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Ecological Assessment Lot 1 DP 1097743 and Lot 6 252223 Pacific Highway Moonee Beach, NSW

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Executive Summary

This report presents the results of terrestrial and aquatic ecological surveys undertaken on Lot 1 DP (1097743) and Lot 6 (252223) Pacific Highway NSW (refer to Figure 1 for details).

Surveys were conducted over a two year period (Winter 2010 and March-October-December 2011) and included a range of detailed surveys. These surveys were designed to identify the ecology of the site, and if present, significant threatened species, populations, communities or their habitats. Surveys were undertaken within lands proposed to be cleared (the "impact site") and lands that are proposed for conservation.

The main findings are:

- The largest area to be impacted is grazed and slashed pasture with scattered trees, which are mostly regrowth trees of less than approximately 10 years of age;
- Fauna species recorded in cleared areas are common species that are often only associated with cleared land or farmland; and,
- Only 16 hollow bearing trees were recorded in the impact site, none of which were identified as significant.

Surveys identified 5 significant threatened species on the site proposed for clearing, including:

- Osprey;
- Squirrel glider;
- Glossy-Black Cockatoo;
- Little Bentwing Bat;
- Eastern Bentwing Bat.

Impacts are predicted to occur on Squirrel glider, and Glossy Black Cockatoo. The remaining species whilst being recorded onsite have little interaction with the site and this is reserved to the area of the site that will not be impacted by the proposal.

No Endangered populations or Endangered Ecological Communities were recorded within the impact site. Although, some small areas of habitat were identified for a range of other locally occurring threatened species, these are not considered to be significant areas of habitat due to the small amount of habitat and small number of habitat elements recorded. Moreover, these habitat elements are considered relatively "common" and can be found throughout the local area.

There are areas of wetland onsite, which will be retained and buffered to limit edge impacts. A reserve will be established that increase habitat for Wallum froglet, Squirrel glider, Koala, Glossy-Black Cockatoo and micro-bats. Once established this reserve will be managed for a period of five years.

The Coffs Harbour Council Comprehensive Koala Plan of Management identifies the impact site as cleared and Secondary habitat, Therefore, it is considered that the impact site potentially supports koalas, and the matter requires referral to the Minister of the Environment, as the proposal could potentially impact on Matters of National Environmental Significance pursuant to the EPBC Act 1999.

In the regional context, the impact site provides ecological support for the region's ecology, and as such, is considered of moderate ecological value. These results are fully supported by recent studies undertaken on the local area and the koala habitat mapping undertaken by Coffs Harbour Council (CHC 2006).

In conclusion, without appropriate mitigation the proposed clearing of the impact site will impact on local ecology (i.e. TSC Act and EPBC Act species). No areas of critical habitat were identified and the activity will not introduce any key threating processes that may impact on surrounding ecology. No significant species or communities identified in the Fisheries Management Act were recorded adjacent to the site in Moonee Creek, however the regional importance of the Moonee Estuary system is considered very high.

The results of 7–part tests on the potential impact species concludes that with the adoption of the proposed mitigation measures the proposal will have an acceptable level of impact and **not** necessitate the preparation of a Species Impact Statement.

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Section A- Scope of Work, Purpose and Review of Literature

1.0 Introduction and Scope

This Ecological Assessment has been prepared in support of an application for Residential development on Lot 1 DP (1097743) Pacific Highway NSW, and provides information relating to Lot 6 DP (252223). This activity will be assessed in accordance with legislative requirements for a Part 3A project under the EPA Act. This study identifies constraints and opportunities for possible future development.

A detailed description of the proposal, and the localities of infrastructure of the proposed activity, is provided in Section 3.0 (section which assesses impacts). The information provided by JW Planning will form the basis of the assessment on environmental considerations examined within this report.

- The specific areas of issue for this report are presented below and diagrammatically in Figure 1 and Figure 2.
- Sub-Regional Area- This includes all terrestrial lands within the wider catchment which have biodiversity links with the Local Area. Populations within this area are usually considered the meta-population.
- Local Area - Includes all terrestrial lands within a defined geographic area associated with the Subject Site (usually 10km area surrounding the site).
- Study Area- Includes all terrestrial lands that are linked as one remnant within the Local Area and when possible are surveyed in the same manner as the Subject Site.
- Subject Site- This includes all terrestrial lands within Lot 1 DP (1097743) and Lot 6 DP (252223) Pacific Highway Moonee Beach, as shown in Figure 1.

1.1 General Approach

The general aim of this report is to undertake a flora and fauna assessment to identify potential terrestrial and aquatic ecological issues which may be impacted upon by the approval of the proposed activity. The main focus of the "impact assessment" will be on the footprint of the proposal inclusive of Subject Site and the connections with remnants in the Local Area and where pertinent the Sub-Regional Area.

The specific aims are to:

- Conduct a literature review and data base search for the Local Area. Where ecological surveys, assessments and data sets have been undertaken this information will be included within discussions examining the site in a wider local area context;
- Provide an assessment of the ecological characteristics of the Subject Site;
- Determine the potential impacts of the proposal on ecological matters;
- Undertake pertinent legislative assessments; and,
- Provide management recommendations to minimise and mitigate impacts on terrestrial ecology.

2.0 Relevant Literature

The collection and review of relevant literature for the project includes the known distribution of significant species, populations and communities in the Local Area, pertinent local assessments, management plans, planning documents and peer reviewed literature. Guidelines prepared for ecological survey and assessments are also included in the review of literature and interpreted against the findings from other data sources.

2.0.1 Coffs Harbour City Council Local Environmental Plan 2000

The LEP 2000 identifies the site as residential and conservation land as part of the Moonee Urban Release Area as shown in Figure 1.

Figure 1 Site (Lot 1= Red Lot 6 = Blue) as part of the Moonee Urban Release Area. Pink is residential and Orange is Conservation

2.0.2 Moonee Beach- Development Control Plan (DCP)

The relevant components of the DCP which will be directly addressed within this report are the Natural Environment Strategies. These include:

- Exclude urban development from within 100m of Moonee Creek, 50m of Skinners Creek, and from within 20 m of all other creeks, to protect riparian vegetation and maintain water quality, and provide habitat linkages;
- Exclude urban development from within 50m of SEPP No 14 Coastal Wetlands.
- Eliminate adverse impacts of development upon the aesthetic, recreational and ecological values of the flood plain (the 1 in 100 year flood extent);
- No development is to occur within 100m of any osprey nest, access roads may encroach within 100m, but no closer that 70m;
- Any high value and very high value vegetation communities identified in Council's Vegetation Strategy within 100m of Solitary Islands Marine Park are to be protected.
- All high value and very high value vegetation identified by council's Vegetation Strategy with the low level of disturbance is to be protected;
- Known Wallum Froglet is to be protected;
- Figure 2 identifies (Hatched area of map) land considered to be subject to significant constraints requiring protection.
- All potential wallum froglet habitat areas are to be investigated to accurately map actual habitat;
- Exclude from development, areas of potential high water table where there is likely to be adverse impacts on groundwater or surface water quality;
- Land identified as containing regionally significant land is to be protected. Long term management is to be in accordance with Council's Vegetation Strategy;
- A minimum 40m operation area is to be provided between areas to be protected and future housing to ensure adequate bushfire protection is able to be provided without the need to remove protected vegetation;
- Any areas that are undevelopable due to the effect of the 40m separation area to be added to the land to be dedicated.

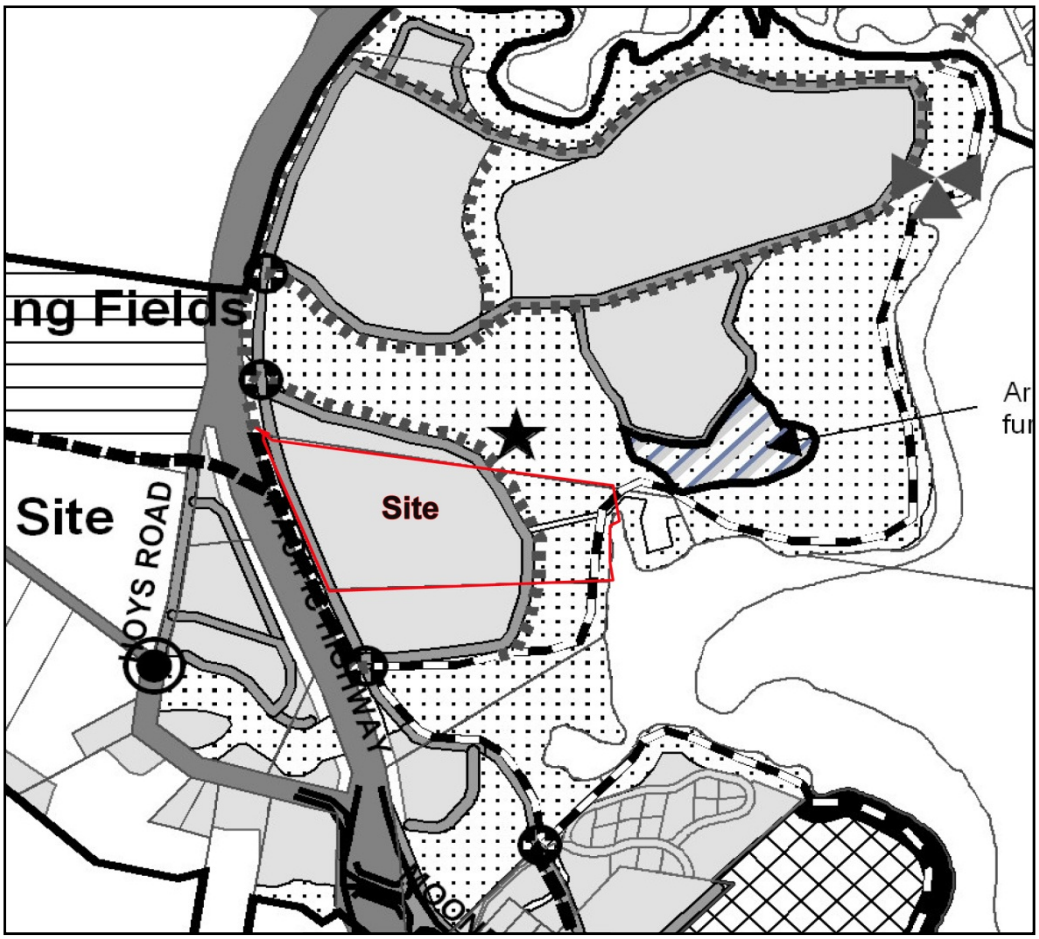

Figure 2 DCP, hatched area is conservation. Star is an Osprey nest tree that has fallen down. Grey is residential.

2.0.3 Wildlife Atlas-BioNet Database

The BioNet (http://www.bionet.nsw.gov.au/database) holds the records for native flora and fauna findings made by individuals holding licences for ecological education, research and business activities across NSW. This data includes lists and locations of significant species pursuant to the Threatened Species Conservation Act 1995. Part of the role of this assessment is to examine the local distribution of these threatened species; and assess the likely impacts of the proposal on these local species. The BioNet database is a key tool used for this assessment. The results of the BioNet search are shown in Results (section 3 of this report).

2.0.4 Matters of National Environmental Significance

Under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), actions that have, or are likely to have, a significant impact on a matter of national environmental significance require approval from the Australian Government Minister for Sustainability, Environment, Water, Population and Communities (the minister). The minister will decide whether assessment and approval is required under the EPBC Act.

The eight matters of national environmental significance protected under the EPBC Act are:

1. world heritage properties
2. national heritage places
3. wetlands of international importance (listed under the Ramsar Convention)

4. listed threatened species and ecological communities
5. migratory species protected under international agreements
6. Commonwealth marine areas
7. the Great Barrier Reef Marine Park
8. nuclear actions (including uranium mines)

Items 3, 4, 5 and 6 are relevant to this assessment. Items 3 and 4 are considered in section 3 of this report, whilst marine areas are considered under the heading "aquatic and marine interactions with the subject site" section 3.8 of this assessment.

2.1 Peer Reviewed Literature

2.1.1 Document 1

James Warren Report - Flora assessment

James Warren & Associates (JWA) (2004) undertook a systematic survey of the Local Area, including the Subject Site. They reported eight vegetation communities and identified 97 flora species on Lot 6 & the adjacent Lot 7. No threatened species were found. JWA (2004) describes the conservation values of identified vegetation communities according to the same rules that were used in the Coffs Harbour City Council Draft Vegetation Management Study to assign conservation values, that is, all Forest Eco systems (FEs) that have <=33% of reservation target met are considered "very high ecological value". Using this rule, which they modified with an assessment of current condition, JWA (2004) concluded that parts of the site included high conservation value areas.

2.1.2 Document 2

Eco-Logical Flora assessment

Field assessment of the subject site was undertaken on 19th December 2006. A total of nine person hours was spent on-site.

A traverse of the subject site was made to ground-truth both the JWA 2004 report and the Coffs Harbour City Council (from here on referred to as Council - Fisher *et al.* 1996) vegetation mapping. Each vegetation community on the site was inspected, and assessed floristically and structurally. A flora species list for the subject site was accumulated during the traverse. An assessment was made of the habitat value of each vegetation type in relation to its perceived ability to support threatened species. Available habitats were assessed in relation to on-site values and also at broader spatial scales to provide a context for the site's conservation values and to allow planning for integrated protection and enhancement of those values at local and landscape levels. Accordingly, the proposed creek buffers along Moonee and Cunningham's creeks were assessed for their current and potential habitat corridor values.

2.1.3 Document 3

Estuary Management Plan for Moonee Creek

An Estuary Management Plan for Moonee Creek was prepared for Council and Department of Environment and Climate Change (DECC), to fulfil the requirements of the NSW Estuary Management Policy (1992) and the NSW Coastal Policy (1997). The Plan provides a program of strategic actions to assist government authorities and other stakeholder groups to sustain a healthy estuary through appropriate waterway, foreshore and catchment management. The Plan presents an integrated suite of management strategies, giving due consideration to the complex interactions between many estuarine processes and functions.

Its main objectives that are relevant here are:

- Improve management of storm water runoff from Moonee Creek catchment by diverting stormwater runoff through retrofitted detention basins and wetlands, or treatment via other best available technology
- Revegetation of foreshore areas, which are susceptible to bank erosion, using combination of aquatic macrophytes and terrestrial species.
- Infill inappropriate artificial drains that have concentrated flows and caused localised erosion scarps (e.g. in Skinner Creek).
- Ensure compliance with sediment and erosion control requirements during construction of new developments, redevelopment of existing sites, and any other works carried out along the foreshore (e.g. revegetation).
- Expansion of existing SEPP-14 wetland boundaries and/or creation of new wetland areas to be included in SEPP-14.
- Revegetate foreshores and other degraded areas around the estuary that have been partly or totally cleared of natural vegetation.
- Ensure that all new developments are fully sewered.

Management Recommendations based on Processes Understanding

There are a number of key issues which need to be addressed for the effective management of Moonee Creek Estuary, which will ensure that the Creek remains healthy and sustainable in the future. These issues include:

- Control on the types and extent of development that is undertaken within the catchment, ensuring the pristine nature of Moonee Creek is maintained;
- Stabilisation of banks, especially within the entrance;
- Enforcement of recreational uses of the estuary, including current regulations concerning dog walking, and horse riding;
- Removal of inappropriate foreshore structures and possible replacement with alternative bank protection measures; and
- Preservation and enhancement of existing riparian vegetation and estuarine habitats

2.1.4 Document 4

Marine bioregional plan for the Temperate East Marine Region

The *Marine Parks Act 1997* objectives are:

- To conserve marine biological diversity and marine habitats by declaring and providing for the management of a comprehensive system of marine parks;
- To maintain ecological processes in marine parks;
- To provide for ecologically sustainable use of fish (including commercial and recreational fishing) and marine vegetation in marine parks; and
- To provide opportunities for public appreciation, understanding and enjoyment of marine parks.
- The Marine Parks Act 1997 provides for the creation of marine parks. Once a marine park has been declared, a zoning plan is created to regulate activities within the marine park in a manner that is consistent with the objectives of the Marine Parks Act 1997.

The Subject Site falls within the Marine Park area and must meet the objectives of the plan, which details the objectives for regional management of Marine Habitats.

2.1.5 Document 5

Commonwealth of Australia (2001) Solitary Islands Marine Reserve (Commonwealth Waters) Management Plan. Environment Australia, Canberra

The Solitary Islands Marine Park (SIMP) was declared on 2 January 1998 under the Marine Parks Act 1997. The marine park extends for 75 km from Muttonbird Island in the south to Plover Island in the north (outside of the study area), and from the mean high water mark (MHWM) and upper tidal limits of coastal estuaries to the limit of the NSW State waters. It covers an area of approximately 71,000 hectares of estuarine and marine habitats, and includes five main islands (North Solitary Island, North West Solitary Island, South West Solitary Island (Groper Island), South Solitary Island and Split Solitary Island).

For activities below MHWM (e.g. seawalls, beach nourishment, beach erosion management etc.), MPA would need to be consulted as part of the development assessment process and may be a concurrent consent authority.

The ten management categories outlined in the Operational Plan are:

1. Management for Conservation of Biodiversity and Maintenance of Ecological Processes: the aim is to ensure maintenance of ecological processes and the protection of the diverse range of habitats within the Solitary Islands Marine Park. Particular emphasis is placed on conserving all marine species that are susceptible to human impacts and are categorised as threatened, protected or endemic;
2. Management for Ecological Sustainable Use: the aim is to ensure that the values of the marine park remain intact for future generations, whilst allowing for particular activities to be carried out. The operational plan provided management actions for the following activities: fishing and collecting, aquaculture, scuba diving and snorkelling, marine mammal watch, boating and personal water craft, beaching and camping activities, and vehicle use;
3. Management of Indigenous Culture: this ensures the protection of aboriginal sites of significance and ecologically sustainable Aboriginal use of resources;
4. Management of Non –Indigenous Culture: the aim is to provide protection to shipwrecks and scenic features both above and below the surface, as well as the coastal views. These features were originally deemed to be of national significance and resulted in the Marine Park being listed on the Register of the National Estate in 1993; and Management of other issues: The aim is to ensure a coordinated and rapid response to incidents within the marine parks, early detection of marine pests, provision of safe moorings and appropriate consideration of development applications;
5. Research and monitoring: The aim is to research and monitor different aspects of the park including biodiversity and ecological processes, Aboriginal and non-Aboriginal cultural and heritage, ecological sustainable use and specific impacts;
6. Community education and involvement: The aim is to encourage interaction between people and marine flora and fauna without causing harm;
7. Compliance programs: to ensure that the zones in the Marine Park are used appropriately compliance programs are run to ensure that users understand and comply to the zoning scheme;
8. Permit system: A permit system is used for regulating activities and operations in the marine park, limiting impacts on particular areas, separating conflicting activities and ensuring that the park is used appropriately by a large number of people. Permit systems also enable data collection; and
9. Management arrangements with Commonwealth: the Marine Parks Authority works with a number of Government Departments under a variety of management arrangements.
10. For each of these categories different management actions have been developed to ensure that the Marine Park is managed effectively.

The strategic objectives, management goals and management strategies for the Reserve will, to the maximum extent possible, be consistent with the management regime to be developed by the NSW MPA for the Park. Accordingly, the zones applied to the Commonwealth Reserve have similar provisions to the zones used in the adjoining State marine park. The Reserve overall is assigned by the Plan as an International Union Conservation Network (IUCN) protected area management category VI (managed resource protected area). The Plan then divides the Reserve into three zones and assigns them to IUCN.

1. **General Use Zone** (IUCN category VI) applies to most of the Reserve, allowing for all ecologically sustainable activities currently undertaken within the Reserve to continue, in conjunction with measures to maintain its biological diversity and other natural values;

2. **Sanctuary Zone** (IUCN category Ia — strict nature reserve) encompasses the area within a 500 metre radius around the centre of Pimpernel Rock and provides a 'no-take' area, primarily to protect the pinnacle benthic communities, established ecological processes, and associated sensitive marine species such as grey nurse sharks;

3. **Habitat Protection Zone** (IUCN category IV — habitat/species management area) encompasses the Sanctuary Zone and protects a representative sample of whole reef complex, including soft substrate sediments and sub tidal reef habitats, deep water biotic communities and predator-prey assemblages, mammals and seabirds.

2.1.6 Document 6

The Northern Rivers Regional Biodiversity Management Plan

The Northern Rivers Regional Biodiversity Management Plan ('the Plan') has been prepared by DECCW and supported by the Northern Rivers Catchment Management Authority (CMA).

The Plan constitutes the national regional recovery plan for federally-listed threatened species and ecological communities, having been prepared in accordance with the Commonwealth Environment Protection and Biodiversity Conservation Act 1999. It also meets the requirements of NSW recovery planning for threatened species, populations and ecological communities. The Plan addresses 298 threatened entities listed on Commonwealth and State legislation (as of March 2009), including 273 species, 5 populations and 20 ecological communities.

A detailed threat analysis identifies the threats acting on biodiversity at both the regional level and for each of the four broad landscape units delineated for the Region: coastal plains, midland hills, escarpment ranges and tablelands. Threats are assessed, grouped into categories and then ranked. Additionally, biodiversity conservation and restoration priority areas are identified using a wide range of spatial data and techniques, including the Biodiversity Forecasting Tool, fauna habitat modelling and expert opinion. Regional, landscape, local and specific recovery actions address the identified threats at the most appropriate geographic or biological scale and location.

To achieve the vision, the Plan has set the following eight objectives:

1. To maintain and improve biodiversity and ecological processes by the rehabilitation and management of native vegetation across all land tenures.

2. To identify and mitigate the impacts of threats acting on threatened species, populations and ecological communities.

3. To mitigate the potential impacts of climate change by increasing landscape connectivity across all habitat types and land tenures.

4. To provide a basis for a consistent, coordinated and prioritised approach to the recovery of Terrestrial, freshwater and estuarine threatened species, populations and ecological communities.

5. To improve community awareness and encourage and support landowner and community participation in recovery planning and on-ground activities.

6. To develop partnerships between agencies, organisations, communities and individuals to achieve recovery of threatened species.

7. To recognise and incorporate cultural values into biodiversity landscape planning and encourage Indigenous engagement.

8. To contribute to targets, priority actions and outcomes of the *Northern Rivers Catchment Action Plan*, NSW State Plan, federal natural resources management targets, and the NSW *Threatened Species Priorities Action Statements*.

2.1.7 Document 7

Coffs Harbour Biodiversity Action Strategy 2012

The subject site falls within the "Coastal Plains" landscape under the strategy. Endangered Ecological Communities of this landscape identified are:

- Littoral Rainforest and Coastal Vine Thickets of eastern Australia.
- Lowland Rainforest of Subtropical Australia.
- Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions
- Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion
- Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Themeda Grassland on Seacliffs and Coastal Headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions.

Key Flora species known to the landscape are:

- Coastal Petaltail (*Petalurs litorea*)
- Floyds Grass (*Alexfloydia repens*)
- Milky Silkpod (*Parsonia dorrigoensis*)
- Orara Boronia (*Boronia umbellata*)

- Moonee Quassia (Quassia sp. Monney Creek)
- Headland Zieria (*Zieria prostrata)*
- Austral Toadflax (*Thesium australe)*
- Coast Headland Pea (*Pultenaea maritime)*

Key Fauna species of the Coffs Harbour coastal plains include:

- enda ngered coastal Emu *Dromaius novaehollandiae* population
- Wallum Froglet *Crinia tinnula*
- Bla ck-necked Stork *Ephippiorhynchus asiaticus*
- Brolga *Grus rubicunda*
- Eastern Ground Parrot *Pezoporus wallicus wallicus*
- Osp rey *Pandion cristatus*
- Square-taile d Kite *Lophoictinia isura*
- Glossy Black-Cockatoo *Calyptorhynchys lathami*
- Powerful Owl *Ninox strenua*
- Brush-taile d Phascogale *Phascogale tapoatafa*
- Comm on Planigale *Planigale maculata*
- Koala *Phascolarctos cinereus*
- Squirrel Glider *Petaurus norfolcensis*
- Long -nosed Potoroo *Potorous tridactylus*
- Grey-hea ded Flying-fox *Pteropus poliocephalus*
- Eastern Blossom-bat *Syconycteris australis*
- Little Bentwing–bat *Miniopterus australis*
- Hoa ry Bat *Chalinolobus nigrogriseus*
- Coastal Petaltail *Petalura litorea*.

Relevant Management area (Emerald Beach – Moonee Creek – Wedding Bells)

This area extends from Moonee Beach Nature Rese rve and li nks through rem nant coastal complex habitats and open forests to Wedding Bells State Forest. The corridor is fragmented by the settlement of Emerald B each and clearing associated with Moo nee Creek. However, it still suppo rts important remnant coastal heaths, wetlands, Swamp Sclerophyll Forest EEC and forest areas that are known to support threatened species.

An important Voluntary Co nservation Area supports a population of the n ationally endangered Giant Barred Frog. A potentially important Koala population may also persist in the western part of the area along with plants like the Rusty Plum. The Wallum Froglet, Common Planigale, Squirrel Glider, Grey-headed Flyin g-fox, Comm on Blossom -bat and O sprey have all been re corded. Part of the area i s mapped a s a Re gional Priority Co nserve an d Repair A rea i n the North ern Rivers Regional Biodiversity Plan

The largest estuaries are in Coffs, Bon ville and Pi ne creeks in t he south, and Moonee, Corindi a nd Saltwater creeks in the north. The se estuaries p rovide impo rtant habitat for a variety of wad ers, shorebirds, fish, crustaceans, other invertebrates, and marine and estuarine vegetation. Estuaries are also significant for recreational fishing and the commercial fishing industry.

2.1.8 Document 8

Comprehensive Koala Plan of Management

The Coffs Harbour Comprehensive Koala Plan of Management was developed by the NSW National Parks and Wildlife Service (NPWS) in consultation with Council, under the provisions of SEPP 44 – Koala Habitat Protection. This Plan of Management replaces the requirements of SEPP 44 within the Coffs Harbour LGA. The aim of this plan is to provide a framework for the conservation and management of koala habitat and the management of threat to koalas, to ensure a permanent free-living population over their present range in Coffs Harbour LGA and reverse the current trend of koala population decline. The Plan of Management applies to all land within the Coffs Harbour LGA.

2.2 Generally accepted Guidelines for Survey for the Assessment of Ecological impacts

Guidelines for ecological assessment prepared by the Department of the Environment and Climate Change for flora and fauna and aquatic (Now the Office of the Environment and Heritage-OEH) detail an appropriate level of survey for ecological assessment (DECC 2009). Table 1 provides a summary of these guidelines and when required throughout this report these are referred to in direct relation to the species, population or community under investigation.

Table 1. Suggested survey methods and effort for Ecological Surveys DECC NSW 2009.

Method	Suggested minimum effort	Survey period
Flora		
Quadrats	1 quadrat per stratification unit <2 hectares 2 quadrats per 2-50 hectares of stratification unit 3 quadrats per 51-250 hectares of stratification unit 5 quadrats per 251-500 hectares of stratification unit 10 quadrats per 501-1000 hectares of stratification unit, plus one additional quadrat for each extra 100 hectares thereof.	Seasonal
Traverses	1x100m traverse per stratification unit <2 hectares 2x100m traverses per 2-50 hectares of stratification unit 3x100m traverses per 51-250 hectares of stratification unit 5x100m traverses per 251-500 hectares of stratification unit 10x100m traverses per 501-1000 hectares of stratification unit, plus one additional 100m traverse for each extra 100 hectares thereof	Seasonal
Frogs		
Systematic day habitat search	One hour per stratification unit	Varies according to the seasonal peak of activity of target species
Night habitat search of damp and watery sites	30 minutes on two separate nights per stratification unit	See above
Nocturnal call playback	At least one playback on each of two separate nights	See above
Night watercourse search	Two hours per 200m of water body edge	See above
Reptiles		
Total Effort	Effort per stratification unit up to 100 hectares on the coast and ranges, and up to 200 hectares west of the ranges	Survey period
Habitat search	30-minute search on two separate days targeting specific habitat	November to March
Pitfall traps with drift nets	24 trap nights, preferably using six traps for a minimum of four consecutive nights	November to March
Spotlighting	30-minute search on two separate nights targeting specific habitat	November to March
Diurnal Birds		
Area search	This matter has not been resolved as yet but it is likely that a species-time curve approach should be utilised for surveying diurnal birds. For example, the survey session for a particular day may cease when no additional species are identified within a set time period. This approach better accommodates the variety of habitat types and birds found in NSW. Per stratification unit.	All year
Wetland census	A one-hour census at dawn or dusk, for each identified wetland.	All year
Water source census	A 20-minute census at dawn or dusk, for each identified water source.	All year
Nocturnal Birds		
Call playback	Sites should be separated by 800 metres – 1km, and each site must have the playback session repeated as follows: -at least 5 visits per site, on different nights are required for the Powerful Owl, Barking Owl and the Grass Owl; -at least 6 visits per site for the Sooty Owl, and 8 visits per site for the Masked Owl are required. Sites for Bush Stone-curlew surveys should be 2-4km apart and conducted during the breeding season.	All year
Day habitat search	Search habitat for pellets, and likely hollows. Flushing of Bush Stone-curlews by walking through potential habitat.	All year

Method	Suggested minimum effort	Survey period
Stag-watching	Observing potential roost hollows for 30mins prior to sunset and 60mins following sunset.	All year
Spotlighting	Spotlighting for Plains Wanderer and Bush Stone-curlew by foot or from a vehicle driven in first gear.	All year
Non-flying mammals		
Total Effort	Effort per stratification unit up to 50 hectares, plus an additional effort for every additional 100 hectares	Animal sampled
Small Elliott traps	100 trap nights over 3-4 consecutive nights	small mammals
Large Elliott traps	100 trap nights over 3-4 consecutive nights	Medium to large mammals
Arboreal Elliott traps	24 trap nights over 3-4 consecutive nights	Arboreal mammals
Wire cage traps	24 trap nights over 3-4 consecutive nights	Medium to large mammals
Pitfall traps with drift nets	24 trap nights over 3-4 consecutive nights	small mammals
Hair tubes	10 large and 10 small tubes in pairs for at least 4 days and 4 nights	small and medium mammals
Arboreal hair tubes	3 tubes in each of 10 habitat trees up to 100 hectares of stratification unit, for at least 4 arboreal mammalsdays and 4 nights	
Spotlighting on foot	2 x 1 hour and 1km up to 200 hectares of stratification unit, walking at approximately 1km per hour on 2 separate nights	arboreal and terrestrial mammals
Spotlighting from vehicle	2 x 1 km of track at maximum speed of 5km per hour, up to 200 hectares of stratification unit, on 2 separate nights	arboreal and terrestrial mammals
Sand plots	6 soil plots for 4 nights	mostly medium to large terrestrial mammals
Call playback	2 sites per stratification unit up to 200 hectares, plus an additional site per 100 hectares above 200 hectares. Each playback site must have the session conducted twice, on separate nights	gliders, koalas
Stag-watching	Observing potential roost hollows for 30 minutes prior to sunset and 60 minutes following sunset	gliders and possums
Search for scats and signs	30 minutes searching each relevant habitat, including trees for scratch marks	all mammals
Track search	1km of track search with emphasis on where substrate is soft	mostly medium to large terrestrial mammals
Collection of predator scats	Opportunistic collection of predator scats for hair analysis	all mammals
Bats		
Method	Effort per 100 hectares (or portion thereof) of stratification unit targeting preferred habitat	Survey period
Harp trapping	Four trap nights over two consecutive nights (with one trap placed outside the flyways for one night)	October to March
Mist netting	For targeted survey: one trap set for at least two hours duration starting at dusk, for two nights	October to March
Ultrasonic call recording	Two sound activated recording devices utilised *for the entire night (a minimum of four hours)*, starting at dusk for two nights	October to March
Trip line	For targeted survey of water bodies: at least two hours duration starting at dusk, for two	October to March

Method	Suggested minimum effort	Survey period
	nights	
Spotlighting and transect Walking.	For targeted survey near likely food resources: 2 x 1 hour spotlighting on two separate nights	All year
Day habitat search	Search for bat excreta at or near potential habitats	All year

Section B - Methods

3.0 Surveys within the Subject Site

3.1 General approach to Flora Survey

Vegetation sampling for ecological assessments generally has several aims, these being: to map vegetation; identify habitats for significant species, populations or communities; produce a list of species; and identify ecological conditions on site, such as weeds, and disturbance. Typically this involves Eight (8) main stages before a final product is presented:

- Review of mapping resources for the site, such as, DEEC mapping (2003);
- The mapping of the site prior to field surveys to establish the area (ha) of units, and the typing of vegetation communities;
- Determination of the survey effort based on DECC survey guidelines;
- Onsite walking transect surveys;
- Redraft of vegetation mapping using transect data;
- Redrafting of vegetation maps, comparing results with resources and initial maps;
- Determination of field survey effort from new mapping results using logic shown in Table 2, including targeted survey requirements;
- Conduct quantitative plots and targeted surveys; and,
- Prepare final vegetation community maps, threatened species habitat maps and condition maps.

The above process was followed for the preparation of vegetation data and maps for this assessment within terrestrial and aquatic habitats. For simplicity, only the field survey methods are detailed below, the remaining techniques follow common, logical processes.

Flora species and vegetation communities were sampled in accordance with the guidelines established by DECC. The survey effort undertaken for the site is listed below. The site was surveyed using a variety of survey techniques including transects, quadrat searches and haphazard searches (random transects).

Table 2. *DECC survey guideline survey requirements for flora and vegetation community descriptions.* ***Point 2 of the above list determines how many transects are initially used onsite. Point 7 determines the final level of survey required. That is, unless during this final survey, important habitat or significant species are located. When this occurs additional surveys are included that target the locations and habitats for the sub-population recorded onsite.***

Area	Structure	Survey requirements		
		Transects	**Plot (per community)**	**Replicates**
0-1ha	Simple	1-2	1	1 If there is evidence of management history i.e. grazing.
	Complex	1-2	1	1 If there is evidence of management history i.e. grazing.
1-10	Simple	3	1	1 per community 5ha
	Complex	3	2	1 per community 5ha
11-50ha	Simple	4-6	1	1 per community 5ha
	Complex	4-6	2	1 per community 5ha
>50ha	Simple	7-10	2	1 per community 10ha
	Complex	7-10	2	1 per community 10ha

In general, transects are used to establish major vegetation parameters onsite and collect data on disturbance history and management issues (Refer to Figure 3). Quadrats are used to gather information on vegetation parameters including structural, floristic, cover abundance as well as targeted information on threatened species. Hapha zard searches are utilised to gain an understanding of the subject site by locating threatened flora species and/or their potential habitat in order to identify areas that are potentially constrained.

Where required, access to aquatic habitats was achieved by use of a canoe and flora samples were collected and community boundaries mapped.

Figure 3. Flora and Vegetation Community Transects (Plots, searches and descriptions for communities)

3.1.1 Interpretation of Vegetation Associations

Methods used to interpret vegetation associations included all fundamental environmental parameters required to describe vegetation communities, these included:

- Vegetation structure
- Floristic composition
- Topography
- Soils type
- Geology
- Slope
- Aspect
- Disturbance history
- Successional Change
- Connectivity to other bush land areas
- Distance from water sources

3.1.2 Traverses

Six traverses (in this case interchangeable with transects or random meanders) were undertaken targeting vegetation within Subject Site and the Local Area. Transects were randomly walked, particularly within disturbed vegetation in order to maximise the identification of species retained.

Transects are used to establish major vegetation parameters onsite and collect data on disturbance history and management issues. In effect these surveys influence the design of quantitative plot surveys (see below), therefore they are the first data collected onsite, and often are used to produce draft community and condition maps that are used to determine the number of plots and assist in designing targeted surveys. Data is collected whilst walking along transects this includes; communities present, the boundaries between communities, species present, identifying locations for plot-based surveys, and data on the potential for disturbance of threatened species.

3.1.3 Plots

Quantitative survey plots (or Quadrats) are taken within 400m^2 (20mx20m) defined and measured survey plots. In total four (4) plots were sampled (as per Table 3). The locations of the plots were established using coordinates (MGA 94) generated using a random number algorithm (RNGP) and plotted in the Mapinfo GIS software (v10.5). In addition to the vegetation parameters detailed in section 2.2.1 structural, floristic, cover abundance and threatened and significant data was also collected.

Where these RNGP's landed in cleared or developed areas they were excluded from the survey. When the quota of required plots is reached, pursuant to the recommendations in the DECC Flora and Fauna survey guidelines 2009 the survey design was complete and additional sites ignored.

3.1.4 Reference Sites

Reference sites can be used to help locate cryptic or threatened species, or diminish the possibility of a threatened species being present. For example cryptic species that can only be easily located when flowering, a reference site where the species is known to occur can be assessed for flowering individuals, so it can reasonably be assumed that any species present within the study area would also be flowering. The reference site obviously needs to be similar habitat to the study area habitat (i.e. soils, aspect, and moisture); a similar vegetation association and it should be as close to the local area as possible.

The Local Area reference sites that were surveyed as part of this assessment included:

- Moonee Nature Reserve;
- Moonee Beach headland;
- Adjoining Lands.

3.2 Vegetation Mapping

Vegetation mapping is usually undertaken through aerial photograph interpretation (API), which involves identification of areas of vegetation which appear to be more or less internally homogenous on the aerial photograph (i.e. similar texture, colour, etc.). Mapping may seek to define areas (or polygons) based on vegetation structure (dominant growth form, height, density), or floristics (constituent plant species) or both. The API is supported by ground-truthing (i.e. checking aerial photograph interpretations on the ground). The quality of a vegetation map is proportional to the amount of ground-truthing, especially where floristics is used to define polygons. Ground-truthing may be targeted (i.e. investigating specific areas of API interest) or use some form of systematic sampling (e.g. transects).

The definition and delineation of vegetation polygons is subjective. A map of the vegetation of any area seeks to describe the distribution of plant species in that area by defining a number of vegetation map units (floristic assemblages or 'communities') which are relatively internally homogeneous with sharp boundaries between adjoining 'communities'. Whilst such mapping is a convenient tool, it greatly oversimplifies the real situation. A plant 'community' is essentially an artificial device developed to simplify our interpretation of the real world. Plants rarely occur in well defined 'communities', although the distribution of some species may consistently partially overlap due to broadly similar environmental requirements. The 'communities' of any vegetation map are generally intuitively defined to reflect broad similarities in environmental requirements of species, but it is important to remember that in many situations the 'communities' could just have easily been defined in some other manner. Accordingly, vegetation units used for any map should be viewed as generalised plant species assemblages rather than distinct 'communities'.

In addition, plant 'communities', no matter how they are defined, rarely have sharp boundaries but gradually merge into each other. Any mapped boundary is as arbitrary as the definition of the 'communities'. The boundaries shown on a vegetation map should therefore be viewed as being indicative of the extent of the defined 'communities' rather than being precise edges.

Thus a vegetation map is not a 'photograph' of the vegetation of the site but rather a model of the distribution of plant species designed to demonstrate some inferred ecological relationships between plant species as well as the generalised distribution of major species. Care should therefore be exercised in using the map for any other purpose.

3.3 Plant Identification

Plant identification follows Harden (2000, 2002, 1992 and 1993) *Flora of New South Wales Volumes 1, 2, 3 & 4;* where a plant cannot be identified to species level it is sent to the Australian Herbarium for verification or identification. A number of other resources are also used including CD-ROM plant identification keys such as *Euclid* (2001) and *Ausgrass* (2002), other identification guides (see Bibliography) and the Internet has a number of resources useful for plant identification including PlantNET and EucaLink.

3.4 Vegetation Condition

Vegetation community condition is described by applying vegetation condition classes to vegetation units on the subject site. There are 6 classes described by the Bradley Method, these being:

Table 3. Vegetation condition assessment methodology

Class	Description
Very Good	Near natural condition with few weeds. Canopy in good health, little evidence of edge effects. Nearly full range of expected component plants.
Good	Vegetation in good condition but with some weeds evident and degradation processes evident. Almost full range of expected component species.
Moderate	Vegetation in reasonable condition with weeds common, evidence of degradation processes common. Some canopy dieback maybe evident. About 40-70% of expected component species are present.
Poor	Vegetation in poor condition with weeds common and evidence of degradation processes common. Canopy dieback of mature trees is often evident. About 20-50% of expected component species are present.
Very Poor	Vegetation in a very poor condition with weeds abundant, and evidence of degradation processes widespread. Canopy dieback of mature trees is often common. About 10-30% of expected component species are present
Non Existent	Little natural vegetation remains. Few scattered trees and understorey plants remain. Mostly highly disturbed and 75-95% of component species missing.

3.5 Wetland Boundary Delineation

To assist in determining what the ecological limit of the wetland area on Lot 1and Lot 6 constituted, detailed quantitative transects (No 5) were undertaken across the wetland boundary that buffers Moonee Creek. These transects started within the upland terrestrial area of Lot 1 and Lot 6 and travelled towards the water's edge. Along these transects species were identified and placed into two major groups, wetland plants and non-wetland plants. In total, 5 transects were undertaken of varying lengths as shown in Figure 4.

Figure 4. Wetland Boundary transects (orange lines)

3.6 Limitations to Flora Surveys

No limitations identified.

3.7 General Approach to Fauna Surveys

The fauna investigations conducted for the preparation of this report had the objectives of:

- Identifying the fauna assemblage of the study area;
- Identifying the habitat qualities of the study area;
- Locating important habitat in the study area;
- Identifying significant species habitat;
- Identifying fauna movement corridors and habitat connectivity; and
- Identifying conservation areas.

The review of the general fauna assemblage of the Study Area was conducted through scoping of fauna records and the correlation of habitat requirements of significant species with the vegetation units contained in the study area. The vegetation units were then examined based on their habitat characteristics in order to determine which of the significant species would be likely to inhabit those vegetation units, based on their habitat requirements. Surveys are then designed to accommodate the seasonal variations in movements of potential significant species to the Local Area. Table 4 show the

seasonality of surveys undertaken for this assessment and Figure 5 shows that survey locations along transects.

Table 4. Summary of fauna Surveys undertaken for this assessment.

Survey Method	2010				2011			
	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn
Trapping all sorts	✔	✔	✔		✔			✔
Frog surveys	✔	✔	✔		✔			✔
Spotlighting	✔	✔	✔					
Anabat		✔	✔					
Harp trapping		✔	✔					
Nocturnal bird surveys	✔	✔	✔		✔			✔
Aquatic Surveys	✔	✔	✔		✔			✔
Diurnal bird surveys	✔	✔	✔		✔			✔

Figure 5. Fauna survey locations. All surveys shown in table 4 were conducted along transects as shown, with the exception of aquatic surveys.

3.7.1 Amphibian Survey

Relevant literature relating to survey methods for amphibians was reviewed to determine the most appropriate approach for surveying the amphibian assemblages within the study area (Table 5). The most common approach to amphibian surveys involved a listening period followed by an active search of that area (Hazell 2001; Lemckert 1999). A mixture of these methods were undertaken onsite for Amphibian species (See Table 6).

Table 5. Literature search methods commonly applied for amphibians.

Study	Method	Method Details
Hazell et al. (2001)	1. Listening	5 minute listening period away from edge to determine assemblage followed by a 10 minute survey period at edge to determine abundance.
	2. Spotlight search area	5 minute active search in a 2m wide strip of riparian vegetation and shallow water to identify non-calling frogs.
Lemckert (1999)	1. Listening	5 minute listening period
	2. Spotlight inspection	Spotlight search of water's edge and adjacent vegetation.

Study	Method	Method Details
NSW NPWS & National Parks Association (2004)	1. Transect 2. Diurnal targeted search 3. Call recognition	Survey sample point every 50m Active search of targeted habitat Call and listen for 30 minutes

Table 6. DECC survey guidelines for amphibians.

Survey Group	Survey Technique	Survey Period	Survey Effort per Community
Diurnal searches	Systematic searches	All year	30 minutes on 2 separate occasions
Nocturnal searches	Spotlight searches	All year	12 person hours per habitat over five seasons
	Playback of recorded calls	All year	Once on each of 2 separate nights
Specific	habitat searches	All year	10 person hrs. survey of water body edge
	Call recording	All year	10 person hrs

Surveys for amphibians were undertaken during optimal time and conditions for the range of species that could expected in the regional area (See Table 7).

3.7.2 Reptiles Survey

A review of relevant literature was undertaken to determine the most appropriate methods for surveying reptiles within the study area (Table 8). The most common approach to reptile surveys involves a transect search in combination with an active search of a predetermined unit size (MacNally and Brown 2001; NSW National Parks Wildlife Service and National Parks Association 2004). In general all surveys for reptiles should target periods of high activity (dawn or dusk) and be undertaken in sunny weather with high temperatures (18 – 34ºC) (MacNally and Brown 2001). Refer to Table 8 for surveys undertaken as part of this assessment see)

Table 7. Review of reptile survey methodology.

Study	Method	Method Details
MacNally and Brown (2001)	1. Timed transects 2. Active search plot	50m long x 10m wide 250m2 Both searched for 10 minutes.
NPWS & NPA (2004)	1. Transect 2. Active search plot	100m long x 50m wide 500m2
Loyn et al. (2004)	1. Passive (auditory, visual) 2. Active search of area 3. Active search of subplot	Area determined by searcher Area determined by searcher 250m2
Klomp et al. (2001)	1. Identify likely habitat 2. Active search of area 3. Pitfall trapping	Determined by habitat features Extent of habitat identified 5 pitfalls 5m apart connected with drift fence
Singh et al. (2002)	1. Pitfall trapping 2. Time-constrained searches	20 traps per plot randomly placed 15 minute search of each plot

Table 8. LDECC survey guidelines for reptiles.

Survey Group	Survey Technique	Survey Period	Survey Effort per Community
Diurnal searches	Habitat searches	Sep-Mar	1 ha search for one person hour on 2 separate days per habitat

Survey Group	Survey Technique	Survey Period	Survey Effort per Community
Nocturnal searches	Habitat searches	Sep-Mar	Walking rate 1km hour per person on 2 separate nights
Specific habitats	Diurnal & nocturnal searches	Sep-Mar	1 person hour diurnal + 1 person hour per ha nocturnal
optional Pitfall	trapping	Sep-Mar	

Reptiles were surveyed across the study area on the 18 December 2011 using a variety of methods including passive and active search methods along random transects and subplots. In addition targeted searches of likely reptile habitat (e.g. rocks, hollows, rubbish) were conducted throughout the subject site.

Two (2) randomly located transects were conducted on the 18 June 2010 following the dimensions recommended by MacNally and Brown (2001) (50 m long and 10m wide). The transects were surveyed diurnally over a timed period (10 minutes) searching for auditory and visual cues of reptile species. Where a species was observed an opportunistic active search of that particular location was undertaken.

Five (5) randomly located subplots (5m x 10m) were placed along the transects and actively searched once the timed transect survey had been completed. Active searches within these subplots employed destructive sampling techniques, such as the raking of leaf litter, 'rock rolling' (overturning of rocks) and the turning and destruction of logs and log hollows to determine the presence of reptile species. The data gathered for each pseudo-replicated quadrat was then pooled together to produce a result for an active search area of a combined 250m2.

Haphazard searches (active) of likely reptile habitat were conducted during field surveys when suitable habitat was randomly encountered. This was to provide any additional information on reptile assemblages in the subject site.

3.7.3 Avifauna Survey

Recent research has shown that inventory-based studies such as transects recommended in several survey guidelines (e.g. DECC 2009) can generate data of less completeness than other bird survey methods, such as a "standardised search" approach (Watson 2003). In comparative studies of bird survey techniques fixed transects were shown to record only 38.9% species completeness, compared to the stopping rule based search which peaked at 75% completeness (Watson 2004). In short, Watson (2004) believes that fixed area sampling efforts of only 20 minutes may only be suitable for the smallest of sites or sites with limited complexity.

Birds were surveyed across the study area by random transects targeting periods of high bird activity, predominantly between the hours of 6 am and 9 am. As a minimum the surveys followed the following:

- Estimating the area of search
- Generally, for smaller patches (<50 hectares) one moves freely throughout the patch in every sample period. In comparison, larger patches (>50 hectares) can be broken into sub-sets and these sampled as independent (i.e. not overlap samples). A variation of methods was used across the study area dependent on patch size. All species are recorded by ear and unknown species are keyed out on site with the use of a digital recorder.
- Interval time
- An appropriate interval time ranges from 15 min – 60 min based on patch size and habitat density. Again this was scaled across the sites.
- Stopping rule
- A compound stopping rule in which "surveying was stopped after three sequential periods in which in total two new or fewer species were encountered" was applied.

In total, 12 area searches were conducted over five (5) seasons (2011=3 & 2012= 2) each occurring during a one week period for a 60 minute survey period at each site (n=60 hrs search). Surveys were conducted between 0700 and 1000 hours or between 1700 and 1900 hours, windy or rainy days were avoided.

3.7.4 Non-flying Mammals Survey

Trapping for non-flying mammals was undertaken over four consecutive nights between 11 December 2011 and 14 December 2011 using both terrestrial "A type" Elliott traps and cage traps and arboreal HWR Glider traps. Traps were baited with a mixture of honey, oats, peanut butter and vanilla essence. As an attractant, each arboreal trap was sprayed with a 50:50 mixture of honey and water with a splash of vanilla. Each animal captured was given a unique tag using non-toxic/non-permanent hair dye and released at point of capture.

Arboreal trapping stations were established in the survey area containing at least ten glider traps. Traps were attached to trees approximately four metres above the ground and were placed between 5 and 20 metres apart depending on availability of trees.

Terrestrial transects were established within broad vegetation units with the subject site, each containing at least ten (10) "A Type" Elliott traps. All terrestrial traps were placed at approximately 5 metre intervals.

Five (5) cage traps was placed in secure locations within the Local Area, where they were baited with meat and set in dense understory vegetation suitable for medium sized terrestrial mammals. Traps were set for five nights and checked every morning.

Non-flying mammals can be divided in to two broad categories, terrestrial mammals and arboreal mammals. Table 9 identifies the minimum survey effort and survey methods undertaken in the Local Area.

Table 9. DECC survey guidelines for non-flying mammals.

Fauna Group	Survey Technique	Survey Period	Survey Effort per Community
Small terrestrial mammals	Small mammal traps	All year	620 trap nights over 3-4 consecutive nights each survey, conducted over five seasons.
optional Pitfall	trapping	All year	10 consecutive trap nights in spring 2010
Medium Terrestrial mammals	Cage/B Elliot traps	All year	620 trap nights over 3-4 consecutive nights each survey, conducted over five seasons.
Arboreal Mammals	B Elliot traps	All year	920 trap nights over 3-4 consecutive nights each survey, conducted over five seasons
	Faecal pellet counts	All year	15 person hours of survey across whole site.
	Spotlighting All	year	27 person hours across site and in Local Area

"A type" Elliott traps, cage traps and arboreal Glider traps were used to sample non-flying mammals within the study area.

Arboreal traps were sprayed with an attractant, a 50:50 mixture of honey and water with a splash of vanilla and any animal captured was given a unique tag using non-toxic/non-permanent hair dye and released at point of capture.

Terrestrial Elliot traps were baited with either meat or rolled oats with peanut butter and honey. In inclement weather traps are put in plastic bags to prevent rain entering trap.

Cage traps usually baited with meat or other attractant with similar affect. Cage traps covered with hessian bags and plastic (in inclement weather) to provide protection for any trapped animal.

3.7.5 Flying Mammals Survey

Temporal variation in microchiropteran bat activity can make the estimation of diversity at a site difficult, particularly when undertaking short term surveys (such as most ecological assessments) difficult. Table 10 shows the range of activity levels of microchiropteran species during a typical season. This variation makes it hard to eliminate the presence of a species from a site. Surveys conducted for this site included during periods of high activity.

Table 10. Seasonal Activity levels of Threatened Microchiropteran Bats.

Species	Summer	Autumn	Winter	Spring	Hibernate or Migrate
Miniopterus australis				Hiber	nate
Miniopterus schreibersii				Hiber	nate
Myotis adversus				Hiber	nate
Mormopterus nofolkensis	Unknown				Unknown
Saccolaimus flaviventris				Migrate	
Falsistrellus tasmaniensis				Hiber	nate
Scoteanax rueppellii				Hiber	nate
Kerivoula papuensis				Unkn	own
Chalinolobus dwyeri				Hiber	nate

Key:

Most	activity
Moder	ate activity
	Least active

The minimum survey effort required to sample flying mammals DECC Survey Guidelines (2010) is shown in Table 11.

Table 11. Bat Surveys undertaken

Survey	Survey Technique	Survey Period	Survey Effort per Community
Microchiropteran Bats	Harp traps	All year, limited captures in winter	12 harp trap nights. 2 per broad habitat type.
	Echolocation	All year, limited results in winter	80 hours of continuous recording including call activated all night
Megachiropteran Bats	Spotlighting & listening	All year	Walking transects of 12 person hours

3.8 Aquatic Survey

Moonee Creek aquatic ecosystem is well studied with detailed management recommendations established (WBM 2006). The subject site has very little tidal interaction with Moonee Creek, only occurring under severe flood conditions. Moreover this only occurs over a small portion of the site that is proposed as reserve. Aquatic flora and fauna was sampled by netting along with grab samples at three locations within the Moonee creek interface.

Samples were passed through a 1mm sieve on site, and preserved in formalin for transport to the laboratory, where they were sorted to remove the organisms retained on the sieve. Animals were then identified and counted using a stereo microscope.

3.9 Limitations to Fauna Surveys

Flora and fauna surveys aim to provide a list of species present on a site within a certain time frame. They also aid in the identification of potential habitat for threatened species not detected at the time of the study. Snap-shot surveys are limited in that they are only conducted over a short time period

which can result in some species not being detected due to large home ranges or cryptic flowering or behaviours.

Survey effectiveness can be affected by:

- a species' behaviour or lifecycle (especially within the breeding season);
- the range of survey methods used;
- the experience of the observer;
- weather conditions (rainfall, temperature, wind);
- the type of vegetation;
- the season when the survey is undertaken;
- the time of day when the survey is undertaken; and
- The amount of time spent surveying.

The extensive surveys undertaken for this assessment over a two year period in conjunction with many local area reports that include the subject site we are confident that no species of potential issue to the subject site has been missed by the surveys.

Section C - Results

4.0 Existing Environment

This section presents the results of background searches of ecological issues, using databases, academic recourses and background reports conducted in the Local Area, and the results of the field surveys undertaken on the subject site.

Species that are identified as significant to the local area that were recorded onsite or have habitat on the site becomes "potential impact issues", these species, populations, and communities are addressed formally within Section D of this report. Where an impact is predicted mitigation and design changes are recommended and if these potential impacts cannot be limited to an acceptable degree recommendations for future survey and or assessment are made in the conclusions of this report.

4.1 Significant Vegetation Characteristics of the Local Area

The wider local area contains a range of natural terrestrial features that have the potential to be impacted by the proposal. This section details the broad natural habitats identified within the Local Area and specifically details the features that could potentially be at risk of impact from the proposed activity. The Endangered Ecological Communities and Protected marine communities recorded in the regional area are shown in Table 12.

Table 12. Endangered Ecological Communities and Protected marine communities Identified as occurring with the Coastal Plains of the Coffs Harbour LGA listed under the TSC Act 1995.

	Status	Relevance to subject site
Littoral Rainforest and Coastal Vine Thickets of eastern Australia. Lowland Rainforest of Subtropical Australia.	EEC	Not recorded onsite, however known to Moonee Headland 1.7km to the south east.
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregion	EEC	Not recorded onsite.
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	EEC	Not recorded onsite.
Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions **Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions**	EEC	Not recorded onsite, however known to Moonee Headland 1.7km to the south east.
Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion	EEC	Not recorded onsite, however known to Hinterland 2.1 km to the south west.
Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion	EEC	Not recorded onsite.
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	EEC	Not recorded onsite.
Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	EEC	Recorded onsite. Small area of 1.6ha that has been subjected to long term clearing and grazing. Great portion of forest cover on adjoining land has been removed.
Themeda Grassland on Seacliffs and Coastal Headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions.	EEC	Not recorded onsite, however known to Moonee Headland 1.7km to the south east.
Riparian Mangrove Forest	NA	Recorded onsite ad edge of Moonee Creek. Falls within the conservation reserve area of the subject site.

4.2 General Terrestrial Habitats within the Local Area

The habitats within the Local Area contain a range of natural terrestrial features that provide important habitats for significant species, which have the potential to overlap with the Subject Site. This section describes the broad natural habitats surrounding the Subject Site and details ecological niches provided by these habitats. Refer to table 13 for detail of some of the habitats provided by the local area vegetation.

Table 13. Habitat opportunities for important fauna in the local area vegetation units.

Habitat Type	Niche Habitats
Wetland- Heath	Wet heath provide a range of habitats for significant species, such as Eastern Chestnut Mouse, Long-Nosed Potoroo, Wallum froglet and a range of bird species, including Grass Owl. Groundwater table interactions and dense cover are key characteristics.
Wetland-Forest (i.e. Swamp forest)	Swamp Forest provide a range of habitats for significant species, most importantly winter feed resources for Squirrel glider, Grey-headed Flying Fox and feed trees for Koala.
Coastal fringe and rock shelves	The coastal fringe provides feeding and roosting habitat for rare pelagic birds, migratory waders, and coastal/estuarine birds such as, oyster catchers and Black Bittern.
Estuarine system	Including all parts of the Creek systems below the high tide mark the estuarine system provides significant habitat for waders, estuarine birds and birds of prey, such as Osprey.
Steep slopes and gullies	Steep slopes and Gullies can provide thick tall cover and narrow creek lines, as well as unique flora, including Vines, Thickets and Rainforest species. Where steepness and a southerly aspect overlap diverse habitat opportunities arise, such as caves, large fallen timber, rock shelves and boulders and fruit bearing trees. Significant habitats include, Quoll, Sooty and Powerful Owl, Frugivore birds, and rainforest frogs.
Coastal Rainforest	Generally not as tall or sheltered as temperate rainforest. Nonetheless, there is a great increase in floristic and structural diversity and foraging opportunities for birds. As above provides habitat for Quoll, Sooty and Powerful Owl, Frugivore birds, and rainforest frogs.
Woodland/Forest poor soils	Woodland and forest on low nutrient soils, such as podzoics. Provide habitat for hollow bearing species, such as Squirrel gliders, and hollow roosting bats as well as foraging habitat.

4.3 Significant Flora recorded within the Wider Local Area

A number of significant flora species are known or predicted to occur within the local landscape (Refer to Table 14). A search of a number of databases, including Plantnet (NSW Botanical Gardens), Wildlife Atlas (NP WS), Matters of National Environmental Significance (Department of Environment and Heritage) was conducted June 2012, and based on these records in combination with local report records the following flora species have potential habitat in the coastal plans of the Coffs Harbour.

Table 14. Significant Flora and Fauna recorded in the regional area as listed under the TSC Act and the EPBC Act.

Common Name	Scientific Name	Vegetation Habitats	Habitat Present	Recorded onsite?	Risk	Significant Impact likely	Mitigation
Austral Toadflax	*Thesium australe*	Headlands & Woodlands	Marginal	No	Low	No, because it tends to prefer coastal headland area and good cover of Kangaroo Grass which are neither characteristics of the site	None required
Byron Bay Diuris	*Diuris sp. aff. chrysantha*	Heathlands	No No		None	No.	None required
Heath Wrinklewort	*Rutidosis heterogama*	Heathlands No		No	None	No.	None required
Maundia triglochinoides	*Maundia triglochinoides*	Wetlands	Yes	No	Low	Prefers swamps, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, low nutrients. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required
Native Milkwort	*Polygala linariifolia*	Dry sclerophyll	Yes	No	Low	Prefers sparse understories, subject site grass cover may be too great, however has potential habitat but not ideal, and thus a significant impact on potential habitat is unlikely.	None required
Pink Nodding Orchid	*Geodorum densiflorum*	Dry sclerophyll	Yes	No	Low	No. Surveys were undertaken during flowering time and with large distinctive leaves would be expected to be recorded.	None required
Rotala tripartita	*Rotala tripartita*	Wetlands	Marginal	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required
Sand Spurge	*Chamaesyce psammogeton*	Littoral/ dunes	No	No	None	No.	None required
Small Pale Grass-lily	*Caesia parviflora var. minor*	Heathlands & Sclerophyll forests	Yes	No	Low	No. Surveys were undertaken during flowering time and with large distinctive leaves would be expected to be recorded	None required
Square-stemmed Spike-rush	*Eleocharis tetraquetra*	Wetlands	Yes	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required
Swamp Foxglove	*Centranthera cochinchinensis*	Wetlands	Yes	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required
Waterwheel Plant	*Aldrovanda vesiculosa*	Wetlands	No	No	None	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required
Brown Fairy-chain Orchid	*Peristeranthus hillii*	Rainforests No		No	None	No.	None required
Dark Greenhood	*Pterostylis nigricans*	Heathlands No		No	None	No.	None required
Lady Tankerville's Swamp Orchid	*Phaius tankervilleae*	Swamp sclerophyll	Yes	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required
Red-flowered King of the	*Oberonia titania*	Rainforests No		No	None	No.	None required

Common Name	Scientific Name	Vegetation Habitats	Habitat Present	Recorded onsite?	Risk	Significant Impact likely	Mitigation
Fairies							
Southern Swamp Orchid	*Phaius australis*	Swamp sclerophyll	Yes	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required
Fraser's Screw Fern	*Lindsaea fraseri*	Swamp sclerophyll	Yes	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required
Slender Screw Fern	*Lindsaea incisa*	Heathlands	No	No	None	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required
Floyd's Grass	*Alexfloydia repens*	Swamp sclerophyll	Yes	No	Low	No. Found in Casuarina glauca forest and along the uppermost fringe of mangroves which is present onsite. Nonetheless its habitat is to be conserved and buffered.	None required
Hairy Jointgrass	*Arthraxon hispidus*	Rainforests No		No	None	No.	None required
Lemon-scented Grass	*Elyonurus citreus*	Riparian in Heathlands	No	No	None	No.	None required
Brush Sauropus	*Phyllanthus microcladus*	Rainforests No		No	None	No.	None required
Coast Headland Pea	*Pultenaea maritima*	Headlands No		No	None	No.	None required
Headland Zieria	*Zieria prostrata*	Headlands No		No	None	No.	None required
Nabiac Casuarina	*Allocasuarina simulans*	Heathlands No		No	None	No.	None required
Native Justicia	*Calophanoides hygrophiloides*	Rainforests No		No	None	No.	None required
Square-stemmed Olax	*Olax angulata*	Heathlands No		No	None	No.	None required
Swamp Mint-bush	*Prostanthera palustris*	Wetlands No		No	None	No.	None required
Thorny Pea	*Desmodium acanthocladum*	Rainforests No		No	None	No.	None required
Dwarf Heath Casuarina	*Allocasuarina defungens*	Heathlands No		No	None	No.	None required
Silverbush	*Sophora tomentosa subsp. australis*	Heathlands No		No	None	No.	None required
Weeping Paperbark	*Melaleuca irbyana*	Dry sclerophyll	Yes	No	Low	No. No plains paperbarks onsite.	None required
Red Boppel Nut	*Hicksbeachia pinnatifolia*	Rainforests No		No	None	No.	None required
Scented Acronychia	*Acronychia littoralis*	Littoral No		No	None	No.	None required

Common Name	Scientific Name	Vegetation Habitats	Habitat Present	Recorded onsite?	Risk	Significant Impact likely	Mitigation
Stinking Cryptocarya	*Cryptocarya foetida*	Rainforests No		No	None	No.	None required
Basket Fern	*Drynaria rigidula*	Rainforests No		No	None	No.	None required
Flat Fork Fern	*Psilotum complanatum*	Rainforests No		No	None	No.	None required
Spider orchid	*Dendrobium melaleucaphilum*	Sclerophyll forests	Yes	No	Low	*Yes. There are several ideal habitat trees:* Melaleuca styphelioides, to be cleared onsite. No Spider orchid was recorded.	Yes. All Melaleuca styphelioides trees to be checked for Spider orchid prior to clearing and individuals transplanted as required.

Flora species identified in various documents as being important species to the landscape of the coastal Plains of Coffs Harbour which includes the subject site are shown in Table 6. These species are a subset of those flora species shown in Table 14 above and are more likely to be present in the vicinity of the subject site based on habitat preferences and past records (Refer to Table 15).

Table 15. Flora species of significant that have been previously recorded on the coastal plains of Coffs Harbour.

Endangered Ecological Communities and Protected marine communities Identified as occurring with the Coastal Plains of the Coffs Harbour LGA	Status	Relevance to subject site
Floyds Grass (*Alexfloydia repens*)		See above table.
Milky Silkpod (*Parsonia dorrigoensis*)		There is habitat; however no vines of this genius were recorded onsite.
Orara Boronia (*Boronia umbellata*)		Recorded from Weddings Bells State Park. Forests on sandstone and usually in pristine conditions, grazing and slashing of site greatly limits habitat
Moonee Quassia (Quassia sp. Monney Creek)		Not recorded onsite, however known to local area in and around Moonee Creek to the south, west and north west. Prefers wet sclerophyll forest, typically comprising canopy species such as Eucalyptus microcorys (Tallowwood), Lophostemon confertus (Brushbox), Syncarpia glomulifera (Turpentine), and Allocasuarina torulosa (Forest Oak). This wet forest habitat usually supports a varying density and diversity of rainforest understorey species. Not habitats that are found onsite.
Headland Zieria (*Zieria prostrata)*		A headland species
Austral Toadflax (*Thesium australe)*		Sea above table
Coast Headland Pea (*Pultenaea maritime)*		Only found on coastal headlands with grasslands present.

4.4 Significant Fauna recorded within the Wider Local Area

A number of significant fauna species are known or predicted to occur within the local landscape. A search of a number of databases, including Wildlife Atlas (NPWS), Matters of National Environmental Significance (Department of Environment and Heritage) was conducted June 2012, and based on these records in combination with local report records the following fauna species have potential habitat in the coastal plans of the Coffs Harbour. Refer to Table 16.

Table 16. Fauna species of significance recorded in the local area.

Common Name	Scientific Name	Vegetation Habitats	Habitat Present	Recorded onsite?	Risk	Significant Impact likely	Mitigation
Coastal Petaltail Dragonfly	Petalura litorea	Riparian	Marginal	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Giant Dragonfly	Petalura gigantea	Riparian	Marginal	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Black Grass-dart	Ocybadistes knightorum	Swamp sclerophyll	Marginal	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Laced Fritillary	Argyreus hyperbius	Swamp sclerophyll	Marginal	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Oxleyan Pygmy Perch	Nannoperca oxleyana	Heathlands - Aquatic	Marginal	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Purple Spotted Gudgen	Mogurnda adspersa	Aquatic	Marginal	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Green and Golden Bell Frog	Litoria aurea	Heathlands & Sclerophyll forests	Marginal	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Green-thighed Frog	Litoria brevipalmata	Heathlands & Sclerophyll forests	Marginal	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Wallum Froglet	Crinia tinnula	Wetlands	Marginal	NO?		No. Not ideal onsite, surveys show conditions onsite likely to Alkaline and drain too quickly to support individuals. Nonetheless its habitat is to be conserved and buffered and expanded through habitat creation and management. (See next section for details).	Yes. See section below
Green Turtle	Chelonia mydas	Marine	Marginal	Ditto	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Leathery Turtle	Dermochelys coriacea	Marine	Marginal	ditto	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and	None required.

Common Name	Scientific Name	Vegetation Habitats	Habitat Present	Recorded onsite?	Risk	Significant Impact likely	Mitigation
						buffered.	
Pale-headed Snake	Hoplocephalus bitorquatus	Sclerophyll forests & Woodlands	No		Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
White-crowned Snake	Cacophis harriettae	Dry sclerophyll & Woodlands	Marginal			No. It particularly likes areas with a varied and well-developed litter layer in wetter understorey components which are not prevalent on this grazed and slashed site.	None required.
Barred Cuckoo-shrike	Coracina lineata	Wet sclerophyll & Rainforests	Marginal		Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Collared Kingfisher	Todiramphus chloris	Estuarine	Yes		Low	Not Ideal habitat onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Glossy Black-cockatoo	Calyptorhynchus lathami	Sclerophyll forests & Woodlands	Yes Y	es	Medium	Impact will occur, however through mitigation impacts can be reduced. See following section.	Yes. Design of project has been altered and Habitat creation proposed. See following section.
Mangrove Honeyeater	Lichenostomus fasciogularis	Estuarine	Yes	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Olive Whistler	Pachycephala olivacea	Wet sclerophyll & Rainforests	Marginal	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Painted Honeyeater	Grantiella picta	Sclerophyll forests & Woodlands	Marginal	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Red-tailed Black-Cockatoo	Calyptorhynchus banksii	Sclerophyll forests & Woodlands	Marginal	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Regent Honeyeater	Xanthomyza phrygia	Dry sclerophyll & Woodlands	Marginal	No	Low	No. Not ideal onsite.	None required.
Rose-crowned Fruit-dove	Ptilinopus regina	Wet sclerophyll & Rainforests	No	No	Low	No. Limit fruit supplies.	None required.
Superb Fruit-dove	Ptilinopus superbus	Wet sclerophyll & Rainforests	No	No	Low	No. Limit fruit supplies.	None required.
White-eared Monarch	Monarcha leucotis	Wet sclerophyll & Rainforests	No	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.

Common Name	Scientific Name	Vegetation Habitats	Habitat Present	Recorded onsite?	Risk	Significant Impact likely	Mitigation
Wompoo Fruit-dove	Ptilinopus magnificus	Wet sclerophyll & Rainforests	No	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Beach Stone-curlew	Esacus neglectus	Heathlands, Wetlands & Swamp sclerophyll	Marginal	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Bush Stone-curlew	Burhinus grallarius	**Sclerophyll forests**	Yes No		Medium	Impact will occur, however through mitigation impacts can be reduced. See following section	Redesign and regenerate degraded habitats.
Bush-hen	Amaurornis olivaceus	Wet sclerophyll & Rainforests	No	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Eastern Ground Parrot	Pezoporus wallicus wallicus	Heathlands No		No	Low	No.	None required.
Flesh-footed Shearwater	Puffinus carneipes	Marine	No	No	Low	No.	None required.
Gould's Petrel	Pterodroma leucoptera leucoptera	Littoral No		No	Low	No.	None required.
Grey Ternlet	Procelsterna cerulea	Marine	No	No	No	No. .	None required.
Little Shearwater	Puffinus assimilis	Marine	No	No	No	No.	None required.
Little Tern	Sterna albifrons	Estuarine	No	No	No	No.	None required.
Pied Oystercatcher	Haematopus longirostris	Littoral	Yes	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Sooty Oystercatcher	Haematopus fuliginosus	Littoral	Yes	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Sooty Tern	Sterna fuscata	Marine	No	No	No	No.	None required.
White Tern	Gygis alba	Marine	No	No	No	No.	None required.
Barking Owl	Ninox connivens	Sclerophyll forests & Woodlands	Marginal	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Grass Owl	Tyto capensis	Heathlands	Marginal	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Osprey	Pandion haliaetus	**Estuarine**	Yes	Yes	High	Impact unlikely, Previously nested onsite, however nest tree fell down. Has established a nest site in nature reserve 500 metres from the site, was recorded within Moonee estuary daily during visits to site. See following section for more information of impacts	None required.

Common Name	Scientific Name	Vegetation Habitats	Habitat Present	Recorded onsite?	Risk	Significant Impact likely	Mitigation
Red Goshawk	Erythrotriorchis radiatus	Sclerophyll forests & Woodlands	Marginal	No	Low	No. Not ideal onsite.	None required.
Square-tailed Kite	Lophoictinia isura	Sclerophyll forests & Woodlands	Marginal	Yes	Medium	No. Not ideal onsite was recorded on several occasions at Moonee headland and estuary and onsite (above) site once. Nonetheless its habitat is to be conserved and buffered.	Same as for Osprey.
Black-tailed Godwit	Limosa limosa	Estuarine	No	No	No	No.	None required.
Broad-billed Sandpiper	Limicola falcinellus	Estuarine	No	No	No	No.	None required.
Great Knot	Calidris tenuirostris	Estuarine	No	No	No	No.	None required.
Greater Sand-plover	Charadrius leschenaultii	Estuarine	No	No	No	No.	None required.
Lesser Sand-plover	Charadrius mongolus	Estuarine	No	No	No	No.	None required.
Sanderling	Calidris alba	Estuarine	No	No	No	No.	None required.
Terek Sandpiper	Xenus cinereus	Estuarine	No	No	No	No.	None required.
Australasian Bittern	Botaurus poiciloptilus	Wetlands	No	No	No	No.	None required.
Black Bittern	Ixobrychus flavicollis	Riparian	No	No	No	No.	None required.
Black-necked Stork	Ephippiorhynchus asiaticus	Wetlands	No	No	No	No.	None required.
Blue-billed Duck	Oxyura australis	Wetlands	No	No	No	No.	None required.
Brolga	Grus rubicunda	Wetlands & Heathlands	No	No	No	No.	None required.
Comb-crested Jacana	Irediparra gallinacea	Wetlands	No	No	No	No.	None required.
Cotton Pygmy-goose	Nettapus coromandelianus	Wetlands	No	No	No	No.	None required.
Freckled Duck	Stictonetta naevosa	Wetlands	No	No	No	No.	None required.
Magpie Goose	Anseranas semipalmata	Wetlands	No	No	No	No.	None required.
Painted Snipe	Rostratula benghalensis	Wetlands	No	No	No	No.	None required.
Hooded Robin (south-eastern	Melanodryas cucullata cucullata	Dry sclerophyll & Woodlands	No	No	Low	No. Not ideal onsite prefers dry open grassy country.	None required.

Common Name	Scientific Name	Vegetation Habitats	Habitat Present	Recorded onsite?	Risk	Significant Impact likely	Mitigation
form)							
Grey-crowned Babbler (easternsubspecies)	Pomatostomus temporalis temporalis	Dry sclerophyll & Woodlands	No	No	Low	No. Not ideal onsite, likely to sandy for this species, likes better fertility and diversity in ground structure.	None required.
Swift Parrot	Lathamus discolor	Sclerophyll forests & Woodlands	Marginal	No	Low	Recorded at Moonee Headlands a while back (1998). Not ideal habitat onsite, unlikely to be impacted.	None required.
Koala	Phascolarctos cinereus	Sclerophyll forests & Woodlands	Yes Y	es, on the southern boundary of Lot 6. Not recorded on Lot 1 or within the other areas of Lot 6	Med	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	Regenerate degraded habitats in reserve area.
Squirrel Glider	Petaurus norfolcensis	Sclerophyll forests & Woodlands	Yes	Yes	High	Yes. If not mitigated	Change design and regenerate degraded habitats.
Yellow-bellied Glider	Petaurus australis	Sclerophyll forests & Woodlands	Yes	No	Low	No. it's a little too isolated from the tall forests that this species like	None required.
Beccari's Freetail-bat	Mormopterus beccarii	Rainforests, Sclerophyll forests & Woodlands	Marginal	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Common Blossom-bat	Syconycteris australis	Scleropyll forests & Rainforests &Heathlands	Marginal	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Eastern Bentwing-bat	Miniopterus schreibersii oceanensis	Rainforests, Sclerophyll forests & Woodlands	Yes	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Eastern Cave Bat	Vespadelus troughtoni	Sclerophyll forests & Woodlands	Yes	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Eastern False Pipistrelle	Falsistrellus tasmaniensis Sclerop hyll forests & Rainforests		Yes	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Eastern Freetail-bat	Mormopterus norfolkensiss	Rainforests, Sclerophyll forests &Woodland	Yes	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Eastern Long-eared Bat	Nyctophilus bifax	Rainforests, Sclerophyll forests,Woodlands & Heathlands	Yes	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Grey-headed Flying-fox	Pteropus poliocephalus	Sclerophyll forests & Rainforests &Heathlands	Yes	Yes	medium	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	Regenerate degraded habitats.
Hoary Wattled Bat	Chalinolobus nigrogriseus	Sclerophyll forests & Woodlands	Yes	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.

Common Name	Scientific Name	Vegetation Habitats	Habitat Present	Recorded onsite?	Risk	Significant Impact likely	Mitigation
Large-footed Myotis	Myotis adversus	Riparian in Sclerophyll forests &Rainforests	Marginal	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Little Bentwing-bat	Miniopterus australis	Rainforests, Sclerophyll forests &Woodlands	Yes	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Brush-tailed Phascogale	Phascogale tapoatafa	Dry sclerophyll & Woodlands	Yes	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Common Planigale	Planigale maculata	Rainforests, Sclerophyll forests,Woodlands & Heathlands	Marginal	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Spotted-tailed Quoll	Dasyurus maculatus	Rainforests, Sclerophyll forests &Woodlands	Marginal	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Eastern Chestnut Mouse	Pseudomys gracilicaudatus	Heathlands & Sclerophyll forests	Marginal	No	Low	No. Not ideal onsite, nonetheless its habitat is to be conserved and buffered.	None required.
Zieria smithii population at Diggers Head	Zieria smithii population at Diggers Head	Littoral No		No	No	No	None required.
Glycine clandestina population in the Nambucca LGA	Glycine clandestina population in the Nambucca LGA	Headlands No		No	No	No	None required.
Adelotus brevis population in the Nandewar and New England Tablelands Bioregions	Adelotus brevis population in the Nandewar and New England Tablelands Bioregions	Riparian in Sclerophyll forests	No	No	No	No	None required.
Dromaius novaehollandiae population in the NSW North Coast Bioregion and Coffs Harbour LGA	Dromaius novaehollandiae population in the NSW North Coast Bioregion and Coffs Harbour LGA	Heathlands & Sclerophyll forests	No No		No	No	No
Long-nosed Potoroo population at Cobaki Lakes and Tweed Heads West	Long-nosed Potoroo population at Cobaki Lakes and Tweed Heads West	Swamp sclerophyll & Heathlands	No No		No	No	No

4.5 Corridors and Connections of Important Habitats

4.5.1 Sub-Regional Corridor Connections

Habitat mapping as part of the Coffs Harbour Council Biodiversity Strategy identified a regional biodiversity connection from Moonee Headlands into Wedding Bells State Park (number 5 on Figure 3).See Figure 6Below. As can be seen below this connection passes south of the subject site.

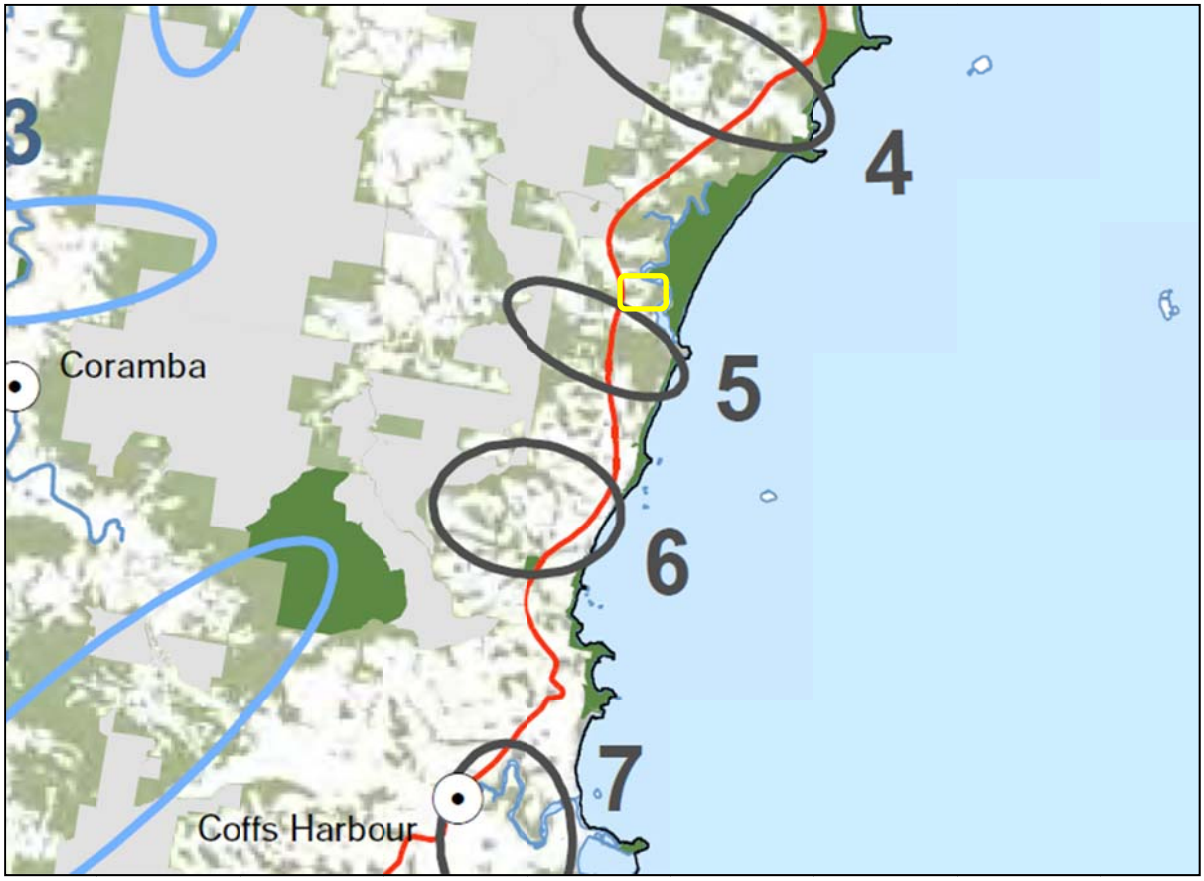

Figure 6. CHCC Biodiversity Strategy including nodes for corridors. The Yellow box shows the approximate subject site.

Important habitats identified in the Moonee estuary Strategy (WBM 2006) include as Priority 1(Highest conservation value in the shire) the area to the north Skinners Creek south to Cunningham's Creek to including the subject site as a key corridor and regeneration area. Refer to Figure 7 below.

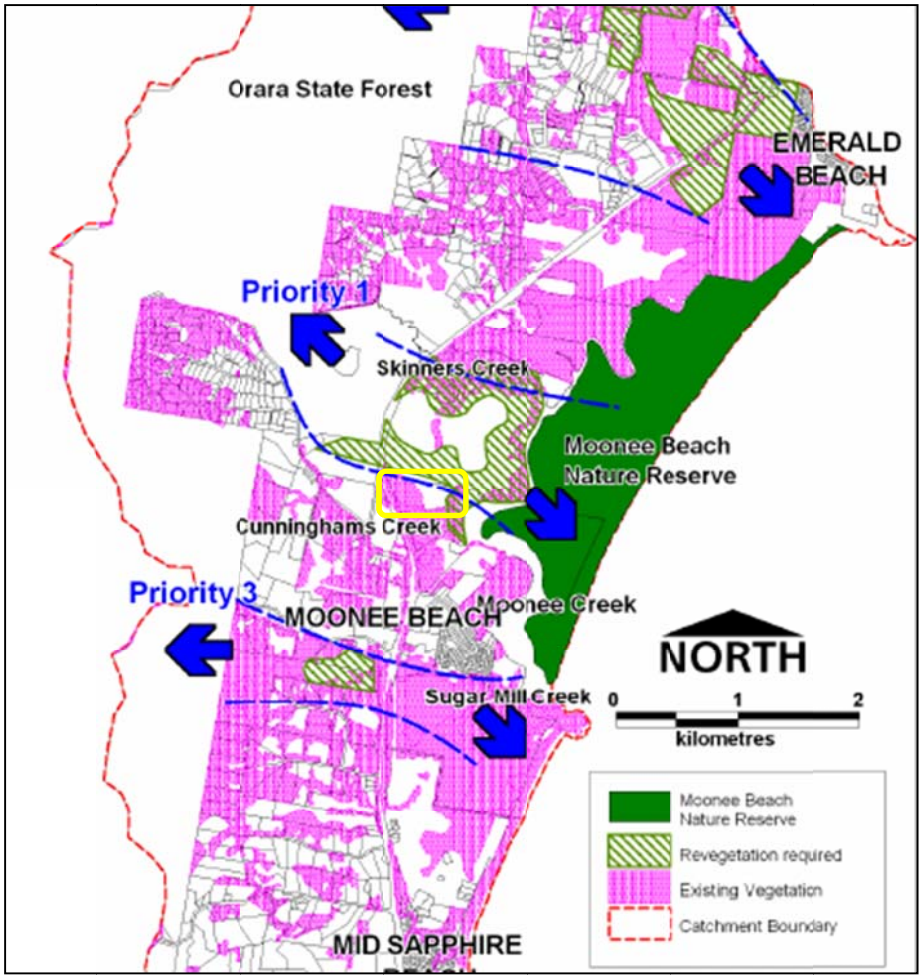

Figure 7. Regional corridor linkages and corridor priorities for Moonee Beach. Yellow box approximate boundary. Main corridor on boundary of the subject site.

Looking closely at the vegetation found on the subject site it's clear that the key movement potential of existing vegetation and link is found along Moonee Creek, this obviously has the advantage of including the Moonee buffer area as well. Refer to Figure 8 Below.

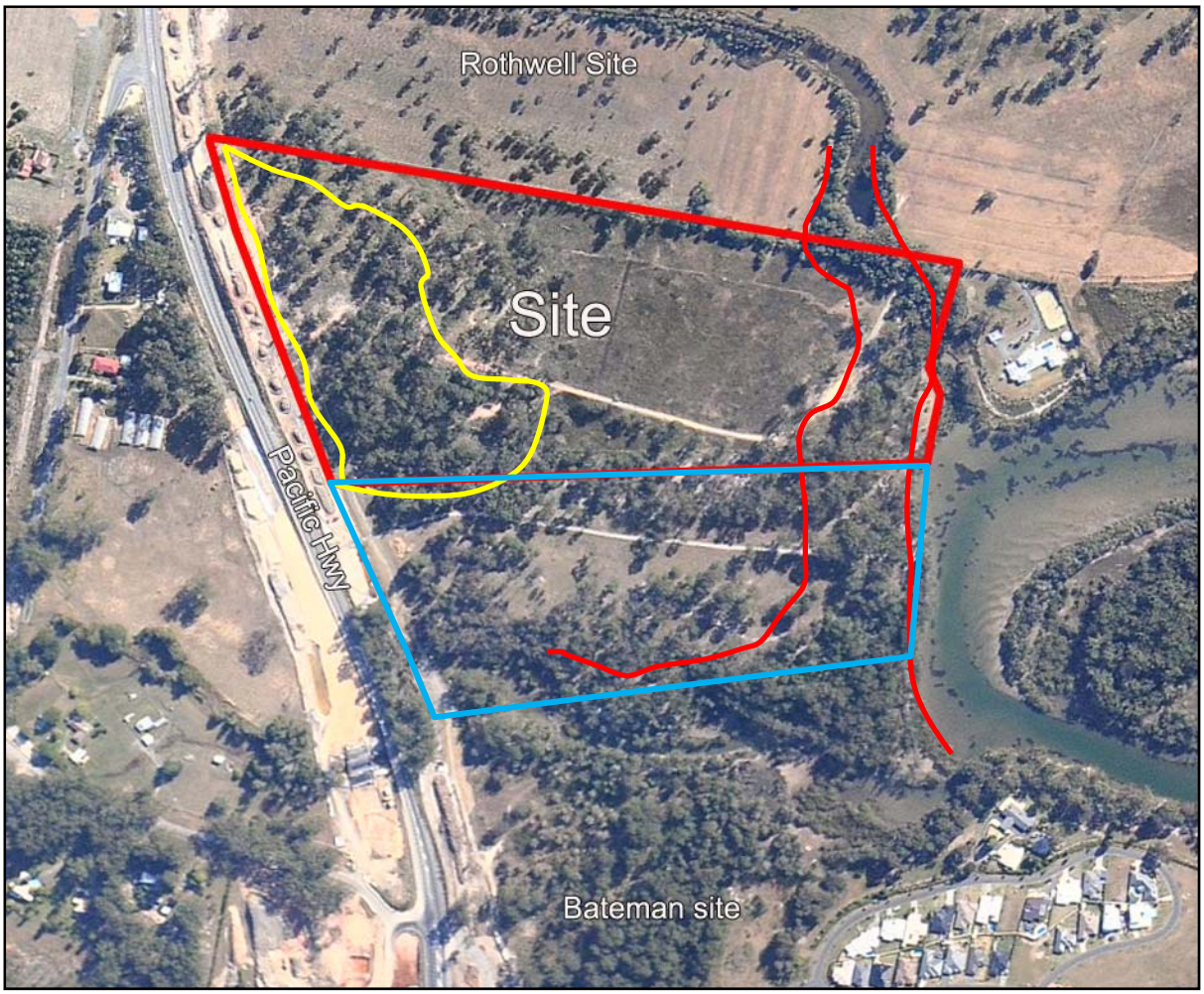

Figure 8. Red lines provide a connection with other habitats that also buffer Moonee Creek. The yellow area habitat has no connection due to Pacific Highway link and has been significantly reduced since the upgrade to the Pacific HWY. Lot 1 Red Polygon, Lot 6 Blue Polygon.

Moonee Estuary Management Strategy and the Coffs Harbour Biodiversity Strategy identified three nodes in the Moonee area that provided important ecological links; this is related to habitat links that are important for the movement of genetic material through immigration and migration into adjoining habitats of similar qualities. The subject site is not included as an important link. Refer to Figure 9 below.

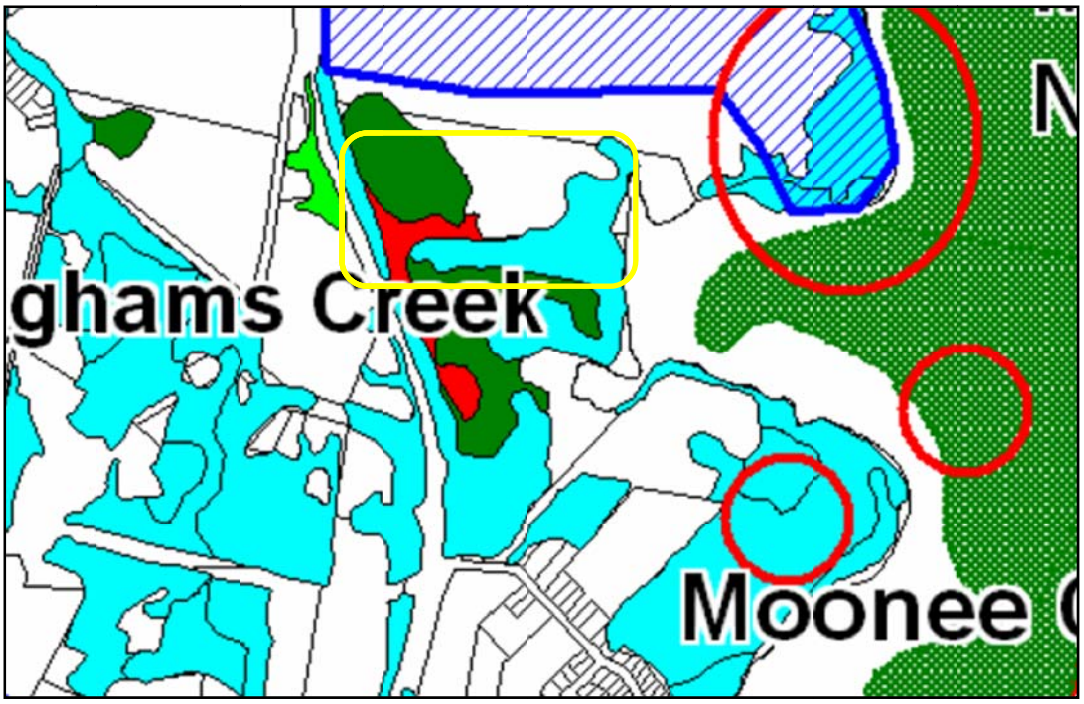

Figure 9. Regional vegetation mapping (CHCC 2011). Red nodes are the important connections with habitats separated by Moonee Creek. The yellow box is approximately the subject site.

4.6 Connections identified in this report

Two Sub-Regional area connections were identified in this study, one extending from the lower slopes up the Hinterland from south west of the Subject Site to the North West. This continuous remnant is 11,600 hectares and includes a mix of habitat types (mostly to the west of the highway). The only other continuous connection is the coastal connection, which runs from the Northern side of Moonee Creek to the southern headland of Emerald Beach. Whilst relatively small (451 ha) compared to the lower slopes hinterland corridor, it is large enough to support viable populations. Refer to Figure 10 for more details.

4.6.1 Local Area Corridor Connections

Local Area forest connections between the Subject Site and Sub-Regional corridors are critical for several reasons, including:

- Maintaining genetic flow between viable remnants (>500 hectares);
- Decrease the likelihood of stochastic events having long-term deleterious effects on meta-populations;
- Provides movement corridors for species requiring semi-continuous forest to undertake critical activities for improved population viability, such as Koala for satellite breeding males or Squirrel glider moving to winter feed resources.

The corridor shown in Figure 10 has three fingers and four corridor connections for a total size of 55 hectares and 2.9 km in length with a connection between the Subject Site and the Moonee Local remnant and Sub-Regional remnant of less than 1 kilometre. In isolation this remnant is considered too small to maintain long-term viably populations for the significant species under consideration that require semi-continuous connections, such as Koala and Squirrel glider. The four connections illustrated in Figure 11 achieve different key objectives in the Local Area:

- **Connection 1**. Provides an indirect connection through the Glades Estate and the 11,600 hectare Sub-Regional via the enhanced Pacific Highway underpass.

- **Connection 2.** Provides a direct connection between the Subject Site and the 11,600 hectare Sub-Regional via the enhanced Pacific Highway underpass and creek line corridor onsite.
- **Connection 3.** Provides a direct connection between the Subject Site and the Moonee Beach remnant and the larger remnants.
- **Connection 4.** Provides for an indirect connection through the Glades Estate and the Coastal corridor (>500 hectares).

The Pacific Highway (including upgrade) presents a major barrier to movement for non-flying species with the exception of the underpasses located at Connection 1 and 2 on Figure 11.

Research has shown (Doerr *et al* 2010) that semicontinuous, broken or corridors with pinch points still function well as corridors. All forms of structural connectivity for which there were sufficient data for analyses were effective to some degree in both providing habitat and in facilitating movement. In terms of providing habitat, analyses suggest that while all forms were better habitat than matrix for most species, continuous corridors were better than discontinuous linear elements which were better than stepping stones. However, in terms of facilitating movement, the analyses suggest that stepping stones (generally, these were scattered paddock trees) were at least as effective if not more effective as continuous corridors.

An important factor is the interact-crossing threshold. That is, how far apart do remnants have to be before the functionality of the corridor becomes unviable. The CSIRO research concluded that interpatch-crossing threshold of 1100m, indicating that many species are unable to disperse between patches of habitat separated by >1100m, even where structural connectivity exists between the patches. While it must be reiterated that these threshold values are based on limited data that come primarily from bird and mammal species inhabiting wooded habitats, they should provide a useful starting point for future connectivity research, modelling and planning.

In conclusion, the authors state:

> *"Structural connectivity is currently providing some benefit for native species in Australian landscapes, but that with better information resulting from new research, these benefits and their cost-effectiveness could be significantly improved. Although limited, currently available data indicate that the effectiveness of connectivity initiatives could be enhanced for many species by considering diverse types of structural connectivity (particularly scattered trees separated by no more than ~100m) and by targeting patches less than 1.1km apart for connectivity protection and restoration" (Doerr et al 2010).*

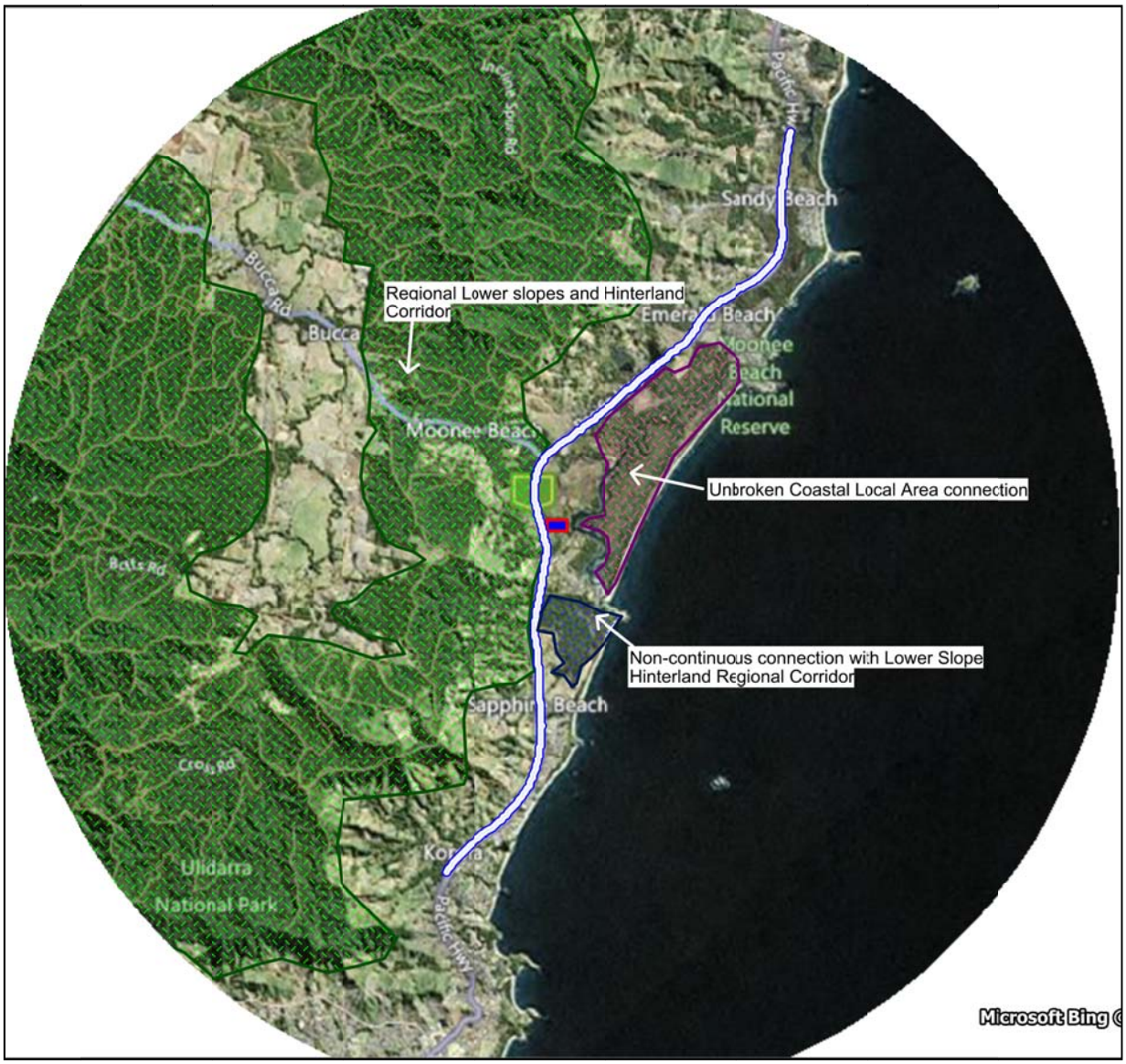

Figure 10. Regional Corridor Links and remnants. Subject site Centre blue square with red outline.

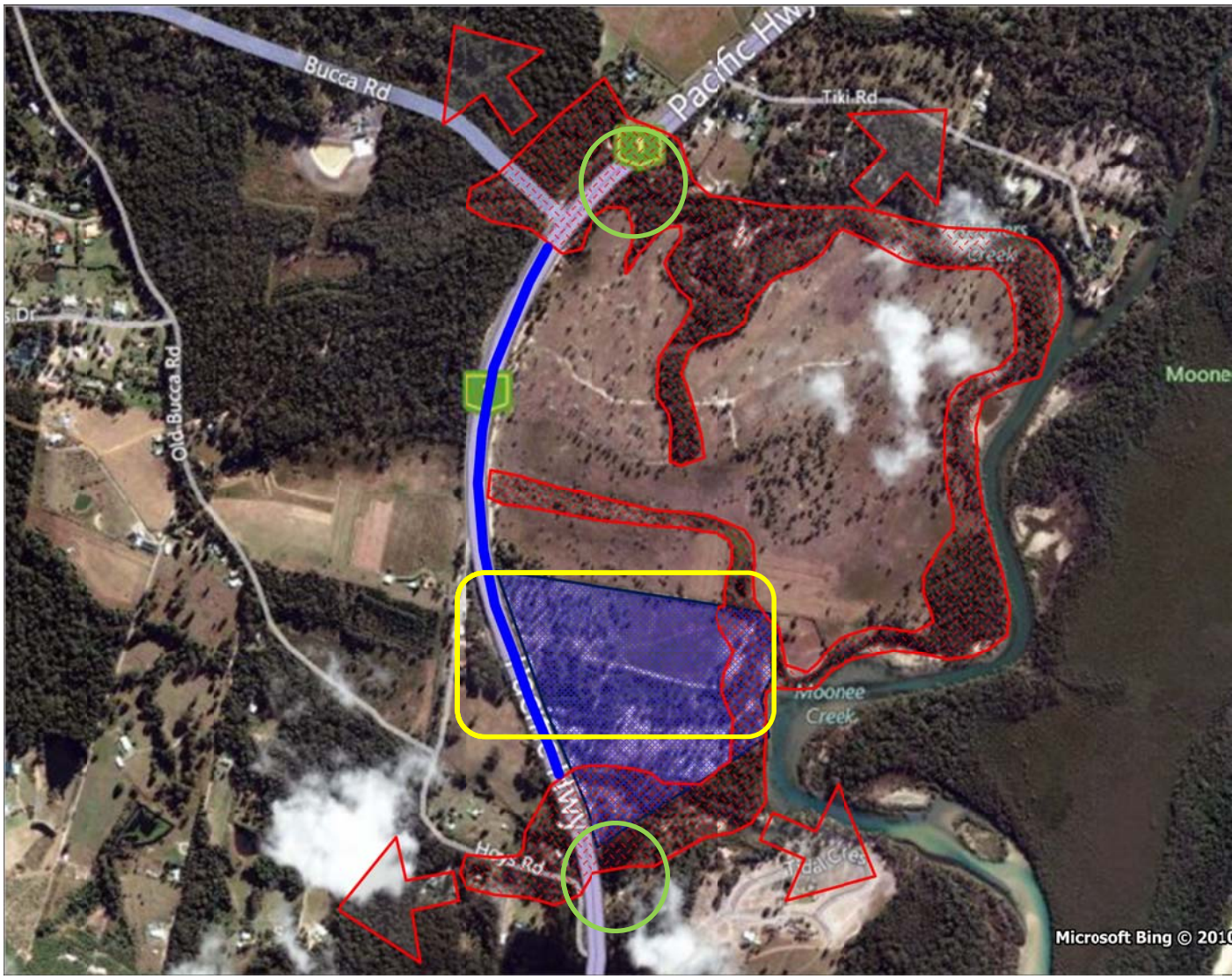

Figure 11. Local connections recorded in this study. Yellow box approximate site. Red polygon are the local connections that are uninterrupted by barriers that will limit genetic material of subject site species. The green circles are the approximate locality of the fauna underpasses. Blue Polygon represents both Lot 1 and Lot 6.

5.0 Survey Results

5.1 Floral Diversity and Abundance

There were 433 flora species recorded within the Local Area – of these 27 were significant species, were 66 exotic weed species. Approximately 15% of the floral diversity recorded is contributed to non-indigenous flora species.

The protected matters search (EPBC Act) conducted on the 24 Oct 2012 identified two (2) invasive species Bitou Bush (*Chrysanthemoides monilifera*) and Lantana (*Lantana camara*) which were identified to occur on site in very low densities (single plants). An invasive species is defined as a species occurring, as a result of human activities, beyond its accepted normal distribution and which threatens valued environmental, agricultural or other social resources by the damage it causes. The invasion of native plant communities by these species are listed as Key Threatening Process under the NSW TSC Act and as such these weeds should be controlled to prevent further spread.

The flora was sampled in the winter, spring and summer of 2010 and winter of 2011 in accordance with the methodology outlined in section 3. Searches recorded all vascular plant species observed within the Subject Site. Less intensive investigations were undertaken on land surrounding the study area with the aim of developing a general description of the surrounding vegetation. In total, 115 flora species were recorded within the Subject Site. Appendix A shows the complete flora data recorded.

No threatened flora species were recorded within the Subject Site despite targeted surveys. Of the species, 42 (37%) are introduced species. Blackberry and Mother-of-Millions, are listed as Noxious under the Noxious Weeds Act 1993 (NW Act) and are categorised as a W3 and W2 weed within the LGA, respectively. A W3 weed means its numbers, spread and distribution must be controlled and reduced. A W2 weed must be fully and continuously suppressed until destroyed.

5.2 Vegetation Communities

Coffs Harbour Council Draft Fine Scale Vegetation Mapping (CHCC 2012) identified in the mapping that the site has five vegetation communities (refer to Figure 12), including:

Dry Sclerophyll Forest

CH DOF01

- Blackbutt-Pink bloodwood Turpentine Grassy Dry Open tall Forest.

CHDOF06

- Swamp Box Broad Leaved Paperbark- Forest red gum Red Mahogany Transitional Dry opens forest of coastal lowlands and valleys.

CHDOF09

- Pink Bloodwood Blackbutt Smooth Barked Apple dry to tall open forest on sand

Fresh Water Wetlands

CHF rW01

Broad leaved Paperbark Swamp Oak Willow Bottle Brush forested wetland on floodplain

Saline Wetlands

CH SW01

- River Mangrove Grey Mangrove riparian estuarine forest.

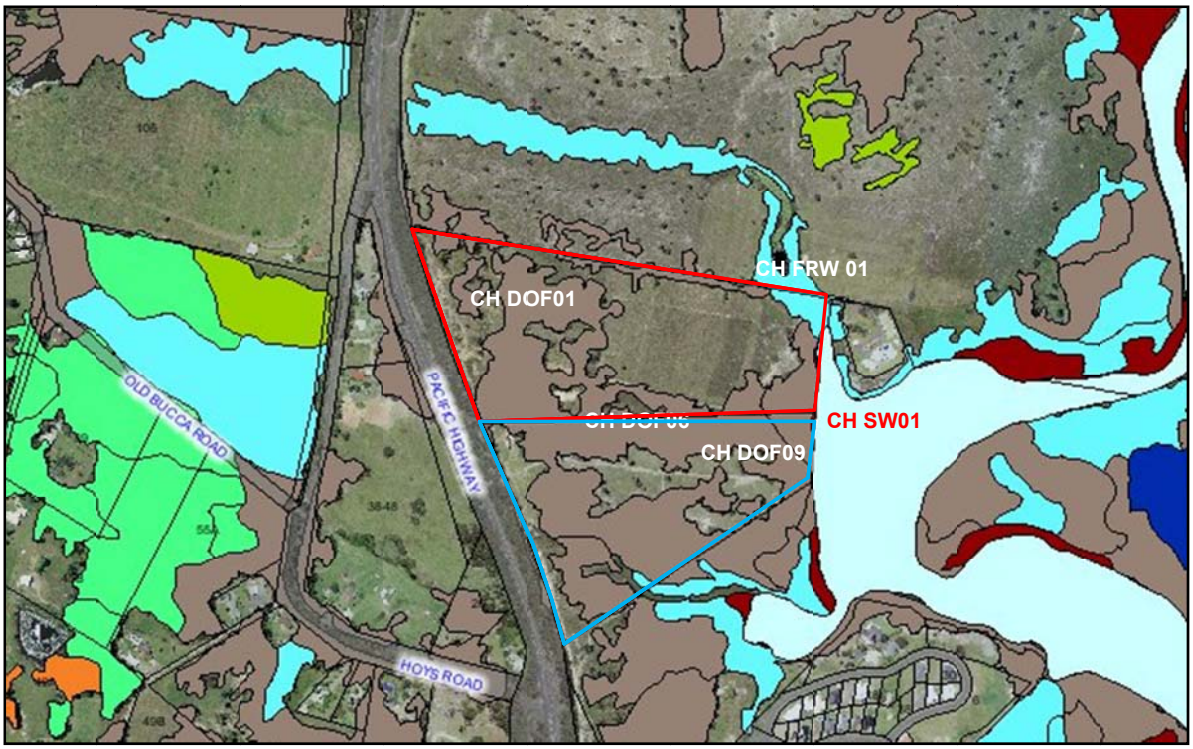

Figure 12. CHC Fine scale vegetation mapping f the Subject site. Lot 1 = Red Polygon and Lot 6 = Blue.

The vegetation associations within the Subject Site were a mosaic of eucalypt species with mixed canopy species and understorey structures. Landscape features which occurred within the Subject Site included slopes, gullies, and riparian areas. Variation in vegetation is associated not only with slope and aspect but geology and soil changes.

In total, Five (5) vegetation units were identified from the surveys. These descriptions were determined from the walking surveys and the results of the quadrat data. These communities are variations of the Draft vegetation mapping (CHCC 2012) shown above, which is largely associated with modification and simplification of remnants. The division of these communities is based on floristic and structural differences. These communities are listed below and shown in Figure 13:

- **Map Unit 1: Dry Sclerophyll Forrest**
  - o Dry Sclerophyll Blackbutt Pink Bloodwood modified Forest Community
- **Map Unit 2: Dry Sclerophyll communities on transitional soils**
  - o **2:** Red Mahogany -Paperbark Swamp Sclerophyll Forest
- **Map Unit 3: Wetlands**
  - o **3:** Broad leaved paperbark, She Oak, Red Mahogany Swamp Sclerophyll Forest
- **Map Unit 4: Intertidal communities**
  - o **4a:** Twigrush Closed Sedgeland
  - o **4b:** Grey Mangrove Riparian Forest

5.2.1 Map Units

Approximately 4.7 ha of the subject site comprises poor health disturbed Eucalypt forest, 3.9 hectares of moderate to good condition Eucalypt forest, 0.25 hecatres of Riparian corridor, 0.5 hectares of Swamp forest, with the remaining consisting of 0.32 hectares of cleared developed land - this does not appear correct as majority of site is cleared and or underscrubbed.

Map Unit 1: Dry Sclerophyll forest/woodland Communities

Tall open forest (Blackbutt + Pink Bloodwood/- mixed species)

Area: 8.6 ha

Sites:

Landforms: described as an erosion landscape, comprising rolling low hills with moderately deep structured yellow red and brown earths and associated soils typically on slopes of 5-20 precent.

Soil: The soils are acid, locally stony, of low subsoil fertility and high credibility. There is a low probability of acid sulphate soil s with sulphates bei ng greate r th an 3m b elow the gro und surface

Trees: This community is dominated by Blackbutt with Smooth-barked apple, Pink bloodwood and Turpentine also present. Midstorey species include Hopbush, while Saw sedge and several grass species occur as groundcovers.

Comments: Mixed ag e a nd semi-cleared (On-going man agement for g razing pu rposes). Hollow bearing trees all but absent.

Map Unit 2: Dry Sclerophyll communities on transitional soils

2: Red Mahogany -Paperbark Sclerophyll Forest

Area: 0.62 ha

Sites:

Landforms: A tran sitional landform into swamp landscape, occupies low level to un dulating coastal back-barrier flood plains on estuarine sediments.

Soil: The soils a re p oorly drai ned deep yellow podzolics th at are strongly to very strongl y acidic, lo cally strongly saline a nd subject to seasonal waterlogging a nd flo oding. Th ere is a low p robability of acid sul phate soils with su lphate soils bu ried to a d epth of between 1-3 meters.

Comments: This is an intact community with a remnant over storey & mid-stratum. Groundcover of wet heath species. Hollows present in some mature, large trees according to James Warren. Hollow bearing trees absent according to site report by Eco-Logical .

Ideal ha bitat for *Lindsaea incise*, which is a sm all g round fern th at gro ws in healthy op en forest grading into swamp sclerophyll forest on seasonally waterlogged or poorly drained sites it is listed as endangered under the threatened Species Conservation act 1995.

Map Unit 3: Wetlands

3: Broad leaved paperbark, She Oak, Red Mahogany Swamp Sclerophyll Forest

Area: 0.65 ha

Sites:

Landforms: A transitio nal l andform into swamp la ndscape, occupi es lo w level to undul ating coastal back-barrier flood plains on estuarine sediments.

Soil: The soils are poorly drained deep yellow podzolics that are strongly to very strongly acidic, locally strongly saline and subject to seasonal waterlogging and flooding. There is a high probability of acid sulphate soils with sulphate soils buried to within 1 meter of the ground surface.

Trees: Broad leaved paperbark / Swamp Mahogany, Swamp Oak Swamp Oak flood plain forest (Endangered Ecological Community (threatened Species Conservation Act 1995) .This is a regrowth community.

Comments: Regrowth Community, Swamp Sclerophyll Forest on floodplain listed on the Endangered Ecological Community (threatened Species Conservation Act 1995) Broad leaved paperbark winter flowering species limiting factor for a number of threatened species.

Map Unit 4: Intertidal communities

4a: Twigrush Closed Sedgeland

Area: 0.21 ha

Sites:

Landforms: swamp landscape, occupies low level to undulating coastal back-barrier flood plains on estuarine sediments.

Soil: The soils are poorly drained deep yellow podzolics that are strongly to very strongly acidic, locally strongly saline and subject to seasonal waterlogging and flooding.

Trees: Absent

Comments: Intact Community

4b: Grey Mangrove Swamp

Area: 0.004 ha

Sites:

Landforms: swamp landscape, occupies low level to undulating coastal back-barrier flood plains on estuarine sediments.

Soil: The soils are poorly drained deep yellow podzolics that are strongly to very strongly acidic, locally strongly saline and subject to seasonal waterlogging and flooding

Trees: *Avicenna marina*

Comments: Intact Riparian mangrove corridor with small areas of low trees in small flats of creek.

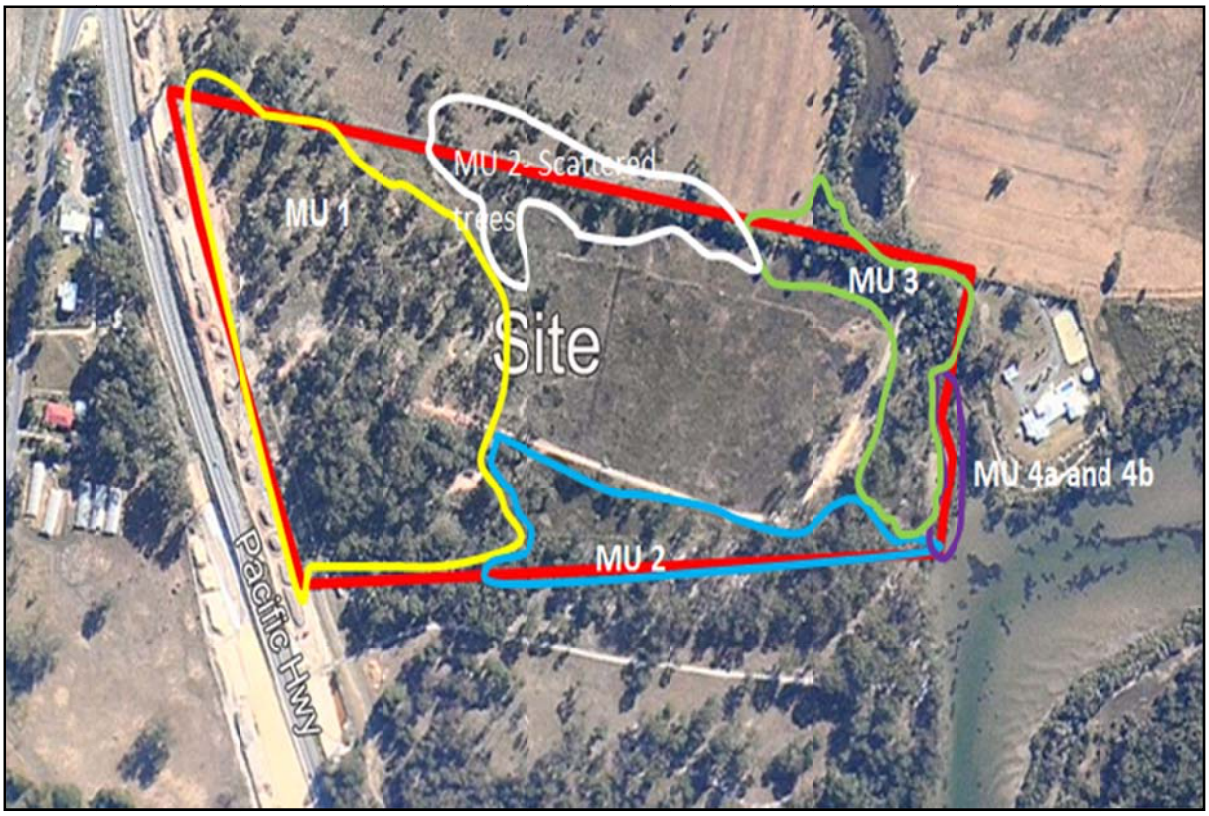

Figure 13. Vegetation Communities recorded during surveys for this assessment.

5.3 Aquatic and Wetland vegetation communities

Mapping of the Moonee Estuary for the Estuary Management Plan identified areas of seagrass bed within the area of the subject site. Over time there are always changes in seagrass bed formation and distribution within a system, however there is a gradual trend of decreasing cover in developed catchments. The mapping in Figure 13 identifies seagrass and other marine habitats relative to the subject site.

5.3.1 Wetland Delineation

At the start of each transect plants were largely terrestrial species, such as grasses, shrubs, herds. At varying points along each transect, there is a shift towards a dominance of wetland plants, which included, sedges, rushes, wetland herbs and halophytic plants (e.g. can tolerate high levels of salinity). Where a shift was recorded towards wetland plants and terrestrial species become start to absent or marginal, we are within the "wetland boundary". In some cases this boundary can be very wide (100m) and ambiguous (50-50 mix of the two groups) in many cases, however, it is clear and within a metre wide. The factors determining this width include:

- Topography;
- Gradients;
- Chemistry (soil and water);
- Salinity;
- Hydrology;
- Geology;
- Landscape position i.e. on floodplain or edge of creek;
- Climatic conditions; and,

- Distu rbance;

Within these transects, the factors than govern this boundary include:

- The water is saline to brackish with periods of fresher flooding;
- There is sma ll estuari ne fl at adjacent to M oonee Creek which sli ghtly rise s a way from the creek before more steeply rising at the newly installed road leading to the adjoining property;
- The soils at t he e stuarine flat area are part of th e M oonee e stuarine system whilst furth er upland there is a shift toward s introduc ed and tu rned soil p rofiles, likely as a result of road construction;
- Historically it is likely that these wetland elements penetrated fu rther into th e site prio r to changes in the topography (from the road) and changes to other contours and introduction of drainage channels. Nonetheless, currently there is a clear boundary at the road edge.

Figure 14 below details the results of these surveys. From this survey, I was able to determine three key wetland distinctions.

1 extent of king tide without flood conditions:

- This was marked during the transect survey then surveyed during king tide conditions (on two occasions) to test the survey precision.

2 extent of habitat that represents flood area in conjunction with a spring tide:

- Again similar to the above approach, however this area was tested during a flood event in October 2 011. Within the bound ary (f rom this lin e towards Moonee Cre ek), there i s a dominance o f wetland an d estua rine species. Beyo nd here is a mix of estuarine a nd terrestrial species. This in dicates that there is some movement of dominance of wetland plants b ased on climati c conditio ns. This is an a lmost ubiq uitous h abit of wetland boundaries. The area from this point towards the upland terrestrial vegetation in this case forms a wetland/terrestrial ecotone.

3 extent of habitat that requires a 20m buffer:

- This is the extent of the we tland area which includes a large area of what is the ecotone. As a control for imp acts on this ed ge a 20 metre buff er from this line towards the upland area i s re commended. This provide s an “on p aper” z one that attempts to limit impac ts that may occur on the ed ge. Ho wever, as disc ussed below, any line (buffer) is arbit rary and more importantly ineffective without appropriated management.

5.3.2 Management of Wetland Boundary

A buffer is only as good as its management. To this end, as a minimum the boundary shown in Figure 14 shall be established and managed consistent with these recommendations:

1. The edge shall be a mix of hard and soft natural and made-made structures of a width at least 4 metres wide th at effectively limits access by mean s of deterren ce and visual interference, that is, “a way in” cannot be seen.
2. No storm water o r landfall (diffuse) flow should pass from the site across this boundary. To prevent th is on th e eastern edge of the pe rimeter road a hi gher swale will direct flow into the stormwater water system away from the edge.
3. There will be no “garden” edge to the boundary and this area can only be maintained by regenerators. Maintenance by mowing and slashing can only occur beyond the edge.

4. The restoration design and regeneration program within the reserve must in clude details of edge man agement and design, spe cifically targeting the minimization of movement across the barrier, including humans, nutrients, and water.
5. Vegetation e stablishment within the rese rve mu st focus o n limiting move ment and providing fauna habitat, not to provide visual amenity for residents.
6. Once the rehabilitation is established it sh all b e man aged by ong oing phy sical maintenance for a pe riod of 5 years con sistent with an a pproved restoration a nd management plan.

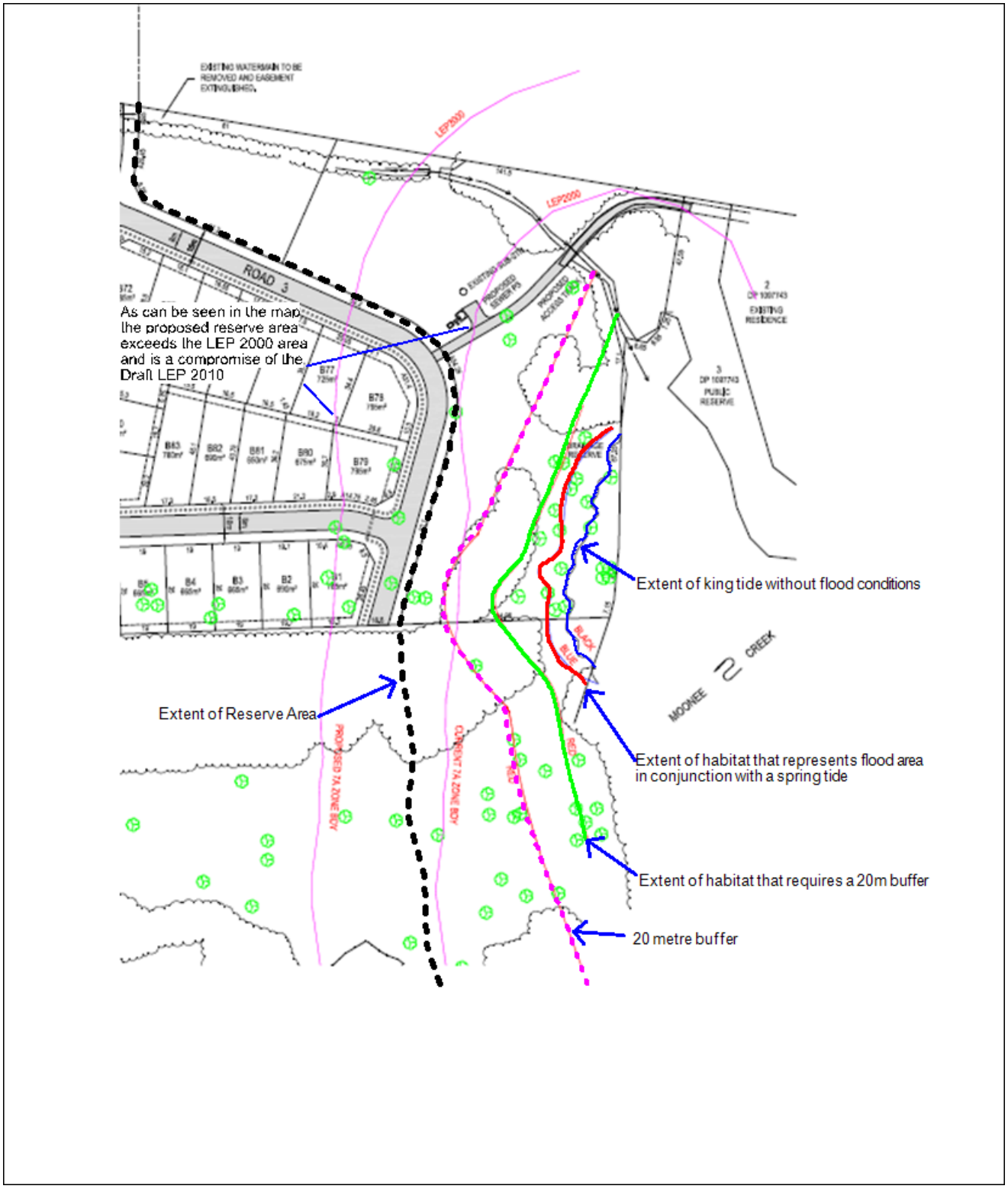

Figure 14. Identified boundaries relati ng to wetlands an d th e rese rve a rea r ecorded o nsite d uring detailed s urvey of wetland bou ndaries, a nd c onsultation with hy drological e ngineers re lating to fl ow, flooding and storm water management. This reserve boundary delineates the area to be managed under a restoration and management plan.

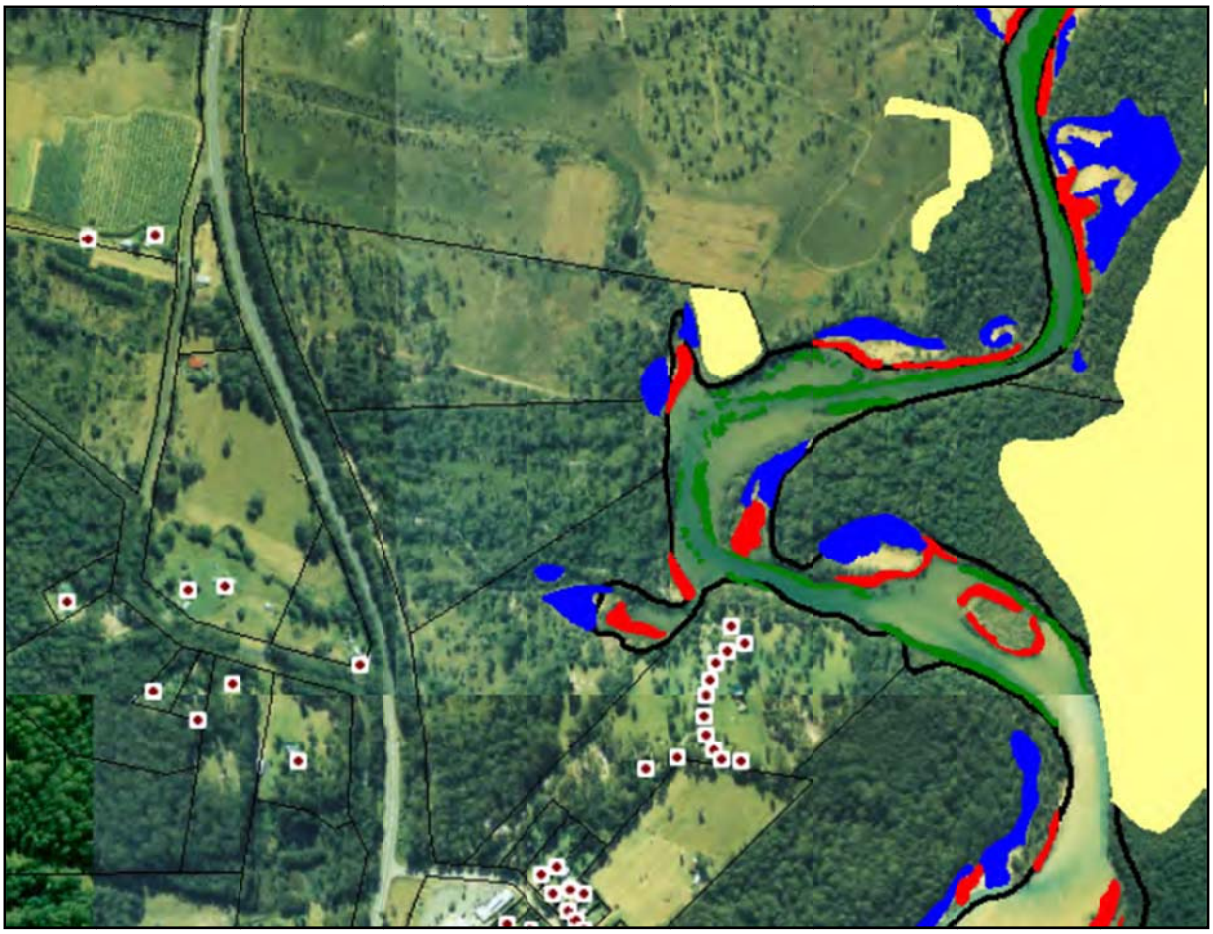

Figure 15. Green is Zosteria Capricornia seagrass, Red is mangrove areas and, Blue are a Saltmarsh communities.

5.4 Vegetation Condition

The vegetation units identified during this survey were assigned classes based on these characteristics; these are shown in Table 17.

Table 17. Vegetation condition recorded onsite.

Vegetation Communities	Condition Class
Tall open forest (Blackbutt +/- mixed species)	Poor to Moderate
Red Mahogany -Paperbark Swamp Sclerophyll Forest	Moderate
Broad leaved paperbark, Swamp Mahogany Swamp Sclerophyll Forest	Good
Twigrush Closed Sedgeland	Good
Grey Mangrove Swamp	Very Good

5.5 Significant Vegetation Communities

The community described as Map Unit 3 Broad leaved paperbark, She Oak, Red Mahogany Swamp Sclerophyll Forest is consistent with the determination for Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions and in parts with Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions both EEC's under the provisions of the threatened Species Conservation Act 1995. Refer to Figure 15 below.

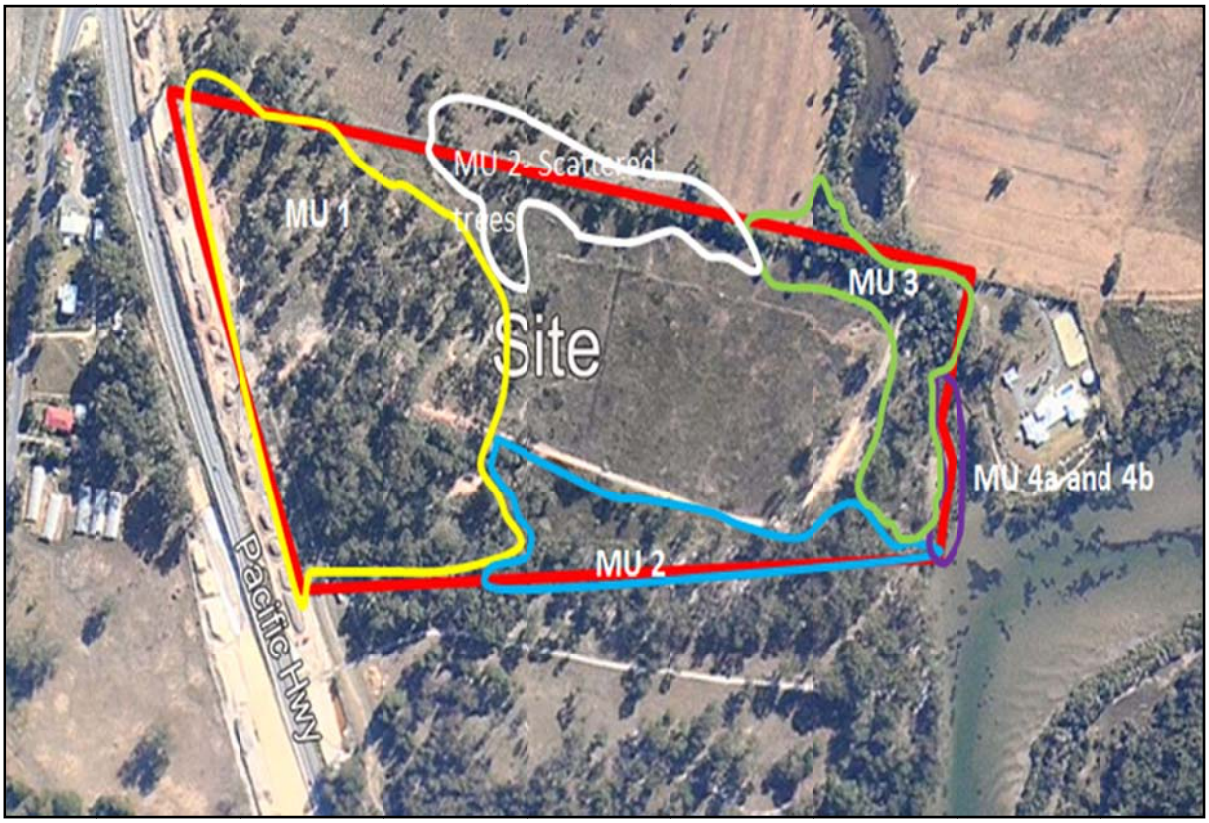

Figure 16. Map Unit 3 is consistent with an EEC's for Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions and in parts with Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

5.6 Fauna Field Survey Results

5.6.1 Local Area Results

Local Area results for fauna surveys recorded two hundred and fifty eight (258) fauna species consisting of one (9) amphibian, three (7) reptiles, forty (290) birds, ten (10) non-flying mammals and nine (9) flying-mammals.

5.6.2 Subject Site Results

Amphibians Results

Eleven (11) amphibi an sp ecies were recorded calli ng infreq uently from in and near wetlands a nd Creek lines on site. No threatened amphibians were recorded on the subject site.

Frogs recorded during winter are listed in Table 18.

Table 18. Winter Frogs recorded on and adjacent to the subject site during surveys.

Winter and Autumn calling frogs recorded		
Common Name	**Species Name**	**Comment**
Common Eastern Froglet	*Crinia signifera*	Ubiquitous when raining across the site
Sing Froglet	*Crinia parinsignifera*	Ubiquitous of low lying drainage areas and puddles when raining across the site
Brown Striped Frog	*Limnodynastes peronii*	Very common when damp.
Spotted Grass Frog	*Limnodynastes tasmaniensis*	Occasional calls from mixed localities
Tusked Frog	Adelotus brevis	Recorded calling from near site.
Broad-palmed Frog	*Litoria latopalmata*	Common through edge of dam on adjacent site.

Summer and spring frogs were equally as common around the site (5 recorded) with the Dainty green tree frog being the least common in the local area (refer Table 19).

Table 19. Summer calling frogs recorded on and adjacent to the subject site during surveys.

Spring and Summer Calling Frogs Recorded		
Common Name	**Species Name**	**Comment**
Green Tree Frog	Litoria caerulea	One maybe two recorded in and near the site
Bleating Tree Frog	Litoria dentata	Common at the low lying parts around the dam where trees are present.
Eastern Dwarf Tree Frog	Litoria fallax	Very common on creek line and dam
Dainty Green Tree Frog	Litoria gracilenta	One maybe more recorded near dam
Lesueur's Frog	Litoria lesueuri	Recorded calling from glades estate

Common frogs known to the local area not recorded during this survey, and would be unlikely to be recorded due to lack of suitable habitat are listed in Table 20:

Table 20. Common frogs not recorded on or adjacent to the subject site during surveys.

Common Frogs not recorded		
Long-thumbed Frog	Limnodynastes fletcheri	No suitable habitat for these species.
Eastern Banjo Frog	Limnodynastes dumerilii	
Freycinet's Frog	Litoria freycineti	
Red-eyed Tree Frog	Litoria chloris	

Threatened Frogs known to the local area that do not have habitat on the site, were not recorded and would be unlikely to be in the vicinity of the subject site are listed in Table 21.

Table 21. Threatened frogs not recorded on or adjacent to the subject site during surveys.

Threatened Frogs unlikely to be recorded onsite.		
Giant Barred Frog	*Mixophyes iteratus*	No habitat, stream rain forest frog
Stuttering Frog	*Mixophyes balbus*	No habitat, stream rain forest frog
Fletcher's Frog	Lechriodus fletcheri	Very poor habitat on site for this species
	Crinia sp.	Whilst there is marginal habitat for C.tinnula, the genetically most similar of frogs to this species and found in similar habitats. *The distribution and habitat requirements of this unnamed species are not yet wel understood. Given the condition fo the site and the habiat for Crinia* parinsignifera there is less confidence in overlap of habiatts onsite. only Common Crinia were recorded onsite and next to the site during surveys (2011-2012) and by Arthur White (2006).
Green and Golden Bell Frog	Litoria aurea	Lacks semi-permanent and permanent water bodies and that would be suitable for this species.
Booroolong Frog	Litoria booroolongensis	Rainforest and wet sclerophyll species with only marginal habitat.
Green-thighed Frog	Litoria brevipalmata	Wetland forests and thick heaths in association with forests and other wetland areas where they can move to breeding pond that fills during heavy and prolonged rain. No such breeding pond and the wetland forests onsite are being retained. Known just to the south of the site, so retention of this habitat onsite could assist the local population.
Pouched Frog	Assa darlingtoni	Very poor habitat on site for this species

Previous surveys of the Local Area have identified that parts of the Subject Site and the adjoining lands provide potential habitat for the threatened species Wallum froglet (*Crinia tinnula*). Specific surveys were undertaken to test the value of habitat for this species on the Subject Site. The results of these surveys area shown in Table 22

Table 22.

Habitat recorded onsite for the threatened species Crinia tinnula (Wallum froglet).

Parameters for Crinia tinnula	Subject Site	Reference Sites			Habitat comparison with subject site
		Coffs Airport	Emerald Beach wetland	Sandy Beach Wetland	
Acid swamps with Ph between 7 and 4.5Ph	Low acidic range recorded onsite most often during samples= 6 to 7 High condition acidic range recorded less often as low as 5.5 and above 6.5 Site range between high 5.5 to low 7	5.5 -6	5.2-6.0	5.5-5.8	The site is within the range of acidity, however this may be a relic artefact that has hung on since before clearing for the site and it might be expected to deteriate overtime (untested as yet). This makes parts of the site at least breeding habitat.
Surface water for longer than 20 consecutive days during a season	Following three heavy raining events during 2011 and 2012 the site only held surface water for 3 to 4 days due to man made drains draining the wetland.	>20 days in some localities	>20 days in some localities	>20 days in some localities	It's clear from surveys during ideal rain and seasonality (autumn and Winter) conditions in 2011 that the site is not breeding habitat.
Complexity of mulching Humic layer of different flora species, varying depths and structural complexities, i.e. leaves, twigs, fruit, reeds, algae	Low to absent in cleared and slashed and grazed areas. Depths on substances very low(100mm) and simple in structure (lot of leaves from scattered trees but not much else)	High number of species in Humic layers and pre-decomposition structures. Depth as great as 300mm in some places. Sticks and complex layers of reeds and trees materials.	High number of species in Humic layers and pre-decomposition structures. Depth as great as 300mm in some places. Sticks and complex layers of reeds and trees materials.	High number of species in Humic layers and pre-decomposition structures. Depth as great as 300mm in some places. Sticks and complex layers of reeds and trees materials.	This is a telling sign, as I believe of habitat quality for this species (unpublished post grad research data held by author) Far more convincing than position in landscape and vegetation structure and floristics. In my view this limits the habitat value of the site.. It is understood that low pH values of naturally acidic aquatic environments are the result of the input of high concentrations of allochthonous dissolved organic carbon (ADOC) containing humic acids (HA) derived from the surrounding vegetation and peatlands. There is limited hydrological connectivity to surrounding terrestrial landscapes and the opportunity for in situ creation of reasonable levels of DOM is limited by the lack of emergent vegetation onsite and forested communities within the site. (Arthington et al., 1986; Collier et al., 1990; Posa et al., 2011).This of course is a function of anthropogenic interference.
Presence of pond that could be suitable for breeding or evidence of breeding within a pond recorded	No such pond or water holding structure present. The site has had small drainage infrastructure constructed at one time, which effectively drains surface water away very effectively. The groundwater table even during very heavy rain does not stay above the surface for very long.	Good breeding ponds present and breeding evidenced.	Good breeding ponds present and breeding evidenced.	Good breeding ponds present and breeding evidenced.	It's clear there is no breeding habitat onsite, In this matter Arthur White agreed in 2006. This is a function of manmade draining of the site.

Despite many local area surveys, the occurence of Wallum froglet within 1 km of the site has not been established. Local populations are not inhabiting the local area, this means that at the present, the site is unlikely to be habitat for a local population. Nonetheless, this does not discont the future occupation of the site under changed or "ëxtreme" environmental conditions, or given the migration of the local population under long term seasaonal favuorable conditions. The lack of evidence of presence in my view does not mean that the speices would be absent in the future. Figure 16 shows that the closet record (other than ones that are misidentifed as other crinia species) to the site is north 5 kilomertres away. Given the site has potenital for occupation it is recommended that within the proposed reserve an area of suitable habtait be created to enhance the qualities fo the local area. It is reccomed that this habtait area fit the following criteria:

1 The wetland is designed to develop and maintain a pH of between 4 and 5.5 pH;
2 The wetland is designed so that the water level is influenced by groundwater movements;
3 There is access (creek imputes) to Dissolved Organic Matter from upland terrestrial forests, this is key to maintaining the water chemistry. The current placement of the wetland within the reserve follows this principle;
4 That the regeneration of the wetland is consistent with the local recorded species that are common to Wallum froglet habitat, regardless if we can't get the first three points correct these plants will not be able to compete with more aggressive floristic competitors;
5 The wetland includes an area that represents a suitable breeding pond habitat;
6 To achieve all of the above steps requires the restoration and management plan to be designed by a Wallum froglet expert.

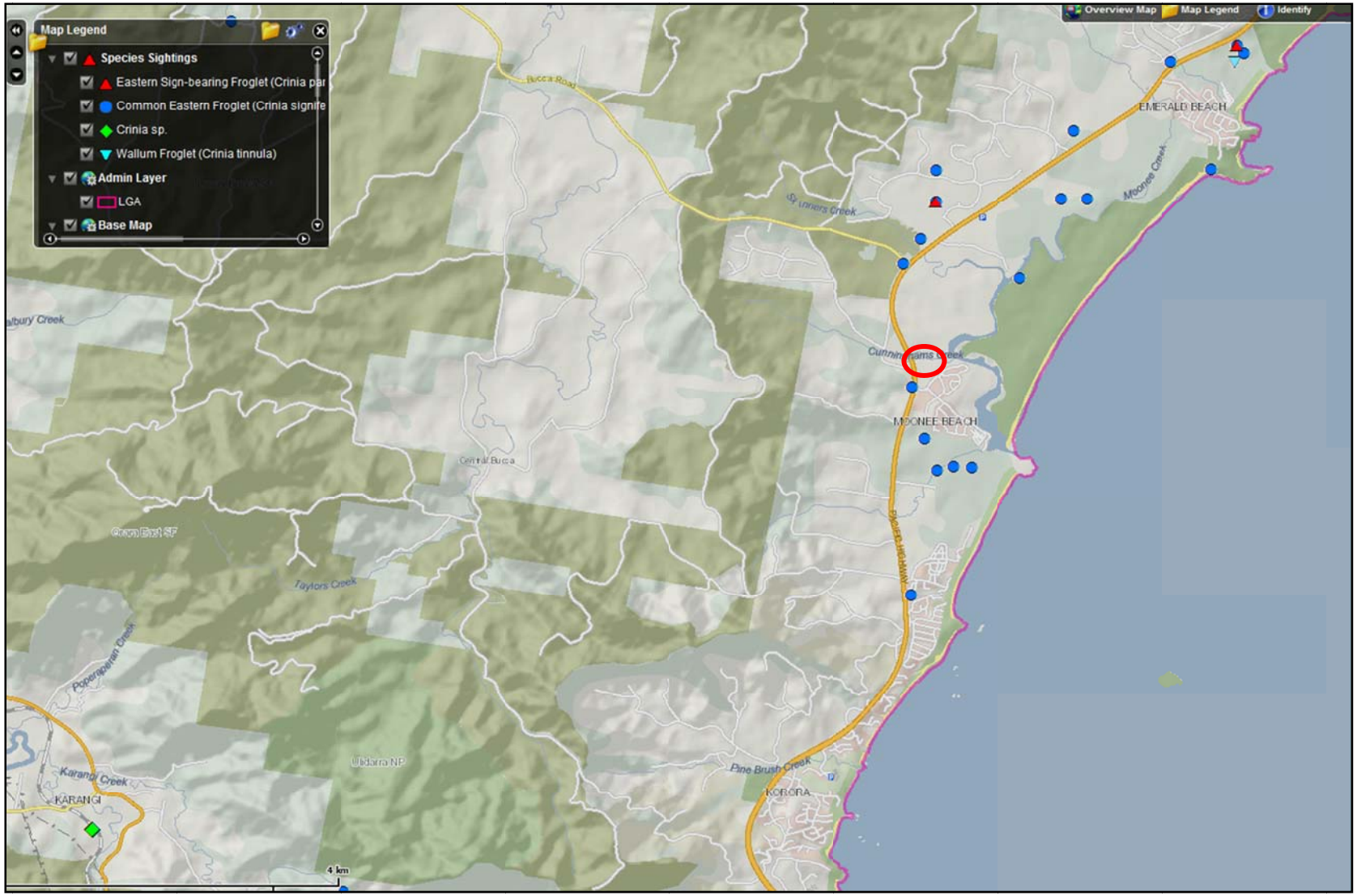

Figure 17. Wallum froglet in the local area. Red oval approximate location.

5.6.3 Reptile Results

Three (3) reptile species, Garden Sun-skink (*Lampropholis delicata*), Lace Monitor (*Varanus varius*) and Red-bellied Black-snake (*Pseudechis porphyriacus*) were recorded on the subject site. No threatened reptiles were recorded on the subject site.

5.6.4 Bird Results

In total, 211 Bird species were recorded in the Local Area during surveys of the Local area and reference sites. Of these only 36 species were recorded on the subject site, less than 17% of the local diversity. This is largely because the local area reference sites include a range of habitats, such as rainforest, headland, marine, coastal, heath, forest and estuarine. By comparison the subject site only includes forest and estuarine and cleared and underscrubbed forests. Refer to Table 23.

Table 23. Birds records made during surveys for this assessment.

	Impact Area	Reference Sites		
	Subject site	**Coffs Airport**	**Moonee Headland**	**Sandy Beach Wetland**
Species recorded	36 58		85	61
Threated species recorded (TSC Act and EPBC)	2 2		6	3
Migratory Species recorded (EPBC Act)	2 9		9	7
Specialist habitat species recorded (rainforest)	6 24		41	37
Disturbed area species recorded	10 3		2	2

5.7 Significant Bird Findings

5.7.1 Glossy-Black Cockatoo Results

Evidence of Glossy-Black Cockatoo foraging was recorded along the boundary between the subject site and the Glades estate (north boundary) refer to Figure 18. Feeding had been quite heavy on Allocasuarina torulosa seed pods, and the area is considered to be used somewhat frequently by individuals from the local population. This species was recorded at all reference sites during surveys and heard from the Moonee Beach Nature reserve on several occasions during surveys. Two individuals were recorded on Lot 6 during surveys. The subject site provides a “mixed Bag” of habitat for the species, which is largely the result of slashing and clearing. Based on field evidence and historical photographs the site would have been ideal habitat for the species. There is a clear need to provide mitigation for this species as part of the proposal; these plans are detailed in the last section of this report.

Figure 18. Glossy-Black Cockatoo records for the subject site. The red stars are localities were seed feeding was recorded and in high intensity. The green bar was the location of two individuals recorded (Lot 6).

5.7.2 Osprey Results

Osprey was recorded onsite roosting during nocturnal surveys (Refer to Figure 19 below). It was not recorded any other time during the 4 separate survey season conducted for this report. Locals informed me that the tree that was used as a nest tree had fallen down. The proponent has informed JW Planning that the individual bird appears to be now nesting on the eastern banks of Moonee Creek with a mate. This does not require any mitigation.

Figure 19. Location of Osprey recorded roosting on the site.

5.7.3 Flying Mammals

Nine (9) flying mammal species were recorded from spotlighting and ultrasonic call detection on the subject site. (Figure 20). These include:

Gould's Wattled Bat (*Chalinolobus gouldii*), Chocolate Wattled Bat (*Chalinolobus morio*), Little Bentwing-bat (*Miniopterus australis*), Eastern Bentwing-bat (*Miniopterus schreibersii* oceanensis), Lesser Long-eared Bat (Nyctophilus geoffroyi), Eastern Broad-nosed Bat (*Scotorepens orion*), Little Forest Bat (Vespadelus vulturnus) and East-coast Freetail-bat (*Mormopterus norfolkensis*).

Of the eight (8) Microchiropteran species recorded on the subject site, little Bentwing-bat (*Miniopterus australis*), Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) and East-coast Freetail-bat (*Mormopterus norfolkensis*) are listed as Vulnerable under schedule 2 of the Threatened Species Act 1995.

Grey-headed Flying-foxes (*Pteropus poliocephalus*) were regularly recorded foraging in trees but no Flying-fox "camp" was found on or near the site. Grey-headed Flying-fox is listed as Vulnerable under both the Threatened Species Act 1995 and the Environment Protection and Biodiversity Conservation Act 1999.

Given the findings and the local distribution of significant bat species the subject site is included as part of the local habitat for all locally recorded bat species. Whilst the proposal is not removing very much of this habitat it nonetheless required mitigation and management, which will be addressed in the final section of this report.

Figure 20. Yellow Diamond; Little Bentwing-bat (Miniopterus australis), Green Diamond; Eastern Bentwing-bat (Miniopterusschreibersii oceanensis), Red diamond; East-coast Freetail-bat (Mormopterus norfolkensis), and Blue Diamond Grey-headed Flying-foxes (Pteropus poliocephalus) across the site.

5.7.4 Non-flying Mammals

Eight (8) native non-flying mammal species were recorded on the subject site (Table 24). Surveys included all methods commonly used to detect all types of native mammals; however some species such as quoll have large home ranges and seasonal habitat differences. In such cases ideal habitat and/or linking with known home ranges for a local population are included as "home range habitat". That is, it's not found but is expected to be there at some time in the future and be used in the past. Given these considerations I believe that the site does not provide any habitats for species that may be at the site at different times. The species recorded are representative.

Table 24. Ground and arboreal mammals recorded during surveys for this assessment.

Scientific Name	Common name	TSC Status
Antechinus stuartii	Brown Antechinus	
Isoodon macrourus or *Perameles nasuta*	bandicoot	
Petaurus breviceps	Sugar Glider	
Petaurus norfolkensis	Squirrel Glider	t[#]
Pseudocheirus peregrinus	Common Ringtail Possum	
Trichosurus vulpecula	Common Brushtail Possum	
Macropus giganteus	Eastern Grey Kangaroo	
Wallabia bicolor	Swamp Wallaby	

t= threatened species as listed under the TSC Act.

One significant recording was made on the subject site during surveys, Squirrel glider is listed as Vulnerable under schedule 2 of the Threatened Species Act 1995 and vulnerable under the provisions of the EPBC Act 1999.

5.8 Koala Records- Local Area

Koala is commonly recorded in the local area. It is found in most forested habitats on the coastal plains, due to a high presence of known koala feed trees in these habitats. Refer to Figure 21. The records show historical records on the subject site and a pattern that extends to the south and north of the subject site. It is likley that all of the forested vegetation would play either a role as feed trees or refuge trees. These records indicate that the local koala population inhabits the area and that the site likley plays a function in the conservation of this species.

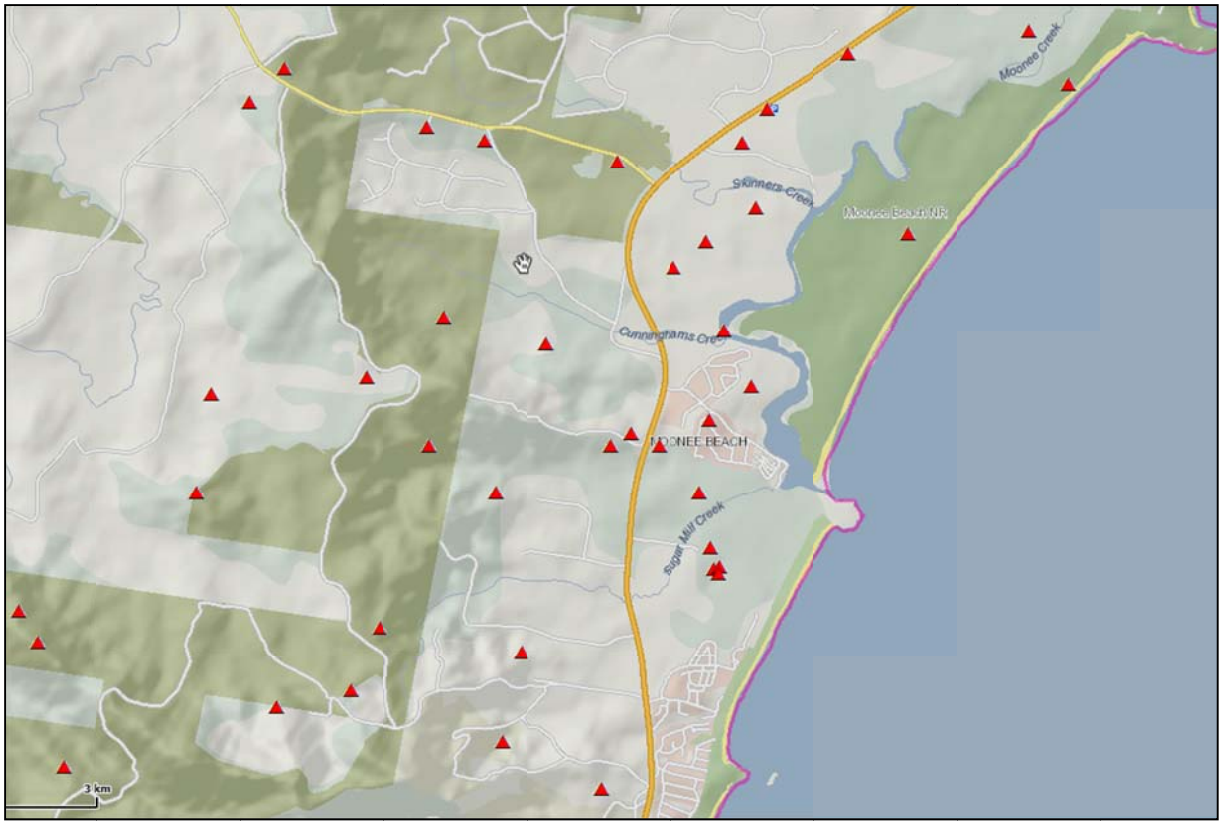

Figure 21. Local Koala records (DECC 2012)

The subject site is identified as supplementary koala habtiat under the terms of the CKPOM (CHCC 2006) and the results of this survey confirm the habtiat mapping detailed in that plan, refer to Figure 22. Mitigation is required to satisfy the provisions of the TSC Act, EPBC Act and the CKOPM (CHCC). These are addressed in the last section of this report.

Surveys identified a single Koala on the south western boundary of Lot 6. This individual was recorded in the winter of 2010 and further surveys (following two years) did not locate any more individuals. no recent records in the area have arisen. It is likely that this individual was on the move or that to the south of Lot 6 there are areas of Koala habitat and this represents the northern limit of movement. Given the very low records of scats and that these were all identified within the area were the individual was recorded, it is likely that there is limited habitat on Lot 1 and of the habitat present it is restricted to the reserve area, and is well removed from development activity. The proposed increase in feed trees within the reserve area will, in the future, provide a good corridor link to the north of Lot 1.

5.9 Squirrel glider records- Local Area.

Local records for gliders are interesting. The apparent gaps are likely to be data gaps rather than habitat gaps. That is, the local records are incomplete and there is likely a greater population than the records show. Habitats within Moonee Beach Nature Reserve are ideal as are habitats on the western side of the Pacific Highway. The tall coastal plan forests and the Swamp Mahogany forests of the local area are all good habitat. There is a high abundance of suitable hollows and winter flowering trees. All forested coastal plain forests in the Local area are considered habitat. Both Sugar and Squirrel glider were recorded on the subject site during this study, which is not unusual (Winning and King 2009). Sympatric populations are common where there is an overlap in resources such as hollows and sap/flowering resources, which allows for a decrease in competitive pressures. Also Squirrel glider have been drawn as far as 500m away (overnight movement pattern) by previous

studies in the Myall lake region (King personal observations) suggesting that habitat separation by these species can sometimes be confused by trapping surveys. Refer to Figure 23.

Figure 22. Supplementary Koala habitat as mapped in the CKPOM (CHCC 2006)

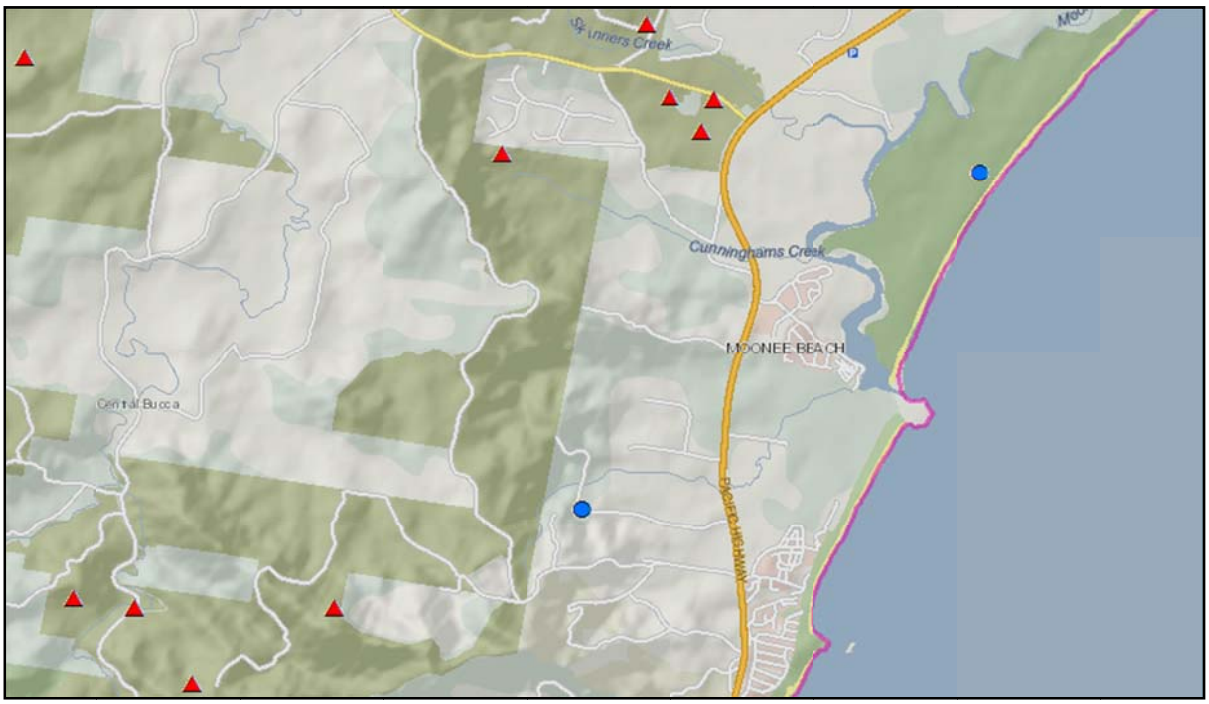

Figure 23. Local records for gliders. Blue dot Squirrel glider and Red triangle Yellow Bellied Glider.

Two individuals were recorded on three occasions during surveys, refer to Figure 24.

Figure 24. Red box are Squirrel glider records on the subject site (Lot 7) and Blue are those recorded on site (Lot 6).

The site provides breeding and foraging habitat for Squirrel glider, and at the least, the site provides marginal to moderate support for surrounding ecosystems and habitats. Any proposed loss of habitat from the site requires mitigation, which can be achieved by the retention and enhancement of the Moonee Creek corridors as per the DCP. This approach in conjunction will detailed plans for the clearing of the site will improve the long term viability for the local population of this species.

5.10 Aquatic Results

These samples were collected from three locations. One just prior to track crossing onsite, two from the edge of Moonee Creek at the entrance to the creek into the subject site and 3 at edge of Moonee Creek in line with the southern boundary, refer to Figure 25.

Figure 25. Aquatic Survey locations

A total of 251 animals from 31 aquatic species were collected from the three sampling locations within the Moonee estuary. The following conclusions can be drawn from the data:

- The dominant organisms were the polychaete worm (F. Capitellidae) Barantolla lepte.
- The bivalve mollusc Tellina deltoidalis was common across the different parts of the area.
- Other common species include Scoloplos simplex and Orhinild polychaete

5.10.1 Freshwater Aquatic Insects

For macro invertebrates, sweep samples using a 0.3 millimetre mesh net were collected over 10-minute period. Samples were then sorted in the field and abundance of each family recorded on a four-point scale:

1. Rare (1 to 3 individuals)
2. Present (4 to 10 individuals)
3. Common (11 to 50 individuals)
4. Very Common (greater than 50 individuals)

A small number of each type were placed in ethanol for subsequent identification to family level classification using a dissecting microscope. The number of discrete taxa ("species") was also scored for each family.

Macroinvertebrate data was entered into a database that calculated the total number of taxa and a water quality index (SIGNAL index). The SIGNAL index (Chessman, 1995) is a measure of water

quality using the factors of indicator animals and abundance. It has been developed for Australian waters. Animals are identified to family level classification, with each family assigned a grade between 1 and 10 depending on the tolerance to common pollutants (higher values represent lower levels of tolerance). Each species is then assessed for abundance on a 4-point scale. Scores for each type are calculated from the product of grade and abundance.

The Index is derived from the sum of scores divided by the sum of abundances. This provides a comprehensive ecological indicator that takes into account the number and abundance of pollutant sensitive animals.

SIGNAL indices are classified into 4 levels:

- less than 4 = probable severe pollution
- 4 - 5 = probable moderate pollution
- 5 - 6 = doubtful quality, possible mild pollution
- greater than 6 = clean water

The signal score recorded for the site was 5.6.

5.10.2 Moonee Creek condition and quality

Moonee Creek estuary is considered to be in a relatively healthy condition and provides significant environmental values at local and regional scales. Although at times (mostly after rainfall) water quality can be degraded, it does not receive excessive urban pollutants. Further, runoff from the agricultural lands in the upper catchment is moderated by the extensive bushland fringing the estuary and its good natural flushing capacity (i.e. regular exchange of waters with the ocean).

Within the lower tidal reaches of Moonee Creek, hydraulic processes are dominated by the semidiurnal ocean tide, which moves into and out of the estuary through the heavily shoaled entrance.

Tides provide very effective flushing of the estuary. During spring tides, over 70% of the water in the estuary can be exchanged with the ocean. This proportion reduces to about 40% during neap tides. Ocean waters can intrude a distance of about 3-4 km inside the estuary during large spring tides. This means that all waters downstream of Skinners Creek are essentially ocean water at high water slack.

Moonee Creek has a range of estuarine habitats, including seagrass, saltmarshes, mangroves, and sedgeheath. The seagrass extent in Moonee Creek tends to be highly variable over time, although there has been no clear increase or decrease. Seagrass tends to be restricted to the edge of the channel in the shallow waters.

5.10.3 Seagrass

Inspection of the substrate and banks revealed that seagrasses occur near the subject site. *Zostera capricorni* was recorded on bank of 200m upstream.

5.10.4 Mangroves

The bank of Moonee Creek in the vicinity of the subject site consists of a gentle sloping gradual channel, which consists of a narrow mud flat area delineating between channel and upland wetland habitats. The topography rises gradually 10-12 metres away from the bank, which is covered in terrestrial vegetation (trees and rushes). There are no mangroves beyond the 2-3 metre strip in this mud flat area.

The bank contains a few scattered river mangroves, *Aegiceras corniculatum*, amongst Grey Mangroves Avicenia marina and a couple of small Red spider Mangrove (*Rhyzophora stlosa*) which have colonised shallow intertidal sediments at the base of the bank.

5.10.5 Habitat for threatened Fish

Whilst no significant fish were recorded in the local area there remains habitat for some of the listed species.

i. ***Trout Cod (Maccullochella macquariensis)***

The Trout cod (*Maccullochella macquariensis*) is not reported by Faragher and Harris (1994) to occur on the north coast of NSW, but rather is reported to occur naturally in the Murray-Darling River system, and has been translocated to the south coast of NSW. Harris and Gehrke (1997) did not record this species from north coast freshwaters in the NSW Rivers Survey.

Response: unlikely to occur

ii. ***Eastern Cod (Maccullochella ikei)***

The Eastern Cod (*Maccullochella ikei*) was reported by Faragher and Harris (1994) to occur in the northern coastal region of NSW, and was recorded from north coast freshwaters by Harris and Gehrke (1997) in the NSW Rivers Survey. McDowall (1996) reports its present distribution to be limited to the Clarence and Richmond Rivers.

Response: unlikely to occur on subject site due to small scale of habitats

iii. **Oxleyan Pygmy Perch (Nannoperca oxleyana)**

The Oxleyan pygmy perch (*Nannoperca oxleyana*) is reported to occur in the north coast region of NSW by Faragher and Harris (1994), but was not recorded in the NSW Rivers Survey (*Harris and Gehrke, 1997*). McDowall (*1996*) describes its distribution as much more restricted than formerly and is now known from only 18 localities: in small coastal and swampy drainages on the mainland of southeast Queensland and on Fraser and Moreton Islands; in the Noosa River; and from North Range Lake in Bundjalung National Park, south of the Richmond River in northern NSW (*Arthington, 1996*).

N. oxleyana was recorded at only one locality (*North Range Lake*) out of 33 sites surveyed in the coastal heathland region of northern NSW in 1993 (*Arthington, 1996*). The southernmost study site in that survey was Wanderer Creek south of Grafton. According to Arthington (*1996*), Llewellyn (*see McDowall*, *1996*) had reported *N. oxleyana* from Lake Hiawatha, near Grafton, but it was not found at that location during the 1993 survey.

The Oxleyan pygmy perch is a small, shy fish found only in streams, swampy areas, and two lakes in coastal wallum (*Banksia*-dominated heathland), usually where there is dense aquatic vegetation. It prefers waters which are still to slow moving, are acidic (*pH 5.4-5.7*) and have very low conductivity, often darkly stained with humic acids, over substrates of siliceous sand and plant debris (*from McDowall, 1996*). This fish species was collected in shallow beds of submerged sedge (*Eleocharis sp.*) in North Range Lake (*near Grafton*) during 1993 (*Arthington, 1996*).

Response: unlikely to occur as prefers larger areas of acidic wetland and creek systems.

iv. ***Purple-spotted gudgeon (Mogurnda adspersa)***

The Purple-spotted gudgeon (*Mogurnda adspersa*) was recorded from north coast rivers during the NSW Rivers Survey (*Harris and Gehrke, 1997*), but McDowall (*1996*) indicates that it only occurs in coastal drainages north of the study area from about the Clarence River northwards. It is also occurs

patchily in the inland drainages of NSW. The suggested decline of this species is a result of high densities of Eastern gambusia (*Gambusia holbrooki*). Its natural habitat is slow flowing water among aquatic weeds and where suitable hard substrates are available for spawning.

Response: unlikely to occur

v. ***Honey blue-eye (Pseudomugil mellis)***

The Honey blue-eye (*Pseudomugil mellis*) is not reported to occur in north coast freshwaters (*Faragher and Harris, 1994; McDowall, 1996*), nor was it recorded in the NSW Rivers Survey (*Harris and Gehrke, 1997*). McDowall (*1996*) describes its natural range as very restricted, found only in wallum country in southeastern Queensland from about Brisbane north to Bundaberg, and also on Fraser Island.

Response: unlikely to occur

5.11 Potentially Threatened Species

In addition to the above-declared (*FM Act 1994*) and listed (*ASFB*) threatened species, there are several marine and freshwater species that are potentially threatened. These fish have been fully protected in NSW, under the FM Act 1994, by prohibiting their capture by any means.

The two freshwater protected species (*Australian grayling and Macquarie perch*) can be readily dismissed from further discussion because they do not occur within or near the study area. The Australian grayling is not known to occur north of the Grose River near Sydney, and the Macquarie perch naturally occurs in western-flowing drainages from the Lachlan River southward into Victoria.

The truly marine species are predominantly open ocean or rocky reef inhabitants, such as:

- Ballina angelfish *Chaetodontoplus ballinae*
- Black rock cod *Epinephelus daemelii*
- Eastern blue devil fish *Paraplesiops bleekeri*
- Elegant wrasse *Anampses elegans*
- Estuary cod *Epinephelus coioides*
- Giant Queensland groper *Epinephelus lanceolatus*
- Grey nurse shark *Carcharias taurus*
- Herbsts nurse shark *Odontaspis ferox*
- Great white shark *Carcharodon carcharias*
- Wee dy seadragon *Phyllopteryx taeniolatus*

The Estuary cod is found on reefs and mainland estuaries, but its normal range is further north in Queensland, and only rare errant individuals are found in NSW waters.

5.12 Species Reduced in Numbers in NSW

The following three species of fresh water fish are not currently protected in NSW waters but their populations are considered to be reduced in numbers (*NSW Fisheries, 1998b*):

- Non-parasitic lamprey *Mordacia praecox*
- Silver perch *Bidyanus bidyanus*
- Freshwater catfish *Tandanus sp.*

The Non-parasitic lamprey does not occur in northern NSW, and has a very restricted range in southern NSW (Moruya and Tuross Rivers) and probably Victoria. The Silver perch (*Bidyanus bidyanus*) has dramatically declined throughout most of its natural range, which is the Murray-Darling drainage system, but has been translocated to much eastern drainage and is now also subject to

intensive fish farming for the restaurant trade (*McDowall, 1996; NSW Fisheries, 1998b*). Silver perch cannot be captured by either commercial or recreational anglers, other than in the backed-up waters of dams or reservoirs. Although reported to occur in north coast rivers, it was not recorded in the NSW Rivers Survey (*Harris and Gehrke, 1997*).

5.13 Seagrass species

The vast majority of the seagrass is *Zostera capricorni*, small amounts of *Halophila ovalis* (paddleweed).

5.14 Areas of Environmental Sensitivity within Subject Site

No World Heritage Properties or RASMSAR sites were identified by the MNES search within the regional area, and we can confirm there are no areas of environmental sensitivity within the Local Area or the Subject Site.

Section D - Impacts

6.0 Ecological Footprint of Proposal

The ecological footprint of the proposal takes into account the actual footprint of the proposal; which is approximately 6.4 hectares (TBC), and the cumulative and wider scale impacts of the proposal, such as downstream impacts on water bodies, fragmentation, or increase in pests.etc. This section identifies:

- all relative impacts from the proposal;
- the effect these impacts are likely to have on significant ecological matters;
- an ecological risk assessment of these impacts;
- Mitigation and ameliorative measures recommended to reduce impacts; and finally,
- the ecological matters that are to be passed though legislative assessment of impacts taking into account the prescribed management recommendations. Chapter headings should be consistent with these dot points.

6.1 Actual footprint of Proposal

It is proposed that 10.53 ha of the Subject Site will be impacted by the development footprint. The proposed development area includes 30% of the total area of remnant vegetation within the subject site, Figure 26.

The proposal will retain 2.4 ha of the Subject Site as habitat, which represents 69% of the remnant vegetation. Once the buffer area and wetland habitats are regenerated the proposal will results in a net balance in habitat offsets.

The retention of the Moonee Creek corridor and Buffer per the DCP and Moonee Creek Management plan must follow the following principles to be considered as **"not being impacted"** by the proposal:

1. That all physical structures that can be removed from the reserve area are removed and placed within the development footprint;
2. Structures that are man-made "natural" structures, e.g. swales and detention basins must meet the like-for like test of the ecological communities being created;
3. These structures should also be a shape that does not prevent the movement of organisms through the corridor, ideally, these structures will be linear running north-south, thus, allowing for the creation of a continuous forested corridor.

6.2 Cumulative Impacts of Proposal

There is a total of approximately 12,000 hectares of remnant vegetation within the Local Area of which 70% is within conservation zones. The potential loss of 3 hectares of remnant forest represents 0.02% of the Local Area habitat. When considered with other proposals in the Local Area the proposal represents a small cumulative input into development pressures on remnant vegetation, especially considering that the proposal provides a positive reservation outcome on site and the impact area's largest proportion is highly disturbed scattered trees and cleared ands.

6.3 Wider Scale Impacts of the Proposal

No wid er scale impa cts have been i dentified as part of the propo sal. The propo sed st orm wate r management desig n will only disch arge the hi ghest quality water po ssible into su rrounding environments (See sto rm water documents). The propo sed li nking of corrido rs a nd restoration of habitats will provide the ecological ele ments to sup port lo cal po pulations. Th e proje ct will also no t introduce any potential barriers to movement.

6.4 Fragmentation Impacts

The proposal does not increase fragmentation in the Local Area. In effect it further secures connectivity through the allocation of corridors into the conservation reserves system.

Figure 2 6. Draft L ayout including bu ffer b etween 100m from rear of lo ts to maximum of 225 metres from Moonee Cr eek. Bu ffer area is to b e rehabilitated with importan t local species habitat.

6.5 Assessment of Impacts on Remnant Vegetation

Impacts of the proposal of vegetation and the habitats that it provides are detailed in table 25.

Table 25. Map unit impacts predicted from proposal

	Map units		
Community parameters	**1** **Cleared**	**2** **Wetland**	**3** **Eucalypt Forest**
Sensitivity	Low sensitivity High impact	High sensitivity low impact	Moderate sensitivity Moderate impact
Value	Low value high impact	High value low impact	High value moderate impact
Quality of the Environment	Low quality high impact	High quality low impact	Low quality moderate impact
Impact Characteristics	**1**	**2**	**3**
Intensity	High intensity	No impact if drainage is managed per recommendations	Moderate clearing of low quality habitat, that still provides habitat for a range of important species
Duration	Permanent Permanent		Short term loss, however regeneration of corridor will see long term retention of habitats on the subject site.
Magnitude	All	None of the wetlands should be impacted onsite	Almost all of remnant modified forests will be impacted
Geographic extent	Extent of cleared area onsite	If drainage is managed per recommendations then no impacts	Impacts onsite will not spread to beyond the site if corridor recommendations are met.

6.6 Assessment of Impacts of wetland vegetation

The proposal will not directly impact on any areas of wetland. The proposal includes the development of wetland buffers and recommends the development of detailed management and restoration programs. The proposal includes the development of wet heath and wetland habitat within the reserve area to increase the stability of the local area by increasing the area of wetland around the creek lines and swamp forest habitats.

6.7 Mitigation and Ameliorative Measures Recommended to Reduce Impacts

The proposal includes the following mitigation measures (Table 26) and summaries of how these relate with the relevant planning instruments. Green highlighted boxes are generally not consistent however; mitigation is proposed to offset the level of impact.

Table 26. Proposed mitigation

Mitigation measure Proposed	Coffs Harbour LEP	Moonee Beach- DCP	Estuary Management Plan for Moonee Creek	Marine bioregional plan for Temperate East Marine Region	Solitary Islands Marine Reserve (Commonwealth Waters) Management Plan.	The Northern Rivers Regional Biodiversity Management Plan	Coffs harbour Biodiversity action strategy2012	Comprehensive Koala Plan of Management
Retain Moonee Creek buffer of 100m across the site.	Consistent with objective. Refer to SEE.	Consistent with objective. Refer to SEE.	If water quality can be safe guarded through stormwater management systems that it is consistent.	Activity outside of the Marine Park and generally consistent with objectives.	Activity outside of the Marine Park and generally consistent with objectives.	NA NA		NA
Regenerate this buffer with wetland and sclerophyll forests using known koala feed trees and important winter flowering plants	Consistent with objective and greater in some areas	Consistent with objective and greater in some areas	Consistent with objective and greater in some areas	NA	NA	Important corridors not impacted and important habitats not removed. Yes generally consistent.	Potential Wallum froglet will be impacted. This aspect not consistent. Koala and Squirrel glider habitat to also be impacted, however all of these will be mitigated in the proposal.	Supplementary habitat to be impacted and replaced. Not consistent.
Create a suitable wallum froglet habitat area within offset area that will provide support for local frog species	Consistent with objective...	Consistent with objective.	NA	NA	NA	NA	Consistent with objective.	Consistent with objective.
Replace damaged Osprey nest with the tested appropriate man-made solution	NA Consist	ent with objective...	NA	NA	NA	NA	Consistent with objective...	Consistent with objective...
Control storm water leaving the site so that no storm water flows directly into the Moonee Creek without treatment occurring to a level that does not increase pollution loads in the system.	NA NA		Consistent with objective	Consistent with objective	Consistent with objective	NA	NA	NA

6.8 Moonee Beach- Development Control Plan (DCP)

Key objectives and our response to relative objectives are listed below.

i. Exclude urban development from within 100m of Moonee Creek, 50m of Skinners Creek, and from within 20 m of all other cree ks, to protect riparian vegetation and maintain water quality, and provide habitat linkages;

Response: No Lots are within the Moonee Creek development exclusion area. Access roads do overlap within this area; however this provides a drainage opportunity away from Moonee Creek which is of great value for management of water quality.

ii. Exclude urban development from within 50m for SEPP No 14 Coastal Wetlands.

Response: Not applicable.

iii. Eliminate adverse impacts of development upon the aesthetic, recreational and ecological value for the flood plain (the 1 in 100 year flood extent);

Response: No development within the 1 in 100 year flood plain and the development will be visually buffered by the regeneration project.

iv. No development is to occur within 100m of any osprey nest, access roads may encroach within 100m, but no closer that 70m;

Response: No longer applicable as nest stag has fallen down.

v. Any high value and very high value vegetation communities identified in Council's Vegetation Strategy within 100m of Solitary Islands Marine Park are to be protected.

Response: The high value vegetation is being conserved and rehabilitated.

vi. All high value and very high value vegetation identified by council's Vegetation Strategy with the low level of disturbance is to be protected;

Response: only areas outside of the high value area and habitats with high levels of disturbance are to be developed.

vii. Known Wallum Froglet habitat is to be protected;

Response: The site is not known as wallum froglet potential habitat area, however it is described here and by White (2006) as potential wallum froglet habitat but not suitable for breeding. The proposal will increase the area of potential habitat within the reserve buffer for Moonee Creek.

viii. Figure 26 identifies (Hatched area of map) land considered to be subject to significant constraints requiring protection. (Figure 27).

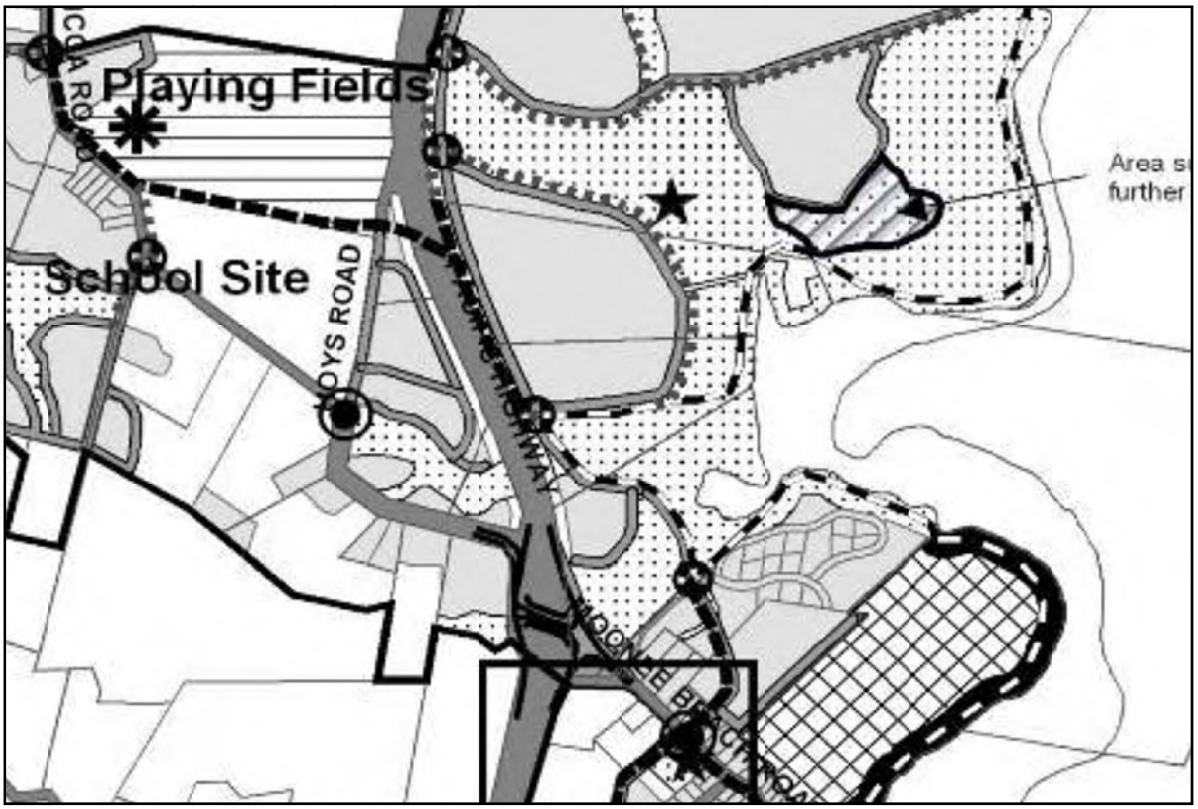

Figure 27. DCP

Response: Our plan generally matches the DCP plan.

ix. All potential wallum froglet habitat areas are to be investigated to accurately map actual habitat;

Response: this has been undertaken and the results show that there is no actual habitat in the impact area, however this does not limit the potential use of the area in the future by the species.

x. Exclude from development, areas of potential high water table where there is likely to be adverse impacts on groundwater or surface water quality;

Response: Refer to Martens Groundwater Report for the subject site.

xi. Land identified as containing regionally significant land is to be protected. Long term management is to be in accordance with Council's Vegetation Strategy;

Response: Not regionally significant land

xii. A minimum 40 m-separation area is to be provided between areas to be protected and future housing area to ensure adequate bushfire protection is able to be provided without the need to remove protected vegetation;

Response: Refer to Bushfire report prepared by Building Code and Bushfire Hazard Solutions for the subject site.

xiii. Any areas that are undevelopable due to the effect of the 40m separation area to be added to the land to be dedicated.

Response: Refer to the EA report prepared by JW Planning.

6.9 Estuary Management Plan for Moonee Creek

i. Improve management of stormwater runoff from Moonee Creek catchment by diverting stormwater runoff through retrofitted detention basins and wetlands, or treatment via other best available technology

Response: Storm water to be re-directed away from Moonee Creek for treatment.

ii. Ensure a suitable emergency response plan is prepared to protect Moonee Creek in the event of spills and accidents on the Pacific Highway.

Response: NA

iii. Revegetation of foreshore areas, which are susceptible to bank erosion, using combination of aquatic macrophytes and terrestrial species.

Response: Revegetation will occur however the areas highlighted on the plan do not include the subject site. Refer to Figure 28 below

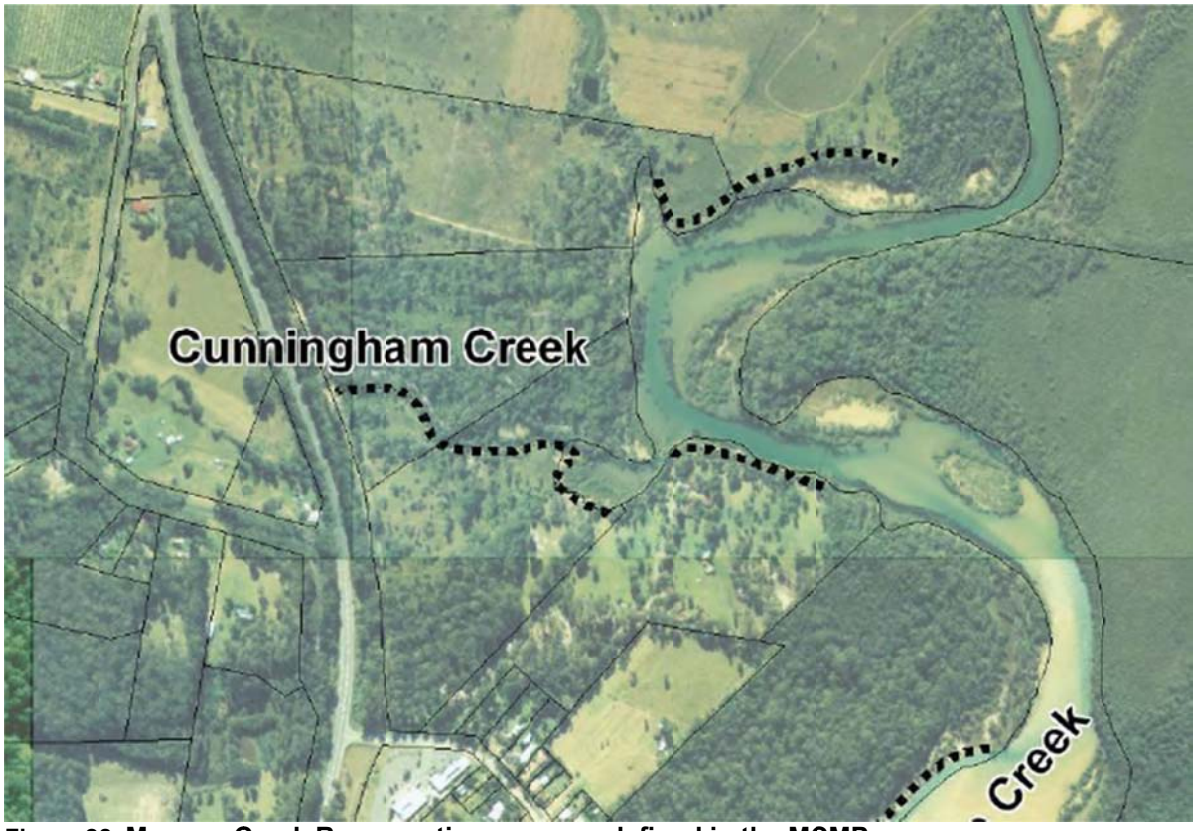

Figure 28. Moonee Creek Regeneration areas as defined in the MCMP.

iv. Infill inappropriate artificial drains that have concentrated flows and caused localised erosion scarps (e.g. in Skinner Creek).

Response: There are several drains on the subject site, these are to be filled in and storm water re-directed away from Moonee Creek.

i. Ensure compliance with sediment and erosion control requirements during construction of new developments, redevelopment of existing sites, and any other works carried out along the foreshore (e.g. revegetation).

Response: Erosion and sedimentation control to be implemented with conditions of approval.

ii. Expansion of existing SEPP-14 wetland boundaries and/or creation of new wetland areas to be include in SEPP-14.

Response: No areas of SEPP 14 wetlands were recorded onsite.

iii. Revegetate foreshores and other degraded areas around the estuary that have been partly or totally cleared of natural vegetation.

Response: see above

iv. Ensure that all new developments are fully sewered.

Response: Development will be sewered.

v. Prepare a new planning instrument to restrict the proximity of development to Moonee Creek foreshores in order to maintain fully vegetated buffers between the development and the sensitive estuarine environments.

Response: N/A.

vi. Modify planning instruments to require all new developments in the catchment to have no net increase of surface runoff and pollutant loads to Moonee Creek. Create formal walking trails and boardwalks around the estuary to limit informal access trials.

Response: N/A.

vii. Control on the types and extent of development that is undertaken within the catchment, ensuring the pristine nature of Moonee Creek is maintained;

Response: N/A

viii. Stabilisation of banks, especially within the entrance;

Response: The regeneration plan will include stabilisation of banks within the site.

ix. Enforcement of recreational uses of the estuary, including current regulations concerning dog walking, and horse riding;

Response: N/A.

x. Removal of inappropriate foreshore structures and possible replacement with alternative bank protection measures;

Response: N/A

xi. Preservation and enhancement of existing riparian vegetation and estuarine habitats

Response: The proposal is consistent with this objective.

6.10 Marine bioregional plan for the Temperate East Marine Region

Key objectives and our response to relative objectives are listed below.

xii. To conserve marine biological diversity and marine habitats by declaring and providing for the management of a comprehensive system of marine parks;

Response: NA

xiii. To maintain ecological processes in marine parks;

Response: This project will foramlize buffer conditions for the marine park

xiv. To provide for ecologically sustainable use of fish (including commercial and recreational fishing) and marine vegetation in marine parks;

Response: NA

xv. To provide opportunities for public appreciation, understanding and enjoyment of marine parks.

Response: NA

xvi. The Marine Parks Act 1997 provides for the creation of marine parks. Once a marine park has been declared, a zoning plan is created to regulate activities within the marine park in a manner that is consistent with the objectives of the Marine Parks Act 1997.
Response: NA

6.10 Commonwealth of Australia (2001) Solitary Islands Marine Reserve (Commonwealth Waters) Management Plan. Environment Australia, Canberra Objectives

i. Management for Conservation of Biodiversity and Maintenance of Ecological Processes: the aim is to ensure maintenance of ecological processes and the protection of the diverse range of habitats within the Solitary Islands Marine Park. Particular emphasis is placed on conserving all marine species that are susceptible to human impacts and are categorised as threatened, protected or endemic;

Response: The offset, buffer and regeneration proposals are consistent with meeting these objectives.

ii. Management for Ecological Sustainable Use: the aim is to ensure that the values of the marine park remain intact for future generations, whilst allowing for particular activities to be carried out. The operational plan provided management actions for the following activities: fishing and collecting, aquaculture, scuba diving and snorkelling, marine mammal watch, boating and personal water craft, beaching and camping activities, and vehicle use;

Response: NA

iii. Management of Indigenous Culture: this ensures the protection of aboriginal sites of significance and ecologically sustainable Aboriginal use of resources;

Response: NA

iv. Management of Non –Indigenous Culture: the aim is to provide protection to shipwrecks and scenic features both above and below the surface, as well as the coastal views. These features were originally deemed to be of national significance and resulted in the Marine Park

being listed on the Register of the National Estate in 1993; and Management of other issues: The aim is to ensure a coordinated and rapid response to incidents within the marine parks, early detection of marine pests, provision of safe moorings and appropriate consideration of development applications;

Response: NA

v. Research and monitoring: The aim is to research and monitor different aspects of the park including bio diversity and ecological processes, Aboriginal and non-Aboriginal cultural and heritage, ecological sustainable use and specific impacts;

Response: NA

vi. Community education and involvement: The aim is to encourage interaction between people and marine flora and fauna without causing harm;

vii. Compliance programs: to ensure that the zones in the Marine Park are used appropriately compliance programs are run to ensure that users understand and comply to the zoning scheme;

Response: NA

viii. Permit system: A permit system is used for regulating activities and operations in the marine park, limiting impacts on particular areas, separating conflicting activities and ensuring that the park is used appropriately by a large number of people. Permit systems also enable data collection;

Response: NA

ix. Management arrangements with Commonwealth: the Marine Parks Authority works with a number of Government Departments under a variety of management arrangements.

Response: NA

x. For each of these categories different management actions have been developed to ensure that the Marine Park is managed effectively.

Response: NA

5.11 The Northern Rivers Regional Biodiversity Management Plan

To achieve the vision, the Plan has set the following eight objectives:

i. To maintain and improve biodiversity and ecological processes by the rehabilitation and management of native vegetation across all land tenures.

Response: Part of the subject site will be rehabilitated and the remaining remnant vegetation will be managed.

i. To identify and mitigate the impacts of threats acting on threatened species, populations and ecological communities.

Response: The main threat identified is to the long term viability of the Moonee Estuary system, which will be buffered by the inclusion of the reserve and the movement of stormwater away from Moonee Creek.

ii. To mitigate the potential impacts of climate change by increasing landscape connectivity across all habitat types and land tenures.

Response: Mitigation of climate change impacts on the site has been taken into account during the master planning stage where reserves and buffers have been designed to accommodate future scenarios.

iii. To provide a basis for a consistent, coordinated and prioritised approach to the recovery of terrestrial, freshwater and estuarine threatened species, populations and ecological communities.

Response: N/A

iv. To improve community awareness and encourage and support landowner and community participation in recovery planning and on-ground activities.

Response: NA

v. To develop partnerships between agencies, organisations, communities and individuals to achieve recovery of threatened species.

- **Response: NA**

vi. To recognise and incorporate cultural values into biodiversity landscape planning and encourage Indigenous engagement.

- **Response: NA**

vii. To contribute to targets, priority actions and outcomes of the *Northern Rivers Catchment Action Plan*, NSW State Plan, federal natural resources management targets, and the NSW *Threatened Species Priorities Action Statements*.

- **Response: NA**

5.12 Coffs Harbour Biodiversity Action Strategy 2012

The parts of the plan that specifically relate to the Moonee Bach area include:

i. The Moonee corridor is fragmented by the settlement of Emerald Beach and clearing associated with Moonee Creek. However, it still supports important remnant coastal heaths, wetlands, Swamp Sclerophyll Forest EEC and forest areas that are known to support threatened species.

Response: Our results agree with this management statement. The plan to retain those communities that are important and to regenerate those to achieve a higher ecological value is part of the proposal.

ii. An important Voluntary Conservation Area supports a population of the nationally endangered Giant Barred Frog.

Response: This is area is to the south of the subject site where rainforest and drainage corridors within forest are present. There is no habitat onsite and the proposal will not impact on such habitats.

iii. A potentially important Koala population may also persist in the western part of the area

Response: Koala was the southern limit of Lot 6 to the south of the site. It is likely that this individual was at the northern limit of the local habitat area, as no further records were made in two years of survey on the site. A resident population resides to the south east of

the site with its core area approximately 2 kilometres away. Regardless, the proposal will retain habitat and regenerate to improve conditions.

The Wallum Froglet, Common Planigale, Squirrel Glider, Grey-headed Flying-fox, Common Blossom-bat and Osprey have all been recorded.

Response: Habitats for each of these species will be conserved and improved.

iv. Part of the area is mapped as a Regional Priority Conserve and Repair Area in the Northern Rivers Regional Biodiversity Plan

Response: The proposal retains all areas of significant vegetation and plans the regeneration of degraded habitats.

v. The largest estuaries are in Coffs, Bonville and Pine creeks in the south, and Moonee, Corindi and Saltwater creeks in the north. These estuaries provide important habitat for a variety of waders, shorebirds, fish, crustaceans, other invertebrates, and marine and estuarine vegetation. Estuaries are also significant for recreational fishing and the commercial fishing industry.

Response: The proposal will not remove habitat for any of these issues and the objective is to regenerate to improve these habitats.

5.13 Comprehensive Koala Plan of Management

The aim of this plan is to:

i. Provide a framework for the conservation and management of koala habitat and the management of threat to koalas,

Response: The CKPOM identified the subject site as secondary habitat and cleared areas as non-koala habitat. The proposal plans to retain the areas of secondary habitat with the exception of proposed clearing of trees within the western part of the site. The area mapped in the CKPOM is largely devoid of trees, a major part of this proposal will include the rehabilitation of this with known koala feed trees, the enforcement of traffic rules that reduce risks to koala be the implementation of a koala traffic management plan. Backyard pools will be fenced with koala proof fencing.

ii. To ensure a permanent free-living population over their present range in Coffs Harbour LGA;

Response: The subject site provides habitat for the local population and based on koala records and mapping there is a viable local population. The limitations, whilst not completely deleterious are the Pacific Highway to the west that whilst providing crossing points, they are limited and urban development to the north (Glades Estate) The vegetation to the south of the subject site provides habitat that is both connected and in better condition than the subject site. Refer to Figure 29.

iii. Reverse the current trend of koala population decline. The Plan of Management applies to all land within the Coffs Harbour LGA.

Response: the current decline of koala requires intervention; however, this proposal will be removing some areas that have been identified as secondary habitat and replacing areas that area cleared with feed trees. How this influence trends for the population is not clear, however any loss of habitat must be seen as a negative and any plus (such as the planting proposed here) must be seen as a positive.

Figure 29. Koala habitat quality recorded on site. Red lines are cleared areas with no koala habitat. Green lines is forest with some habitat but little to none (at some localities) of known koala feed trees, blue lines include known koala feed trees and in some localities they are the dominant trees. Also this blue area has greater density of larger trees with established understorey, is largely in the lower and far eastern half of this area (as can be seen by the aerial). The small red square identifies were a Koala was recorded 2 years ago. The pink line roughly identifies the boundary for the reserve area. Red polygon = lot 1 and Blue polygon = Lot 6.

Section E - Legislative and Planning Requirements

6.0 Relevant Planning and Legislative Considerations

6.1 EPBC Act1999

The Commonwealth Environment Protection & Biodiversity Conservation Act, 1999 (EPBC Act) provides for the need for the approval of the Commonwealth Environment Minister for all actions that will or are likely to have a significant impact on a matter of national environmental significance (MNES).

A 'significant impact' is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts. You should consider all of these factors when determining whether an action is likely to have a significant impact on matters of national environmental significance.

Koala is the main species identified through this report that could potentially be impacted by this activity. It is recommended that a referral be made to the Minister based on its potential for harm. Nonetheless, based on the national plan for koala, interpretation of the impact assessment guidelines and the habitat onsite it is unlikely that this action would become a controlled action under the provisions of the EPBC Act 1999.

6.2 Environmental Planning and Assessment Act 1979

The EP&A Act provides a framework for the assessment of activities which are likely to impact on threatened species, populations or ecological communities as listed pursuant to the TSC Act. It also requires that all relevant threat abatement plans and recovery plans are considered. Where an impact is deemed likely following an assessment pursuant to s.5A of the Environmental Planning and Assessment Act 1979 (EP&A Act), it is necessary to prepare a species impact statement (SIS).

The following EPA Act species are to be impacted by the proposal:

- **Koala**
- **Squirrel glider**
- **Glossy-black Cockatoo**
- **Osprey**

Mitigation is required. See above and discussion for mitigation measures and the recommendations related to the implementation of such measures. If these recommendations cannot be achieved or the proponent does not wish to undertake these actions, then the impacts on these species could become significant.

6.3 State Environmental Planning Policies

6.3.1 SEPP 14 – Wetlands

State Environmental Planning Policy 14 - Coastal Wetlands (SEPP 14) was introduced to protect coastal wetlands in New South Wales (outside of the Sydney Metropolitan area). Any activity involving filling, draining, levee bank construction or clearing in a wetland shown on one of the SEPP 14 maps is designated development under the EPA Act. An EIS is required to be prepared for all designated

development. This would, subject to clarification of the application of the new State planning reforms, require consent by council and concurrence of the Director-General of Department of Planning under Part 4 of the EPA Act.

Where an impact on a SEPP 14 wetland is unavoidable, it would be expected that this impact would be compensated by, for example, rehabilitation of a nearby degraded wetland, reservation of an area of land containing wetlands, enhancing the management of an area of wetland, etc.

No such wetlands in the vicinity of the site.

6.3.2 SEPP 26 – Littoral Rainforest

State Environmental Planning Policy 26 – Littoral Rainforest was introduced to provide a mechanism for the consideration of applications for development that is likely to damage or destroy littoral rainforest areas with a view to the preservation of those areas in their natural state. This policy applies to:

- Land enclosed by the outer edge of the heavy black line on the series of maps held in the Department and marked "State Environmental Planning Policy No 26—Littoral Rainforests (Amendment No 2)", and
- Land not so enclosed but within a distance of 100 metres from the outer edge of that heavy black line except residential land and land to which State Environmental Planning Policy No 14—Coastal Wetlands applies.

If development that requires the consent of the council by virtue of clause 7 (1) is State significant development, the consent authority is the Minister (as provided by the Act) and the concurrence of the Director or Minister is not required, despite anything to the contrary in the policy.

Moonee headland has good examples of littoral rainforest; however this is removed from the subject site.

6.3.3 Comprehensive Koala Plan of Management

The consent authority shall not grant consent to the carrying out of development on areas identified as Secondary Koala Habitat which will remove the following tree species: Tallowwood *Eucalyptus microcorys*, Swamp Mahogany *E. robusta*, Flooded Gum *E. grandis* (except when part of a forest plantation), Forest Red Gum *E. tereticornis*, or Small fruited Grey Gum *E. propinqua*, unless the development will not significantly destroy, damage or compromise the values of the land as koala habitat. In assessing an application the consent authority shall take into consideration:

i. that there will be minimal net loss of Secondary Koala Habitat;

Response: the number of trees proposed for removal will be replanted within the reserve area. This replanting will entirely include known koala feed trees.

ii. the level of significance to koalas of the trees proposed to be removed;

Response: Low level koala population recorded in the local area to the south of the site using small number of Swamp Mahogany . No large or extensive areas of habitat present.

iii. the number of trees proposed to be removed in relationship to the extent and quality of adjacent or nearby Primary and/or Secondary Koala Habitat;

Response: There are potentially 50 trees that could be used by koala in the subject site. The proposal will likely remove half of these trees. Land to the south of the site includes area of swamp mahogany forest that link to areas around Moonee Creek reserve that

include large areas of swamp forest. This removal is small by comparison to the local area habitat.

iv. the threats to koalas which may result from the development.

Response: the proposal will not isolate habitats or disturb any corridors. Traffic will be controlled. The key threat is the loss of habitat which will be replaced in full within the reserve.

v. all other options for protecting koala trees as listed above; and,

Response: SEE ABOVE

vi. the impacts to existing or potential koala movement corridors;

Response: the proposal will not isolate habitats or disturb any corridors.

vii. whether the land is accredited under the *Timber Plantation (Harvest Guarantee) Act 1995*

Response: na

The consent authority shall not grant consent to the carrying out of development in areas identified as Secondary Koala Habitat unless it is satisfied that:

viii. the proposal will not result in significant barriers to koala movement;

Response: Correct the design has included a wide (up to 250m wide) corridor that will include known koala feed trees

ix. boundary fencing does not prevent the free movement of koalas;

Response: within the reserve area fencing will be limited and when used it will allow free movement of koala

x. lighting and koala exclusion fencing is provided where appropriate on roadways adjacent to koala habitat;

Response: at the edge of the reserve koala proof fencing will be used to keep koala from the road network.

xi. tree species listed above under Secondary Koala Habitat are retained, where possible;

Response: The majority of secondary koala habitat is retained.

xii. new local roads are designed to reduce traffic speed to 40 kph in potential koala blackspots;

Response: This has been achieved.

xiii. preferred koala trees are used in landscaping where suitable;

Response: this has been achieved.

xiv. threats to koalas by dogs have been minimised ie. banning of dogs or confining of dogs to koala proof yards;

Response: Lot owners with dogs will require koala proof yards.

xv. fire protection zones, including fuel reduced zones and radiation zones, are provided generally outside of Secondary Koala Habitat.

Response: See bushfire report

This proposal includes the removal of secondary koala habitat. This proposal is however balanced and is consistent with the CKPOM.

6.4 Threatened Species Act

The TSC Act provides a framework for the listing and declaration of threatened species, populations, endangered ecological communities, key threatening processes and critical habitat. It also provides a framework for the preparation and implementation of recovery plans and threat abatement plans and for licensing. This Act also allows for the implementation of offsets through the Biodiversity Certification process.

A number of significant species and ecological communities are known or predicted to occur within the regional and local area (approximately 10 kilometres). A search of a number of databases, including Plantnet (NSW Botanical Gardens), Wildlife Atlas (OEH), Matters of National Environmental Significance (Department of Environment and Heritage) was conducted. Search results are contained in Appendix 3.

This proposal as reported in this report is likely to have impacts on four threatened species. The assessment of these key impact species is known below by means of the 7-part test.

6.4.1 Koala Phascolarctos cinereus 7-Part Test

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

Notwithstanding the definitive appearance of this species, making observations of the free-ranging Koalas can be difficult. This is in part due to the cryptic nature of the species and the large and complex home ranges that individuals occupy 100 hectares plus (White 1990). The species is identified as a species in decline and there are many intricate factors that limit free-ranging Koala populations, including food tree preferences, history of disturbance, and Chlamydia infection, all of which make longer-term population trends of many populations difficult to predict (Phillips 2000).

Evidence of tree use by Koalas and, therefore, the presence of Koala are generally determined by faecal pellets counts. Studies conducted by Phillips (2000) in the Coffs Harbour local government area showed that 10 Eucalyptus species and 9 species of non-eucalypt were utilised by Koalas in that area. Significant variation in the levels of utilisation amongst and between different tree species was reported. Even though it has been suggested that faecal pellet counts can determine preferred tree usage and indicate a reliance on particular dietary species (Phillips 2000), others consider it an unreliable indicator of tree preference (Ellis et al 2002). Nonetheless, determining usage of a site by Koalas irrespective of individual tree preference is best determined by surveys that concentrate on faecal pellet counts.

Previous surveys

Surveyor	Effort	Results
Phillips *et al* 2000	Surveyed 3,000 trees	Found ten Eucalypt species and nine Non-Eucalypt species that were used by koala
Lunney 1999	Surveyed 2,000 trees	Found that *E. robusta* and *E. parramattensis* were the preferred feed tree of the species

Koalas have been recorded to occur at different densities within different habitats, the densities differences indicate that habitat quality may affect demography. In a major study conducted on the Tomago Sandbeds, Phillips et al. (2000) reported a mean activity level of 32.41% ±4.0% in addition to percentage equivalent strike-rates of 55.5% ±3.6% and 53.6% ±3.1%, respectively, for the preferentially utilised tree species E. robusta and E. parramattensis. Moreover, it has been generally acknowledged that, within a particular area, only a few of the available Eucalyptus species will be preferentially utilized while others, including some non-eucalypt genera, which appear to be browsed opportunistically or used for other behavioural purposes (Lee and Martin 1988; Lee and Carrick 1989; Phillips 1990; Pahl and Hume 1990; Hindell and Lee 1990).

The Management of habitat for populations requires the prevention of three main habitat impacts, habitat loss, fragmentation, and degradation. Net loss of habitat and habitat fragmentation permanently decreases carrying capacity, and although dispersal in the koala has been shown to be unhindered by isolation of habitats (Ellis 1999), the development of physical barriers to movement and an increased risk of harm from aggressors do negatively impact on the viability of a population. Fragmentation has two main effects, first it is likely to hinder dispersal, thus reducing the chance of re-colonising in a meta-population, secondly, adverse processes such as edge effects including, fire, dogs, weeds and cars increase. To access the likely effects of management actions one needs to know the current status of the Koala population and to model the effect of particular management scenarios.

Koala survey methods were adapted from those of Phillips (2002). This approach allows the estimation of activity levels based on the percentage of trees with scats present. Our survey comprised two stages. The first involved the locating of likely habitat trees and their searching. Any tree found to have scats present was flagged and further searches where conducted in other areas removed from the vicinity of this tree. Return surveys were conducted on previously identified areas of Koala activity, thus focusing our efforts on areas of high activity. The closest 30 trees around these identified trees were searched for scats. All tree species were recorded, as was the location of the plot. Scats were compared to reference pellets to ensure correct identification. The only deviation from this method was in the vegetation dominated by Paperbark, were no koala pellets could be found. Within these sites several searches were conducted in the absence of any use by koala.

Koala activity was recorded by the spot assessments. In total, 90 trees were surveyed during this census and a mean strike rate of 10.2% see Table 27 and Figure

Table 27. Koala pellet survey results

Site type	Fauna Survey Site	Scat search conducted	Evidence of Koala	Koala activity level (%)	Activity within Impact area
Reserve Area and land of the development site	1 Y		y 25		No within reserve
	2	N	N	0	No
	3 Y		y 14		No within reserve
	4	Y	y	21	No within reserve
Impact Area	5 Y		N 0		No within reserve
	6	Y	N	0	No
	7 Y		N O		No
	8	Y	N	0	No
	9 Y		N 0		No

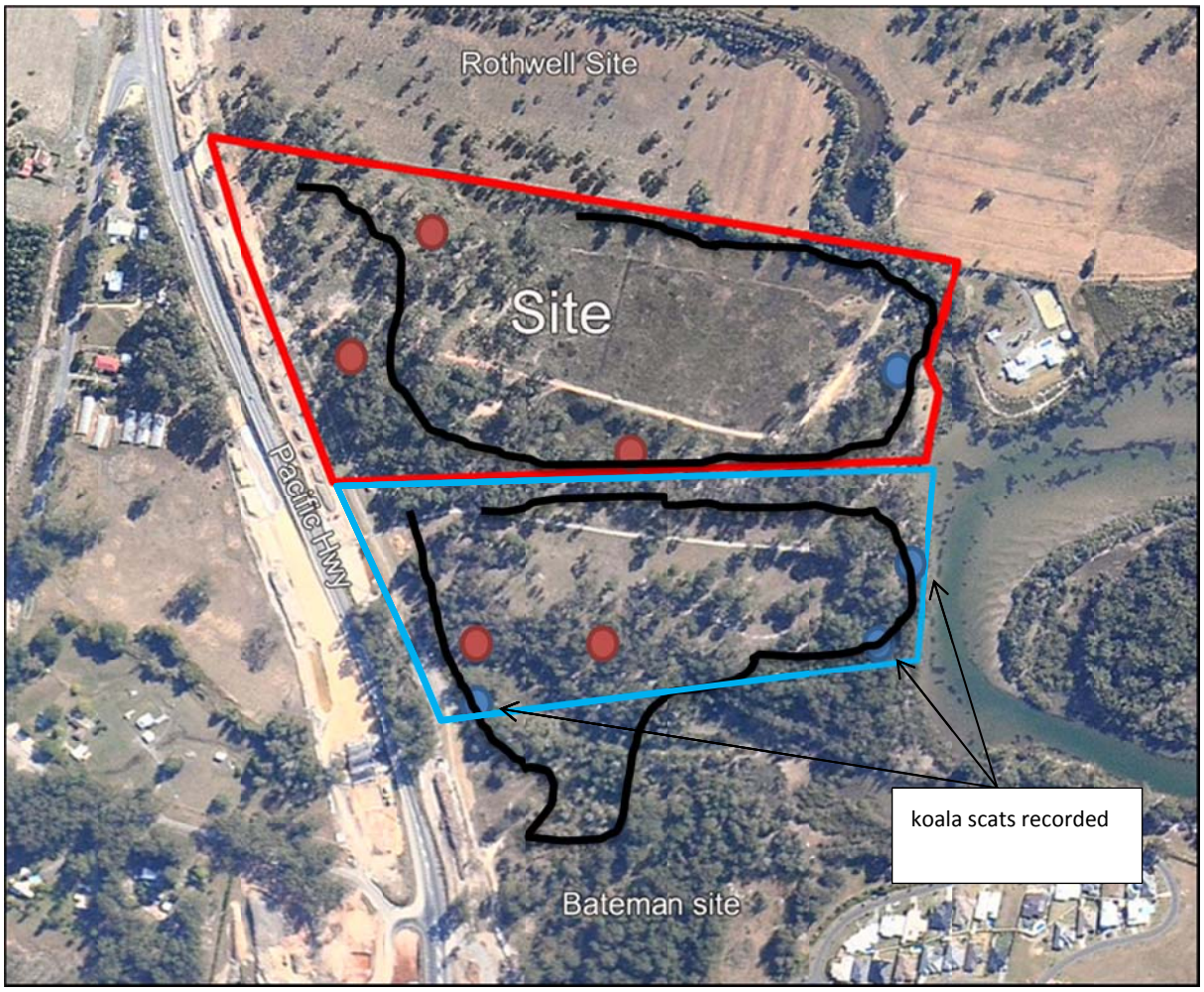

Figure 30. Koala survey sites. The Red dots are locations within the impact area that the surrounding 30 trees were searched for evidence of koala, the blue represent the same searches within the proposed reserve areas of the site. The black lines represents transects (meanders) that were undertaken within the site in search of evidence of koala. This involves searching for scats under trees as one moves around, looking for some evidence of koala. When evidence is found the intensive survey is undertaken. In the absence of evidence, koala scat plots are undertaken in an area where healthy, mature trees are present. The low lying parts of the site (Blue dots) showed some evidence of koala. In the more elevated parts of the site (red dots) there was no evidence of koala

As a less mobile species, geographical and human-made barriers, including large areas of cleared land and busy wide highways, can limit movement of Koala. Thus the contemporary distribution of Koalas can be seen as a series of local populations in areas of good habitat separated by human settlements, farmland and large geographical barriers, such as Coffs Harbour (see fig 7). However, Ellis et al (2002) has shown that current theories of the spatial extent of local Koala populations may be underestimating the breeding dynamics of the Koala, and siring capabilities of transient males.

Given, the fragmented nature of vegetation in the local area, especially and the separation of the National Park reserves in the west by the Pacific Highway, and the difficulty of defining local population, we consider that, the Koalas occurring on site and in the North and to the south (and likely beyond) to be part of the local population (~2000ha). This spatial distribution puts the individuals using the site within the bounds of this local population and given the planned maintenance and development of corridors in the study area; we believe the individuals recorded are not considered at risk of isolation from the local population. The Comprehensive Koala Plan of Management (Coffs

Harbour Council 2002) has identified the habitats onsite as secondary habitats, which by definition requires the minimal amount of tree loss in an area.

Given the above factors, it is considered that the proposed activities **will not** disrupt the lifecycle of a viable local population or **will not** place this species at risk of extinction if the reserve habitats can be regenerated consistent with a detailed restoration plan specifically for Koala.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

This factor applies a similar test as in factor (a) to endangered populations.

(c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be removed or modified as a result of the action.

Not applicable to Koala.

ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable to Koala.

(d) In relation to the habitat of a threatened species, population, or ecological community:

i. The extent to which habitat is likely to be removed or modified as a result of the action proposed.

The proposed activity will result in the removal of pasture with scattered trees in the impact site, identified here as marginal habitat.

ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

Based on the small scale of impact (<20 0 large trees) the potential habitat is unlikely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The importance of the habitat to be removed is considered moderate. The density of trees within the sites is not likely to preclude movement of Koala; however there is a conserved corridor with known koala feed trees that can be used to transverse the local area. Therefore, the proposal **will not** isolate individuals or fragment habitats.

(e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No such habitats have yet been gazetted for Koala. The proposal will not remove any habitat that will directly impact on this species to maintain its lifecycle within the locality.

(f) Whether the action proposed is consistent with the objectives or actions of a recovery or threat abatement plan.

A recovery plan has been prepared for this species by OEH. This assessment is consistent with the objectives of this plan.

(g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

None of the 34 'key' threatening processes listed under the Threatened Species Conservation Act apply to the proposed actions on these sites. The NSW OEH have identified that the following processes are affecting this species:

- Human-induced climate change;

Response: Not applicable.

- Loss, modification and fragmentation;

Response: The action will result in the loss of ~200 large trees some of which were identified as koala feed trees. This removal will not isolate habitats or impact on individuals by fragmentation.

- Predation by feral and domestic dogs;

Response: This is a risk under residential occupation and requires management plans to take into account predation risks to koala and if required limit pets within the entire or parts of the estate.

- Intense fires;

Response: Bushfire management plan will be implemented within the reserve area.

- Road kills.

Response: This is a risk under residential occupation and requires management plans to take into account road kill risks to koala and if required limit speeds and implement warning signs within the entire or parts of the estate.

The proposed action is not considered to constitute a threatening process, nor is it considered to contribute to the increased impact of a threatening process.

6.4.2 Petaurus norfolcensis Squirrel Glider 7-Part Test

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

Squirrel Glides are known to occur within a variety of woodlands and forests containing an over storey of winte r flo wering species such a s Spotted Gu m (Corym bia maculata), Swamp Mah ogany (E. robusta) and Forest Red Gum (E. tereticornis) (Smith and Murray 2003). Where a suitable over storey isn't availa ble they are known to o ccupy wo odlands a nd fo rests c ontaining suitable un derstorey of gum pro ducing aca cias p articularly pin nate leaved species or fo rests/woodlands containing a mix o f resources which provide winter and autumn flowering mid storey sp ecies such a s ba nksias (B . integrifolia, B . spinul osa, B. serrata, B . aemula) in asso ciation with sprin g a nd summe r f lowering eucalypts like Scribbly g ums and Smooth-barked Apple or sap fed tree s like Bloodwoods (Smith and Murray 2003).

Squirrel gliders generally prefer a more open forest compared to the habitats utilised by Sugar gliders and are ge nerally o bserved mo re f requently in th e upper can opy (Jackson 2000). Typically have a home ran ge of between 4 -8 hectares but home range a nd group structure can be i nfluenced by habitat quality and drought (Sharp 2004), particularly flowering intensity as this will influen ce breeding potential (Goldingay et al. 2006; Goldingay & Sharp 2004; Quin 1995).

Squirrel Gliders live in fami ly group s of a singl e adult male one o r more a dult females a nd offspring. Require abundant tree hollows for refuge and nest sites. Diet varies seasonally and consists of Acacia gum, e ucalypt sa p, ne ctar, ho neydew and m anna, with inve rtebrates and poll en p roviding protein (DEC 2006b). Gliders have been observed to glide 30 metres (Jackson 2000).

A small a rea of habitat was recorded within the subject site, wh ich m ay incl ude b reeding habitat. Given this area of habitat, the removal of these resource s **will not** reduce the viability of Squirrel glider in the l ocal area, to a deg ree that could put the local population at ri sk of extinction if a dequate mitigation is not proposed.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

This factor applies a similar test as in factor (a) to endangered populations.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be removed or modified as a result of the action.

Not applicable to Squirrel Glider.

ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable to Squirrel Glider.

(d) in relation to the habitat of a threatened species, population, or ecological community:

i. The extent to which habitat is likely to be removed or modified as a result of the action proposed.

The proposed activity will result in the removal of 3ha of a pasture with scattered trees in the impact site, identified here as marginal habitat.

ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

The proposal will not contribute to the cumulative loss of habitat and the increased fragmentation or isolation of habitat.

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

It is currently difficult to quantify the importance of the habitat, however the foraging records made nightly during these surveys indicate that the species utilizes the site occasionally. Given the small scale of removal it is predicted that this would not constitute a loss of significant habitat.

(e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No such habitats have yet been gazetted for Squirrel Glider.

(f) Whether the action proposed is consistent with the objectives or actions of a recovery or threat abatement plan.

NSW DEH has identified 9 PAS actions to help with the recovery and amelioration of threats on this species. These include:

1. Control feral horses at relevant sites to promote retention and growth of mid-storey shrubs;
2. Prepare EIA guidelines which address the retention of hollow bearing trees maintaining diversity of age groups, species diversity. Give priority to largest hollow bearing trees;
3. Ensure the largest hollow bearing trees (including dead trees) are given highest priority for retention in PVP assessments and other environmental planning instruments, or other land assessment tools;
4. Investigate the effectiveness of logging prescriptions;
5. Prepare a recovery plan for the Squirrel Glider;
6. Conduct surveys and assessments of less known sites to confirm presence of species and negotiate, develop and implement conservation management agreements for high priority sites;
7. Delineate boundaries of population to identify the extent to which populations are interconnected (to determine propensity to move across cleared land);
8. Conduct surveys on the Far South Coast, from Murramarong National Park south to Eden, to determine population size and extent and connectivity of populations (surveys should incorporate potential habitat on public as well as private land); and
9. Model and predict the distribution of Squirrel Gliders across the south west slopes.

In terms of this project, the actions this document will contribute are points 6,7 and 8.

(g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed action will only constitute minor vegetation modification and loss. While minor, these actions are likely to contribute, albeit not in a significant manner to the following key threatening processes.

- Native vegetation clearing; and
- Anthrop ogenic climate change.

The NSW DEH have identified that the following threatening processes are acting upon this species:

- Loss and fragmentation of habitat.
- Loss of hollow-bearing trees.
- Loss of flowering understorey and midstorey shrubs in forests.
- Individuals can get caught in barbed wire fences while gliding.

The proposed action will not impact upon any of the threatening process identified by DEH. The modification of already disturbed forest is unlikely to impact on any habitat utilised by this species.

6.4.3 Calyptorhynchus lathami Glossy Black-cockatoo 7-Part Test

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

Occur in wo odlands or op en scl erophyll forests dominated by E ucalypts or An gophora with a mid-stratum do minated by Alloca suarina species. Roo st communally in the cano py of tall leafy eucalypt trees usually less than 1 kilometre from feeding site, or within 30 metre s of nest site during breeding period.

Nests in eucalypts in hollow limbs or trunk hollows in either dead or living trees. Nest is predominantly located in wo odlands in trees that are locate d in small clearings surrounded by low casuari na forest near water.

Forage a rboreal amo ng t he bran ches of Alloca suarina u pon which it is dependent for foo d. They prefer foraging on mature sparse trees between 2 and 10 metres tall. Feed in small groups of up to 3 birds and only come down to the ground to drink.

A small area of proven foraging ha bitat was recorded within the subject site. Given the small area of habitat re corded on th e si te, the remov al of these resources **will not** reduce t he viability of Glossy Black Cockatoo in the local area, to a degree that could put the local population at risk of extinction.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

This factor applies a similar test as in factor (a) to endangered populations.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be removed or modified as a result of the action.

Not applicable to Glossy Black Cockatoo.

ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable to Glossy Black Cockatoo.

(d) in relation to the habitat of a threatened species, population, or ecological community:

i. The extent to which habitat is likely to be removed or modified as a result of the action proposed.

The proposed action **would** result in the loss of 15 trees that provide habitat from the subject site.

ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

The proposal will not contribute to the cumulative loss of habitat and the increased fragmentation or isolation of habitat.

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

It is currently difficult to quantify the importance of the habitat, however the foraging records made during these surveys indicate that the species utilizes a small area of the site occasionally. Given the small scale of removal it is predicted that this would not constitute a loss of significant habitat.

(e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No such habitats have yet been gazetted for Glossy Black Cockatoo.

(f) Whether the action proposed is consistent with the objectives or actions of a recovery or threat abatement plan.

NSW DEH has identified 5 PAS actions to help with the recovery and amelioration of threats on this species. These include:

1. Increase landholder and public awareness and interest in Glossy Black Cockatoo conservation and habitat management;
2. Utilise the Glossy Black Cockatoo as a flagship threatened species for woodland and forest conservation education and awareness programs;
3. Develop/encourage strategic planning approach for Glossy Black Cockatoo at the local and regional level;
4. Periodically review IFOA prescriptions to ensure adequate protection of nesting and foraging habitat;
5. Prepare and distribute EIA guidelines to decision makers;
6. Provide incentives for landholders to fence and manage key sites;
7. Assist landholders who wish to enter into voluntary conservation agreements at key sites;
8. Encourage the restoration of foraging habitat that has been cleared or degraded by previous impacts;
9. Continue existing monitoring programs (e.g. Goonoo population) and encourage other community groups to develop a monitoring program of local populations; and

10. Identify and map key breeding and foraging habitat, similar to the mapping done by Robinson (2004) at St Georges Basin.

In terms of this project, the actions this document will contribute are points 8, 9, and 10

(g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed action will constitute removal of vegetation. While minor, these actions are likely to contribute, albeit not in a significant manner to the following key threatening processes.

- Native vegetation clearing; and
- Anthropogenic climate change.

The NSW DEH have identified that the following threatening processes are acting upon this species:

- Loss of tree hollows.
- Excessively frequent fire which reduces the abundance and recovery of she-oaks and also may destroy nest trees.
- Illegal bird smuggling and egg-collecting.
- Reduction of suitable habitat through clearing for development.

The proposed action will not impact upon any of the threatening process identified by DEH. The modification of already disturbed forests is unlikely to impact on any habitat utilised by this species.

6.4.4 Pandion cristatus Osprey 7-Part Test

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

Osprey occurs in coastal water bodies, such as lakes, lagoons, estuaries, rover mouths and upstream environments. Usually found in clear water habitats were it can hunt for fish. Within NSW it is known to occur commonly along the north coast but limited from the lower mid-north coast down to Newcastle. Site in lower mid north coast?

Breeding sites are always dead trees along or near watercourses with the nest placed in the fork or horizontal limb of eucalypt. The same nest could be used in successive years or a new nest built in the same tree or very close by (within 200m).

Generally observed on their own, but can be seen as pairs during the breeding period. Osprey was observed roosting onsite during surveys and a nest tree was previously established on the adjoining block (to the north); however it fell during a storm in 2011.

Given the small area of limited habitat potential of the site, the removal of these resources **will not** reduce the viability of Osprey in the local area, to a degree that could put the local population at risk of extinction.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

This factor applies a similar test as in factor (a) to endangered populations.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be removed or modified as a result of the action.

Not applicable to Osprey.

ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable to Osprey.

(d) in relation to the habitat of a threatened species, population, or ecological community:

i. The extent to which habitat is likely to be removed or modified as a result of the action proposed.

The proposed action **would** result in the loss of 1.8 hectares of potential marginal habitat from the subject site.

ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

The proposal will not contribute to the cumulative loss of habitat and the increased fragmentation or isolation of habitat.

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

It is currently difficult to quantify the importance of the habitat, however the foraging records made nightly during these surveys indicate that the species utilizes the site occasionally. Given the small scale of removal it is predicted that this would not constitute a loss of significant habitat.

(e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

The proposal would not have any adverse effect on critical habitat. There is a capacity for critical habitats to be gazetted under the Threatened Species Conservation Act 1995. No such habitats have yet been gazetted for Osprey.

(f) Whether the action proposed is consistent with the objectives or actions of a recovery or threat abatement plan.

NSW DEH has identified 3 PAS actions to help with the recovery and amelioration of threats on this species. These include:

1. Identify and protect nest trees, and monitor reproduction;
2. Ensure implementation of management strategies that reduce disturbance of riparian areas; and
3. Liaise with local field ornithologist to obtain data on the Osprey in the area.

PAS actions require individuals to where possible identify actions to which they can contribute. In terms of this project, the actions this document will contribute are points 1, 2.

(g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed action will only constitute minor vegetation removal. While minor, these actions are likely to contribute, albeit not in a significant manner to the following key threatening processes.

- Native vegetation clearing; and
- Anthropogenic climate change.

The NSW DEH have identified that the following threatening processes are acting upon this species:

- Clearing, logging, burning, and grazing of habitats resulting in a reduction in nesting and feeding resources.
- Disturbance to or removal of potential nest trees near watercourses.
- Illegal egg collection and shooting.

The proposed action will not impact upon any of the threatening process identified by DEH. The modification of already disturbed road corridors is unlikely to impact on any habitat utilised by this species.

Section F - Management

7.0 Management of Construction and Operation Impacts from Proposal

7.1 Introduction

Management regimes are very important to maintain the ecological processes that support the health and condition of remnant vegetation and fauna habitat resources. Management regimes should be incorporated into management plans, so the implementation of management regime can be organised and conducted adequately. Management plans that may be required for a remnant bushland area include: bushfire management plans; sediment and erosion control plan, archaeological management plan, restoration plans, weed management plans and threatened species management plan. Effective management plans requires that there is adequate monitoring to identify management issues as they arise. Without the monitoring of ecological issues, effective management is unable to be determined..

7.2 Proposed General Management Recommendations

All activities on land s ai m to conserve, monito r and man age ecolo gy in the area p ursuant to development consent conditions and environmental management plans. As a minimum the following should be considered as the future ecological management actions for the site:

i. Placing of felled trees between areas of remnant bushland to provide runways of ground cover for the dispersion of animals;

ii. Supplementary planting of locally occurring native species (using local provenance) in landscape areas;

iii. Introduction of additional nest/roost boxes (>40);

iv. Development of a clearing management plan by an experienced ecologist;

v. Development of a restoration plan by a suitably qualified ecologist;

vi. Development of a best-practice erosion and sediment control plan.

vii. Provide appropriate stormwater and nutrient control systems designed to reduce the effects of runoff and ensure water flowing from the site does not enter Moonee Creek directly and when it does get there it is of a suitable “best practice” quality.

viii. The construction site should be managed to ensure that there is no accidental incursions into wetlands or any other areas which are not subject to the proposal.

ix. Any landscaping associated with the proposal including street trees, should comprise endemic native plants and where possible these should be sourced from local seed stock to ensure that genetic viability is maintained.

x. Where possible suitable tree hollows removed from the Subject Site should be re-erected to retained forests on the subject site. In addition to this, supplementary habitat (nest boxes) should be installed to mitigate the loss of hollows which are unable to be re-erected. Hollows which cannot be re-erected should be placed on the ground within the retained forests on the subject site to provide habitat for terrestrial fauna.

xi. A suitable structure that is proven for nesting of Osprey should be constructed within the buffer zone.

xii. Glossy Black Cockatoo and Squirrel glider feed tree species should be planted within the buffer area and as street trees.

xiii. Dogs and swimming pools should be prohibited from the estate;

xiv. A traffic management plan for koala should be established

xv. The vegetation being retained on the subject site should be effectively managed to enhance and maintain the ecological integrity of this area.

xvi. The regeneration plan of the site should include habitats for koala, squirrel glider, glossy-Black Cockatoos and Osprey;

xvii. The approval and implementation of the restoration plan including a bond should be in place prior to the release of construction certificates.

xviii. The reserve habitats will be re generated consistent with a detailed restoration pla n specifically for Koala.

Management recommendations which are specific to the reserve area to be created as per the DCP:

1. That all phy sical structures that can be removed from the reserve area are removed a nd placed within the development footprint;
2. Structures th at are ma n-made "n atural" stru ctures, e.g. swales and detentio n basins mu st meet the like-for like test of the ecological communities being created;
3. These struc tures should also be a shape that d oes not p revent the moveme nt of org anisms through the corridor; ideally, these structures will be linear running north-south, thus, allowing for the creation of a continuous forested corridor.

Management recommen dations which are sp ecific to th e reserv e area and Buffers for Wetlands

1. The edge shall be a mix of hard and soft natural and made-made structures of a width at least 4 metres wide that effecti vely limits acce ss by means of deterrence and visual interference, that is, "a way in" cannot be seen.
2. No storm water o r landfall (diffuse) flow should pass from th e site across this boundary. To prevent this on the eastern edge of the perimeter road a high er swale will direct flow into the storm water system away from the edge.
3. There will be no "garden" edg e to the boundary and thi s area can only be maintained by regenerators. Maintenance by mowing and slashing can only occur beyond the edge.
4. The restoration design and regeneration prog ram within the rese rve must inclu de details of edge management and design, specifically targeting the minimization of movement across the barrier, including humans, nutrients, and water.
5. Vegetation establishment within the re serve must focus on limiting movement and providing fauna habitat, not to provide visual amenity for residents.
6. Once the rehabilitation is established it shall be managed by ongoing physical maintenance for a period of 5 years consistent with an approved restoration and management plan.

Management recommendations which are specific to creation of Wallum froglet habitat

1 The wetland is designed to develop and maintain a pH of between 4 and 5.5 pH;
2 The wetland is designed so that the water level is influenced by groundwater movements;
3 There is access (creek imputes) to Dissolved Organic Matter from upland terrestrial forests, this is key to maintaining the water chemistry. The current placement of the wetland within the reserve follows this principle;
4 That the regeneration of the wetland is consistent with the local recorded species that are common to Wallum froglet habitat, regardless if we can't get the first three points correct these plants will not be able to compete with more aggressive floristic competitors;
5 The wetland includes an area that represents a suitable breeding pond habitat;

7 To achieve all of the above steps requires the restoration and management plan to be designed by a Wallum froglet expert.

Section G – Conclusions and Recommendations

The assessment presented in this report demonstrates that future development of the Subject Site would likely have a minimal ecological impact on threatened species under the provisions of the TSC Act and on MNES under the provisions of the EPBC Act. The proposal will not impact on Marine habitats or species relevant to the FM Act, and it also meets the objectives of the Solitary Island Marine Park management plan. The main provision to this conclusion is that storm water be treated to an industry "best" standard prior to leaving the site, as discussed in the previous section.

The result of investigations, specifically finds that the proposal will not have a significant effect on threatened species, populations or communities. Additionally, if the recommendations made in Section F are implemented, we see a general long-term improvement in habitats as a result of the proposal. If all of these recommendations are implemented in a timely fashion (before loss of habitat) ecological impacts will be minimised to a very low acceptable level.

Nonetheless, given the sensitivity of the local area, this assessment found that this matter should be referred to the Director General of the Department of Environment and Heritage.

Whilst the proposal generally meets the objectives of the Biodiversity strategy and the Moonee Creek Management Plan, the losses of potential and actual habitat does limit the proposals value as providing a positive outcome for the local area. Nonetheless, with considered forward planning and the implementation, any potential impacts can be greatly reduced to an acceptable level.

In conclusion, without appropriate mitigation the proposed clearing of the impact site will impact on the local ecology (but not impact on TSC Act and EPC Act species).The full implementation of the recommendations, as set out above, is required to limit the extent that threatened species may be put at further risk of extinction. In other words, the main conclusions of this report are reliant on all recommendations being undertaken and, moreover, many being undertaken prior to clearing.

No areas of critical habitat were identified on the Subject Site, and the activity will not introduce any key threatening processes that may impact on surrounding ecology. No significant species or communities identified in the Fisheries Management Act were recorded adjacent to the site in Moonee Creek, however the regional importance of the Moonee Estuary system is considered very high.

The results of 7–part tests on the potential impact species concludes that with the adoption of the proposed mitigation measures the proposal will have an acceptable level of impact, and **not** necessitate the preparation of a Species Impact Statement.