APPENDIX B

niche Environment and Heritage

BIODIVERSITY CONSTRAINTS ANALYSIS: DEFERRED AREAS CHCC DRAFT LEP (2013)

Hearnes Lake, Sandy Beach, Emerald Beach and Moonee Beach Areas

July 2014

DOCUMENT CONTROL

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Front Cover Photograph: Swamp Sclerophyll Forest within the study area

EXECUTIVE SUMMARY

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by Monteath and Powys Pty Ltd on behalf of Coffs Harbour Council (CHCC) to conduct a flora and fauna investigation as part of a Local Environmental Study (LES) for Hearnes Lake, Sandy Beach, Emerald Beach and Moonee Beach 'deferred areas' (the study area) in Coffs Harbour City Council (CHCC) local government area (LGA). This report is part of a broader investigation designed to assess the suitability of the deferred areas for future development (i.e. land zoning).

This investigation involved:

- A detailed literature review of management plans, previous flora and fauna survey, consultant reports and existing mapping;
- A two-day site inspection (October 2013) to validate existing mapping and to undertake habitat assessments, spotlighting and ultrasonic bat detection; and
- Constraints mapping and recommendations.

The literature review, site inspection and geospatial analysis of various datasets identified the following matters of conservation significance (i.e. biodiversity constraint) across the study area:

- Threatened ecological communities (TECs);
- Over cleared vegetation types (OCVTs);
- Hollow-bearing trees;
- Wildlife corridors;
- Areas of candidate old growth forest (High value arboreal mapping – May 2014);
- Watercourses (e.g. wildlife corridors and important habitat);
- Habitat suitability for threatened and migratory species;
- Wetlands protected by State Environment Planning Policy (SEPP) 14 Coastal Wetlands; and
- Habitat variously protected by SEPP 44 Koala Habitat Protection.

A relative constraint index was established to consolidate the above constraints into a single coherent constraints map. Lands with the greatest constraint generally comprised TECs followed by OCVTs known to contain a high representation of 'ecosystem predicted' threatened species. Areas of least constraint were typically those that had already been cleared or substantially modified.

The constraints map provides a useful predictive tool for the consideration of land use planning throughout the study area. The map allows for an integrated consideration of the complex regulatory framework used to assess impacts on biodiversity. It is recommended that consideration be given to the usefulness of the NSW Biodiversity Certification Scheme as means of delivering a "maintain and improve" outcome for biodiversity impacts within the deferred areas.

GLOSSARY AND ABBREVIATIONS

Study area: Deferred areas (A-I).

Flora and fauna of conservation significance: threatened species or populations listed on the schedules of the TSC Act and/or listed as matters of National Environmental Significance (NES) under the EPBC Act.

Local population: the population of a particular threatened species that occurs in the locality.

Locality: the area within 10 km of the study area.

Local occurrence: refers to the distribution of an ecological community within the study area and continuous with it.

Matters of NES: matters of national environmental significance.

OEH: Office of Environment and Heritage.

TEC: Threatened ecological community as listed on the TSC Act and or EPBC Act. Collective term to describe vulnerable, endangered and critically endangered ecological communities.

Threatened biodiversity: Threatened species, populations and ecological communities as listed on the TSC and or EPBC Acts.

TSC Act: NSW *Threatened Species Conservation Act 1995*

EPBC Act: Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

EP&A Act: NSW *Environmental Planning and Assessment Act 1979*

CHCC: Coffs Harbour City Council

NRCMA: Northern Rivers Catchment Management Authority

OCVT: Over Cleared Vegetation Type

RBVT: Revised Biometric Vegetation Type

SEPP: State Environment Planning Policy

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1 INTRODUCTION

1.1 Background

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by Monteath and Powys Pty Ltd on behalf of Coffs Harbour Council (CHCC) to conduct a flora and fauna investigation as part of a Local Environmental Study (LES) for various 'deferred areas' known as Hearnes Lake, Sandy Beach, Emerald Beach and Moonee Beach in the CHCC local government area (LGA). This report is part of a broader investigation designed to assess the suitability of the deferred areas for future development (i.e. land zones).

1.2 The study area

The study area consists of nine individual precincts occurring between Hearnes Lake in the south and Moonee Beach in the north as shown in Figure 1 and Figure 2. These areas comprise a mix of land use zones adjacent to Moonee Beach Nature Reserve and Coffs Coast Regional Park.

1.3 Project context

Detailed planning for the Moonee Release Area commenced in 1998 and was included under a Development Control Plan (DCP) and Contributions Plan (CP), which came into effect in 1999. This was amended in 2003 and brought into effect in 2004. A draft Local Environment Plan (LEP; Number 24) under the Coffs Harbour 2000 LEP was produced, prior to further planning occurring between 2004 and the present time, including Part 3A Applications under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

Detailed planning for the Hearnes Lake/ Sandy Beach Release Area commenced in 2004, again in the form of a DCP, which came into effect in 2005 as amended in 2008. The Coffs Harbour 2000 LEP was amended in draft form in 2006 (amendment number 29) to afford greater protection for biodiversity values within the area. This coincided with a Part 3A Application occurred over Lot 22, DP 1070182, located to the south of Hearnes Lake, for a 300 lot residential subdivision.

LEP amendment (amendment number 23) under the Coffs Harbour 2000 LEP came into effect in 2003 to provide greater protections for biodiversity values contained with the Emerald Beach area. Subsequent investigations have occurred, also recognising the high biodiversity values of the area. An approved BioBanking Statement has been issued for part of the Emerald Beach release area for a proposed residential development.

1.4 Purpose and objectives

This report aims to provide biodiversity information in a form suitable for the broader investigation of land use suitability within the deferred areas. In this respect the primary objective of this report is to describe and assess the constraining ecological values prevailing within the study area. The investigation involved:

- A detailed literature review of management plans, previous flora and fauna survey, consultant reports and existing mapping;
- A two-day site inspection to validate existing mapping and to undertake habitat assessments, spotlighting and ultrasonic bat detection; and
- Constraints analysis, mapping and recommendations.

As per the brief the tasks undertaken as part of the investigation is as follows:

- Review existing studies including previous flora fauna assessments, council plans and existing vegetation mapping;
- Prepare a detailed vegetation map of the study area;
- Identify areas of significant vegetation in the study area from previous studies and field investigations as required;
- Identify measures for conservation of existing and potential wildlife corridors;
- Identify previously recorded threatened species, populations and communities listed on the NSW *Threatened Species Conservation Act* 1995 (TSC Act) and or *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) and those having potential to occur;
- Investigate the conservation significance of Moonee Quassia;
- Conduct spotlighting and ultrasonic bat recording;
- Assess conservation significance of fauna habitats, particularly their importance as habitat or linkages in a local and regional context, and their resilience to potential development;
- Identify measures for the conservation of threatened flora and fauna and their habitats;
- Outline measures for the long-term management of conservation/ open space areas proposed within the study area, including measures for revegetation and rehabilitation, ownership and access;
- Identify old growth and hollow-bearing trees in the study area and map their location.

In relation to the last scope item, CHCC requested the inclusion of High Value Arboreal Mapping published in May 2014 (Fisher et al 2014) as part of the assessment of conservation significance (Nigel Cotsell pers. com. June 2014). While outside the 2013 Council brief and Niche scope it was agreed that the inclusion of this recently published information would be of benefit to the analysis provided in this report.

1.5 Report structure

1.5.1 Structure

The structure of this report is as follows:

- Methods including approach used to consolidate investigation findings into a conservation assessment (i.e. biodiversity constraints mapping);
- Results (findings from literature, database and site investigations);
- Conservation significance assessment (interpretation of results and compilation of biodiversity constraint maps that provide an evaluation of conservation significance across the study area); and
- Recommendations (how the constraints mapping can be used to deliver long term management of conservation/ open space areas).

1.5.2 Response to brief

The Project brief, as defined by CHCC, provided specific terms of reference for the delivery of biodiversity input into the Local Environmental Study. Niche has addressed the brief as indicated in Table 1, subject to limitations outlined in Section 1.6.

Table 1. Project brief

Brief	Addressed
Review existing studies including previous flora fauna assessments, council plans and existing vegetation mapping	Sections 3.2 and 3.3
Prepare a detailed vegetation map of the study area	Section 3.3
Identify areas of significant vegetation in the study area from previous studies and field investigations as required	Sections 4.2, 4.3, 4.4
Identify measures for conservation of existing and potential wildlife corridors	Sections 5.2 and 5.3
Identify previously recorded threatened species, populations and communities listed on the NSW Threatened Species Conservation Act 1995 (TSC Act) and or Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and those having potential to occur	Appendix C
Investigate the conservation significance of Moonee Quassia	Sections 3.4.1 and 4.5.1
Conduct spotlighting and ultrasonic bat recording	Section 2.3, Figure 3 and Figure 4
Assess conservation significance of fauna habitats, particularly their importance as habitat or linkages in a local and regional context, and their resilience to potential development	Sections 2.6, 3.5, 4
Identify measures for the conservation of threatened flora and fauna and their habitats	Section 5
Outline measures for the long-term management of conservation/ open space areas proposed within the study area, including measures for revegetation and rehabilitation, ownership and access	Section 5
Identify old growth and hollow-bearing trees in the study area and map their location	Sections 2.3.6, 3.5.2 and 4.6

With respect to requirements for 'old growth and hollow bearing tree assessment' Niche complied with the brief by conducting an agreed study area wide survey for hollow-bearing trees. The completeness of this dataset was compromised where CHCC was unable to obtain access for parts of the study area (e.g. Hearnes Lake and Emerald Beach). Methods used to address these limitations were developed, applied and documented through earlier drafts.

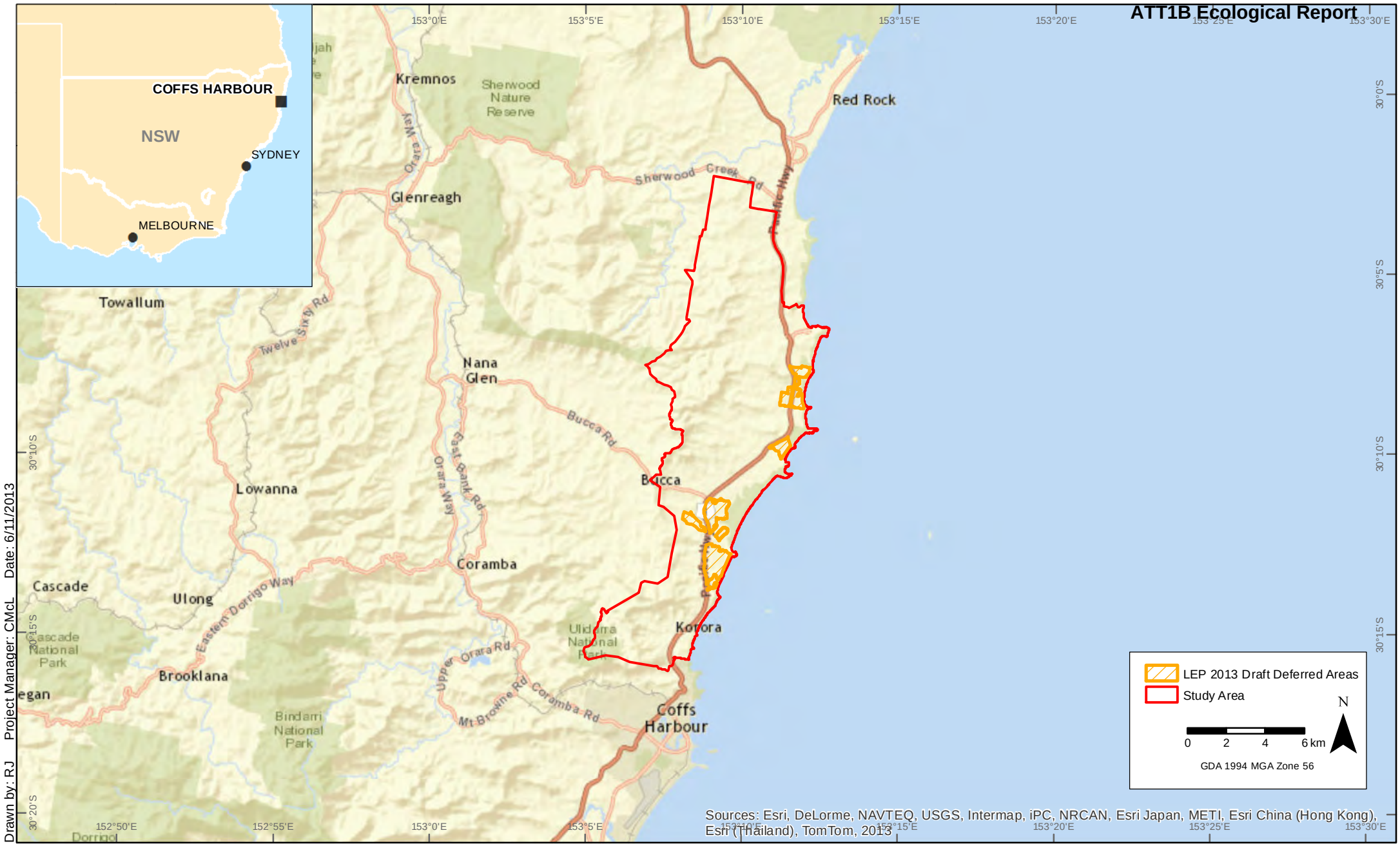
Subsequent to draft report submission and review Niche was advised by CHCC that a Council endorsed dataset describing the distribution of 'High Value Arboreal Habitat' through the LGA had become newly available and was considered to be superior to the work completed by Niche. While beyond scope and not budgeted, Niche proceeded to incorporate this important information into the analysis, foregoing the Niche derived dataset. From a methodological perspective a hybrid approach (i.e. use of both datasets) was not adopted in this analysis as such an approach would introduce unresolvable inconsistencies that would significantly undermine methodological integrity (i.e. objective analysis avoiding bias where ever possible). Similarly, local variations to these scores based on individual opinions are not included as they introduce personal biases into the data.

1.6 Limitations

The following are limitations to the current constraints investigation:

- Land access limitations prevent Niche from entering various properties within the study area during the designated survey period (e.g. Hearnes Lake, Emerald Beach). Existing datasets such as those generated by CHHC were heavily relied on to overcome this limitation.
- The Project brief and associated field survey component was designed to be a rapid assessment of current vegetation mapping, habitat types and tree hollow/old growth assessment. The survey was to be used to assist aerial photography interpretation and mapping. As such, the survey did not involve any targeted fauna trapping, nor the recommended floristic plots as specified in DECC (2007) Threatened Species Assessment Guidelines: The Assessment of Significance, DECCW Hurstville and DECCW (2011) Biodiversity Certification Assessment Methodology.

- Habitat-based assessments were conducted which are considered a conservative method of assessing threatened fauna as presence is determined on the basis of the presence of suitable habitat, not observations from the study area.
- Some plant species are cryptic and can only be detected when flowering at certain times of the year and many fauna are difficult to detect without using specialised survey techniques.
- Spotlighting and Anabats were conducted in areas of potential habitat that were predicted to yield the best results and could be accessed. As such, not all vegetation types were able to be surveyed. This is a relatively minor limitation.
- The vegetation mapping provided in the previous flora and fauna reports (section 2) were not aligned to the CHCC vegetation types, nor the RBVT database. As such, a 'best fit' alignment to the CHCC and RBVT vegetation types was determined based on the descriptions of each community in the corresponding report.
- Data acquisition compliant with BioMetric (Gibbons et al 2009) for use in this analysis was limited by property access restrictions. As such, data acquisition focused on vegetation patches visually showing clear signs of disturbance and or modification (i.e. identified through aerial photography interpretation and on site evaluations). Notional datasets were generated for vegetation cover considered to be in a moderate to good (high) condition and lands not accessible during the investigation. Sampling sites were determined from aerial photography interpretation and professional judgement whilst in the field.
- All areas of derived grassland were not able to be surveyed due to the size of the patches and land access, a matter important aligning vegetation wtih RBVTs. Furthermore, it is likely that some smaller areas with the areas mapped as 'derived grassland' may contain less than 50 percent of native ground cover and no native canopy of midstorey (i.e. not classed as native vegetation cover). This can only be determined through detailed site investigations. For the purposes of the biodiversity constraint index calculations, derived grasslands were classified as forming part of NR117 and assigned quadrat values obtained during the field survey.
- Due to the size of the study area, not all hollow-bearing trees could be recorded during the field survey. As such, CHCC High Value Arboreal Habitat Mapping has been relied on as the most suitable data layer for evaluating this ecological attribute.
- The old growth forest mapping did not include any field verification or any baseline old growth for direct comparison. As directed Niche has deferred to the High Value Arboreal Habitat mapping (Fisher et al 2014) to overcome this limitation.
- Only those literature sources provided by CHCC and those that could be found by Niche in the public domain were reviewed in this assessment.
- Notional BioMetric datasets were generated from visual estimates of vegetation condition during the field survey, and aerial photography interpretation and professional judgement to be used for the biodiversity constraints.
- Corridor mapping relied on previous studies (Scotts 2003 and CHCC 2012), as mapping of corridors within the study area was beyond the scope of this assessment.
- The Koala habitat mapping is based on the presence of Koala feed trees within identified vegetation communities and is supported by mapping completed for the CKPoM. No field verification occurred through the Spot Assessment Technique (in order to determine levels of Koala activity) to determine if the predicted important habitat maintains a viable Koala population.
- The identified corridors should only be used as a guide and were identified by Scotts (2003) regional corridor mapping. Their effectiveness for the movement of different species has not been examined.



Drawn by: RJ Project Manager: CMcL Date: 6/11/2013

Regional Project Location

Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 1

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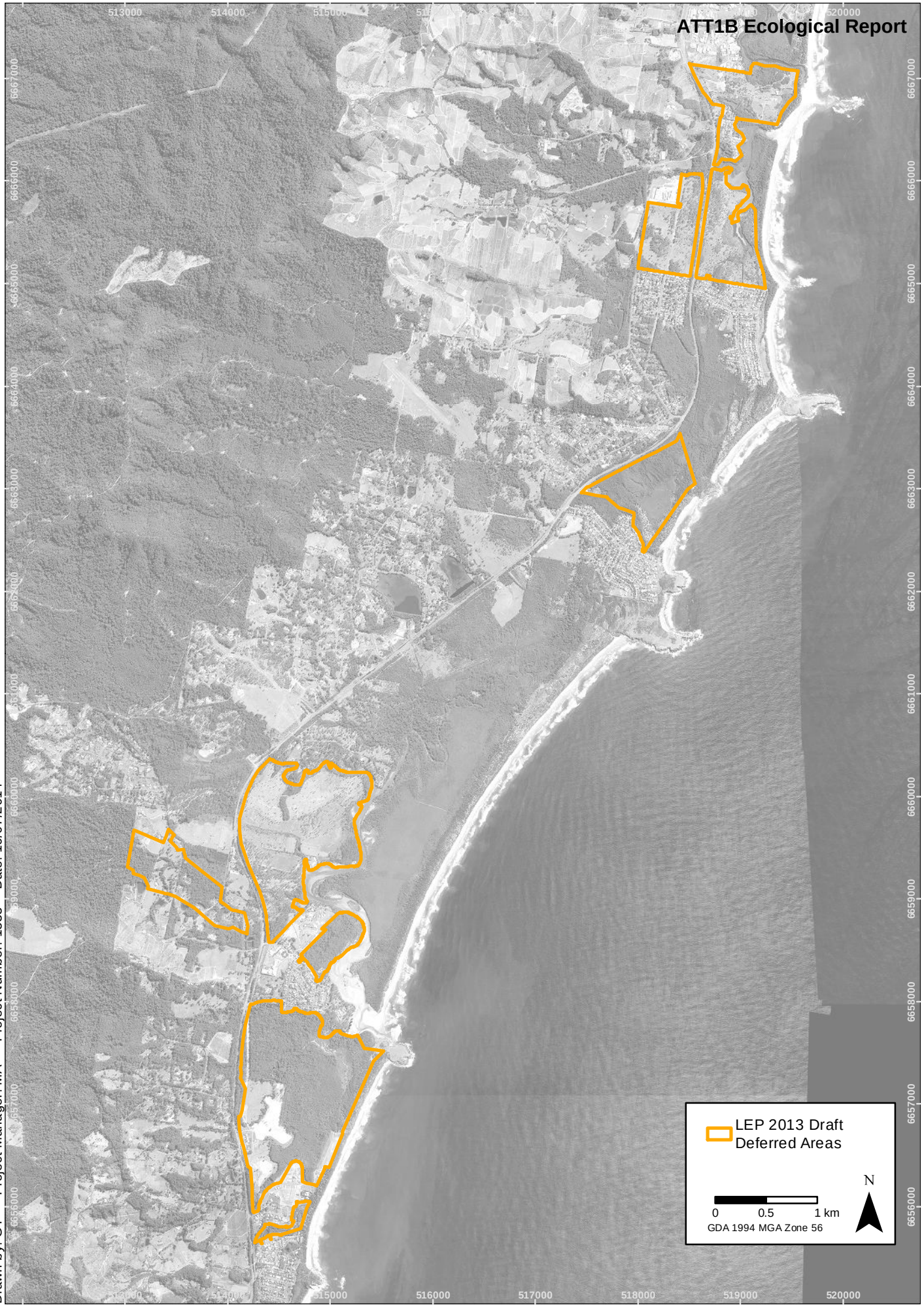

Drawn by: GT Project Manager: MA Project Number: 1553 Date: 16/07/2014

The Study Area

Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 2

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2 METHODOLOGY

The following sections outline the method used to obtain and consolidate information on the biodiversity values present within the study area in preparation for the assessment of conservation significance otherwise referred to as biodiversity constraints mapping in this report. This includes various desktop based reviews (i.e. literature and database sources), site inspections and data analysis culminating in a biodiversity constraints mapping. Site investigations were completed on 8-9 October 2013.

2.1 Database and literature sources

Databases reviewed as part of this investigation included:

- OEH Threatened Species Profiles Database, NSW Department of Environment and Climate Change;
- OEH Atlas of NSW Wildlife (accessed November 2013);
- Class 5 Vegetation Mapping of Coffs Harbour Local Government Area (LGA);
- OEH Vegetation Types Database;
- CHCC High Value Arboreal Habitat mapping (Fisher et al 2014);
- OEH Vegetation Benchmarks Database; and
- The EPBC Act Protected Matters Search Tool (accessed November 2013).

Literature and data sources reviewed are listed below:

- Conacher Environmental Group (2008). Ecological survey and assessment report - Sandy Beach North Lot 22 in DP 1070182 Pacific Highway Sandy Beach.
- Conacher Environmental Group (2010). Comments on extent of Endangered Ecological Communities - Sandy Beach North Lot 22 in DP 1070182 Pacific Highway Sandy Beach.
- Conacher Environmental Group (2011). Comments on soils and ecological communities - Sandy Beach North Lot 22 in DP 1070182 Pacific Highway Sandy Beach.
- Conacher Travers (2006). Comments on environmental constraints analysis report - Sandy Beach North Lot 22 in DP 1070182 Pacific Highway Sandy Beach.
- Conacher Travers (2007) Historical land use ecological assessment - Sandy Beach North Lot 22 in DP 1070182 Pacific Highway Sandy Beach.
- Department of Environment and Conservation (NSW) (2005) Approved Recovery Plan for *Quassia* sp. Mooney Creek (Moonee Quassia);
- Department of Conservation, Climate Change and Water (2010) Northern Rivers Regional Biodiversity Management Plan;
- EcoLogical Australia (2007) Flora and Fauna Assessment, Lot 21 DP 714858, 45 Hearnes Lake Road, Woolgoolga;
- Gunninah Environmental Consultants (2006) Moonee Waters Flora and Fauna Assessment, Lot 66, DP 551005, Moonee Beach;
- Gunninah Environmental Consultants (2010) Sandy Beach North Lot 22 in DP 1070182 Pacific Highway Sandy Beach.
- James Warren and Associates (2007a) Flora and Fauna Assessment, Lots 1 and 2, DP 725785 Pacific Highway Moonee;

- James Warren and Associates (2007b) Flora and Fauna Assessment, Lot 211, DP 1044292 Pacific Highway Moonee;
- James Warren and Associates (2008) Flora and Fauna Assessment, Lot 5, DP 252223, Pacific Highway, Moonee;
- Lunney, D., Moon, C., Matthews, A., and Turbill, J. (1999) Coffs Harbour City Koala Plan of Management. Part A: The Plan;
- Lunney, D., Moon, C., Matthews, A., and Turbill, J. (1999) Coffs Harbour City Koala Plan of Management. Part B: Coffs Harbour Koala Study; and
- PEA Consulting (2013) Ecological Assessment, Lot 1, DP 1097743 and Lot 6, DP 252223, Moonee Beach.

In recognising the value of background literature it is important to note that surveys and reports prepared prior to 2009 (i.e. greater then five years) are likely to have limited suitability when used as the basis for characterisation current ecological values and condition within the study area.

2.2 Vegetation mapping

Existing vegetation mapping comprising digitised vegetation map units codified with a floristic community was reviewed to gain an appreciation of vegetation cover within the study area (CHCC 2012). These floristic communities were then aligned with the Revised Biometric Vegetation Types (RBVTs) database using published classification descriptors. Keith Class, Formation and threatened ecological community (TEC) type, if relevant, was also elucidated. Polygon areas are reported in hectares (ha).

Where required, existing vegetation mapping was validated through a site inspection. Data was also collected for the purpose of evaluating condition. Methods used include aerial photography interpretation and standard survey methods, which are further discussed in the following sections.

2.2.1 Aerial photography interpretation

Existing vegetation mapping was compared with ortho-rectified digital aerial photography in a GIS to examine for significant data gaps. A cognitive process involving photo-interpretation was conducted with data gap identification reliant on the detection of differences in crown/canopy colour, crown-shadow shape, canopy pattern and topographic association. For the latter, contour data supplied by CHCC was used to discriminate, for example, between in-channel and floodplain vegetation.

Vegetation map units were updated through this process using a minimum vegetation polygon size of 0.25 hectares (c. 50 x 50 m: longer and narrower polygons were digitised for riparian areas); this being consistent with the minimum map unit used in the NSW BioBanking Assessment Methodology (DECCW 2009). Limitations encountered included the relatively low colour contrast across the scene (i.e. the overall green cast limited discrimination between different vegetation communities).

2.2.2 Validation

As distribution of vegetation cover cannot be accurately predicted using remote sensing and GIS alone it is necessary to validate using information sourced from ground truthed reference or control points. In this respect rapid data points (RDPs) were used to collect information on plant species dominance and structure; a recognised survey method used to validate vegetation mapping (Bell 2009). RDPs principally

focused on areas where data gaps in the vegetation mapping were identified, although their wider use throughout the study area facilitated a rapid point based evaluation of condition.

RDPs are summaries of dominant floristic information recorded at specific points in the field. Data was recorded on field sheets together with a GPS waypoint for transfer to GIS. Information recorded included:

- Canopy layer dominant species;
- Shrub layer dominant species;
- Ground layer dominant species;
- Suspected vegetation unit;
- Vegetation condition (Niche use a measure of 'ecosystem resilience' as a function of disturbance), BioBanking condition (moderate-good, low and cleared) and other notes regarding habitat and other important features; and
- Physical attributes of the site (vegetation structure, soil type, elevation, slope, aspect, geomorphic position) are also recorded and photographs taken for later reference.

2.2.3 Vegetation and habitat condition

A more formal systematic approach to the evaluation of condition was undertaken using methods prescribed by the NSW BioBanking Assessment Methodology (DECC 2009). BioBanking plots measuring 20m X 50m were completed in the common vegetation types within the study area to provide greater resolution on vegetation and habitat condition for comparison against published benchmarks. The following site attributes were measured in each plot:

- Native Species Richness (NSR);
- Native Over-Storey Cover (NOS);
- Native Mid-Storey Cover (NMS);
- Native Ground Cover (grasses) (NGCG);
- Native Ground Cover (shrubs) (NGCS);
- Native Ground Cover (other) (NGCO);
- Exotic Cover (EC);
- Overstorey Regeneration (OR);
- Number Of Trees With Hollows (NTH); and
- Total Length of Fallen Logs (FL).

Data was transferred into the BioBanking template plot form. This data was used in a notional BioBanking assessment for the study area where comparisons between site conditions and benchmark values were made. The method for transferring information derived from this analysis into a constraint layer is further discussed in Section 2.6.

2.2.4 Opportunistic surveys

General traverses were conducted between and around plot, with the purpose of these traverses being opportunistic/ targeted searches for threatened plant species.

2.3 Fauna

2.3.1 Site investigations

As defined by the brief a limited fauna survey was undertaken and involved completion of the following tasks:

- Habitat assessments;
- Ultrasonic bat call recording (anabat);
- Spotlighting;
- Hollow-bearing trees; and
- Old Growth Tree assessment (see HV Arboreal Habitat mapping).

Survey locations are shown in Figure 3 and Figure 4.

2.3.2 Habitat assessments

BioMetric plots were used as the primary method for quantifying habitat within the study area. Supplementary habitat assessments were also completed at various locations where BioMetric plots were not completed and involved an assessment of the type and condition of fauna habitat as well as potential for threatened species to occur. The habitat assessment was guided by plant community structure and the occurrence of important features such as tree hollows, canopy feeding resources, leaf litter, fallen timber, water bodies and specific feeding resources such as koala feed trees.

2.3.3 Microchiropteran bat surveys

Three ultrasonic recording devices (anabats) were deployed at five separate sites across the study area to survey for microchiropteran bats or microbats. These survey instruments were deployed for one night duration at each site and recorded from dusk until dawn. The anabats were placed in areas likely to yield the most results based on the surrounding potential microbat habitat.

2.3.4 Spotlighting

Spotlighting surveys were restricted to easily accessible lands that contained the most hollow-bearing trees and larger trees. The survey effort for each night was approximately 8 person hours. Surveyors had one handheld 50-watt spotlight. Active listening for frogs was conducted concurrently with the spotlighting survey where any areas of water were present.

2.3.5 Hollow-bearing tree survey

Locating all hollow-bearing trees was not possible given budgetary and land access limitations. Where observed, hollow-bearing trees were recorded with a hand held GPS to identify its position within the study area.

The area east of Graham Drive and west of the Pacific Highway was observed to contain a large number of hollow bearing trees with GPS location of all the trees not being possible. As such two 100 metre by 100 metre quadrats were used to count hollow-bearing trees to estimate density per hectare. The average was then multiplied by the area of the sampled patch.

Areas containing high densities of hollow-bearing trees that were not surveyed were identified through air photo interpretation. The method is described in Section 3.3.6 below.

2.3.6 'Old Growth' forest survey

The terminology of 'old growth' forest is not considered appropriate for use in this context, as the JANIS criterion defines an old growth forest as 'a forest where the effects of disturbances are now negligible' (JANIS 1997). This definition cannot be demonstrated in the study area as the forests within are represented by relatively small patch sizes where there is a greater exposure chronic disturbance due to high ratio of edge to area), are variously fragmented, lie adjacent to various permanent impacting land uses including a major arterial highway and have unmanaged weed disturbances.

Within the Code of Practice for Private Native Forestry in north-eastern New South Wales, old growth forest is defined as:

"Ecologically mature forest where the effects of disturbance are now negligible that have an area of forest greater than 5ha where:

- The overstorey is in late to over-mature growth stage with the presence of relatively large old trees (many containing hollows and often with the presence of dieback or dead branches);
- The age (growth) structure of the stand measured as relative crown cover consists of less than 10% of regeneration and advance growth and more than 10% of late to overmature (senescent) growth;
- The effects of unnatural disturbance are now negligible (DEC 2007)".

Within the study area, it is considered unlikely that the *effects of unnatural disturbance are now negligible*. Thus instead the term uneven aged stand forest or forest containing old growth forest elements (e.g. large logs, high densities of senescing hollow-bearing trees) should be used when describing more mature forest within the study area.

Alternatively, at the request of CHCC, Niche has used the recently published High Value (HV) Arboreal Habitat mapping for the CHCC LGA (Fisher *et al* 2014). This mapping classifies native vegetation cover within the CHCC LGA as listed below:

- HV Arboreal Habitat category 1 – old-growth;
- HV Arboreal Habitat category 2 – forest areas >10 hectares with ≥ 5 senescent trees per hectare;
- HV Arboreal Habitat category 3 – forest areas 5-10 hectares with ≥ 5 senescent trees per hectare; and
- HV Arboreal Habitat category 4 – forest areas 1-5 hectares with ≥ 5 senescent trees per hectare.

The delineation and identification of HV Arboreal Habitat reflected forest structure and disturbance regimes (Fisher et al 2014) in a form useful in natural resource management within the study area.

2.4 Corridor mapping

Scotts (2003) delineated regional, sub-regional and local corridors following an examination of regional and local key habitats and associated connecting native vegetation cover. Corridor classifications are described as follows.

Regional wildlife corridors - corridors wide enough to have their own ecological integrity, including sufficient habitat for resident populations of focal species and interior habitat for species detrimentally impacted by edge effects.

- Width of a minimum of 500 metres would be acceptable in certain instances but typically at least 1000 metres width;
- Regional corridors will often link formal reserves to other public lands, key habitats or to other corridor;
- Regional corridors will often run along major gradients such as altitudinal and latitudinal gradients;
- Where ever possible, regional corridors should occupy all available landforms (ridge, mid-slope, flat, gully) to ensure representation of habitat variation and resources.

Sub-regional Corridors- corridors wide enough to support resident populations of at least a subset of priority species or wide enough to provide a substantial link between key habitats and other key habitats, reserves, public lands or other corridors.

- A benchmark minimum width of 300 metres is envisaged but, where possible, they should be wider (e.g. 400 – 1000 metres);
- Sub-regional corridors should be positioned to maximise the protection and linkage of available landforms (ridge, mid-slope, flat, gully);

Local Corridors- as well as regional and sub-regional corridors which are intended to provide a framework for conservation planning at the landscape scale, local corridors designed to link more localised key habitats into a protected area network are also required.

- Local corridors may be narrower than regional and sub-regional corridors (e.g. less than 500 metres width;
- Local corridors may include riparian and roadside as well as remnants. Whenever possible local corridors should link into the wider regional and sub-regional network.

Stepping-stone patches - while less-mobile species require continuous corridors to facilitate movement between larger protected key habitats some more mobile species, such as some birds and bats, can move via stepping-stone patches of habitat across otherwise unsuitable matrices.

- Stepping-stone patches include any key habitats that have not been linked into the proposed protected area network by regional or sub-regional corridors.
- Some of these may be linked in to the network by local corridors, derived at a later stage, and any consequent improvement in overall connectivity is considered valuable. Others will remain more isolated but their protection and enhancement is also promoted.

This corridor mapping was used to locate and classify corridors present within the study area, hence use in the landscape assessment. This mapping has identified the key fauna habitats and corridors for north east NSW and including lands contained within the study area. However, as local corridors were not mapped by Scotts (2003), this project has relied upon the local connections identified in CHCC (2012) Biodiversity Action Strategy. CHCC (2012) identify these 'landscape connections' as significant at local, regional and state scales because they:

- Support threatened species (TSC Act, EBPC Act & FM Act), regional core habitats, and conservation priority fauna (CHCC 2012);

- Provide critical links between larger, core habitat areas at a landscape and local level— these corridors facilitate the movement of genes, individual plants/animals and species across the landscape;
- Provide climate change pathways for biodiversity mitigation and adaptation in the face of likely climate change impacts on species, communities and ecosystems.

Watercourses are also recognised as facilitating biodiversity movement pathways and providing important habitat generally. A buffer of 50 metres has been applied to significant waterbodies to spatially represent these areas in the constraints mapping.

2.5 Threatened flora and fauna likelihood of occurrence

A list of subject threatened flora and fauna within the locality (10 kilometre radius) was determined from database searches (OEH Atlas of NSW Wildlife and EPBC Act Protected Matters Search Tool). Likelihood of occurrence was attributed to each species determined using five categories (Table 2). Information developed through this process was used to qualitatively evaluate calculations for the vegetation constraint index.

Table 2. Likelihood of occurrence criteria

Likelihood rating	Threatened flora criteria	Threatened and migratory fauna criteria
Known	The species was observed within the study area.	The species was observed within the study area.
High	It is likely that a species inhabits or utilises habitat within the study area.	It is likely that a species inhabits or utilises habitat within the study area.
Moderate	Potential habitat for a species occurs on the site. Adequate field survey would determine if there is a 'high' or 'low' likelihood of occurrence for the species within the study area.	Potential habitat for a species occurs on the site and the species may occasionally utilise that habitat. Species unlikely to be wholly dependent on the habitat present within the study area.
Low	It is unlikely that the species inhabits the study area.	It is unlikely that the species inhabits the study area. If present at the site the species would likely be a transient visitor. The site contains only very common habitat for this species which the species would not rely on for its on-going local existence.
None	The habitat within the study area is unsuitable for the species.	The habitat within the study area is unsuitable for the species.

2.6 Conservation significance assessment

Assessing the conservation significance of biodiversity within the study area has necessitated the consideration of a considerable quantity of contextual and spatial information as indicated in the preceding sections. In this assessment, the approach taken to evaluating conservation significance has been through an accumulated consideration of each information resource to minimise the inherent complexity of the assessment. The results of this assessment has been presented in the form of a 'relative constraint index' otherwise referred to as 'biodiversity constraints', with all these terms being interchangeable in this report.

The 'relative constraint index' is a composite of relevant biodiversity values obtained from the literature, available GIS datasets, data analysis and field investigations. This has been the preferred approach to consolidating the vast quantum of contextual and spatial information. The index represents a rank based approach designed for an intra study area evaluation of biodiversity values. In this assessment areas of

high conservation significance explicitly match areas identified as having high biodiversity constraint (i.e. a 'relative constraint index' of high numerical value).

Constraint classes having specific planning implications such as mapping for SEPP 14 Coastal Wetlands, SEPP 26 Littoral Rainforests and critical habitat were separately mapped as an overlay on the 'biodiversity constraints' map due to the direct planning implications arising from these constraints. This approach allows for a dual interpretation of biodiversity constraints (e.g. mandatory planning assessment pathways for development within mapped SEPP 14 wetlands, SEPP 26 Littoral Rainforests and critical habitat).

The assessment of conservation significance, which is reflected in the 'relative constraint index', was calculated by the summation of each equal weighted constraint layer (unless otherwise stated) in a GIS using RBVT vegetation polygons as the base mapping unit. This approach has limited the potential for bias in the analysis other than for any pre-existing co-correlations between constraint classes (e.g. overcleared vegetation types are often dual classified as endangered ecological communities). Point defined constraints that are additional to the base mapping unit (i.e. RBVT polygons) were also included where relevant (e.g. Osprey nest site). Constraint classes such as the known occurrence of specific threatened species and mapped wildlife corridors were added.

The range of values used to quantify each constraint class was limited to between 0 (i.e. no constraint) and 1 (i.e. maximum constraint) with the 'relative constraint index' being the sum of all constraint classes used in the analysis. Again this approach was taken to limit subjective bias in the analysis. However, it is recognised that certain constraint classes may, at a local level, have greater importance than others. The approach taken here provides the capacity to adjust constraint quantification by introducing user defined weightings should the Council decide to do so. For instance, it may be determined that High Value Arboreal Habitat represents the highest order constraint and, in recognition of this, a multiplier may be applied to enhance the expression of this constraint in the 'relative constraints index'. Similarly, another constraint class may be considered to be of limited importance resulting in the consideration of downward adjustment.

Specific assumptions and mapping criteria apply to the mapping of these constraints, which are further discussed in the following sections.

2.6.1 Constraint classes

Constraint classes used to calculate the 'relative constraint index' are listed below:

- Vegetation cover (RBVTs);
- OCVTs;
- TECs;
- Threatened species occurrences;
- Koala habitat;
- HV arboreal habitat; and
- Corridors.

The spatial quantification of these constraint classes is described in the following sections.

Vegetation type

Quantifying the biodiversity value of native vegetation cover (types) contained within the study area was achieved through the use of BioMetric (Gibbons et. al. 2009); a method designed to evaluate biodiversity value by comparing condition states (i.e. published benchmark versus measured site condition). Site data

was obtained using BioMetric plots as described by Gibbons *et. al.* (2009). Numerical computations were performed in accordance with the NSW BioBanking Assessment Methodology (BBAM) resulting in the generation of a 'site value score' for each vegetation type and condition classification. Data sources used to generate the site value score are listed below:

- Field and notional datasets describing the condition of RBVTs occurring within the study area;
- Published RBVT benchmark database; and
- The mapped area (i.e. hectares) of RBVTs including condition derived from field verified and RBVT equivocated CHCC vegetation mapping.

Site value scores range from zero (no biodiversity value) to a theoretical maximum of 100.

The BBCC calculated site value score was then converted into a measure known as 'ecosystem credits' following an evaluation of landscape context (i.e. landscape score). Data sources used to calculate the landscape score are listed below:

- Per cent native vegetation cover (i.e. cleared versus uncleared);
- Connectivity width and condition;
- Patch size including adjacent patch;
- Catchment management area and relevant subregion; and
- Mitchell Landscape.

The measure 'ecosystem credits per hectare' was then calculated by dividing the number of ecosystem credits generated for a RBVT by its mapped extent. For the purposes of constraint mapping these results were range standardised to between 0 (i.e. lowest relative constraint) and 1 (i.e. highest relative constraint) without any specific weighting. Range standardised values were spatially attributed to RBVT/ condition states as per verified CHCC mapping. Predicted ecosystem species responsible for driving the ecosystem credit score was also noted, reported and discussed.

OCVTs

A binary scoring system was adopted for estimating constraints associated with OCVTs. Published information identifying RBVTs as having greater than 70 % cleared status were assigned a constraint score of 1 with residual areas of native vegetation scoring 0. CHCC supplied OCVTs mapping was used to map identified constraint features.

TECs

A binary scoring system was adopted for estimating constraints associated with TECs. Published information identifying RBVTs as being classed as a TEC were assigned a constraint score of 1 with residual areas of native vegetation scoring 0. CHCC supplied TEC mapping was used to map identified constraint features.

Threatened species

The occurrence of specific threatened species was used to quantify, at a local scale, the importance of that location for that species. Only specific species such as those listed as non-ecosystem predicted species on the Threatened Species Database (OEH 2014) were considered in this analysis. 'Ecosystem predicted' species were not considered as these species are considered in the calculation of the vegetation cover constraint class (i.e. via the BBCC). Further, such considerations were only afforded to species where a distinct mapped feature could be used utilised (e.g. threatened plant occurrence, nest of a threatened raptor). A radial buffer was applied to point locations depicting an occurrence, habitat

feature or the like. A feature specific buffer radius was applied. Lands within the buffer scored 1 with residual lands scoring a 0.

Koala Habitat

Lands mapped as Koala habitat in the CHCC Comprehensive Koala Plan of Management (CKPoM) were assigned a constraint value as follows:

- Primary habitat 1.0
- Secondary habitat 0.6
- Tertiary habitat 0.3

Arboreal Habitat

CHCC HV Arboreal Habitat Mapping (Fisher *et. al.* 2014) was used as the request of Council (June 2014) as a source of information suitable for the consideration of 'old growth'. Constraint values assigned to mapped features as listed below:

- category 1 – 1.00
- category 2 – 0.75
- category 3 – 0.50
- category 4 – 0.25

When requesting the incorporation of this information into the relative constraint index (July 2014), CHCC stated that arboreal habitats represent some of the highest conservation values present within the study area. Accordingly, a weighting of 2 has been applied this constraint class when calculating the 'relative constraint index'.

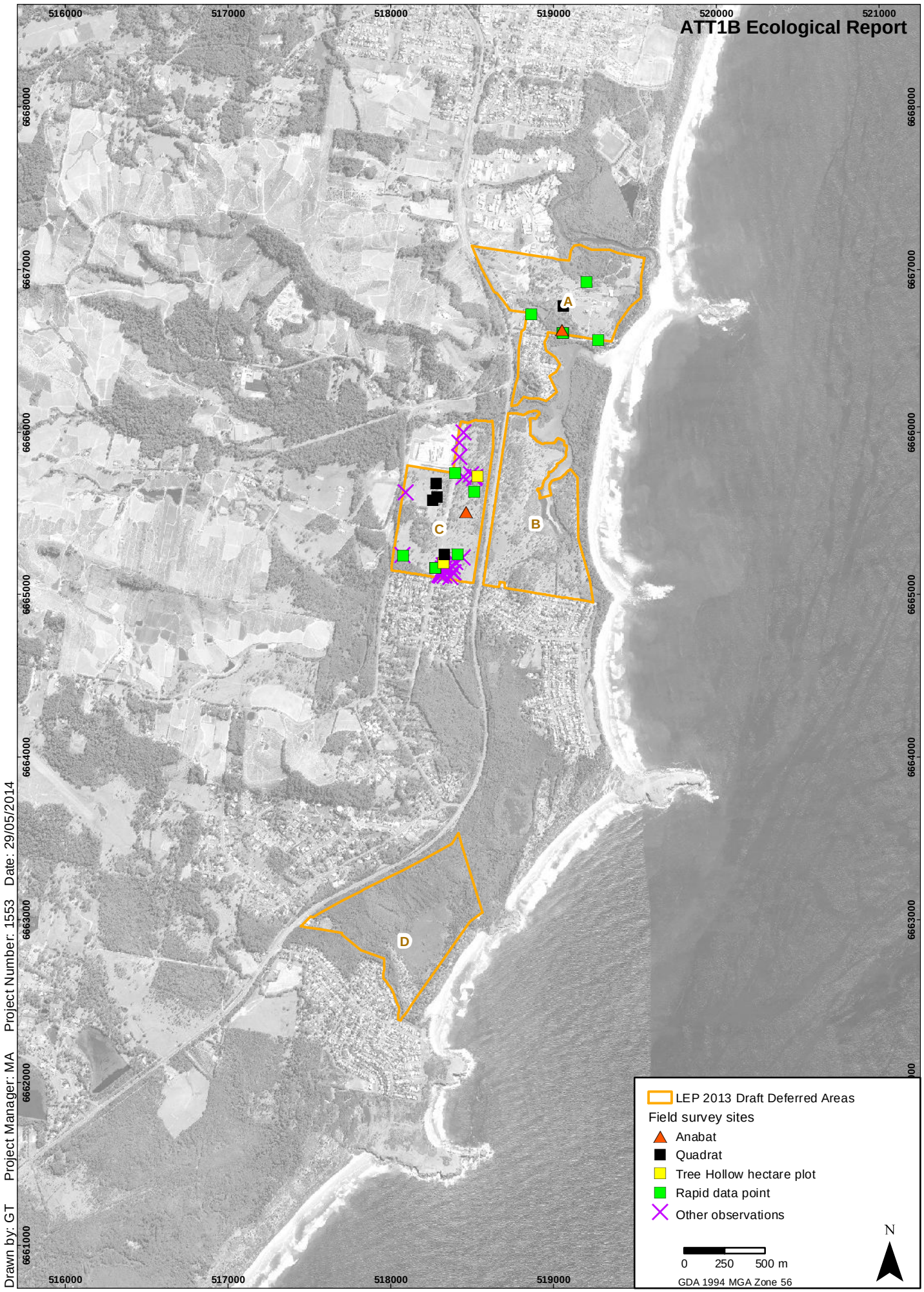
Notwithstanding the value of the HV Arboreal Habitat Mapping, it should be noted that such considerations are inherent in the calculation of the 'vegetation type' constraint class using the BioBanking methodology included the consideration of habitat condition (e.g. hollow bearing trees). As such there is potential for the duplication of this constraint theme in the 'relative constraint index'.

Corridors

Lands mapped as regional or subregion corridors by Scotts (2003) in the CHCC CKPoM were assigned the following constraint values:

- Regional 1.0
- Subregional 0.5

Areas contained within the 50 metre of major waterways have been includes and where additional to the Scott (2003) mapping have scored a value of 1.



Drawn by: GT Project Manager: MA Project Number: 1553 Date: 29/05/2014

Survey effort (study area north)

Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 3

niche Environment and Heritage

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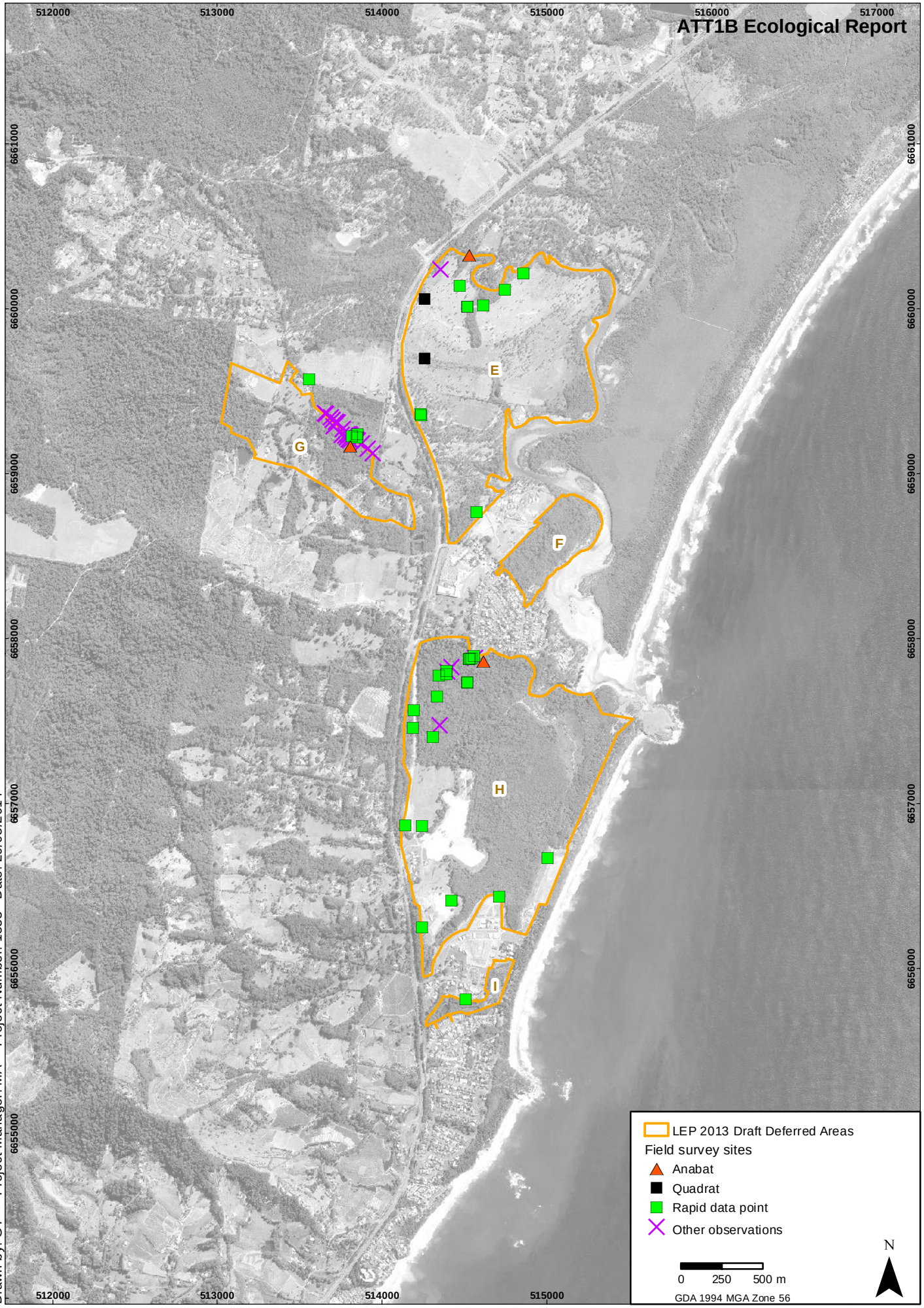
Imagery: (c) CCC 2009



Drawn by: GT Project Manager: MA Project Number: 1553 Date: 29/05/2014

Survey effort (study area south)

Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 4

niche Environment and Heritage

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Imagery: (c) CCC 2009

3 RESULTS

3.1 Landscape context

The study area is located within the Northern Rivers Catchment Management Authority (CMA) of the Northern Rivers Bioregion. Details on relevant Mitchell Landscapes and connectivity are provided as follows.

3.1.1 Mitchell Landscapes

NSW Landscapes mapping also known as the Mitchell landscape (DECC 2003) provides a meaningful framework for the NSW Ecosystems Database. It creates a consistent State wide map using the best available data useful for developing and tracking conservation priorities and progress across NSW. Mapping is primarily based on geomorphic characteristics and as such provides a useful adjunct to more detailed vegetation mapping where the latter is available.

Mitchell Landscapes occurring within the study area are shown in Figure 5 and Figure 6.The dominant Mitchell Landscape for each area is outlined in Table 3. Table 4 briefly outlines key catchment and vegetation cover statistics for these Mitchell Landscapes.

Table 3. Mitchell Landscapes found within the study area

Area	A	B	C	D	E	F	G	H	I
NSW Mitchell landscape	Brooms Head - Kempsey Coastal Ramp	Manning - Macleay Coastal Alluvial Plain	Brooms Head - Kempsey Coastal Ramp	Manning - Macleay Barriers and Beaches	Manning - Macleay Coastal Alluvial Plain	Manning - Macleay Coastal Alluvial Plain	Brooms Head - Kempsey Coastal Ramp	Manning - Macleay Coastal Alluvial Plain	Manning - Macleay Coastal Alluvial Plain

Table 4. Mitchell Landscapes statistics

NSW Mitchell Landscapes	Landscape area (ha)	Reserved area (ha)	Reserved %	Cleared %
Brooms Head - Kempsey Coastal Ramp	76,431	21,301	27.9	26
Manning - Macleay Barriers and Beaches	40,146	25,299	63.0	24
Manning - Macleay Coastal Alluvial Plain	161,278	29,732	18.4	57

The most prominent hence relevant Mitchell Landscape within the study area is Manning - Macleay Coastal Alluvial Plain and is described as follows:

'Wide valleys, channels, floodplains, swamps, and terraces of the Manning and Macleay rivers and other coastal streams on Quaternary alluvium, general elevation 0 to 50m, local relief 15m. Dark organic loams and silty clay on the floodplain, gradational brown loams and yellow-brown texture-contrast soil on terraces, organic silty mud in swamps' (DECC 2003).

As indicated in Table 4 none of these landscapes are classified as overcleared (i.e. > 70 % cleared). However, potential exists for the dominant Mitchell Landscape of the study area (i.e. Manning Macleay Coastal Alluvium Plains) to progress towards an overcleared status and as such further vegetation loss in these areas may have substantial cumulative impacts. Further, individual vegetation communities known

to occur in this landscape may be classified as overcleared where there has been disproportionate land clearing effort.

3.1.2 Corridors

Regional and sub regional corridors identified within the study area by Scotts (2003) are shown in Figure 7. Scotts (2003) identified a regional north-south corridor following the coastline through parts of the study area. A sub-regional east-west corridor also intersects the study area, which links the regional north-south coastal corridor to a regional north-south corridor occurring further inland.

Local corridors identified by CHCC (2012) that occur in the study area include:

- Mullaway – Arrawarra – Darlington;
- Hearnes Lake - Double Crossing Creek;
- Emerald Beach - Moonee Creek - Wedding Bells;
- South Moonee Forest - Wedding Bells; and
- Korora - Korora Basin

These local corridors have been identified by CHCC (2012) as supporting important biodiversity values and providing overall habitat connectivity.

3.2 Prior site investigations

A review of flora and fauna investigations prepared for various development proposals in parts of the study area is provided. The following sections summarise information considered relevant to this investigation including survey effort and investigation results.

3.2.1 Survey methods and effort

Survey methods and effort reported in prior site investigations of the study area is provided in Table 5.

Table 5. Previous survey effort in study area

Survey method	Whelans (2006) Moonee Waters	James Warren (2007a)	James Warren (2007b)	ELA (2007)	James Warren (2008)	PEA (2013)
Flora survey	Plots and random meander 3 days	Plots and random meander	Plots and random meander	6.5 hours including targeted survey for *Thesium australe.*	Plots and random meander	Quadrats and random meander
Spotlighting	23 hours			2 hours 50 mins	Unspecified/ opportunistic	27 hours
Pitfall traps	24 trap nights	25 trap nights				10 trap nights
Harp traps	10 trap nights	6 nights		8 trap nights		
Elliot trapping (terrestrial)		336 trap nights				620 trap nights
Elliot trapping (arboreal)		33 trap nights				920 trap nights
Cage trapping		32 nights				
Koala searches	17 hours			opportunistic		
Call playback	2 nights	4 nights		3 hours 40 mins		
Anabat recording	34.5 hours	24 hours		2 hours 40 mins	Unspecified	80 hours
Bird survey	Opportunistic	4 morning targeted survey			Opportunistic	
Reptile	Opportunistic				Opportunistic	Opportunistic

Survey method	Whelans (2006) Moonee Waters	James Warren (2007a)	James Warren (2007b)	ELA (2007)	James Warren (2008)	PEA (2013)
Amphibian		2 hours		3 hours	Opportunistic	Opportunistic
Hair tubes		420 trap nights				
Fauna habitat assessment	Opportunistic	Opportunistic	Opportunistic	Opportunistic		

The PEA (2013) and James Warren (2007a) surveys appear to be the most comprehensive surveys conducted in the study area although it appears that not all the survey methods prescribed by DEC (2004) were completed.

3.2.2 Hearnes Lake

ELA (2007) prepared a detailed flora and fauna assessment for a proposed staged residential subdivision within Lot 21 DP 714858, at 45 Hearnes Lake Road, Woolgoolga. Investigation methods included random meanders, ultrasonic bat detector recording, call playback, habitat assessments and targeted surveys including a focus on Austral Toadflax (*Thesium australe*). The investigation findings included:

- The confirmed presence of the threatened plant Austral Toadflax with an estimated 600 individuals;
- Presence of four TECs these being:
  - Swamp Sclerophyll Forest in the NSW North Coast Bioregion EEC;
  - Freshwater Wetland on Floodplain in the NSW North Coast Bioregion EEC;
  - Littoral Rainforest in the NSW North Coast Bioregion EEC, which is commensurate with the Littoral Rainforests and Coastal Vine Thickets critically endangered ecological community listing under the EPBC Act;
  - Subtropical Coastal Floodplain Forest in the NSW North Coast Bioregion EEC.

3.2.3 Moonee Beach

Flora and fauna assessments for Lots 1 & 2 DP 725785 (James Warren and Associates 2007a), Lot 211 DP1044292 (James Warren and Associates 2007b) and Lot 5, DP 252223 (James Warren and Associates 2008) were completed for various proposed residential developments. Investigations included analysis of vegetation cover, habitat values and corridors using standard survey methods. James Warren and Associates (2007a) reported the following biodiversity values in Lots 1 & 2 DP 725785:

- 167 species of flora were recorded, however none were listed as threatened;
- Two regionally significant flora species were recorded, being the White Stringybark (*Eucalyptus globoidea*) and Christmas Bells (*Blandfordia grandiflora*);
- 99 fauna species were recorded, including 29 mammal species, 59 bird species, 6 amphibian species and 5 reptile species. These included 11 threatened species, as listed below:
  - Squirrel Glider;
  - Little Bent Wing Bat;
  - Common Bent Wing Bat;
  - Large-footed Myotis;
  - Koala;
  - Grey-headed Flying Fox;
  - Glossy-black Cockatoo;

- Eastern Osprey;
- Wallum Froglet (possible);
- Varied Sittella; and
- Little Lorikeet.

Similar results were reported by Lot 5 DP 252223 James Warren and Associates (2008). Findings included:

- 143 flora species recorded with none listed as threatened;
- Two TECs including Swamp Sclerophyll Forest on Coastal Floodplains in the NSW North Coast Bioregion EEC and Saltmarsh in the NSW North Coast Bioregion, which is also commensurate with Subtropical and Temperate Saltmarsh (a TEC under the EPBC Act).
- 81 fauna species, consisting of six species of reptiles, four species of amphibians, 49 bird species and 22 mammals including the following threatened fauna species:
  - Glossy-black Cockatoo;
  - Little Bent Wing Bat;
  - Common Bent Wing Bat;
  - Large-footed Myotis;
  - Koala; and
  - Grey Headed Flying Fox.

Fewer biodiversity values were reported within Lot 211 DP1044292 by James Warren and Associates (2007b) although it is likely that reduced survey methods and effort have influenced the reported findings. Results included:

- 154 flora species recorded, including two threatened flora species, being the Rusty Plum and the Moonee Creek Quassia; and
- Recorded 20 species of birds and two mammals. Surveys occurred in winter, thus no data occurred for reptiles, amphibians or microbats. No threatened fauna were recorded in this survey.

Whelans Insites (2006) reported the following biodiversity values in a flora and fauna assessment for Lot 66 DP 551005:

- 296 native plant species recorded on the site including two listed threatened species these being the Rusty Plum (*Amorphospermum whitei*) and the Moonee Quassia;
- One plant of regional conservation significance was recorded, being the Climbing Maidenhair (*Lygodium microphyllum*);
- Five TECs including:
  - Swamp Oak Forest in the North Coast Bioregion;
  - Swamp Sclerophyll Forest in the North Coast Bioregion;
  - Freshwater Wetlands on Coastal Floodplains in the North Coast Bioregion;
  - Littoral Rainforest in the North Coast Bioregion, which is commensurate with Littoral Rainforest and Coastal Vine Thickets Critically Endangered Ecological Community listing under the EPBC Act;
  - Saltmarsh in the NSW North Coast Bioregion, which is commensurate with the EPBC Act listed Subtropical and Temperate Saltmarshes; and
- 146 fauna species including 15 threatened fauna species, these being:
  - Eastern Osprey;
  - Square-tailed Kite;
  - Regent Honeyeater;
  - Glossy-black Cockatoo;

- Grey-headed Flying Fox;
- Yellow-bellied Glider;
- Koala;
- Common Planigale;
- Common Blossom Bat;
- Eastern Freetail Bat;
- Little Bent Wing Bat;
- Common Bent Wing Bat;
- Golden Tipped Bat;
- Yellow-bellied Sheathtail Bat;
- Large-footed Myotis.

While informative it should be noted that the collective findings may not accurately characterise current ecological condition and biodiversity values present within the Moonee Beach precinct as these investigations are greater than five years old.

The most recent site investigation completed by PEA Consulting (2013) within Lot 1 DP1097743 and Lot 6 DP252223 was a relatively comprehensive study. Surveys were conducted over a two year period (Winter 2010 and March-October-December 2011) using a range of survey methods that were generally in accordance with DEC (2004). Relevant survey findings were:

- 115 flora species including 42 species of weeds. No threatened species were observed;
- The occurrence of one TEC (i.e. Swamp Sclerophyll Forest on Coastal Floodplains in the NSW North Coast Bioregion EEC);
- 64 fauna species including 11 species of amphibians, 36 species of birds, nine microchiropteran bats and eight ground/ arboreal mammals. Seven threatened fauna species were reported these being:
  - Glossy-black Cockatoo;
  - Eastern Osprey;
  - Grey-headed Flying Fox;
  - Little Bent Wing Bat;
  - Eastern Bent Wing Bat;
  - East Coast Freetail Bat;
  - Squirrel Glider.

Unlike studies completed prior to 2009 it is considered that the results reported in this investigation are informative for the purposes of characterising the current ecological values present in the Moonee Beach precinct.

3.2.4 Sandy Beach North

Gunninah Environmental Consultants (2010) discusses the occurrence of the TECs 'Swamp Sclerophyll Forest on Coastal Floodplains on the NSW North Coast Bioregion' and 'Subtropical Coastal Floodplain Forest on the NSW North Coast Bioregion' within Lot 22 DP1070182 as does Conacher Environmental Group (2008, 2010, 2011). A 'Historical land use ecological assessment' has also been prepared (Conacher Travers 2007), which concludes that anthropogenic land use results in a loss of vegetation condition, habitat and biodiversity values.

Gunninah Environmental Consultants (2010), Conacher Environmental Group (2008) and Conacher Environmental Group (2010) conclude that the two TECs do not occur onsite despite CHCC (2012) vegetation mapping showing the contrary. However, it was conceded that the floristic composition of vegetation communities mapped within Lot 22 align with the aforementioned TECs. The argument for dismissing the presence of these TECs is based on the vegetation not occurring on a floodplain Conacher Environmental Group (2010) and Conacher Environmental Group (2011). Land and Environment Court judgement 2007 NSW LEC 74 does not necessarily support this conclusion. It is considered prudent to adopt the precautionary approach in classifying constraints within this area until proven otherwise.

3.3 Vegetation

3.3.1 CHCC mapping

Vegetation mapping based on high resolution imagery prepared by CHCC (2012) was produced for the Coffs Harbour LGA as shown in Figure 8, Figure 9, Figure 10 and Figure 11. Vegetation communities mapped in the study area are listed in Table 6.

Table 6. Mapped vegetation communities and areas

Vegetation community (MU Code)	Vegetation Community (CHCC 2012)	Area (ha)
CH_DOF01	Coast and Escarpment Blackbutt Dry Forest	70.0
CH_DOF04	Hinterland Needlebark Stringybark - Scribbly Gum - Red Mahogany Dry Forest	4.6
CH_DOF05	Foothills Grey Gum - Ironbark - Mahogany Dry Forest	11.6
CH_DOF06	Lowlands Swamp Box - Paperbark - Red Gum Dry Forest	40.7
CH_DOF08	Coastal Sand Bloodwood - Banksia Forest	0.7
CH_DOF09	Coast Sand Blackbutt - Bloodwood - Apple Forest	3.9
CH_FrW01	Coastal Paperbark Swamp Oak Floodplain Forest	45.1
CH_FrW02	Coastal Swamp Mahogany Forest	8.7
CH_FrW03	Coastal Paperbark Bottlebrush Channel Forest	2.4
CH_FrW04	Coastal Paperbark Sedgeland Dominated Forest	37.7
CH_FrW05	Coastal Paperbark Swamp Box Littoral Forest	5.7
CH_FrW09	Coastal Wallum Swamp Mahogany Sieber's Paperbark Forest	3.2
CH_FrW10	Swamp Oak Forested Wetland	9
CH_FrW11	Estuarine Paperbark Twig-rush Forest	2.9
CH_FrW11	Estuarine Paperbark Twig-rush Forest	5.7
CH_FW02	Coastal Wallum Paperbark Banksia Grass Tree Wet Heathland	7.9
CH_FW07	Coastal Jointed Twig-rush Freshwater Wetland	0.8
CH_FW08	Coastal Freshwater Wetland	0.3
CH_H01	Coast Banksia Shrubland on Holocene Dunes	10.4
CH_H01	Coast Banksia Shrubland on Holocene Dunes	0.1
CH_H02	Coast Wattle Shrublands	0.6
CH_H03	Kangaroo Grass Headland Grasslands	0.2
CH_H07	Coastal Headland Swamp Oak Shrublands	0.1

Vegetation community (MU Code)	Vegetation Community (CHCC 2012)	Area (ha)
CH_H08	Wallum Banksia Black She-oak Shrubland	0.8
CH_MV01	Seagrass beds	2.4
CH_NRV01	Native remnant vegetation	5.4
CH_P03	Environmental plantings	0.6
CH_RF07	Coastal Exposed Dune Littoral Rainforest	3.5
CH_RF08	Headland Brush Box Littoral Rainforest	0.2
CH_RF11	Escarpment and Lowland Bangalow - Carabeen - Black Booyong Palm Gully Rainforest	1.2
CH_SW01	Estuarine Mangrove Forest	4.4
CH_SW02	Estuarine Twig Rush Saltmarsh	2.1
CH_SW06	Sea Rush Saltmarsh	3.7
CH_SW07	Estuarine Samphire - Saltwater Couch Saltmarsh	3.1
CH_WSF01	Coast and Hinterland Riparian Flooded Gum Bangalow Wet Forest	10.5
CH_WSF05	Foothills to Escarpment Brush Box - Tallowwood - Blackbutt Wet Forest	19.4
CH_WSF09	Northern Escarpment Blackbutt - Apple Wet Ferny Forest	3.5
CH_WSF10	Hinterland and Escarpment Tallowwood - Blackbutt - Blue Gum Wet Ferny Forest	0.8
CH_WSF17	Foothills Turpentine - Grey Gum - Ironbark Moist Shrubby Forest	4.9
DOF06	Lowlands Swamp Box - Paperbark - Red Gum Dry Forest	12.6
	TOTAL mapped in study area	**351.4**

3.3.2 Validation and alignment

The 61 vegetation communities mapped by CHCC within the study area were validated with adjustments made for this analysis shown in Figure 13, Figure 14 and Figure 15. The vegetation communities were aligned with 22 RBVTs as shown in Appendix A and Figure 16 and Figure 17. Table 7 provides a summary of the aligned vegetation type classified as over-cleared vegetation types (OCVTs).

Table 7. Vegetation type alignment within study area

MU_CODE	MU Name	RBVT Code	RBVT	Percent cleared
CH_H03	Kangaroo Grass Headland Grasslands	NR271	*Themeda australis* sod tussock grassland of coastal areas of the North Coast	90
CH_H01 / CH_RF07	Coastal Exposed Dune Littoral Rainforest			
CH_RF07	Coastal Exposed Dune Littoral Rainforest			
CH_EX02 / CH_RF11	Escarpment and Lowland Bangalow - Carabeen - Black Booyong Palm Gully Rainforest	NR111	Black Booyong - Rosewood - Yellow Carabeen subtropical rainforest of the North Coast	75
CH_SW01	Estuarine Mangrove Forest	NR182	Mangrove - Grey Mangrove low closed forest of the NSW Coastal Bioregions.	75
CH_SW06 / CH_SW01	Estuarine Mangrove Forest			
CH_DOF06/ CH_FrW01	Coastal Paperbark Swamp Oak Floodplain Forest	NR217	Paperbark swamp forest of the coastal lowlands of the North Coast.	75
CH_DOF08/ CH_FrW05	Coastal Paperbark Swamp Box Littoral Forest			
CH_FrW01	Coastal Paperbark Swamp Oak Floodplain Forest			
CH_FrW01/ CH_FrW04	Coastal Paperbark Sedgeland Dominated Forest			

MU_CODE	MU Name	RBVT Code	RBVT	Percent cleared
CH_FrW03	Coastal Paperbark Bottlebrush Channel Forest			
CH_FrW04	Coastal Paperbark Sedgeland Dominated Forest			
CH_FrW05	Coastal Paperbark Swamp Box Littoral Forest			
CH_SW01 / CH_SW07	Estuarine Samphire - Saltwater Couch Saltmarsh	NR225	Saltmarsh complex of the North Coast	75
CH_SW02	Estuarine Twig Rush Saltmarsh			
CH_SW06	Sea Rush Saltmarsh			
CH_SW07	Estuarine Samphire - Saltwater Couch Saltmarsh			
CH_FrW02	Coastal Swamp Mahogany Forest	NR254	Swamp Mahogany swamp forest of the coastal lowlands of the North Coast.	75
CH_FrW09	Coastal Wallum Swamp Mahogany Sieber's Paperbark Forest			
CH_FrW01/ CH_FrW11	Estuarine Paperbark Twig-rush Forest	NR255	Swamp Oak swamp forest of the coastal lowlands of the North Coast	75
CH_FrW10	Swamp Oak Forested Wetland			
CH_FrW11	Estuarine Paperbark Twig-rush Forest			
CH_H08	Wallum Banksia Black She-oak Shrubland	NR105	Banksia dry shrubland on coastal sands of the North Coast	70

OCVTs are RBVTs that have more than 70 percent of their former extent cleared. As a consequence these vegetation types often contain a disproportionate quantum of threatened and or declining biodiversity. Eight RBVTs identified within the study area are considered to also be OCVTs and which are shown in Figure 18 and Figure 19.

3.3.3 Threatened Ecological Communities

Six TECs listed under the TSC Act align to vegetation mapped within the study area as shown in Figure 20 and Figure 21, these being:

- Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions;
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions;
- Littoral Rainforest in the NSW North Coast, Sydney Basin and South Eat Corner Bioregions;
- Subtropical Coastal Floodplain Forest of the NSW North Coast Bioregion;
- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions; and
- Themeda Grassland on Seacliffs and Coastal Headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions.

Littoral rainforest is a critically endangered ecological community under the EPBC Act while Coastal Saltmarsh is a vulnerable ecological community under the EPBC Act. The alignment of the vegetation and listed TECs is provided in Appendix A.

3.3.4 Condition

Definitions for condition as provided by the BBAM (DECCW 2009) indicate that most of the vegetation cover occurring within the study area is native vegetation in moderate to good condition. The larger

patches of treed vegetation cover, which have not been heavily exposed to prior disturbance, are likely to be within benchmark condition (see OEH 2012). Smaller patches, which are often exposed to edge effects, are likely to exhibit lower biodiversity values hence representative of poorer condition. Condition assessments have included, where appropriate, the consideration of site attribute data collected from the study area as shown in Appendix B.

Observed native vegetation condition ranged from moderate to good - poor (e.g. treeless vegetation comprising low native plant species richness and depleted vegetation structure and habitat) to moderate to good - high (i.e. intact native plant floristics and vegetation structure). An outline of the conditions classes observed in the study area is provided as follows.

Modified condition (moderate to good – poor)

Treeless vegetation cover, which has been previously or is currently being disturbed, was frequently observed as having more than 50 per cent native plant species cover in the groundcover stratum. Natural biodiversity values remain in these areas albeit less than what would be expected for vegetation in benchmark condition.

The detailed mapping of 'derived' native vegetation such as native grasslands (e.g. poorer condition native vegetation having no overstorey or midstorey representation) has not been undertaken as the mapping of this native vegetation cover requires considerable field based verification. However, native vegetation classified in poor condition, such as derived native grasslands, still have biodiversity values and as such have potential to function as habitat for threatened flora and fauna species. Areas of this type of native vegetation cover may occur within areas mapped by CHCC (2011) as non-native vegetation.

Benchmark condition (moderate to good – high)

Treed vegetation cover showing evidence of an intact understorey can be visually estimated from aerial photography interpretation. Such areas are assumed to be within benchmark condition for the purposes of this assessment, although, it is acknowledged that a wider range of condition states would be elucidated from a more detailed field investigation. This represents a conservative approach to classifying vegetation condition.

3.4 Flora

A total of 49 listed threatened flora were identified from database searches, literature review and field surveys. Likelihood of occurrence for these threatened species is provided in Appendix C. Of these, 32 species have a moderate to high likelihood of occurrence within the study area. Prominent factors supporting the moderate to high likelihood of occurrence include:

- Known associations with vegetation types;
- Known occurrences with the Mitchell Landscapes; and
- Known occurrences within 10 kilometres of the study area.

Threatened flora species previously recorded in the study area include:

- Austral Toadflax (*Thesium australe*): Area A;
- Rusty Plum: Area H; and
- Moonee Quassia: Area H.

The site investigation confirmed the presence of *Quassia* sp. Mooney Creek within the study area. It was recorded south of Moonee Creek in Area H and mapped in Figure 22 and Figure 23. Approximately four

individuals were recorded in potential habitat and all were recorded in close proximity to one another. Further targeted surveys are required to refine the likelihood of occurrence for these species, especially in areas of high potential habitat.

3.4.1 *Quassia* sp. Mooney Creek (Moonee Quassia)

The Monee Quassia (Quassia sp. 'Moonee Creek') is a shrub or small trees, which, as at 2005 is known from only 18 locations between Moonee Beach in the south and McCrae's Knob, 12km east of Ulmarra in the north (DEC 2005). An estimated number of between 5,000-7,000 individuals occur, with an estimated 3,000 individuals occurring in Orara East and Conglomerate State Forests, to the northwest of Coffs Harbour (DEC 2005). The species is listed as Endangered under the NSW TSC Act and Commonwealth EPBC Act. The typical habitat for the species is classified as wet sclerophyll forest, with a canopy of Tallowwood (*Eucalyptus microcorys*), Brush Box (*Lophostemon confertus*), Turpentine (*Syncarpia glomulifera*) and Forest Oak (*Allocasuarina torulosa*; DEC 2005).

Little is known of the ecology of the species. It is unknown if it flowers annually, the level of seed set, the effect of competition from other plants and the effect of fire regimes on the long term survival of the species (DEC 2005). Seedlings are rarely observed and the species are difficult to age, although mature plants are known to have extensive root systems (DEC 2005). The impact of weeds on the long-term survival of the species also requires quantification, as the preferred habitat is often dominated by dense thickets of Lantana (*Lantana camara*) and other environmental weeds.

Prior records indicate this species predominantly occurs along streams, gullies and drainage lines in wet sclerophyll forest. *Quassia sp. Mooney Creek* has been previously recorded in the study area and was recorded in this investigation near Moonee Creek in the vegetation community 'Foothills to Escarpment Brush Box - Tallowwood - Blackbutt Wet Forest'. Vegetation communities containing potential habitat as detailed in DEC (2005) include:

- Coastal Exposed Dune Littoral Rainforest;
- Escarpment and Lowland Bangalow - Carabeen - Black Booyong Palm Gully Rainforest;
- Foothills to Escarpment Brush Box - Tallowwood - Blackbutt Wet Forest;
- Headland Brush Box Littoral Rainforest;
- Foothills Grey Gum - Ironbark - Mahogany Dry Forest;
- Foothills Turpentine - Grey Gum - Ironbark Moist Shrubby Forest;
- Coast and Escarpment Blackbutt Dry Forest;
- Coast and Hinterland Riparian Flooded Gum Bangalow Wet Forest;
- Hinterland and Escarpment Tallowwood - Blackbutt - Blue Gum Wet Ferny Forest;
- Northern Escarpment Blackbutt - Apple Wet Ferny Forest.

The previous records, current record and predicted habitat are shown in Figure 22 and Figure 23.

3.5 Fauna

Diurnal site investigations conducted in October 2013 resulted in the observation of 32 birds, two frogs, three non-flying mammals and three reptile species. The spotlighting survey resulted in the observation of one sugar glider in vegetation mapped as Coast and Hinterland Riparian Flooded Gum Bangalow Wet Forest to the north of Area G. Microchiropteran bat surveys resulted in the recording of the following microbats:

- Area A (Lowlands Swamp Box - Paperbark - Red Gum Dry Forest, near creek) = Unidentified Long-eared Bat (*Nyctophilus sp.*);
- Area C (Lowlands Swamp Box Paperbark Forest near large tree hollow) = White-striped Mastiff Bat (*Tadarida australis*), Gould's Wattled Bat (*Chalinolobus gouldii*), Hoary Wattled Bat (*Chalinolobus nigrogriseus*), Little Bent-wing Bat (*Miniopterus australis*), Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*);
- Area E (Coast Escarpment Blackbutt Dry Forest, near a creek) = no calls;
- Area G (Foothills Grey Gum Ironbark Moist Shrubby Forest , near creek) = Gould's Wattled Bat (*Chalinolobus gouldii*); and
- Area H (Foothills Grey Gum Ironbark Moist Shrubby Forest, near creek) = Eastern Horseshoe Bat (*Rhinolophus megaphyllus*), Hoary Wattled Bat (*Chalinolobus nigrogriseus)* and Little Bent-wing Bat (*Miniopterus australis*).

Survey results are provided in Appendix D. Threatened fauna species are further discussed in Section 3.5.3.

3.5.1 Habitat types

The habitat types found within the study area comprise of the following vegetation formations:

- Coastal Dune Dry Sclerophyll Forests;
- Coastal Floodplain Wetlands;
- Coastal Freshwater Lagoons;
- Coastal Headland Heaths;
- Coastal Swamp Forests;
- Coastal Valley Grassy Woodlands;
- Cool Temperate Rainforests;
- Littoral Rainforests;
- Mangrove Swamps;
- Maritime Grasslands;
- North Coast Wet Sclerophyll Forests;
- Northern Hinterland Wet Sclerophyll Forests;
- Northern Montane Heaths;
- Saltmarshes;
- Subtropical Rainforests; and
- Wallum Sand Heaths.

The wetland and swamp sclerophyll vegetation formations provide known habitat for many listed ecosystem predicted threatened species such as Wallum Froglet. Threatened waterbirds including Australasian Bittern, Black Bittern and Painted Snipe have suitable habitat within these vegetation formations and highly likely to occur.

There is some evidence of habitat degradation at the edges of swamp sclerophyll forests where notable weed invasions by species including Lantana (*Lantana camara*), Narrow Leaf Privet, Camphor Laurel and Blue Morning Glory were observed. Vegetation away from the edges is generally in a good condition (i.e. benchmark condition).

3.5.2 Tree hollows (High Value Arboreal Habitat)

Land access limitations have meant that not all native vegetation cover could be inspected as part of this biodiversity constraints analysis resulting in a partial hollow-bearing tree survey. A total of 38 hollow-bearing trees were recorded opportunistically during the field survey with occurrence correlating well with HV Arboreal Habitat mapping as shown in Figure 24 and Figure 25 (Fisher et. al. 2014). Many of the hollow-bearing trees are recorded along road edges and east of Area C. Two, one hectare tree hollow plots in Area C recorded an average density of 7 hollow-bearing trees per ha, which when compared to the size of the area (20 hectares), results in approximately 140 hollow-bearing trees in Area C. This hollow-bearing tree density is above benchmark condition for the corresponding vegetation types.

A relatively low abundance of hollow bearing trees occurs within vegetation dominated by Spotted Gum, Sydney Blue Gum and Coastal Blackbutt. It is likely that these observations are linked to the effects of previous logging activity, which commenced locally in the mid 1800s with at least 10 harvests since commencement (Forests NSW CRAFTI logging records).

Conversely, areas less suited to timber production such as the Swamp Forests support higher densities of hollow-bearing trees. Swamp Mahogany forests are prime habitat for hollow dependant species such as the Squirrel Glider, a species which has been shown to reach high densities within similar vegetation communities near Tuncurry (Niche 2013). These forests are also important for Koala breeding activity.

3.5.3 Threatened fauna

A total of 96 threatened fauna listed on the TSC Act and or EPBC Act were generated from database searches. Threatened species previously recorded in each area include:

- Area E: Glossy Black Cockatoo, Eastern Bent Wing Bat, Little Bent Wing Bat, Large-footed Myotis, Koala, Grey-headed Flying Fox, Squirrel Glider, Eastern Osprey, East Coast Freetail Bat;
- Area H: Eastern Osprey, Square-tailed Kite, Regent Honeyeater, Glossy Black Cockatoo, Grey-headed Flying Fox, Yellow-bellied Glider, Koala, Common Planigale, Eastern Blossom Bat, Eastern Freetail Bat, Litlte Bent Wing Bat, Eastern Bent Wing Bat, Golden Tipped Bat, Yellow-bellied Sheathtail Bat and Broad-footed Myotis.

Threatened fauna species observed or recorded during the October survey include the Eastern Osprey (Area C), Glossy Black-cockatoo, Hoary Wattled Bat (Areas C and H), Little Bent-wing Bat (Areas C and H) and Eastern Bent-wing Bat (Areas C and H). An actively used Eastern Osprey nest was observed in the far north of Area C. Evidence of the Glossy Black Cockatoo was recorded in Area E.

A likelihood of occurrence analysis was prepared for each of the 96 threatened species and is provided in Appendix C. Given the extensive habitat features of the study area, 62 species have been assessed as having a moderate to high likelihood of occurrence within the study area.

3.6 Planning instruments

The following planning instruments have been considered in this investigation.

3.6.1 Northern Rivers Regional Biodiversity Management Plan

The Northern Rivers Regional Biodiversity Management Plan (DECCW 2010) aims to conserve and recover threatened species in the region. The specific actions discussed in this plan provide an important overarching narrative for the consideration of biodiversity values in the study area. Important considerations include:

- Anthropogenic climate change- universal threat;
- Decision making and knowledge gaps- universal threat;
- Clearing and fragmentation;
- Inappropriate fire regimes;
- Weeds;
- Pests;
- Forestry;
- Dieback;
- Hydrology and water quality;
- Diseases and pathogens;
- Human interference;
- Livestock;
- Chemical and waste;
- Demographic changes on small populations;
- Community engagement; and
- Information collation, monitoring, reporting.

Many of these considerations align or relate to key threatening process listed on the TSC Act with the negative effects on biodiversity most pronounced in over cleared vegetation types (OCVTs).

3.6.2 SEPP 14 – Coastal wetlands

A small portion of a SEPP 14 wetland occurs within Area A, while within Area H an entire SEPP 14 wetland occurs. These wetlands represent absolute constraints where specific planning requirements apply for development within these areas. Mapping showing the extent of SEP 14 Coastal Wetlands is provided as a distinct constraint layer on the final constraint map.

3.6.3 SEPP 26 littoral rainforests

There are no mapped occurrences of SEPP 26 Littoral Rainforests within the study area.

3.6.4 SEPP 44 – Koala habitat protection

In 1999 CHCC adopted the CKPoM for the Coffs Harbour LGA in place of the Koala habitat protection provisions defined in SEPP 44. The CHCC CKPoM identifies potential and known Koala habitat, ranking of habitat importance and Koala habitat corridors. The plan provides recommendations for planning determinations and controls.

Koala Habitat

Primary, Secondary or Tertiary Koala Habitat represent the conventional classification nomenclature used in a CKPoM to map Koala habitat. Such mapping has considered, among other factors, the preferred Koala

feed tree species identified in the Coffs Harbour LGA. Locally, the most important preferred Koala feed tree species is Tallowwood (*Eucalyptus microcorys*), which is commonly found in wet and dry sclerophyll forests above and within the floodplain landscape. Other important preferred Koala feed tree species include Swamp Mahogany (*Eucalyptus robusta*) and Forest Redgum (*Eucalyptus tereticornis*), these being commonly associated with floodplain landscapes.

Koala habitat types shown in Figure 26 indicate that the study area predominantly consists of secondary Koala habitat. There are no mapped occurrences of Primary Koala habitat and small areas of tertiary Koala habitat are present in Areas C and G. Mapping indicates that the study area provides an important contribution to overall habitat availability in the locality and is likely to provide an important role in linking areas of Primary Koala Habitat and supporting other lifecycle needs (e.g. dispersing and juvenile koalas, provide seasonal and drought foraging habitat, and may act as fire refuges).

Areas mapped as Tertiary Koala Habitat occur predominantly in rural parts of the LGA, generally west of the coastal range. While koala records occur throughout this area, and some important populations occur, Koala records are generally lower in these areas than those within other mapped habitat types in the LGA. Small areas of Tertiary Koala Habitat also occur within the study area.

Habitat Links

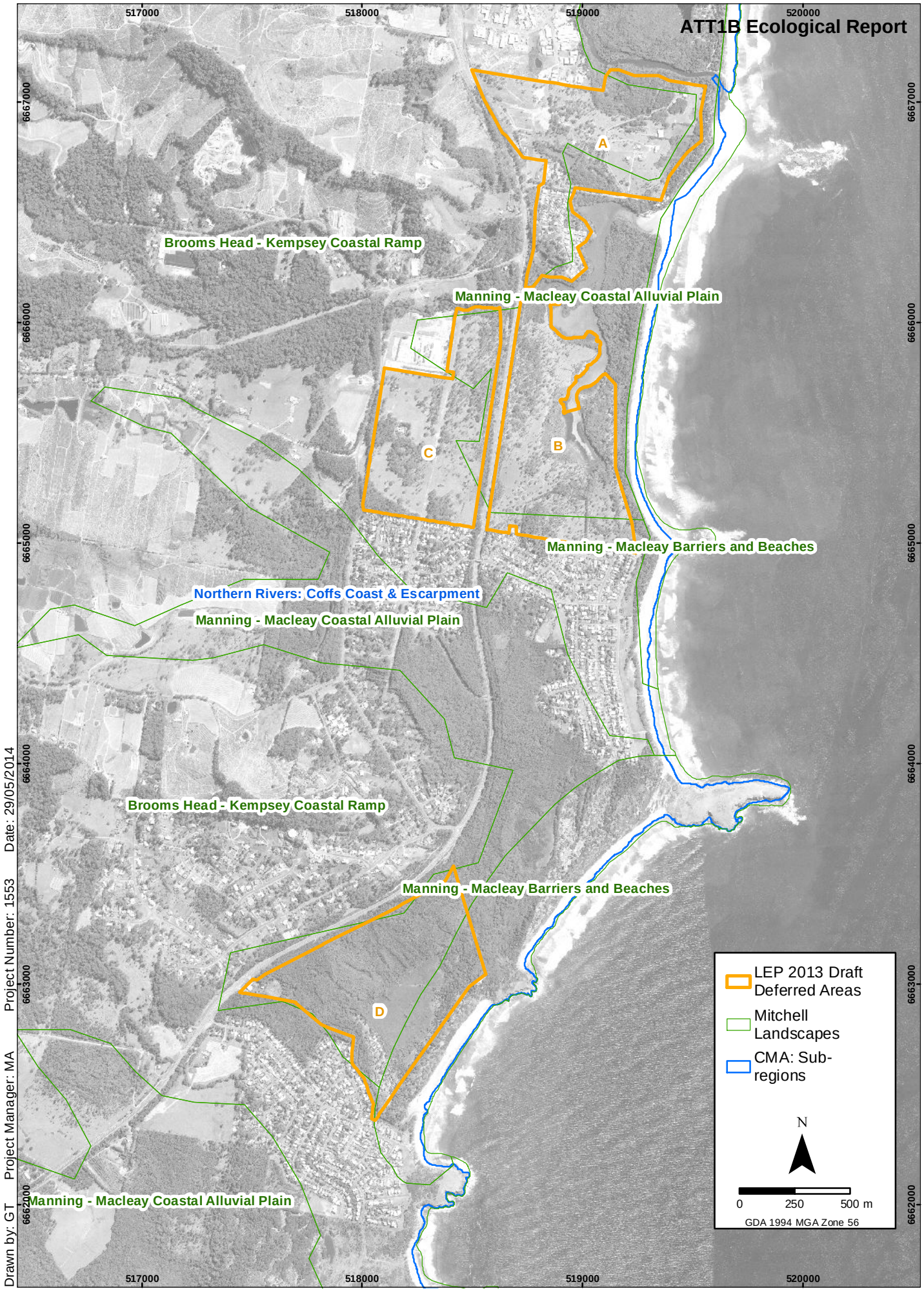
Habitat fragmentation has been long recognised as a key problem for maintaining a healthy Koala population in Coffs Harbour LGA. Identification, retention, management and enhancement of locally and regionally significant habitat links are considered by CHCC as vital to the long-term sustainability of a viable Koala population in the LGA, particularly in the south-east. Major habitat links mapped by CHCC do not coincide with the study area.

Locally Significant Links

Locally significant links need to be maintained or protected to provide resources across the landscape for Koalas to maintain normal social behavioural patterns within the population such as dispersal/recruitment of animals, maintenance of male social hierarchy and seasonal responses to habitat resources.

Regionally Significant Links

Regionally significant links provide for wider dispersal from larger habitat areas and the opportunity for re-establishment of koalas in areas where local extinction may have occurred. The opportunity for immigration on a regional level also buffers against potential loss of genetic diversity.



Date: 29/05/2014
Project Number: 1553
Project Manager: MA
Drawn by: GT

CMA, CMA Subregion and Mitchell Landscapes (study area north)

Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 5

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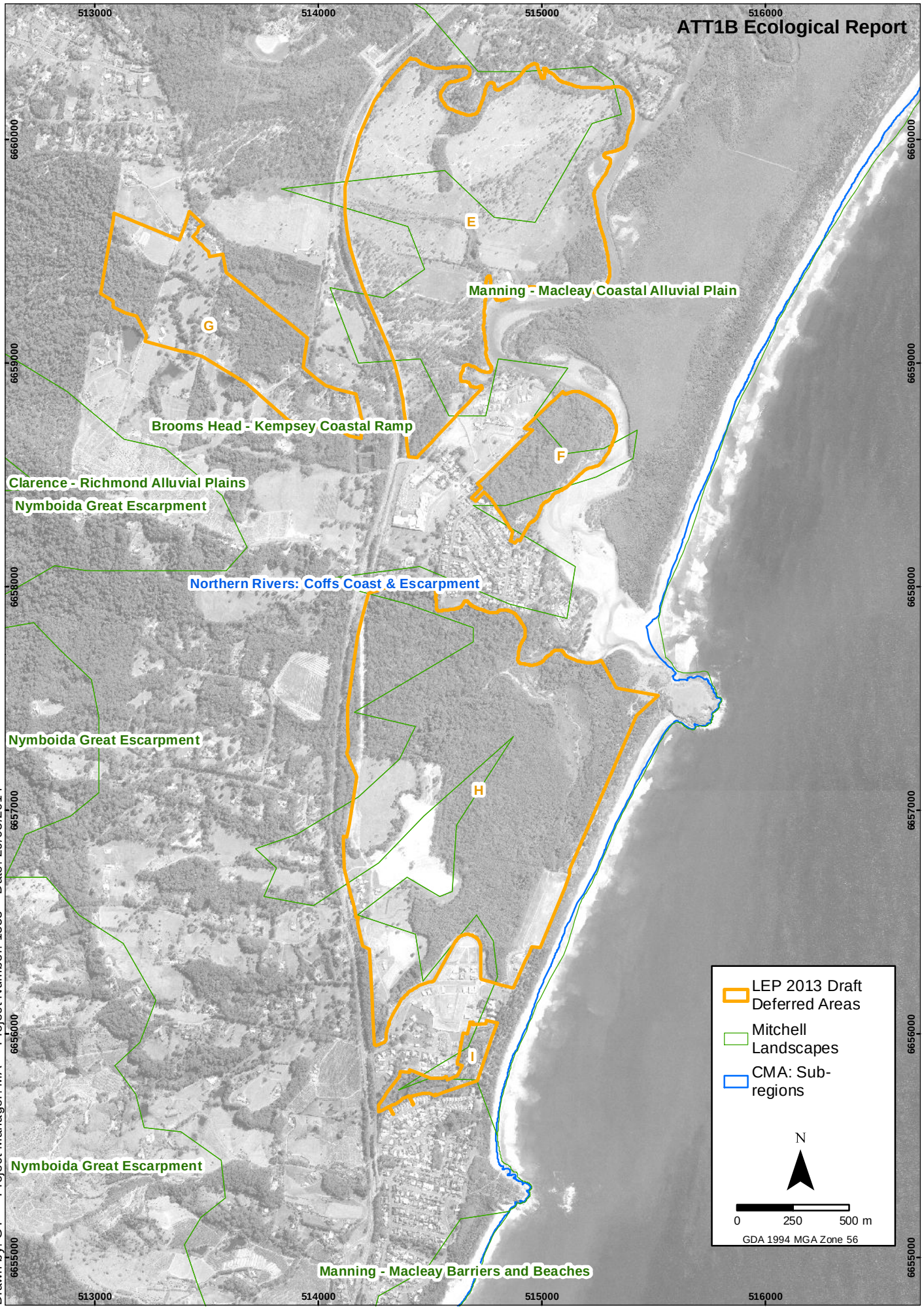

Drawn by: GT Project Manager: MA Project Number: 1553 Date: 29/05/2014

CMA, CMA Subregion and Mitchell Landscapes (study area south)

Coffs Harbour LEP Deferred Areas Local Environmental Study

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FIGURE 6

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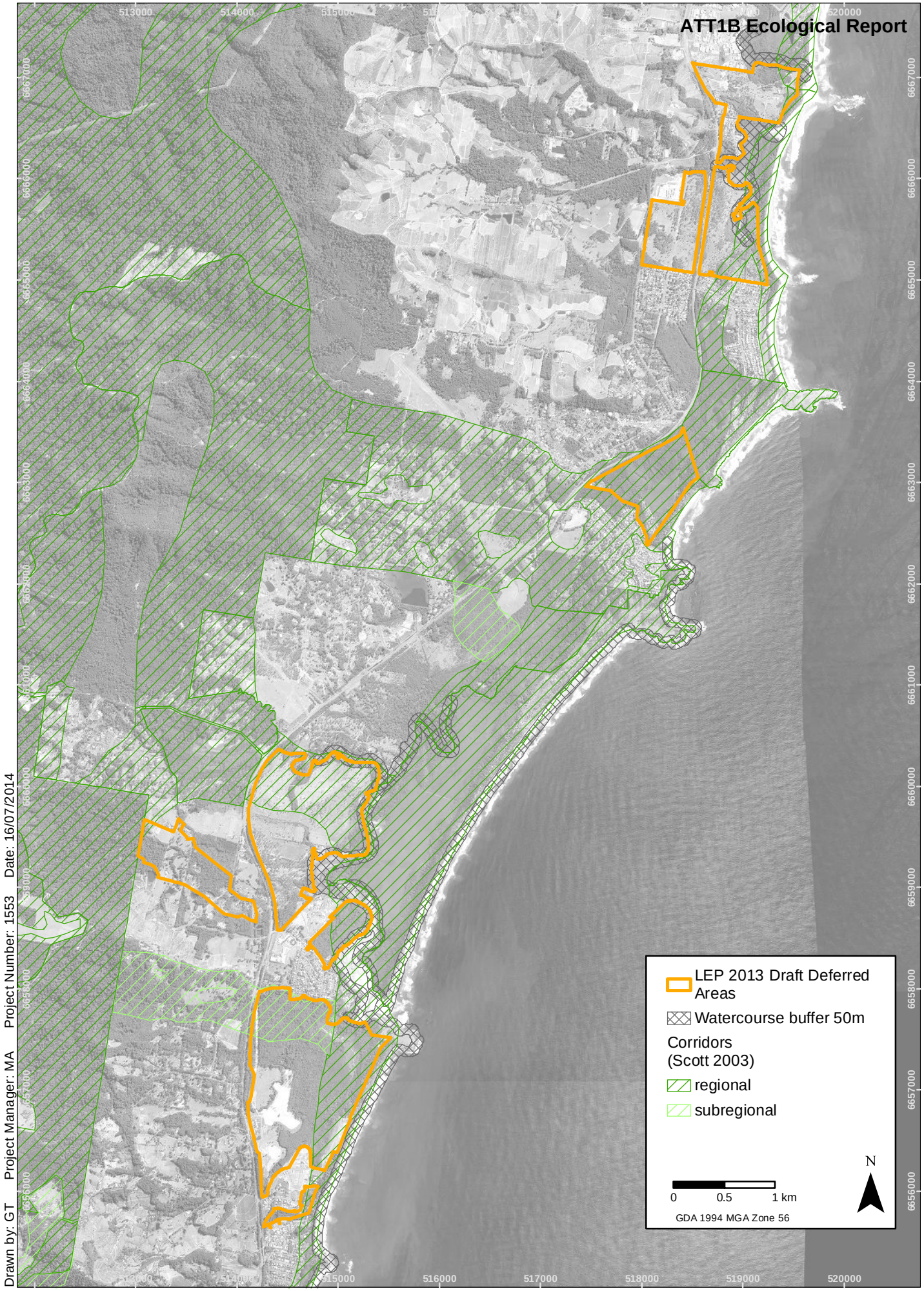

Drawn by: GT Project Manager: MA Project Number: 1553 Date: 16/07/2014

Connectivity and corridors

Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 7

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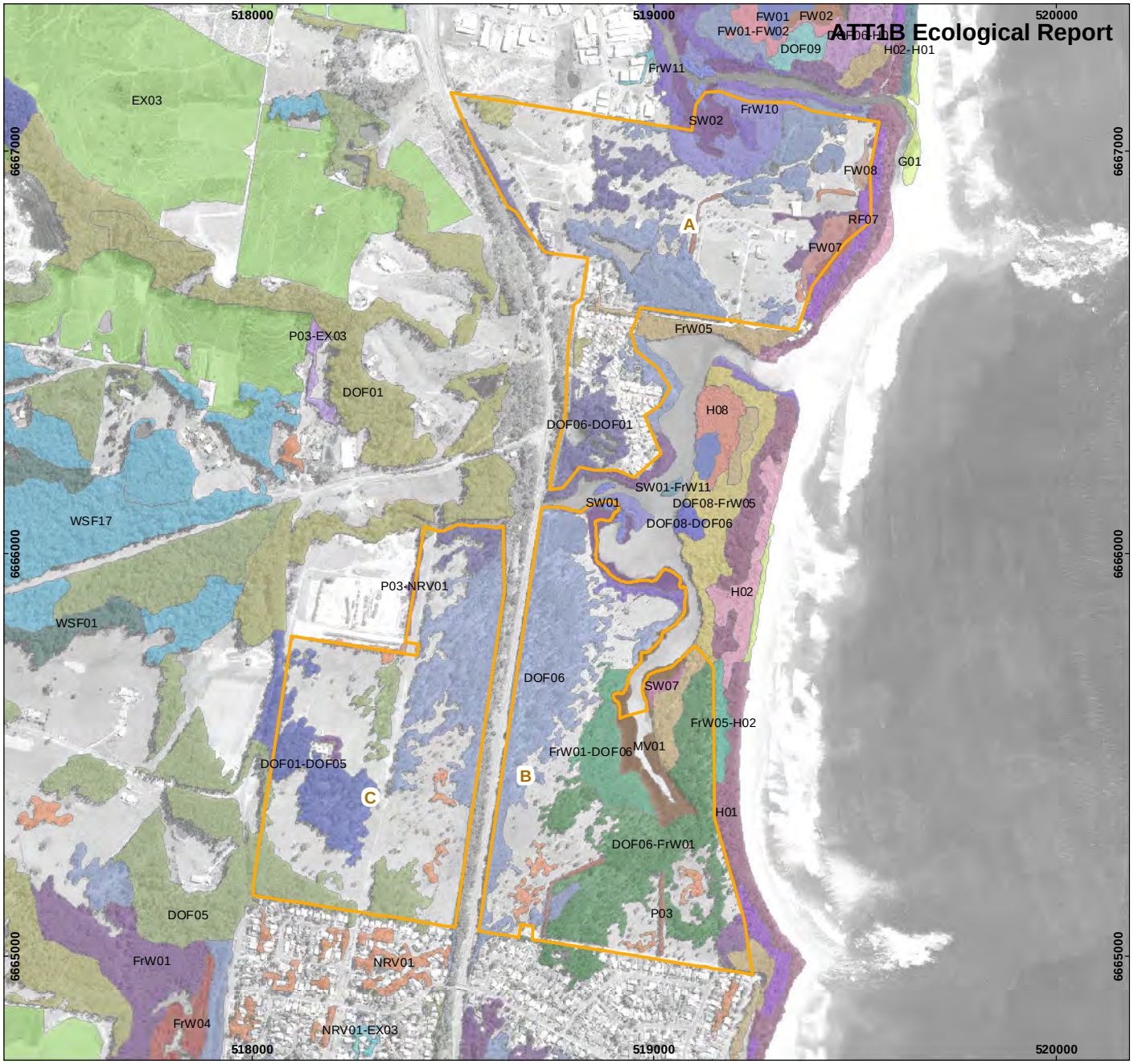

Date: 29/05/2014
Project Number: 1553
Project Manager: MA
Drawn by: GT

- LEP 2013 Draft Deferred Areas

Vegetation CCC

- DOF01, Coast and Escarpment Blackbutt Dry Forest
- DOF01-DOF05, Coast and Escarpment Blackbutt Dry Forest
- DOF05, Foothills Grey Gum - Ironbark - Mahogany Dry Forest
- DOF06, Lowlands Swamp Box - Paperbark - Red Gum Dry Forest
- DOF06-DOF01, Lowlands Swamp Box - Paperbark - Red Gum Dry Forest
- DOF06-FrW01, Lowlands Swamp Box - Paperbark - Red Gum Dry Forest
- DOF06-H01, Lowlands Swamp Box - Paperbark - Red Gum Dry Forest
- DOF08-DOF06, Coastal Sand Bloodwood - Banksia Forest
- DOF08-FrW05, Coastal Sand Bloodwood - Banksia Forest
- DOF09, Coast Sand Blackbutt - Bloodwood - Apple Forest
- EX03, Exotic vegetation
- FW01, Coastal Wallum Teatree Banksia Wet Heathland Shrubland
- FW01-FW02, Coastal Wallum Teatree Banksia Wet Heathland Shrubland
- FW02, Coastal Wallum Paperbark Banksia Grass Tree Wet Heathland
- FW07, Coastal Jointed Twig-rush Freshwater Wetland
- FW08, Coastal Freshwater Wetland
- FrW01, Coastal Paperbark Swamp Oak Floodplain Forest
- FrW01-DOF06, Coastal Paperbark Swamp Oak Floodplain Forest
- FrW04, Coastal Paperbark Sedgeland Dominated Forest
- FrW05, Coastal Paperbark Swamp Box Littoral Forest
- FrW05-H02, Coastal Paperbark Swamp Box Littoral Forest
- FrW10, Swamp Oak Forested Wetland
- FrW11, Estuarine Paperbark Twig-rush Forest
- G01, Strandline Grassland
- H01, Coast Banksia Shrubland on Holocene Dunes
- H02, Coast Wattle Shrublands
- H02-H01, Coast Wattle Shrublands
- H08, Wallum Banksia Black She-oak Shrubland
- MV01, Seagrass beds
- NRV01, Native remnant vegetation
- NRV01-EX03, Native remnant vegetation
- P03, Environmental plantings
- P03-EX03, Environmental plantings
- P03-NRV01, Environmental plantings
- RF07, Coastal Exposed Dune Littoral Rainforest
- SW01, Estuarine Mangrove Forest
- SW01-FrW11, Estuarine Mangrove Forest
- SW02, Estuarine Twig Rush Saltmarsh
- SW07, Estuarine Samphire - Saltwater Couch Saltmarsh
- WSF01, Coast and Hinterland Riparian Flooded Gum Bangalow Wet Forest
- WSF17, Foothills Turpentine - Grey Gum - Ironbark Moist Shrubby Forest

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GDA 1994 MGA Zone 56

CHCC (2011) vegetation mapping (areas A, B and C)

Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 8

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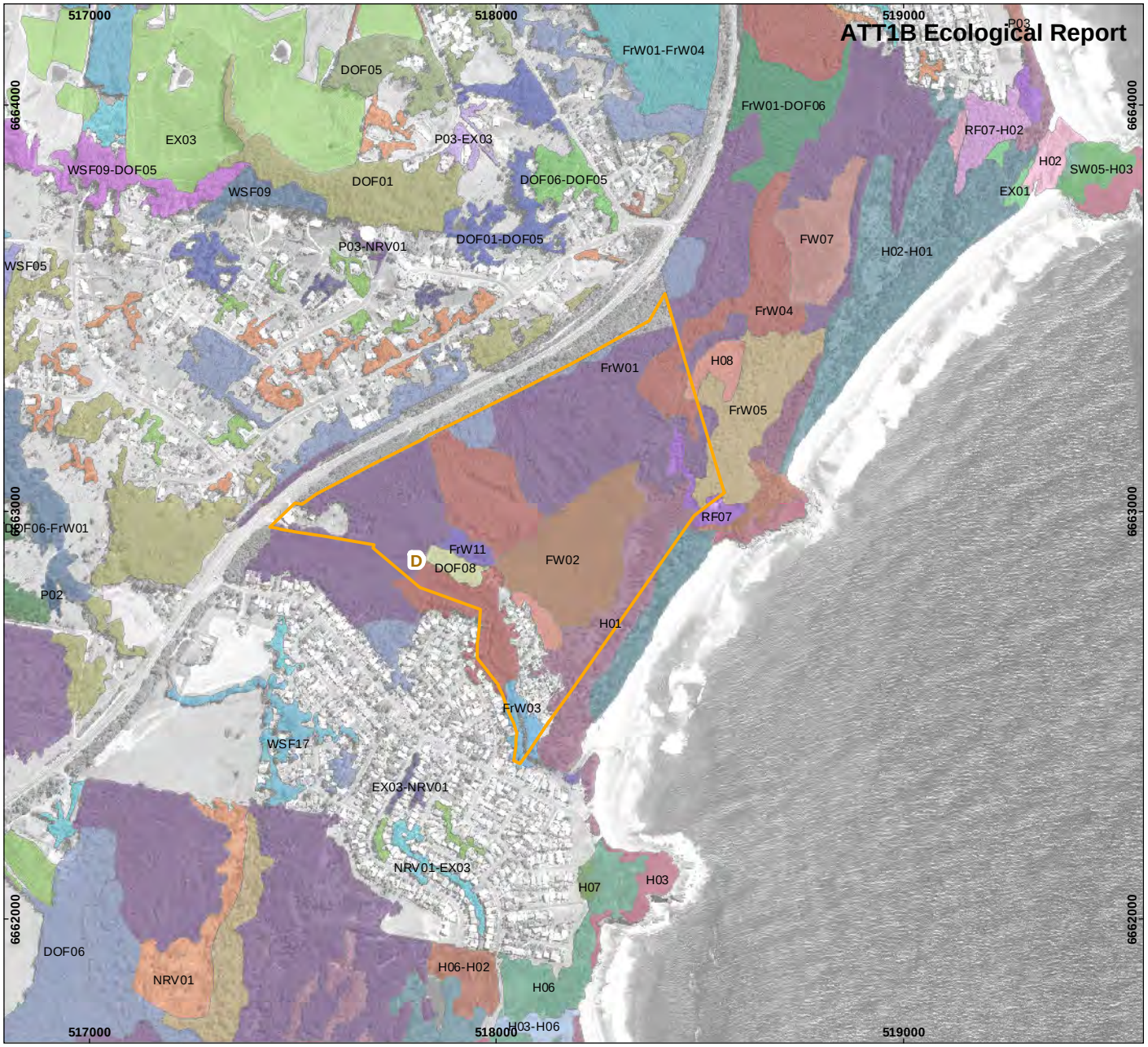
Imagery: (c) CCC 2009



Date: 29/05/2014 Project Number: 1553 Project Manager: MA Drawn by: GT

LEP 2013 Draft Deferred Areas

Vegetation CCC

- DOF01, Coast and Escarpment Blackbutt Dry Forest
- DOF01-DOF05, Coast and Escarpment Blackbutt Dry Forest
- DOF05, Foothills Grey Gum - Ironbark - Mahogany Dry Forest
- DOF06, Lowlands Swamp Box - Paperbark - Red Gum Dry Forest
- DOF06-DOF05, Lowlands Swamp Box - Paperbark - Red Gum Dry Forest
- DOF06-FrW01, Lowlands Swamp Box - Paperbark - Red Gum Dry Forest
- DOF06-WSF17, Lowlands Swamp Box - Paperbark - Red Gum Dry Forest
- DOF08, Coastal Sand Bloodwood - Banksia Forest
- EX01, Bitou bush
- EX03, Exotic vegetation
- EX03-NRV01, Exotic vegetation
- FW02, Coastal Wallum Paperbark Banksia Grass Tree Wet Heathland
- FW07, Coastal Jointed Twig-rush Freshwater Wetland
- FrW01, Coastal Paperbark Swamp Oak Floodplain Forest
- FrW01-DOF06, Coastal Paperbark Swamp Oak Floodplain Forest
- FrW01-FrW04, Coastal Paperbark Swamp Oak Floodplain Forest
- FrW03, Coastal Paperbark Bottlebrush Channel Forest
- FrW04, Coastal Paperbark Sedgeland Dominated Forest
- FrW05, Coastal Paperbark Swamp Box Littoral Forest
- FrW11, Estuarine Paperbark Twig-rush Forest
- H01, Coast Banksia Shrubland on Holocene Dunes
- H02, Coast Wattle Shrublands
- H02-H01, Coast Wattle Shrublands
- H03, Kangaroo Grass Headland Grasslands
- H03-H06, Kangaroo Grass Headland Grasslands
- H06, Coastal Headland Banksia
- H06-H02, Coastal Headland Banksia
- H07, Coastal Headland Swamp Oak Shrublands
- H08, Wallum Banksia Black She-oak Shrubland
- NRV01, Native remnant vegetation
- NRV01-EX03, Native remnant vegetation
- P02, Plantation - exotic/pine species
- P03, Environmental plantings
- P03-EX03, Environmental plantings
- P03-NRV01, Environmental plantings
- RF07, Coastal Exposed Dune Littoral Rainforest
- RF07-H02, Coastal Exposed Dune Littoral Rainforest
- SW05, Twig Rush Headland Sedgeland Soaks
- SW05-H03, Twig Rush Headland Sedgeland Soaks
- WSF05, Foothills to Escarpment Brush Box - Tallowwood - Blackbutt Wet Forest
- WSF09, Northern Escarpment Blackbutt - Apple Wet Ferny Forest
- WSF09-DOF05, Northern Escarpment Blackbutt - Apple Wet Ferny Forest
- WSF17, Foothills Turpentine - Grey Gum - Ironbark Moist Shrubby Forest

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0 100 200 300 m

GDA 1994 MGA Zone 56

CHCC (2011) vegetation mapping (area D)

Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 9

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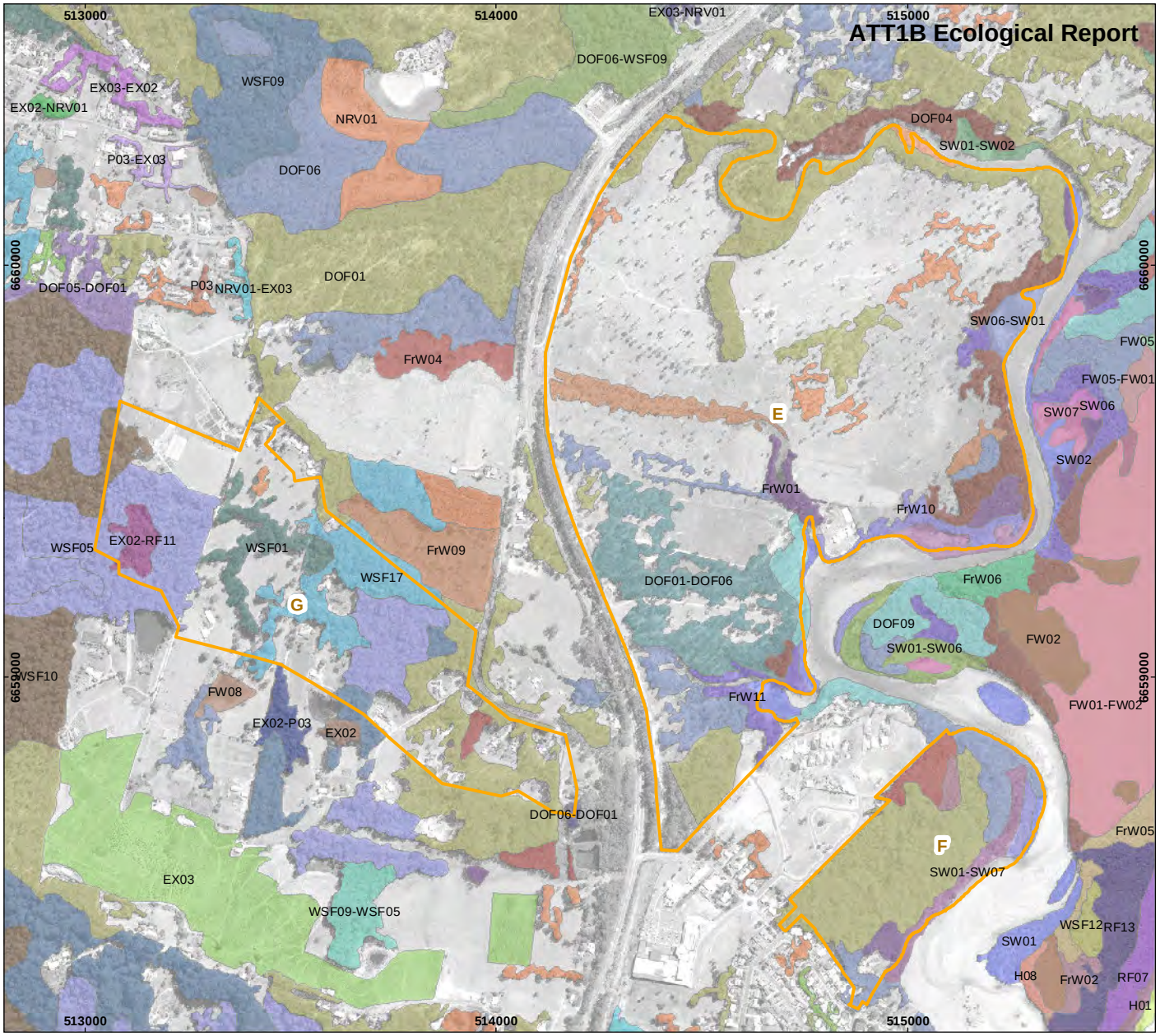
Imagery: (c) CCC 2009



Date: 29/05/2014
Project Number: 1553
Project Manager: MA
Drawn by: GT

- LEP 2013 Draft Deferred Areas

Vegetation CCC

- DOF01, Coast and Escarpment Blackbutt Dry Forest
- DOF01-DOF06, Coast and Escarpment Blackbutt Dry Forest
- DOF04, Hinterland Needlebark Stringybark - Scribbly Gum - Red Mahogany Dry Forest
- DOF05-DOF01, Foothills Grey Gum - Ironbark - Mahogany Dry Forest
- DOF06, Lowlands Swamp Box - Paperbark - Red Gum Dry Forest
- DOF06-DOF01, Lowlands Swamp Box - Paperbark - Red Gum Dry Forest
- DOF06-WSF09, Lowlands Swamp Box - Paperbark - Red Gum Dry Forest
- DOF09, Coast Sand Blackbutt - Bloodwood - Apple Forest
- EX02, Camphor laurel
- EX02-NRV01, Camphor laurel
- EX02-P03, Camphor laurel
- EX02-RF11, Camphor laurel
- EX03, Exotic vegetation
- EX03-EX02, Exotic vegetation
- EX03-NRV01, Exotic vegetation
- FW01-FW02, Coastal Wallum Teatree Banksia Wet Heathland Shrubland
- FW01-FrW01, Coastal Wallum Teatree Banksia Wet Heathland Shrubland
- FW02, Coastal Wallum Paperbark Banksia Grass Tree Wet Heathland
- FW05, Coastal Wallum Paperbark Wet Shrubland
- FW05-FW01, Coastal Wallum Paperbark Wet Shrubland
- FW08, Coastal Freshwater Wetland
- FrW01, Coastal Paperbark Swamp Oak Floodplain Forest
- FrW02, Coastal Swamp Mahogany Forest
- FrW04, Coastal Paperbark Sedgeland Dominated Forest
- FrW05, Coastal Paperbark Swamp Box Littoral Forest
- FrW06, Coastal Wallum Swamp Mahogany Paperbark Satinwood Forest
- FrW09, Coastal Wallum Swamp Mahogany Sieber's Paperbark Forest
- FrW10, Swamp Oak Forested Wetland
- FrW11, Estuarine Paperbark Twig-rush Forest
- G01, Strandline Grassland
- H01, Coast Banksia Shrubland on Holocene Dunes
- H08, Wallum Banksia Black She-oak Shrubland
- NRV01, Native remnant vegetation
- NRV01-EX03, Native remnant vegetation
- P03, Environmental plantings
- P03-EX03, Environmental plantings
- RF07, Coastal Exposed Dune Littoral Rainforest
- RF13, Coastal Sheltered Dune Littoral Rainforest
- SW01, Estuarine Mangrove Forest
- SW01-SW02, Estuarine Mangrove Forest
- SW01-SW06, Estuarine Mangrove Forest
- SW01-SW07, Estuarine Mangrove Forest
- SW02, Estuarine Twig Rush Saltmarsh
- SW06, Sea Rush Saltmarsh
- SW06-SW01, Sea Rush Saltmarsh
- SW07, Estuarine Samphire - Saltwater Couch Saltmarsh
- WSF01, Coast and Hinterland Riparian Flooded Gum Bangalow Wet Forest
- WSF05, Foothills to Escarpment Brush Box - Tallowwood - Blackbutt Wet Forest
- WSF09, Northern Escarpment Blackbutt - Apple Wet Ferny Forest
- WSF09-WSF05, Northern Escarpment Blackbutt - Apple Wet Ferny Forest
- WSF10, Hinterland and Escarpment Tallowwood - Blackbutt - Blue Gum Wet Ferny Forest
- WSF12, Brush Box Corkwood Forest on Sand
- WSF17, Foothills Turpentine - Grey Gum - Ironbark Moist Shrubby Forest

N

0 100 200 300 m

GDA 1994 MGA Zone 56

CHCC (2011) vegetation mapping (areas E, F and G)

Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 10

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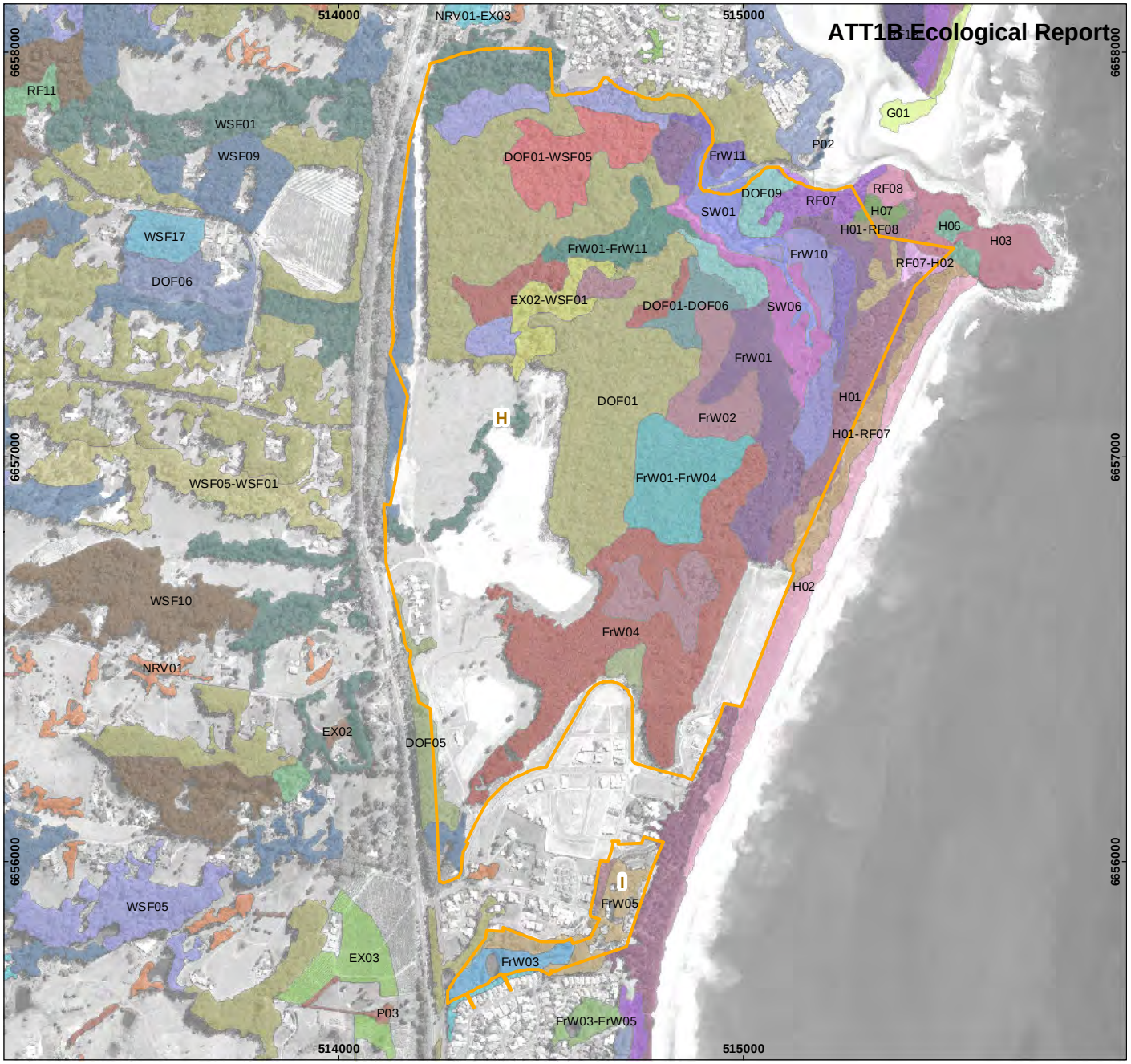

Date: 29/05/2014
Project Number: 1553
Project Manager: MA
Drawn by: GT

LEP 2013 Draft Deferred Areas

Vegetation CCC

- DOF01, Coast and Escarpment Blackbutt Dry Forest
- DOF01-DOF06, Coast and Escarpment Blackbutt Dry Forest
- DOF01-WSF05, Coast and Escarpment Blackbutt Dry Forest
- DOF05, Foothills Grey Gum - Ironbark - Mahogany Dry Forest
- DOF06, Lowlands Swamp Box - Paperbark - Red Gum Dry Forest
- DOF09, Coast Sand Blackbutt - Bloodwood - Apple Forest
- EX02, Camphor laurel
- EX02-WSF01, Camphor laurel
- EX03, Exotic vegetation
- FrW01, Coastal Paperbark Swamp Oak Floodplain Forest
- FrW01-FrW04, Coastal Paperbark Swamp Oak Floodplain Forest
- FrW01-FrW11, Coastal Paperbark Swamp Oak Floodplain Forest
- FrW02, Coastal Swamp Mahogany Forest
- FrW03, Coastal Paperbark Bottlebrush Channel Forest
- FrW03-FrW05, Coastal Paperbark Bottlebrush Channel Forest
- FrW04, Coastal Paperbark Sedgeland Dominated Forest
- FrW05, Coastal Paperbark Swamp Box Littoral Forest
- FrW10, Swamp Oak Forested Wetland
- FrW11, Estuarine Paperbark Twig-rush Forest
- G01, Strandline Grassland
- H01, Coast Banksia Shrubland on Holocene Dunes
- H01-RF07, Coast Banksia Shrubland on Holocene Dunes
- H01-RF08, Coast Banksia Shrubland on Holocene Dunes
- H02, Coast Wattle Shrublands
- H03, Kangaroo Grass Headland Grasslands
- H06, Coastal Headland Banksia
- H07, Coastal Headland Swamp Oak Shrublands
- NRV01, Native remnant vegetation
- NRV01-EX03, Native remnant vegetation
- P02, Plantation - exotic/pine species
- P03, Environmental plantings
- RF07, Coastal Exposed Dune Littoral Rainforest
- RF07-H02, Coastal Exposed Dune Littoral Rainforest
- RF08, Headland Brush Box Littoral Rainforest
- RF11, Escarpment and Lowland Bangalow - Carabeen - Black Booyong Palm Gully Rainforest
- RF13, Coastal Sheltered Dune Littoral Rainforest
- SW01, Estuarine Mangrove Forest
- SW06, Sea Rush Saltmarsh
- WSF01, Coast and Hinterland Riparian Flooded Gum Bangalow Wet Forest
- WSF05, Foothills to Escarpment Brush Box - Tallowwood - Blackbutt Wet Forest
- WSF05-WSF01, Foothills to Escarpment Brush Box - Tallowwood - Blackbutt Wet Forest
- WSF09, Northern Escarpment Blackbutt - Apple Wet Ferny Forest
- WSF10, Hinterland and Escarpment Tallowwood - Blackbutt - Blue Gum Wet Ferny Forest
- WSF17, Foothills Turpentine - Grey Gum - Ironbark Moist Shrubby Forest

N

GDA 1994 MGA Zone 56 0 100 200 300 m

CHCC (2011) vegetation mapping (areas H and I)

Coffs Harbour LEP Deferred Areas Local Environmental Study

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FIGURE 11

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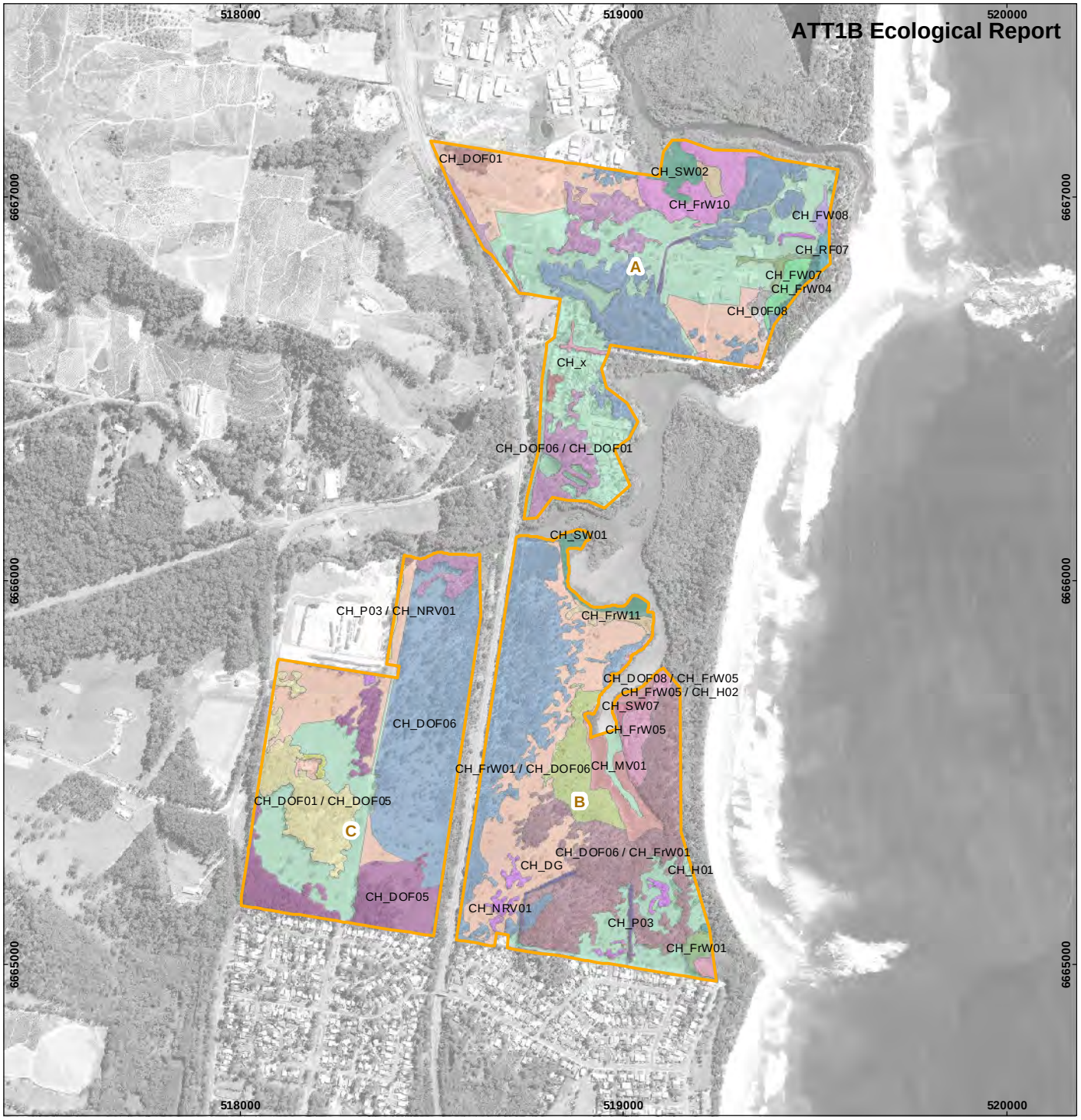
Imagery: (c) CCC 2009



Date: 29/05/2014
Project Number: 1553
Project Manager: MA
Drawn by: GT

LEP 2013 Draft Deferred Areas

Vegetation Niche

- CH_DG, Derived grassland
- CH_DOF01 / CH_DOF05, Coast and Escarpment Blackbutt Dry Forest
- CH_DOF01, Coast and Escarpment Blackbutt Dry Forest
- CH_DOF05, Foothills Grey Gum - Ironbark - Mahogany Dry Forest
- CH_DOF06 / CH_DOF01, Lowlands Swamp Box - Paperbark - Red Gum Dry Forest
- CH_DOF06 / CH_FrW01, Lowlands Swamp Box - Paperbark - Red Gum Dry Forest
- CH_DOF06, Lowlands Swamp Box - Paperbark - Red Gum Dry Forest
- CH_DOF08 / CH_FrW05, Coastal Sand Bloodwood - Banksia Forest
- CH_FW07, Coastal Jointed Twig-rush Freshwater Wetland
- CH_FW08, Coastal Freshwater Wetland
- CH_FrW01 / CH_DOF06, Coastal Paperbark Swamp Oak Floodplain Forest
- CH_FrW01, Coastal Paperbark Swamp Oak Floodplain Forest
- CH_FrW04, Coastal Paperbark Sedgeland Dominated Forest
- CH_FrW05 / CH_H02, Coastal Paperbark Swamp Box Littoral Forest
- CH_FrW05, Coastal Paperbark Swamp Box Littoral Forest
- CH_FrW10, Swamp Oak Forested Wetland
- CH_FrW11, Estuarine Paperbark Twig-rush Forest
- CH_H01, Coast Banksia Shrubland on Holocene Dunes
- CH_MV01, Seagrass beds
- CH_NRV01, Native remnant vegetation
- CH_P03 / CH_NRV01, Environmental plantings
- CH_P03, Environmental plantings
- CH_RF07, Coastal Exposed Dune Littoral Rainforest
- CH_SW01, Estuarine Mangrove Forest
- CH_SW02, Estuarine Twig Rush Saltmarsh
- CH_SW07, Estuarine Samphire - Saltwater Couch Saltmarsh
- CH_x, non-native

N

0 100 200 300 m

GDA 1994 MGA Zone 56

Vegetation validation (Areas A, B and C)

Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 12

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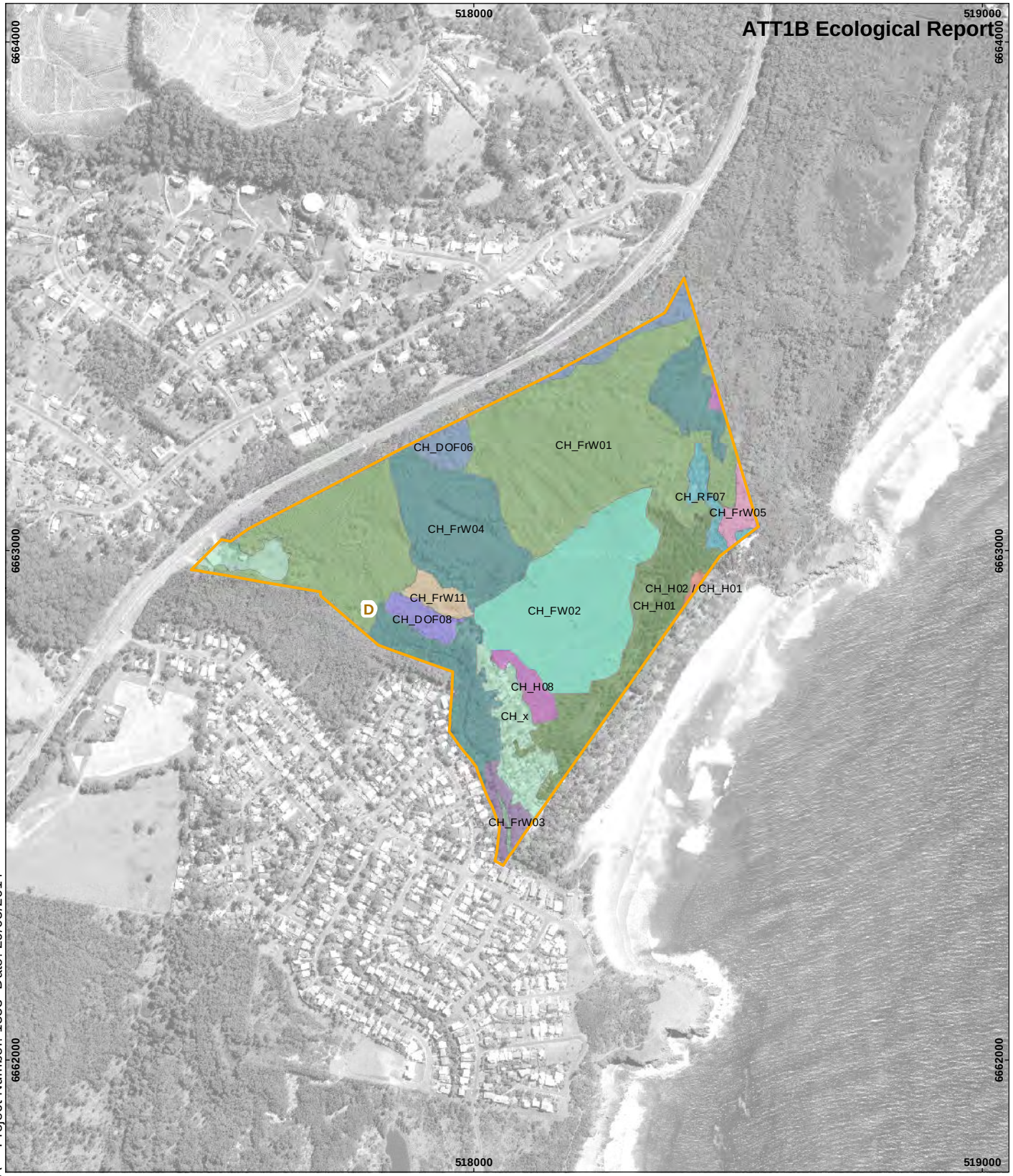


Project Number: 1553 Date: 29/05/2014

Project Manager: MA

Drawn by: GT

LEP 2013 Draft Deferred Areas

Vegetation Niche

- CH_DOF06, Lowlands Swamp Box - Paperbark - Red Gum Dry Forest
- CH_DOF08, Coastal Sand Bloodwood - Banksia Forest
- CH_FW02, Coastal Wallum Paperbark Banksia Grass Tree Wet Heathland
- CH_FrW01, Coastal Paperbark Swamp Oak Floodplain Forest
- CH_FrW03, Coastal Paperbark Bottlebrush Channel Forest
- CH_FrW04, Coastal Paperbark Sedgeland Dominated Forest
- CH_FrW05, Coastal Paperbark Swamp Box Littoral Forest
- CH_FrW11, Estuarine Paperbark Twig-rush Forest
- CH_H01, Coast Banksia Shrubland on Holocene Dunes
- CH_H02 / CH_H01, Coast Wattle Shrublands
- CH_H08, Wallum Banksia Black She-oak Shrubland
- CH_RF07, Coastal Exposed Dune Littoral Rainforest
- CH_x, non-native

N

0 100 200 m

GDA 1994 MGA Zone 56

Vegetation validation (Area D)

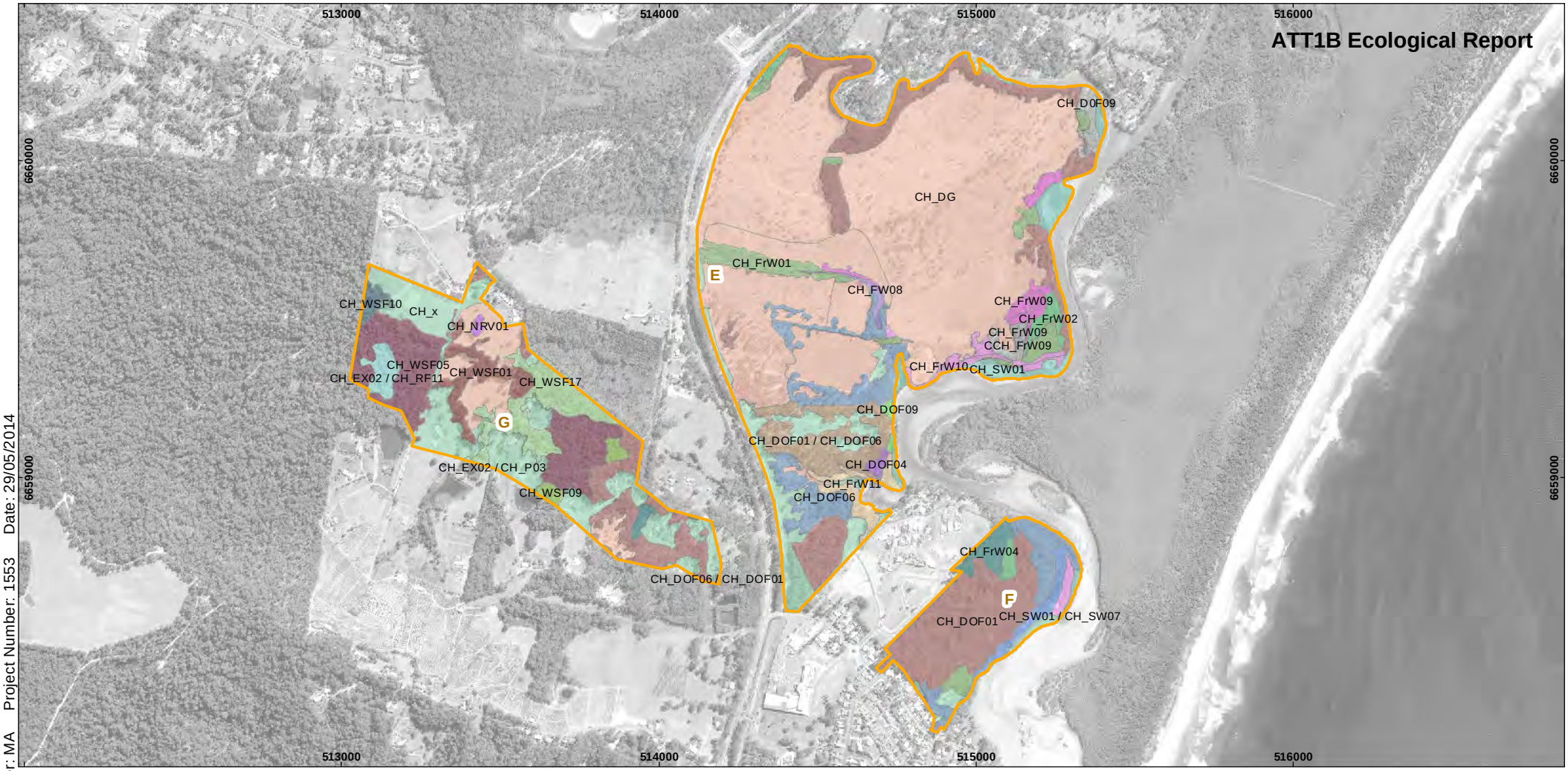
Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 13

niche Environment and Heritage

Path: T:\spatial\projects\a1500\a1553_MooneeBeachLEP\Maps\renumber20140528\1553_Figure_13_VegValid_D.mxd

Imagery: (c) CCC 2009



Date: 29/05/2014
Project Number: 1553
Project Manager: MA
Drawn by: GT

LEP 2013 Draft Deferred Areas

Vegetation Niche

- CH_DG, Derived grassland
- CH_DOF01 / CH_DOF06, Coast and Escarpment Blackbutt Dry Forest
- CH_DOF01, Coast and Escarpment Blackbutt Dry Forest
- CH_DOF04, Hinterland Needlebark Stringybark - Scribbly Gum - Red Mahogany Dry Forest
- CH_DOF06 / CH_DOF01, Lowlands Swamp Box - Paperbark - Red Gum Dry Forest
- CH_DOF06, Lowlands Swamp Box - Paperbark - Red Gum Dry Forest
- CH_DOF09, Coast Sand Blackbutt - Bloodwood - Apple Forest
- CH_EX02 / CH_P03, Camphor laurel
- CH_EX02 / CH_RF11, Camphor laurel
- CH_FW08, Coastal Freshwater Wetland
- CH_FrW01, Coastal Paperbark Swamp Oak Floodplain Forest
- CH_FrW02, Coastal Swamp Mahogany Forest
- CH_FrW04, Coastal Paperbark Sedgeland Dominated Forest
- CH_FrW09, Coastal Wallum Swamp Mahogany Sieber's Paperbark Forest
- CH_FrW10, Swamp Oak Forested Wetland
- CH_FrW11, Estuarine Paperbark Twig-rush Forest
- CH_NRV01, Native remnant vegetation
- CH_SW01 / CH_SW07, Estuarine Mangrove Forest
- CH_SW01, Estuarine Mangrove Forest
- CH_WSF01, Coast and Hinterland Riparian Flooded Gum Bangalow Wet Forest
- CH_WSF05, Foothills to Escarpment Brush Box - Tallowwood - Blackbutt Wet Forest
- CH_WSF09, Northern Escarpment Blackbutt - Apple Wet Ferny Forest
- CH_WSF10, Hinterland and Escarpment Tallowwood - Blackbutt - Blue Gum Wet Ferny Forest
- CH_WSF17, Foothills Turpentine - Grey Gum - Ironbark Moist Shrubby Forest
- CH_x, non-native

N

0 100 200 300 m
GDA 1994 MGA Zone 56

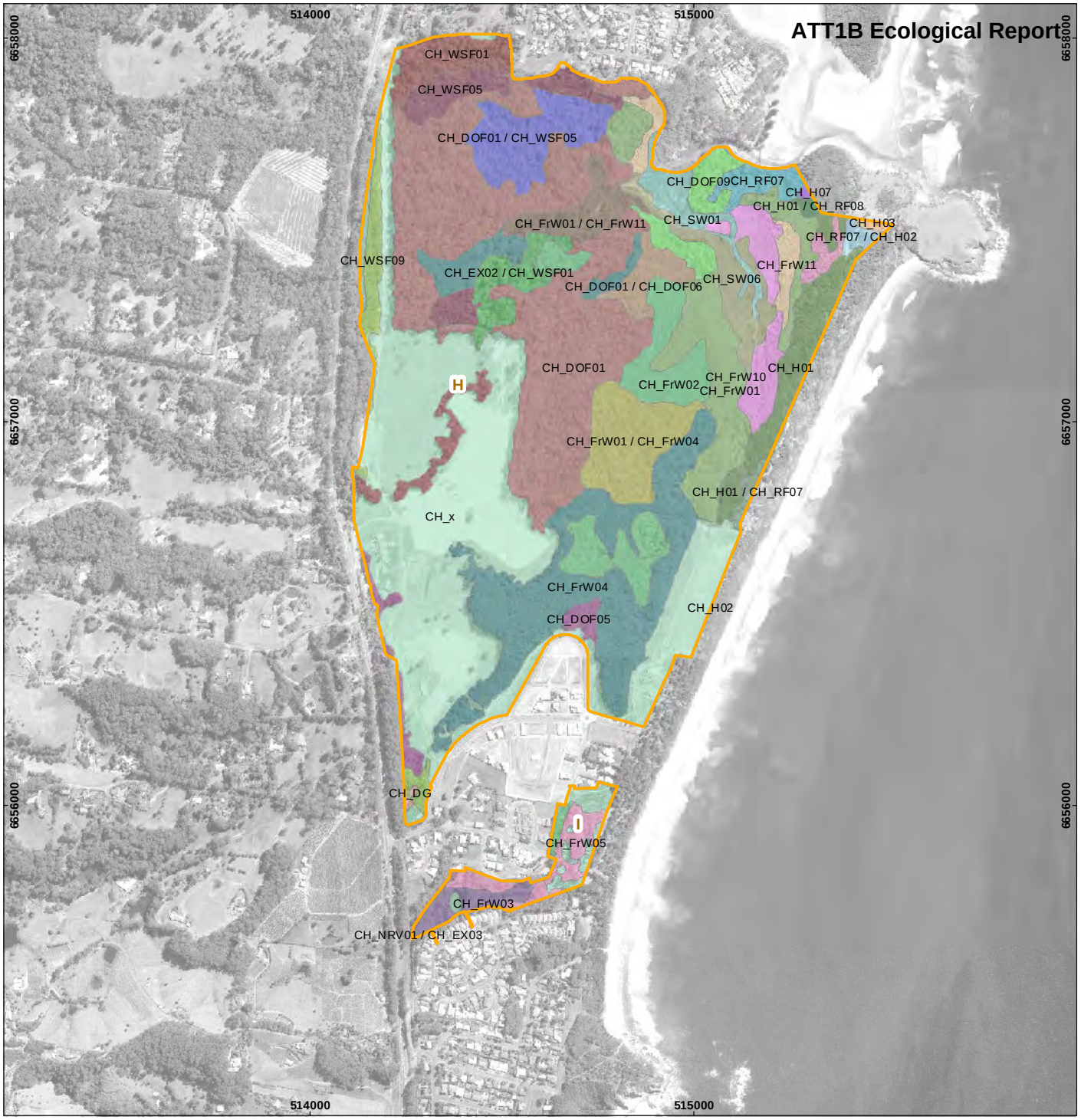
Vegetation validation (Areas E, F and G)

Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 14

niche Environment and Heritage

Path: T:\spatial\projects\a1500\a1553_MooneeBeachLEP\Maps\renumber20140528\1553_Figure_14_VegValid_EFG.mxd



Drawn by: GT Project Manager: MA Project Number: 1553 Date: 29/05/2014

LEP 2013 Draft Deferred Areas

Vegetation Niche

- CH_DG, Derived grassland
- CH_DOF01 / CH_DOF06, Coast and Escarpment Blackbutt Dry Forest
- CH_DOF01 / CH_WSF05, Coast and Escarpment Blackbutt Dry Forest
- CH_DOF01, Coast and Escarpment Blackbutt Dry Forest
- CH_DOF05, Foothills Grey Gum - Ironbark - Mahogany Dry Forest
- CH_DOF09, Coast Sand Blackbutt - Bloodwood - Apple Forest
- CH_EX02 / CH_WSF01, Camphor laurel
- CH_FrW01 / CH_FrW04, Coastal Paperbark Swamp Oak Floodplain Forest
- CH_FrW01 / CH_FrW11, Coastal Paperbark Swamp Oak Floodplain Forest
- CH_FrW01, Coastal Paperbark Swamp Oak Floodplain Forest
- CH_FrW02, Coastal Swamp Mahogany Forest
- CH_FrW03, Coastal Paperbark Bottlebrush Channel Forest
- CH_FrW04, Coastal Paperbark Sedgeland Dominated Forest
- CH_FrW05, Coastal Paperbark Swamp Box Littoral Forest
- CH_FrW10, Swamp Oak Forested Wetland
- CH_FrW11, Estuarine Paperbark Twig-rush Forest
- CH_H01 / CH_RF07, Coast Banksia Shrubland on Holocene Dunes
- CH_H01 / CH_RF08, Coast Banksia Shrubland on Holocene Dunes
- CH_H01, Coast Banksia Shrubland on Holocene Dunes
- CH_H02, Coast Wattle Shrublands
- CH_H03, Kangaroo Grass Headland Grasslands
- CH_H06, Coastal Headland Banksia
- CH_H07, Coastal Headland Swamp Oak Shrublands
- CH_NRV01 / CH_EX03, Native remnant vegetation
- CH_RF07 / CH_H02, Coastal Exposed Dune Littoral Rainforest
- CH_RF07, Coastal Exposed Dune Littoral Rainforest
- CH_SW01, Estuarine Mangrove Forest
- CH_SW06, Sea Rush Saltmarsh
- CH_WSF01, Coast and Hinterland Riparian Flooded Gum Bangalow Wet Forest
- CH_WSF05, Foothills to Escarpment Brush Box - Tallowwood - Blackbutt Wet Forest
- CH_WSF09, Northern Escarpment Blackbutt - Apple Wet Ferny Forest
- CH_x, non-native

N

0 100 200 300 m

GDA 1994 MGA Zone 56

Vegetation validation (Areas H and I)

Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 15

niche Environment and Heritage

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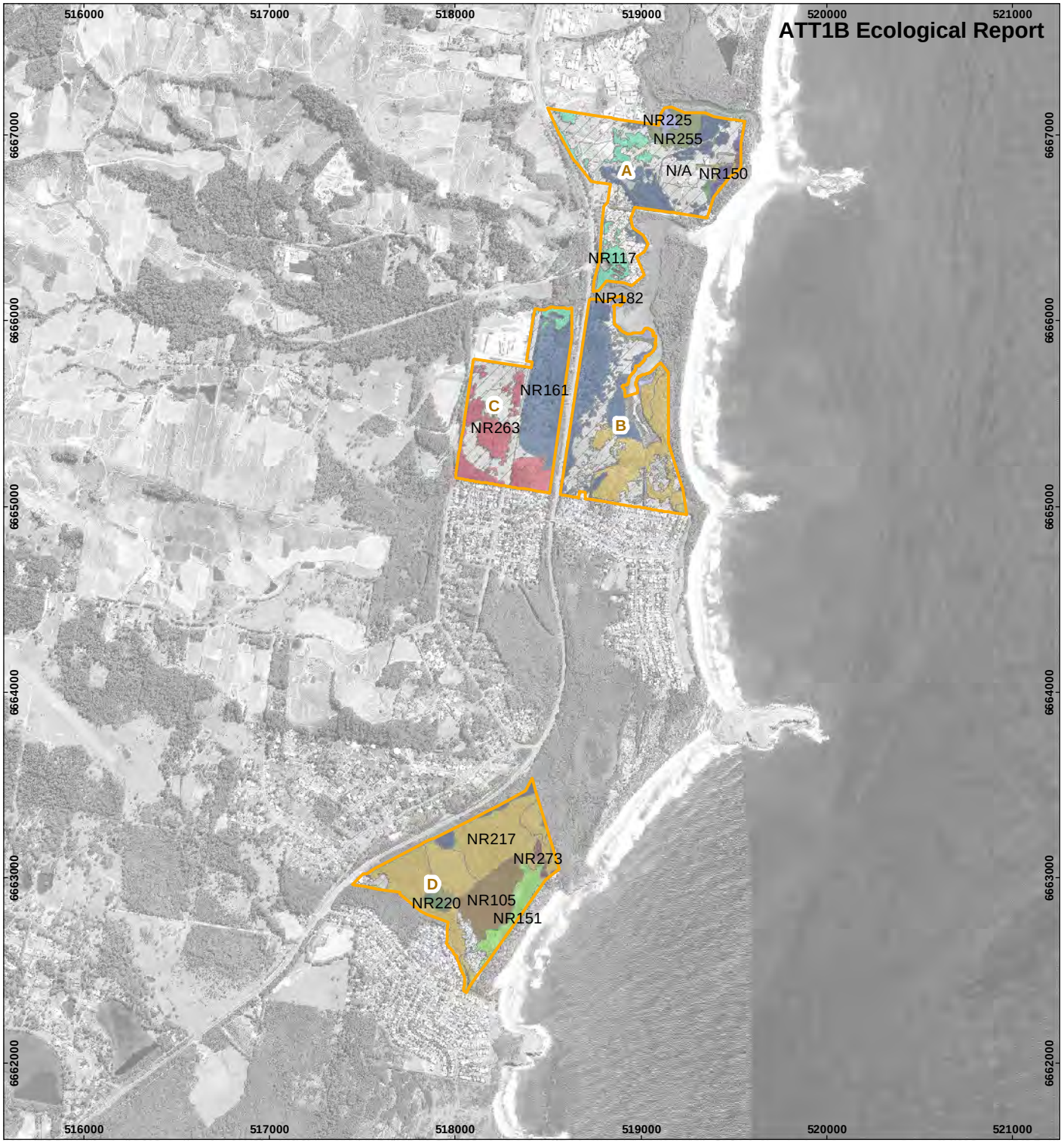


Project Number: 1553 Date: 29/05/2014
Project Manager: MA
Drawn by: GT

- LEP 2013 Draft Deferred Areas
- NR105, Banksia dry shrubland on coastal sands of the North Coast
- NR117, Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the North Coast
- NR150, Coastal freshwater meadows and forblands of lagoons and wetlands
- NR151, Coastal headland heaths of the North Coast
- NR161, Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast
- NR182, Mangrove - Grey Mangrove low closed forest of the NSW Coastal Bioregions
- NR217, Paperbark swamp forest of the coastal lowlands of the North Coast
- NR220, Pink Bloodwood open forest of the coastal lowlands of the North Coast
- NR225, Saltmarsh complex of the North Coast
- NR255, Swamp Oak swamp forest of the coastal lowlands of the North Coast
- NR263, Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of North Coast
- NR273, Tuckeroo - Riberry - Yellow Tulipwood littoral rainforest of the North Coast
- N/A

0 250 500 m

GDA 1994 MGA Zone 56

N

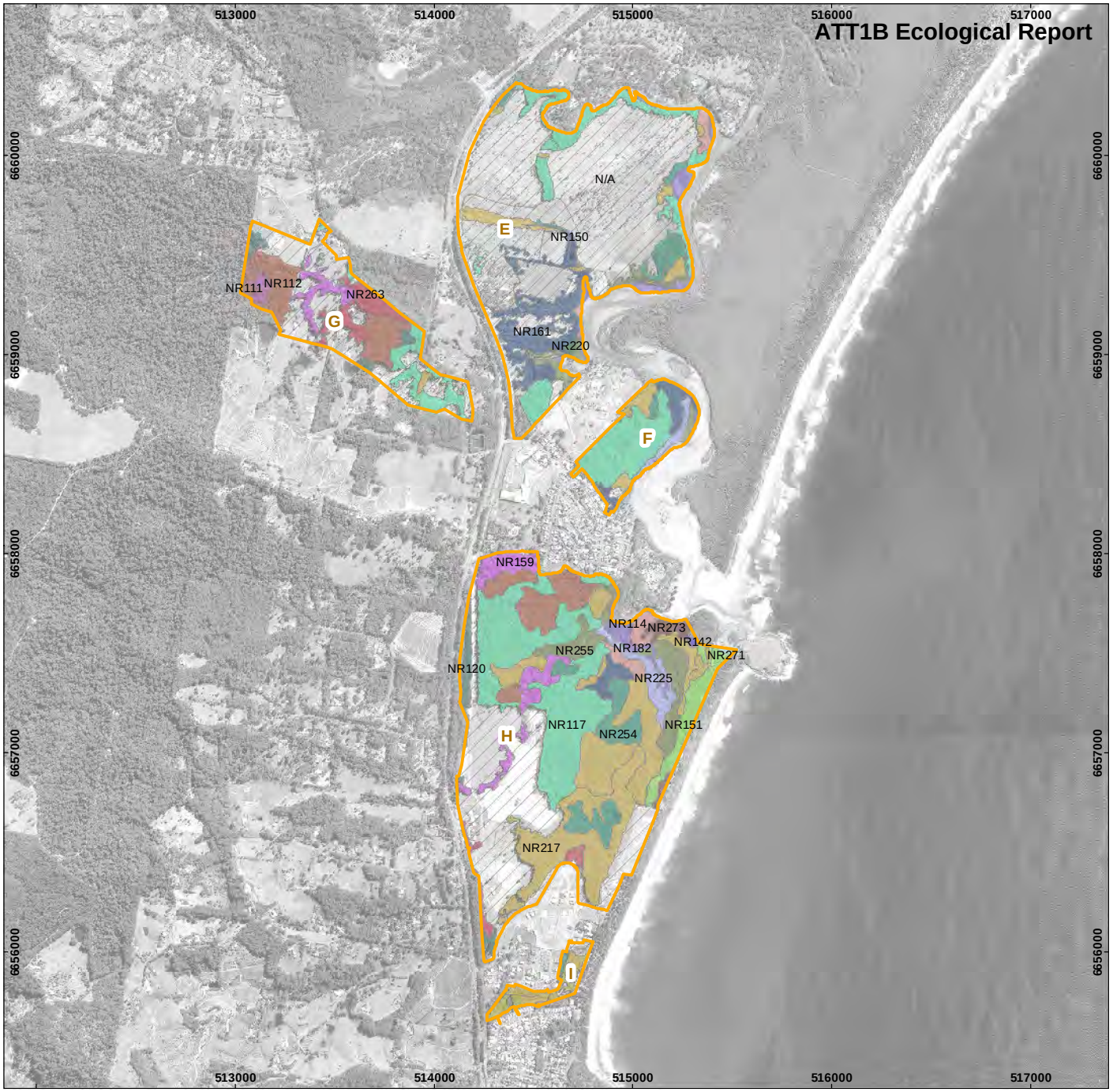
RBVT Alignment (study area north)

Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 16

niche Environment and Heritage

Path: T:\spatial\projects\a1500\a1553_MooneeBeachLEP\Maps\renumber20140528\1553_Figure_16_RBVT_N.mxd



Date: 29/05/2014

Project Number: 1553

Project Manager: MA

Drawn by: GT

LEP 2013 Draft Deferred Areas

RBVT

- NR111, Black Booyong - Rosewood - Yellow Carabeen subtropical rainforest of the North Coast
- NR112, Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central North Coast
- NR114, Blackbutt - bloodwood dry heathy open forest on Quaternary sands of the northern
- NR117, Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the North Coast
- NR120, Blackbutt - Tallowwood moist ferny open forest of the coastal ranges of the North Coast
- NR142, Brush Box - Tuckeroo littoral rainforest on coastal headlands of the North Coast
- NR150, Coastal freshwater meadows and forblands of lagoons and wetlands
- NR151, Coastal headland heaths of the North Coast
- NR159, Flooded Gum - Brush Box moist forest of the coastal ranges of the North Coast
- NR161, Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast
- NR182, Mangrove - Grey Mangrove low closed forest of the NSW Coastal Bioregions
- NR217, Paperbark swamp forest of the coastal lowlands of the North Coast
- NR220, Pink Bloodwood open forest of the coastal lowlands of the North Coast
- NR225, Saltmarsh complex of the North Coast
- NR254, Swamp Mahogany swamp forest of the coastal lowlands of the North Coast
- NR255, Swamp Oak swamp forest of the coastal lowlands of the North Coast
- NR263, Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of North Coast
- NR271, Themeda australis sod tussock grassland of coastal areas of the North Coast
- NR273, Tuckeroo - Riberry - Yellow Tulipwood littoral rainforest of the North Coast
- N/A

0 250 500 m

GDA 1994 MGA Zone 56

N

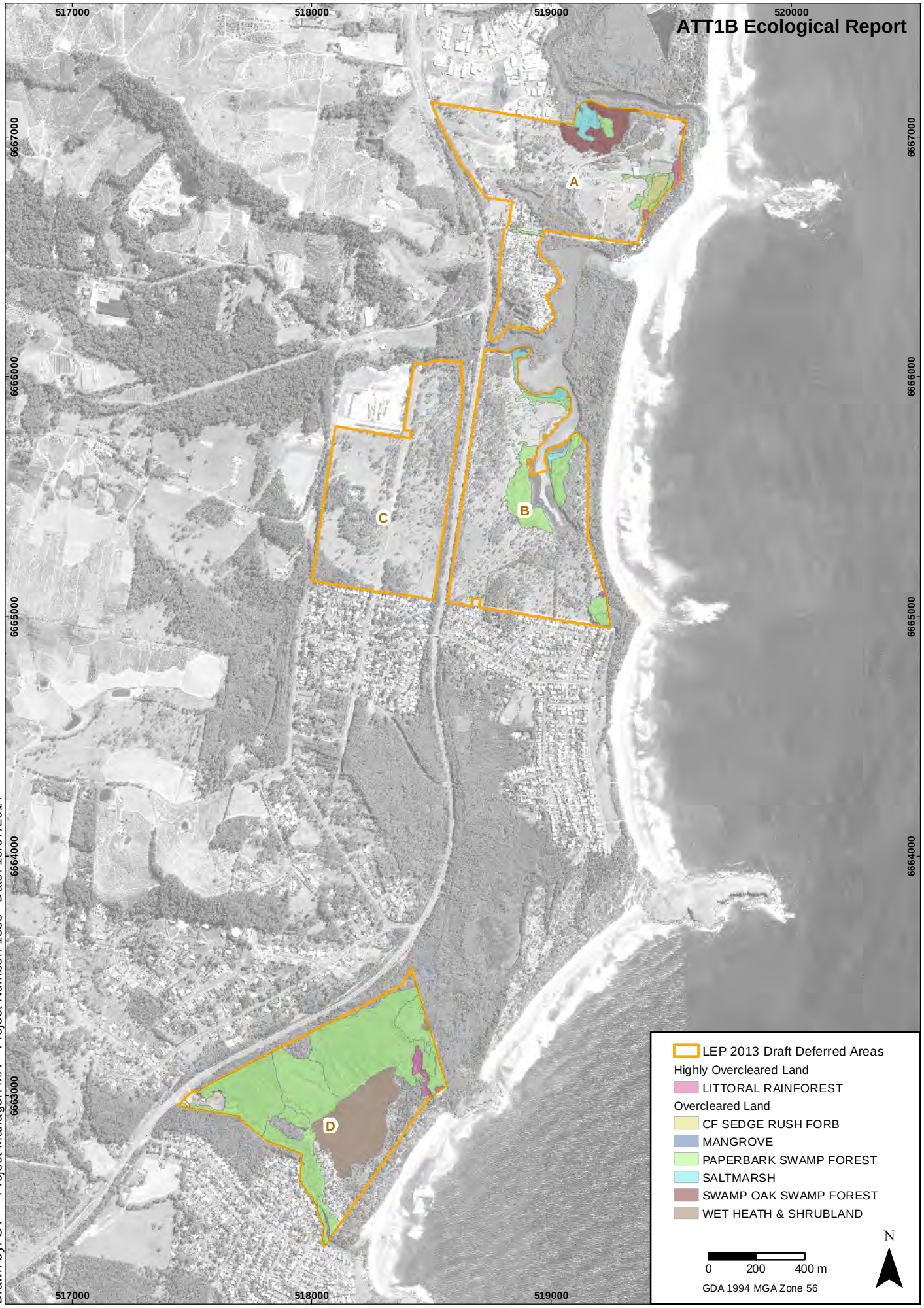
RBVT Alignment (study area south)

Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 17

niche Environment and Heritage

Path: T:\spatial\projects\a1500\a1553_MooneeBeachLEP\Maps\renumber20140528\1553_Figure_17_RBVT_S.mxd



Drawn by: GT Project Manager: MA Project Number: 1553 Date: 15/07/2014

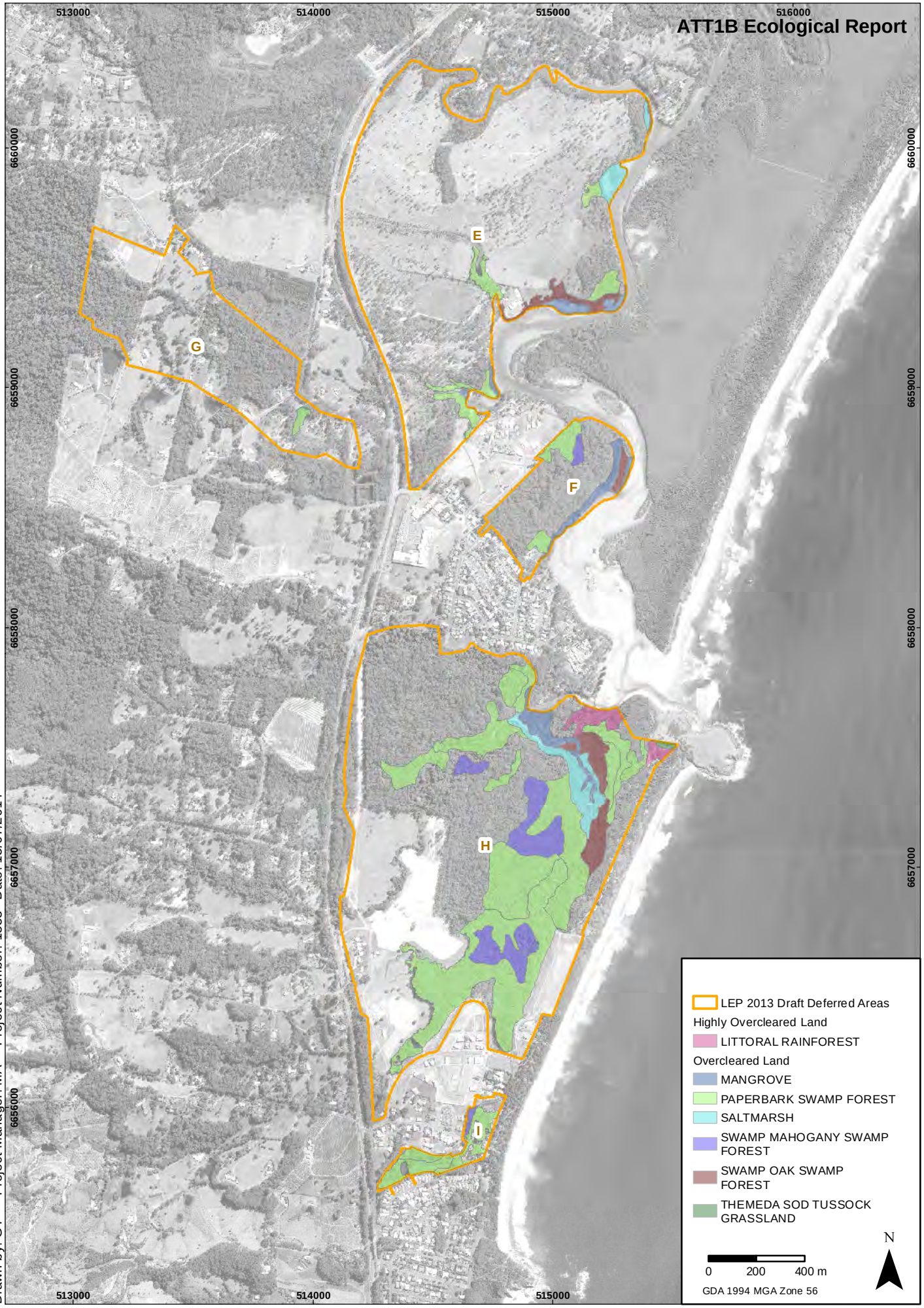
OCVTs (study area north)

Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 18

Path: T:\spatial\projects\a1500\a1553_MooneeBeachLEP\Maps\report_20140715\1553_Figure_18_Overcleared_N.mxd

Imagery: (c) CCC 2009



Drawn by: GT Project Manager: MA Project Number: 1553 Date: 15/07/2014

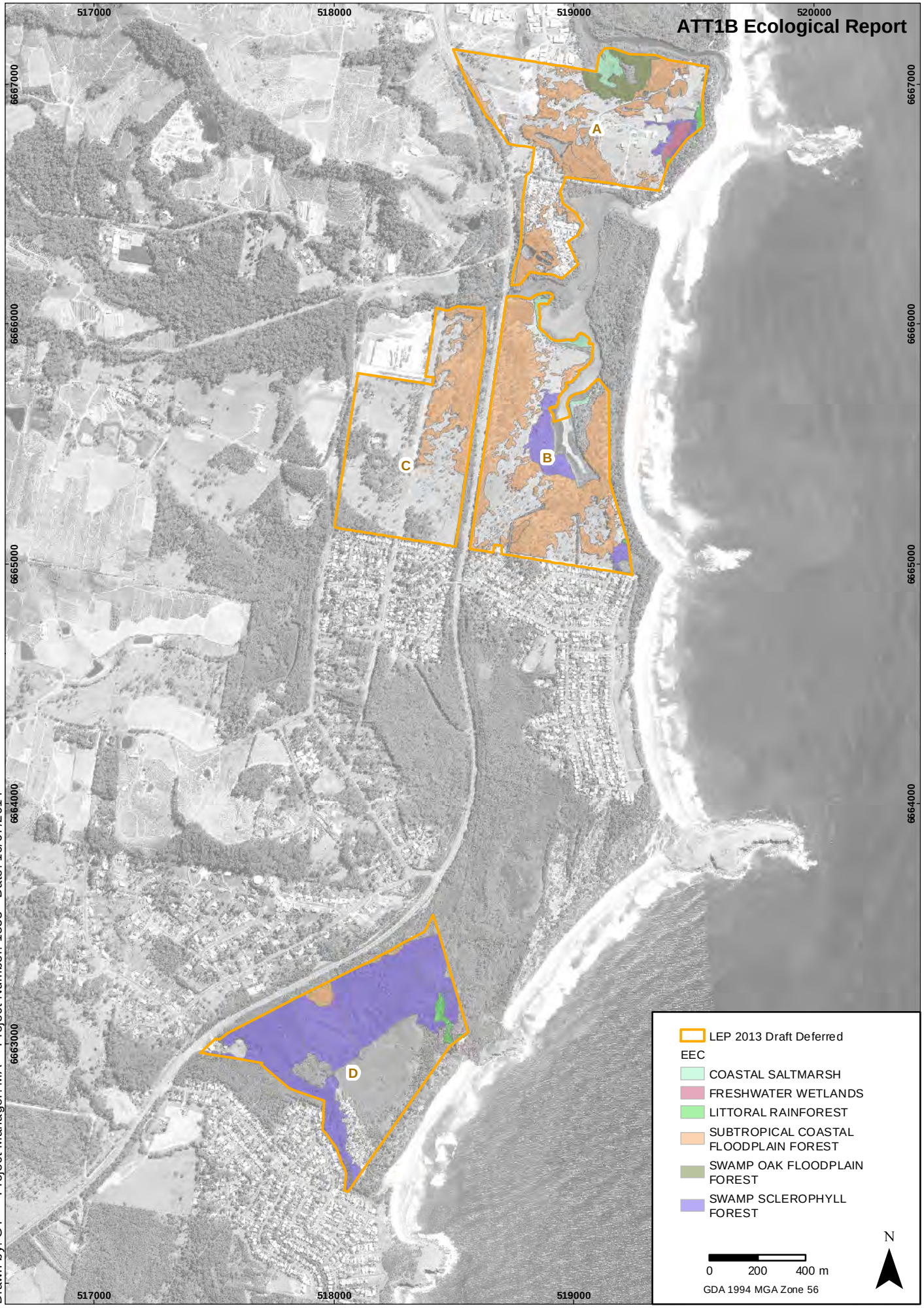
OCVTs (study area south)

Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 19

niche Environment and Heritage

Path: T:\spatial\projects\a1500\a1553_MooneeBeachLEP\Maps\report_20140715\1553_Figure_19_Overcleared_S.mxd



Threatened Ecological Communities (study area north)

Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 20

niche Environment and Heritage

Path: T:\spatial\projects\a1500\a1553_MooneeBeachLEP\Maps\report_20140715\1553_Figure_20_EEC_N.mxd

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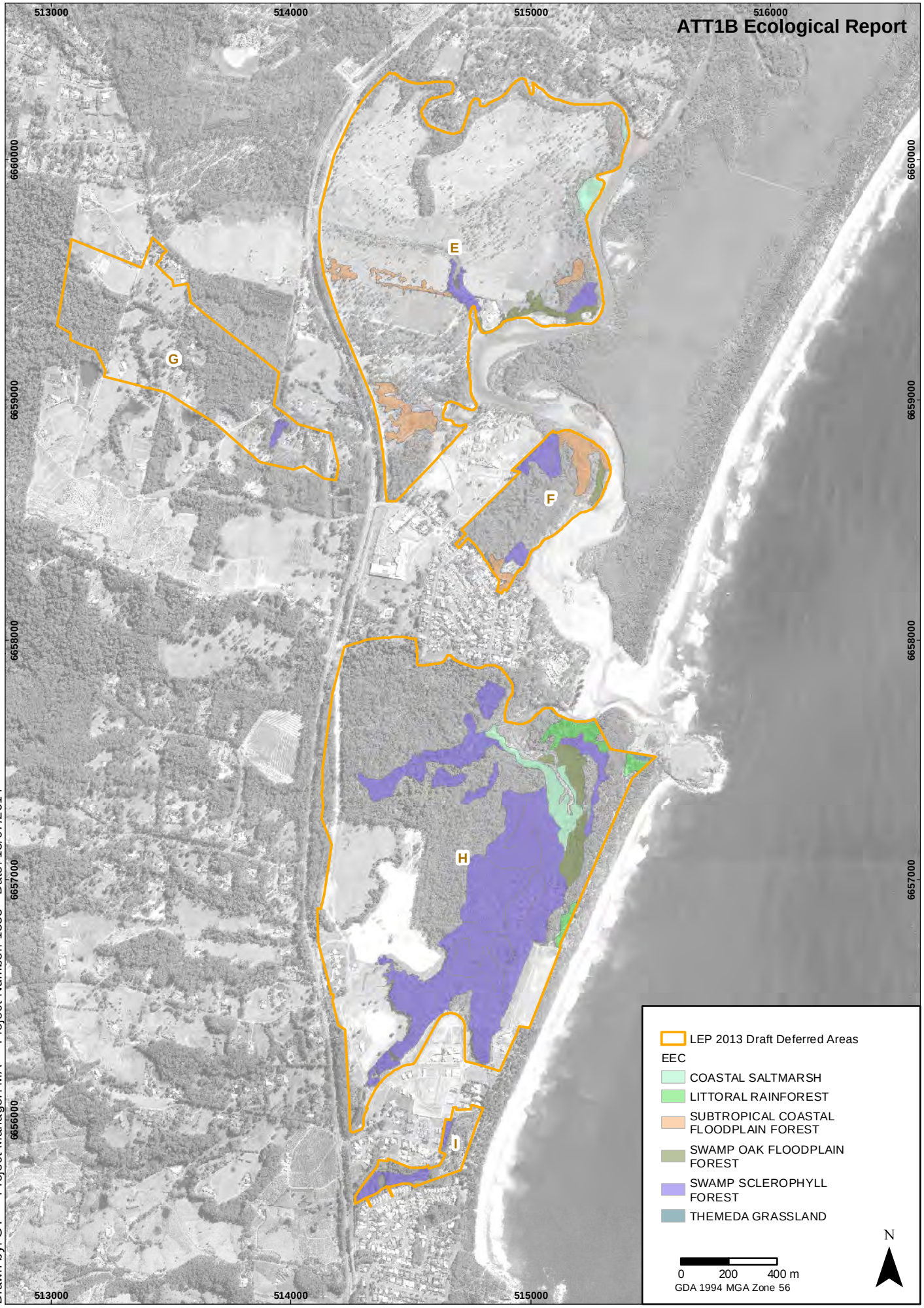


Drawn by: GT Project Manager: MA Project Number: 1553 Date: 15/07/2014

Threatened Ecological Communities (study area south)

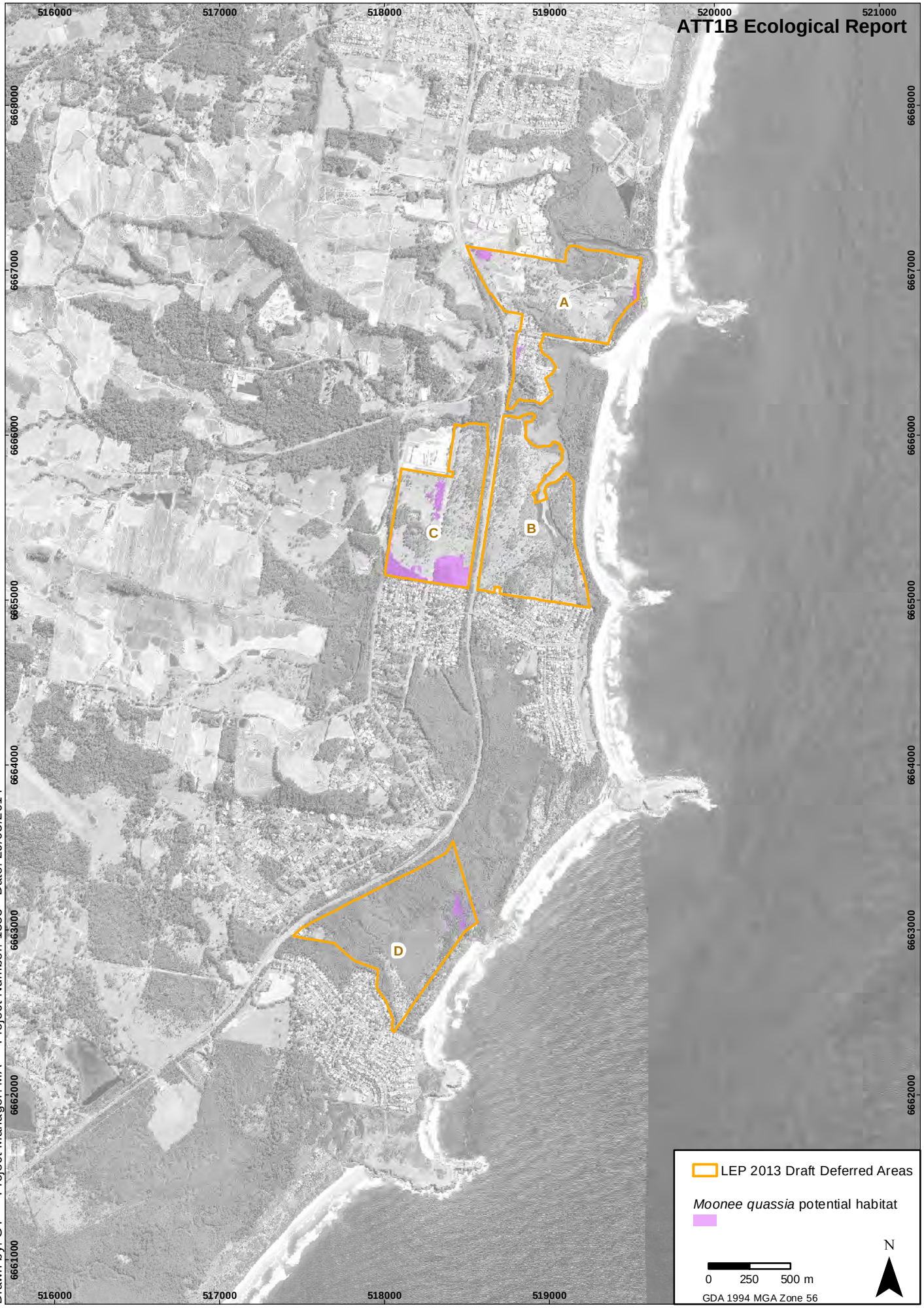
Coffs Harbour LEP Deferred Areas Local Environmental Study

niche Environment and Heritage

FIGURE 21

Path: T:\spatial\projects\a1500\a1553_MooneeBeachLEP\Maps\report_20140715\1553_Figure_21_EEC_S.mxd

Imagery: (c) CCC 2009



Drawn by: GT Project Manager: MA Project Number: 1553 Date: 29/05/2014

Moonee Creek Quassia records (study area north)

Coffs Harbour LEP Deferred Areas Local Environmental Study

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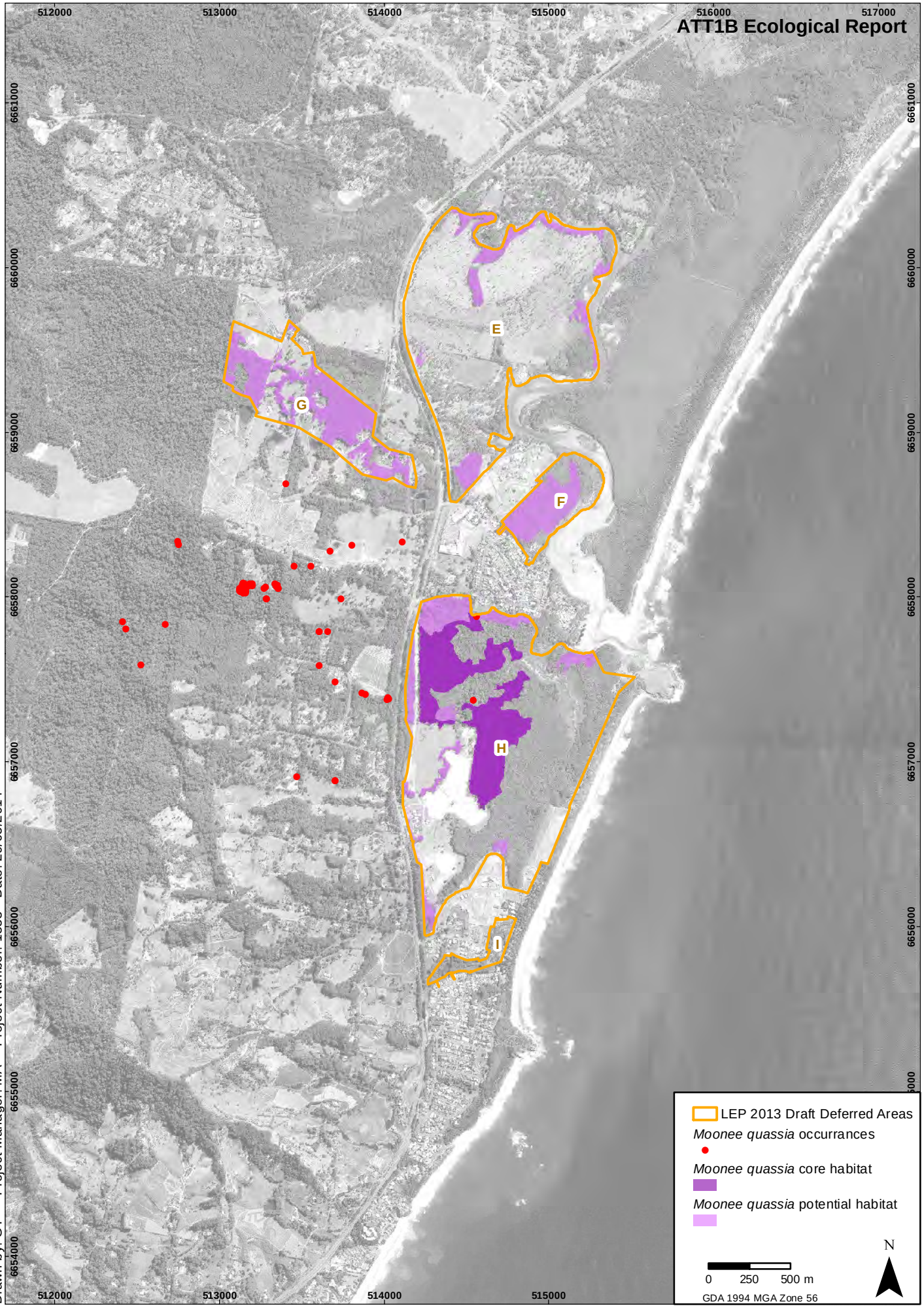
FIGURE 22

Path: T:\spatial\projects\a1500\a1553_MooneeBeachLEP\Maps\renumber20140528\1553_Figure_22_Quassia_N.mxd

Imagery: (c) CCC 2009



Drawn by: GT Project Manager: MA Project Number: 1553 Date: 29/05/2014

Moonee Creek Quassia records (study area south)

Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 23

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Path: T:\spatial\projects\a1500\a1553_MooneeBeachLEP\Maps\renumber20140528\1553_Figure_23_Quassia_S.mxd

Drawn by: GT Project Manager: MA Project Number: 1553 Date: 16/07/2014

High Value Arboreal Habitat (study area north)

Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 24

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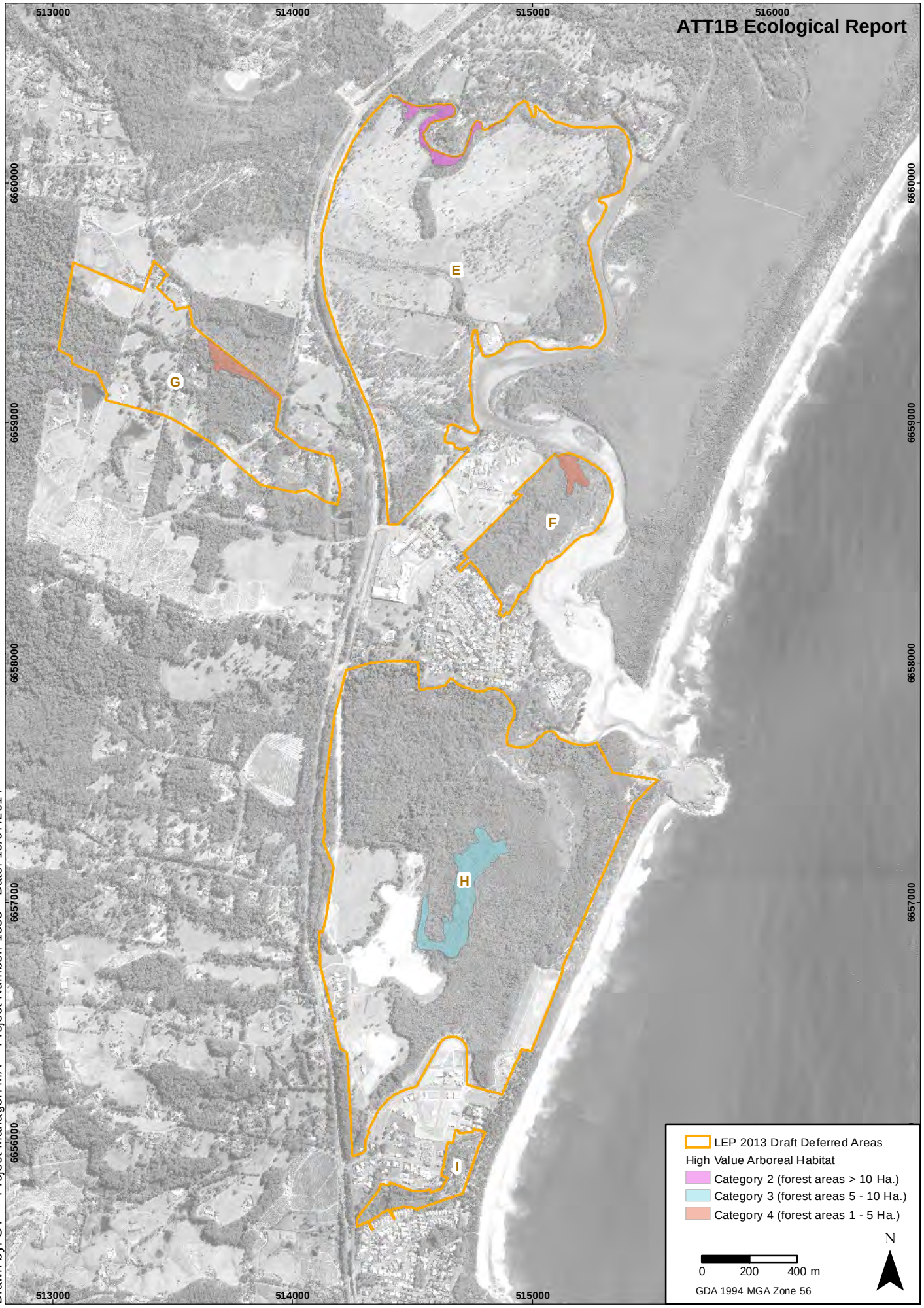
Path: T:\spatial\projects\a1500\a1553_MooneeBeachLEP\Maps\report_20140715\1553_Figure_24_Habitat_N.mxd

Imagery: (c) CCC 2009



Drawn by: GT Project Manager: MA Project Number: 1553 Date: 16/07/2014

High Value Arboreal Habitat (study area south)

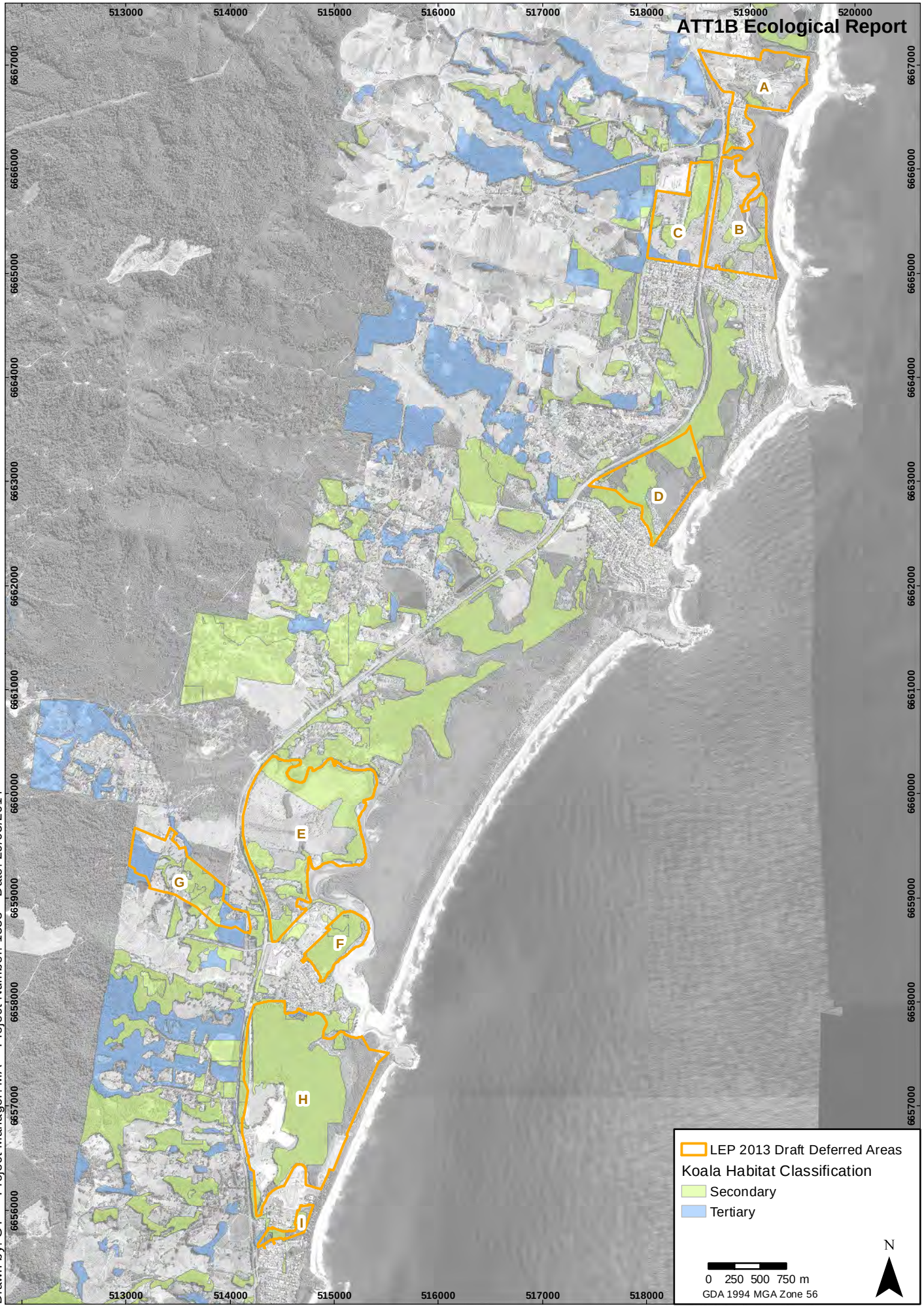
Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 25

niche Environment and Heritage

Path: T:\spatial\projects\a1500\a1553_MooneeBeachLEP\Maps\report_20140715\1553_Figure_25_Habitat_S.mxd

Imagery: (c) CCC 2009



Drawn by: GT Project Manager: MA Project Number: 1553 Date: 29/05/2014

SEPP 44 Koala Habitats and Links

Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 26

niche Environment and Heritage

Path: T:\spatial\projects\a1500\a1553_MooneeBeachLEP\Maps\renumber20140528\1553_Figure_26_Koala_N.mxd

Imagery: (c) CCC 2009

4 BIODIVERSITY CONSTRAINTS ANALYSIS

4.1 Constraint classes

Biodiversity constraint classes identified within the study area include:

- Six TECs;
- Eight OCVTs;
- Vegetation containing habitat suitable for 32 threatened flora and 62 threatened fauna species;
- Threatened species occurrences such as Moonee Quassia and Eastern Osprey;
- High value arboreal habitat (Fisher *et. al.* 2014);
- Secondary and Tertiary Koala habitat and linkages; and
- SEPP 14 coastal wetlands.

Parameters quantitatively defining these constraint classes, hence permitting the calculation of the 'relative constraints index', are shown in Table 8. Biodiversity constraints mapping reflective of all the identified constraint classes discussed in Section 3 is shown in Figure 27, Figure 28, Figure 29 and Figure 30. Planning based constraints such as SEPP 14 Coastal Wetlands and lands with an approved BioBanking Statement are also mapped where relevant.

Table 8. Relative constraints index: Mapping parameters

Constraint	Mapping parameter (index scoring)	Mapping unit
Native vegetation (based on ecosystem credit calculations)	Credits per hectare 70-50 = 1.0 Credits per hectare 50-30 = 0.6 Credits per hectare 30-10 = 0.3	Vegetation polygons (RBVTs)
OCVT	Highly overcleared = 2.0 Overcleared = 1.0 Absent = = 0.0	Vegetation polygons (RBVTs)
TEC	Present = 1.0 Absent = 0.0	Vegetation polygons (RBVTs)
Moonie Quassia plants	50 metre buffer	Known mapped plant occurrences
Moonie Quassia habitat	RBVTs containing the species = 1.0 Other = 0.0	RBVTs known to contain the species = 1 Other = 0
Eastern Osprey	200 metre buffer = 1.0	Known nest locations
Koala Habitat	Primary habitat = 1.0 Secondary habitat = 0.6 Tertiary habitat = 0.3	CHCC Koala habitat mapping
Areas of old growth forest	category 1 = 2.0 category 2 = 1.5 category 3 = 1.0 category 4 = 0.5	CHCC High Value Arboreal Habitat mapping (Fisher *et al* 2014)
Corridors	Regional = 1.0 Subregional = 0.6 Local = 0.3	Native vegetation intersects with corridors previously mapped by Scotts (2003)

The following sections outline how each constraint class contributed to the relative constraints index.

4.2 Vegetation

Quantifying biodiversity constraints by using native vegetation type mapping has been achieved through a notional BioBanking assessment. This notional assessment has concurrently evaluated landscape value and vegetation type when quantitatively determining the biodiversity value of each mapped patch of native vegetation cover. Assumptions used to determine the biodiversity constraints for native vegetation (i.e. landscape value (score) and vegetation condition) are outlined in the following sections.

4.2.1 Landscape score

The assumptions outlined in Table 9 provide for a conservative calculation of the current landscape value (score) of study area. Key factors considered in determining landscape value include native vegetation per cent cover, patch size, adjacent remnant size, connectedness and condition.

Table 9. Landscape context of the study area

	Landscape feature
Bioregion	Northern Rivers Bioregion
CMA	Northern Rivers Catchment Management Authority (CMA)
Mitchell Landscape	Manning - Macleay Coastal Alluvial Plain
Sub-region	Northern Rivers: Coffs Coast & Escarpment
Patch size	> 500 ha (highest classification for quantifying landscape score)
Adjacent remnant area	> 500 ha (highest classification for quantifying landscape score)
Primary links (width and condition)	> 500 m in Benchmark condition (highest classification for quantifying landscape score)

The BBCC uses the landscape value (score) as a modifier when calculating the ecosystem credits for each mapped vegetation type in the assessment area. The conservative assumptions used have limited the potential for misidentifying vegetation types of high conservation value.

4.2.2 Native vegetation cover

Aerial photography interpretation and site inspections, where not restricted by property access constraints, have aided broadly in the identification of native vegetation cover (i.e. RBVTs) in moderate to good (high) condition throughout the study area. Similarly, lands have also been identified as cleared or not having native vegetation cover where no condition or constraint could be quantified.

Lands covered by native vegetation not readily identifiable as high condition were treated as being in a modified condition thereby containing a reduced biodiversity value. These areas were generically referred to as derived grasslands although it should be noted that some patches described as such may contain scattered tree cover. Condition statements for these areas were calculated using actual field data, where possible, although land access limitations did influence the extent of this condition analysis.

Results from the BBCC were scrutinised both in terms of the range of ecosystem credit scores and the relevance of the BBCC selected ecosystem predicted threatened species modifier (i.e. species with the lowest recovery potential). Results are provided in Appendix E. Scores were largely within expectation although it was noted that the selected ecosystem predicted species (i.e. Large-footed Myotis) was not universally considered an appropriate species in the calculation (i.e. tends to occupy habitats near water

bodies). Notwithstanding, on further analysis of the BBCC results it was noted that other more suitable ecosystem predicted species of equally low recovery potential were identified and, if used, would produce the same outcome.

4.3 OCVTs

Eight OCVTs were identified within the study area with one classified as highly overcleared (i.e. Littoral Rainforest). As noted in Table 8 the highly overcleared vegetation type has received the maximum score for this constraint class (i.e. 2) with the remaining overcleared vegetation types scoring 1. Survey results from prior surveys and assessments, as discussed in Section 3.2, support the inclusion of OCVTs as a distinct constraint class as many of the threatened species previously observed within the study area are threatened by the processes outlined in Section 3.6.1.

4.4 Threatened Ecological Communities

Six TECs were identified and assigned the highest constraint class score of 1.0. While some co-correlation exists with OCVTs, and hence there is the potential to distort the calculation of relative constraint index, it is important to recognise the spatial extents of TECs within the study area in this constraints analysis as specific planning assessment procedures would apply to the development of these lands.

4.5 Threatened flora and fauna

Three species have been specifically included in the constraints mapping these being:

- Moonee Quassia
- Eastern Osprey; and
- Koala.

Criteria and parameters used to spatially represent these constraints are discussed in the following sections.

4.5.1 Moonee Quassia (*Quassia* sp. Mooney Creek)

Five specific objectives of the Recovery Plan (DEC 2005) established for this species are summarised below:

- Coordinate the recovery of the Moonee Quassia;
- Increase the level of understanding of the ecology and life history of the species;
- Locate additional populations;
- To ensure the broader community has access to information about the distribution, conservation and management of the Moonee Quassia and its habitat; and
- Retention of each known population at its current size.

In light of the above recovery actions for the Moonee Quassia the mapping of this constraint was defined by the following spatial parameters:

- Known recorded locations plus a buffer of 50 metres; and
- RBVTs known to contain the species (i.e. vegetation polygon).

4.5.2 Eastern Osprey

A nest site actively used by the Eastern Osprey was observed within the study area. A radial buffer of 200 metres around the nest tree site was applied to spatially represent habitat of importance for this species as a constraint in this assessment.

4.5.3 Koala

Threats to Koalas are more specifically linked to agricultural activities on these lands which involve the clearing and disturbance of Koala habitat, in particular areas mapped as Primary and Secondary Koala habitat. Additionally, selective logging of Tallowwood, Swamp Mahogany, Flooded Gum (*E. grandis*), Forest Red Gum, or Small-fruited Grey Gum (*E. propinqua*) within areas mapped as Tertiary Koala Habitat has the potential to impact on Koalas by the removal of key resource trees important for parts of the species lifecycle.

The CKPoM states that development consent cannot be granted in circumstances where areas identified as Secondary Koala Habitat are to be removed unless it can be shown that the development will not significantly destroy, damage or compromise the values of the land as Koala habitat. As much of the study area is classed as Secondary Koala Habitat it is considered that this represents a constraint to land development. This constraint has been recognised in developing the relative constraint index as indicated by the relevant constraint class scale defined in Section 2.6.1.

4.6 High value arboreal habitat

As specified in Table 8 the mapping parameters used to display the HV Arboreal Habitat mapping (Fisher *et. al.* 2014) has been weighted by a factor of two to account for the perceived higher relative importance of this biodiversity constraint. As indicated in Section 2.3.6, no areas of Category 1 'old growth' were mapped within the study area. However, vegetation cover consistent with other categories of HV arboreal habitat were identified and hence included in the constraints mapping.

4.7 Corridors

Scotts (2003) regional corridor mapping was incorporated into the biodiversity constraint mapping by intersecting mapped regional, subregional and local corridors with RBVT map units. Vegetation cover contained within the corridor was scored accordingly as defined by the scale exhibited in Table 8.

4.8 Planning controls

No mapped areas of SEPP 26 Littoral Rainforests or critical habitat listed under the TSC Act or EPBC Act occurs within the study area. Planning controls mapped as a constraint to development are quantified in the following sections.

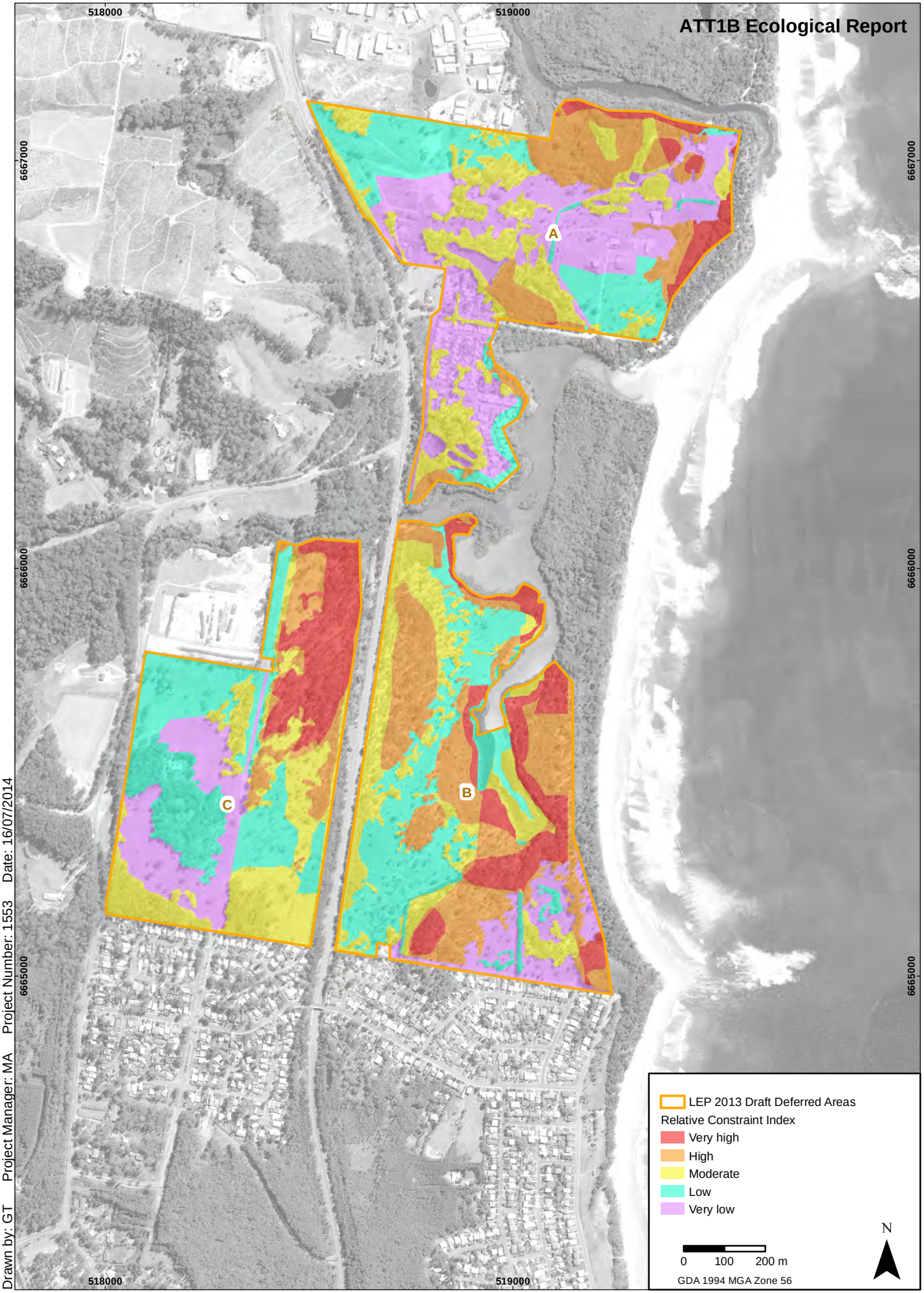
4.8.1 SEPP 14 – Coastal wetlands

SEPP 14 wetland occurrences have been included in the constraints map as a distinct map unit thereby allowing for a clear understanding of the planning implications of this constraint.

4.8.2 Other environment protection or agreements

No known BioBanking site agreements currently exist within the study area.

The Moonee Beach Nature Reserve occurs outside the study area to the north of the township of Moonee and covers an area of 336 hectares. The consideration of OEHs policy for developments adjacent to conservation areas may apply should future land uses be proposed in close proximity to this reserve. A buffer of 100 metres surround these reserves has been applied to spatially represent these constraints.



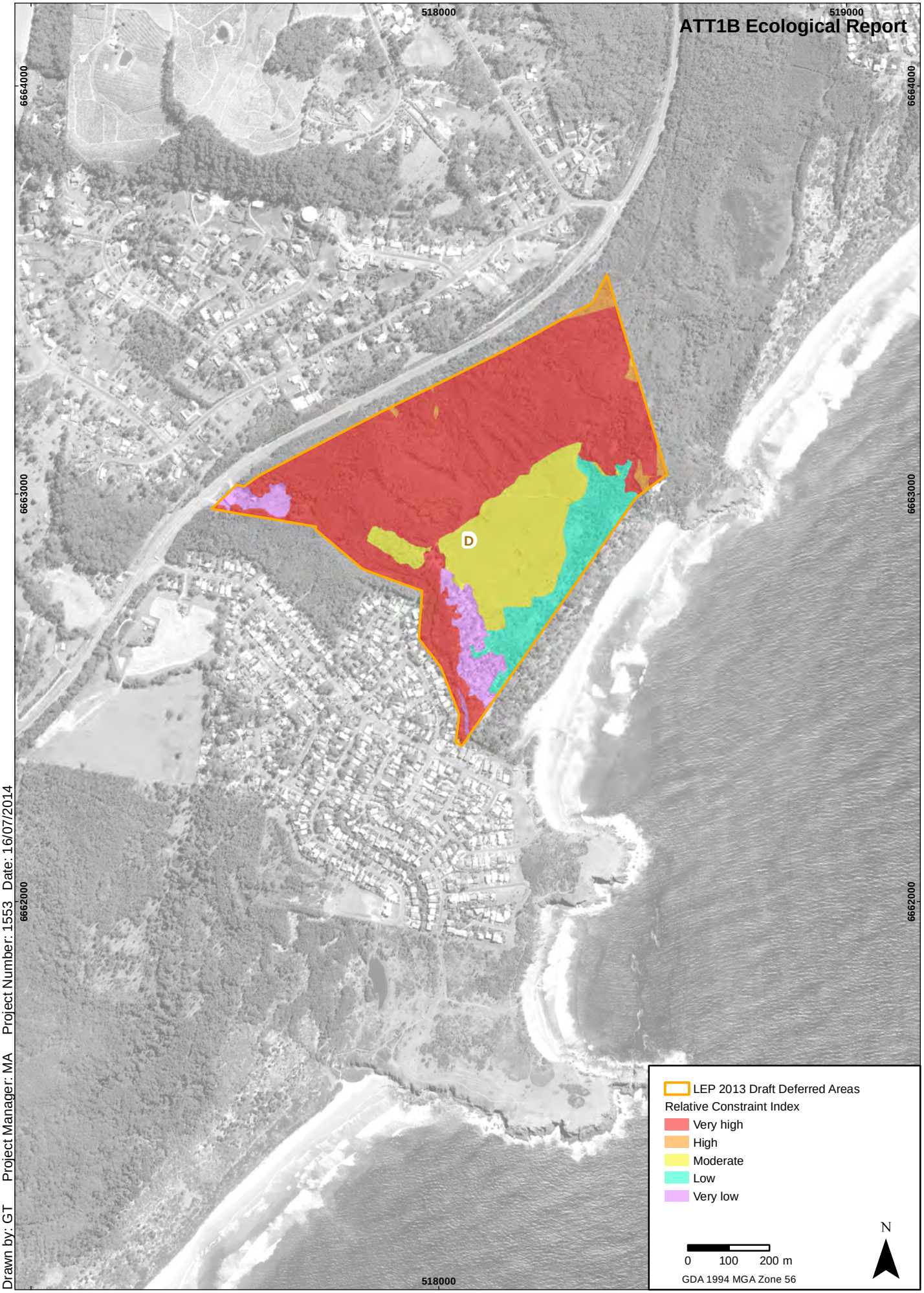
Biodiversity constraints (areas A, B and C)

Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 27

Path: T:\spatial\projects\a1500\a1553_MooneeBeachLEP\Maps\report_20140715\1553_Figure_27_Constraints_ABC.mxd

Imagery: (c) CCC 2009



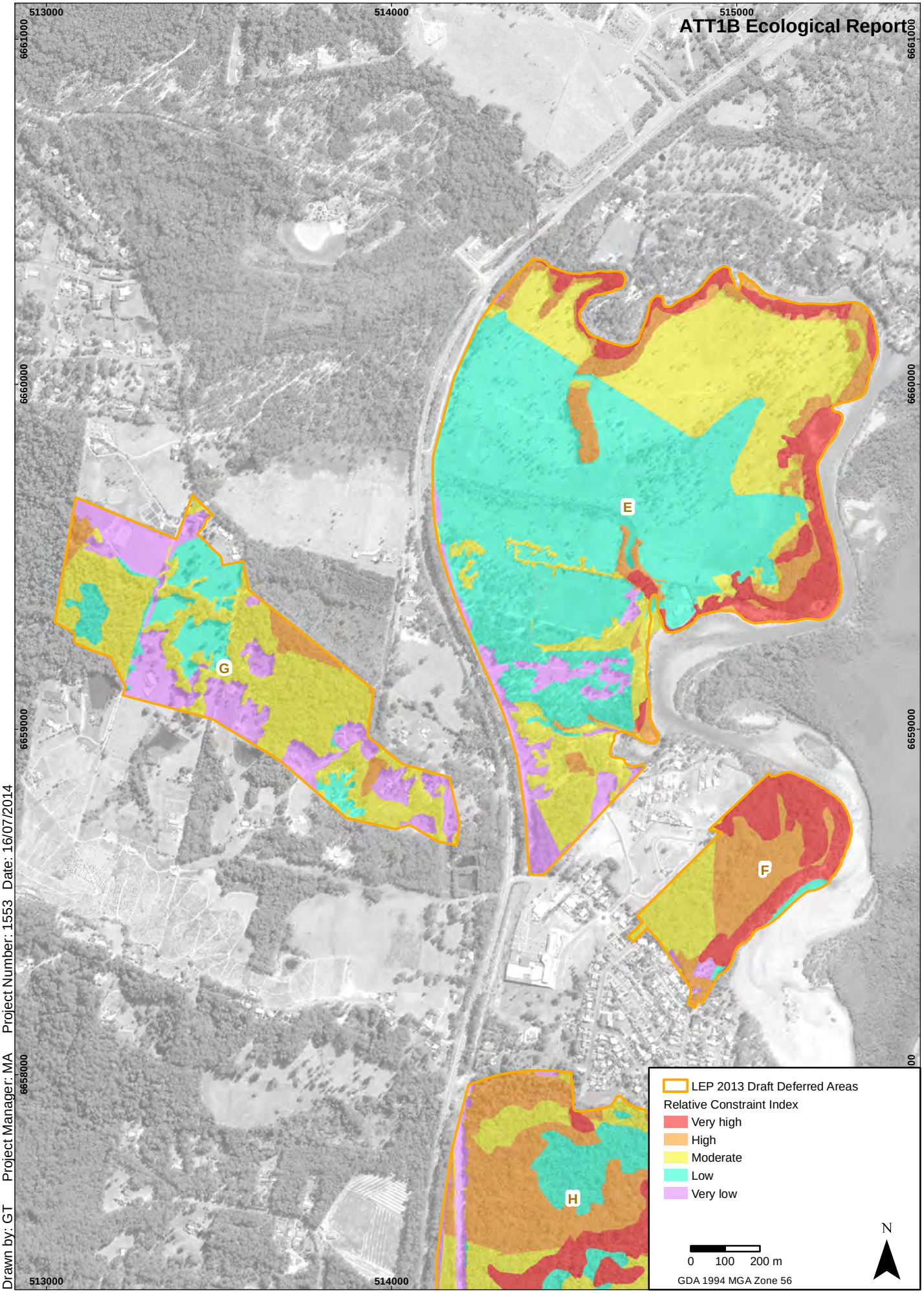
Drawn by: GT Project Manager: MA Project Number: 1553 Date: 16/07/2014

Biodiversity constraints (area D)

Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 28

Path: T:\spatial\projects\a1500\a1553_MooneeBeachLEP\Maps\renumber20140528\1553_Figure_28_Constraints_D.mxd



Drawn by: GT Project Manager: MA Project Number: 1553 Date: 16/07/2014

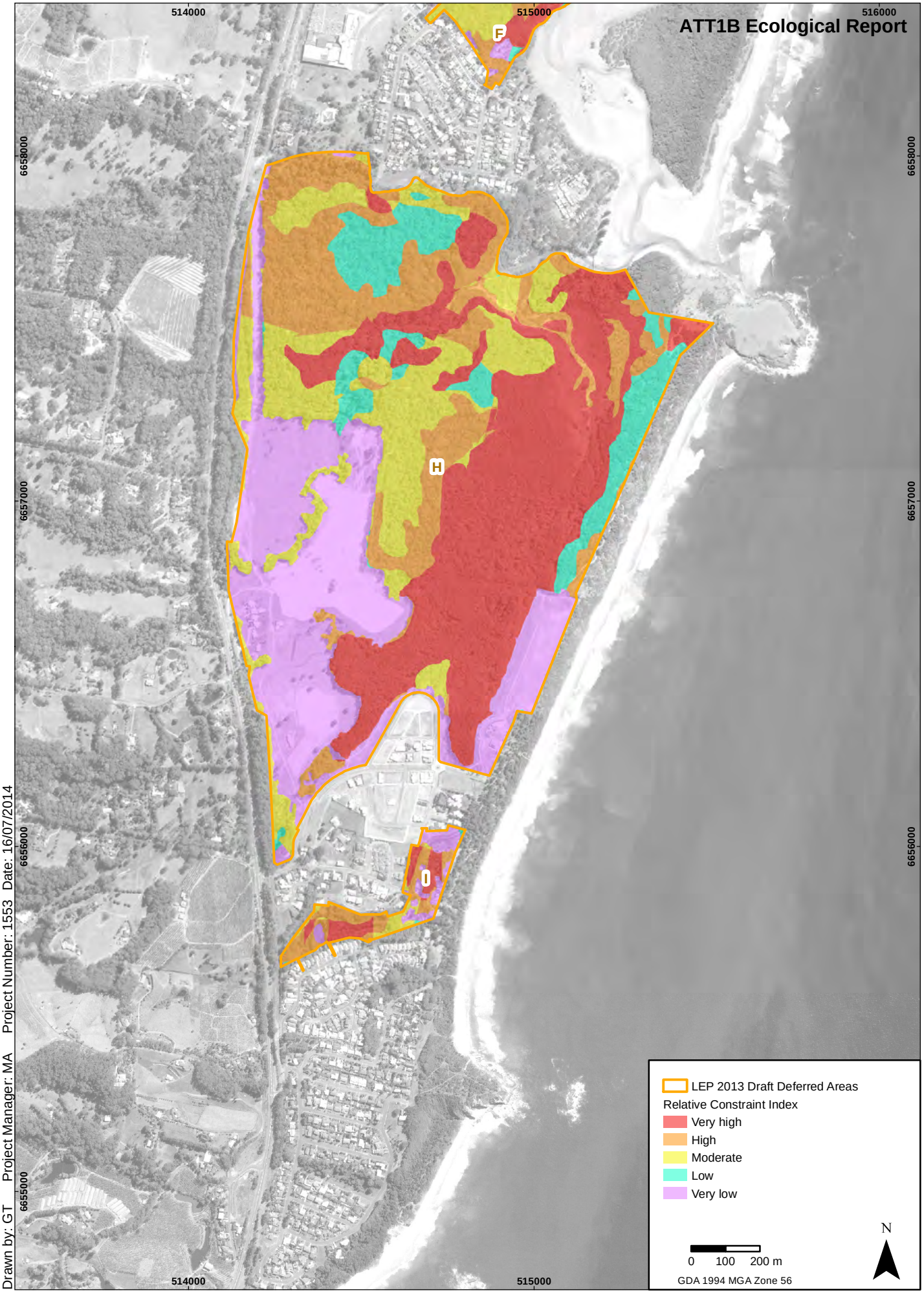
Biodiversity constraints (areas E, F and G)

Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 29

Path: T:\spatial\projects\a1500\a1553_MooneeBeachLEP\Maps\report_20140715\1553_Figure_29_Constraints_EFG.mxd

Imagery: (c) CCC 2009



Drawn by: GT Project Manager: MA Project Number: 1553 Date: 16/07/2014

Biodiversity constraints (areas H and I)

Coffs Harbour LEP Deferred Areas Local Environmental Study

FIGURE 30

Path: T:\spatial\projects\a1500\a1553_MooneeBeachLEP\Maps\report_20140715\1553_Figure_30_Constraints_HI.mxd

Imagery: (c) CCC 2009

5 RECOMMENDATIONS

5.1 Overview

As shown in the constraints mapping, Area D and Area H generated the greatest proportion of high biodiversity constraints implicating these areas as having the highest conservation significance. The high relative constraint index for both these areas was primarily attributed to the presence of TECs and OCVTs coincident with Scotts (2003) corridor mapping. The added presence of SEPP 14 Coastal Wetlands provides additional consideration when determining future land use options.

Area A, Area C, and Area G contained areas with the lowest relative constraint index scores. These portions either contained no native vegetation cover or the vegetation was modified and or not associated with a listed TEC, OCVT or mapped area of Koala habitat. While these areas may posses lower biodiversity values they may still contribute value through the linking and/ or buffering of high biodiversity areas.

5.2 Managing future land uses

Conceptually, the best approach to managing the impacts of development on biodiversity starts by examining the potential for impact avoidance matched with conservation outcomes. Once exhausted, impact minimisation represents the next level of consideration. The last and least preferable option is the use of biodiversity offsets. The following sections provide a broad narrative for the consideration of this conceptual framework in the planning of future land uses within the study area.

5.2.1 Impact avoidance

Land use zoning is the principal strategic mechanism used to avoid impacts on biodiversity. Strategic planning initiatives such as rezoning should, where possible, attempt to align lands comprising high to very high biodiversity constraints with sympathetic land use zonings. Again, wherever possible, corridors linking these important areas of habitat should be conserved or managed for conservation.

Applied to the study area impact avoidance initiatives would have the greatest effect in areas of high to very high biodiversity constraint such as those identified in Areas D and H. Noteworthy is the coincidence of these high conservation value lands with the Scotts (2003) corridor mapping. In the absence of detailed local corridor mapping, the Scotts (2003) corridor mapping, as shown in Figure 7, should be used as a guide for evaluating an integrated strategic land use plan. Design criteria for effective corridors should aim establish contiguous tracts of native vegetation cover of at least 100 metres width (DECC 2009), although greater width are preferred if attainable.

5.2.2 Conservation

Areas comprising high biodiversity constraints should be targeted for inclusion in conservation outcomes designed to protect the associated biodiversity values. Conservation outcomes may be established through formal reservation (i.e. inclusion in the conservation reserve network through addition to a National Park or Reserve) or other conservation mechanisms such as those listed below:

- ❒ BioBanking agreement established under Section 7A of the TSC Act;

- A Property Vegetation Plan (PVP) established under the NSW Native Vegetation Act 2003 (applicable only to rural zoned land);
- A Voluntary Conservation Agreement established under the NSW National Park and Wildlife Act 1974; and
- A trust agreement established under the Nature Conservation Trust Act 2001.

Conservation outcomes could also be encouraged through sympathetic zoning and associated on going commitment to weed and pest animal control and enhancement of riparian areas (CHCC 2012), although the benefit of such measures are generally weaker than the aforementioned outcomes. However, sympathetic land use zones have substantial benefit when seeking to establish linkages between areas high conservation value. Revegetation and passive regeneration may be used as an adjunct to land use zoning to enhance otherwise compromised corridors although the details for such actions can only be determined through site specific planning.

To achieve a maintain or improve biodiversity outcome in protected areas, it is highly recommended that specific management plans be developed and implemented together with adequate funding. The management plans should take into consideration the following land management issues:

- Control of exotic flora and fauna;
- Fire management;
- Boundary management to prevent edge related degradation of conservation values;
- Erosion control along creeklines; and
- Emplacement of supplementary habitat such as nest boxes and fallen logs.

5.2.3 Impact minimisation

A raft of mitigation responses are available to treat specific impacts that frequently arise from land development. Although briefly outlined in Section 5.2.2 they are not discussed here as their suitability and associated prescriptions are invariably site specific.

A broader strategic approach to minimise impacts on areas of high conservation value is the use of buffers, although suitability and prescriptions for such initiatives are almost always determined at the site scale. As listed below, Sainty (2006a, 2006b, 2006c) has provided guidance on buffer types and the prescriptions for their use in the study area. The recommended buffer widths are designed to protect:

- Terrestrial environments adjacent to foredune vegetation (30 metre buffer);
- Threatened ecological communities (50 metre buffer);
- Migratory bird habitat associated with saltmarsh (100 metre buffer); and
- Terrestrial biodiversity near the mean high water mark, which is otherwise vulnerable to sea level rise (retreat zone to 3.5 metre AHD contour).

In making these prescriptions Sainty (2006a, 2006b, 2006c) also noted the importance of maintaining flexibility in applying buffers, viz:

> *"variations to reduce the width of the environmental buffers may be considered where these would provide more practical development outcomes and where further assessment justifies any variations, and where any variations may be offset by increasing the size and/or width of the environmental buffers elsewhere on the site".*

Such flexibility recognises the value of site specific assessments hence potential for generating relevant alternative measures capable of delivering the intended outcomes. Within this context it is considered that the exclusion of these buffer specifications from the mapping of biodiversity constraints is justified.

5.2.4 Offsetting

Where rezoning implicates a future loss of native vegetation it is recommended that consideration be given to the provision of formal biodiversity offsets to address these losses (e.g. an in perpetuity conservation outcome through the NSW Biodiversity Banking Offsets Scheme). Conversely, areas most suited for use as biodiversity offsets include those identified as having high biodiversity constraint (i.e. high conservation significance) and should be protected accordingly. Offsets may also be developed to preserve and or enhance wildlife corridors that link areas of high conservation significance. The conservation mechanisms outlined in Section 5.2.2 may be used to deliver these outcomes.

5.3 Future impact assessment options

Future impact assessment options will shape the will have a significant bearing on the suitability and effectiveness of management measures for the long term protection of high value biodiversity areas. The following impact assessment options currently apply to lands within the study area where future land development would have an impact on biodiversity values:

- ❒ Part 5A of the EP&A Act (Seven Part Test) and controlling provisions listed under the EPBC Act;
- ❒ NSW BioBanking Scheme; or
- ❒ NSW Biodiversity Certification scheme.

The first two assessment options are variably applicable to the study area and, depending on the nature of proposed development, may or may not be suitable within the wider context. They generally have limited assessment focus (i.e. site specific) and more often than not deliver ad hoc disconnected outcomes.

The principles defining the latter assessment option (i.e. Biodiversity Certification) are closely aligned with those of strategic land use planning, although is only available through a government authority such as Council. This impact assessment framework provides valuable tools for handling large areas comprising a complex array of biodiversity values and land ownership. It also has capacity to align with assessment processes followed in 'Strategic Assessments' completed under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) thereby providing holistic assessment outcomes that avoid ad hoc uncertainties generally posed by site specific assessment pathways.

5.3.1 Biodiversity Certification

The NSW Biodiversity Certification Scheme offers planning authorities the opportunity to engage in a rigorous but streamlined biodiversity assessment process compatible with strategic level planning processes. The scheme is designed to move away from an *ad hoc* approach to development by delivering a landscape level blending of development and conservation. It has functionality designed to identify areas of high conservation value independent of development planning, and provides multiple pathways for the protection of important biodiversity assets while providing mechanisms for the identification of lands for development. After biodiversity certification is conferred on an area by OEH, development may proceed without the usual assessment requirements specified under the *Environmental Planning and Assessment Act* 1979 for site-by-site threatened species assessment (i.e. Seven Part Tests).

Only planning authorities can apply to the Minister to have biodiversity certification conferred over an area of land meaning that individual landholders or proponents cannot directly engage in this process. However, Council on behalf of a syndicate of interested parties may apply for biodiversity certification. In this capacity Council would develop a Biodiversity Certification Strategy, which details the conservation measures used to improve or maintain biodiversity values otherwise impacted by development within the certified area. This biodiversity certification strategy can also be completed in parallel with a Strategic Assessment under the EPBC Act and in so doing simultaneously address both State and Commonwealth tiers of environmental assessment in efficient and effective manner.

Biodiversity certification provides clear directions for delivering maintain or improve outcomes through the identification offset lands, the management requirements for those lands and funding requirements necessary for successful management implementation.

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APPENDICES

Appendix A: Vegetation community alignment

MU code	MU name	RBVT Code	RBVT	Vegetation formation	Vegetation class	Percentage cleared	TEC
CH_DOF01	Coast and Escarpment Blackbutt Dry Forest	NR117	Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the North Coast	Wet Sclerophyll Forests (Shrubby subformation) [NR]	North Coast Wet Sclerophyll Forests	50	
CH_WSF01	Coast and Hinterland Riparian Flooded Gum Bangalow Wet Forest	NR159	Flooded Gum - Brush Box moist forest of the coastal ranges of the North Coast	Wet Sclerophyll Forests (Shrubby subformation) [NR]	North Coast Wet Sclerophyll Forests	40	
CH_H01	Coast Banksia Shrubland on Holocene Dunes	NR151	Coastal headland heaths of the North Coast	Heathlands [NR]	Coastal Headland Heaths	30	
CH_DOF09	Coast Sand Blackbutt - Bloodwood - Apple Forest	NR114	Blackbutt - bloodwood dry heathy open forest on Quaternary sands of the northern	Dry Sclerophyll Forests (Shrubby subformation) [NR]	North Coast Dry Sclerophyll Forests	40	
CH_H02	Coast Wattle Shrublands	NR151	Coastal headland heaths of the North Coast	Heathlands [NR]	Coastal Headland Heaths	30	
CH_RF07	Coastal Exposed Dune Littoral Rainforest	NR273	Tuckeroo - Riberry - Yellow Tulipwood littoral rainforest of the North Coast	Rainforests [NR]	Littoral Rainforests	90	Littoral Rainforests in the NSW North Coast, Sydney Basin and South East Corner Bioregions
CH_FW08	Coastal Freshwater Wetland	NR150	Coastal freshwater meadows and forblands of lagoons and wetlands	Freshwater Wetlands [NR]	Coastal Freshwater Lagoons	40	Freshwater Wetlands on Coastal Floodplains
CH_H06	Coastal Headland Banksia	NR151	Coastal headland heaths of the North Coast	Heathlands [NR]	Coastal Headland Heaths	30	Themeda Grassland on Seacliffs and Coastal Headlands
CH_H07	Coastal Headland Swamp Oak Shrublands	N/A	N/A	N/A	N/A	N/A	
CH_FW07	Coastal Jointed Twig-rush Freshwater Wetland	NR150	Coastal freshwater meadows and forblands of lagoons and wetlands	Freshwater Wetlands [NR]	Coastal Freshwater Lagoons	40	Freshwater Wetlands on Coastal Floodplains
CH_FrW01	Coastal Paperbark - Swamp Oak Floodplain Forest	NR217	Paperbark swamp forest of the coastal lowlands of the North Coast.	Forested Wetlands [NR]	Coastal Swamp Forests	75	Swamp Sclerophyll Forest on Coastal Floodplains
CH_FrW03	Coastal Paperbark Bottlebrush Channel Forest	NR217	Paperbark swamp forest of the coastal lowlands of the North Coast.	Forested Wetlands [NR]	Coastal Swamp Forests	75	Swamp Sclerophyll Forest on Coastal Floodplains
CH_FrW04	Coastal Paperbark Sedgeland Dominated Forest	NR217	Paperbark swamp forest of the coastal lowlands of the North Coast.	Forested Wetlands [NR]	Coastal Swamp Forests	75	Swamp Sclerophyll Forest on Coastal Floodplains
CH_FrW05	Coastal Paperbark Swamp Box Littoral Forest	NR217	Paperbark swamp forest of the coastal lowlands of the North Coast.	Forested Wetlands [NR]	Coastal Swamp Forests	75	Swamp Sclerophyll Forest on Coastal Floodplains
CH_FrW01	Coastal Paperbark Swamp Oak Floodplain Forest	NR217	Paperbark swamp forest of the coastal lowlands of the North Coast.	Forested Wetlands [NR]	Coastal Swamp Forests	75	Swamp Sclerophyll Forest on Coastal Floodplains
CH_DOF08	Coastal Sand Bloodwood - Banksia Forest	NR220	Pink Bloodwood open forest of the coastal lowlands of the North Coast	Dry Sclerophyll Forests (Shrubby subformation) [NR]	Coastal Dune Dry Sclerophyll Forests	25	

MU code	MU name	RBVT Code	RBVT	Vegetation formation	Vegetation class	Percentage cleared	TEC
CH_FrW02	Coastal Swamp Mahogany Forest	NR254	Swamp Mahogany swamp forest of the coastal lowlands of the North Coast	Forested Wetlands [NR]	Coastal Swamp Forests	75	Swamp sclerophyll forest on coastal floodplains
CH_FW02	Coastal Wallum Paperbark Banksia Grass Tree Wet Heathland	NR152	Coastal heath on sands of the North Coast	Heathlands [NR]	Northern Montane Heaths	10	
CH_FrW09	Coastal Wallum Swamp Mahogany Sieber's Paperbark Forest	NR254	Swamp Mahogany swamp forest of the coastal lowlands of the North Coast.	Forested Wetlands [NR]	Coastal Swamp Forests	75	Swamp Sclerophyll Forest on Coastal Floodplains
Niche	Derived grassland	N/A	N/A	N/A	N/A	N/A	
CH_P03	Environmental plantings	N/A	N/A	N/A	N/A	N/A	
CH_RF11	Escarpment and Lowland Bangalow - Carabeen - Black Booyong Palm Gully Rainforest	NR111	Black Booyong - Rosewood - Yellow Carabeen subtropical rainforest of the North Coast	Rainforests [NR]	Subtropical Rainforests	75	
CH_SW01	Estuarine Mangrove Forest	NR182	Mangrove - Grey Mangrove low closed forest of the NSW Coastal Bioregions.	Saline Wetlands [NR]	Mangrove Swamps	75	Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions
CH_FrW11	Estuarine Paperbark Twig-rush Forest	NR255	Swamp Oak swamp forest of the coastal lowlands of the North Coast	Forested Wetlands [NR]	Coastal Floodplain Wetlands	75	Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions
CH_SW07	Estuarine Samphire - Saltwater Couch Saltmarsh	NR225	Saltmarsh complex of the North Coast	Saline Wetlands [NR]	Saltmarshes	75	Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions
CH_SW02	Estuarine Twig Rush Saltmarsh	NR225	Saltmarsh complex of the North Coast	Saline Wetlands [NR]	Saltmarshes	75	Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions
CH_EX03	Exotic vegetation	N/A	N/A	N/A	N/A	N/A	
CH_DOF05	Foothills Grey Gum - Ironbark - Mahogany Dry Forest	NR263	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of North Coast	Wet Sclerophyll Forests (Grassy subformation) [NR]	Northern Hinterland Wet Sclerophyll Forests	30	
CH_WSF05	Foothills to Escarpment Brush Box - Tallowwood - Blackbutt Wet Forest	NR112	Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central North Coast	Rainforests [NR]	Cool Temperate Rainforests	10	
CH_WSF17	Foothills Turpentine - Grey Gum - Ironbark Moist Shrubby Forest	NR263	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of North Coast	Wet Sclerophyll Forests (Grassy subformation) [NR]	Northern Hinterland Wet Sclerophyll Forests	30	

MU code	MU name	RBVT Code	RBVT	Vegetation formation	Vegetation class	Percentage cleared	TEC
CH_RF08	Headland Brush Box Littoral Rainforest	NR142	Brush Box - Tuckeroo littoral rainforest on coastal headlands of the North Coast	Rainforests [NR]	Littoral Rainforests	35	Littoral Rainforest in the NSW North Coast, Sydney Basin and South Eat Corner Bioregions
CH_WSF10	Hinterland and Escarpment Tallowwood - Blackbutt - Blue Gum Wet Ferny Forest	NR120	Blackbutt - Tallowwood moist ferny open forest of the coastal ranges of the North Coast	Wet Sclerophyll Forests (Shrubby subformation) [NR]	North Coast Wet Sclerophyll Forests	15	
CH_DOF04	Hinterland Needlebark Stringybark - Scribbly Gum - Red Mahogany Dry Forest	NR220	Pink Bloodwood open forest of the coastal lowlands of the North Coast	Dry Sclerophyll Forests (Shrubby subformation) [NR]	Coastal Dune Dry Sclerophyll Forests	25	
CH_H03	Kangaroo Grass Headland Grasslands	NR271	Themeda australis sod tussock grassland of coastal areas of the North Coast	Grasslands [NR]	Maritime Grasslands	90	Themeda Grassland on Seacliffs and Coastal Headlands
CH_DOF06	Lowlands Swamp Box - Paperbark - Red Gum Dry Forest	NR161	Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast	Grassy Woodlands [NR]	Coastal Valley Grassy Woodlands	60	Subtropical Coastal Floodplain Forest
CH_NRV01	Native remnant vegetation	N/A	N/A	N/A	N/A	N/A	
CH_WSF09	Northern Escarpment Blackbutt - Apple Wet Ferny Forest	NR120	Blackbutt - Tallowwood moist ferny open forest of the coastal ranges of the North Coast	Wet Sclerophyll Forests (Shrubby subformation) [NR]	North Coast Wet Sclerophyll Forests	15	
CH_DOF02	Sandstone Bloodwood Needlebark Stringbark Heathy Forest	NR104	Bailey's Stringybark - Needlebark Stringybark heathy woodland on sandstones of the lower Clarence Valley of the North Coast	Dry Sclerophyll Forests (Shrubby subformation) [NR]	North Coast Dry Sclerophyll Forests	25	
CH_SW06	Sea Rush Saltmarsh	NR225	Saltmarsh complex of the North Coast	Saline Wetlands [NR]	Saltmarshes	75	Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions
CH_MV01	Seagrass beds	N/A	N/A	N/A	N/A	N/A	
CH_FrW10	Swamp Oak Forested Wetland	NR255	Swamp Oak swamp forest of the coastal lowlands of the North Coast	Forested Wetlands [NR]	Coastal Floodplain Wetlands	75	Freshwater Wetlands on Coastal Floodplains
CH_H08	Wallum Banksia Black She-oak Shrubland	NR105	Banksia dry shrubland on coastal sands of the North Coast	Heathlands [NR]	Wallum Sand Heaths	70	

Appendix B: Site attributes

RBVT Code	RVBT	NPS	NOS	NMS	NGC G	NGC O	NGCS	EC	OR	HBT	FL
NR117	Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the North Coast	22	3	0	66	0	10	0	0	0.5	0
NR220	Pink Bloodwood open forest of the coastal lowlands of the North Coast		37	10	0	5	5	5	0	2	1
NR225	Saltmarsh complex of the North Coast	5	0	0	0	0	5	0	0	1	0
NR263	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of North Coast	40	20	8	10	0	10	0	1	1	20
NR255	Swamp Oak swamp forest of the coastal lowlands of the North Coast	13	10	5	1	0	1	0	1	1	0
NR254	Swamp Mahogany swamp forest of the coastal lowlands of the North Coast	6	10	0	0	0	5	0	0	1	5
NR104	Bailey's Stringybark - Needlebark Stringybark heathy woodland on sandstones of the lower Clarence Valley of the North Coast	32	10	5	0	10	5	0	2	1	10
NR105	Banksia dry shrubland on coastal sands of the North Coast	35	0	0	0	20	5	0	0	1	0
NR111	Black Booyong - Rosewood - Yellow Carabeen subtropical rainforest of the North Coast	50	50	10	0	0	10	0	0	1	0
NR112	Black Olive Berry - Rough Possumwood cool temperate rainforest of eastern New England Tablelands	17	60	10	0	0	10	0	0	1	10
NR114	Blackbutt - bloodwood dry heathy open forest on Quaternary sands of the northern North Coast	32	10	5	0	10	5	0	2	1	10
NR117	Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the North Coast	40	15	25	0	0	10	0	1	1	10
NR120	Blackbutt - Tallowwood moist ferny open forest of the coastal ranges of the North Coast	40	15	25	0	0	10	0	1	1	10
NR142	Brush Box - Tuckeroo littoral rainforest on coastal headlands of the North Coast	45	40	10	0	5	5	0	0	1	0
NR150	Coastal freshwater meadows and forblands of lagoons and wetlands	45	40	10	0	5	5	0	0	1	0
NR150	Coastal freshwater meadows and forblands of lagoons and wetlands	5	0	0	0	0	2	0	0	1	0
NR151	Coastal headland heaths of the North Coast	25	0	0	5	5	1	0	0	1	0

RBVT Code	RVBT	NPS	NOS	NMS	NGCG	NGCO	NGCS	EC	OR	HBT	FL
NR152	Coastal heath on sands of the North Coast	12	0	0	0	5	0	0	0	1	0
NR159	Flooded Gum - Brush Box moist forest of the coastal ranges of the North Coast	40	15	25	0	0	10	0	1	1	10
NR161	Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast	35	10	5	10	0	5	0	1	1	5
NR182	Mangrove - Grey Mangrove low closed forest of the NSW Coastal Bioregions	2	5	0	0	0	0	0	0	1	0
NR217	Paperbark swamp forest of the coastal lowlands of the North Coast	6	10	0	0	0	5	0	0	1	5
NR220	Pink Bloodwood open forest of the coastal lowlands of the North Coast	37	10	0	5	5	5	0	2	1	7
NR225	Saltmarsh complex of the North Coast	5	0	0	0	0	5	0	0	1	0
NR254	Swamp Mahogany swamp forest of the coastal lowlands of the North Coast	6	10	0	0	0	5	0	0	1	5
NR255	Swamp Oak swamp forest of the coastal lowlands of the North Coast	13	10	5	1	0	1	0	1	1	0
NR263	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of North Coast	40	20	8	10	0	10	0	1	1	20

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Appendix C: Threatened biodiversity likelihood of occurrence table

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence	Ecosystem Credit Species (Y/N)
Plants						
Acronychia littoralis	Scented Acronychia	E	E	Scented Acronychia is found between Fraser Island in Queensland and Port Macquarie on the north coast of NSW. Scented Acronychia grows in littoral rainforest on sand.	High (previously recorded in locality OEH 2013)	N
Alexfloydia repens	Floyd's Grass	E	-	Found only in the Coffs Harbour area. It is known from Bongil Bongil National Park and on private property. Floyd's Grass is confined to coastal stands of Swamp Oak and Paperbark in peat-like soil edging the upper tidal areas of mangroves. It is known to grow on the banks of estuarine creeks. Floyd's Grass is the sole food plant for the caterpillar of the Endangered Black Grass-dart butterfly Ocybadistes knightorum.	High (previously recorded in locality OEH 2013)	N
Allocasuarina defungens	Dwarf Heath Casuarina	E	E	Found only in NSW from the Nabiac area, north-west of Forster, to Byron Bay on the NSW north coast. Grows mainly in tall heath on sand, but can also occur on clay soils and sandstone. The species also extends onto exposed nearby-coastal hills or headlands adjacent to sandplains.	High (previously recorded in locality OEH 2013)	N
Angophora robur	Sandstone Rough-barked Apple	V	V	Dry open forest in sandy or skeletal soils on sandstone, or occasionally granite, with frequent outcrops of rock.	Low	N
Arthraxon hispidus	Hairy-joint Grass	V	V	Moisture and shade-loving grass, found in or on the edges of rainforest and in wet eucalypt forest, often near creeks or swamps.	Moderate	N
Boronia umbellata		V	V	Grows as an understorey shrub in and around gullies in wet open forest.	High (previously recorded in locality OEH 2013)	N
Chamaesyce psammogeton		E	-	Found sparsely along the coast from south of Jervis Bay (at Currarong, Culburra and Seven Mile Beach National Park) to Queensland (and Lord Howe Island). Populations have been recorded in Wamberal Lagoon Nature Reserve, Myall Lakes National Park and Bundjalung National Park. Grows on fore-dunes and exposed headlands, often with Spinifex sericeus.	High (previously recorded in locality OEH 2013)	N
Corynocarpus rupestris subsp. rupestris	Glenugie Karaka	V	V	Dry rainforest on steep basalt boulder slopes. Soil is scarce but relatively high in nutrients and very well-drained.	Low	N
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V	Grows in swamp-heath on sandy soils, chiefly in coastal districts, south from the Gibraltar Range.	Moderate	N
Diospyros mabacea	Red-fruited Ebony	E	E	Usually grows as an understorey tree in lowland subtropical rainforest, often close to rivers. Soils are generally basalt-derived or alluvial.	Moderate (previously recorded in locality OEH 2013)	N
Diploglottis campbellii	Small-leaved Tamarind	E	E	Confined to the warm subtropical rainforests of the NSW-Queensland border lowlands and adjacent low ranges.	Moderate (previously recorded in locality OEH 2013)	N
Diuris praecox		V	V	Occurs between Ourimbah and Nelson Bay. Grows on hills and slopes of near-coastal districts in open forests which have a grassy to fairly dense understorey. Exists as subterranean tubers most of the year. It produces leaves and flowering stems in winter.	Low	N

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence	Ecosystem Credit Species (Y/N)
Endiandra floydii	Crystal Creek Walnut	E	E	Warm temperate or subtropical rainforest with Brush Box overstorey, and in regrowth rainforest and Camphor Laurel forest.	Moderate (previously recorded in locality OEH 2013)	N
Endiandra hayesii	Rusty Rose Walnut	V	V	Sheltered moist gullies in lowland subtropical and warm temperate rainforest on alluvium or basaltic soils.	Moderate (previously recorded in locality OEH 2013)	N
Eucalyptus tetrapleura	Square-fruited Ironbark	V	V	Dry or moist eucalypt forest on moderately fertile soil, often in low areas with poor drainage.	Low	N
Hakea archaeoides	Big Nellie Hakea	V	V	Found on steep, rocky, sheltered slopes and in deep gullies in open eucalypt forest.	Low	N
Hicksbeachia pinnatifolia	Red Boppel Nut	V	V	Subtropical rainforest, moist eucalypt forest and Brush Box forest.	Moderate (previously recorded in locality OEH 2013)	N
Kennedia retrorsa		V	V	Found in a variety of habitats from mountainsides to riparian zones, from sheltered forest to steep, exposed rocky ridgelines.	Moderate (previously recorded in locality OEH 2013)	N
Leucopogon confertus	Torrington Beard-heath	E	E	Torrington Beard-heath possibly occurs in open forest and woodland on rocky granite areas.	Low	N
Lindsaea incisa	Slender Screw Fern	E	-	Dry eucalypt forest on sandstone and moist shrubby eucalypt forest on metasediments. It is usually found in waterlogged or poorly drained sites along creeks, where ferns, sedges and shrubs grow thickly.	High (previously recorded in locality OEH 2013)	N
Macadamia integrifolia	Macadamia Nut	-	V	The Macadamia Nut grows in remnant rainforest, preferring partially open areas such as rainforest edges. However, this habitat is not continuously fit for the species.	High (previously recorded in locality OEH 2013)	N
Macadamia tetraphylla	Rough-shelled Bush Nut	V	V	Found in subtropical rainforest, usually near the coast.	High (previously recorded in locality OEH 2013)	N
Marsdenia longiloba		E	V	Subtropical and warm temperate rainforest, lowland moist eucalypt forest adjoining rainforest and, sometimes, in areas with rock outcrops.	Moderate (previously recorded in locality OEH 2013)	N
Melichrus hirsutus	Hairy Melichrus	E	E	Dry eucalypt forest with a shrubby understorey on sandy infertile soils with rock outcrops.	Low (previously recorded in locality OEH 2013)	N
Myrsine richmondensis	Ripple-leaf Muttonwood	E	E	Subtropical and dry rainforest and swamp forest on creek flats and slopes on basalt derived soil	Low (previously recorded in locality OEH 2013)	N
Niemeyera whitei	Rusty Plum	V	-	Rainforest and the adjacent understorey of moist eucalypt forest.	Known. Gunninah Environmental Consultants (2006); James Warren and Associates (2007b)	N
Oberonia complanata	Yellow-flowered King of the Fairies	E	-	This species grows on trees and rocks in littoral rainforest, subtropical rainforest, dry rainforest, wet or dry eucalypt forests, dunes (including stabilised sands), stream-side areas, swampy forests and mangroves.	Moderate (previously recorded in locality OEH 2013)	N
Parsonsia dorrigoensis	Milky Silkpod	V	E	Found in subtropical and warm-temperature rainforest, on rainforest margins, and in moist eucalypt forest up to 800	Moderate (previously recorded	N

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence	Ecosystem Credit Species (Y/N)
				m, on brown clay soils.	in locality OEH 2013)	
Peristeranthus hillii	Brown Fairy-chain Orchid	V	-	Restricted to coastal and near-coastal environments, particularly Littoral Rainforest and the threatened ecological community Lowland Rainforest on Floodplain. The species is an epiphyte, growing in clumps on tree trunks and thick vines.	Moderate (previously recorded in locality OEH 2013)	N
Persicaria elatior		V	V	This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	Low (previously recorded in locality OEH 2013)	N
Phaius australis	Southern Swamp Orchid	E	E	Swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest, mostly in coastal areas.	Moderate (previously recorded in locality OEH 2013)	N
Phaius tancarvilleae	Lady Tankerville's Swamp Orchid	E	E	This orchid is found in swampy grassland or swampy forest, including rainforest, eucalypt and paperbark forest.	Moderate (previously recorded in locality OEH 2013)	N
Pultenaea maritima		V	-	The species occurs in grasslands, shrublands and heath on exposed coastal headlands.	Moderate (previously recorded in locality OEH 2013)	N
Quassia sp. Mooney Creek	Moonee Quassia	E	E	Shrubby layer below tall moist eucalypt forest and tall dry eucalypt forest, including forest edges, mostly at lower altitudes.	Known. Gunninah Environmental Consultants (2006); James Warren and Associates (2007b)	N
Sarcochilus fitzgeraldii	Ravine Orchid	V	V	The Ravine Orchid grows mainly on rocks, amongst organic matter, in cool, moist, shady ravines, gorges and on cliff faces in dense subtropical rainforest at altitudes between 500 and 700 m. Occasional clumps are found on the bases of fibrous-barked trees.	Low	N
Sarcochilus hartmannii	Hartman's Sarcochilus	V	V	From the Richmond River in northern NSW to Gympie in south-east Queensland. Favours cliff faces on steep narrow ridges supporting eucalypt forest and clefts in volcanic rock from 500 to 1,000 m in altitude.	Low	N
Senna acclinis		E	-	Grows in or on the edges of subtropical and dry rainforest.	Moderate (previously recorded in locality OEH 2013)	N
Sophora tomentosa	Silverbush	E	-	Silverbush occurs on coastal dunes.	High (previously recorded in locality OEH 2013)	N
Streblus pendulinus	Siah's Backbone	-	E	Siah's Backbone is a tree or large shrub that grows to 6 m in height. Found in warmer rainforests, chiefly along watercourses.	Low	N
Syzygium paniculatum		E	V	Found only in NSW, in a narrow, linear coastal strip from Bulahdelah to Conjola State forest. On the south coast the species occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral rainforest. On the central coast it occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities	Low	N
Taeniophyllum muelleri	Minute Orchid	-	V	Grows on outer branches and branchlets of rainforest trees; coast and coastal ranges, from sea level to 250 m alt., north from the Bellinger R.	Low	N

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence	Ecosystem Credit Species (Y/N)
Thesium australe		V	V	Grows in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland or grassy woodland. Grows on kangaroo grass tussocks but has also been recorded within the exotic coolatai grass.	Known. Ecological Australia (2007)	N
Tinospora tinosporoides	Arrow-head Vine	V	V	Wetter subtropical rainforest, including littoral rainforest, on fertile, basalt-derived soils.	Low	N
Tylophora woollsii		E	E	This species grows in moist eucalypt forest, moist sites in dry eucalypt forest and rainforest margins. Thought to be wind-dispersed. Plants appear to persist as a network of stems under leaf litter when aerial stems are absent.	Moderate	N
Typhonium sp. aff. brownii	Stink Lily	E	-	Occurs on reasonably fertile soils, in moist eucalypt forest and the moist eucalypt forest-subtropical rainforest interface.	Moderate	N
Uromyrtus australis	Peach Myrtle	E	E	Warm temperate rainforest on less fertile soils derived from rhyolite rock. Often associated with coachwood.	Low	N
Uvidicolus sphyrurus		-	V	Occurs in dry sclerophyll open forest and woodland associated with outcrops of granite, basalt, sandstone and metamorphic rocks. The majority of sites are associated with granite outcrops.	Low	N
Zieria prostrata	Headland Zieria	E	E	Low grassy heath on exposed sites and wind-pruned open to sparse shrubland on more sheltered aspects.	Low	N
Zieria smithii		EP	-	Occurs in low heath with Kangaroo Grass (*Themeda australis*) on a coastal headland.	Low	N
Amphibians						
Crinia tinnula	Wallum Froglet	V	-	Wallum Froglets are found in acid paperbark swamps and sedge swamps of the coastal 'wallum' country. Their tadpoles are adapted to acid conditions and may be outcompeted by the Common Froglet. Males call from the base of vegetation in and around the breeding site and are almost impossible to locate. Calling occurs from Autumn to Spring, being most strongly associated with flooding following rainfall. Its range extends from SE QLD to the Kurnell Peninsular of Sydney.	Known. James Warren and Associates (2007a) (Possible)	N
Litoria aurea	Green and Golden Bell Frog	E	V	Inhabits a very wide range of water bodies including marshes, dams and streams, particularly those containing emergent vegetation such as bullrushes or spikerushes. It also inhabits numerous types of man-made water bodies including quarries and sand extraction sites. Optimum habitat includes water-bodies that are un-shaded, free of predatory fish such as Plague Minnow, have a grassy area nearby and diurnal sheltering sites available.	Low	N
Litoria booroolongensis	Booroolong Frog	E	E	The Booroolong Frog is found along permanent western flowing streams of the Great Dividing Range through most of NSW and down into northern Victorua. Streams range from small slow-flowing creeks to large rivers and the adults are found on or near cobble banks and other rock structures within stream margins and shelter under rocks or amongst vegetation near the ground on the stream edge. The species occurs along streams in both forested areas and open pasture, but has been affected by the presence of the introduced willow tree. Booroolong Frogs sometimes basks in the sun on exposed rocks near flowing water during summer.	Low	N

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence	Ecosystem Credit Species (Y/N)
Litoria brevipalmata	Green-thighed Frog	V	-	This species is distributed from south-east Queensland to the NSW Central Coast. It occurs in a range of habitat types including rainforest, moist eucalypt forest, dry eucalypt forest and heath, but is most closely associated with wetter forest types in the southern part of its range. Calling and breeding is highly correlated with heavy rainfalls that lead to the formation of large ephemeral pools in a range of sites, but always in association with some native vegetation. Calling occurring only for one or two nights at a time anywhere between September and May.	Moderate; suitable habitat exists	N
Litoria olongburensis	Olongburra Frog	V	V	The Wallum Tree Frog is found in coastal areas from Fraser Island in south-east Queensland to Woolgoolga in northern NSW. The species is strongly associated with acid swamps and sedge swamps, known as wallum swamps, with the tadpoles being adapted to living in a low pH environment. Individuals can be observed on emergent vegetation at any time and are most active after rainfall events that flood the swamplands.	Low	N
Mixophyes balbus	Stuttering Frog	E	V	Associated with streams in dry sclerophyll and wet sclerophyll forests and rainforests of more upland areas of the Great Dividing Range of NSW and down into Victoria. Breeding occurs along forest streams with permanent water where eggs are deposited within nests excavated in riffle zones by the females and the tadpoles swim free into the stream when large enough to do so. Outside of breeding, individuals range widely across the forest floor and can be found hundres of metres from water	Low	N
Mixophyes iteratus	Giant Barred Frog	E	E	This species is found along larger streams of the coast and adjacent ranges of NSW and SE QLD. It inhabits rainforest and wet sclerophyll forest, but is also found within cleared farmland where fringing vegetation is retained, including lantana beds. Many sites where the Giant Barred Frog is known to occur are the lower reaches of streams which have been affected by major disturbances such as clearing, timber harvesting and urban development in their headwaters.	Low	N
Philoria sphagnicolus	Sphagnum Frog	V	-	This is the most widespread of the Mountain Frogs and is found in rainforests, including Antarctic Beech forest, moist eucalypt forest and sphagnum moss beds at higher elevations from Mount Marsh to north of Dorrigo area of NSW. Sphagnum Frogs burrow in loose, moist soil or moss, under leaf litter often in soaks or seepages, or may use cracks and cavities behind and beside large or small waterfalls where the environment remains saturated with moisture. These high continuous moisture levels are essential for the survival of their terrestrial eggs and tadpoles that remain in the nest and complete development without free water.	None	N
Birds						
Anthochaera phrygia	Regent Honeyeater	CE	E,M	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests.	Known. Previously recorded by Gunninah Environmental Consultants (2006)	N
Apus pacificus	Fork-tailed Swift	-	M	The Fork-tailed Swift is almost exclusively aerial, flying from less then one metre to at least 300 metres above ground and probably much higher.	High; potential habitat occurs	N
Ardea alba	Great Egret	-	M	Great Egrets prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp	High; potential habitat occurs	N

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence	Ecosystem Credit Species (Y/N)
				grasslands.		
Ardea ibis	Cattle Egret	-	M	The Cattle Egret is found in grasslands, woodlands and wetlands, and is not common in arid areas. It also uses pastures and croplands, especially where drainage is poor.	High; potential habitat occurs	N
Botaurus poiciloptilus	Australasian Bittern	E	E	The Australasian Bitterns is widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes and spikerushes.	High; potential habitat occurs	N
Burhinus grallarius	Bush Stone-curlew	E	-	The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Largely nocturnal, being especially active on moonlit nights.	Moderate; potential habitat occurs	Y
Calidris ferruginea	Curlew Sandpiper	E	-	The Curlew Sandpiper is distributed around most of the coastline of Australia. It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes the inland	Moderate; potential habitat occurs	N
Calidris tenuirostris	Great Knot	V	-	In NSW, the species has been recorded at scattered sites along the coast to about Narooma. It has also been observed inland at Tullakool, Armidale, Gilgandra and Griffith. Occurs within sheltered, coastal habitats containing large, intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons. Often recorded on sandy beaches with mudflats nearby, sandy spits and islets and sometimes on exposed reefs or rock platforms.	Moderate; potential habitat occurs	N
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	Inhabits forest with low nutrients, characteristically with key Allocasuarina spp. Tends to prefer drier forest types with a middle stratum of Allocasuarina below Eucalyptus or Angophora. Often confined to remnant patches in hills and gullies. Breed in hollows stumps or limbs, either living or dead. Endangered population in the Riverina.	Known. Gunninah Environmental Consultants (2006); James Warren and Associates (2007b, 2008); PEA Consulting (2013)	Y
Climacteris picumnus victoriae	Brown Treecreeper	V	-	Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (Eucalyptus camaldulensis) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains.	Low	Y
Coracina lineata	Barred Cuckoo-shrike	V	-	Rainforest, eucalypt forests and woodlands, clearings in secondary growth, swamp woodlands and timber along watercourses. They are usually seen in pairs or small flocks foraging among foliage of trees for insects and fruit. They are active birds, frequently moving from tree to tree.	High; potential habitat occurs	Y

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence	Ecosystem Credit Species (Y/N)
Cyclopsitta diopthalma coxeni	Coxen's Fig-Parrot	CE	E	Usually recorded from drier rainforests and adjacent wetter eucalypt forest but rarely seen due to its small size and cryptic habits. Also found in the wetter lowland rainforests that are now largely cleared in NSW.	Low	N
Daphoenositta chrysoptera	Varied Sittella	V	-	Inhabits wide variety of dry eucalypt forests and woodlands, usually with either shrubby under storey or grassy ground cover or both, in all climatic zones of Australia. Usually in areas with rough-barked trees, such as stringybarks or ironbarks, but also in paperbarks or mature Eucalypts with hollows.	Known. James Warren and Associates (2007a)	N
Dasyornis brachypterus	Eastern Bristlebird	E	E	Found in coastal woodlands, dense scrub and heathlands, particularly where it borders taller woodlands.	Low	N
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	Mainly found on shallow, permanent, freshwater terrestrial wetlands, and surrounding marginal vegetation, including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters, as well as extending into adjacent grasslands, paddocks and open savannah woodlands. They also forage within or around estuaries and along intertidal shorelines, such as saltmarshes, mudflats and sandflats, and mangrove vegetation.	Moderate; suitable wetland habitat occurs.	N
Erythrotriorchis radiatus	Red Goshawk	CE	-	The Red Goshawk occurs in coastal and sub-coastal areas in wooded and forested lands of tropical and warm-temperate Australia.	Low	N
Gallinago hardwickii	Latham's Snipe	-	M	Latham's Snipe is a non-breeding migrant to the south east of Australia including Tasmania, passing through the north and New Guinea on passage. Latham's Snipe breed in Japan and on the east Asian mainland. seen in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. They are found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration.	Moderate; suitable habitat occurs	N
Glossopsitta pusilla	Little Lorikeet	V	-	Distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range in NSW, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Mostly occur in dry, open eucalypt forests and woodlands. They feed primarily on nectar and pollen in the tree canopy. Nest hollows are located at heights of between 2 m and 15 m, mostly in living, smooth-barked eucalypts. Most breeding records come from the western slopes.	Known. James Warren and Associates (2007a)	Y
Grantiella picta	Painted Honeyeater	V	-	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits boree, brigalow and box-gum woodlands and box-ironbark forests.	Low	Y
Grus rubicunda	Brolga	V	-	The Brolga was formerly found across Australia, except for the south-east corner, Tasmania and the south-western third of the country. It still abundant in the northern tropics, but very sparse across the southern part of its range. Though Brolgas often feed in dry grassland or ploughed paddocks or even desert claypans, they are dependent on wetlands too, especially shallow swamps, where they will forage with their head entirely submerged.	Low	Y
Haematopus fuliginosus	Sooty Oystercatcher	V	-	In NSW the Sooty Oystercatcher occupies rocky headlands, reefs and offshore islands along the entire coast, apparently as a single continuous population.	High; suitable habitat occurs	N

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence	Ecosystem Credit Species (Y/N)
Haematopus longirostris	Pied Oystercatcher	E	-	The Pied Oystercatcher inhabits marine littoral habitats, including islands. It occupies muddy, sandy, stony or rocky estuaries, inlets and beaches, particularly intertidal mudflats and sandbanks in large marine bays.	High; suitable habitat occurs.	N
Haliaeetus leucogaster	White-bellied Sea-Eagle	-	M	Inhabits coastal and near coastal areas, building large stick nests, and feeding mostly on marine and estuarine fish and aquatic fauna.	High; suitable habitat occurs.	N
Hieraaetus morphnoides	Little Eagle	V	-	Most abundant in lightly timbered areas with open areas nearby. Often recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. May nest in farmland, woodland and forest in tall trees.	High; suitable habitat occurs.	N
Hirundapus caudacutus	White-throated Needletail	-	M	An aerial species found in feeding concentrations over cities, hilltops and timbered ranges.	High; suitable habitat occurs.	N
Irediparra gallinacea	Comb-crested Jacana	V	-	Inhabits permanent wetlands with a good surface cover of floating vegetation, especially water-lilies.	Moderate; suitable habitat occurs.	N
Ixobrychus flavicollis	Black Bittern	V	-	Usually found on coastal plains below 200 m. Often found along timbered watercourses, in wetlands with fringing trees and shrub vegetation. The sites where they occur are characterized by dense waterside vegetation.	High; suitable habitat occurs.	N
Lathamus discolor	Swift Parrot	E	E	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects . The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW . This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability.	High; suitable habitat occurs.	Y
Limosa limosa	Black-tailed Godwit	V	-	Primarily a coastal species. Usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and-or sandflats. Further inland, it can also be found on mudflats and in water less than 10 cm deep, around muddy lakes and swamps.	Moderate; suitable habitat occurs.	N
Lophoictinia isura	Square-tailed Kite	V	-	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by Eucalyptus longifolia, Corymbia maculata, E. elata or E. smithii. Individuals appear to occupy large hunting ranges of more than 100km2. They require large living trees for breeding, particularly near water with surrounding woodland -forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.	Known. Gunninah Environmental Consultants (2006)	N
Merops ornatus	Rainbow Bee-eater	-	M	Found throughout mainland Australia most often in open forests, woodlands and shrublands, and cleared areas, usually near water. It will be found on farmland with remnant vegetation and in orchards and vineyards. It will use disturbed sites such as quarries, cuttings and mines to build its nesting tunnels.	High; potential habitat occurs.	N
Monarcha melanopsis	Black-faced Monarch	-	M	Found along the coast of eastern Australia, becoming less common further south. Inhabits rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating.	High; potential habitat occurs.	N
Monarcha trivirgatus	Spectacled Monarch	-	M	Coastal north-eastern and eastern Australia, including coastal islands, from Cape York, Queensland to Port Stephens, New South Wales. Prefers thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves.	High; potential habitat occurs.	N

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence	Ecosystem Credit Species (Y/N)
Myiagra cyanoleuca	Satin Flycatcher	-	M	The Satin Flycatcher is found along the east coast of Australia from far northern Queensland to Tasmania, including south-eastern South Australia. Found in tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests.	High; potential habitat occurs	N
Ninox connivens	Barking Owl	V	-	Generally found in open forests, woodlands, swamp woodlands and dense scrub. Can also be found in the foothills and timber along watercourses in otherwise open country.	Low	Y
Ninox strenua	Powerful Owl	V	-	Occupies wet and dry eucalypt forests and rainforests. Can occupy both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. It is most commonly recorded within red turpentine in tall open forests and black she-oak within open forests. Large mature trees with hollows at least 0.5 m deep are required for nesting. Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials. Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm.	High; potential habitat occurs	Y
Pandion cristatus	Eastern Osprey	V	-	Favour coastal areas, especially the mouths of large rivers, lagoons and lakes.	Known. Gunninah Environmental Consultants (2006); James Warren and Associates (2007a); PEA Consulting (2013)	N
Petroica boodang	Scarlet Robin	V	-	The Scarlet Robin is found from SE Queensland to SE South Australia and also in Tasmania and SW Western Australia. In NSW, it occurs from the coast to the inland slopes. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs.	Moderate; potential habitat occurs	Y
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V	-	Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains.	Low	N
Ptilinopus magnificus	Wompoo Fruit-dove	V	-	Distributed north of the Hunter River in NSW on the coast and coastal ranges. Inhabits rainforest, monsoon forest, adjacent eucalypt forest and brush box forest.	High; potential habitat occurs	N
Ptilinopus regina	Rose-crowned Fruit-dove	V	-	Coast and ranges of eastern NSW and Queensland, from Newcastle to Cape York. Vagrants are occasionally found further south to Victoria. Rose-crowned Fruit-doves occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful.	Moderate; potential habitat occurs	N
Ptilinopus superbus	Superb Fruit-dove	V	-	The Superb Fruit-dove occurs principally from north-eastern in Queensland to north-eastern NSW. It is much less common further south, where it is largely confined to pockets of suitable habitat as far south as Moruya. There are records of vagrants as far south as eastern Victoria and Tasmania. Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees.	Moderate; potential habitat occurs.	Y
Rhipidura rufifrons	Rufous Fantail	-	M	In east and south-east Australia, the Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood (Eucalyptus microcorys), Mountain Grey Gum (E. cypellocarpa), Narrow-leaved Peppermint (E. radiata), Mountain Ash (E. regnans), Alpine Ash (E. delegatensis), Blackbutt (E. pilularis) or Red Mahogany (E. resinifera); usually with a dense shrubby understorey often including ferns.	High; potential habitat occurs.	N

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence	Ecosystem Credit Species (Y/N)
Rostratula australis	Australian Painted Snipe	E	E, M	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds.	High; potential habitat occurs	N
Stictonetta naevosa	Freckled Duck	V	-	The freckled duck breeds in permanent fresh swamps that are heavily vegetated. Found in fresh or salty permanent open lakes, especially during drought. Often seen in groups on fallen trees and sand spits.	Low	Y
Todiramphus chloris	Collared Kingfisher	V	-	In NSW, the species is observed regularly only at Ukerebagh and nearby Cobaki Broadwater, and it breeds along the Tweed River estuary. Collared Kingfishers are virtually restricted to mangrove associations of estuaries, inlets, sheltered bays and islands, and the tidal flats and littoral zone bordering mangroves. They sometimes occur in terrestrial forests or woodlands bordering mangroves, and are sometimes see in streets or gardens in built-up areas bordering mangrove vegetation.	Low	N
Turnix melanogaster	Black-breasted Button-quail	CE	V	The Black-breasted Button-quail is endemic to south-eastern Queensland and far north-eastern NSW, at scattered sites from the Byfield region south to the Border Ranges and mainly on and east of the Great Divide but extending inland to the inner western slopes, up to 300 km from the coast. Preferred habitat is drier low closed forests, including dry rainforests, vine forest and vine thickets, often in association with hoop pine, and bottletree scrubs.	Low	N
Tyto longimembris	Eastern Grass Owl	V	-	Eastern Grass Owls are found in areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains.	Moderate; potential habitat occurs	Y
Tyto novaehollandiae	Masked Owl	V	-	Inhabits a diverse range of wooded habitat that provide tall or dense mature trees with hollows suitable for nesting and roosting. Mostly recorded in open forest and woodlands adjacent to cleared lands. Nest in hollows, in trunks and in near vertical spouts or large trees, usually living but sometimes dead. Nest hollows are usually located within dense forests or woodlands. Masked owls prey upon hollow-dependent arboreal marsupials, but terrestrial mammals make up the largest proportion of the diet.	High; potential habitat occurs	Y
Tyto tenebricosa	Sooty Owl	V	-	Often found in tall old-growth forests, including temperate and subtropical rainforests. In NSW mostly found on escarpments with a mean altitude less than 500 metres. Nests and roosts in hollows of tall emergent trees, mainly eucalypts often located in gullies. Nests have been located in trees 125 to 161 centimetres in diameter.	High; potential habitat occurs	Y
Invertebrates						
Ocybadistes knightorum	Black Grass-dart Butterfly	E	-	The Black Grass-dart Butterfly is found on the Mid North Coast between Digger's Headland and Warrell Creek (just south of Macksville). The Black Grass-dart is confined to areas of swamp forest and coastal headlands where the laval food plant Floyd's grass occurs.	Moderate; potential habitat occurs	N
Phyllodes imperialis smithersi	Pink Underwing Moth	E	E	The Pink Underwing Moth is found below the altitude of 600 m in undisturbed, subtropical rainforest.	Low	N
Mammals						

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence	Ecosystem Credit Species (Y/N)
Aepyprymnus rufescens	Rufous Bettong	V	-	The original range from Coen in north Queensland to central Victoria has been reduced to a patchy distribution from Cooktown, Queensland, to north-eastern NSW as far south as Mt Royal National Park. In NSW it has largely vanished from inland areas but there are sporadic, unconfirmed records from the Pilliga and Torrington districts. Rufous Bettongs inhabit a variety of forests from tall, moist eucalypt forest to open woodland, with a tussock grass understorey. A dense cover of tall native grasses is the preferred shelter. They sleep during the day in cone-shaped nests constructed of grass in a shallow depression at the base of a tussock or fallen log. At night they feed on grasses, herbs, seeds, flowers, roots, tubers, fungi and occasionally insects.	Low	N
Cercartetus nanus	Eastern Pygmy-possum	V	-	Inhabits rainforest through to sclerophyll forest and tree heath. Banksias and myrtaceous shrubs and trees are a favoured food source. Will often nest in tree hollows, but can also construct its own nest . Because of its small size it is able to utilise a range of hollow sizes including very small hollows. Individuals will use a number of different hollows and an individual has been recorded using up to 9 nest sites within a 0.5ha area over a 5 month period .	Moderate; suitable habitat occurs	Y
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Located in a variety of drier habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range. Can also be found on the edges of rainforests and in wet sclerophyll forests. This species roosts in caves and mines in groups of between 3 and 37 individuals.	Low	N
Chalinolobus nigrogriseus	Hoary Wattled Bat	V	-	In north east NSW it reaches the lower Clarence and Richmond River areas, extending from near Murwillumbah in the north, south to between Grafton and Coffs Harbour. Occurs in dry open eucalypt forests, favouring forests dominated by spotted gum, boxes and ironbarks, and heathy coastal forests where red bloodwood and scribbly gum are common.	Moderate; suitable habitat occurs	Y
Dasyurus maculatus	Spotted-tailed Quoll	V	-	Spotted-tailed Quoll are found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland. Only in Tasmania is it still considered common. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.	Moderate; suitable habitat occurs	Y
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Inhabit sclerophyll forests, preferring wet habitats where trees are more than 20 m high. Two observations have been made of roosts in stem holes of living eucalypts. There is debate about whether or not this species moves to lower altitudes during winter, or whether they remain sedentary but enter torpor . This species also appears to be highly mobile and records showing movements of up to 12 km between roosting and foraging sites .	High; suitable habitat occurs	N
Kerivoula papuensis	Golden-tipped Bat	V	-	Distributed along the east coast of Australia in scattered locations from Cape York Peninsula in Queensland to Bega in southern NSW. Found in rainforest and adjacent sclerophyll forest. Roost in abandoned hanging Yellow-throated Scrubwren and Brown Gerygone nests located in rainforest gullies on small first- and second-order streams.	Known. Gunninah Environmental Consultants (2006)	Y
Miniopterus australis	Little Bentwing-bat	V	-	Coastal north-eastern NSW and eastern Queensland. Little Bent-wing Bat is an insectivorous bat that roost in caves, in old mines, in tunnels, under bridges, or in similar structures. They breed in large aggregations in a small number of known caves and may travel 100s km from feeding home ranges to breeding sites. Little Bent-wing Bat has a preference for moist eucalypt forest, rainforest or dense coastal banksia scrub where it forages below the canopy for insects.	Known. Gunninah Environmental Consultants (2006); James Warren and Associates (2007a and 2008); PEA Consulting (2013)	N

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence	Ecosystem Credit Species (Y/N)
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	Eastern Bent-wing Bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young.	Known. Gunninah Environmental Consultants (2006); James Warren and Associates (2007a and 2008); PEA Consulting (2013)	N
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	Most records are from dry eucalypt forests and woodlands to the east of the Great Dividing Range. Appears to roost in trees, but little is known of this species' habits.	Known. Gunninah Environmental Consultants (2006) PEA Consulting (2013)	Y
Myotis macropus	Southern Myotis	V	-	The Large-footed Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage.	Known. Previously recorded by Gunninah Environmental Consultants (2006) and James Warren and Associates (2007a and 2008)	N
Petaurus australis	Yellow-bellied Glider	V	-	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria.	Known. Gunninah Environmental Consultants (2006)	Y
Petaurus norfolcensis	Squirrel Glider	V	-	Generally occurs in dry sclerophyll forests and woodlands but is absent from dense coastal ranges in the southern part of its range . Requires abundant hollow bearing trees and a mix of eucalypts, banksias and acacias . There is only limited information available on den tree use by Squirrel gliders, but it has been observed using both living and dead trees as well as hollow stumps. Within a suitable vegetation community at least one species should flower heavily in winter and one species of eucalypt should be smooth barked. Endangered population in the Wagga Wagga LGA.	Known. James Warren and Associates (2007a) and PEA Consulting (2013)	Y
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Found in rocky areas in a wide variety of habitats including rainforest gullies, wet and dry sclerophyll forest, open woodland and rocky outcrops in semi-arid country. Commonly sites have a northerly aspect with numerous ledges, caves and crevices.	Low	N
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	The Brush-tailed Phascogale has a patchy distribution around the coast of Australia. In NSW it is mainly found east of the Great Dividing Range although there are occassional records west ot the divide. Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest.	High; suitable habitat occurs	N

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence	Ecosystem Credit Species (Y/N)
Phascolarctos cinereus	Koala	V	V	Inhabits eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate and rainfall .	Known. Gunninah Environmental Consultants (2006); James Warren and Associates (2007a and 2008)	Y
Planigale maculata	Common Planigale	V	-	Common Planigales inhabit rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water. The female builds a nest lined with grass, eucalypt leaves or shredded bark.	Known. Gunninah Environmental Consultants (2006)	N
Potorous tridactylus	Long-nosed Potoroo	V	-	Inhabits coastal heath and wet and dry sclerophyll forests. Generally found in areas with rainfall greater than 760 mm. Requires relatively thick ground cover where the soil is light and sandy.	Low	Y
Pseudomys novaehollandiae	New Holland Mouse	-	V	The New Holland Mouse currently has a disjunct, fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes.	Low	N
Pseudomys oralis	Hastings River Mouse	E	E	A patchy distribution spanning the Great Dividing Rane from the Hunter Valley, south of Mt Royal, north to the Bunya Mountains near Kingaroy in south-east Queensland, at elevations between 300 m and 1100 m. A variety of dry open forest types with dense, low ground cover and a diverse mixture of ferns, grass, sedges and herbs. Access to seepage zones, creeks and gullies is important, as is permanent shelter such as rocky outcrops.	Low	N
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Bats commute daily to foraging areas, usually within 15 km of the day roost although some individuals may travel up to 70 km.	Known. Gunninah Environmental Consultants (2006); James Warren and Associates (2007a and 2008); PEA Consulting (2013)	N
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory.	Known. Gunninah Environmental Consultants (2006)	N
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Prefer moist gullies in mature coastal forests and rainforests, between the Great Dividing Range and the coast. They are only found at low altitudes below 500 m. In dense environments they utilise natural and human-made opening in the forest for flight paths. Creeks and small rivers are favoured foraging habitat. This species roosts in hollow tree trunks and branches.	Moderate; suitable habitat occurs	N
Syconycteris australis	Common Blossom-bat	V	-	Often roost in littoral rainforest and feed on nectar and pollen from flowers in adjacent heathland and paperbark swamps. They have also been recorded in a range of subtropical forest types, rainforest, wet sclerophyll forest and coastal eucalypt forest. They generally roost individually in dense foliage and vine thickets of the sub-canopy, staying in the same general area for a season. They change roost sites daily, but each roost site is generally only 50m or so away from other recent roosts.	Known. Gunninah Environmental Consultants (2006)	Y

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence	Ecosystem Credit Species (Y/N)
Reptiles						
Coeranoscincus reticulatus	Three-toed Snake-tooth Skink	V	V	The Three-toed Snake-tooth Skink occurs on the coast and ranges from the Macleay valley in NSW to south-eastern Queensland. It is very uncommon south of Grafton. Rainforest and occasionally moist eucalypt forest, on loamy or sandy soils.	Low	N
Emydura macquarii signata (Bellinger River, NSW)	Macquarie River Turtle	-	V	The population of Macquarie River Turtle (previously known Bellinger River Emydura) prefers long pools with a rocky substrate and sheltering features such as snags, overhanging banks or clumps of vegetation such as Hydrilla (Hydrilla verticillata). They are often found in shallow waters of such pools and they utilise partially submerged logs as basking platforms. Near Thora they occupy several long, deep pools along moderately broad reaches within a 200 m stretch of river.	Low	N
Hoplocephalus bitorquatus	Pale-headed Snake	V	-	The Pale-Headed Snake has a patchy distribution from north-east Queensland to north-east NSW. In NSW it occurs from the coast to the western side of the Great Divide as far south as Tuggerah and out to the western plains. It is found mainly in dry eucalypt forests and woodlands, cypress woodland and occasionally in rainforest or moist eucalypt forest where it favours streamside areas, particularly in drier habitats. They shelter during under loose bark or in hollows and have a preference for frogs as prey, although lizards and small mammals are also taken. This species breeds and shelters in hollows in live and dead trees and in and under fallen timber. It is best detected from mid spring to mid autumn and is mostly nocturnal.	Low	N
Hoplocephalus stephensii	Stephens' Banded Snake	V	-	The Stephens Banded Snake is found through the coast and adjacent ranges of NSW from the Central Coast northwards and into SE Queensland. It is most commonly found living in wet sclerophyll and rainforest areas, but can be found in taller dry forest areas and even in some areas of dry forest where there is significant rock outcropping. They spend the majority of the time in tree tops, either in large hollows or in dense vegetation, coming to the ground for forage for a range of vertebrates.	Moderate; potential habitat occurs	Y

Key: CE = Critically Endangered; E, E1 = Endangered; EP = Endangered Population; V = Vulnerable; M = Migratory.

Note: Fauna that are exclusively dependant on marine environments, including near shore environments, were not included in the assessment due to lack of suitable habitat.

Habitat descriptions taken from the relevant profiles on the OEH Threatened Species web-site unless otherwise stated.

Appendix D: Fauna species list

BIRDS	
Australian Magpie	*Cracticus tibicen*
Black-faced Monarch	*Monarcha melanopsis*
Channel-billed Cuckoo	*Scythrops novaehollandiae*
Dollarbird	*Eurystomus orientalis*
Eastern Osprey	*Pandion cristatus*
Eastern Rosella	*Platycercus eximius*
Eastern Yellow Robin	*Eopsaltria australis*
Fan-tailed Cuckoo	*Cuculus flabelliformis*
Glossy Black-cockatoo	*Calyptorhynchus lathami*
Green Catbird	*Ailuroedus crassirostris*
Grey Butcherbird	*Cracticus torquatus*
Grey Fantail	*Rhipidura fuliginosa*
Grey Shrike-thrush	*Colluricincla harmonica*
Laughing Kookaburra	*Dacelo novaeguineae*
Lewin Honeyeater	*Meliphaga lewini*
Noisy Friarbird	*Philemon corniculatus*
Noisy Miner	*Manorina melanocephala*
Olive-backed Oriole	*Oriolus sagitattus*
Pied Butcherbird	*Cracticus nigrogularis*
Pied Currawong	*Strepera graculina*
Rufous Whistler	*Pachycephala rufiventris*
Sacred Kingfisher	*Todiramphus sanctus*
Scaly-breasted Lorikeet	*Trichoglossus chlorolepidotus*
Scarlet Honeyeater	*Myzomela sanguinolenta*
Spangled Drongo	*Dicrurus bracteatus*
Striated Pardalote	*Pardalotus striatus*
Tawny Frogmouth	*Podargus strigoides*
Torresian Crow	*Corvus orru*
Varied Triller	*Lalage leucomela*
White-throated Gerygone	*Gerygone albogularis*
Yellow-faced Honeyeater	*Lichenostomus chrysops*
FROGS	
Eastern Dwarf Tree Frog	*Litoria fallax*
Laughing Tree Frog	*Litoria tyleri*
MAMMALS	
Common Brush-tailed Possum	*Trichosurus vulpecula*
Eastern Grey Kangaroo	*Macropus giganteus*
Sugar Glider	*Petarurus breviceps*
REPTILES	
Eastern Water Dragon	*Physignathus lesueuri*
Garden Sun-skink	*Lampropholis delicata*
Red-bellied Black Snake	*Pseudechis porphyriacus*

Appendix E. Biodiversity constraint index

Relative index: 1 = TECs, 0.8 = OCVTs, 0.6 = Credits 70-50, 0.4= Credits 50-30 , 0.2 = Credits 30-10

Veg code	Vegetation name	Credits for biodiversity	Credits for TS	TS with highest credit requirement	Species Tg value	Final credits requirement	Percentage cleared	OCVT	TEC	Relative index
NR104	Bailey's Stringybark - Needlebark Stringybark heathy woodland on sandstones of the lower Clarence Valley of the North Coast	28	66	Large-footed Myotis	0.4	66	25			0.6
NR105	Banksia dry shrubland on coastal sands of the North Coast	28	36	Swift Parrot	0.75	36	70	Yes		0.4
NR111	Black Booyong - Rosewood - Yellow Carabeen subtropical rainforest of the North Coast	28	45	Large-footed Myotis	0.4	45	75	Yes		0.8
NR112	Black Olive Berry - Rough Possumwood cool temperate rainforest of eastern New England Tablelands	28	0		0	28	10			0.2
NR114	Blackbutt - bloodwood dry heathy open forest on Quaternary sands of the northern North Coast	28	66	Large-footed Myotis	0.4	66	40			0.6
NR117	Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the North Coast	28	66	Large-footed Myotis	0.4	66	50			0.6
NR120	Blackbutt - Tallowwood moist ferny open forest of the coastal ranges of the North Coast	28	66	Large-footed Myotis	0.4	66	15			0.6
NR142	Brush Box - Tuckeroo littoral rainforest on coastal headlands of the North Coast	28	45	Large-footed Myotis	0.4	45	35		Yes	1
NR150	Coastal freshwater meadows and forblands of lagoons and wetlands	28	45	Large-footed Myotis	0.4	45	40		Yes	1
NR151	Coastal headland heaths of the North Coast	28	0		0	28	30			0.2
NR152	Coastal heath on sands of the North Coast	28	45	Large-footed Myotis	0.4	45	10			0.4
NR159	Flooded Gum - Brush Box moist forest of the coastal ranges of the North Coast	28	66	Large-footed Myotis	0.4	66	40			0.6
NR161	Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast	28	66	Large-footed Myotis	0.4	66	60			0.6
NR161 DOF06	Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast	28	66	Large-footed Myotis	0.4	66	60		Yes	1
NR182	Mangrove - Grey Mangrove low closed forest of the NSW Coastal Bioregions	28	45	Large-footed Myotis	0.4	45	75	Yes	Yes	1

Veg code	Vegetation name	Credits for biodiversity	Credits for TS	TS with highest credit requirement	Species Tg value	Final credits requirement	Percentage cleared	OCVT	TEC	Relative index
NR217	Paperbark swamp forest of the coastal lowlands of the North Coast	28	45	Large-footed Myotis	0.4	45	75	Yes	Yes	1
NR225	Saltmarsh complex of the North Coast	28	45	Large-footed Myotis	0.4	45	75	Yes	Yes	1
NR263	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of North Coast	28	66	Large-footed Myotis	0.4	66	30			0.6
NR255	Swamp Oak swamp forest of the coastal lowlands of the North Coast	28	66	Large-footed Myotis	0.4	66	75	Yes	Yes	1
NR254	Swamp Mahogany swamp forest of the coastal lowlands of the North Coast	28	45	Large-footed Myotis	0.4	45	75	Yes	Yes	1
NR220	Pink Bloodwood open forest of the coastal lowlands of the North Coast	28	66	Large-footed Myotis	0.4	66	25			0.6
NR225	Saltmarsh complex of the North Coast	28	45	Large-footed Myotis	0.4	45	75	Yes	Yes	1
NR263	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of North Coast	28	66	Large-footed Myotis	0.4	66	30			0.6
NR255	Swamp Oak swamp forest of the coastal lowlands of the North Coast	28	66	Large-footed Myotis	0.4	66	75	Yes	Yes	1
NR117 Niche DS	Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the North Coast	11	31	Large-footed Myotis	0.40	31	50			0.4
NR271	Themeda Grassland on Seacliffs and Coastal Headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Credit calculator does not work with this veg type					90	Yes	Yes	1
H07	Coastal Headland Swamp Oak Shrublands	No alignment for this veg type					N/A			0.2
MV01	Seagrass beds	No alignment for this veg type					N/A			0.2
CH_P03	Environmental Plantings									0
CH_NRV 01	Remnant vegetation	Requires further validation especially in areas of restricted access.					N/A	N/A	N/A	0.2
CH_EX0 3	Exotic vegetation						N/A	N/A	0	N/A