	RUBIACEAE									
	<i>Caelospermum paniculatum</i>							•		
	<i>Cyclophyllum coprosmoides</i>	Canthium						•		
	<i>Cyclophyllum longipetalum</i>	Coast Canthium					•			
	<i>Hodgkinsonia ovatiflora</i>						•			
	<i>Ixora beckleri</i>	Native Ixora							•	
	<i>Morinda jasminoides</i>	Morinda				•	•	•	•	
	<i>Opercularia aspera</i>	Common Stinkweed						•		
	<i>Opercularia diphylla</i>	Stinkweed					•	•		
	<i>Opercularia hispida</i>	Hairy Stinkweed				•				
	<i>Pomax umbellata</i>	Pomax				•	•	•	•	
	<i>Psychotria loniceroides</i>	Hairy Psychotria					•	•		
	<i>Richardia brasiliensis</i>	Mexican Clover	i				•	•		
	<i>Richardia stellaris</i>		i				•			
	ACANTHACEAE									
	<i>Avicennia marina</i>	Grey Mangrove					•		•	
	<i>Brunoniella australis</i>	Blue Trumpet				•	•	•	•	
	<i>Hygrophila angustifolia</i>							•		
	<i>Isoglossa eranthemoides</i>			e					•	
	<i>Pseuderanthemum variable</i>	Pastel Flower				•	•	•	•	
	<i>Rostellularia adscendens</i>								•	
	<i>Thunbergia alata</i>	Black-eyed Susan Vine	i			•				
	BIGNONIACEAE									
	<i>Jacaranda mimosifolia</i>	Jacaranda	i			•	•			
	<i>Pandorea pandorana</i>	Wonga Vine				•	•	•	•	
	LAMIACEAE									
	<i>Ajuga australis</i>	Austral Bugle					•	•	•	
	<i>Chloanthes stoechadis</i>	Common Chloanthes					•			
	<i>Clerodendrum floribundum</i>								•	
	<i>Clerodendrum tomentosum</i>	Hairy Clerodendrum				•	•			
	<i>Lamium amplexicaule</i>	Henbit	i					•		
	<i>Lycopus australis</i>	Australian Gipsywort					•			
	<i>Mentha satuireioides</i>	Creeping Mint					•			
	<i>Plectranthus parviflorus</i>	Cockspur Flower				•	•	•	•	
	<i>Plectranthus suaveolens</i>								•	
	<i>Prostanthera caerulea</i>	Lilac Mint Bush				•				
	<i>Prostanthera cineolifera</i>			v	v			•		

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections			
						1-2	3-5	6-8	9-11
	<i>Prostanthera palustris</i>			v				•	
	LENTIBULARIACEAE								
	<i>Utricularia caerulea</i>	Blue Bladderwort						•	
	<i>Utricularis gibba</i>	Floating Bladderwort						•	•
	<i>Utricularia lateriflora</i>	Small Bladderwort				•			
	<i>Utricularia uniflora</i>						•		•
	MYOPORACEAE								
	<i>Eremophila debilis</i>	Winter Apple					•		
	<i>Myoporum betcheanum</i>								•
	<i>Myoporum montanum</i>	Western Boobialla							•
	OLEACEAE								
	<i>Jasminum suavissimum</i>						•		
	<i>Ligustrum lucidum</i>	Large-leaf Privet	i					•	•
	<i>Ligustrum sinense</i>	Small-leaf Privet	i				•	•	•
	<i>Notelaea longifolia</i>	Large Mock Olive					•	•	•
	<i>Notelaea longifolia f. longifolia</i>	Large Mock Olive				•			
	<i>Notelaea microcarpa var. microcarpa</i>	Velvet Mock-olive					•		
	<i>Notelaea ovata</i>	Broad-leaf Mock Olive				•	•	•	
	<i>Notelaea venosa</i>	Smooth Mock Olive				•			•
	PLANTAGINACEAE								
	<i>Plantago debilis</i>	Slender Plantain						•	
	<i>Plantago lanceolata</i>	Plantain	i			•	•	•	
	<i>Plantago varia</i>	Variable Plantain					•		
	SCROPHULARIACEAE								
	<i>Artanema fimbriatum</i>							•	
	<i>Gratiola pedunculata</i>						•	•	
	<i>Mimulus moschatus</i>	Musk Money Flower	i					•	
	<i>Mimulus repens</i>	Creeping Monkey-flower					•		
	<i>Veronica calycina</i>	Common Speedwell					•		•
	<i>Veronica plebeia</i>	Trailing Speedwell				•	•	•	
	VERBENACEAE								
	<i>Lantana camara</i>	Lantana	i			•	•	•	•
	<i>Verbena bonariensis</i>	Purple Top	i			•	•	•	
	<i>Verbena litoralis</i>	Long-spike Verbena	i				•		
	<i>Verbena officinalis</i>	Common Verbena	i						•
	<i>Verbena rigidus</i>	Creeping Verbena	i			•	•		
	CONVOLVULACEAE								
	<i>Calystegia marginata</i>	Forest Bindweed						•	
	<i>Convolvulus erubescens</i>	Pink Bindweed					•		
	<i>Cuscuta australis</i>	Australian Dodder							•
	<i>Dichondra repens</i>	Kidney Weed				•	•	•	•

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections				
						1-2	3-5	6-8	9-11	
	<i>Ipomoea cairica</i>	Coastal Morning Glory	i					•	•	
	<i>Ipomoea indica</i>	Blue Morning Glory	i					•		
	<i>Ipomoea purpurea</i>	Purple Morning Glory	i				•			
	<i>Polymeria calycina</i>	Woodland Bindweed				•	•	•		
	SOLANACEAE									
	<i>Duboisia myoporoides</i>	Poison Corkwood				•	•	•		
	<i>Physalis peruviana</i>	Cape Gooseberry	i				•	•		
	<i>Solanum americanum</i>	Glossy Nightshade	i					•		
	<i>Solanum capsicoides</i>		i					•		
	<i>Solanum cinereum</i>	Narrawa Burr							•	
	<i>Solanum densevestitum</i>							•	•	
	<i>Solanum inaequilaterum</i>						•		•	
	<i>Solanum laxum</i>	Potato Weed	i				•			
	<i>Solanum mauritianum</i>	Wild Tobacco	i			•	•	•	•	
	<i>Solanum nigrum</i>	Black Nightshade	i			•	•	•	•	
	<i>Solanum prinophyllum</i>	Forest Nightshade						•		
	<i>Solanum pseudocapsicum</i>	Jerusalem Cherry	i			•		•		
	<i>Solanum seforthianum</i>	Climbing Nightshade	i					•	•	
	APIACEAE									
	<i>Actinotus helianthi</i>	Flannel Flower							•	
	<i>Centella asiatica</i>	Swamp Pennywort				•	•	•	•	
	<i>Cyclospermum leptophyllum</i>	Slender Celery				•				
	<i>Eryngium expansum</i>							•		
	<i>Hydrocotyle acutiloba</i>							•		
	<i>Hydrocotyle bonariensis</i>	Pennywort	i					•		
	<i>Hydrocotyle laxiflora</i>	Stinking Pennywort						•		
	<i>Hydrocotyle peduncularis</i>	Hairy Pennywort				•	•		•	
	<i>Hydrocotyle tripartita</i>	Tre-foil Pennywort					•	•		
	<i>Platysace ericoides</i>	Heath Platysace				•	•		•	
	<i>Trachymene incisa</i> subsp. <i>incisa</i>	Native Carrot					•			
	<i>Xanthosia pilosa</i>	Hairy Xanthosia							•	
	ARALIACEAE									
	<i>Polyscias elegans</i>	Celery Wood							•	
	<i>Polyscias murrayi</i>	Pencil Cedar				•	•			
	<i>Polyscias sambucifolia</i>	Elderberry Panax				•	•	•		
	<i>Schefflera actinophylla</i>	Umbrella Tree						•	•	
	PITTOSPORACEAE									
	<i>Billardiera scandens</i>	Apple-berry					•	•		
	<i>Billardiera scandens</i> var. <i>scandens</i>	Apple Dumplings				•				
	<i>Billardiera scandens</i> var. <i>sericata</i>	Apple Dumplings				•				

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections				
						1-2	3-5	6-8	9-11	
	<i>Bursaria spinosa</i>	Blackthorn					•	•	•	
	<i>Bursaria spinosa</i> var. <i>spinosa</i>	Blackthorn				•				
	<i>Hymenosporum flavum</i>	Native Frangipani					•			
	<i>Pittosporum multiflorum</i>	Orange Thorn					•	•	•	
	<i>Pittosporum revolutum</i>	Yellow Pittosporum				•	•	•	•	
	<i>Pittosporum undulatum</i>	Native Daphne						•	•	
	ASTERACEAE									
	<i>Acmella grandiflora</i> var. <i>brachyglossa</i>							•		
	<i>Ageratina adenophora</i>	Crofton Weed	i			•	•	•	•	
	<i>Ageratina riparia</i>	Mistflower	i					•	•	
	<i>Ageratum houstonianum</i>	Blue Billygoat Weed	i				•	•	•	
	<i>Ambrosia</i> spp.	Ragweed	i				•			
	<i>Ambrosia artemisiifolia</i>	Annual Ragweed	i			•		•	•	
	<i>Artemisia verlotiorum</i>	Chinese Wormwood	i				•			
	<i>Aster subulatus</i>	Wild Aster	i					•	•	
	<i>Baccharis halimifolia</i>	Groundsel Bush	i			•	•	•	•	
	<i>Bidens pilosa</i>	Cobblers Peg	i			•	•	•	•	
	<i>Bidens subalternans</i>	Greater Beggar's Tick							•	
	<i>Brachycome microcarpa</i>						•	•		
	<i>Brachyscome multifida</i>	Cut-leaf Brachycome					•			
	<i>Cassinia aculeata</i>	Dollybush						•		
	<i>Cassinia laevis</i>	Cough Bush						•		
	<i>Cassinia quinquefaria</i>							•		
	<i>Centipeda cunninghamii</i>	Sneeze Weed					•		•	
	<i>Centipeda minima</i>							•		
	<i>Centratherum riparium</i>							•		
	<i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i>	Bitou Bush	i			•		•	•	
	<i>Chrysocephalum apiculatum</i>	Yellow Buttons				•	•	•		
	<i>Chrysocephalum semipapposum</i>	Yellow Buttons					•			
	<i>Cirsium vulgare</i>	Scotch Thistle	i			•	•	•	•	
	<i>Conyza</i> spp.	Fleabane	i				•			
	<i>Conyza bonariensis</i>	Fleabane	i				•	•	•	
	<i>Conyza parva</i>	Small-flower Fleabane	i						•	
	<i>Conyza sumatrensis</i>	Tall Fleabane	i						•	
	<i>Cotula australis</i>	Lawn Cotula						•		
	<i>Craspedia variabilis</i>							•		
	<i>Crassocephalum crepidioides</i>	Thickhead	i					•	•	
	<i>Dichrocephala integrifolia</i>							•		

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections				
						1-2	3-5	6-8	9-11	
	<i>Eclipta platyglossa</i>	Eclipta							•	
	<i>Eclipta prostrata</i>								• •	
	<i>Enydra fluctuans</i>	Enydra							•	
	<i>Epaltes australis</i>	Spreading Nut-heads				•	•			
	<i>Epaltes cunninghamii</i>								•	
	<i>Erechtites valerianifolia</i>	Brazilian Fireweed	i			•		•		
	<i>Euchiton gymnocephalus</i>						•			
	<i>Euchiton sphaericus</i>								•	
	<i>Facelis retusa</i>	Facelis	i					•		
	<i>Gamochaeta spicata</i>							•		
	<i>Glossocardia bidens</i>	Cobblers Tack						•		
	<i>Hypochaeris radicata</i>	Flatweed	i			•		•	•	
	<i>Lagenophora gracilis</i>	Slender Bottle-daisy				•		•		
	<i>Lagenophora stipitata</i>	Bottle-daisy						•	•	
	<i>Leptinella longipes</i>	Leptinella						•	•	
	<i>Leucanthemum vulgare</i>	Ox-eye Daisy						•		
	<i>Ozothamnus diosmifolius</i>	Tall Paperdaisy				•	•	•		
	<i>Ozothamnus rufescens</i>								•	
	<i>Senecio sp.</i>	Fireweed	i						•	
	<i>Senecio amygdalifolius</i>	Almong-leaved Grounel							•	
	<i>Senecio madagascariensis</i>	Fireweed	i			•	•	•	•	
	<i>Sigesbeckia orientalis</i>	Indian Weed						•	•	
	<i>Sonchus oleraceus</i>	Common Sow-thistle	i					•	•	
	<i>Tagetes minuta</i>	Stinking Roger	i			•				
	<i>Vernonia cinerea</i>	Vernonia				•				
	<i>Vernonia cinerea var. cinerea</i>	Vernonia						•	•	
	<i>Xanthium occidentale</i>	Noogoora Burr	i					•		
	CAMPANULACEAE									
	<i>Wahlenbergia communis</i>	Tufted Bluebell				•	•			
	<i>Wahlenbergia gracilis</i>	Sprawling Bluebell						•	•	
	<i>Wahlenbergia stricta</i>	Tall Bluebell							•	
	GOODENIACEAE									
	<i>Dampiera stricta</i>	Blue Dampiera				•	•	•	•	
	<i>Dampiera sylvestris</i>							•		
	<i>Goodenia bellidifolia</i>	Goodenia							•	
	<i>Goodenia bellidifolia subsp. argentea</i>	Daisy-leaved Goodenia				•				
	<i>Goodenia bellidifolia subsp. bellidifolia</i>					•				
	<i>Goodenia hederacea subsp. hederacea</i>	Ivy-leaf Goodenia							•	
	<i>Goodenia heterophylla</i>	Variable-leaf Goodenia						•	•	

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						1-2	3-5	6-8	9-11
	<i>Goodenia heterophylla</i> subsp. <i>eglandulosa</i>	Variable-leaf Goodenia				•			
	<i>Goodenia ovata</i>	Ovate Goodenia					•		
	<i>Goodenia paniculata</i>	Panicled Goodenia						•	
	<i>Goodenia rotundifolia</i>							•	
	<i>Velleia paradoxa</i>	Spur Velleia					•	•	
	LOBELIACEAE								
	<i>Isotoma armstrongii</i>							•	
	<i>Isotoma fluviatilis</i> subsp. <i>fluviatilis</i>	Swamp Isotoma					•		
	<i>Lobelia anceps</i>	Angled Lobelia				•	•		
	<i>Lobelia dentata</i>					•		•	
	<i>Lobelia gibbosa</i>	Lobelia					•		
	<i>Lobelia gracilis</i>	Trailing Lobelia					•		
	<i>Pratia purpurascens</i>	White Root				•	•	•	•
	MENYANTHACEAE								
	<i>Villarsia exaltata</i>	Villarsia						•	•
	STYLIDIACEAE								
	<i>Stylidium debile</i>	Frail Trigger Plant					•	•	
	<i>Stylidium graminifolium</i>	Grass-leaf Trigger Plant							•
	<i>Stylidium laricifolium</i>	Larch-leaf Trigger Plant					•	•	
	Flowering Plants - Monocotyledons								
	ARACEAE								
	<i>Alocasia brisbanensis</i>	Cunjevoi						•	
	<i>Gymnostachys anceps</i>	Caterpillar Flower						•	
	HYDROCHARITACEAE								
	<i>Ottelia ovalifolia</i>	Swamp Lily				•		•	
	JUNCAGINACEAE								
	<i>Maundia triglochoides</i>	Maundia		v		•	•	•	•
	<i>Triglochin microtuberosum</i>	Small-tubered Water Ribbons					•		
	<i>Triglochin procerum</i>							•	
	<i>Triglochin procerum sens. lat.</i>					•			
	<i>Triglochin procerum sens. st.</i>	Twisted Water Ribbons					•		
	<i>Triglochin striatum</i>	Streaked Arrowgrass					•		
	POTAMOGETONACEAE								
	<i>Potamogeton javanicus</i>						•		
	DIOSCOREACEAE								
	<i>Dioscorea transversa</i>	Native Yam					•		•
	COLCHICACEAE								
	<i>Burchardia umbellata</i>	Milkmaids				•			
	LILIACEAE								
	<i>Lilium formosanum</i>	Formosa Lily	i			•			
	LUZURIAGACEAE								

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						1-2	3-5	6-8	9-11
	<i>Eustrephus latifolius</i>	Wombat Berry				•	•	•	•
	<i>Geitonoplesium cymosum</i>	Scrambling Lily				•	•	•	•
	RIPOGONACEAE								
	<i>Ripogonum album</i>	White Supplejack					•	•	
	SMILACACEAE								
	<i>Smilax australis</i>	Lawyer Vine				•		•	•
	<i>Smilax glycyphylla</i>	Sweet Sarsaparilla				•	•	•	•
	AMARYLLIDACEAE								
	<i>Crinum pedunculatum</i>	Stream Lily					•	•	•
	ANTHERICACEAE								
	<i>Arthropodium milleflorum</i>	Vanilla Lily				•	•	•	
	<i>Caesia parviflora</i> var. <i>parviflora</i> ?	Pale Grass-lily					•	•	
	<i>Caesia parviflora</i> var. <i>vittata</i>	Blue Grass-lily				•			
	<i>Laxmannia compacta</i>						•		•
	<i>Laxmannia gracilis</i>	Grass Wire-lily				•	•	•	
	<i>Thysanotus juncifolius</i>						•		
	<i>Thysanotus tuberosus</i>	Fringe Lily				•			•
	<i>Thysanotus tuberosus</i> subsp. <i>tuberosus</i>	Common Fringe-lily							•
	<i>Tricoryne anceps</i>							•	
	<i>Tricoryne elatior</i>	Yellow Rush-lily				•	•	•	
	ASPARAGACEAE								
	<i>Asparagus aethiopicus</i>	Asparagus Fern	i				•	•	•
	<i>Asparagus africanus</i>		i					•	
	<i>Asparagus plumosus</i>	Climbing Asparagus Fern	i						•
	ASTELIACEAE								
	<i>Cordyline petiolaris</i>	Broad-leaved Palm Lily							•
	<i>Cordyline rubra</i>	Palm Lily							•
	<i>Cordyline stricta</i>	Narrow-leaf palm-lily				•		•	
	BLANDFORDIACEAE								
	<i>Blandfordia grandiflora</i>	Christmas Bells						•	
	HYPOXIDACEAE								
	<i>Curculigo ensifolia</i> var. <i>ensifolia</i>							•	
	<i>Hypoxis hygrometrica</i> var. <i>villosisepala</i>	Yellow Weather-grass					•		
	IRIDACEAE								
	<i>Patersonia glabrata</i>	Cauline-leaf Purple-flag				•		•	
	<i>Patersonia sericea</i>	Silky Purple Flag				•		•	
	<i>Patersonia sericea</i> var. <i>sericea</i>	Basal-leaf Purple-flag					•		
	<i>Sisyrinchium</i> sp. A	Scourweed	i			•	•		
	LOMANDRACEAE								

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						1-2	3-5	6-8	9-11	
	<i>Lomandra confertifolia</i> subsp. <i>pallida</i>							•		
	<i>Lomandra elongata</i>						•			
	<i>Lomandra filiformis</i>							•	•	
	<i>Lomandra filiformis</i> subsp. <i>coriacea</i>	Wattle Mat-rush				•				
	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	Wattle Mat-rush				•	•			
	<i>Lomandra glauca</i>	Glaucous Mat-rush				•				
	<i>Lomandra gracilis</i>						•			
	<i>Lomandra hystrix</i>						•	•	•	
	<i>Lomandra laxa</i>						•	•		
	<i>Lomandra longifolia</i>	Spiny Mat-rush				•		•	•	
	<i>Lomandra longifolia</i> subsp. <i>longifolia</i>						•			
	<i>Lomandra multiflora</i>							•		
	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	Many-flowered Mat-rush				•	•			
	ORCHIDACEAE									
	<i>Acianthella amplexicaulis?</i>						•			
	<i>Acianthus caudatus</i>	Mayfly Orchid						•		
	<i>Acianthus fornicatus ?</i>	Pixie Caps					•	•		
	<i>Arthrochilus prolixus</i>							•		
	<i>Caladenia alata</i>	Fairy Orchid						•		
	<i>Caladenia catenata</i>	White Fingers					•	•		
	<i>Chiloglottis</i> spp.	Ant Orchid					•	•		
	<i>Chiloglottis diphylla</i>							•		
	<i>Corybas</i> spp.	Helmet-orchid					•			
	<i>Corybas aconitiflorus</i>	Spurred Helmet-orchid						•		
	<i>Cryptostylis erecta</i>							•		
	<i>Cryptostylis subulata</i>	Large Tongue-orchid						•		
	<i>Cymbidium madidum</i>						•			
	<i>Cymbidium suave</i>	Snake Flower				•		•	•	
	<i>Dendrobium aemulum</i>	Ironbark Orchid						•		
	<i>Dendrobium linguiforme</i>	Tongue Orchid					•	•		
	<i>Dendrobium teretifolia</i>	Rat's Tail Orchid						•		
	<i>Dipodium variegatum</i>	Hyacinth Orchid					•	•		
	<i>Epidendrum ibaguense</i>	Crucifix Orchid	i				•			
	<i>Microtis unifolia</i>	Onion-orchid					•			
	<i>Oberonia titania</i>			v				•		
	<i>Plectorrhiza tridentata</i>	Tangle Orchid						•		
	<i>Pterostylis</i> spp.	Greenhood					•	•		
	<i>Pterostylis grandiflora</i>	Superb Greenhood						•		
	<i>Pterostylis nutans</i>	Nodding Greenhood					•	•		

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						1-2	3-5	6-8	9-11
	<i>Spiranthes sinensis</i> var. <i>australis</i>	Austral Ladies' Tresses					•		
	<i>Thelymitra ixioides</i> var. <i>ixioides</i>	Spotted Sun Orchid				•			
	PHORMIACEAE								
	<i>Dianella caerulea</i>							•	•
	<i>Dianella caerulea</i> var. <i>caerulea</i>	Leafy Blue Flax Lily					•		
	<i>Dianella caerulea</i> var. <i>producta</i>	Stemmed Blue Flax Lily				•			
	<i>Dianella longifolia</i>							•	
	<i>Dianella longifolia</i> var. <i>longifolia</i>	Long-leaf Flax Lily				•	•		
	<i>Dianella revoluta</i>							•	•
	<i>Dianella revoluta</i> var. <i>revoluta</i>	Black-anther Flax Lily				•			
	XANTHORRHOEACEAE								
	<i>Xanthorrhoea</i> sp.	Grass-tree					•		
	<i>Xanthorrhoea fulva</i>	Northern Swamp Grass-tree				•	•	•	•
	<i>Xanthorrhoea glauca</i> subsp. <i>glauca</i>	Grass-tree				•	•		•
	<i>Xanthorrhoea johnsonii</i>	Johnsons Grass-tree				•			
	<i>Xanthorrhoea latifolia</i> subsp. <i>latifolia</i>	Broad-leaf Grass-tree				•	•	•	•
	<i>Xanthorrhoea latifolia</i> subsp. <i>maxima</i>							•	
	<i>Xanthorrhoea macronema</i>	Narrow-scape Grass-tree				•		•	
	ARECACEAE								
	<i>Archontophoenix cunninghamiana</i>	Bangalow Palm				•		•	•
	<i>Calamus muelleri</i>	Lawyer Vine							•
	<i>Linospadix monostachya</i>	Walking-stick Palm							•
	<i>Livistona australis</i>	Cabbage Tree Palm						•	•
	<i>Phoenix canariensis</i>	Canary Island Date Palm	i			•			
	CYPERACEAE								
	<i>Abildgaardia vaginata</i>								•
	<i>Baumea articulata</i>	Jointed Twig-rush				•	•	•	
	<i>Baumea juncea</i>	Slender Twig-rush					•	•	
	<i>Baumea rubiginosa</i>	Soft Twig-rush				•	•	•	
	<i>Baumea teretifolia</i>	Wrinkle-nut Twig-rush				•	•	•	
	<i>Bulbostylis barbata</i>							•	
	<i>Carex appressa</i>	Tussock Tassel-sedge				•	•	•	
	<i>Carex breviculmis</i>							•	
	<i>Carex lophocarpa</i>								•

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						1-2	3-5	6-8	9-11
	<i>Carex maculata</i>	Kikuyu Tassel-sedge						•	
	<i>Carex polyantha</i>						•		
	<i>Caustis blakei</i>								•
	<i>Caustis flexuosa</i>	Curved Caustis				•			•
	<i>Caustis pentandra</i>	Straight Caustis				•	•		
	<i>Caustis recurvata</i>	Curly Caustis						•	•
	<i>Chorizandra cymbaria</i>	Bristle-rush				•	•	•	
	<i>Chorizandra sphaerocephala</i>	Round-headed Bristle-rush					•	•	
	<i>Cladium procerum</i>	Cladium						•	
	<i>Cyperus spp.</i>						•		
	<i>Cyperus aquatilis</i>	Water Nutgrass		e				•	
	<i>Cyperus brevifolius</i>	Mullumbimby Couch					•		•
	<i>Cyperus dietrichiae</i> var. <i>brevibracteatus</i>							•	
	<i>Cyperus enervis</i>							•	•
	<i>Cyperus eragrostis</i>	Umbrella Sedge	i			•			•
	<i>Cyperus exaltatus</i>	a tall leafy-bract sedge					•	•	
	<i>Cyperus flavidus</i>	Yellow Flat Sedge						•	
	<i>Cyperus gracilis</i>	Slender Flat Sedge					•		•
	<i>Cyperus haspan</i> subsp. <i>haspan</i>							•	
	<i>Cyperus haspan</i> subsp. <i>juncooides</i>							•	
	<i>Cyperus imbecillis</i>								•
	<i>Cyperus iria</i>							•	
	<i>Cyperus laevis</i>	sedge							•
	<i>Cyperus odoratus</i>	Lacey Sedge					•		
	<i>Cyperus pilosus</i>							•	
	<i>Cyperus polystachyos</i>	Bunchy Flat-sedge					•	•	•
	<i>Cyperus papyrus</i>	Papyrus	i			•			
	<i>Cyperus rotundus</i>	Nutgrass	i					•	
	<i>Cyperus sesquiflorus</i>	Mullumbimby Couch							•
	<i>Cyperus sphaeroideus</i>						•		•
	<i>Cyperus stradbrokeensis</i>							•	
	<i>Cyperus trinervis</i>							•	
	<i>Eleocharis acuta</i>	Common Spike-rush					•	•	
	<i>Eleocharis cylindrostachys</i>	Spike-rush						•	
	<i>Eleocharis dietrichiana</i>	Spike-rush						•	
	<i>Eleocharis equisetina</i>	Spike-rush				•			
	<i>Eleocharis gracilis</i>	Slender Spike-rush				•	•		
	<i>Eleocharis pallens</i>	Pale Spike-sedge							•
	<i>Eleocharis sphacelata</i>	Tall Spike-rush					•		

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						1-2	3-5	6-8	9-11	
	<i>Fimbristylis cinnamometorum</i>							•	•	
	<i>Fimbristylis dichotoma</i>	Common Fringe-rush				•	•	•		
	<i>Fimbristylis nutans</i>							•		
	<i>Fimbristylis tristachya</i>					•				
	<i>Fuirena ciliaris</i>							•		
	<i>Gahnia aspera</i>	Rough Saw-sedge				•	•	•		
	<i>Gahnia clarkei</i>	Tall Saw-sedge				•	•	•		
	<i>Gahnia sieberiana</i>	Red-fruited Saw-sedge				•	•	•	•	
	<i>Isolepis cernua</i>	Nodding Club-rush					•			
	<i>Isolepis inundata</i>	Club-rush					•	•	•	
	<i>Isolepis nodosa</i>	Knobby Club-rush						•		
	<i>Lepidosperma filiforme</i>	Slender Rapiersedge				•	•			
	<i>Lepidosperma laterale</i>	Variable Swordsedge				•	•	•	•	
	<i>Lepidosperma viscidum</i>						•			
	<i>Lepironia articulata</i>	Giant Sedge					•	•	•	
	<i>Ptilothrix deusta</i>	Ptilanthelium				•		•		
	<i>Schoenoplectus mucronatus</i>	Angled Club-rush				•	•			
	<i>Schoenoplectus validus</i>	River Club-rush				•				
	<i>Schoenus apogon</i>	Common Bog-rush				•	•	•		
	<i>Schoenus brevifolius</i>	Zig-zag Bog-rush				•	•	•	•	
	<i>Schoenus ericetorum</i>	Heath Bog-rush				•				
	<i>Schoenus melanostachys</i>	Black Bog-rush						•		
	<i>Scleria levis</i>							•		
	FLAGELLARIACEAE									
	<i>Flagellaria indica</i>	Whip Vine						•	•	
	JUNCACEAE									
	<i>Juncus continuus</i>	Sand Rush						•	•	
	<i>Juncus mollis</i>	Pale Rush				•	•			
	<i>Juncus planifolius</i>	Broadleaf Rush					•			
	<i>Juncus polyanthemus</i>	Many-flowered Rush					•			
	<i>Juncus prismatocarpus</i>	Branching Rush				•	•	•		
	<i>Juncus subsecundus</i>							•	•	
	<i>Juncus usitatus</i>	Common Rush				•	•	•	•	
	POACEAE									
	<i>Andropogon virginicus</i>	Whisky Grass	i			•	•	•	•	
	<i>Anisopogon avenaceus</i>	Oat Spear Grass				•				
	<i>Arthraxon hispidus</i>	Hairy-joint Grass		v	v				•	
	<i>Aristida benthamii</i>							•		
	<i>Aristida calycina</i> var. <i>calycina</i>	Three-awned Spear Grass				•				

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						1-2	3-5	6-8	9-11
	<i>Aristida ramosa</i>	Three-awned Spear Grass					•		
	<i>Aristida ramosa</i> var. <i>ramosa</i>							•	
	<i>Aristida ramosa</i> var. <i>speciosa</i>							•	
	<i>Aristida vagans</i>	Three-awned Spear Grass				•	•	•	•
	<i>Aristida warburgii</i>						•		
	<i>Austrodanthonia fulva</i>	Wallaby Grass				•			
	<i>Austrodanthonia fulva</i> var. <i>fulva</i>	Wallaby Grass					•		
	<i>Austrostipa pubescens</i>	Tall Spear Grass				•	•	•	
	<i>Austrostipa verticillata</i>	Slender Bamboo Spear Grass					•		
	<i>Axonopus affinis</i>	Carpet Grass	i				•	•	
	<i>Axonopus fissifolius</i>	Narrow-leaved Carpet Grass	i			•			
	<i>Bothriochloa decipiens</i>	Red Grass				•	•	•	
	<i>Bothriochloa macra</i>	Red-leg Grass					•		
	<i>Briza maxima</i>	Quaking Grass	i			•			
	<i>Capillipedium parviflorum</i>	Scented-top Grass						•	
	<i>Capillipedium spicigerum</i>	Scented-top Grass						•	
	<i>Chloris gayana</i>	Rhodes Grass	i			•	•	•	•
	<i>Chloris ventricosa</i>	Tall Windmill Grass					•		
	<i>Chloris virgata</i>	Feathertop Rhodes Grass							•
	<i>Chrysopogon filipes</i>	Vetiveria filipes						•	
	<i>Cymbopogon refractus</i>	Barbed Wire Grass				•	•	•	•
	<i>Cymbopogon obtectus</i>	Silky Heads					•		
	<i>Cynodon dactylon</i>	Common Couch				•		•	•
	<i>Dichanthium sericeum</i> subsp. <i>sericeum</i>	Queensland Bluegrass					•		
	<i>Dichelachne micrantha</i>	Short-hair Plume Grass				•	•		•
	<i>Dichelachne rara</i>	Spreading Plume Grass						•	
	<i>Digitaria ciliaris</i>	Summer Grass	i			•			
	<i>Digitaria parviflora</i>	Small-flower Finger Grass				•	•	•	
	<i>Digitaria ramularis</i>							•	•
	<i>Echinochloa esculenta</i>	Japanese Millet	i						•
	<i>Echinopogon caespitosus</i>	Hedgehog Grass					•	•	•
	<i>Echinopogon caespitosus</i> var. <i>caespitosus</i>	Hedgehog Grass				•			
	<i>Echinopogon ovatus</i>	Hedgehog Grass					•		
	<i>Eleusine indica</i>	Crowsfoot Grass	i					•	
	<i>Entolasia marginata</i>	Margined Panic				•	•	•	•

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections			
						1-2	3-5	6-8	9-11
	<i>Entolasia stricta</i>	Wiry Panic				•			•
	<i>Eragrostis brownii</i>	Brown's Lovegrass				•	•	•	
	<i>Eragrostis cilianensis</i>	Stinkgrass	i				•		
	<i>Eragrostis curvula</i>	African Lovegrass	i				•		•
	<i>Eragrostis elongata</i>	Narrow Lovegrass					•		•
	<i>Eragrostis leptostachya</i>	Paddock Lovegrass				•	•	•	
	<i>Eragrostis parviflora</i>	Weeping Lovegrass					•		
	<i>Eragrostis sororia</i>							•	
	<i>Eragrostis tenuifolia</i>	Elastic Grass	i				•	•	
	<i>Eragrostis trachycarpa</i>							•	
	<i>Hordeum leporinum</i>	Barley Grass	i				•		
	<i>Hyparrhenia hirta</i>	Coolatai Grass	i				•	•	
	<i>Imperata cylindrica</i>	Blady Grass					•		•
	<i>Imperata cylindrica var. major</i>	Blady Grass				•		•	
	<i>Isachne globosa</i>	Swamp Millet				•			
	<i>Ischaemum australe</i>							•	
	<i>Ischaemum australe var. australe</i>	Ischaemum					•		
	<i>Leersia hexandra</i>	Swamp Ricegrass						•	
	<i>Melinis minutiflora</i>		i					•	
	<i>Melinis repens</i>	Red Natal Grass	i			•	•	•	
	<i>Microlaena stipoides</i>							•	•
	<i>Microlaena stipoides var. stipoides</i>	Weeping Grass					•		
	<i>Oplismenus aemulus</i>	Broad-leaf Beard-grass				•	•	•	•
	<i>Oplismenus imbecillis</i>	Narrow-leaf Beard-grass				•	•	•	•
	<i>Oplismenus undulatifolius</i>								•
	<i>Ottochloa gracillima</i>							•	•
	<i>Panicum effusum</i>	Hairy Panic					•		
	<i>Panicum maximum</i>	Guinea Grass	i			•		•	•
	<i>Panicum maximum var. maximum</i>	Guinea Grass	i				•		
	<i>Panicum maximum var. trichoglume</i>	Green Panic	i						•
	<i>Panicum queenslandicum</i>	Yabila Grass					•		
	<i>Panicum schinzii</i>		i					•	
	<i>Panicum simile</i>	Two-colour panic				•	•	•	
	<i>Paspalidium distans</i>	Paspalidium					•	•	
	<i>Paspalum dilatatum</i>	Paspalum	i			•	•	•	•
	<i>Paspalum orbiculare</i>	Ditch Millet					•	•	
	<i>Paspalum paniculatum</i>	Russell River Grass	i						•
	<i>Paspalum scrobiculatum</i>	Scrobic	i					•	

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections				
						1-2	3-5	6-8	9-11	
	<i>Paspalum urvillei</i>	Vasey Grass	i			•	•	•		
	<i>Paspalum mandiocanum</i>	Broad-leaf Paspalum	i			•	•	•	•	
	<i>Pennisetum clandestinum</i>	Kikuyu	i					•		
	<i>Phalaris aquatica</i>	Canary Grass					•			
	<i>Phragmites australis</i>	Common Reed				•	•		•	
	<i>Plinthanthesis paradoxa</i>	Wiry Wallaby Grass					•			
	<i>Poa labillardieri</i>							•	•	
	<i>Poa labillardieri</i> var. <i>labillardieri</i>	Tussock Grass				•				
	<i>Pseudoraphis paradoxa</i>	Slender Mudgrass					•			
	<i>Saccharum officinarum</i>	Sugar Cane	i			•				
	<i>Sacciolepis indica</i>	Indian Cupscale Grass						•		
	<i>Setaria</i> spp.	Pigeon Grass					•			
	<i>Setaria gracilis</i>	Slender Pigeon Grass	i				•			
	<i>Setaria palmifolia</i>	Palm Grass	i				•			
	<i>Setaria pumila</i>	Pale Pigeon Grass	i			•			•	
	<i>Setaria sphacelata</i>	South African Pigeon Grass	i			•	•	•		
	<i>Sorghum halepense</i>	Johnson Grass	i					•		
	<i>Sporobolus africanus</i>	Parramatta Grass	i			•	•			
	<i>Sporobolus diander</i>	Open Rats Tail Grass						•		
	<i>Sporobolus elongatus</i>	Slender Rats Tail Grass					•		•	
	<i>Sporobolus fertilis</i>	Giant Parramatta Grass	i					•		
	<i>Sporobolus virginicus</i> var. <i>virginicus</i>	Sand Couch							•	
	<i>Sporobolus virginicus</i> var. <i>minor</i>	Saltmarsh Couch					•			
	<i>Stenotaphrum secundatum</i>	Buffalo Grass	i						•	
	<i>Themeda australis</i>	Kangaroo Grass				•	•	•	•	
	<i>Urochloa decumbens</i>		i					•		
	RESTIONACEAE									
	<i>Baloskion pallens</i>	Pale Cord-rush					•	•		
	<i>Baloskion tetraphyllum</i>	Tassel Cord-rush				•		•	•	
	<i>Baloskion tetraphyllum</i> subsp. <i>meiostachyum</i>	Tassel Cord-rush					•			
	<i>Empodisma minus</i>	Spreading Rope-rush					•	•		
	<i>Eurychorda complanata</i>	Flat Cord-rush					•			
	<i>Leptocarpus tenax</i>	Slender Scale-rush				•		•		
	<i>Lepyrodia</i> sp.	Cord Rush				•				
	<i>Lepyrodia</i> sp. A sensu						•			
	<i>Lepyrodia interrupta</i>						•			

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GROUP	Classification/scientific name	Common name	Conditions	TSC Act	EPBC Act	Project sections			
						1-2	3-5	6-8	9-11
	<i>Lepyrodia scariosa</i>	Chaffy Scale-rush				•	•	•	
	<i>Sporadanthus caudatus</i>								•
	<i>Sporadanthus interruptus</i>	Knotted Scale-rush							•
	TYPHACEAE								
	<i>Typha orientalis</i>	Broad-leaf Cumbungi				•	•	•	•
	XYRIDACEAE								
	<i>Xyris gracilis</i>	Slender Yellow-eye					•	•	
	<i>Xyris juncea</i>	Dwarf Yellow-eye				•			
	<i>Xyris operculata</i>	Tall Yellow-eye						•	•
	COMMELINACEAE								
	<i>Aneilema acuminatum</i>	Pointed Aneilema					•		•
	<i>Commelina benghalensis</i>		i					•	
	<i>Commelina cyanea</i>	Scurvy Weed					•	•	•
	<i>Murdannia graminea</i>	Blue Murdannia				•		•	
	<i>Pollia crispata</i>	Pollia					•		•
	<i>Tradescantia albiflora</i>	Wandering Jew	i				•	•	•
	HAEMODORACEAE								
	<i>Haemodorum austroqueenslandicum</i>							•	
	<i>Haemodorum planifolium</i>	Bloodroot				•	•	•	
	PHILYDRACEAE								
	<i>Philydrum lanuginosum</i>	Frogsmouth				•	•	•	•
	PONTEDERIACEAE								
	<i>Eichhornia crassipes</i>	Water Hyacinth	i					•	
	MUSACEAE								
	<i>Musa sp.</i>		i			•			
	ZINGIBERACEAE								
	<i>Alpinia caerulea</i> var. <i>caerulea</i>	Native Ginger					•	•	•
	<i>Hedychium gardnerianum</i>	Ginger Lily	i			•			

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Appendix H Terrestrial fauna

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KEY TO ABBREVIATIONS USED IN APPENDIX H

Abbreviation	Status
NV	Nationally Vulnerable species (EPBC Act)
NE	Nationally Endangered species (EPBC Act)
V	Vulnerable species (NSW TSC Act)
E	Endangered species (NSW TSC Act)
EP	Endangered Population (NSW TSC Act)
M	Migratory listed species (EPBC Act)

Family / Scientific name	Common name	Status	Project section			
			1-2	3-5	6-8	9-11
BIRDS						
Casuariidae						
<i>Dromaius novaehollandiae</i>	Emu	EP		•		
Megapodiidae						
<i>Alectura lathamii</i>	Australian Brush-turkey					•
Phasianidae						
<i>Coturnix ypsilophora</i>	Brown Quail		•	•	•	•
Anseranatidae						
<i>Anseranas semipalmata</i>	Magpie Goose	V		•		
Anatidae						
<i>Chenonetta jubata</i>	Australian Wood Duck		•	•	•	•
<i>Cygnus atratus</i>	Black Swan			•		•
<i>Dendrocygna eytoni</i>	Plumed Whistling Duck			•		
<i>Anas superciliosa</i>	Pacific Black Duck		•	•		•
<i>Anas castanea</i>	Chestnut Teal					•
<i>Anas gracilis</i>	Grey Teal					•
<i>Aythya australis</i>	Hardhead					•
Podicipedidae						
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe		•		•	
Anhingidae						
<i>Anhinga melanogaster</i>	Darter					•
Phalacrocoracidae						
<i>Phalacrocorax carbo</i>	Great Cormorant			•	•	•
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant			•		•
<i>Phalacrocorax varius</i>	Pied Cormorant			•		•
<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant			•		•
Pelecanidae						
<i>Pelecanus conspicillatus</i>	Australian Pelican			•		•
Ardeidae						
<i>Bubulcus ibis</i>	Cattle Egret	M		•	•	•
<i>Egretta garzetta</i>	Little Egret					•
<i>Ardea intermedia</i>	Intermediate Egret			•		
<i>Ardea alba</i>	Great Egret	M		•		•
<i>Egretta novaehollandiae</i>	White-faced Heron			•		•
<i>Ardea pacifica</i>	White-necked Heron			•	•	
<i>Butorides striatus</i>	Striated Heron					•
<i>Botaurus poiciloptilus</i>	Australasian Bittern	NE,V		•		
Threskiornithidae						
<i>Plegadis falcinellus</i>	Glossy Ibis	M		•		•
<i>Threskiornis molucca</i>	Australian White Ibis			•	•	•

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Family / Scientific name	Common name	Status	Project section			
			1-2	3-5	6-8	9-11
<i>Threskiornis spinicollis</i>	Straw-necked Ibis			•	•	•
Ciconiidae						
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E		•		•
Accipitridae						
<i>Circus approximans</i>	Swamp Harrier					•
<i>Accipiter novaehollandiae</i>	Grey Goshawk				•	
<i>Accipiter fasciatus</i>	Brown Goshawk					•
<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk		•			•
<i>Aquila audax</i>	Wedge-tailed Eagle		•	•	•	•
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	M	•	•		•
<i>Haliastur indus</i>	Brahminy Kite			•	•	•
<i>Haliastur sphenurus</i>	Whistling Kite			•	•	•
<i>Elanus axillaris</i>	Black-shouldered Kite			•	•	•
<i>Aviceda subcristata</i>	Pacific Baza					•
<i>Pandion haliaetus</i>	Eastern Osprey	V	•	•		•
Falconidae						
<i>Falco longipennis</i>	Australian Hobby					•
<i>Falco peregrinus</i>	Peregrine Falcon		•			•
<i>Falco cenchroides</i>	Nankeen Kestrel		•	•	•	•
Gruidae						
<i>Grus rubicunda</i>	Brolga	V	•	•		
Rallidae						
<i>Gallirallus philippensis</i>	Buff-banded Rail			•		•
<i>Gallinula tenebrosa</i>	Dusky Moorhen		•	•		•
<i>Porphyrio porphyrio</i>	Purple Swamphen		•	•		•
<i>Fulica atra</i>	Eurasian Coot					•
Turnicidae						
<i>Turnix varia</i>	Painted Button-quail					•
Scolopacidae						
<i>Gallinago hardwickii</i>	Latham's Snipe	M		•		
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	M				•
Haematopodidae						
<i>Haematopus longirostris</i>	Pied Oystercatcher	V	•			•
Charadriidae						
<i>Vanellus miles</i>	Masked Lapwing		•	•	•	•
Laridae						
<i>Sterna bergii</i>	Crested Tern					•
Columbidae						
<i>Ptilinopus regina</i>	Rose-crowned Fruit-Dove	V				•
<i>Lopholaimus antarcticus</i>	Topknot Pigeon				•	•
<i>Columba leucomela</i>	White-headed Pigeon			•	•	•
<i>Macropygia amboinensis</i>	Brown Cuckoo-Dove			•		•
<i>Geopelia placida</i>	Peaceful Dove		•	•	•	•
<i>Phaps chalcoptera</i>	Common Bronzewing			•		
<i>Geopelia humeralis</i>	Bar-shouldered Dove		•	•	•	•
<i>Ocyphaps lophotes</i>	Crested Pigeon		•	•	•	•
<i>Leucosarcia melanoleuca</i>	Wonga Pigeon		•	•	•	•
Cacatuidae						

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Family / Scientific name	Common name	Status	Project section			
			1-2	3-5	6-8	9-11
<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	V	•	•	•	
<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-Cockatoo		•	•	•	•
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo		•	•	•	•
<i>Eolophus roseicapillus</i>	Galah		•	•		•
Psittacidae						
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet		•	•	•	•
<i>Trichoglossus chlorolepidotus</i>	Scaly-breasted Lorikeet		•	•	•	•
<i>Glossopsitta concinna</i>	Musk Lorikeet		•	•	•	
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	•	•	•	
<i>Alisterus scapularis</i>	Australian King-Parrot		•	•	•	•
<i>Platycercus adscitus eximius</i>	Eastern Rosella		•	•		•
Cuculidae						
<i>Cuculus saturatus</i>	Oriental Cuckoo					•
<i>Cuculus pallidus</i>	Pallid Cuckoo					•
<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo		•	•	•	
<i>Cacomantis variolosus</i>	Brush Cuckoo		•	•		•
<i>Chalcites basalis</i>	Horsfield's Bronze-Cuckoo		•	•		
<i>Chalcites lucidus</i>	Shining Bronze-Cuckoo		•	•	•	•
<i>Chalcites minutillus</i>	Little Bronze-Cuckoo			•		
<i>Eudynamys orientalis</i>	Pacific Koel		•	•		•
<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo		•	•	•	
Centropodidae						
<i>Centropus phasianinus</i>	Pheasant Coucal		•	•		•
Strigidae						
<i>Ninox boobook</i>	Southern Boobook		•	•	•	•
<i>Ninox strenua</i>	Powerful Owl	V		•	•	
Tytonidae						
<i>Tyto novaehollandiae</i>	Masked Owl	V			•	
<i>Tyto longimembris</i>	Eastern Grass Owl	V				•
<i>Tyto tenebricosa</i>	Sooty Owl	V	•			
Podargidae						
<i>Podargus strigoides</i>	Tawny Frogmouth		•	•	•	•
Aegothelidae						
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar		•	•	•	•
Caprimulgidae						
<i>Eurostopodus mystacalis</i>	White-throated Nightjar		•	•	•	
Apodidae						
<i>Hirundapus caudacutus</i>	White-throated Needletail	M	•			•
Alcedinidae						
<i>Alcedo azurea</i>	Azure Kingfisher		•		•	
<i>Dacelo novaeguineae</i>	Laughing Kookaburra		•	•	•	•
<i>Todiramphus sanctus</i>	Sacred Kingfisher		•	•		•
Meropidae						
<i>Merops ornatus</i>	Rainbow Bee-eater	M	•	•	•	•
Coraciidae						
<i>Eurystomus orientalis</i>	Dollarbird		•	•		•
Climacteridae						

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Family / Scientific name	Common name	Status	Project section			
			1-2	3-5	6-8	9-11
<i>Climacteris picumnus</i>	Brown Treecreeper	V	•	•	•	
<i>Cormobates leucophaea</i>	White-throated Treecreeper		•	•	•	•
Maluridae						
<i>Malurus cyaneus</i>	Superb Fairy-wren		•	•	•	•
<i>Malurus lamberti</i>	Variiegated Fairy-wren		•	•	•	•
<i>Malurus melanocephalus</i>	Red-backed Fairy-wren		•	•	•	•
Pardalotidae						
<i>Pardalotus punctatus</i>	Spotted Pardalote		•	•	•	•
<i>Pardalotus striatus</i>	Striated Pardalote		•	•	•	•
Acanthizidae						
<i>Gerygone olivacea</i>	White-throated Gerygone		•	•	•	•
<i>Gerygone mouki</i>	Brown Gerygone				•	
<i>Gerygone levigaster</i>	Mangrove Gerygone					•
<i>Smicromis brevirostris</i>	Weebill		•	•		
<i>Acanthiza lineata</i>	Striated Thornbill		•	•	•	•
<i>Acanthiza nana</i>	Yellow Thornbill		•	•	•	•
<i>Acanthiza pusilla</i>	Brown Thornbill		•	•	•	•
<i>Acanthiza reguloides</i>	Buff-rumped Thornbill		•	•		
<i>Sericornis frontalis</i>	White-browed Scrubwren		•	•	•	•
<i>Sericornis magnirostris</i>	Large-billed Scrubwren			•		•
Meliphagidae						
<i>Melithreptus lunatus</i>	White-naped Honeyeater		•	•	•	•
<i>Melithreptus albogularis</i>	White-throated Honeyeater			•	•	•
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	V	•	•		
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater				•	
<i>Plectorhyncha lanceolata</i>	Striped Honeyeater					•
<i>Myzomela sanguinolenta</i>	Scarlet Honeyeater		•	•	•	•
<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill		•	•		
<i>Lichmera indistincta</i>	Brown Honeyeater		•	•	•	•
<i>Meliphaga lewinii</i>	Lewin's Honeyeater		•	•	•	•
<i>Lichenostomus fasciogularis</i>	Mangrove Honeyeater	V				•
<i>Lichenostomus fuscus</i>	Fuscous Honeyeater		•	•	•	
<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater		•	•	•	•
<i>Lichenostomus leucotis</i>	White-eared Honeyeater				•	
<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater		•	•	•	
<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater		•			
<i>Phylidonyris nigra</i>	White-cheeked Honeyeater		•	•	•	•
<i>Manorina melanocephala</i>	Noisy Miner		•	•	•	•
<i>Anthochaera chrysoptera</i>	Little Wattlebird		•	•	•	
<i>Anthochaera carunculata</i>	Red Wattlebird		•	•	•	•
<i>Entomyzon cyanotis</i>	Blue-faced Honeyeater		•	•	•	•
<i>Philemon corniculatus</i>	Noisy Friarbird		•	•	•	•
<i>Philemon citreogularis</i>	Little Friarbird		•	•	•	

Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

Family / Scientific name	Common name	Status	Project section			
			1-2	3-5	6-8	9-11
Petroicidae						
<i>Microeca fascinans</i>	Jacky Winter		•	•	•	•
<i>Petroica multicolor</i>	Scarlet Robin				•	
<i>Eopsaltria australis</i>	Eastern Yellow Robin		•	•	•	•
Pomatostomidae						
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)	V	•	•	•	•
Eupetidae						
<i>Psophodes olivaceus</i>	Eastern Whipbird		•	•	•	•
Neosittidae						
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	•	•	•	
Pachycephalidae						
<i>Pachycephala pectoralis</i>	Golden Whistler		•	•	•	•
<i>Pachycephala rufiventris</i>	Rufous Whistler		•	•	•	•
<i>Colluricincla harmonica</i>	Grey Shrike-thrush		•	•	•	•
<i>Colluricincla megarhyncha</i>	Little Shrike-thrush					•
<i>Falcunculus frontatus</i>	Eastern Shrike-tit			•	•	
Dicruridae						
<i>Rhipidura albiscapa</i>	Grey Fantail		•	•	•	•
<i>Rhipidura rufifrons</i>	Rufous Fantail	M		•	•	•
<i>Rhipidura leucophrys</i>	Willie Wagtail		•	•		•
<i>Myiagra rubecula</i>	Leaden Flycatcher		•	•	•	•
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	M	•		•	•
<i>Myiagra inquieta</i>	Restless Flycatcher			•	•	•
<i>Grallina cyanoleuca</i>	Magpie-lark		•	•	•	•
<i>Dicrurus bracteatus</i>	Spangled Drongo		•	•	•	•
Campephagidae						
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike		•	•	•	•
<i>Coracina papuensis</i>	White-bellied Cuckoo-shrike		•	•	•	
<i>Coracina tenuirostris</i>	Cicadabird		•	•	•	•
<i>Lalage leucomela</i>	Varied Triller					•
Oriolidae						
<i>Oriolus sagittatus</i>	Olive-backed Oriole		•	•	•	•
<i>Sphecotheres vieilloti</i>	Australasian Figbird		•	•		•
<i>Sphecotheres viridis</i>	Figbird					•
Artamidae						
<i>Artamus leucorhynchus</i>	White-breasted Woodswallow					•
<i>Artamus cyanopterus</i>	Dusky Woodswallow		•		•	
<i>Strepera graculina</i>	Pied Currawong		•	•	•	•
<i>Cracticus nigrogularis</i>	Pied Butcherbird			•	•	•
<i>Cracticus torquatus</i>	Grey Butcherbird		•	•	•	•
<i>Gymnorhina tibicen</i>	Australian Magpie		•	•	•	•
Corvidae						
<i>Corvus orro</i>	Torresian Crow			•	•	•
<i>Corvus tasmanicus</i>	Forest Raven				•	
<i>Corvus coronoides</i>	Australian Raven		•	•	•	

Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

Family / Scientific name	Common name	Status	Project section			
			1-2	3-5	6-8	9-11
<i>Corvus mellori</i>	Little Raven		•		•	
Ptilonorhynchidae						
<i>Ptilonorhynchus violaceus</i>	Satin Bowerbird					•
Motacillidae						
<i>Anthus australis</i>	Australian Pipit			•		
<i>Anthus novaeseelandiae</i>	Richard's Pipit					•
Estrildidae						
<i>Taeniopygia bichenovii</i>	Double-barred Finch		•	•	•	•
<i>Lonchura castaneothorax</i>	Chestnut-breasted Mannikin					•
<i>Neochmia temporalis</i>	Red-browed Finch		•	•	•	•
Dicaeidae						
<i>Dicaeum hirundinaceum</i>	Mistletoebird		•	•	•	•
Hirundinidae						
<i>Hirundo neoxena</i>	Welcome Swallow		•	•	•	•
<i>Petrochelidon nigricans</i>	Tree Martin		•	•		•
<i>Petrochelidon ariel</i>	Fairy Martin			•		•
Sylviidae						
<i>Megalurus timoriensis</i>	Tawny Grassbird		•			•
<i>Acrocephalus australis</i>	Australian Reed-Warbler			•		
Cisticolidae						
<i>Cisticola exilis</i>	Golden-headed Cisticola					•
Zosteropidae						
<i>Zosterops lateralis</i>	Silvereye		•	•	•	•
INTRODUCED						
Columbidae						
<i>Columba livia</i>	Rock Dove					•
<i>Streptopelia chinensis</i>	Spotted Turtle-Dove				•	•
Sturnidae						
<i>Acridotheres tristis</i>	Common Myna		•			•
<i>Sturnus vulgaris</i>	Common Starling		•	•		•
NON-FLYING MAMMALS						
Tachyglossidae						
<i>Tachyglossus aculeatus</i>	Short-beaked Echidna		•	•	•	
Dasyuridae						
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	V		•	•	
<i>Antechinus flavipes</i>	Yellow-footed Antechinus		•	•	•	•
<i>Planigale maculata</i>	Common Planigale	V	•			•
<i>Sminthopsis murina</i>	Common Dunnart		•			
<i>Antechinus stuartii</i>	Brown Antechinus		•		•	
Peramelidae						
<i>Isodon macrourus</i>	Northern Brown Bandicoot		•	•	•	•
<i>Perameles nasuta</i>	Long-nosed Bandicoot		•	•		•
Phascolarctidae						
<i>Phascolarctos cinereus</i>	Koala	NV, V		•		•
Burramyidae						
Petauridae						
<i>Petaurus australis</i>	Yellow-bellied Glider	V	•	•	•	
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	•	•	•	•

Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

Family / Scientific name	Common name	Status	Project section			
			1-2	3-5	6-8	9-11
<i>Petaurus breviceps</i>	Sugar Glider			•	•	•
Pseudocheiridae						
<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum		•	•	•	•
<i>Petauroides volans</i>	Greater Glider		•	•	•	
Acrobatidae						
<i>Acrobates pygmaeus</i>	Feathertail Glider		•	•	•	
Phalangeridae						
<i>Trichosurus caninus</i>	Mountain Brushtail Possum		•			•
<i>Trichosurus vulpecula</i>	Common Brushtail Possum		•	•	•	•
Potoroidae						
<i>Aepyprymnus rufescens</i>	Rufous Bettong	V	•	•		
Macropodidae						
<i>Thylogale thetis</i>	Red-necked Pademelon		•			
<i>Wallabia bicolor</i>	Swamp Wallaby		•	•	•	•
<i>Macropus parryi</i>	Whiptail Wallaby	E		•		
<i>Macropus rufogriseus</i>	Red-necked Wallaby		•	•	•	
<i>Macropus giganteus</i>	Eastern Grey Kangaroo		•	•	•	•
Muridae						
<i>Rattus fuscipes</i>	Bush Rat		•	•	•	
<i>Rattus lutreolus</i>	Swamp Rat		•		•	
<i>Rattus tunneyi</i>	Pale Field-rat		•			
<i>Melomys cervinipes</i>	Fawn-footed Melomys		•			•
<i>Melomys burtoni</i>	Grassland Melomys		•		•	•
FLYING MAMMALS						
Pteropodidae						
<i>Syconycteris australis</i>	Common Blossom Bat	V				•
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	NV, V	•	•	•	•
<i>Pteropus scapulatus</i>	Little Red Flying-fox		•		•	•
Rhinolophidae						
<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe-bat		•	•	•	
Molossidae						
<i>Tadarida australis</i>	White-striped Freetail-bat		•	•	•	
<i>Mormopterus</i> sp.	Freetail Bat		•	•	•	•
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V			•	
Vespertilionidae						
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	V	•		•	
<i>Nyctophilus</i> sp.	Long-eared Bat		•	•		•
<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat			•	•	•
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat			•	•	
<i>Nyctophilus bifax</i>	Eastern Long-eared Bat	V			•	•
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V	•		•	
<i>Miniopterus australis</i>	Little Bentwing-bat	V	•	•	•	•
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat		•	•	•	•
<i>Chalinolobus morio</i>	Chocolate Wattled Bat		•	•	•	
<i>Chalinolobus nigrogriseus</i>	Hoary Wattled Bat	V	•	•	•	•
<i>Myotis macropus</i>	Southern Myotis	V	•		•	

Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

Family / Scientific name	Common name	Status	Project section			
			1-2	3-5	6-8	9-11
<i>Scotorepens</i> sp.			•			
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	•			
<i>Scotorepens greyii</i>	Little Broad-nosed Bat			•		
<i>Scotorepens orion</i>	Eastern Broad-nosed Bat		•	•	•	•
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	•	•		•
<i>Vespadelus pumilus</i>	Eastern Forest Bat		•	•	•	
<i>Vespadelus regulus</i>	Southern Forest Bat				•	
<i>Vespadelus vulturnus</i>	Little Forest Bat		•	•	•	
<i>Vespadelus darlingtoni</i>	Large Forest Bat		•		•	
INTRODUCED						
Canidae						
<i>Canis lupus</i>	Dingo, domestic dog		•	•	•	
<i>Vulpes vulpes</i>	Fox			•	•	
Felidae						
<i>Felis catus</i>	Cat			•	•	
Leporidae						
<i>Oryctolagus cuniculus</i>	Rabbit		•	•		
<i>Lepus capensis</i>	Brown Hare			•		
Muridae						
<i>Rattus rattus</i>	Black Rat			•	•	•
<i>Mus musculus</i>	House Mouse			•	•	•
Equidae						
<i>Equus caballus</i>	Horse		•	•		
Suidae						
<i>Sus scrofa</i>	Pig			•		
Bovidae						
<i>Bos taurus</i>	European cattle		•			
AMPHIBIANS						
Myobatrachidae						
<i>Adelotus brevis</i>	Tusked Frog		•			
<i>Uperoleia fusca</i>	Dusky Toadlet		•	•		
<i>Limnodynastes peronii</i>	Striped Marsh Frog		•	•	•	•
<i>Limnodynastes tasmaniensis</i>	Spotted Grass Frog			•		
<i>Limnodynastes terraereginae</i>	Northern Banjo Frog		•		•	•
<i>Mixophyes fasciolatus</i>	Great Barred Frog			•	•	
<i>Mixophyes iteratus</i>	Giant Barred Frog	NE, E	•			
<i>Limnodynastes ornatus</i>	Ornate Burrowing Frog		•			•
<i>Pseudophryne</i> sp.						•
<i>Pseudophryne bibronii</i>	Bibron's Toadlet				•	•
<i>Pseudophryne coriacea</i>	Red-backed Toadlet		•	•	•	
<i>Crinia parinsignifera</i>	Eastern Sign-bearing Froglet			•	•	
<i>Crinia signifera</i>	Common Eastern Froglet		•	•	•	•
<i>Crinia tinnula</i>	Wallum Froglet	V	•		•	•
<i>Uperoleia fusca</i>	Dusky Toadlet			•		
<i>Uperoleia laevigata</i>	Smooth Toadlet		•	•	•	
<i>Uperoleia tyleri</i>	Tyler's Toadlet			•		
<i>Uperoleia</i> sp.			•			

Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

Family / Scientific name	Common name	Status	Project section			
			1-2	3-5	6-8	9-11
Hylidae						
<i>Litoria brevipalmata</i>	Green-thighed Frog	V	•		•	
<i>Litoria caerulea</i>	Green Tree Frog		•	•	•	
<i>Litoria dentata</i>	Bleating Tree Frog		•	•	•	
<i>Litoria fallax</i>	Eastern Dwarf Tree Frog		•	•	•	•
<i>Litoria freycineti</i>	Freycinet's Frog		•			•
<i>Litoria gracilentata</i>	Dainty Green Tree Frog		•		•	
<i>Litoria latopalmata</i>	Broad-palmed Frog		•	•	•	
<i>Litoria nasuta</i>	Rocket Frog		•	•	•	
<i>Litoria peronii</i>	Peron's Tree Frog		•	•	•	•
<i>Litoria tyleri</i>	Tyler's Tree Frog		•	•	•	•
<i>Litoria revelata</i>	Revealed Frog		•			
<i>Litoria lesueuri</i>	Lesueur's Frog			•		
INTRODUCED						
Bufo						
<i>Bufo marinus</i>	Cane Toad				•	•
REPTILES						
Chelidae						
<i>Chelodina longicollis</i>	Eastern Snake-necked Turtle			•		
Agamidae						
<i>Pogona barbata</i>	Bearded Dragon		•	•		
<i>Amphibolurus muricatus</i>	Jacky Lizard			•		•
<i>Amphibolurus nobbi</i>	Nobbi		•			•
<i>Physignathus lesueurii</i>	Eastern Water Dragon		•	•	•	
Varanidae						
<i>Varanus gouldii</i>	Gould's Goanna		•			
<i>Varanus varius</i>	Lace Monitor		•	•	•	•
Scincidae						
<i>Calyptotis ruficauda</i>	Red-tailed Calyptotis		•		•	
<i>Ctenotus</i> sp.						•
<i>Egernia mcphreei</i>	Eastern Crevice Skink		•		•	
<i>Lampropholis</i> sp.						•
<i>Lygisaurus foliorum</i>	Tree-base Litter-skink			•		
<i>Carlia vivax</i>	Tussock Rainbow-skink			•		
<i>Cryptoblepharus virgatus</i>	Cream-striped Shinning-skink		•	•		•
<i>Ctenotus robustus</i>	Robust Ctenotus		•	•		•
<i>Ctenotus taeniolatus</i>	Copper-tailed Skink		•	•		•
<i>Egernia frerei</i>	Major Skink			•		
<i>Egernia major</i>	Land Mullet		•	•	•	•
<i>Lampropholis delicata</i>	Dark-flecked Garden Sunskink		•	•	•	•
<i>Lampropholis guichenoti</i>	Pale-flecked Garden Sunskink			•		•
<i>Saiphos equalis</i>	Three-toed Skink		•		•	•
<i>Eulamprus quoyii</i>	Eastern Water-skink		•	•	•	
<i>Eulamprus martini</i>	Dark Bar-sided Skink				•	
<i>Eulamprus tenuis</i>	Barred-sided Skink		•			

Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

Family / Scientific name	Common name	Status	Project section			
			1-2	3-5	6-8	9-11
<i>Tiliqua scincoides</i>	Eastern Blue-tongue		•	•		
Typhlopidae						
<i>Ramphotyphlops nigrescens</i>	Blackish Blind Snake				•	
Boidae						
<i>Morelia spilota</i>	Carpet & Diamond Pythons			•		
Colubridae						
<i>Dendrelaphis punctulatus</i>	Common Tree Snake			•	•	•
Elapidae						
<i>Cryptophis nigrescens</i>	Eastern Small-eyed Snake			•		
<i>Demansia psammophis</i>	Yellow-faced Whip Snake		•	•	•	•
<i>Hemiaspis signata</i>	Black-bellied Swamp Snake			•		
<i>Hoplocephalus stephensii</i>	Stephens' Banded Snake	V		•		
<i>Pseudechis porphyriacus</i>	Red-bellied Black Snake		•	•	•	•
INVERTEBRATES						
Noctuidae						
<i>Phyllodes imperialis</i> (southern subsp.)	Pink Underwing Moth	NE, E				•
Carabidae						
<i>Nurus atlas</i>	Atlas Rainforest Ground Beetle	NE				•

Appendix I Aquatic fauna

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KEY TO ABBREVIATIONS USED IN APPENDIX I

Abbreviation	Status
NE	Nationally Endangered species (EPBC Act)
E	Endangered species (NSW FM Act)

Family / Scientific name	Common name	Status	PROJECT SECTION			
			1-2	3-5	6-8	9-11
ESTUARINE/MARINE FISH						
Ambassidae						
<i>Ambassis marianus</i>	Estuary Perchlet					•
Atherinidae						
<i>Atherinosoma microstoma</i>	Small-mouthed Hardy Head					•
Mugilidae						
<i>Mugil cephalus</i>	Sea Mullet		•			•
Percichthyidae						
<i>Macquaria colonorum</i>	Estuary Perch		•	•		
Sparidae						
<i>Acanthopagrus australis</i>	Yellowtail Bream					•
Tetraodontidae						
<i>Torquigener pleurogramma</i>	Banded Toadfish					•
Tetrarogidae						
<i>Notesthes robusta</i>	Bullrout					•
FRESHWATER FISH						
Ambassidae						
<i>Ambassis agassizii</i>	Olive Perchlet			•	•	•
Anguillidae						
<i>Anguilla australis</i>	Short-finned Eel		•			
<i>Anguilla reinhardtii</i>	Long-finned Eel		•		•	
Ariidae						
<i>Ariopsis graeffei</i>	Blue Catfish		•			
Clupeidae						
<i>Potamalosa richmondia</i>	Freshwater Herring					•
Eleotridae						
<i>Gobiomorphus australis</i>	Striped Gudgeon		•		•	•
<i>Hypseleotris compressa</i>	Empire Gudgeon		•	•	•	•
<i>Hypseleotris galii</i>	Fire Tail Gudgeon		•	•	•	•
<i>Hypseleotris klunzingeri</i>	Carp Gudgeon				•	
<i>Philypnodon sp.</i>	Dwarf flathead gudgeon			•		
<i>Philypnodon grandiceps</i>	Flathead Gudgeon			•	•	•
Gobiidae						
<i>Unidentified Gobies</i>	Unidentified Gobies					•
Melanotaeniidae						
<i>Melanotaenia duboulayi</i>	Crimson-Spotted Rainbowfish		•			
<i>Rhadinocentrus ornatus</i>	Ornate Rainbow Fish		•		•	
Percichthyidae						
<i>Nannoperca oxleyana</i>	Oxleyan Pygmy Perch	NE, E			•	•
Plotosidae						
<i>Tandanus tandanus</i>	Freshwater Catfish			•		
INTRODUCED						

Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

Family / Scientific name	Common name	Status	PROJECT SECTION			
			1-2	3-5	6-8	9-11
Poeciliidae						
<i>Gambusia Holbrooki</i>	Plague Minnow		•	•	•	•
AQUATIC INVERTEBRATES						
Atyidae						
<i>Cardinia spp.</i>	Freshwater Shrimp					•
Mictyridae						
<i>Mictyris longicarpus</i>	Soldier Crab				•	
Parastacidae						
<i>Cherax destructor</i>	Freshwater Yabby			•		
Penaeidae						
<i>Metapenaeus bennettiae</i>	Greentail Prawn					•
<i>Metapenaeus macleayi</i>	School Prawn					•
Portunidae						
<i>Scylla serrata</i>	Mud Crab					•

Appendix J Summary of stakeholder engagement

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Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

Meeting	Agency	Issue	Strategy
W2BPA, RMS, OEH at Federation House 22/07/11 10.00am to 2.00pm	OEH	Connectivity strategy - OEH to review the Broadwater National Park report, Woodburn to Ballina Upgrading the Pacific Highway Proposed Pacific Highway Upgrade through the Broadwater National Park – Working Paper July 2008 and provide comments to RMS.	Connectivity Strategy
W2BPA, RMS, OEH at Federation House 22/07/11 10.00am to 2.00pm	OEH	<p>Connectivity strategy - RMS/W2BA to take into considerations issues raised regarding the connectivity strategy, design of the project and land acquisition activities.</p> <p>Issues raised:</p> <ul style="list-style-type: none"> - The strategy needs enough information to identify the connectivity objectives at each location and at each structure eg location, type, minimum dimensions, length of the crossing, fill heights. - Higher resolution mapping needed. - Achieve the outcome that at detailed design there is confidence in the footprint required for structures (therefore enough land has been acquired) and that there are clear objectives about structures including launch sites (trees/poles) etc and confidence in the amount of fill required. - The extent of scour is unknown until detailed design, however minimum outcome where scour is an issue should be identified eg principles, minimum standards, considers designs with the dual purpose of fauna + scour protection etc. - Some types of scour protection can be considered appropriate for fauna crossings depending on design eg rock rolling rather than straight concrete if there are appropriate species eg reptiles etc. The test will be whether it is a functional fauna crossing even with scour protection. - When fauna crossing locations are identified they should be considered and matched to existing highway crossing opportunities. - Need confidence in bridge design requirements. - Need to consider boundary fencing. - The fauna crossing strategy at Broadwater National Park was developed in consultation with DECC back in 2006. RTA requests OEH to review the information to ensure it accords with best practice including further information gathered about land bridges etc. 	Connectivity Strategy
W2BPA, RMS, DPI, Local Councils, OEH, RIS, DTI, DL - PHU W2B Planning Focus meeting 09/08/11	OEH	Consider how population dynamics and impacts are associated with/impacted by change to connectivity, fragmentation, genetic drift, isolating resources	Connectivity Strategy
W2BPA, RMS, DPI, Local Councils, OEH, RIS, DTI, DL - PHU W2B Planning Focus meeting 09/08/11	OEH	Widening median (eg for connectivity for arboreal species) - Consider existing monitoring from other projects. Review current proposed poles, rope overpasses, consider retaining vegetation	Connectivity Strategy
W2BPA, RMS, DPI, Local Councils, OEH, RIS, DTI, DL - PHU W2B Planning Focus meeting 09/08/11	DPI	Early agreement on connectivity structures/locations/design principles will require greater justification eg emus	Connectivity Strategy

Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

Meeting	Agency	Issue	Strategy
W2BPA, RMS, DSEWPAC at DSEWPAC 09/09/11 10.30am - 12.30pm	DSEWP AC	Regional Corridors - Priority areas targeting connectivity eg revegetating breaks in corridors, connectivity strategies and offsets.	Connectivity Strategy
W2BPA, RMS, DSEWPAC at DSEWPAC 09/09/11 10.30am - 12.30pm	DSEWP AC	Connectivity Strategies - Emus be aware of other work in determining correct connectivity solutions Cassowary in QLD	Connectivity Strategy
W2BPA, RMS, DSEWPAC at DSEWPAC 09/09/11 10.30am - 12.30pm	DSEWP AC	Connectivity Strategies - Evidence of Cassowary chicks getting under fencing?	Connectivity Strategy
W2BPA, RMS, DSEWPAC at DSEWPAC 09/09/11 10.30am - 12.30pm	DSEWP AC	Connectivity Strategies - Direct link between commonwealth species and mitigation strategies need to be developed eg OPP.	Connectivity Strategy
W2BPA, RMS, DSEWPAC at DSEWPAC 09/09/11 10.30am - 12.30pm	DSEWP AC	Connectivity Strategies - Connectivity, mitigation and offset.	Connectivity Strategy
W2BPA, RMS, DSEWPAC at DSEWPAC 09/09/11 10.30am - 12.30pm	DSEWP AC	Action - review scope for the EA - Revegetating breaks in connectivity strategies.	Connectivity Strategy
EPA Comments - W2B Concept Design 20/10/11	EPA	Woolgoolga to Wells Crossing - EPA notes that there appears to be insufficient terrestrial connectivity in the vicinity of Wells Crossing Flora Reserve. This area is well known for its Rufous Bettong population and adequate connectivity will be essential.	Connectivity Strategy
EPA Comments - W2B Concept Design 20/10/11	EPA	Woolgoolga to Wells Crossing - There appears to be insufficient arboreal crossings and widened medians to maintain connectivity for gliders.	Connectivity Strategy
EPA Comments - W2B Concept Design 20/10/11	EPA	Woolgoolga to Wells Crossing - Clarification regarding strategies to provide terrestrial connectivity between the new highway and the existing highway in this area is required.	Connectivity Strategy
EPA Comments - W2B Concept Design 20/10/11	EPA	Wells Crossing to Iluka - It is noted that bridges are no longer proposed in the area of Eight Mile Lane and this may eliminate or reduce effective terrestrial connectivity in this area. There are substantial road kill records and observations records of Rufous Bettongs in this area.	Connectivity Strategy
EPA Comments - W2B Concept Design 20/10/11	EPA	Wells Crossing to Iluka - There appears to be no arboreal crossings and/or widen medians to maintain connectivity for gliders. Particularly in the areas between Cold Stream River to Champions Creek.	Connectivity Strategy
EPA Comments - W2B Concept Design 20/10/11	EPA	Wells Crossing to Iluka - EPA highlights the high ecological values of Pheasant Creek, Cold Stream River, Black Snake Creek, Bostocks Gully, Champions Creek, and Chaffin Creek and the importance of providing effective connectivity in these areas.	Connectivity Strategy
EPA Comments - W2B Concept Design 20/10/11	EPA	Wells Crossing to Iluka - The ecological sensitivity and value of the Cold Stream River should be considered and addressed. This is a substantial wildlife corridor. To avoid impacts on this area, consideration should be given to shifting the alignment east towards the top of the catchment in existing cleared areas.	Connectivity Strategy

Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

Meeting	Agency	Issue	Strategy
EPA Comments - W2B Concept Design 20/10/11	EPA	Wells Crossing to Iluka - The ecological sensitivity and value of Chafin Swamp should be considered and addressed. This area is known to provide habitat for a wide range of threatened species	Connectivity Strategy
EPA Comments - W2B Concept Design 20/10/11	EPA	Wells Crossing to Iluka - The ecological sensitivity and value of Stokes Waterhole should be considered and addressed. This area is known to provide habitat for a wide range of threatened species. ie giant barred frog, broilga, black necked stalk, etc.	Connectivity Strategy
EPA Comments - W2B Concept Design 20/10/11	EPA	Wells Crossing to Iluka - EPA notes, that the location of connectivity structures have been determined prior to detailed biodiversity surveys being undertaken. Flexibility in the design, location and frequency of arboreal and terrestrial connectivity structures will be essential in this context. It is recommended that the structures proposed currently are reviewed following the outcomes of detailed biodiversity surveys.	Connectivity Strategy
EPA Comments - W2B Concept Design 20/10/11	EPA	Wells Crossing to Iluka - EPA notes, that the proposed fill heights appear to be compatible with the sizing of available pre-cast units (eg. 3.6m for box culverts). We highlight the importance of ensuring that there is flexibility in these fill heights at strategic locations to ensure that the design of terrestrial connectivity structures can be based on sound science, species characteristics, optimising height and aperture and minimising the length of the crossing.	Connectivity Strategy
EPA Comments - W2B Concept Design 20/10/11	EPA	Iluka to Woodburn - There appears to be insufficient arboreal crossings and/or widen medians to maintain connectivity for gliders in this section.	Connectivity Strategy
EPA Comments - W2B Concept Design 20/10/11	EPA	Iluka to Woodburn - With reference to the comments noted above the EPA also highlights the need for adequate and effective terrestrial crossings between the area of Iluka and Woodburn.	Connectivity Strategy
EPA Comments - W2B Concept Design 20/10/11	EPA	Iluka to Woodburn - Tabbimoble Nature Reserve - According to the Concept Design Plans V1 dated 26/09/11, EPA notes that the proposed road corridor avoids direct impacts on Tabbimoble Nature Reserve.	Connectivity Strategy
EPA Comments - W2B Concept Design 20/10/11	EPA	Iluka to Woodburn - Mororo Creek Nature Reserve - According to the Concept Design Plans V1 dated 26/09/11, EPA notes that the proposed road corridor avoids direct impacts on Mororo Creek Nature Reserve, including works along Banana Road.	Connectivity Strategy
EPA Comments - W2B Concept Design 20/10/11	EPA	Iluka to Woodburn - Bundjalung National Park - According to the Concept Design Plans V1 dated 26/09/11 – Sheet 112, EPA notes that the proposed road corridor boundary line goes through the national park but does not appear to be associated with the highway upgrade.	Connectivity Strategy

Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

Meeting	Agency	Issue	Strategy
EPA Comments - W2B Concept Design 20/10/11	EPA	Iluka to Woodburn - Yaegl Nature Reserve – the following issues should be addressed in the process to refine the design in this area: - The Farlows Lane bridge area is a known wildlife corridor and is identified in the Parks Plan of Management (POM) as an area to be enhanced to improve wildlife movement. - Drainage – rate, frequency, scale & PASS (potential acid sulphate soils) and the impact this may have on the swamp. - Loss of the SFAZ – on the western boundary potential reduction capacity to restrict fires coming off the road easement. - Access - the high ground on Farlows Lane is the main point (& only all weather access) for management works on the western side and some form of all weather access is required in this area.	Connectivity Strategy
EPA Comments - W2B Concept Design 20/10/11	EPA	Bridge Design Principles - To enable effective fauna passage, bridge design should include adequate set back to ensure at least 3m wide passage from the toe of scour protection to the mean high water mark.	Connectivity Strategy
W2BPA, RMS, NPWS, OEH at Broadwater National Park 07/12/11 1.00pm to 3.15pm	NPWS/OEH	Access to the park via service road northbound and upgrade southbound overbridge allow interconnectivity between the park either side of the upgrade corridor.	Connectivity Strategy
W2BPA, RMS, NPWS, OEH at Broadwater National Park 07/12/11 1.00pm to 3.15pm	NPWS/OEH	Connectivity over bridges need to be effective. The understanding of the fauna that is likely to use it needs to be understood including the review of the unlikely use by emus previously considered a possibility. Habitat unlikely for emus (remnant coastal hinterland forest). No NP rangers have seen Emus in the park. Visual fauna fencing may not be required.	Connectivity Strategy
W2BPA, RMS, NPWS, OEH at Yaegl Nature Reserve 07/12/11 9.00am to 11.30am	NPWS/OEH	Connectivity - has been considered with 35m 1.6 x 1.2m RCBC requiring special inlet (entrance) treatment as located in cutting. The location of this structure may need to be considered further. One solution might be to combine the proposed drainage culvert with the underpass. The proposed drainage culvert next to the fauna underpass is relatively small (4ft), is this structure designed as a Frog/small mammal underpass? Larger culverts located to the east of the reserve on the flood plain may also need to be considered in respect to fauna corridor and connectivity with model designs on culvert inverts to be considered to allow low flow and potential dry access for fauna. Balancing hydrology and fauna passage. Refer to “RMS combined Fauna Crossing Principles”. Species using the crossings need to be known and targeted as part of ecology investigation. Landcare (Russell Jayco 6664 4055, 0428 644055 or Greg Clancy) and Wetland Care Australia (recently done a study on the SEPP14 wetland near Farlows Flat. Will have a good idea on vegetation mapping and species in the area) are key stakeholders that may add value in understanding the species. Also the Farlow property owners.	Connectivity Strategy

Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

Meeting	Agency	Issue	Strategy
W2BPA, RMS, NPWS, OEH at Yaegl Nature Reserve 07/12/11 9.00am to 11.30am	NPWS/OEH	Access to the nature reserve would be via Farlow Lane and Koala Lane and under the upgrade. Access would also allow for fauna passage for larger species ie Kangaroos that require a 3mx3m passage. Kangaroos use the existing underpass on a regular basis. The current design does not seem to allow for the reinstatement of the bridge nor the access. Steep terrain to the west of the existing access will also be a constraint to be considered further.	Connectivity Strategy
W2BPA, RMS, NPWS, OEH at Yaegl Nature Reserve 07/12/11 9.00am to 11.30am	NPWS/OEH	Is YNR a Wildlife Corridor? Will need to be considered.	Connectivity Strategy
W2BPA, RMS, NPWS, OEH at Yaegl Nature Reserve 07/12/11 9.00am to 11.30am	NPWS/OEH	CVC have a Koala Plan of management which shows data mapping of koala habitat with considerable reference to roads. Plan is currently been exhibited for public comment and is subject to approval by DoP&I.	Connectivity Strategy
W2BPA, RMS, DPI at DPI 19/12/11 10.30am - 11.30am	W2BPA	There is a focus on connectivity.	Connectivity Strategy
W2BPA, RMS, DPI at DPI 19/12/11 10.30am - 11.30am	DPI	Fauna connectivity is an important issue, including crossing locations and structures.	Connectivity Strategy
W2BPA, RMS, DPI at DPI Grafton 09/03/12 9.30am	DPI	Forests - Land management issues on adjoining state forest land (protection zones and access). Suggestion that connectivity measures could match forestry protection zones (eg along gullies and waterways, which are protected from logging). Action - Provide state forests with connectivity points in state forests along route. Obtain mapping of state forest zonings to assist with matching connectivity locations, and assessing state forest access needs.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Design/underpass principles - Verify term 'native forest' to ensure it includes all relevant types of native fauna habitat.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Design principles - Fauna fencing – Check height requirements to prevent kangaroos crossing (and leaving joeys behind - Glenugie example).	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Design principles - Grade and length of culverts needs to be considered when designing fish passage.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Fish passage - Consider use of Bebo arch structures for fish passage.	Connectivity Strategy

Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

Meeting	Agency	Issue	Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Fish passage - Sections 8 & 9 should also consider potential OPP. Critical habitat declaration made is conservative and was developed during drought. Since then, OPP habitat has increased.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Fish passage - More robust scour protection including on streambeds is starting to be used – strategy to consider where this may be required and how this may affect fish passage widths.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Fish passage - Box culverts at major fish habitat = poor logic – check whether these are really class 1 waterways.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Fish passage - Cross check waterway classes against proposed structures.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Fish passage - Identify waterway class in the structures table.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Fish passage - Fisheries input is required at the detailed design stage - initially Woolgoolga to Glenugie.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Fish passage - Grade and length of culverts needs to be considered when designing fish passage and be captured in the principles.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Fish passage - CH18900 to CH130107 – This is potential OPP habitat. The OPP construction mitigation measures apply. Include in the table.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Consider threatened amphibians.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Suggest ground-truth proposed structures to confirm feasibility.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Ensure passage outcomes (including tree heights) for both A – M class are addressed.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	When surveying tree heights consider all construction footprint requirements/drainage /other infrastructure etc to establish clearing limits.	Connectivity Strategy

Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

Meeting	Agency	Issue	Strategy
Presentation			
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Demonstrate how the design principles achieve ESD.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Demonstrate how the principles help achieve recovery plan objectives/key priority actions etc - eg koalas.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 1 - Common planigale	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 1 - Giant barred frog	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 1 - Potoroo (Sherwood and Wells Crossing)	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 1 - Koalas south of Glenugie?	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 1 - Bettongs near Eight mile lane.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Near Cassons and Redbank Creek – acceptable as only potential OPP habitat. Won't be acceptable further north Section 1 - where there are known records of OPP.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 1 - However, what is proposed at Redbank Creek does not meet class 1 waterway requirements. Need to check classification of waterway and habitat.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 1 - CH8510 – Length is 170 m. Check sizing meets relevant design principles, can it be enlarged?	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 1 - CH8600 – Possibility for planigales.	Connectivity Strategy

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Meeting	Agency	Issue	Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 1 - CH11785 – Length missing – Check length.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 1 - CH 13315 – Investigate: - Actual break in culvert for daylight. - Whether culvert is needed at the service road. - Check total length.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 1 - CH17800 - Investigate if another crossing is possible at this location. This location is limited by low fill.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 1 - CH 18000 to 20500 – There are mainly incidental crossings in this location. Consider alternatives eg: - Widths considering fill heights. - –Low plank bridges as at Bonville and Millhill.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 1 - CH 23600 – Investigate gliders poles. Are they still needed given the widened median?	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 1 - CH23125 – Note 1.8 m is low for a dedicated structure. Investigate: - Can height be increased? - Will two short culverts be suitable? - Can the location be integrated into the median crossing?	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 2 - CH 18000 – 20500- need to identify alternatives as area is in low fill.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 2 - CH 23125 - Scope to increase height (is fill height enough). - Look at fauna fencing as tied in to the widened median.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 2 - CH 25950 - Update table to include length - Look at increasing height	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 2 - General: update table to include all structure lengths	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 2 - CH 27420 – check if structure can be 3x3 or 3.6x3	Connectivity Strategy

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Meeting	Agency	Issue	Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 3 - Koala records in this area need to be considered.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 3 - CH39650 - Structure is too low, is there scope to increase height? -Need to clarify if there are two structures or one. - Clarify the gap between the two structures	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 3 - CH54706 – Check that koalas and phascogales are included as target species.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 3 - CH61750 to Tyndale interchange (CH67300) - Is there opportunity for arboreal crossing (gliders). - Fragmented potential habitat for gliders on western side. - Known habitat on the eastern side.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 3 - CH56550 - Potential Giant Barred Frog and in the vicinity of Chaffin Swamp. - Active nest site on the western side for Black Neck Stork near Tyndale and Chaffin Swamp. - NPWS to provide information about this.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	CH75500, look at revegetation from underpass to habitat	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	CH75900 (Green Hill) - review justification of crossing and the location. - Clarify presence of arboreal species and if the structure is suitable.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 6 - CH96000-CH10000 – look at opportunities for: - Dedicated culverts.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 6 - CH101100 – Check length.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 6 - CH103000 to 105500 – Check for: - More crossing opportunities. - Revegetation opportunities.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 6 - Consider all of Section 6 as potential OPP. Fisheries are happy with the crossing structures proposed, however OPP construction mitigation measures need to be included in this section (put into table).	Connectivity Strategy

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Meeting	Agency	Issue	Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 7 - CH113920 - Look at opportunity of bridge instead of existing culvert. - Confirm presence of OPP.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 7 - CH116400 - note that structure within median widening, check if structure needed after tree assessment.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 7 - Need to consider broader impacts at the tie-in with Devils Pulpit.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 7 - CH117300 – Check feasibility of the dedicated structure.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 7 - CH11600-11850 - Consider feasibility and constructability of median widening and structure as in a 6m fill. - Check tie-in with existing road.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 7 - CH 120500 – Gap in this area - requires investigation into possibility for structures.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 7 - CH123590 – Major fish habitat – Check waterway class check that structure meets design principles/requirements. Is a bridge needed?	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 7 - General - Check for yellow-bellied glider, wallum froglet and amphibians in general, brush-tailed phascogale.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 8 - CH134600 – OPP confirmed – Small waterway - investigate bridge/arch structure - most likely needed for EPBC approval.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 9 - CH138430 – investigate need for this structure considering targeted species and function of overpass. As part of investigations confirm length/gap dimensions.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 9 - CH139440 – investigate need for this structure considering targeted species and function of overpass. As part of investigations, confirm length/gap dimensions.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint	W2BPA/RMS	Section 9 - Re CH above - If split carriageway, consider whether need two structures or one.	Connectivity Strategy

Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

Meeting	Agency	Issue	Strategy
Presentation			
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 9 - Broadwater NP – Review options taking into account the revocation area.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 9 - CH140620 – Review tree heights and investigate whether glider poles are feasible.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 9 - CH143000 - CH143200 – Check the drainage lines/waterway class and check against small culvert sizes (re OPP).	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 10 - Ch146360 – Check culvert size against length (3x3 and 38 m).	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 10 - CH150030 – CH150600 – Check culvert sizes against design principles and targeted species. Consider koalas. Consider context eg - fauna passage provided by adjacent viaducts. These structures may need to be downgraded to 'incidental'.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 10 - CH154055 – Currently 'incidental' - investigate whether this can become a connectivity structure.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 10 - CH157500 – CH158000- Investigate change to incidental structure.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	End of section 10 to start of section 11 - Investigate where habitat is for species recorded by Alliance but not in Atlas.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 11 - CH157500 – CH158000 – Investigate change to incidental structures.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 11 - CH159600 – Identify the gap between service road and highway. Consider increasing height as this is a dedicated structure.	Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Design principles - Clarify the design principles to define the passage envelope for emus as - 3.6 m to the soffit with a minimum width of 4 m wide – Consider including a sketch.	Emu Strategy/Connectivity Strategy

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Meeting	Agency	Issue	Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Design principles - Land bridges – Re-consider minimum width requirements for land bridges and include specific requirements for emus.	Emu Strategy/Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 3 - CH48300 – note this is the potential emu land bridge location. Yet to agree on the design principles.	Emu Strategy/Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 3 - Questioned emu connectivity value of the 'combined' overpasses (eg CH54706 and etc) and underpasses (eg CH56898). Refer to these as 'incidental'.	Emu Strategy/Connectivity Strategy
PHU W2B Connectivity Workshop 01/06/12 PowerPoint Presentation	W2BPA/RMS	Section 4 - Between Tyndale and Maclean Interchange - Reconsider providing emu passage, provide fencing at bottom of fill embankment - Fencing strategy important	Emu Strategy/Connectivity Strategy
W2BPA, RMS, OEH at Federation House 14/06/11 12.00pm to 3.00pm	OEH	Emu strategy - OEH identified that more information is needed on the draft emu strategy to determine a cost effective approach. OEH would seek the opportunity for funds to contribute towards the research.	Emu Strategy
W2BPA, RMS, OEH at Federation House 14/06/11 12.00pm to 3.00pm	OEH, RMS	Emu strategy - RMS and OEH would progress on the emu strategy including the aims, intent, methodology and outcomes	Emu Strategy
W2BPA, RMS, OEH at Federation House 14/06/11 12.00pm to 3.00pm	OEH, RMS, W2BPA	Emu strategy - To facilitate this, the draft emu strategy needs to be updated to include methodologies, aims and objectives of the research approaches as listed below: <ul style="list-style-type: none"> • Satellite tracking (could it be feasible)? • Scat analysis. • DNA analysis. • Identify if there are any existing structures on local roads that can be used for trials. • Identify suitable locations along the project alignment for early fencing and/or structure and fencing trials. • OEH Wildlife Atlas updated (this could be by a person provided by RMS or the Alliance working with Gina Hart). • We also talked about the strategy addressing / discussing its feasibility, practicality in being undertaken, duration, performance criteria, equipment, resources etc, constraints, limitations, risks. All these factors and variables would need to be considered / addressed in order to move forward with a methodology that can be implemented. • We also talked about the design principles and location of the connectivity structures that have been incorporated into the concept/detailed design. This conversation included: <ul style="list-style-type: none"> • Emu specialist recommended 6m height clearance for structures, passage. Structures have been designed to 3.6m in height as a minimum, constraints associated with the fill heights. Location and design of the structures developed in consult with project 	Emu Strategy

Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

Meeting	Agency	Issue	Strategy
		<p>ecologist.</p> <ul style="list-style-type: none"> • It was also commented that project would significantly impact on the southern Emu population, talked about the need to consider diet and therefore eliminate food resources away from the road and place in locations of connectivity as part of landscape plan. • Discussed how, scat analysis would help identify food resources, thus potential movement patters based on seasonal fruiting and thus identified species to address in the landscape plan. Discussed the constraints and limitations to scat analysis surveys due to the vast area of land to cover, how to make the survey representative, age of scats, viability etc. • Discussed the feedback from property owner about repeated behaviour of visiting farm dam during summer – their use of dams. • Discussed the opportunity to carryout Emu survey with landowners particularly the RTA is proposing to commence property acquisition as soon as possible. The Emu survey could tie in with this activity. 	
W2BPA, RMS, OEH at Federation House 22/07/11 10.00am to 2.00pm	OEH	Emu strategy - RMS/W2BPA to provide a resource to update the Atlas with emu data. This is to be done at the Grafton office and is anticipated to take two weeks.	Emu Strategy
W2BPA, RMS, OEH at Federation House 22/07/11 10.00am to 2.00pm	OEH	Emu strategy - RMS/W2BPA to investigate known hot spots for emu road kill to identify the characteristics of the surrounding area eg topography, habitat, visibility etc to see whether there are common characteristics that encourage emus to cross at certain locations.	Emu Strategy
W2BPA, RMS, OEH at Federation House 22/07/11 10.00am to 2.00pm	OEH	Emu strategy - RMS/W2BPA to investigate/scope the feasibility and cost of trialling fences and a structure on Kerry Cranney's property.	Emu Strategy
W2BPA, RMS, OEH at Federation House 22/07/11 10.00am to 2.00pm	OEH	Emu strategy - RMS/W2BPA to identify any hardship acquisition sites on the alignment that could be used as a trial site for structures and fencing.	Emu Strategy
W2BPA, RMS, OEH at Federation House 22/07/11 10.00am to 2.00pm	OEH	Emu strategy - OEH to prepare cost and scope for undertaking analysis of the genetic material extracted from feathers by Macquarie University.	Emu Strategy
W2BPA, RMS, OEH at Federation House 22/07/11 10.00am to 2.00pm	OEH	Emu strategy - OEH/RMS/W2BPA to prepare cost and scope for scat study including collection of scats and analysis for genetic and dietary information.	Emu Strategy

Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

Meeting	Agency	Issue	Strategy
W2BPA, RMS, OEH at Federation House 22/07/11 10.00am to 2.00pm	OEH	Emu strategy - OEH/RMS/W2BPA to liaise with wildlife carers and prepare cost and scope for providing wildlife carers (eg Kerry Cranney) with satellite tracking devices for use if any emus come into care and are subsequently released.	Emu Strategy
W2BPA, RMS, OEH at Federation House 22/07/11 10.00am to 2.00pm	OEH	Emu strategy - RMS/W2BPA to liaise with emu experts prior to the next meeting.	Emu Strategy
W2BPA, RMS, OEH at Federation House 22/07/11 10.00am to 2.00pm	OEH	Emu strategy - OEH/RMS/W2BPA/Kerry Cranney and any other relevant persons to meet again in September to discuss and further the emu strategy and its implementation	Emu Strategy
W2BPA, RMS, DPI, Local Councils, OEH, RIS, DTI, DL - PHU W2B Planning Focus meeting 09/08/11	DPI	Emu strategy- relevant councils involvement needed	Emu Strategy
W2BPA, RMS, OEH, CSIRO at Federation House 12/10/11 10.30am to 4.00pm	OEH	Emu strategy - Check that the design of the three metre dry passage for emus beneath the bridges is three metres from the toe of the scour protection, not from the embankment (CT/CG).	Emu Strategy
W2BPA, RMS, OEH, CSIRO at Federation House 12/10/11 10.30am to 4.00pm	OEH	Emu strategy - Continue efforts to involve Miriam Gooseman (CT/AN).	Emu Strategy
W2BPA, RMS, OEH, CSIRO at Federation House 12/10/11 10.30am to 4.00pm	OEH	Emu strategy - Contact Dr Brain Chambers (CT/AN).	Emu Strategy
W2BPA, RMS, OEH, CSIRO at Federation House 12/10/11 10.30am to 4.00pm	OEH	Emu strategy - OEH to provide feedback on the structure trial methodology by 26th Oct (SG/CH).	Emu Strategy
W2BPA, RMS, OEH, CSIRO at Federation House 12/10/11 10.30am to 4.00pm	OEH	Emu strategy - Develop survey form for use during the concept design display identifying property ownership over the Pillar valley eg who, where the structures are etc (GM/Alliance).	Emu Strategy
W2BPA, RMS, OEH, CSIRO at Federation House 12/10/11 10.30am to 4.00pm	OEH	Emu strategy - Advise RTA of lab time available for DNA and diet analysis (DW).	Emu Strategy
W2BPA, RMS, OEH, CSIRO at Federation House 12/10/11 10.30am to 4.00pm	OEH	Emu strategy - Emu team to develop methodology for collection and the timing for collection (Alliance/RTA emu team).	Emu Strategy

Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

Meeting	Agency	Issue	Strategy
W2BPA, RMS, OEH, CSIRO at Federation House 12/10/11 10.30am to 4.00pm	OEH	Emu strategy - Identify whether an early pilot study is needed or not (Alliance/RMS emu team).	Emu Strategy
W2BPA, RMS, OEH, CSIRO at Federation House 12/10/11 10.30am to 4.00pm	OEH	Emu strategy - Develop a leaflet seeking emu information from the local community by 14 Oct (RM).	Emu Strategy
W2BPA, RMS, OEH, CSIRO at Federation House 12/10/11 10.30am to 4.00pm	OEH	Emu strategy - The methodology for the DNA analysis has been updated following the meeting and provided to OEH. RTA requests OEH feedback on the methodology by 26th October 2011 (OEH).	Emu Strategy
W2BPA, RMS, OEH, CSIRO at Federation House 12/10/11 10.30am to 4.00pm	OEH	Emu strategy - New data in Atlas to be considered in the vehicle collision study (CT).	Emu Strategy
W2BPA, RMS, OEH, CSIRO at Federation House 12/10/11 10.30am to 4.00pm	OEH	Emu strategy - Emu team to further consider the satellite tracking methodology including potentially releasing emu chicks (at around 7 months old) from the property in the Pillar Valley and the use of GPS trackers (RMS/Alliance emu team).	Emu Strategy
W2BPA, RMS, OEH, CSIRO at Federation House 12/10/11 10.30am to 4.00pm	OEH	Emu strategy - W2BPA updated the OEH Atlas with emu records, including more than 50 new road kill sites. Action - W2BPA are now to investigate these areas as part of the vehicle collision study.	Emu Strategy
W2BPA, RMS, OEH, CSIRO at Federation House 12/10/11 10.30am to 4.00pm	OEH	Emu strategy - OEH (Macquarie University) analysis of genetic material extracted from feathers. Outcome - The analysis of the feather DNA against the western emu population won't change the scope of this project and so this work is not a high priority for the EIS. This option is identified as a low priority option and no further actions are proposed at this time	Emu Strategy
W2BPA, RMS, OEH, CSIRO at Federation House 12/10/11 10.30am to 4.00pm	OEH	Emu strategy - RMS/W2BPA to liaise with emu experts. Outcome - Neither W2BPA nor OEH have had any luck liaising with emu experts. CT contacted the Australian emu breeders association however they were reluctant to be involved. No one has been able to contact Miriam Gooseman. Action - CSIRO to ask Miriam to contact RMS. W2BPA/RMS will contact Dr Brian Chambers.	Emu Strategy

Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

Meeting	Agency	Issue	Strategy
W2BPA, RMS, OEH, CSIRO at Federation House 12/10/11 10.30am to 4.00pm	OEH	Emu strategy - RMS/W2BPA to identify any hardship acquisition sites on the alignment that could be used as a trial site for structures and fencing. Outcome - The alignment between Pine Brush State Forest and Coldstream is identified as the location where structures and fencing could be trailed. Ideally there would be as great a continuous length as possible, up to 2-3 km. The trials would aim at assessing whether the emus can be directed to gaps in the fencing and also whether they would traverse structures the size of the proposed culverts. The RMS would need to acquire or lease land to undertake the trials. RMS does own some land along this length. A section 91 licence is likely to be required for the work. OEH Northern region identified that they can assist with any application made. W2BPA identified that a survey form could be used during the concept design display to make contact with land owners along the alignment. Actions - The methodology for the structure trials has been updated following the meeting and provided to OEH. RMS requests OEH feedback on the methodology by 26th October 2011 (OEH). Develop survey form for use during the concept design display identifying property ownership over the Pillar valley eg who, where the structures are etc (W2BPA).	Emu Strategy
W2BPA, RMS, OEH, CSIRO at Federation House 12/10/11 10.30am to 4.00pm	OEH	Emu strategy - RMS/W2BPA to investigate/scope the feasibility and cost of trialling fences and a structure on Kerry Cranney's property. Outcome – The trialling of structures and fences on Kerry Cranney's property has been considered. The conditions at this property do not match those along the alignment and the emus that may pass through the structures are likely to have been hand reared and habituated to humans and their structures. This option is identified as a low priority option and no further actions are proposed at this time.	Emu Strategy
W2BPA, RMS, OEH, CSIRO at Federation House 12/10/11 10.30am to 4.00pm	OEH	Emu strategy - OEH to investigate scat study for DNA and diet. Outcome – David Westcott from CSIRO provided a presentation on how scat analysis may assist the investigations. Actions: - CSIRO to advise RTA of lab time available for DNA and diet analysis. - W2BPA/Emu team to develop methodology for collection and the timing for collection. - W2BPA/Emu team to identify whether an early pilot study is needed or not. - RMS to develop a leaflet seeking emu information from the local community by 14 October 2011. - OEH to provide feedback to RMS on the methodology for the DNA analysis by 26th October 2011.	Emu Strategy
W2BPA, RMS, OEH, CSIRO at Federation House 12/10/11 10.30am to 4.00pm	OEH	Emu strategy - Vehicle collision study - RMS/W2BPA - to investigate known hot spots for emu road kill to identify the characteristics of the surrounding area eg topography, habitat, visibility etc to see whether there are common characteristics that encourage emus to cross at certain locations. Outcome - W2BPA outlined the further investigations that will be undertaken soon to identify the factors involved in emu road kills. CSIRO advised that involving an accident investigations specialist could provide an important perspective. Action - W2BPA - New data in Atlas to	Emu Strategy

Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

Meeting	Agency	Issue	Strategy
		be considered in the vehicle collision study.	
W2BPA, RMS, OEH, CSIRO at Federation House 12/10/11 10.30am to 4.00pm	OEH	Emu strategy - Satellite Trackers - RMS/W2BPA/OEH to liaise with wildlife carers and prepare cost and scope for providing wildlife carers (eg Kerry Cranney) with satellite tracking devices for use if any emus come into care and are subsequently released. Action - RMS/W2BPA/Emu team to further consider the satellite tracking methodology including potentially releasing emu chicks (at around 7 months old) from the property in the Pillar Valley and the use of GPS trackers (RTA/Alliance emu team).	Emu Strategy
EPA Comments - W2B Concept Design 20/10/11	EPA	Wells Crossing to Iluka - It is noted that around eight bridges have been removed from the design, particularly between Pillar Valley and Coldstream River. EPA understands this is a result of shifting the alignment to the east onto higher ground. This will clearly have an impact on the permeability of the highway to fauna particularly in relation to the Coastal Emu population. The use of elevated road structures, overpasses and bridges should be implemented to minimise impacts on the Emu population.	Emu Strategy
EPA Comments - W2B Concept Design 20/10/11	EPA	Wells Crossing to Iluka - The known Emu activity in the area of Macintyre Lane should be considered and addressed, particularly in relation to access roads, services roads, fencing etc.	Emu Strategy
EPA Comments - W2B Concept Design 20/10/11	EPA	The EPA understands that the 12m design gap between bridges is to accommodate for a future 6 lane highway, with the ultimate design providing a very dark and long (around 100m) fauna passage. We note that such designs will significantly impact on light penetration and is likely to compromise the functionality of the structure for fauna passage, particularly for Emus. The ultimate likely configuration of the highway should be addressed in the current designs to ensure that effective fauna passage can be retained under a 6 lane configuration.	Emu Strategy
W2BPA, RMS, OEH at Federation House 14/06/11 12.00pm to 3.00pm	OEH	Offset strategy - Alliance to consider whether the vegetation mapping is consistent with the biometric vegetation types consistent with the vegetation classification used in Biobanking or if it needs to be converted.	Offset Strategy
W2BPA, RMS, OEH at Federation House 22/07/11 10.00am to 2.00pm	OEH	Offset strategy - RMS/W2BPA to develop offset strategy with consideration to issues raised. Issues raised: - Demonstrate general consistency with the biobanking approach. - Will be good to have the offset strategy in the EIS and approved as part of the EIS and this will improve clarity and certainty. - The strategy should include a methodology developed in consultation with OEH that identifies how to offset species impacts eg based on those fauna that require species credits when using the biobanking approach.	Offset Strategy

Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

Meeting	Agency	Issue	Strategy
		- The strategy should identify the occurrence of available offset areas (broadscale) and present the data in the OEH biometric vegetation types.	
W2BPA, RMS, DPI, Local Councils, OEH, RIS, DTI, DL - PHU W2B Planning Focus meeting 09/08/11	DPI	Offset strategy should include - availability of offset vegetation eg within 100 km	Offset Strategy
W2BPA, RMS, DSEWPAC at DSEWPAC 09/09/11 10.30am - 12.30pm	DSEWPAC	Understanding of habitat corridors and providing more about offset strategies and early understanding of options and opportunities.	Offset Strategy
W2BPA, RMS, DSEWPAC at DSEWPAC 09/09/11 10.30am - 12.30pm	DSEWPAC	Understanding regional corridors would be important in fitting with new offset policy.	Offset Strategy
W2BPA, RMS, DSEWPAC at DSEWPAC 09/09/11 10.30am - 12.30pm	DSEWPAC	Regional Corridors - tying offset packages back to corridors.	Offset Strategy
W2BPA, RMS, DSEWPAC at DSEWPAC 09/09/11 10.30am - 12.30pm	DSEWPAC	Regional Corridors - understanding fragmentation in corridors and offsets.	Offset Strategy
W2BPA, RMS, DSEWPAC at DSEWPAC 09/09/11 10.30am - 12.30pm	DSEWPAC	Regional Corridors - Revegetation of strategic areas would be considered an appropriate offset.	Offset Strategy
W2BPA, RMS, DSEWPAC at DSEWPAC 09/09/11 10.30am - 12.30pm	DSEWPAC	New draft offset strategy (available by end of 2011 online) - There is a calculator that goes with the strategy and the Dept is looking for some consistency with the OEH calculator?	Offset Strategy
W2BPA, RMS, DSEWPAC at DSEWPAC 09/09/11 10.30am - 12.30pm	DSEWPAC	New draft offset strategy - Calculation of impact points, 75% direct compensation, 25% indirect required.	Offset Strategy
W2BPA, RMS, DSEWPAC at DSEWPAC 09/09/11 10.30am - 12.30pm	DSEWPAC	New draft offset strategy - Offsets need to target the Commonwealth species impacted.	Offset Strategy
W2BPA, RMS, DSEWPAC at DSEWPAC 09/09/11 10.30am - 12.30pm	DSEWPAC	Offset Management (Dept preference for management of offset lands) - Dept priority is to have offset to be managed as part of NP or NR. But they did not rule out other options. Reason - because State Government Agencies provide increased certainty in long term protection. National Parks extinguish mining rights.	Offset Strategy

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Meeting	Agency	Issue	Strategy
W2BPA, RMS, DSEWPAC at DSEWPAC 09/09/11 10.30am - 12.30pm	DSEWP AC	Offset Management - Rural private lands require conservation agreements but still a potential risk (mining rights) State Forest land require conservation agreements (Agencies need to accept to achieve protection for Dept).	Offset Strategy
W2BPA, RMS, NPWS, OEH at Broadwater National Park 07/12/11 1.00pm to 3.15pm	NPWS/ OEH	Compensation offset Irongate property is also Cultural Heritage Site (significance with Massacre, River etc.). Haynes property has been targeted Adjacent to Double Duke State Forest. OEH regional strategy at identifying lands is based on Rationalising and consolidation of boundaries, considering key corridor linkages, managing land and consideration of landownership ie compensatory land should not create a new NP in isolation. Compensatory land should border a NR NP or forest to maintain connectivity with existing environment.	Offset Strategy
W2BPA, RMS, NPWS, OEH at Broadwater National Park 07/12/11 1.00pm to 3.15pm	NPWS/ OEH	Understand the residual land from Bell, Watt, and McDonald as an opportunity and that fits with the strategy. OPP habitat would be an issue that would need to be addressed and mitigated as part of the Parks fire management and recovery strategies, issue is consistent with managing fires in riparian zones.	Offset Strategy
W2BPA, RMS, NPWS, OEH at Yaegl Nature Reserve 07/12/11 9.00am to 11.30am	NPWS/ OEH	PWG - have process of assessing potential offset land, methodology includes Bio-banking desk top and EPA principles of offset which includes 'like for like' understanding vegetation type with an equal to or better than outcome. Ray Fowke and Tania Munn Environmental Planning Assessment are the key contacts in respect to Compensation assessment. Lands have been identified for BNP (Irongate Property - Evans Head and Haynes Tabbimoble) The RMS land adjacent to western residue of the reserve will need to be further considered and assessed in respect to the vegetation content/suitability for consideration as compensation.	Offset Strategy
W2BPA, RMS, NPWS, OEH at Yaegl Nature Reserve 07/12/11 9.00am to 11.30am	NPWS/ OEH	Boundary Fencing - OEH not expecting further clearing in reserve (2m) to allow fencing on the boundary. Fencing should be offset to minimise clearing. Details of escape mechanism need to be presented to determine suitability for identified species (may be used in Fire, flood etc.). Fencing must only use plain wire not barbed	Offset Strategy
W2BPA, RMS, DPI at DPI 19/12/11 10.30am - 11.30am	RMS	The bio banking, threatened species profiles tool is being used as part of the methodology for identifying potential habitat and species occurrence.	Offset Strategy
W2BPA, RMS, DPI, Local Councils, OEH, RIS, DTI, DL - PHU W2B Planning Focus meeting 09/08/11	Coffs Harbour City Council	Council has an Estuary management plan for the Corindi River	Other
W2BPA, RMS, DPI, Local Councils, OEH, RIS, DTI, DL - PHU W2B Planning Focus meeting 09/08/11	OEH	Population dynamics of threatened species including direct and indirect impacts	Other

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Meeting	Agency	Issue	Strategy
W2BPA, RMS, DPI, Local Councils, OEH, RIS, DTI, DL - PHU W2B Planning Focus meeting 09/08/11	OEH	Access all existing information, OEH can assist eg. There is information available on koalas south of Broadwater and Maclean, Bettongs- Corindi to Glenugie, Black-legged storks.	Other
W2BPA, RMS, DPI, Local Councils, OEH, RIS, DTI, DL - PHU W2B Planning Focus meeting 09/08/11	OEH	Sheet flow management should mimic existing situation re. cross-drainage needs to be adequate to protect riparian, wetlands habitat etc. (eg. Identify and consider sensitive areas for sheet flow)	Other
W2BPA, RMS, DPI, Local Councils, OEH, RIS, DTI, DL - PHU W2B Planning Focus meeting 09/08/11	OEH	Ospreys at Harwood have been successfully managed by RTA and relocated from the bridge - Consider how they would continue to be managed	Other
W2BPA, RMS, DPI, Local Councils, OEH, RIS, DTI, DL - PHU W2B Planning Focus meeting 09/08/11	OEH	Wetland encroachment has occurred in the region. Validate vegetation mapping and potential distribution of aquatic species, birds and frogs.	Other
W2BPA, RMS, DPI, Local Councils, OEH, RIS, DTI, DL - PHU W2B Planning Focus meeting 09/08/11	OEH	Giant Barred Frog- eg this is a cryptic species occurring in sub-optimal habitat such as dams.	Other
W2BPA, RMS, DPI, Local Councils, OEH, RIS, DTI, DL - PHU W2B Planning Focus meeting 09/08/11	OEH	Vegetation mapping- local council mapping is more accurate than CRAFTI, more accurate mapping should be done earlier.	Other
W2BPA, RMS, DPI, Local Councils, OEH, RIS, DTI, DL - PHU W2B Planning Focus meeting 09/08/11	RIS (Fisheries), DTI	Water quality management - Water quality must be in the low pH range (6.5-8) for Oxleyan Pygmy Perch (OPP) and those ecosystems	Other
W2BPA, RMS, DPI, Local Councils, OEH, RIS, DTI, DL - PHU W2B Planning Focus meeting 09/08/11	RIS (Fisheries), DTI	Lessons learnt of OPP from the Devils Pulpit project to be considered eg. See EPBC conditions of approval	Other
W2BPA, RMS, DPI, Local Councils, OEH, RIS, DTI, DL - PHU W2B Planning Focus meeting 09/08/11	RIS (Fisheries), DTI	OPP- timing constraints regarding construction of waterway crossings	Other
W2BPA, RMS, DPI, Local Councils, OEH, RIS, DTI, DL - PHU W2B Planning Focus meeting 09/08/11	RIS (Fisheries), DTI	Field surveys are likely to find OPP in areas above the pH range	Other
W2BPA, RMS, DPI, Local Councils, OEH, RIS, DTI, DL - PHU W2B Planning Focus meeting 09/08/11	RIS (Fisheries), DTI	OPP have a short life cycle (4 years) therefore need to maintain breeding grounds during construction	Other

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Meeting	Agency	Issue	Strategy
W2BPA, RMS, DPI, Local Councils, OEH, RIS, DTI, DL - PHU W2B Planning Focus meeting 09/08/11	RIS (Fisheries), DTI	OPP use floods to re-distribute so field surveys will only identify their current distribution. Therefore potential distribution needs to be considered and managed/assessed accordingly.	Other
W2BPA, RMS, DPI, Local Councils, OEH, RIS, DTI, DL - PHU W2B Planning Focus meeting 09/08/11	Clarence Valley Council	Council have a Biodiversity Management Strategy identifying priority concerns and wildlife corridors. There is also a Clarence Estuary Management Plan.	Other
W2BPA, RMS, DPI, Local Councils, OEH, RIS, DTI, DL - PHU W2B Planning Focus meeting 09/08/11	DPI	Survey to take into consideration seasons and breeding times	Other
W2BPA, RMS, DSEWPAC at DSEWPAC 09/09/11 10.30am - 12.30pm	DSEWPAC	Fauna - Understanding the fauna species that move around.	Other
W2BPA, RMS, DSEWPAC at DSEWPAC 09/09/11 10.30am - 12.30pm	DSEWPAC	Fauna - Amount of potential habitat for threatened species affected needs to be known.	Other
W2BPA, RMS, DSEWPAC at DSEWPAC 09/09/11 10.30am - 12.30pm	DSEWPAC	Fauna - Map areas in terms of quality of habitat eg foliage.	Other
W2BPA, RMS, DSEWPAC at DSEWPAC 09/09/11 10.30am - 12.30pm	DSEWPAC	Flora - need to determine levels of confidence – particularly for cryptics.	Other
W2BPA, RMS, DSEWPAC at DSEWPAC 09/09/11 10.30am - 12.30pm	DSEWPAC	Base line date - OPP – Where is the potential habitat as they move around.	Other
W2BPA, RMS, DSEWPAC at DSEWPAC 09/09/11 10.30am - 12.30pm	DSEWPAC	Cryptic species - Need confidence in targeted survey and assessment.	Other
W2BPA, RMS, DSEWPAC at DSEWPAC 09/09/11 10.30am - 12.30pm	DSEWPAC	Action - review scope for the EA - Review assessment to see if it adequately addresses potential habitat for threatened species.	Other
W2BPA, RMS, DSEWPAC at DSEWPAC 09/09/11 10.30am - 12.30pm	DSEWPAC	Action - review scope for the EA - Habitat corridors.	Other
EPA Comments - W2B Concept Design 20/10/11	EPA	It is noted that other projects have started to move away from implementing CAR fencing adjacent to vegetated blocks or where an agreement has been obtained with the adjacent property owner and the risk of liability damage is low. The EPA supports these efforts and encourages RMS to explore opportunities to eliminate this fencing wherever possible	Other
EPA Comments - W2B Concept Design	EPA	The EPA also recommends that the use of barbed wire is minimised and that wherever possible plain	Other

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Meeting	Agency	Issue	Strategy
20/10/11		wire is used.	
EPA Comments - W2B Concept Design 20/10/11	EPA	Rest Areas - It is recommended rest area not be located in areas of medium to high conservation and habitat value.	Other
W2BPA, RMS, NPWS, OEH at Broadwater National Park 07/12/11 1.00pm to 3.15pm	NPWS/OEH	Hydrology - need to be certain that previous flow is not changed (maintain existing environment that ecosystem depend on) ie creation of new ponding that may impact on vegetation and access.	Other
W2BPA, RMS, NPWS, OEH at Broadwater National Park 07/12/11 1.00pm to 3.15pm	NPWS/OEH	Existing environment is dry heath land with sandy soils.	Other
W2BPA, RMS, NPWS, OEH at Broadwater National Park 07/12/11 1.00pm to 3.15pm	NPWS/OEH	Koalas need to be considered.	Other
W2BPA, RMS, NPWS, OEH at Broadwater National Park 07/12/11 1.00pm to 3.15pm	NPWS/OEH	Myrtle Rust needs to be considered in the construction phase. Common issue north of Broadwater/Woodburn.	Other
W2BPA, RMS, NPWS, OEH at Yaegl Nature Reserve 07/12/11 9.00am to 11.30am	NPWS/OEH	Construction of major cross drainage will require special consideration in managing environmental impacts.	Other
W2BPA, RMS, NPWS, OEH at Yaegl Nature Reserve 07/12/11 9.00am to 11.30am	NPWS/OEH	Are there additional drainage structures that may change characteristics and behaviour of hydrology that may impact on ecology Ecosystems wetlands, Swamp Sclerophyll Forest (Hydrology needs to be maintained or improved to allow sustainability of reserve ie threat to food source for fauna habitat, risk of disease spreading). It is important to maintain existing sheet flow and avoid creating concentrated flow.	Other
W2BPA, RMS, NPWS, OEH at Yaegl Nature Reserve 07/12/11 9.00am to 11.30am	NPWS/OEH	The current road works being undertaken by RMS at Farlows Flat needs to be allowed for in the ultimate upgrade proposal, (clearance to wetlands may be an issue).	Other
W2BPA, RMS, NPWS, OEH at Yaegl Nature Reserve 07/12/11 9.00am to 11.30am	NPWS/OEH	Remnant forest vegetation north west of the reserve (SEPP 14 Wetland near Farlows Flat) is dying off. The reasons are unknown but may relate to cane drain maintenance exposure of ASS and transfer of acid to the forest during flood event. This needs to be avoided and considered in respect to maintaining the current level of amenity in the reserve.	Other
W2BPA, RMS, NPWS, OEH at Yaegl Nature Reserve 07/12/11 9.00am to 11.30am	NPWS/OEH	Flora and Fauna surveys need to consider Wallum Frog let, Green Thighed Frog, Squirrel Glider, OPP.	Other

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Meeting	Agency	Issue	Strategy
W2BPA, RMS, NPWS, OEH at Yaegl Nature Reserve 07/12/11 9.00am to 11.30am	NPWS/OEH	Environmental investigations will need to determine if Gliders are present on either side of the road in the Reserve.	Other
W2BPA, RMS, NPWS, OEH at Yaegl Nature Reserve 07/12/11 9.00am to 11.30am	NPWS/OEH	What species are being killed in the identified wildlife black spot? (Would be a good indication of species trying to cross the road).	Other
W2BPA, RMS, NPWS, OEH at Yaegl Nature Reserve 07/12/11 9.00am to 11.30am	NPWS/OEH	Revegetating un vegetated area next to road corridor needs to be considered in the context of the adjacent reserve using endemic species.	Other
W2BPA, RMS, DPI at DPI 19/12/11 10.30am - 11.30am	W2BPA	The ecology investigation includes information from current surveys and also makes use of information collected since the preferred option investigation stages (eg older than two years).	Other
W2BPA, RMS, DPI at DPI 19/12/11 10.30am - 11.30am	W2BPA	Where the previous survey data is found to be adequate for the assessment, recent survey of the same area has not been required.	Other
W2BPA, RMS, DPI at DPI 19/12/11 10.30am - 11.30am	W2BPA	The EPA letter to DP&I included criteria that survey information for the EIS should not be older than two years.	Other
W2BPA, RMS, DPI at DPI 19/12/11 10.30am - 11.30am	W2BPA	A conservative approach is being undertaken and where habitat for threatened species is present, their presence is assumed and potential impact assessed.	Other
W2BPA, RMS, DPI at DPI 19/12/11 10.30am - 11.30am	DPI	DP&I noted the two year time criteria for survey information in the EPA letter, but did not include this criteria in the DGRs.	Other
W2BPA, RMS, DPI at DPI 19/12/11 10.30am - 11.30am	DPI	DP&I is satisfied with the use of earlier ecological information where justified and where updated to be in accordance with the methodology in the threatened species guidelines.	Other
W2BPA, RMS, DPI at DPI 19/12/11 10.30am - 11.30am	DPI	Survey periods should be justified including consideration of seasons.	Other
W2BPA, RMS, DPI at DPI 19/12/11 10.30am - 11.30am	DPI	Survey and assumptions to be conservative in respect to targeted or optimum species.	Other
W2BPA, RMS, DPI at DPI Grafton 09/03/12 9.30am	DPI	Weeds - Alligator weed (an aquatic weed) is located at Tuckombil Canal, upstream in Rocky Mountain Creek (?). Tropical soda apple (newly listed terrestrial weed) occurs both sides of the Richmond River (patches) Myrtle Rust is now endemic, has spread throughout NSW. Action - contact / consult Jim Wilmot Far North Coast Weeds(?) about possible inspection (? Prior to construction). Include potential weed control and spread impacts, and weed hygiene protocols and management measures in EIS.	Other

Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

Meeting	Agency	Issue	Strategy
W2BPA, RMS, DPI at DPI Grafton 09/03/12 9.30am	DPI	Fisheries - Identification and management of OPP habitat (& PSG habitat), and temporary waterway crossings. The sizing and location of sediment and water quality basins may impact OPP habitat. This includes water scour (increased velocity of flow) in and from basins. MacDonaldis Creek near Broadwater NP mentioned as an example for this potential impact. Need for a management strategy for temporary crossings in OPP habitat. Action - Management and location of sediment basins needs to be addressed in EIS with special consideration of releasing water in OPP habitat. Concepts and principles for temporary crossings during construction, particularly, but not limited to, OPP habitat, needs to be included in EIS. Potential or actual OPP / PSG habitat needs to be identified in EIS.	Other
W2BPA, RMS, DPI at DPI Grafton 09/03/12 9.30am	DPI	Aquatic Habitat - Construction of major bridges-impact on aquatic habitat. Major bridge construction needs to be addressed in EIS, and should consider 'best practice' options (to minimise and manage potential impact on aquatic habitat), and not left to detailed design. Fisheries recognises that the EIS can't commit to one methodology, but they'd like to see RMS push towards incremental launch. Action - EIS to consider construction of major bridges, including minimising and managing impacts on aquatic habitat. Need to ensure don't have same incident as Macleay. The concern with the rock platform at Macleay River is what will be left behind in the river when they pull out.	Other
W2BPA, RMS, DPI at DPI Grafton 09/03/12 9.30am	DPI	Barriers to fish passage - EIS should consider upstream and downstream barriers to fish passage (why??). Action - EIS should consider upstream and downstream barriers to fish passage(?).	Other
W2BPA, RMS, DPI at DPI Grafton 09/03/12 9.30am	DPI	Cane drain (black ooze impacts) - Black water (acidic) from cane drains can cause fish kill. The cane industry has a protocol – refer publication Bring back the balance. Action - consider cane drain management in EIS, including potential impacts from black ooze and appropriate management measures.	Other
W2BPA, RMS, DPI at DPI Grafton 09/03/12 9.30am	DPI	Snags - Fisheries policy is that there should be no snag removal. Action - Discuss snag removal in EIS(?). Fresh Water Catfish and Olive Perchlet only threatened west of the range. Coldstream River is known for fish kills from Black water after floods. Black water reduces Dissolved Oxygen. SEPP 62 needs to be considered in assessment. Seagrass will not be an issue, however Mangroves will need to be considered.	Other
W2BPA, RMS, DPI at DPI Grafton 09/03/12 9.30am	DPI	Forests - Reinstatement of fire breaks. Forestry has needed to reinstate fire breaks, including clearing, after land has been revoked for Pacific Highway upgrades. The fire break is usually located on the opposite (state forest) side of pacific Highway boundary fencing. Request that this should be considered in EIS, as the strip acquisition of state forests (seven state forests affected) for W2B would lead to this situation. Action - Consider possible strategy for boundary fence locations (fencing strategy) adjacent to state forest acquisitions. Meet with forestry to agree with principles for the internal and external access arrangements.	Other

Upgrading the Pacific Highway – Woolgoolga to Ballina Upgrade

Meeting	Agency	Issue	Strategy
W2BPA, RMS, DPI at DPI Grafton 09/03/12 9.30am	DPI	Forests - Flora Reserve in W2G section. A Wells Crossing Flora Reserve in the W2G section of the upgrade is affected by median widening(?). Acquisition requires act of Parliament. Action - Seek legal advice and commence necessary special acquisition requirements.	Other
Maclean High School 20/03/12	Maclean High School	Bats (Grey-headed flying fox) present at Maclean High School (MHS) for at least 15 years, in the western car park, gully and river. The Gully contains a permanent colony.	Other
Maclean High School 20/03/12	Maclean High School	The Bat Colony around MHS has been ongoing problem and now become destructive of remnant rain forest.	Other
Maclean High School 20/03/12	Maclean High School	Grey Headed flying fox (EPBC listed) Maternal April to August.	Other
Maclean High School 20/03/12	Maclean High School	Strong pro bat lobby - Valley Watch and other proponents very active.	Other
Maclean High School 20/03/12	Maclean High School	Need a license to disperse the bats. The School has applied for a licence – and it's almost unworkable with the conditions of licence (very convoluted and restrictive (150 limit) there are thousands of bats). Local MP supports school and supports dispersal	Other
W2BPA, RMS, MPA at MPA Coffs Harbour 17/04/12 3.30pm to 4.00pm	MPA	The boundary for Marine Park is to the east of existing highway, therefore consent is not required. However consultation is important	Other
W2BPA, RMS, MPA at MPA Coffs Harbour 17/04/12 3.30pm to 4.00pm	MPA	Construction in wet periods highest risk	Other
W2BPA, RMS, MPA at MPA Coffs Harbour 17/04/12 3.30pm to 4.00pm	MPA	Maintain existing drainage flows and velocities important for the natural function of the estuary downstream	Other
PHU W2B Agency Meeting Overview 31/05/12 PowerPoint Presentation	W2BPA/ RMS	Confirm whether SRE includes 'known' or 'potential' habitat for threatened species.	Other

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Appendix K Emu genetics pilot study

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REPORT

DEVELOPMENT OF MOLECULAR ASSAYS TO INVESTIGATE COASTAL EMUS IN THE NORTHERN RIVERS REGION OF NSW

Dr Adam Stow

Shannon Smith

Catriona Burden

JUNE 2012



Summary

- Trialled various DNA extraction protocols on three source materials; feather, scat and tissue (positive control).
- Tissue and feather derived DNA was yielded in detectable quantities while scat-derived DNA of Emu origin was not readily identified.
- Of the DNA extraction protocols trialled the commercial BIOLINE kit provided the highest quality results.
- Feather derived DNA was used to successfully amplify sections of mtDNA and microsatellite loci.
- The quality of DNA varied according to feather characteristics. Large complete feathers consistently yielded high quantities and better quality DNA than smaller incomplete feathers.
- All 82 RMS collected feather samples were sorted and entered into a spread sheet to identify the quantity and quality of each sample, as well as the likelihood of successfully extracting DNA by noting whether there are intact shafts with skin cells present. There were only about 17 samples that had intact or mostly intact shafts that are optimal for DNA extraction. The majority of samples were small broken fragments of feathers. Five RMS samples yielded sufficient DNA for PCR amplification, 2 samples were excluded from analyses when they failed to amplify at more than 3 loci.
- An additional 21 feather samples of sufficient quality have been provided by NPWS.
- PCR conditions were optimised for control region (mtDNA) to present high quality sequencing reads
- PCR conditions were optimised to provide easy-to-score alleles at nine microsatellite loci.
- 27 individuals (feather-derived DNA; NPWS and RMS samples) were genotyped at nine microsatellite loci.
- Loci did not significantly deviate from Hardy-Weinberg Equilibrium, thus demonstrating their suitability for population-genetic approaches.
- The nine loci had sufficient levels of variability to discriminate individuals, including full siblings with a high degree of confidence (>99%).
- We have successfully applied a molecular approach to identify the gender of the Emu sample under consideration.
- We have developed a molecular approach that provides the tools necessary to identify individuals and characterise genetic structuring at a range of spatial and temporal scales.
- Genotypic data from 27 individuals provides no evidence for genetic structuring among individuals separated by distances to 80km in the Northern Rivers Region.
- Samples from additional individuals (ca. 20) will most likely be sufficient to estimate effective population sizes.
- These data now available can be used to compare levels of genetic variation of emus in the northern rivers region with emus in other parts of their distribution. Identifying relatively low levels of genetic variation in emus within the Northern Rivers Region can have implications for conservation management.

Background

Landscape change and the impact it has on the persistence of native species has resulted in policy for conserving biodiversity (Sunnucks & Taylor 2008). Roads and traffic can impact on natural landscapes resulting in habitat loss, fragmentation and degradation (Simmons *et al.* 2010). Where roads act as barriers that prevent or restrict the movement of wildlife, this ultimately reduces connectivity and threatens species persistence (Simmons *et al.* 2010; van der Ree *et al.* 2011). Promoting natural levels of connectivity improves the probability of survival, maintains genetic diversity, thus promoting greater resilience and long-term persistence (Frankham 2005). Knowledge regarding the impacts of roads on dispersal and gene flow contributes towards the effective management of native species and infrastructure (Simmons *et al.* 2010).

Functional connectivity and population processes such as dispersal can be assessed using molecular approaches (Sunnucks & Taylor 2008). Genetic methods can infer movement or dispersal of organisms, and together with field-based methods, can be utilised to assess both the viability of populations subject to the impacts of roads, and mitigation efforts (Simmons *et al.* 2010). DNA can be obtained from various sources including saliva, shed skin, egg shells, urine, faeces, hair and feathers using a non-invasive method of sampling (Waits & Paetkau 2005). Non-invasive sampling removes the need for trapping and direct interaction with study animals, minimizing stress for the animal, e.g. using feathers instead of blood as a source of DNA reduces stress on birds (Baldwin *et al.* 2010; Bello *et al.* 2001). Further, non-invasive sampling has obvious advantages when applied to rare or endangered species (Baldwin *et al.* 2010; Segelbacher 2002). DNA obtained via non-invasive sampling can be used to identify species, individuals, gender, and diet, or evaluate mating systems, relatedness, genetic diversity, population structure and size (Piggott & Taylor 2003; Waits & Paetkau 2005). While the benefits are numerous, non-invasive sampling is not without problems. DNA quality and quantity obtained from non-invasive sampling is often low for various reasons (e.g. lower amounts of DNA available than in tissue or blood, contamination or degradation), which can increase the likelihood of genotyping errors (Piggott & Taylor 2003; Waits & Paetkau 2005).

On the north coast of NSW the Emu *Dromaius novaehollandiae* provides an example of endangerment due to habitat loss and fragmentation. Due to its isolation and small census

size, the NSW North Coast Bioregion Emu population has been listed as an endangered population on Part 2 of Schedule 1 of the Threatened Species Conservation Act 1995 (OEH 2012). There is now the risk of further habitat fragmentation from an upgrade of the Pacific Highway from Woolgoolga to Ballina where the proposed upgrade passes through the populations' already restricted range.

Objectives

To assess a non-invasive genetic approach to collect ecological data on endangered Emus on the far north coast of NSW, we:

- (i) Investigate the efficacy of DNA extraction from feather and faecal samples and determine whether DNA is of sufficient quality and quantity for analysis.
- (ii) Develop and optimise a set of molecular markers, both mitochondrial and microsatellite, to amplify DNA and subsequently examine the utility of these molecular markers for discriminating among individuals.

These molecular tools were used to examine patterns of population genetic structure and patterns of dispersal of emus in the subject area (i.e. the Yuragir sub population) to assist with identification of mitigation and design measures and monitoring of their effectiveness.

The ultimate goal was to:

1. Estimate the total population size and structure and the range of group territories.
2. Identify the proportion of the population using habitat around the alignment in the Pillar Valley / Tucabia area and therefore potentially impacted by the project (using the total population size data from 1).
3. Provide tools for identifying if the road creates a barrier to emu movements and genetic segregation of individuals.

Sampling

The study area is located in the Clarence Valley in the NSW North Coast Bioregion. Sampling took place east of Grafton, NSW, in between Wells Crossing and Iluka, where the Woolgoolga to Ballina Pacific Highway upgrade is proposed to be built. Emu feathers and scats sampled by the RMS were collected along transects in three localities within the subject area: (i) Brooms Head to Taloumbi – transects total 9.5km, (ii) Tucabia to Pillar Valley – transects total 9.5km, and (iii) Woolli to Minnie Waters – transects total 12km.

A. Scat samples

A total of 97 scat samples were collected by the RMS in December 2011. Condition of samples obtained in the field from the subject area varied from extremely dry and hard to wet scats without any real structure. Scats were placed in paper bags within plastic ziplock bags for transportation. Two methods of storage were then trialled for scats samples. Half the samples were stored cold at 4°C, and the other half were dried overnight at 50°C and then stored at room temperature. All scat samples were stored in paper bags until analysis. Two additional fresh scat samples were obtained from Taronga Zoo, Sydney in March 2012 to be used as control samples.

B. Feather samples

A total of 125 Emu feather samples were obtained via three separate sources:

1. NSW National Parks and Wildlife Service (NPWS) – Feathers were collected from 29 individuals over a period spanning more than 6 years, from December 2005 to March 2012. Feathers were obtained mostly from road kill, but occasionally from fences in the subject area where feathers became caught. GPS coordinates were recorded for some samples, while the specific location was described for all samples.
2. NSW Roads and Maritime Services (RMS) – 82 feathers were collected in December 2011 and February 2012, of which 17 feathers were unbroken with shafts intact. Samples collected were moulted feathers found in the field or those that had become caught in fences. GPS coordinates were recorded for all RMS samples.
3. Chris Gregory of Emu Tracks Australasia Pty Ltd – 14 feathers obtained via plucking from 14 separate individuals were collected from farmed Emus in April 2012 to be used as control samples.

In all cases, feathers were placed in envelopes or paper bags and stored dry until analysis.

C. Tissue samples

NPWS also collected three tissue samples over a period between January 2006 and May 2009. Tissue samples were obtained from emu road kill carcasses and were used as positive controls. GPS coordinates were not recorded; rather a specific description of the sampling location was given for each tissue sample.

DNA Extraction

Various DNA extraction protocols were trialled on three source materials; scat, feather, tissue. Emu tissue and feather derived DNA was extracted in detectable quantities, while Emu DNA from scats was not readily identified.

A. DNA extraction from scats

Extraction of Emu DNA from RMS scat samples was trialled using The Bioline ISOLATE Fecal DNA Kit and the Qiagen QIAamp DNA Stool Kit. The Bioline kit was tested using ten scat samples, whereas the Qiagen kit was tested on the three scat samples that previously showed the best result. For each scat sample extracted, three cold stored and three dry replicates were used. Following extraction, DNA samples were visualised on a 2% agarose gel by electrophoresis and stored at -20 °C. The Bioline kit produced the best results in terms of DNA quantity and quality. DNA from cold storage produced stronger DNA bands on agarose; however, subsequent tests involving Polymerase Chain Reaction (PCR) using bacterial-specific primers (16S Ribosomal region) showed that the majority of the DNA extracted was derived from bacterial contamination (Fig. 1a). Mitochondrial DNA (mtDNA) did not amplify for DNA extracted from scats using the Qiagen kit, whereas DNA extracted using the Bioline kit amplified mtDNA well initially (Fig. 1b), but all subsequent PCRs were less successful. This perhaps indicates the presence of a DNA degrading enzyme.

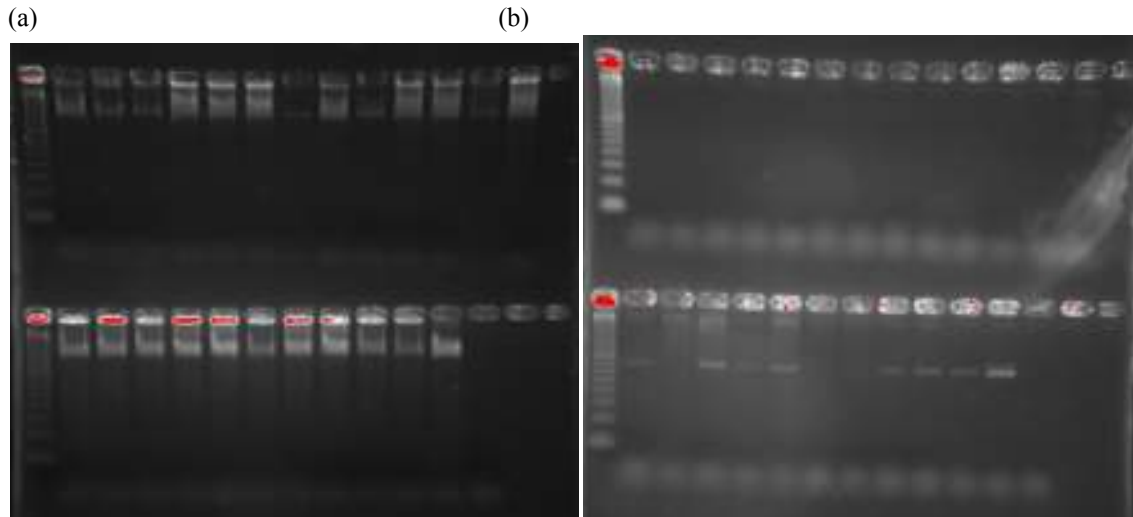


Figure 1(a) The 16S PCR clearly shows amplification of bacterial DNA (16S primers are specific to bacteria and will not amplify Emu DNA) **(b)** PCR amplification of emu mtDNA from scat derived DNA shows amplification of DNA extracted using the BIOLINE KIT (bottom row) but not DNA extracted using the Qiagen Kit (top row).

Due to the lack of success experienced extracting Emu DNA from scat samples using the Bioline and Qiagen kits, a third DNA extraction method was trialled on fresh scat samples from Taronga Zoo, i.e. a surface wash from scat samples using Qiagen ASL buffer followed by a modification of the Qiagen kit protocol as described by Wehausen *et al.* (2004). The procedure used for the surface wash is as follows: scat samples were placed in UV treated plastic ziplock bags, 20 ml of Qiagen ASL buffer heated to 56 °C for 30 minutes was added by pipetting into the corner of the bag not directly onto the sample (some scat types will absorb it leaving none for the surface wash), and samples were then placed in a shaking incubator for 2 hours at 56 °C. The Qiagen kit procedure was then followed with two alterations: (1) after ethanol is added samples are left to incubate at room temperature for 1 hour to maximize DNA precipitation; and (2) after the addition of the AE elution buffer, incubation is extended to 3 minutes and eluted twice to maximise DNA collection. Nanodrop results revealed good quantity and quality of DNA extracted from the Taronga Zoo scat samples, however, the mtDNA control region did not amplify during PCR. This suggests that either the DNA is not of Emu origin or that there were high levels of PCR contaminants. DNA extraction from scat samples has therefore proved challenging, and was not pursued any further due to time restraints.

B. DNA extraction from feathers

Feathers were prepared for DNA extraction by separating the two plumes of the feather, which arise from a single shaft, to expose a small sheath of skin cells visible under a dissecting microscope. The quality and quantity of the skin cells in the sheath are quite variable. These cells were removed for DNA extraction, along with a 1 cm segment of the root of the feather shaft that surrounds the sheath of skin cells.

Two methods for DNA extraction from prepared feathers were trialled on NPWS samples. Initial extractions were performed on multiple feathers from the same individual using an ammonium acetate precipitation method, a method we previously developed, which is modified to reduce loss of DNA in small samples. This method was successful when several feathers from the same individual were available, as was the case with samples supplied by NPWS. However, given the variable size, condition, and number of feathers sampled per individual in this study, the Bioline ISOLATE Genomic DNA Mini Kit (Animal Tissue Protocol) proved a more effective method for extracting DNA from emu feathers since DNA was then able to be extracted successfully from small individual feathers. Following extraction, each DNA sample was visualised on a 2% agarose gel by electrophoresis and stored at -20 °C.

DNA samples were tested by amplifying the control region of mtDNA via PCR, using a primer pair previously verified for the amplification of Emu DNA. DNA degraded samples which were several years old (collected in 2007) did not appear to affect the success rate of the PCR. There was also no apparent difference in the amplification success of mtDNA between feathers obtained from emu carcasses and those sampled from a fence. However, PCRs performed on DNA obtained from Emu Tracks feather samples showed much greater amplification success than experienced with DNA from either NPWS or RMS feather samples (Fig. 2). This suggests that the quality and quantity of DNA extracted from feathers plucked from live Emus is much greater than DNA obtained from carcass feather samples or moulted feathers, both of which are subject to significant DNA degradation.

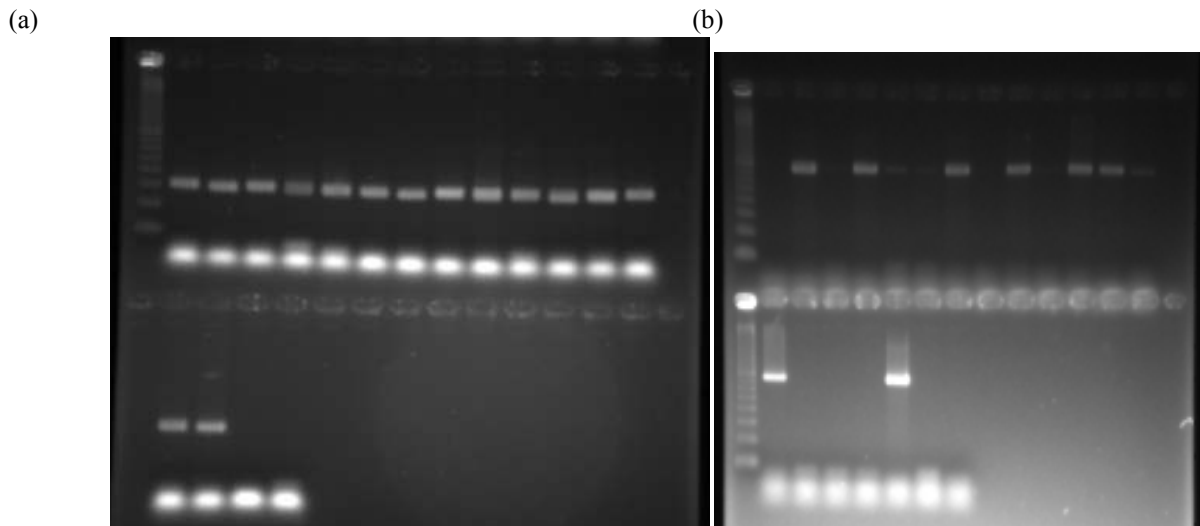


Figure 2 (a) PCR on DNA derived from fresh Emu Tracks feathers showing strong consistent amplification. **(b)** PCR on DNA derived from RMS feather samples showing weak inconsistent amplification.

C. DNA extraction from tissue

DNA extraction from muscle tissue samples was first performed using the ‘salting out’ protocol of Sunnucks and Hales (1996), and then using the Bioline ISOLATE Genomic DNA Mini Kit (Animal Tissue Protocol). Following extraction, DNA samples were visualised on a 2% agarose gel by electrophoresis and stored at -20 °C. The salting out method produced the highest quality and quantity of DNA in this case.

Mitochondrial DNA

Primers were synthesised for the mitochondrial control region, usually the most variable region of the mitochondrial genome.

PCR Conditions

PCR conditions were optimised for DNA extracted from feather samples. Following PCRs, product was visualised on a 2% agarose gel by electrophoresis, bands on gels indicated amplified DNA was of the expected size, and brightness of bands indicated high quality. A number of annealing temperatures for PCR were trialled, and 58 °C was identified as the optimal annealing temperature. However, discrepancies between PCR thermocyclers led to variable results at 58 °C, and thus all subsequent mtDNA PCRs were run using a touchdown setting. PCRs were carried out with a final volume of 40 µl and 50-200ng of DNA using an

MJ Research PTC100 thermocycler with an initial denaturation at 94 °C for 2 min, followed by 6 'touchdown' cycles of 20 sec denaturation at 94 °C, annealing temperatures (60 °C, 59 °C, 58 °C, 57 °C, 56 °C, 55 °C) for 30 sec, and extension step of 72 °C for 45 sec. On completion of the last touchdown cycle another 30 cycles were carried out at 55 °C annealing temperature, followed by a final extension step for 20 min at 72 °C. Each reaction contained: 19.4 µl H₂O, 8.0 µl 5x Go Taq Flexibuffer (Promega), 2.0 mM MgCl₂, 6.4µl dNTPs, 0.8 µl each of forward and reverse primer, and 0.4 µl *Taq* DNA Polymerase (Promega).

Sequencing

Ten samples were purified and sequenced by Macrogen (Korea). High quality sequencing reads were obtained that captured the entire length of the amplicon of interest but little variation was found. Thus, the utility of mtDNA may be limited in the context of this study.

Microsatellite Loci

PCR conditions

A panel of 23 microsatellite primers were tested for amplification success. These markers were trialled with DNA from all sample types (scats, feathers and muscle tissue). Emu muscle tissue and feather derived DNA provided DNA of sufficient quality for PCR amplification. Microsatellites were optimised by exploring various options: three MgCl₂ concentrations (1.5, 2.0 and 2.5 mM), four different DNA polymerases (GoTaq, MyTaq, MangoTaq and Red Hot Taq), different annealing temperatures (two touchdown thermocycling settings, three gradient settings), addition of BSA or RNase, and whether decreasing primer concentrations improved amplification at some loci. MyTaq (Bioline) provided the best and most reliable results, neither BSA nor RNase had a measurable effect on amplification, and decreasing primer concentrations did not noticeably improve amplification success.

All PCRs were carried out with a final volume of 20 µl and 50-200ng of DNA. Final PCR conditions were as follows: 9.6 µl H₂O, 4.0 µl 5x MyTaq Buffer (Bioline), 2.0 mM MgCl₂, 3.2 µl dNTPs, 0.2µl each of forward and reverse primer, and 0.2µl MyTaq 5u/µl(Bioline). PCR amplifications were carried out using an MJ Research PTC100

thermocycler. Two different touchdown settings were used for final PCRS: (i) Dn03, Dn13, emu33 – initial denaturation at 94 °C for 3 min, followed by 6 ‘touchdown’ cycles of 30 sec denaturation at 94 °C, annealing temperatures (60 °C, 58 °C, 56 °C, 54 °C, 52 °C, 50 °C) for 30 sec, and extension step of 72 °C for 45 sec. On completion of the last touchdown cycle another 35 cycles were carried out at 50 °C annealing temperature, followed by a final extension step for 10 min at 72 °C; and (ii) Dn01, Dn06, Dn15, Dn28, Dn34, emu5, emu50 – initial denaturation at 94 °C for 3 min, followed by 6 ‘touchdown’ cycles of 30 sec denaturation at 94 °C, annealing temperatures (65 °C, 63 °C, 61 °C, 59 °C, 57 °C, 55 °C) for 30 sec, and extension step of 72 °C for 45 sec. On completion of the last touchdown cycle another 35 cycles were carried out at 55 °C annealing temperature, followed by a final extension step for 10 min at 72 °C. Following PCRs, product was visualised on a 2% agarose gel by electrophoresis.

Genotyping

Genotyping was carried out for 27 individuals at nine microsatellite loci for which PCR conditions were optimised for three loci (emu5, emu33, emu50), previously described by Taylor *et al.* (1999), and six loci (Dn01, Dn03, Dn06, Dn15, Dn28, Dn34) described by Yanez *et al.* (2008), shown in Table 1. The sampling locations for these 27 individuals are given in appendix 1. Genotyping was carried out partially at the Macquarie University Sequencing Facility, and partially by the Australian Genome Research Facility Ltd (AGRF), Sydney. Allele sizes were scored using Peak Scanner software v.1.0 (Applied Biosystems) and checked by eye. Samples that did not successfully amplify were rerun, and following reruns any individual that did not amplify at more than three loci was removed from the data set. In order to ensure consistency in amplification and scoring an additional 10% of samples were rerun and genotyped.

Table 1. Nine microsatellite loci genotyped for *Dromaius novaehollandiae*. bp = basepairs.

Locus	GenBank accession no.	Primer sequence (5' – 3')	Repeat motif	Expected size range (bp)
emu5	AF147059	F-ACTTCCTCAAGGCTCACAAATCTG R-CATGGCAGCAGCACATAAACTG	(CA) ₁₅	202-257
emu33	AF147061	F-AAAGGTATGGCGTAGGGTTTGG R-TACATTTGGCAGCTATGCACTTC	(CA) ₂₆	168-200
emu50	AF147062	F-CACACTGCAATTCTCACTGGAGTC R-TCCCCACAAGCGTTTGCATTGTC	(CA) ₁₈	297-327
Dn01	VMRC16-71P5 (AC157880)	F-CGATGGTGCTGATGAATAAT R-TGAGGTAAAAGCCACTGTATGT	(TG) ₂₂	176-208
Dn03	VMRC16-127E6 (AC158282)	F-TGTCAGTTTGTTCGCAGGT R-TGGAAAGAAAGAAAGGGAAT	(TC) ₁₉	227-235
Dn06	VMRC16-248F6 (AC159173)	F-CAAGCCAGCCCCAAAGA R-ATAATCCCACTCACTGCGGTA	(TG) ₁₇	271-277
Dn15	VMRC16-150I9 (AC158284)	F-GGAGGCAGCCCTGTTTT R-CCGCCATTCTAGGTGTGT	(AT) ₁₅	141-155
Dn28	VMRC16-186M19 (AC154079)	F-CGGCACAGACGATCAAGAG R-GACAGGGGCACGAAGGA	(CAT) ₈	116-128
Dn34	VMRC16-65A23 (AC154082)	F-CCTACCACCTATCTGTCCGTCT R-GCTTTCTTCTATGCCTCTGCTT	(AC) ₁₉	187-193

Gender Allocation

Molecular sex identification was trialled by carrying out PCR using two primers EF9 and ER10 described by De Kloet (2001). The subsequent PCR amplicon was subject to digest with restriction enzyme *Bgl*III (Promega). Initial trials were performed on tissue samples and showed a promising dichotomous distinction among individuals. Further tests were then performed on DNA derived from the Emu Tracks feather samples, obtained from farmed Emus, for which the sex had been recorded. The sex of six out of seven samples tested was identified correctly. It's possible that for the sample that was incorrectly identified, the sex could have been originally recorded incorrectly due to the difficulty associated with identifying Emu gender from morphology alone. A RAPD assay confirmation was also performed using the OPY14 primer and conditions described by De Kloet (2001). While this method is less dependable, it appeared to confirm the results found using the two primer reaction with EF9 and ER10. Molecular sex identification was not performed for the full data set due to time restraints.

PCR and restriction digest conditions

PCRs were carried out with a final volume of 40µl and 50-200ng of DNA. Final PCR conditions were as follows: 16.8µl H₂O, 8.0 µl 5x MyTaq Buffer (Bioline), 2.0 mM MgCl₂, 6.4µl dNTPs, 1.6µl of each primer, and 0.4µl MyTaq 5u/µl(Bioline). PCR amplifications were carried out using an MJ Research PTC100 thermocycler with an initial denaturation at 94 °C for 3 min, followed by 6 ‘touchdown’ cycles of 30 sec denaturation at 94 °C, annealing temperatures (60 °C, 58 °C, 56 °C, 54 °C, 52 °C, 50 °C) for 30 sec, and extension step of 72 °C for 45 sec. On completion of the last touchdown cycle another 35 cycles were carried out at 50 °C annealing temperature, followed by a final extension step for 10 min at 72 °C. PCR product was visualised on a 2% agarose gel by electrophoresis. The subsequent restriction digest was carried out with a final volume of 10 µl – 5 µl PCR product, 0.1 µl 10x BSA (Promega), 1.0 µl 10x Buffer D (Promega), and 1.0µl *Bg*/III (Promega). The admixture was then incubated at 37 °C for 3 hours, following which 4 µl of ExoSAP-IT (Promega) was added, the admixture was incubated for a further 15 minutes at 37 °C to inactivate *Bg*/III, and finally, at 80 °C for 15 minutes to inactivate the ExoSAP-IT.

Data Analyses

Summary Statistics

Microsatellite data was assessed for suitability by checking for scoring errors and possible null alleles in Micro-checker v.2.2.3 (Van Oosterhout *et al.* 2004). The total number of alleles, observed heterozygosity (H_o) and expected heterozygosity (H_E) were calculated for each locus using GENALEX v.6.41 (Peakall & Smouse 2006). GENALEX v.6.41 was also used to test for significant deviations from Hardy-Weinberg equilibrium. Mitochondrial sequence data were aligned and edited by eye in MEGA v.5.05 (Tamura *et al.* 2011).

Summary statistics were not calculated for mitochondrial data, since little to no variation was observed by eye in the 10 sequences post-alignment.

Probability of Identity

Probability of identity provides an estimate of the average probability that two unrelated individuals, drawn from the same randomly mating population, will by chance have the same multilocus genotype. In molecular ecology, probability of identity can be used to identify the

discriminatory power of genetic markers to distinguish among individuals, even if they are closely related. This analysis was also performed using the software GENALEX v.6.41.

Spatial Analysis

Spatial autocorrelation and pairwise relatedness are genotypic methods that assess genetic variation and structure over relatively short timescales. These analyses were performed in GENALEX v.6.41 in order to test whether genetic dissimilarity increases with geographic distance. Spatial autocorrelation compares genetic similarity between pairs of individuals within and among discrete distance classes (in this case: 0, 40, 80 km). This comparison was performed by investigating the distribution of relatedness, where relatedness (r) is the genetic similarity between pairs of individuals compared at particular distance classes. If dispersal is limited one would expect increasing genetic dissimilarity with increasing geographic distance.

Results

Summary Statistics

DNA was successfully extracted from 29 NPWS feather samples, 3 NPWS tissue samples, and 14 Emu Tracks feather samples. While DNA extractions were performed for 17 promising RMS feather samples, many of these feathers were so degraded that little to no DNA was recovered, and only five were successfully genotyped. A number of samples (six) were also removed from the data set when they failed to amplify at more than three loci, bringing the total number of individuals genotyped down to 27, i.e. 26 feathers (23 NPWS, 3 RMS) and one tissue sample. Emu Tracks feather samples were excluded from analyses since they were not obtained from the subject population. All loci showed appreciable levels of variation. Per locus statistics, allele number and size, and observed and expected heterozygosities, are detailed in Table 2. Two loci, Dn03 and Dn15, had significantly lower observed than expected heterozygosity ($P < 0.001$). Analyses performed in Micro-checker (Van Oosterhout *et al.* 2004) revealed no strong evidence for large allele dropout, scoring error due to stuttering or a high level of null alleles. Nonetheless, a significant deficit of heterozygotes at only Dn03 and Dn15 is suggestive of null alleles or short allele dropout – both well known issues when using degraded DNA (Baldwin *et al.* 20010).

Table 2 Summary statistics for microsatellite loci for *Dromaius novaehollandiae* in the NSW North Coast Bioregion. N_A = number of alleles; N = number of samples; bp = base pairs; H_O = observed heterozygosity, H_E = expected heterozygosity. P value; ns = not significant, * = $P < 0.05$, ** = $P < 0.01$, *** = $P < 0.001$.

Locus	N_A	N	SizeRange (bp)	H_O	H_E	P value
emu5	4	27	203-211	0.593	0.688	ns
emu33	7	26	159-181	0.577	0.702	ns
emu50	6	26	284-298	0.923	0.706	ns
Dn01	5	26	176-208	0.692	0.680	ns
Dn03	4	26	227-235	0.231	0.331	***
Dn06	4	26	271-277	0.731	0.572	ns
Dn15	7	27	141-155	0.667	0.731	***
Dn28	6	27	116-128	0.704	0.737	ns
Dn34	4	27	187-193	0.741	0.636	ns

Probability of Identity

Probability of identity analysis revealed that the nine microsatellite markers have sufficient resolution to identify individuals with a high degree of probability, even if closely related (Fig. 3). Figure 3 shows a cumulative increase in the probability of distinguishing among individuals that are unrelated by pedigree (PI) and individuals that are closely related (PIsibs).

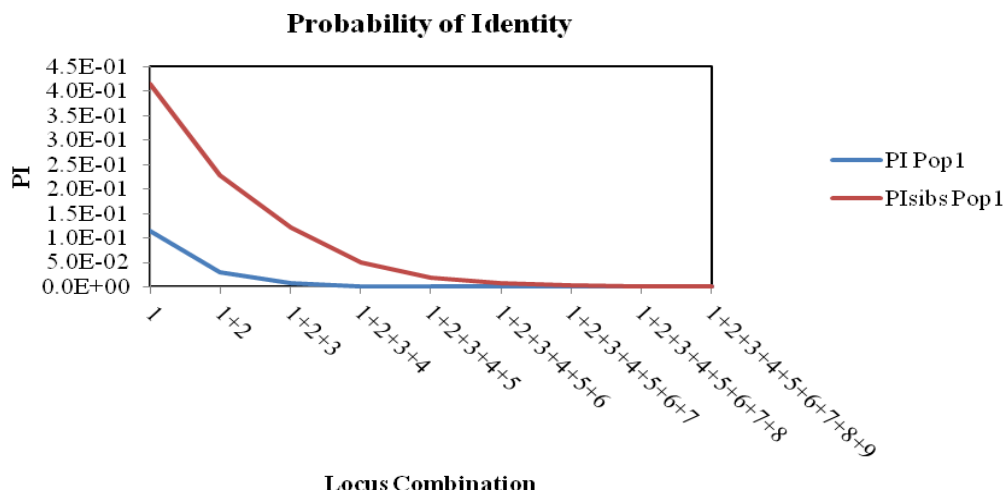


Figure 3. Probability of identity for *Dromaius novaehollandiae* in the NSW North Coast Bioregion. PI = unrelated individuals, PIsibs = closely related individuals.

Spatial Analysis

Spatial autocorrelation of relatedness showed no significant difference in average relatedness between individuals in the same distance class as opposed to individuals in different distance classes (Fig. 4). Thus, these data show that there is no evidence of related individuals being clumped together, implying that the sample is randomly mixed, i.e. mature individuals are freely mixing at distances of up to 80 km.

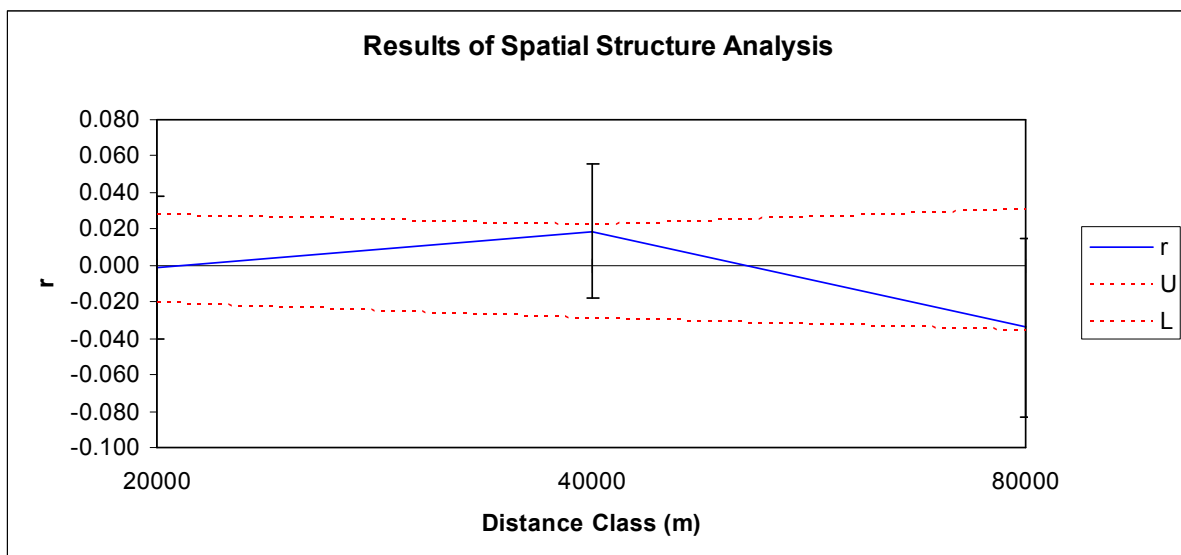


Figure 1 Autocorrelogram of relatedness (r), the genetic similarity between pairs of individuals compared at particular distance classes, for *Dromaius novaehollandiae* in the NSW North Coast Bioregion (\pm standard error). U = upper 95% confidence interval, L = lower 95% confidence interval.

Recommendations

A genetic assay has been developed that is appropriate for DNA sourced from whole feathers and has the resolution to identify individuals. These data can be used to answer a range of questions with the caveat that fresh and largely complete feather samples are obtained. Most of the viable samples collected were from fresh road kill, shed feathers tended to be of poorer quality. Although sample sizes obtained in this pilot study are small the data do not provide any evidence for high levels of genetic structuring to distances of around 80km. On the basis of these preliminary data on genetic structure, and the power of the molecular assay, the following approaches may like to be considered:

- Continue to collect feathers and other suitable emu tissues. Opportunistically collected samples (feathers or tissue) located within approximately 80km of each other can be applied to estimate genetic variation and infer effective population size. Current sample sizes (27) are limited, however the investment made to genotype these individuals can be increased by the addition of samples from approximately another 20 to 30 individuals. It is expected that with these data we could carry out a more robust analysis of genetic partitioning, provide a sound estimate of genetic variation for comparison with levels of variation, at the same loci, from non-threatened populations of emu. This can inform on whether emus in the northern rivers region have especially low levels of genetic variation. Low levels of functional genetic variation have serious implications to survival, including the potential of inbreeding depression and inhibited ability to adapt to new environmental challenges. In addition, an estimate of effective population size can be made with a larger sample size. Effective population size approximates the number of breeding individuals within a population. The effective population size can predict the likelihood of population survival; therefore, this information is highly valued for conservation management (for

more information please refer to work by Frankham et al.). In many respects, effective population size has greater implications to survival than census size.

- Blood or feather samples, and if possible, gender should be collected from tracked individuals. These are easy to obtain and could be potentially useful depending on how research activities develop. For example, one could confirm the involvement of these individuals in breeding activities. In this case the genotypes of the tracked individuals will be included within a data base containing other candidate parents and offspring (under development from opportunistically collected samples).
- There is the potential to collect data to identify whether gene flow or dispersal has been impeded post road construction. This will require a carefully constructed sampling design and potentially the development of 'feather traps'. We are happy to discuss the potential of using genetic data to monitor any influence of road construction on dispersal and gene flow.

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Appendix 1

Figure 1 and Table 1 of show the sampling locations of feathers (samples designated 'Fe') and the Tissue sample (T) used to assess genotypic partitioning. The three RMS samples included are from the Tucabia to Pillar Valley region.

Figure 1



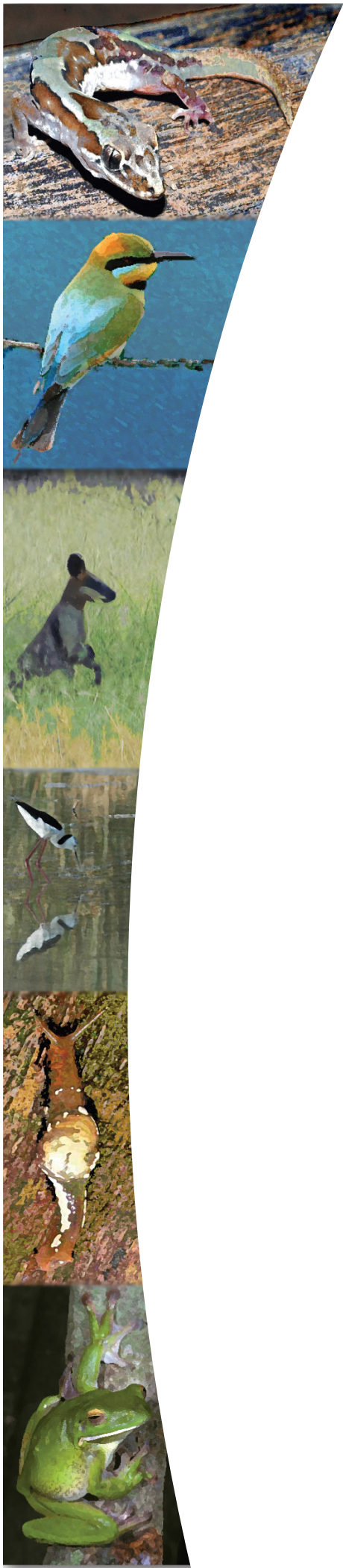
Table 1

Sample ID	Grid Reference	
Fe01	517889	6704400
fe02	528834	6705930
Fe03	527529	6733007
Fe04	531316	6726563
fe05	527306	6700271
Fe06	528115	6706418
Fe08	515177	6711291
Fe10	528834	6705930
Fe11	514971	6706681
fe16	535335	6747607
fe17	524989	6731867
Fe18	531316	6726563
Fe19	505853	6705814
fe20	535138	6749393
Fe21	528201	6706425
Fe22	528890	6705930
fe23	529260	6751525
fe24	525096	6731843
fe25	540331	6775026
Fe27	526300	6705650
Fe28	526800	6705980
Fe29	519200	6736500
Fe30	531243	6726938
RT02	511478	6712234
RT05	511478	6712234
RT08	511988	6711799
T13	518012	6704177

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Appendix L Specialist invertebrate report

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BALLINA TO WOODBURN PACIFIC HIGHWAY UPGRADE

TARGETED THREATENED INVERTEBRATE STUDY

Report prepared
for
Sinclair Knight Merz



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Document Control Sheet

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Project Manager: Dr Lindsay Popple

Client: Sinclair Knight Merz (SKM)

Project Title: Targeted Invertebrate Study for the Woodburn to Ballina Pacific Highway Upgrade

Project Author/s: Dr Lindsay Popple, Dr Jo Chambers and Lui Weber

Project Summary: This report outlines the results of a field study targeting threatened invertebrate species and their host plants (where applicable) along the proposed Pacific Highway upgrade between Ballina and Woodburn in Northern NSW.

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Purpose of Report

Biodiversity Assessment and Management Pty Ltd has produced this report in its capacity as consultants for and on the request of Sinclair Knight Merz (the "**Client**") for the sole purpose of providing the results of a targeted conservation significant invertebrate survey for the Woodburn to Ballina Pacific Highway Upgrade (the "**Specified Purpose**"). This information and any recommendations in this report are particular to the Specified Purpose and are based on facts, matters and circumstances particular to the subject matter of the report and the Specified Purpose at the time of production. This report is not to be used, nor is it suitable, for any purpose other than the Specified Purpose. Biodiversity Assessment and Management Pty Ltd disclaims all liability for any loss and/or damage whatsoever arising either directly or indirectly as a result of any application, use or reliance upon the report for any purpose other than the Specified Purpose.

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Date: 11/04/2012



Managing Director

TARGETED INVERTEBRATE STUDY WOODBURN TO BALLINA PACIFIC HIGHWAY UPGRADE

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List of Abbreviations

ANIC	The Australian National Insect Collection, CSIRO, Black Mountain ACT
BAAM	Biodiversity Assessment and Management Pty Ltd
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
SKM	Sinclair Knight Merz
TSC Act	New South Wales <i>Threatened Species Conservation Act 1995</i>

1.0 INTRODUCTION

1.1. BACKGROUND AND PURPOSE

Biodiversity Assessment and Management (BAAM) has prepared this report for Sinclair Knight Merz (SKM) for the purpose of providing an independent conservation significant invertebrate survey on land between the Bruxner Highway - Pacific Highway interchange just South of Ballina and Tristums Hill South of Woodburn in Northern New South Wales (the 'Study Area').

The specific aims of this report are to:

- Document locations where conservation significant invertebrates and their host plants are known to occur within the Study Area; and
- Comment on suitability of habitats for conservation significant invertebrates and their hosts at specific sites throughout the Study Area.

The results of this report are based on a review of relevant literature and site investigations undertaken by Lindsay Popple and Jo Chambers on 6-10 February 2012 and a follow-up survey conducted by Lindsay Popple and Lui Weber on 13-16 March 2012.

1.2. SITE DESCRIPTION

The Study Area is linear and follows the footprint of the existing Pacific Highway along part of its length (**Figure 1-1**). The overall site broadly follows the Richmond River and includes areas of flat to undulating terrain with sandy dermosols indicating remnants of former coastlines, hydrosols along the river plain and kurosols derived from basalt on slopes in the centre of the alignment (CSIRO, 2006).

The vegetation of the Study Area forms a complex mosaic reflecting substrate and micro relief. Low lying areas on unconsolidated sediments support Swamp Oak and Mangrove forest where there is saline influence, in areas inundated with freshwater lagoons and swamps form supporting sedgeland, reedlands, swamp sclerophyll forests and where fire is absent swamp rainforests. Relict sand sheets and dunes support wet and dry types of wallum shrubland and woodland dominated by *Banksia* spp. (Sheringham *et al.* 2008).

Bedrock areas of metasediment and sedimentary hills support open sclerophyll forest dominated by a range of eucalypts including Blackbutt, Broad Leaved Ironbark and Forest and Narrow Leaved Red Gums. Basalt hills support small pockets of lowland rainforest and Camphor Laurel regrowth (Sheringham *et al.* 2008). Much of the Study Area has been subject to past clearing and the cultivated vegetation consists of pasture grasses or sugarcane plantations.

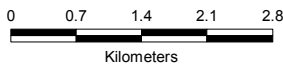
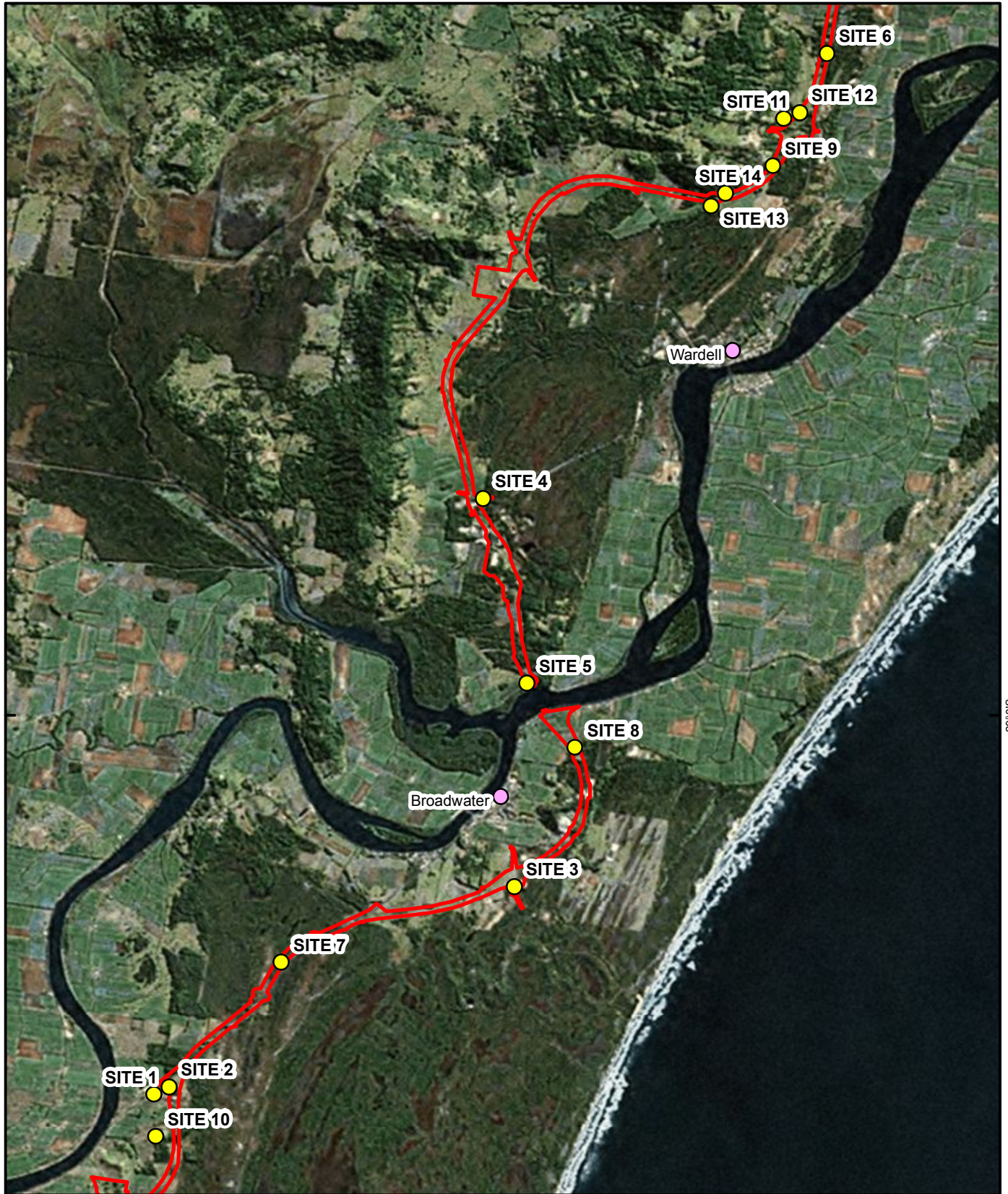
1.3. PROPOSED WORKS

It is understood that a development is intended to take place within the Study Area in the form of a partly raised, multi-lane highway, with new bridges, on-ramps and off-ramps located at appropriate points. These works will require clearing of vegetation and earthworks throughout a significant portion of the entire length of the Study Area

1.4. TARGET SPECIES

Seven conservation significant invertebrate species are known to occur or potentially occur in the Study Area. These include:

- Mitchell's Rainforest Snail *Thersites mitchellae* (listed as Endangered under the New South Wales *Threatened Species Conservation Act 1995* (TSC Act) and Critically Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act),
- Laced Fritillary *Argyreus hyperbius* subsp. *inconstans* (Endangered under the TSC Act),
- Pink Underwing Moth *Phyllodes imperialis* southern subsp. - ANIC 3333 (Endangered under the EPBC Act and the TSC Act),
- Atlas Rainforest Ground Beetle *Nurus atlas* (Endangered under the TSC Act),
- Shorter Rainforest Ground Beetle *Nurus brevis* (Endangered under the TSC Act),
- Coastal Petaltail *Petalura litorea* (Endangered under the TSC Act), and
- Richmond Birdwing *Ornithoptera richmondia* (Regionally Significant under the Byron Biodiversity Conservation Strategy).



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Legend

- Survey Locations
- Towns
- Study Area Boundary

Figure 1-1
Study Area and Survey Locations

Targeted Invertebrate Study
Woodburn to Ballina Upgrade



This present study focuses on each of the above species with the exception of Mitchell's Rainforest Snail, which was the subject of a previous targeted survey (Geolyse, 2007).

The Laced Fritillary is a scarce and apparently declining butterfly species across its known range from the Sunshine Coast in Queensland south to approximately Port Macquarie in New South Wales (Sands and New, 2002). It is restricted to coastal lowland areas and is closely associated with its host plant *Viola betonicifolia* (Sands and New, 2002). Populations of this species have largely disappeared from much of its former range due to changed land use regimes and pressure from development (DEC, 2005a).

The Pink Underwing Moth is a large and spectacular fruit-piercing moth with an equally remarkable and distinctive larva. The southern species occurs from Nambour in Queensland south to the Dorrigo-Bellingen district in New South Wales (DEC, 2005b). Potential breeding areas are considered to be restricted to areas in which its host vine, *Carronia multiseppalea*, occurs (DEC, 2005b). There are no official records of this species breeding in New South Wales; however, the vine has been recorded at a number of locations in the Northern Rivers region. On this basis, it is anticipated that the moth would occur and reproduce locally, despite the lack of observations.

The Atlas Rainforest Ground Beetle is a flightless predatory species that is currently known only from the Alstonville district in northern New South Wales (DEC, 2005c). It lives in distinctive burrows under logs, rocks and other suitable shelter in moist rainforest environments. The related Shorter Rainforest Ground Beetle is slightly more widespread, occurring from around Lismore west to the Mallanganee region (DEC, 2005d). It appears to prefer drier rainforest habitats and also lives in burrows.

The Coastal Petaltail is a large dragonfly species that is distributed from North Stradbroke Island in Queensland south to the Grafton district in New South Wales (DEC, 2005e). It occurs in wallum heathland areas, vegetated swamps and wetlands. Breeding takes place in vegetated coastal freshwater wetlands and the larvae take several years to develop (Theisinger and Hawking, 2006).

The Richmond Birdwing is a large butterfly species that is distinctive both in the adult and

larval form. It occurs from Maryborough in Queensland south to Grafton in New South Wales (Sands, 2008). The species is associated closely with its host vine, which in lowland northern New South Wales is *Pararistolochia praevenosa*.

2.0 METHODOLOGY

The techniques described below were each restricted to active observation. Whilst trapping is a recognised method for capture of some invertebrates of conservation significance (e.g. ground beetles), it has proven to be effective only as a result of monitoring over several weeks or months (Seldon and Beggs, 2010). For shorter term surveys, ground searching is considered to be more effective, and this was adopted in the study described here.

Sites for targeted surveys were chosen subjectively on the basis that the sites contained potential habitat for at least one of the target invertebrate species and/or their host plants. Each site was surveyed comprehensively across a wide representation of the available habitat using the techniques described in the subsections below. Across the Study Area, 14 sites were surveyed in total. The locations of these sites are shown on **Figure 1-1**. The extent of survey locations was limited to where property access was available.

2.1. RANDOM MEANDER SEARCHES

All sites considered to contain suitable habitat for host plants of conservation significant terrestrial invertebrates were surveyed as far as possible within the timeframe of the survey. Each area was surveyed using the method described in the threatened species survey and assessment guidelines (DEC, 2004). This involved a 30 minute meander on foot through each hectare of appropriate habitat whilst actively searching for the host plants. Searching via host plants was the primary method of survey for Australian Fritillary, Richmond Birdwing and Pink Underwing Moth.

2.2. ACTIVE GROUND SEARCHING

This involved intensive investigation of ground layer (under logs, rocks and leaf litter) for the characteristic burrows of the two endangered species of ground beetles. Each site was searched at a rate of approximately 30 minutes per hectare, depending on the complexity of the

ground debris. Following successful location of a potential burrow, the tunnels were excavated using a small digging implement to reveal the invertebrate responsible for constructing the burrow (if present). Beetle specimens were vouchered and deposited in the Queensland Museum for confirmation of identification.

2.3. OPPORTUNISTIC OBSERVATIONS

During the surveys, fauna observations were continuous and species records were obtained outside of the systematic methodology of the survey. Wetland areas and swamps were surveyed for up to 20 minutes at suitable locations within a site to check for the presence of conservation significant invertebrates in transit, including the Australian Fritillary and Coastal Petaltail.

3.0 FIELD SURVEY RESULTS

3.1. CONSERVATION SIGNIFICANT INVERTEBRATE FAUNA

Threatened invertebrates were encountered at two of the 14 sites investigated across the Study Area (**Figure 3-1**). These comprised a single adult Atlas Rainforest Ground Beetle at site 14 and several Pink Underwing Moth larvae at sites 9 and 14. These species were revealed only during the March follow-up survey. No other conservation significant invertebrates were observed during either survey.

The single Atlas Rainforest Ground Beetle was encountered in a burrow positioned under a large protruding root of a White Cedar *Melia azedarach* in soil derived from basalt (**Photos 1, 2 and 3**). The beetle was removed from the burrow through careful manipulation using a series of fine sticks. Its identification was subsequently confirmed by staff at the Queensland Museum. Several other burrows were encountered under logs at site 6 and beneath sheltered earth overhangs at sites 5 and 9 (**Photo 4**). However, none of these burrows displayed the diagnostic features of a *Nurus* spp. burrow. Beetle larvae were discovered in the burrows at site 5; however, these belonged to family Scarabidae (c.f. Caribidae, to which *Nurus* spp. belong). Nothing was unearthed from the burrows at site 9. Some larger burrows at site 9 with webbing at the entrance were clearly created by mygalomorph (i.e. Funnelweb) spiders. These were not excavated.



Photo 1. Atlas Rainforest Ground Beetle burrow at site 14.



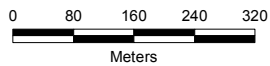
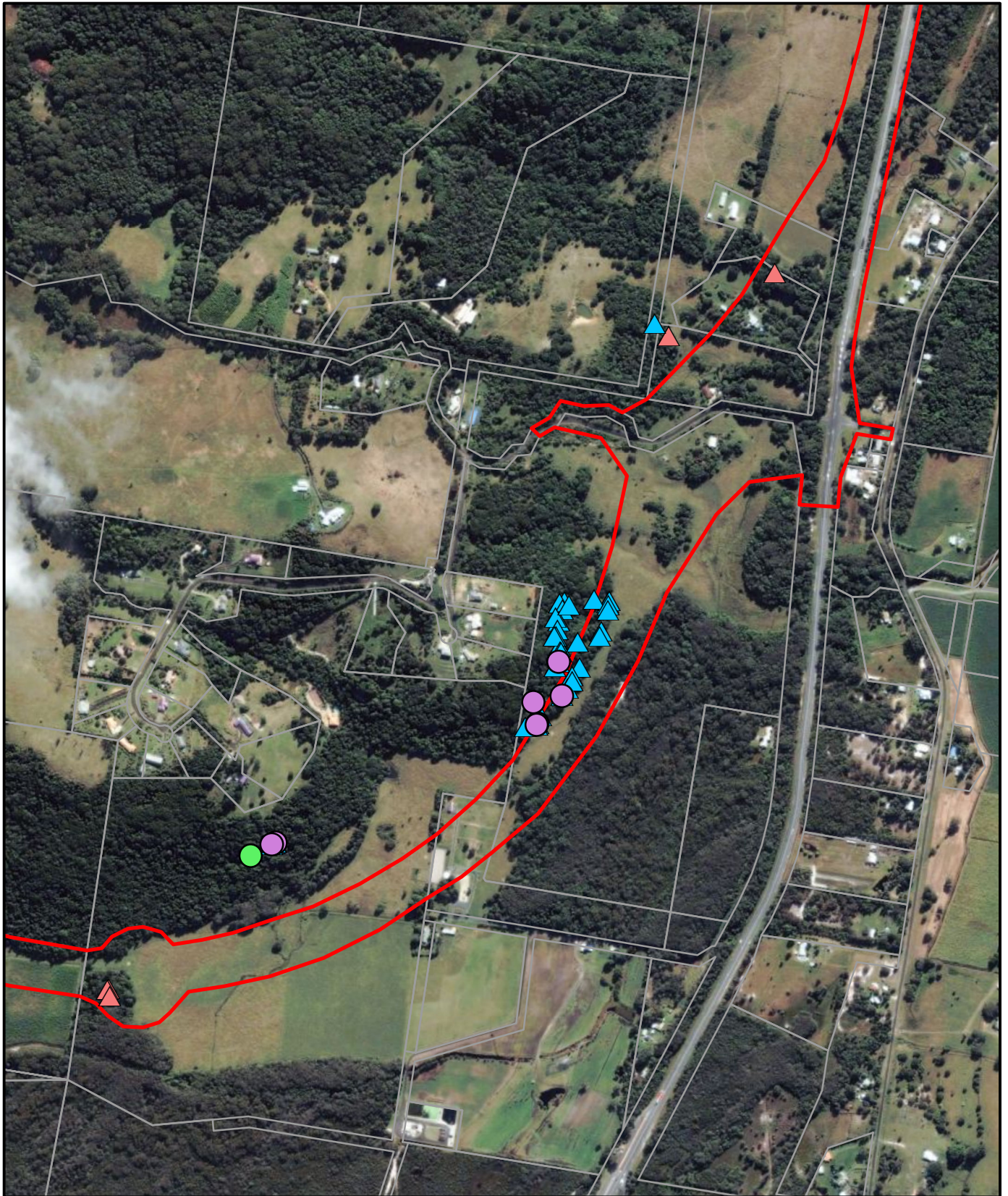
Photo 2. Atlas Rainforest Ground Beetle in burrow at site 14.



Photo 3. Atlas Rainforest Ground Beetle from site 14.



Photo 4. Overhang at site 9.



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Legend

- *Nurus atlas*
- *Phyllodes imperialis* southern subsp. ANIC 3333
- ▲ *Carronia multiseptata*
- ▲ *Pararistolochia praevenosa*
- Study Area Boundary
- Cadastre

Figure 3-2
Threatened Invertebrate
and Host Plant Locations

Targeted Invertebrate Study
Woodburn to Ballina Upgrade



Additional single adult beetles were obtained from the rainforest floor at each of sites 6 and 9. Both were revealed to belong to the same tribe as the genus *Nurus* (Pterostichini). The beetles were subsequently identified by Queensland Museum staff as *Lesticus chloronotus* (site 6) and *Notonomus* sp. (site 9), neither of which are listed as threatened or regionally significant under any relevant statute.



Photo 5. Mature Pink-Underwing Moth larva on *Carronia multiseppalea* at site 14.



Photo 6. Mature Pink-Underwing Moth larva displaying defensive posture at site 14.

A total of 22 larvae of the Pink Underwing Moth were encountered during the March follow-up survey (**Photos 5 and 6**). The majority of these (15 individuals) were found in a localised cluster of the host vine (*Carronia multiseppalea*) at site 14. The remaining seven (relatively immature) larvae were scattered across an area of several hectares in patches of the vine at site 9. During the initial survey, thorough searching of the same site failed to reveal any sign of these larvae and it is likely that these individuals hatched from eggs after this survey took place. Conversely, three larvae of a related fruit piercing moth (*Eudocima fullonia*) were encountered feeding on the same host vine at the same site during the initial survey

(**Photo 7**), but were not present during the follow-up survey. This is not listed as a threatened species. No adults of the Pink Underwing Moth or the other fruit piercing moth species were observed during either survey; however, the adults of both species are nocturnal and difficult to observe during the day.



Photo 7. *Eudocima fullonia*, a fruit piercing moth, feeding on *Carronia multiseppalea*.

Whilst neither the Laced Fritillary nor the Richmond Birdwing was encountered, several other nymphalid and papilionid butterflies were on the wing. The Wanderer, Lesser Wanderer, Swordgrass Brown *Tisiphone abeona morrissi*, Blue Triangle *Graphium sarpedon*, Pale Blue Triangle *Graphium eurypylus lycaon*, Chequered Swallowtail *Papilio demoleus sthenelus* and Orchard Swallowtail *Papilio aegeus aegeus* were particularly conspicuous and the less common Purple Crow *Euploea tulliolus* (**Photo 8**) was also observed on its host vine (*Trophis scandens*). The absence of the two target butterflies is therefore considered to (in part) reflect scarcity/absence of the host plants rather than the timing of the surveys.

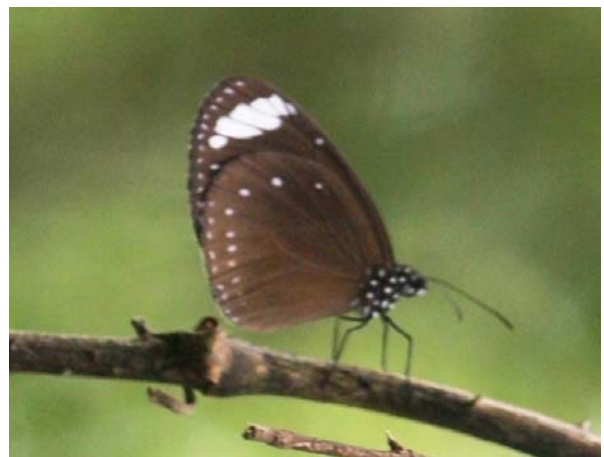


Photo 8. Purple Crow *Euploea tulliolus* on its host vine *Trophis scandens*.

A similar comment can be made for the Coastal Petaltail. Other dragonfly species were quite conspicuous within suitable habitats in the Study Area during the initial survey. Species with a broadly similar colour pattern to the Coastal Petaltail that were identified include the Yellow-striped Hunter *Austrogomphus guerini* and the Australian Emerald *Hemicordulia australiae* (**Photo 9**). Also of note, the Australian Pygmyfly *Nannophya australis*, a far less conspicuous species than the Coastal Petaltail, was observed in the habitat of the latter species. Adults of the Coastal Petaltail are on the wing from late October to early February (Theisinger and Hawking, 2006). Despite the presence of other dragonfly species, the possibility that the timing of this survey reduced the likelihood of encountering the target species cannot be discounted.



Photo 9. Australian Emerald *Hemicordulia australiae*.

3.2. HOST PLANTS OF CONSERVATION SIGNIFICANT INVERTEBRATE FAUNA

Two host plants for conservation significant invertebrate species were encountered during the course of the field survey. Several patches of *Carronia multisepealea* (host for the Pink Underwing Moth) (**Photo 10**) were encountered across sites 9, 11 and 14, and isolated occurrences of *Pararistolochia praevenosa* (host for the Richmond Birdwing) (**Photo 11**) were observed at sites 9, 11, 12, 13 and 14 (**Figure 3-1**). Both were found in regrowth rainforest, mostly growing on rich soil derived from basalt. *Carronia multisepealea* was recorded over an area of 0.212 hectares, 33 % of which falls within the current alignment (**Figure 3-1**).

Feeding damage was observed on *Carronia multisepealea*, and this was thought to be principally attributable to a non-target fruit piercing moth (*Eudocima fullonia*) (**Photo 7**) during the initial survey, and the Pink Underwing Moth (**Photos 5 and 6**) during the follow-up

survey. No sign of recent feeding activity was evident on *Pararistolochia praevenosa* during either survey; however, the persistent occurrence of the vine across a number of adjacent sites suggests that the area is a likely breeding habit as the butterflies have been known to utilise even isolated plants on occasion (Sands and New, 2002).



Photo 10. *Carronia multisepealea*, host for the Pink Underwing Moth *Phyllodes imperialis* at site 9.



Photo 11. *Pararistolochia praevenosa*, host for the Richmond Birdwing *Ornithoptera richmondia*, at site 9.

Thorough searches in areas of what appeared to be ideal habitat for *Viola betonicifolia* (host for the Laced Fritillary) proved to be unsuccessful. Moreover, there are no records from the broader area in the New South Wales Flora database (DECC, 2008). On this basis, it must generally be considered unlikely to occur, although this survey did not cover every part of Study Area and the possibility that a small patch of the violet may occur somewhere in the area cannot be discounted.

3.3. HABITAT SUITABILITY FOR CONSERVATION SIGNIFICANT INVERTEBRATE FAUNA

A summary of the field survey sites with comments on habitat suitability is provided in **Table 3-1**.



The Pink Underwing Moth is known to occur and breed within the Study Area. Its host plant is prevalent from within the alignment to a little beyond the edge of the western buffer zone (**Figure 3-1**). Both the moth and Richmond Birdwing, along with their host vines are likely to occur in suitable rainforest habitat from sites 11-12 south to site 14 and west to beyond site 13. The patches beyond site 13 do fall within the Study Area; however, the relevant properties were not visited during the survey due to access limitations.



Extensive searches at specific sites revealed only one burrow of the Atlas Rainforest Ground Beetle during the surveys, at site 14. The absence of these diagnostic burrows at other survey sites may ultimately be due to lack of suitable habitat at those sites. Further potential habitat also occurs to west of site 14, which was not able to be accessed during the survey. The Shorter Rainforest Ground Beetle is considered to have little or no potential to occur in rainforests within the Study Area, due to the lack of drier rainforest habitats.



The Laced Fritillary is considered unlikely to occur within the Study Area other than as a possible occasional visitor. It is a scarce species and the conspicuous absence of its host plant in near perfect habitat significantly reduces the likelihood of this species breeding within the alignment.



The Coastal Petaltail, whilst not encountered during the survey, is likely to be a breeding resident in the Study Area, including parts of the proposed road alignment. Suitable open habitats for hawking are present along substantial parts of the alignment and ideal wetland breeding locations are also present (especially sites 3, 7 and 10; **Fig. 1-1; Table 3-1**).



Table 3-1. Summary of sites surveyed for conservation significant invertebrate species with habitat descriptions and comments on habitat suitability



Site	Coordinates	Property	Area Surveyed	Habitat Description	Habitat Suitability	Representative photographs
1	S29.05059 E153.38864	Lot 133 on Plan DP839607	One hectare.	Low quality disturbed camphor forest with rainforest regrowth on sandy loam.	No conservation significant butterflies or moths, or their host plants, were observed on site; unlikely habitat for <i>Nurus</i> spp.	
2	S29.04956 E153.39068	Lot 133 on Plan DP839607	One hectare.	Medium quality remnant Swamp Sclerophyll with fan palm/rainforest understorey on sandy loam with rich organic layer; artificial wetland also present.	No conservation significant butterflies or moths, or their host plants, were observed on site; low potential for <i>Nurus atlas</i> ; wetland has low potential as breeding habitat for <i>Petalura litorea</i> .	



Site	Coordinates	Property	Area Surveyed	Habitat Description	Habitat Suitability	Representative photographs
3	S29.02289 E153.43665	Lot 3 on Plan DP818940	Two hectares.	Remnant and partly cleared swampy wallum heathland with permanent wetlands.	No conservation significant butterflies or moths, or their host plants, were observed on site; unlikely habitat for <i>Nurus</i> spp.; wetland with sphagnum has high potential as breeding habitat for <i>Petalura litorea</i> .	 



Site	Coordinates	Property	Area Surveyed	Habitat Description	Habitat Suitability	Representative photographs
4	S28.97113 E153.43251	Lot 248 on Plan DP755691	Two hectares.	Degraded remnant paperbark Swamp Sclerophyll.	No conservation significant butterflies or moths, or their host plants, were observed on site; unlikely habitat for <i>Nurus</i> spp.; wetland has low potential as breeding habitat for <i>Petalura litorea</i> .	 



Site	Coordinates	Property	Area Surveyed	Habitat Description	Habitat Suitability	Representative photographs
5	S28.99576 E153.43835	Lot 22 on Plan DP755691	Two hectares.	Remnant grassy open forest dominated by <i>Eucalyptus pilularis</i> on hillside and adjacent cleared swampy grassland on alluvial flats; no permanent wetlands, apart from the adjacent Richmond River.	No conservation significant butterflies or moths, or their host plants, were observed on site, though high potential for <i>Viola betonicifolia</i> (food plant for larvae of <i>Argyreus hyperbius</i>); unlikely habitat for <i>Nurus</i> spp.; unlikely breeding habitat for <i>Petalura litorea</i> .	 



Site	Coordinates	Property	Area Surveyed	Habitat Description	Habitat Suitability	Representative photographs
6	S28.91184 E153.47833	Pacific Highway road verge	Five hectares.	Swamp rainforest with feather palms.	No conservation significant butterflies or moths, or their host plants, were observed on site; unlikely habitat for <i>Nurus</i> spp. and <i>Petalura litorea</i> .	 



Site	Coordinates	Property	Area Surveyed	Habitat Description	Habitat Suitability	Representative photographs
7	S29.03292 E153.40562	Broadwater National Park (DEC NSW)	Four hectares	High quality remnant wallum heathland with scattered ephemeral and permanent wetland areas	No conservation significant butterflies or moths, or their host plants, were observed on site; unlikely habitat for <i>Nurus</i> spp.; permanent wetlands with sphagnum have high potential as breeding habitat for <i>Petalura litorea</i> .	
8	S29.00434 E153.44476	Lot 6 on Plan DP1043232	Six hectares.	Remnant <i>Callitris columellaris</i> , banksia, paperbark and blackbutt open forest, with an artificial wetland; some small patches of closed forest with rainforest elements also present.	No conservation significant butterflies or moths, or their host plants, were observed on site; unlikely habitat for <i>Nurus</i> spp.; permanent wetland has low potential as breeding habitat for <i>Petalura litorea</i> .	

Site	Coordinates	Property	Area Surveyed	Habitat Description	Habitat Suitability	Representative photographs
9	S28.92683 E153.47112	Lot 61 on Plan DP1088684	Six hectares.	Old regrowth rainforest on rocky basalt soil with nearby Swamp Sclerophyll forest intersected by cleared grassy areas and a drainage line.	Several larvae of <i>Phyllodes imperialis</i> were located on their host vine <i>Carronia multisepealea</i> , in rainforest areas at the site; no adults or larvae of <i>Ornithoptera richmondia</i> were encountered; however, a single <i>Pararistolochia praevenosa</i> (food plant for this species) was located in rainforest areas at the site; low potential for <i>Viola betonicifolia</i> (host for <i>Argyreus hyperbius inconstans</i>) in disturbed open areas; moderate potential for <i>Nurus atlas</i> in rainforest, despite no beetles or burrows being identified on site; wetland associated with a drainage line has low potential as breeding habitat for <i>Petalura litorea</i> .	 

Site	Coordinates	Property	Area Surveyed	Habitat Description	Habitat Suitability	Representative photographs
10	S29.05616 E153.38889	Lot 212 on Plan DP851963	Nine hectares.	Disturbed wallum heathland intersected by large cleared areas, with isolated patches of remnant closed forest, a pine plantation and a permanent wetland associated with a drainage line.	No conservation significant butterflies or moths, or their host plants, were observed on site, though low potential for <i>Viola betonicifolia</i> (host for <i>Argyreus hyperbius inconstans</i>); unlikely habitat for <i>Nurus</i> spp.; permanent wetland with sphagnum has high potential as breeding habitat for <i>Petalura litorea</i> .	 

Site	Coordinates	Property	Area Surveyed	Habitat Description	Habitat Suitability	Representative photographs
11	S28.921270 E153.38889	Lots 4 and 5 on Plan DP877097	Two hectares.	Old regrowth rainforest on basalt adjacent to a cleared paddock.	No conservation significant butterflies or moths were identified on site; however, a patch of <i>Carronia multiseppalea</i> (food plant for larvae of <i>Phyllodes imperialis</i>) and a single <i>Pararistolochia</i> <i>praevenosa</i> (food plant for larvae of <i>Ornithoptera richmondia</i>) were both located at the site; low potential for <i>Viola betonicifolia</i> (host for <i>Argyreus hyperbius</i> <i>inconstans</i>) in disturbed open areas; unlikely habitat for <i>Nurus</i> spp. and <i>Petalura litorea</i> .	 

Site	Coordinates	Property	Area Surveyed	Habitat Description	Habitat Suitability	Representative photographs
12	S28.919842 E153.475265	Lot 3 on Plan DP877097	Two hectares	Riparian rainforest on alluvium adjacent to a cleared paddock.	No conservation significant butterflies or moths were identified on site; however, several <i>Pararistolochia praevenosa</i> (food plant for larvae of <i>Ornithoptera richmondia</i>) were located at the site; unlikely habitat for <i>Nurus</i> spp. and <i>Petalura litorea</i> .	
13	S28.931430 E153.462594	Lot 51 on Plan DP1120710	One hectare.	Disturbed rainforest on sand adjacent to a cleared paddock.	No conservation significant butterflies or moths were identified on site; however, several <i>Pararistolochia praevenosa</i> (food plant for larvae of <i>Ornithoptera richmondia</i>) were located at the site; unlikely habitat for <i>Nurus</i> spp. and <i>Petalura litorea</i> .	

Site	Coordinates	Property	Area Surveyed	Habitat Description	Habitat Suitability	Representative photographs
14	S28.930332 E153.464227	Lot 51 on Plan DP1120710	Two hectares.	High quality old regrowth rainforest on basalt soil with some remnant emergent trees, adjacent to a cleared paddock.	A cluster of larvae of <i>Phyllodes imperialis</i> were located in a localised occurrence of their host vine <i>Carronia multiseptata</i> in rainforest areas at the site; no adults or larvae of <i>Ornithoptera richmondia</i> were encountered; however, the host plant for this species occurs in nearby rainforest (site 13); low potential for <i>Viola betonicifolia</i> (host for <i>Argyreus hyperbius hyperbius</i>) in disturbed open areas; <i>Nurus atlas</i> was found to occur in rainforest habitat on site; unlikely habitat for <i>Petalura litorea</i> .	 

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