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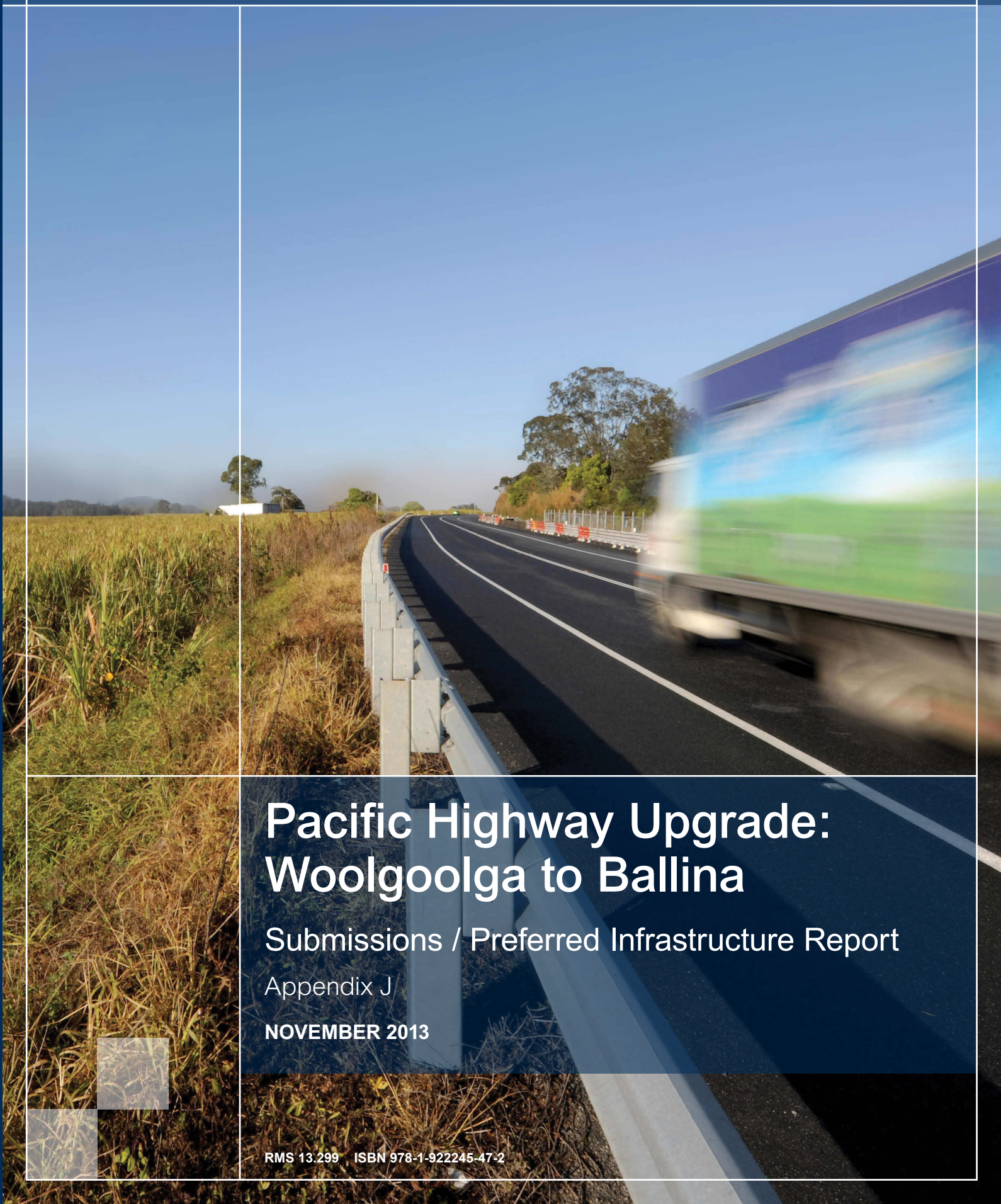

Pacific Highway Upgrade: Woolgoolga to Ballina

Submissions / Preferred Infrastructure Report

Appendix J

NOVEMBER 2013

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NSW Roads and Maritime Services

WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE

SUBMISSIONS / PREFERRED INFRASTRUCTURE REPORT

Appendix J Supplementary biodiversity assessment

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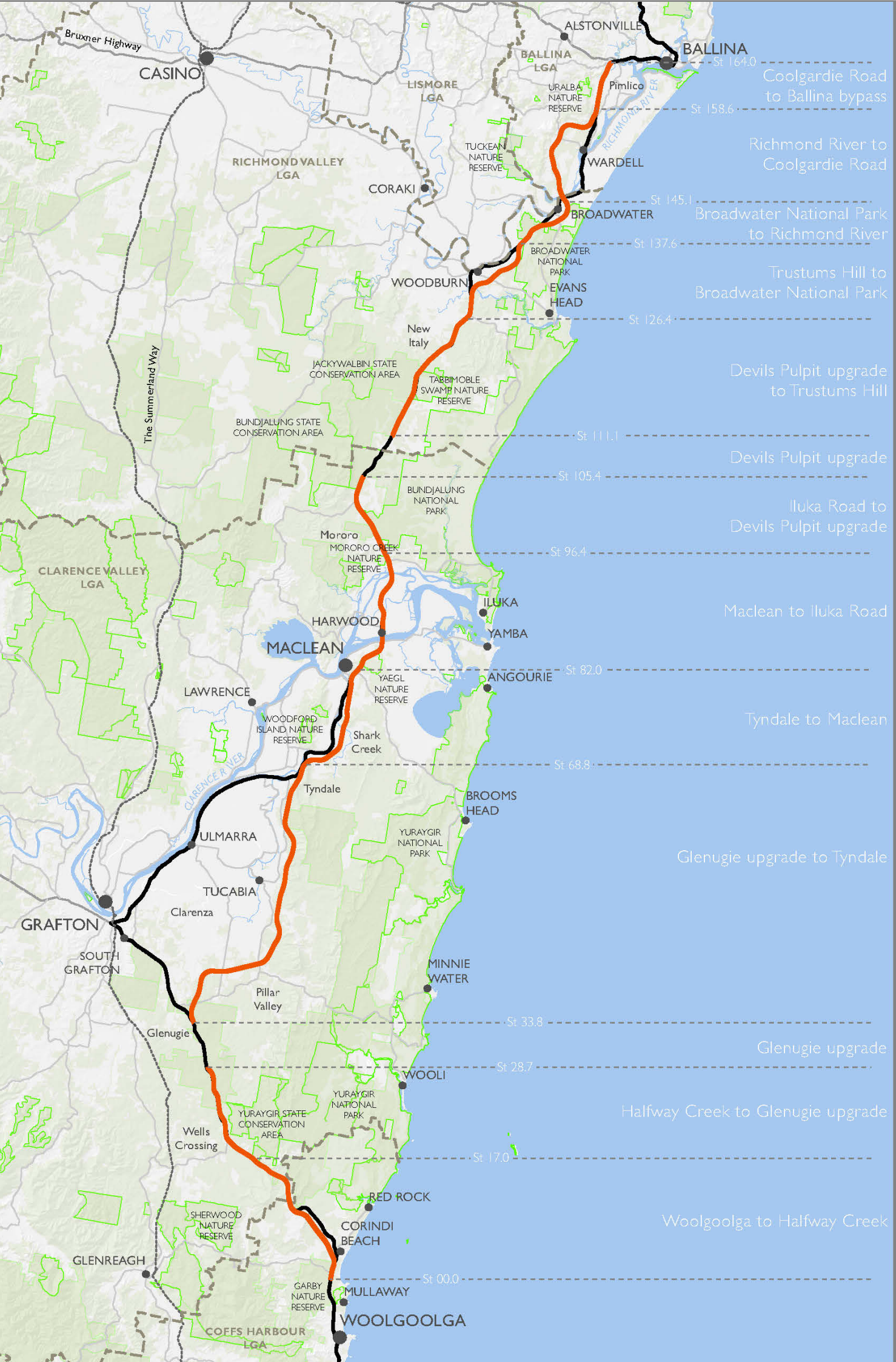
Bruxner Highway
CASINO
ALSTONVILLE
BALLINA
BALLINA LGA
St 164.0
Coolgardie Road to Ballina bypass
11
LISMORE LGA
URALBA NATURE RESERVE
Pimlico
RICHMOND RIVER
St 158.6
Richmond River to Coolgardie Road
10
TUCKEAN NATURE RESERVE
WARDELL
RICHMOND VALLEY LGA
CORAKI
St 145.1
BROADWATER
Broadwater National Park to Richmond River
9
St 137.6
BROADWATER NATIONAL PARK
Trustums Hill to Broadwater National Park
8
WOODBURN
EVANS HEAD
St 126.4
New Italy
JACKYWALBIN STATE CONSERVATION AREA
TABBIMOBLE SWAMP NATURE RESERVE
Devils Pulpit upgrade to Trustums Hill
7
The Summerland Way
BUNDJALUNG STATE CONSERVATION AREA
St 111.1
Devils Pulpit upgrade
St 105.4
BUNDJALUNG NATIONAL PARK
Iluka Road to Devils Pulpit upgrade
6
Mororo
MORORO CREEK NATURE RESERVE
St 96.4
CLARENCE VALLEY LGA
ILUKA
HARWOOD
YAMBA
Maclean to Iluka Road
5
MACLEAN
ANGOURIE
St 82.0
YAEGL NATURE RESERVE
LAWRENCE
WOODFORD ISLAND NATURE RESERVE
Shark Creek
Tyndale to Maclean
4
St 68.8
CLARENCE RIVER
Tyndale
BROOMS HEAD
YURAYGIR NATIONAL PARK
ULMARRA
TUCABIA
Clarenza
Glenugie upgrade to Tyndale
3
GRAFTON
SOUTH GRAFTON
MINNIE WATER
Pillar Valley
St 33.8
Glenugie
Glenugie upgrade
St 28.7
WOOLI
YURAYGIR NATIONAL PARK
YURAYGIR STATE CONSERVATION AREA
Halfway Creek to Glenugie upgrade
2
Wells Crossing
St 17.0
RED ROCK
SHERWOOD NATURE RESERVE
CORINDI BEACH
Woolgoolga to Halfway Creek
1
GLENREAGH
St 00.0
GARBY NATURE RESERVE
MULLAWAY
WOOLGOOLGA
COFFS HARBOUR LGA

UPGRADING THE PACIFIC HIGHWAY

Woolgoolga to Ballina Planning Alliance

UPGRADING THE PACIFIC HIGHWAY

Woolgoolga to Ballina Upgrade

Supplementary Biodiversity Assessment

FINAL

November 2013

NSW GOVERNMENT Transport Roads & Maritime Services

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Contents

Table of figures

Executive summary

This report is an addendum to the Woolgoolga to Ballina Pacific Highway upgrade Environmental Impact Statement (EIS) and the biodiversity working paper that was a key input to the EIS. This report presents supplementary information on:

- Biodiversity impacts that would result from the proposed ancillary facility sites for the highway upgrade project, and refinements made to the project design since the public exhibition of the EIS.
- Additional flora and fauna surveys and impact assessments that have been undertaken since the public exhibition of the EIS, and proposed mitigation measures.

These aspects are outlined below.

Ancillary facility sites

This report addresses the potential biodiversity impacts from the 60 proposed ancillary facility sites that would be located outside of the project boundary and, hence, were not addressed in the EIS. (These sites would be used as compounds, batching plants and storage areas, etc, during the construction of the project).

An initial desktop appraisal found that 14 sites do not require further ecological assessment or field investigations as they would be located in cleared agricultural land, contained exotic gardens or lacked any significant habitat features.

Field surveys were conducted on the remaining 46 sites. The surveys targeted threatened species and Threatened Ecological Communities (TECs) as defined under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The investigation also considered cleared portions of sites where potential habitat could occur for the vulnerable plant species Hairy Joint Grass (*Arthraxon hispidus*), given this species habitat preferences for grazed land.

The key findings of this assessment are that:

- A number of sites were found to contain extensive cover of remnant vegetation suitable for threatened species or would be constrained in their use by the presence of both Threatened Ecological Communities and threatened species and therefore were hence identified as unsuitable. These are:
    - Section 1: Site 1b and additional site 5.
    - Section 2: Site 2.
    - Section 5, Additional site 7 and additional site 8.
    - Section 10: Site 6.

The remaining ancillary facility sites would be suitable and would add minimal cumulative impacts to the project. The key reasons for this finding were that:

- Any patches of threatened ecological communities noted were highly modified, with a low natural floristic and structural diversity. In most cases, there is scope to avoid vegetation removal through appropriate planning.

- Vegetation on these sites is generally characterised by scattered small and fragmented patches in low condition or isolated trees that are well represented in the surrounding locality.
- There are scattered low densities of trees with some potential value for providing shelter or nesting resources for wide-ranging and highly mobile fauna species such as the threatened Grey-headed Flying-fox and Swift Parrot. These species are capable of exploiting resources occurring over very large spatial areas. These resources are expected to remain on the site during construction and post-construction so that the current opportunity to use these resources would remain.
- At two sites, there is evidence of low use by koalas. Both sites are positioned adjacent to extensive areas of suitable habitat for koalas suggesting the site is of low importance and may only contribute to a small portion of a home range or be used by dispersing individuals. These habitat features have been noted and would be protected.
- Any small-scale potential impacts resulting from the use of these ancillary facility sites are considered able to be mitigated through appropriate planning and consideration for the ecological values noted in this assessment. Site-specific mitigation measures are proposed in the report.
- The proposed revegetation of a small number of currently cleared sites adjacent to proposed fauna connectivity structures would improve the connectivity around these structures for future use by fauna. This should occur as a minimum within the road reserve, and over the residual areas of the site where the property is owned by Roads and Maritime.

Design refinements

Roads and Maritime has refined the project design that was presented in the EIS. These refinements are a normal part of the design development process and have arisen through the ongoing process of concept design review, following consultation, and in response to issues raised during exhibition of the EIS. The design refinements are presented in the Submissions/ Preferred Infrastructure Report (SPIR).

This biodiversity report presents an assessment of the design refinements. The assessment involved a desktop appraisal of 27 design refinements to identify likely impacts that would be additional to those reported in the EIS. Where the appraisal identified the need for more detailed assessment, supplementary field surveys for flora and fauna were undertaken at the proposed location of the design refinement.

The report provides an assessment of direct and indirect impacts on listed and non-listed vegetation communities, threatened species, fragmentation, connectivity and aquatic impacts; and an assessment of the likely cumulative impact of refining the design across multiple locations.

The key findings of this assessment are that the design refinements would have the following likely cumulative impacts across multiple locations:

- A net reduction of 4.6 hectares in the clearing of threatened ecological communities.
- No additional net increase in direct loss of Koala habitat.
- An increase of five hectares in the loss of non-listed vegetation communities.

Looked at individually, the design refinements would result in the following changes from the assessment in the EIS:

- Rest area south of Pine Brush State Forest: The design refinement would reduce the loss of habitat for threatened flora and fauna, and would avoid clearing around 408 *Angophora robur* trees.
- Mororo cutting and Range Road intersection: The design refinements would increase the amount of clearing of native vegetation at the cutting and the intersection. Neither site contains any prominent habitat features or plant species that would not otherwise exist within the adjoining forest system. Further, there would be minimal impact on fauna connectivity and regional and local wildlife corridors and no change to the location of proposed crossing structures.
- Koala Drive: The design refinement would improve current connectivity for fauna in combination with targeted revegetation.
- Firth Heinz Road: The design refinement would have an overall minor increase in the clearing of threatened ecological communities, but would increase the clearing of the threatened *Angophora robur* by around 181 trees and increase impacts on the habitat of threatened forest fauna.
- The Interchange at Wardell: The design refinement would have a net benefit by significantly reducing the clearing of listed rainforest communities and habitat of the endangered Pink Underwing Moth. It would also reduce the clearing of three threatened plant species. However, there would be increased impacts on a small area of Koala habitat, and on non-listed vegetation communities.
- Rest area north of the Richmond River: The design refinement would see a significant reduction in clearing of potential habitat for Koala and Long-nosed Potoroo and a significant improvement in fauna connectivity through the upgrade and inclusion of fauna connectivity structures.

Supplementary surveys

The biodiversity assessment presented in the EIS (Biodiversity Assessment Working Paper) was critically reviewed to identify gaps in the survey effort that had occurred due to spatial gaps or the timing of surveys. As a consequence, supplementary flora and fauna surveys were conducted to address:

- Lowland Rainforest of Subtropical Australia (Critically Endangered under the EPBC Act).
- Littoral Rainforest and coastal vine thickets of eastern Australia (Critically Endangered under the EPBC Act).
- Threatened rainforest flora.
- Select threatened flora (non-rainforest).
- Optimal moist conditions and season for some cryptic flora.
- Minor spatial gaps in the project vegetation community mapping.
- Koala (this involved targeted surveys and habitat mapping to address the interim referral advice under the EPBC Act).
- Endangered Pink Underwing Moth.
- Giant Barred Frog.
- Oxleyan Pygmy Perch.

The key findings of the supplementary surveys are that:

- The supplementary surveys confirmed the results and assessment of impacts in the EIS biodiversity working paper. The additional ecological data gathered from these surveys was used in conjunction with the existing data to inform the detailed design in some locations, revise the impact assessment and inform the development of a number of threatened species management plans.

Supplementary impact assessment

The biodiversity assessment presented in the EIS was reviewed following the supplementary surveys, the work undertaken on the ancillary facility sites, and the design refinements and additional analysis of the impacts on biodiversity by the project.

The review highlighted new information on biodiversity impacts that would result from the project – including impacts on non-listed vegetation types and specific impacts on listed biota – and revised the Assessment of Significance where required.

The key findings of the supplementary impact assessment found that there would be notable changes from the impacts reported in the EIS. These would be:

- A reduction of around 60 per cent in the direct impacts on Lowland Rainforest (EPBC Act), which is also critical habitat for the Pink Underwing Moth.
- A reduction of in the direct impacts on Freshwater Wetlands (TSC Act).
- A considerably reduced impact on Coastal Cypress Pine Forest (TSC Act).
- A considerably reduced impact on Subtropical Coastal Floodplain Forest (TSC Act).
- An overall reduction in the direct impact on threatened ecological communities. Overall, the project would have a reduced impact on threatened ecological communities of around 75 hectares from that reported in the EIS. While most communities would have a reduction in impact, there would be an increased impact on two vegetation communities (Littoral Rainforest and Swamp Sclerophyll Forest On Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions)
- A revision in the impacts on rainforest plants. For several species, the proportion of the population impacted by the project is now known to be lower than reported in the EIS. In addition, impacts would be further reduced through the design refinement at the interchange at Wardell. However, there remains the potential for indirect impacts on individuals close to the project boundary as described in the EIS. These individuals are generally in habitats where new edges would be created and/or are downslope of the project boundary.
- There would be potential impacts on threatened terrestrial and aquatic species and ecological communities dependent on groundwater, from the location of cuttings (which are high-risk areas for groundwater).

The supplementary impact assessment provides a revised assessment of significance for species where there has been a change from the impacts reported in the EIS (either an increase or decrease in the level of impact) or the supplementary surveys reported an increase in population size.

The results from the assessment of significance are consistent with the conclusions in the EIS, with the exception of impacts on the following species, which have been revised to not significant and reflect the design changes and impact avoidance measures:

- *Archidendron hendersonii.*
- *Macadamia tetraphylla.*
- *Endiandra muelleri subsp bracteata.*

The revised assessments of significance reported significant impacts for the following species, which were not identified in the EIS (the changes reflect the additional population data and impacts imposed):

- Eleocharis tetraquetra .
- Quassia sp. Moonee Creek.
- Acronychia littoralis.
- Common Planigale.
- Eastern Pygmy Possum.

Supplementary mitigation

The management and mitigation measures presented in the EIS were reviewed and revised to take account of:

- The supplementary impact assessment (which included the ancillary facility sites and the design refinements).
- Threatened species management plans that were produced since the exhibition of the EIS. These plans include species-specific mitigation measures.

The review also evaluated:

- The proposed fauna connectivity mitigation measures in the EIS, and in particular focused on the important Koala populations in the study area.
- The quantity and location of fauna crossing structures.
- The likely effectiveness of the biodiversity mitigation measures in the EIS.

The key findings are that:

- The EIS concludes that without mitigation the highway would create a barrier for the important Koala population north of the Richmond River and this has been addressed in the connectivity strategy and further supported by design refinements in Section 10.
- Given the constraints with fill heights and the presence of threatened ecological communities and plants, the number of structures proposed for the two identified important Koala populations in section

9 and 10 is considered sufficient. There are no significant gaps in relation to linking habitat patches, with the exception of the area around Kays Road (station 156.3 to 156.9). A recommendation has been made to further consider connectivity in this area during detailed design.

- The distribution of Koala activity for the Woombah sub-population shows an area of habitat with demonstrated low Koala use around 500 metres east of the Pacific Highway between stations 95.7 and 97.1 (Section 5). The nearest structure to this is a dedicated underpass that has been located north at Station 99.7 to provide connectivity for fauna across an important regional corridor while this structure is appropriately located it leaves a gap between Station 95.7 and Station 97.1 where there are no structures proposed. Much of the land on the western side of the highway in this location is cleared, however there are two possibilities for connectivity which should be considered further in the detailed design.

- Of the 112 dedicated and combined connectivity structures proposed, 79 structures (70 per cent) would adjoin vegetation on both sides of the road. The remaining structures would adjoin cleared land on at least one side of the road, although their effectiveness is not expected to be compromised due to the targeted fauna species and their habitat preferences. The remaining 18 per cent (20 structures) would require additional strategic re-vegetation in the road reserve to improve their effectiveness, as proposed in the EIS.

An overall review and summary of the likely effectiveness of the proposed biodiversity mitigation measures provided in the EIS is discussed resulting in the rating of their effectiveness and recommendations regarding monitoring and adaptive management where lower ratings are identified.

1. Introduction

1.1. Background

NSW Roads and Maritime Service (Roads and Maritime) is seeking approval to upgrade the Pacific Highway from Woolgoolga to Ballina on the mid and far north coast of NSW (the project).

Roads and Maritime produced an Environmental Impact Statement (EIS) which assessed the likely impacts of the project. A key input to the EIS was a supporting biodiversity assessment working paper (Working paper – Biodiversity Roads and Maritime, 2012). Roads and Maritime released these reports for public comment in December 2012.

This report supplements the biodiversity assessment working paper. It documents additional investigations into proposed ancillary facility sites and design refinements that have been made since the release of the EIS and the working paper.

It also outlines details and findings of supplementary field surveys and an additional biodiversity assessment requested by the Commonwealth Department of Environment (DotE) (formerly known as Department of Sustainability, Environment, Water Populations and Communities (DSEWPaC)), the NSW Department of Planning and Infrastructure (DP&I) and the NSW Office of Environment Heritage (OEH) during the EIS phase. This assessment describes and assesses potential ecological impacts of the project that differ from those identified in the EIS, particularly impacts on threatened species, populations, ecological communities, important habitats and key fauna corridors.

1.1.1. Terms and definitions

This report uses the following terms:

- 'EIS': This refers to the Woolgoolga to Ballina Pacific Highway Upgrade Environmental Impact Statement released for public comment in December 2012.
- 'Working paper': This refers to the biodiversity working paper included as part of the EIS (Roads and Maritime, 2012).
- 'Supplementary biodiversity assessment: This refers to this report, which is an addendum to the Working paper.
- 'Project boundary': This refers to the boundary as identified in the EIS which now incorporates any design refinements that are proposed in the project design.
- 'Ancillary facility sites': This refers to the temporary sites that would be used for construction related activities.
- 'Design refinements': This refers to changes to the project design that have occurred since the release of the EIS.
- 'Highway': This refers to the Pacific Highway.

1.2. Structure of the report

The structure of this report separates the assessments for ancillary facility sites, design refinements and supplementary biodiversity assessment into different chapters, as follows:

- **Chapter 1 – Introduction**: Outlines the purpose and structure of the supplementary biodiversity assessment.
- **Chapter 2 – Ancillary facility sites assessment**: Provides a description of the assessment and survey methods, the results of the field investigations, and assessment of the constraints to proposed ancillary facility sites based on the determined impacts on biodiversity. Recommendations are provided for minimising impacts on biodiversity.
- **Chapter 3 – Design refinements assessment**: Presents the design refinements since release of the EIS, and describes the methodology for conducting additional field investigations and expected impacts on biodiversity and mitigation measures where these differ from the original working paper.
- **Chapter 4 – Critical review**: Outlines the methods and findings of a critical review of the biodiversity working paper in terms of survey effort, impact assessments and mitigation measures to address gaps. The critical review and subsequent information does not include ancillary sites and as a result of design changes (as these are described in Chapters 2 and 3).
- **Chapter 5 – Supplementary surveys**: Describes the methods and results of supplementary surveys and effort to address gaps identified from the critical review.
- **Chapter 6 – Supplementary impact assessment**: Addresses any gaps identified in the impact assessment from the critical review, and provides an updated Assessment of Significance to account for supplementary field survey results or where changes have occurred from the EIS such as ancillary sites and design refinements.
- **Chapter 7 – Supplementary mitigation measures**: Summarises species-specific mitigation measures that are documented in the threatened species management plans and provides a critical review of the effectiveness of the proposed mitigation measures including the biodiversity connectivity strategy. Site specific mitigation measures for ancillary sites and design changes are discussed in Chapters 2 and 3.
- **Chapter 8 – Biodiversity offsets**: Addresses the offsets calculator in the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and provides an assessment of impacts and offsets relating to 'matters of national environmental significance' (MNES) that would be significantly impacted by the project.
- **Summary and conclusions**: Summarises the major findings and conclusions of the supplementary biodiversity assessment.
- **References.**
- **Appendices**: Present additional detailed site descriptions of flora and fauna and detailed site assessments for each ancillary facility site, and targeted survey reports.

2. Ancillary facility site assessment

This chapter provides a description of the assessment and survey methods, the results of the field investigations, and assessment of the constraints to proposed ancillary facility sites based on the determined impacts on biodiversity. The chapter also provides recommendations for minimising impacts on biodiversity.

2.1. Background

Ancillary facility sites are temporary sites used for construction related activities. They may incorporate a range of uses and equipment including:

- Main compounds for offices, sheds, workshops and storage.
- Small satellite compounds.
- Bridge compounds.
- The delivery and storage of bridge girders.
- Concrete and asphalt batch plants.
- Crushing plants and material processing.
- Water treatment, where it is not possible to directly discharge into waterways.
- Stockpiling of materials, spoil and mulch.

The EIS identifies the need for 81 ancillary facility sites. The proposed locations were determined based on a rigorous assessment that included important environmental criteria. After the EIS was placed on public exhibition, another four sites were proposed, bringing the total to 85. The feasibility of each site was based on a desktop assessment; the focus was to ensure that the sites would have low impacts on biodiversity.

Of these 85 sites:

- 25 sites would be located wholly within the project boundary assessed in the EIS. The direct and indirect impacts from the use of the sites are addressed in the biodiversity working paper and EIS as part of the construction of the main alignment and service roads.
- 60 sites would be located outside of the project boundary. The potential ecological impacts of these sites were not assessed in detail in the EIS as the details of the sites were still to be confirmed, so are addressed in this supplementary report. The information provided includes the methods and findings of further desktop review and targeted field investigations (where required) to assess the suitability of each site and to avoid and minimise impacts on threatened species, populations and listed communities. Where required, avoidance and mitigation measures are recommended.

2.2. Assessment methods

2.2.1. Overview

All 60 ancillary facility sites were subject to a desktop assessment to identify those sites with limited ecological value (such as sites on cleared land or lacking any significant habitat). This involved a review of aerial photography and data collected for the EIS, including records of threatened species, regional key habitats and corridors data. Of these 60 sites, 14 did not require further ecological assessment or field investigations.

The remaining 46 ancillary facility sites were subject to field surveys to target all NSW and federally potential threatened species and threatened ecological communities (TECs). These sites comprised complete or partial vegetated cover, mostly light scattered trees, or contained aquatic habitat and were considered to provide potential habitat for threatened species.

The investigation also considered cleared portions of sites where potential habitat for the Hairy Joint Grass (*Arthraxon hispidus*) could occur given this species could also occur on cleared sites. Potential habitat for this species was considered as low-lying wet grassy habitats. The investigation also considered the proximity to other locations where the species has been recorded.

For those sites that were partially within the project boundary, the field surveys focused on the portion of the property lying outside the project boundary, which had not been previously assessed.

The ancillary facility sites that were targeted by supplementary field surveys are listed in Table 2-1.

Table 2-1 Ancillary facility sites targeted in the supplementary field surveys

Project section	Site no.	Approx. site area (ha)	Approx. area outside road corridor (ha)
1	Site 1a & 1b	14.3	14.2
	Site 2	2.4	2.4
	3	1.0	0.2
	Additional site 5	20	16.4
Section 1 Total	**5 sites**	**37.7**	**33.1**
2	Site 1a & 1b	10.7	7.7
	Site 2	1.9	0.6
	Site 3	0.9	0.9
	Site 4	2.7	1.0
	Site 5a	3	2.9
Section 2 Total	**6 sites**	**19.2**	**13.1**
3	Site 2	9.3	9.3
	Site 4	10.1	9.1
	Site 5	1.7	1.3
	Site 6a & 6b	2.0	1.7
	Site 7b	2.5	2.5
	Site 8	3.6	3.6
	Site 9	6.4	6.4

Project section	Site no.	Approx. site area (ha)	Approx. area outside road corridor (ha)
Section 3 Total	**8 sites**	**35.6**	**33.9**
4	Site 4a & 4b & 4c	8.0	6.9
	5	2.7	2.1
	7a	3.7	2.7
Section 4 Total	**5 sites**	**14.4**	**11.7**
5	Site 1	1.2	0.4
5	Site 6	4.8	3.8
5	Additional site 7	14.6	13.6
5	Additional site 8	4.6	2.8
5	Additional site 9	22.5	18.5
Section 5 Total	**5 sites**	**47.7**	**39.1**
6	Site 3a & 3b	23.4	14.8
Section 6 Total	**2 sites**	**23.4**	**14.8**
7	Site 3	7.9	6.9
7	Site 4	8.6	8.6
Section 7 Total	**2 sites**	**16.5**	**15.5**
8	Site 2a, 2b & 2c	13.8	11.2
8	3	4.7	4.7
Section 8 Total	**4 sites**	**18.5**	**15.9**
9	Site 1	7.1	7.1
9	Site 2	3.9	3.9
9	Site 3	7.5	5.0
Section 9 Total	**3 sites**	**18.5**	**16.0**
10	Site 1a & 1b	14.4	5.3
10	Site 3b	2.3	2.3
10	Site 4	7.4	7.4
10	Site 5	1.4	1.0
10	Site 6	11.0	10.6
Section 10 Total	**6 sites**	**36.6**	**26.6**
	46 sites	269.2	219.7

2.2.2. Desktop assessment

Review of key habitats and wildlife corridors

Regional wildlife corridors from the Key Habitats and Corridors project (DEC, 2003) and Climate Change Corridors project (DECC, 2007) were reviewed to identify conflicts with the location of ancillary facility sites. These projects adopted a strategic approach to landscape conservation in north-east NSW by identifying key regional fauna habitats and linking habitat corridors, including current corridor locations and corridors likely to become important in the face of future climate change.

Ancillary facility sites were initially located to minimise impacts on these key habitats and regional wildlife corridors. A further review is documented in this report, which presents the outcomes of the final selection of sites.

Review of threatened species and endangered ecological communities

Previous records of threatened species and populations were reviewed. The data were obtained from a variety of sources including:

- The Atlas of NSW Wildlife Database for records in the area within two kilometres of each site.
- Threatened Species Profile Search for any new species population and ecological communities added to the NSW *Threatened Species Conservation Act 1995* (TSC Act) since the review of the working paper (accessed online January 2013).
- EPBC Act Protected Matters Search Tool (DotE).
- Species profile and threats databases (OEH and DotE) (accessed online January 2013).

2.2.3. Field surveys

Overview

Field surveys were conducted over three weeks during the summer of 2012–13. Surveys occurred on 15 days during this period (3–7 December; 17–21 December and 14–18 January). Details of the weather conditions and weekly rainfall are provided in Table 2-2.

Table 2-2 Weather conditions during the field surveys

Dates	Average daily temp	Rainfall (mm)	Notes
3–7 December 2012	25°C	6	Variable humidity, with rain during the first two days.
17–21 December 2012	24°C	53.2	High humidity and heavy rain occurring mid-week.
14–18 January 2013	23°C	5.6	High humidity at the start of the week, with light rain.

The surveys provided a consistent and systematic approach for identifying the presence of threatened species, important habitat values and evidence of use. Stratified sampling was not used. Due to the small size of the ancillary facility sites, and because the sites were predominantly cleared or had minimal remnant vegetation, each site was traversed. The level of survey effort required and techniques used were determined by the extent of vegetation cover, the habitat for fauna and its condition, and the likelihood of

threatened flora and fauna species to occur. For example, where only scattered and low densities of trees occurred in exotic pasture, a search was made for hollow-bearing trees or large nests suitable for threatened raptor species. These were supplemented with Koala scat searches in lightly treed areas and small tree stands. A more comprehensive approach was used in the few sites that were more extensively vegetated; this included plot sampling and random meanders, as well as diurnal and nocturnal fauna surveys, aquatic surveys and habitat assessment.

Targeted threatened flora surveys were conducted wherever remnant vegetation was noted; this included all densely vegetated patches, light tree cover, scattered isolated trees and cleared land in low, wet areas for *Arthraxon hispidus*. These surveys involved random meanders across all portions of the site and identification of Biometric vegetation types where possible.

The field survey techniques and survey effort are summarised in Table 2-4 and described below.

Flora surveys

The survey to identify vegetation communities used a combination of transects and general traverses to classify vegetation according to the Biometric Vegetation Types database (DEC, 2003), which lists and describes plant communities across NSW.

This enabled comparison with the vegetation descriptions in the working paper. Given the scarcity of remnant vegetation on the ancillary facility sites, the identification of vegetation communities involved comparison with adjoining properties in the field. Where present, vegetation communities were also compared with threatened ecological communities listed under the EPBC Act and the TSC Act.

A general traverse approach was used to target threatened flora species within remnant and regrowth and disturbed and cleared areas. An inventory of common flora species was not undertaken in the field given the dominance of cleared land. Where a threatened species was identified, further survey was conducted to identify the size and extent of the population.

Fauna surveys

The fauna survey focused on sites that contained patches of remnant vegetation, farm dams and adjacent wetlands or mature paddock trees (which are important for hollow-dependent fauna and raptors). The fauna surveys identified important habitat features for threatened species such as nest sites, hollow-bearing trees, drays and dormitories, aquatic habitats (for threatened fish, frogs and waterbirds), remnant vegetation, off-site connectivity and potential Koala habitat and Koala activity. Spotlighting for these species and other nocturnal fauna, including the Giant Barred Frog, was conducted at three sites (Section 1 additional site 5; Section 2 site 2, Section 3 site 2).

Live trapping and spotlighting was used at site 2 (Section 2) to detect the Rufous Bettong, Brush-tailed Phascogale, Yellow-bellied Glider and Squirrel Glider. Ground and tree-based trapping used aluminium folding traps, Elliott type B, (15 x 16 x 45 centimetres) (20 tree and 20 ground) and four cage traps (30 x 30 x 60 centimetres). These traps were set for a period of three nights. Spotlighting and dusk census were conducted during the trapping period over two nights and consisted of traversing the entire site boundary using 50-watt hand-held spotlights. Two observers conducted the survey for one hour on each occasion, which included a 500-metre transect along Halfway Creek adjacent to the ancillary facility site to search for the Giant Barred Frog.

The surveys identified scattered areas of primary and supplementary Koala habitat (according to the NSW Recovery Plan for the Koala – DECC, 2008) in proximity to ancillary facility sites with eucalypt forest cover. Koala scat searches were conducted at these sites and involved targeting vegetation patches on the site and within adjacent fringing areas. The searches ensured spatial representation across the site and, where present, the sampling of different habitat types.

A modified version of the Spot Assessment Technique (Phillips and Callaghan, 2012) was used to detect Koala activity. This technique targeted all trees present in a plot regardless of its status as a Koala food tree species. The aim was to search a total of 30 trees in a plot, but was dependent on the actual number of trees in the plot given the lack of trees at some sites. Searches were conducted at the base of trees over 20 centimetres diameter at breast height (DBH) with particular focus given to any known Koala feed tree species present for the North Coast region as identified in the Recovery Plan for the Koala (DECC, 2008). This included Forest Red Gum (*Eucalyptus tereticornis*), Swamp Mahogany (*E. robusta*) and Tallowwood (*E.microcorys*). The coordinates of any scats found were recorded, as were the tree species and the proportion of each tree species in the canopy. A total of 37 plots were searched using this method across all sites. The data collected from the targeted Koala survey was used to update the EIS database with respect to the presence and distribution of 'habitat critical to the survival of Koala' as per DSEWPaC (2012).

Targeted searches for frogs and reptiles included nocturnal spotlighting and diurnal hand searches for the Giant Barred Frog (*Mixophyes iteratus*) and Wallum Sedge Frog (*Litoria olongburensis*). This was conducted within the confines of the site boundaries at Cassons Creek and Halfway Creek (Section 1) and Pheasants Creek (Section 3). Surveys were area-based and varied in duration according to the length of habitat investigated at each site. The survey timing varied between 20 and 60 minutes and involved a minimum of two people using head torches and spotlights searching for adult frogs and tadpoles in the water column. Streams were surveyed using this time interval or by traversing a 500-metre transect depending on the length of waterway and ease of traversing. Dams were targeted by perimeter searches and listening for calls.

Reptile surveys were integrated into the Koala scat search methods and conducted at all sites where ground cover in the form of logs or debris was present. When searching for Koala scats, small logs, litter and bark around tree bases were overturned to identify any hidden reptiles.

Targeted survey for Oxleyan Pygmy Perch

Investigations for the ancillary facility sites targeted Oxleyan Pygmy Perch at three sites due to the presence of aquatic habitat intersecting the sites. This included habitats associated with Cassons Creek and Halfway Creek (sections 1 and 2) and Pheasants Creek (Section 3). Six locations were sampled using a range of techniques as described in Table 2-3. The surveys were undertaken in consultation with the Department of Primary Industries (Fisheries), and in accordance with the *Survey Guidelines for Australia's Threatened Fish* (DSEWPaC, 2011). This ensured the optimum survey period for the Oxleyan Pygmy Perch and minimised impacts on breeding life-cycle events. Fish sampling methods included electrofishing, dip nets and bait traps. The sampling methodology varied between watercourses, depending upon a number of site characteristics including channel depth, provision of woody snags, provision of submerged vegetation and accessibility. All fish captured were identified and data recorded for relative abundance, size of fish (total length in millimetres) and sampling technique.

Table 2-3 Description of the fish survey techniques and targeted fish group

Survey technique	Target group	Description
Bait traps	Small bodied fish (Oxleyan Pygmy Perch, Purple-spotted Gudgeon)	Unbaited bait traps were set for a period of 30-60 minutes (as baiting does not improve the probability of attracting fish (Knight *et al*. 2007). Ten traps were deployed at each site, set around 1.5-2 metres apart. The traps were deployed within watercourses of a variety of depths amongst stands of emergent vegetation, submerged vegetation, or snag piles, as these areas are likely to have a greater diversity and abundance of small bodied fish.
Dip nets	Small bodied fish (Oxleyan Pygmy Perch, Purple-spotted Gudgeon)	Dip nets (200µm mesh size) were used in shallow creeks and ephemeral pools or locations dense with aquatic snags where the use of other netting methods was unfeasible.
Fyke nets	Mobile, large bodied fish	Large single-wing fyke nets with a 4m leader were set with the cod-end on one bank with the wing attached midstream. The cod-end of each fyke net was always suspended above the water to avoid the mortality of captured air breathing vertebrates. Fyke nets were not deployed at sites with an identified risk of cattle becoming entangled in the net. Typically fyke nets were deployed for a minimum of 2 hours.
Backpack electrofishing	Fish species of a variety of size classes (Oxleyan Pygmy Perch, Purple-spotted Gudgeon)	Electrofishing was undertaken at sites with wadeable habitats, appropriate access and conductivity levels less than 1500 µS/cm. Where habitat and site access allowed, backpack electrofishing was undertaken with an electrical output of 500b, 60Hs pulsed DC to allow capture but without causing muscle rigidity Electrofishing is a commonly used, non-destructive technique for sampling smaller watercourses, the technique temporarily stuns the fish, whereupon they float to the surface and can be identified and counted.

Physico-chemical water quality parameters were measured in-situ using a calibrated Hydrolab water quality probe. The number of survey sites with sampled waterways is detailed in Table 2-4. Measurements were generally collected between 15 and 30 centimetres below the surface depending on the depth of water, with the sampling depth recorded in the field. A range of parameters were measured including:

- Turbidity (NTU): This is a measure of the 'muddiness' of the water. It is important as an indication of the amount of suspended colloidal and particulate matter in the water and how much light can penetrate for important biochemical processes such as photosynthesis. Elevated levels of particulate matter can also impact on dissolved oxygen concentrations and pH.
- Conductivity (mS/cm, uS/cm). This is a measure of the amount of dissolved salts in the water and its ability to conduct an electrical current. It is important as some plant and animal species are salt sensitive whilst others require higher salt concentrations.
- Salinity (pps). This is a measure of the salt concentration of water, measured directly as dissolved salts.
- Temperature (°C). This is a measure of the degree of hotness or coldness of water. It is a form of pollution and can impact on riverine biota and associated biological and chemical processes.
- pH. This is a measure of the acidity or alkalinity of water. Most freshwater and estuarine biota have a range of tolerances between 6.5 and 8.
- Dissolved oxygen (% saturation and mg/L). This is a measure of the amount of oxygen dissolved in water. Dissolved oxygen is vital for many forms of riverine and estuarine biota including native fish and is also vital for the functioning of healthy aquatic ecosystems.

Summary and limitations

Access to private property had to be arranged prior to field investigations; this involved notification to landholders. Access to some properties was denied at the time of the survey (Section 1 site 4b, Section 3 site 3a, Section 4 site 1 and Section 7 site 1). Particular care was taken to inspect these sites from roadside areas and property boundaries. Each of these sites was found to be completely cleared or contain exotic landscape gardens, and therefore was not considered to contain significant biodiversity features, so a field survey on the site was not required.

The field surveys were conducted during the EIS submissions phase and there was no scope to conduct seasonal surveys. However, the summer survey period was considered optimum for detection of a wide range of targeted threatened species and not seen as a major constraint to the survey results. A summary of the survey methods and effort is provided in Table 2-4.

Table 2-4 Overview of the ancillary facility site field survey methods and effort

Section	Site ID	Vegetation cover on site	Technique	Survey effort
3-7 Dec (5days)				
1	Site 1a & 1b	Partial to light tree cover (with some adjoining heavy vegetation cover)	Flora: General traverses across the site	Observer completed 7 transects/plots
			Flora: Biobanking condition assessments	Three biobanking assessment plots in regenerating vegetation and derived grassland.
			Fauna: Opportunistic searches at daytime	Observer traversed across site at day for 30 minutes
			Fauna: Koala scat search focusing on known food trees	Two observers conducted 2 plots across the site searching all trees as only a scattered small number of trees occurs
			Fauna: Habitat assessment and habitat resource mapping (including hollow-bearing trees, raptor nests and drays etc.), plus opportunistic survey.	Observers searched habitats for 30 minutes mapping significant values. Conducted an opportunistic bird survey of the large dam adjacent to site 1b to look for threatened wetland birds such as Black-necked Stork and Brolga
1	Site 2	Area of trees on aerial photograph recently cleared by property owner	Flora: general traverse across the cleared and disturbed area Fauna: visited the site and found that the trees had been recently cleared from the property	Observer completed one transect, trees recently cleared from this block Observer discussed the site fauna with the property owner and took a walk over the recently cleared area.
1	Site 3	Light tree cover	Flora: General traverse around the edges of the property, no vegetation within the ancillary area	Observer complete general meander around the edges of the cleared property.
1	Additional Site 5	Partially cleared on elevated northern end with dense vegetation on southern half and surrounding Cassons Creek	Flora: General traverses across the majority of the site	Observer completed 3 transects/plots
			Fauna: Opportunistic searches at day and night	Observer traversed across site at day for 30 minutes
			Fauna: Spotlighting, frog census over two nights	Two observers undertook spotlighting and the frog census for 1 hour on two nights, the second survey was conducted downstream from the ancillary site towards the exiting highway.
			Fauna: Koala scat search focusing on known food trees	Two observers conducted 2 plots across the site searching 30 trees
			Fauna: Habitat assessment and habitat resource mapping (including hollow-bearing trees, raptor nests and drays etc.)	Observers searched habitats for 30 minutes mapping significant values.
			Aquatic: Bait trapping, fyke nets and Electro fishing at pond sites	Ten bait traps and one fyke net trap setup for 1-2 hours at each of the two ponds. Electrofishing was undertaken at one pond for 1 hour.
			Aquatic: Habitat assessment	Two observers recorded water quality and bank and vegetation characteristics

Section	Site ID	Vegetation cover on site	Technique	Survey effort
2	Site 1a &1b	Part heavily treed.	Flora: General traverses across the majority of the site	Observer completed 2 transects/plots
			Fauna: Opportunistic searches at daytime	Observer traversed across site at day for 30 minutes
			Fauna: Koala scat search focusing on known food trees	Two observers conducted 3 plots across the site searching 30 trees
			Fauna: Habitat assessment and habitat resource mapping (including hollow-bearing trees, raptor nests and drays etc.)	Observers searched habitats for 30 minutes mapping significant values.
2	Site 2	Heavy tree cover	Flora: General traverses across the majority of the site	Observer completed 3 transects/plots
			Fauna: Opportunistic searches at daytime for reptiles and birds and spotlighting at night for Koala, Yellow-bellied Glider, Squirrel Glider, Brush-tailed Phascogale and Giant Barred Frog.	Two observers traversed across site at day and night for 1 hour each period. Included a 500 m transect along Halfway Creek for Giant Barred Frog.
			Fauna: Koala scat search focusing on known food trees and canopy search transects	Two observers conducted 5 plots across the site, searching 30 trees in each plot
			Fauna: Ground trapping targeting Rufous Bettong and Brush-tailed Phascogale.	Ten size B Elliott traps baited with peanut butter/rolled oats and honey set at ground level for three consecutive nights (a total of 30 trap nights). Three cage traps baited with sardines set at ground level for three consecutive nights (a total of nine trap nights)
			Fauna: Habitat assessment and habitat resource mapping (including hollow-bearing trees, raptor nests and drays etc.)	Observers completed 3 plots/transects to quantify the number of hollow-bearing trees and searched habitats for 1 hour for other significant fauna habitat features.
2	Site 3	Light tree cover	Flora: General traverses	Observer traversed site for 20 minutes
2	Site 4	Light tree cover, cleared in the south	Flora: General traverses	Observer traversed site for 30 minutes
			Fauna: Opportunistic searches at daytime	Observer traversed across site at day for 30 minutes
			Fauna: Koala scat search focusing on known food trees and canopy search transects	Two observers conducted 2 plots across the site, searching 30 trees and 3 transects
			Fauna: Record habitat trees	Conducted 2 habitat tree transects in the northern end of the property to quantify habitat trees
2	Site 5a	Scattered light cover	Flora: General traverses	Observer traversed site for 40 minutes
3	Site 2	Light tree cover with aquatic habitat	Flora: General traverses	Observer traversed site for 30 minutes
			Fauna: Opportunistic searches at daytime for reptiles and birds and spotlighting at night for mammals and frogs, including Rufous Bettong, Koala, Brush-tailed Phascogale, Gliders, and Green-thighed Frog.	Two observers traversed across site at day and night for 30 minutes each period. Included a 500 metre transect along the creek to search for Green-thighed Frog.

Section	Site ID	Vegetation cover on site	Technique	Survey effort
			Fauna: Koala scat search focusing on known food trees and canopy search transects	Two observers conducted 1 plot across the site, searching 20-30 trees
			Fauna: Habitat assessment and habitat resource mapping (including hollow-bearing trees, raptor nests and drays etc.)	Observers completed 2 plots/transects and searched habitats for 30 minutes mapping significant values.
			Aquatic: Bait trapping and fyke nets	Ten bait traps and one fyke net trap setup for 1-2 hours along creek. Due to conductivities >1500 µS/cm backpack electrofishing could not be conducted.
			Aquatic: Habitat assessment	Two observers recorded water quality and bank and vegetation characteristics
3	Site 4	Partial tree cover	Flora: General traverses across the majority of the site	Observer completed 5 transects/plots
			Flora: Biobanking condition assessments	Two biobanking assessment plots in regenerating vegetation and derived grassland.
			Fauna: Opportunistic searches at daytime for reptiles and birds and Koala including evidence of emus and Glossy Black-Cockatoo and Grey-crowned Babbler.	Two observers traversed across site at day 60 minutes each period
			Fauna: Koala scat search focusing on known food trees and canopy search transects	Two observers conducted 5 plots across the site, searching 30 trees in each plot
			Fauna: Habitat assessment and habitat resource mapping (including hollow-bearing trees, raptor nests and drays etc.)	Observers completed walkover of entire site and recorded all habitat trees and described habitat condition
3	Site 5	Light tree cover	Fauna: Opportunistic searches at daytime for reptiles and birds	Two observers traversed across site at day 30 minutes each period
			Fauna: Koala scat search focusing on known food trees	Two observers conducted 1 plot across the site, searching 30 trees in each plot
			Fauna: Habitat assessment and habitat resource mapping (including hollow-bearing trees, raptor nests and drays etc.)	Observers completed 1 plots/transects and searched habitats for 30 minutes mapping significant values.
3	Site 6a & 6b	Cleared	Flora: General traverses across the majority of the site	Observer completed 2 transects/plots
			Fauna: General search for habitat trees and large raptor nests.	30 -minute traverse
3	Site 7b	Partially treed	Flora: General traverses across the majority of the site	Observer completed 1-2 transects/plots
			Fauna: General search for habitat trees and large raptor nests.	30-minute traverse

Section	Site ID	Vegetation cover on site	Technique	Survey effort
3	Site 8	Partially tree	Flora: General traverses across the majority of the site	Observer completed 1 transect
			Fauna: General search for habitat trees and large raptor nests.	30-minute traverse
3	Site 9	Scattered light tree cover on edges	Flora: General traverses across the majority of the site	Observer completed 5 transects
			Flora: Biobanking condition assessments	Two biobanking assessment plots in regenerating vegetation and derived grassland.
			Fauna: Opportunistic searches at daytime for reptiles and birds, large raptor nests and habitat trees	Two observers traversed across site at day for 1 hour
			Fauna: Koala scat search focusing on known food trees	Two observers conducted 5 plots across the site, searching 30 trees in each plot
17-21 Dec 2012 (5 days)				
4	Site 4a, 4b, 4c	Scattered light cover (4a,4c), cleared (4b)	Flora: General traverses across the majority of the site	Observer completed 3 transects
			Fauna: Opportunistic searches at daytime for reptiles and birds including Koala and large raptor nests	Two observers traversed across the entire site at day for 1 hour
			Fauna: Koala scat search focusing on known food trees	Two observers conducted 1 plot on site 4a, searching 30 trees
			Fauna: Habitat assessment and habitat resource mapping (including hollow-bearing trees, raptor nests and drays etc.)	Observers completed traverse over the entire site.
4	Site 5	Cleared	Flora: General traverses across the majority of the site	Observer completed a general traverse of this cleared site
4	Site 7a	Light tree cover	Flora: General traverses across the majority of the site	Observer completed a general traverse of this cleared site
5	Site 1	Light tree cover	Flora: General traverses across the majority of the site	Observer completed a general traverse of this predominantly cleared site
			Flora: Biobanking condition assessments	One biobanking assessment plot in regenerating vegetation and derived grassland.
5	Site 6	Partial tree cover	Flora: General traverses across the majority of the site	Observer completed 2 transects
			Flora: Biobanking condition assessments	One biobanking assessment plots in regenerating vegetation and derived grassland.
			Fauna: Opportunistic searches at daytime for reptiles and birds	Two observers traversed across the entire site at day for 30 minutes
			Fauna: Koala scat search and habitat assessment focusing on known food trees	Two observers conducted 1 plot on this sites, searching 30 trees and a fourth plot in the adjoining Mororo Nature Reserve. Also conducted a drive transect through the Nature Reserve to search for koalas and record habitat suitability for koalas.

Section	Site ID	Vegetation cover on site	Technique	Survey effort
			Fauna: Habitat assessment and habitat resource mapping (including hollow-bearing trees, raptor nests and drays etc.)	Observers completed traverse of the entire site and searched habitats for 30 minutes mapping significant values.
5	Additional site 7	Dense tree cover	Flora: General traverses across the majority of the site	Observer completed 2 transects
			Flora: Biobanking condition assessments	One biobanking assessment plots in regenerating vegetation and derived grassland.
			Fauna: Opportunistic searches at daytime for reptiles and birds	Two observers traversed across the entire site at day for 30 minutes
			Fauna: Koala scat search and habitat assessment focusing on known food trees	Two observers conducted 3 plots on this site, searching 90 trees.
			Fauna: Habitat assessment and habitat resource mapping (including hollow-bearing trees, raptor nests and drays etc.)	Observers completed traverse of the entire site and searched habitats for 30 minutes mapping significant values.
5	Additional Site 8	Partial tree cover	Flora: General traverses across the majority of the site	Observer completed 2 transects
			Flora: Biobanking condition assessments	One biobanking assessment plots in regenerating vegetation and derived grassland.
			Fauna: Opportunistic searches at daytime for reptiles and birds	Two observers traversed across the entire site at day for 30 minutes
			Fauna: Koala scat search and habitat assessment focusing on known food trees	Two observers conducted 3 plots on these sites, searching 90 trees and a fourth plot in the adjoining Mororo Nature Reserve. Also conducted a drive transect through the Nature Reserve to search for koalas and record habitat suitability for koalas.
			Fauna: Habitat assessment and habitat resource mapping (including hollow-bearing trees, raptor nests and drays etc.)	Observers completed traverse of the entire site and searched habitats for 30 minutes mapping significant values.
5	Additional Site 9	Partial tree cover	Flora: General traverses across the majority of the site	Observer completed 2 transects
			Flora: Biobanking condition assessments	One biobanking assessment plots in regenerating vegetation and derived grassland.
			Fauna: Opportunistic searches at daytime for reptiles and birds	Two observers traversed across the entire site at day for 30 minutes
			Fauna: Koala scat search and habitat assessment focusing on known food trees	Two observers conducted 1 plot on this site, searching 30 trees and random search of trees where encountered.
			Fauna: Habitat assessment and habitat resource mapping (including hollow-bearing trees, raptor nests and drays etc.)	Observers completed traverse of the entire site and searched habitats for 30 minutes mapping significant values.

Section	Site ID	Vegetation cover on site	Technique	Survey effort
6	Site 3a, 3b	Lightly treed (3a), heavily treed areas to be cleared for future works (3b) in project corridor	Flora: General traverses across the majority of the site	Observer completed 4-6 transects/plots
			Flora: Biobanking condition assessments	Two biobanking assessment plots in regenerating vegetation and derived grassland.
			Fauna: Opportunistic searches at daytime for reptiles and birds	One observer traversed across site at day for 30 minutes
			Fauna: Koala scat search focusing on known food trees	Two observers conducted 3 plots across the two sites, searching 30 trees in each plot.
			Fauna: Habitat assessment and habitat resource mapping (including hollow-bearing trees, raptor nests and drays etc.)	Observers completed traverse by vehicle and foot of the entire site area for around 1 hour, recording habitat trees. Also searched old buildings and sheds for roosting bats.
7	Site 3	Scattered light cover	Flora: General traverses across the majority of the site	Observer completed 1-2 transects/plots
			Fauna: Opportunistic searches at daytime for reptiles and birds	One observer traversed across site at day for 30 minutes
			Fauna: Koala scat search focusing on known food trees	Two observers conducted 2 plots across the site, searching 30 trees in each plot.
			Fauna: Habitat assessment and habitat resource mapping (including hollow-bearing trees, raptor nests and drays etc.)	Observers completed traverse of the entire property for 30 minutes mapping significant values.
7	Site 4	Scattered light cover	Flora: General traverses across the majority of the site	Observer completed 1-2 transects/plots
			Flora: Biobanking condition assessments	One biobanking assessment plots in regenerating vegetation and derived grassland.
			Fauna: Opportunistic searches at daytime for reptiles and birds, including evidence of Glossy Black-Cockatoo and Grey-crowned Babbler	Two observers traversed across the entire site by foot and vehicle for 1 hour.
			Fauna: Koala scat search focusing on known food trees	Two observers conducted 2 plots across the site, searching 30 trees in each plot.
			Fauna: Habitat assessment and habitat resource mapping (including hollow-bearing trees, raptor nests and drays etc.)	Observers completed traverse of the entire site and searched habitats for 1 hour mapping significant values.

Section	Site ID	Vegetation cover on site	Technique	Survey effort
14-18 Jan 2013 (5 days)				
8	Site 2a, 2b, 2c	Some lightly scattered trees	Flora: General traverses across the majority of the site	Observer completed 2 transects
			Fauna: Opportunistic searches at daytime for reptiles and birds by traverse of the majority of this cleared site	One observer traversed across site at day for 30 minutes
8	3	Cleared	Flora: General traverses across the majority of the site	Observer completed 1 transects
			Fauna: Opportunistic searches at daytime for reptiles and birds by traverse of the majority of this cleared site	One observer traversed across site at day for 30 minutes
9	1	Heavy vegetation cover on eastern and western edges	Flora: General traverses across the majority of the site	Observer completed 1 transect
			Flora: Biobanking condition assessments	One biobanking assessment plots in regenerating vegetation and derived grassland.
			Fauna: Opportunistic searches at daytime for reptiles and birds	One observer traversed across site at day for 30 minutes
			Fauna: Koala scat search focusing on known food trees	Two observers conducted 2 plots across the site, searching 30 trees in each plot
			Fauna: Habitat assessment and habitat resource mapping (including hollow-bearing trees, raptor nests and drays etc.)	Observers completed traverse of small vegetated areas and searched habitats for 20 minutes mapping significant values.
9	Site 2	Some lightly scattered trees	Flora: General traverses across the majority of the site	Observer completed 1-2 transects/plots
			Flora: Biobanking condition assessments	Two biobanking assessment plots in regenerating vegetation and derived grassland.
			Fauna: Opportunistic searches at daytime for reptiles and birds including large raptor nests	One observer traversed across site at day for 30 minutes
9	Site 3	Some lightly scattered trees	Flora: General traverses across the majority of the site	Observer completed 3-4 transects/plots
			Flora: Biobanking condition assessments	One biobanking assessment plots in regenerating vegetation and derived grassland.
			Fauna: Opportunistic searches at daytime for reptiles and birds, including large raptor nests	One observer traversed across site at day for 30 minutes
10	Site 1a, 1b	Some lightly scattered trees	Flora: General traverses across the majority of the site	Observer completed 1-4 transects/plots
			Fauna: Opportunistic searches at daytime for reptiles and birds and large raptor nests and paddock trees.	One observer traversed across site at day for 30 minutes
10	Site 3b	Some scattered trees	Flora: General traverses across the majority of the site	Observer completed 1-4 transects/plots
			Fauna: Opportunistic searches at daytime for reptiles and birds and large raptor nests and paddock trees	One observer traversed across site at day for 30 minutes

Section	Site ID	Vegetation cover on site	Technique	Survey effort
10	Site 4	Cleared	Flora: General traverses across the majority of the site	Observer completed 1-4 transects/plots
			Fauna: Opportunistic searches at daytime for reptiles and birds and significant habitat	One observer traversed across site at day for 30 minutes
10	Site 5	Some scattered trees	Flora: General traverses across the majority of the site	Observer completed 1-4 transects/plots
			Fauna: Opportunistic searches at daytime for reptiles and birds and significant fauna habitat	One observer traversed across site at day for 30 minutes
10	Site 6	Some scattered trees	Flora: General traverses across the majority of the site	Observer completed 1-4 transects/plots
			Fauna: Opportunistic searches at daytime for reptiles and birds and significant fauna habitat.	One observer traversed across site at day for 30 minutes

2.3. Results

2.3.1. Data review

The list of threatened species previously recorded from a two-kilometre radius of the assessed sites is listed in Table 2-5. The likelihood that any of these species could occur on the site or be dependent on habitat within the property area is considered only low to moderate due to the predominantly cleared and modified condition of these properties. For example, preferred wetland habitats for species such as the Australasian Bittern and Black-necked Stork were not present within the boundaries of any proposed ancillary facility site, despite there being records of these species in the general area.

The list of species in Table 2-5 therefore provides an indication of the species that have been previously recorded in surrounding areas and habitats for which to target survey effort. Of the fauna species listed, those with a moderate to higher likelihood of occurring would be the highly mobile and wide-ranging species that are tolerant of fragmented habitats. These include microbats, Grey-crowned Babbler, Glossy Black-Cockatoo, Little Lorikeet and Osprey. The Koala and Wallum Froglet are also considered to have a moderate likelihood of occurring, based on scattered small patches of suitable habitat and their known ability to occur in modified habitats.

Table 2-5 Threatened species records close to ancillary facility sites

Scientific name	Common name	Status		Likelihood of occurring on ancillary site
		TSC Act	EPBC Act	
FAUNA				
Botaurus poiciloptilus	Australasian Bittern	E	E	Unlikely
Burhinus grallarius	Bush stone-curlew	E		Unlikely
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	Low
Dromaius novaehollandiae	Coastal Emu	E2	-	Moderate to high Section 3, 4 only)
Irediparra gallinacea	Comb-crested Jacana	V	-	Unlikely
Haematopus longirostris	Pied Oystercatcher	E	-	Unlikely
Calyptorhynchus lathami	Glossy-black Cockatoo	V	-	Moderate
Climacteris picumnus	Brown Treecreeper	V	-	Low
Glossopsitta pusilla	Little Lorikeet	V	-	Moderate
Grus rubicundus	Brolga	V	-	Low
Melithreptus gularis gularis	Black-chinned Honeyeater (estn ssp.)	V	-	Low
Pandion haliaetus	Eastern Osprey	V	-	Moderate
Pomatostomus temporalis temporalis	Grey-crowned Babbler (estn ssp.)	V	-	Moderate to high
Ptilinopus magnificus	Wompoo fruit-Dove	V	-	Low
Lophoictinia isura	Square-tailed Kite	V	-	Moderate
Ninox strenua	Powerful Owl	V	-	Unlikely
Tyto capensis	Eastern Grass Owl	V	-	Moderate to high
Tyto novaehollandiae	Masked Owl	V	-	Low to moderate
Chalinolobus nigrogriseus	Hoary Wattled Bat	V	-	Moderate
Phascolarctos cinereus	Koala	V	V	Moderate only where food resources present
Miniopterus australis	Little Bent-wing Bat	V	-	Moderate, foraging only
Myotis macropus	Southern Myotis	V	-	Moderate, foraging only where dams present
Nyctophilus bifax	Eastern Long-eared Bat	V	-	Moderate

Scientific name	Common name	Status		Likelihood of occurring on ancillary site
		TSC Act	EPBC Act	
Pteropus poliocephalus	Grey-headed Flying-Fox	V	V	Moderate to high
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	V	-	Moderate
Aepyprymnus rufescens	Rufous Bettong	V	-	Moderate
Petaurus australis	Yellow-bellied Glider	V	-	Moderate one site, only where densely vegetated
Petaurus norfolcensis	Squirrel Glider	V	-	Moderate two sites, only where densely vegetated
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	Moderate, habitat fragments
Planigale maculata	Common Planigale	V	-	Moderate one site, where densely vegetated
Dasyurus maculatus maculatus (SE population)	Spotted-tailed Quoll	V	E	Moderate, only on densely vegetated sites
Crinia tinnula	Wallum Froglet	V		Moderate to high, known from cleared and disturbed sites
Litoria brevipalmata	Green-thighed Frog	V		Unlikely
FLORA				
Eucalyptus tetrapleura	Square-fruited Ironbark	V	V	Moderate, in section 1-2
Angophora robur	Sandstone Rough Barked Apple	V	V	High, Section 3 and 4
Melaleuca Irbyana	Weeping Paperbark	E	-	Moderate
Lindsaea incisa	Slender Screw Fern	E	-	Moderate Section 3
Grevillea quadricauda	Four-tailed Grevillea	V	V	Unlikely
Drynaria rigidula	Basket Fern	E	-	Unlikely
Hibbertia marginata	Bordered Guinea Flower	V	V	Unlikely
Oberonia titania	Red-flowered King of the Fairies	V	-	Unlikely
Desmodium acanthocladum	Thorny Pea	V	V	Unlikely
Arthraxon hispidus	Hairy Joint Grass	V	V	High, section 10 and 11

2.3.2. Key habitat and corridor review

The ancillary facility sites were located to minimise impacts on key fauna habitats and corridors, which has largely resulted in avoidance of these high conservation areas. Due to the broad landscape approach used to identify regional corridors, a number of corridors incorporate areas of cleared land. As such, five ancillary facility sites situated on cleared land would be located within an identified regional corridor (refer Table 2-6). This is unlikely to impact of the integrity of the corridor, as the proposed use of these sites is not intended to remove vegetation from that corridor and would be a temporary use of the land.

Table 2-6 Ancillary facility sites located in a key regional corridor

Regional corridor	Location description	Focal species	Ancillary facility sites
Corindi (Corindi River)	Links with Redbank Creek corridor and key habitat areas across existing highway. Corindi River is totally bisected by Section 1.	Brolga, Black-necked Stork,	Section 1 Site 1b
Yuraygir (Yuray-Sherwood, Yuraygir_CR)	Crosses Section 1. Links Sherwood Nature Reserve to Yuraygir National Park. Not totally bisected by project.	Yellow-bellied Glider, Rufous Bettong	Section 2 Site1a
Pine Brush	Crosses Section 3. Not totally bisected by project.	Brush-tailed Phascogale	Section 3 Site 5, Section 3 Site 6a & 6b

2.3.3. Survey results

The surveys confirmed that remnant vegetation and associated high quality habitats are absent or limited on most sites. This indicates that the selection of ancillary facility sites has been appropriate and would have minimal impact on threatened species, populations and communities. Important features on the ancillary facility sites such as habitat structural integrity, hollow-bearing trees, logs, native shrubs and connectivity features for fauna are largely absent. The value of the habitat on these sites is mostly in the presence of scattered and often isolated resources such as small dams, occasional tree hollows for shelter, roosting and nesting habitat for birds and microchiropteran bats and seasonal flowering resources that may be used by wide-ranging nectarivores such as the Grey-headed Flying-fox, Swift Parrot and Little Lorikeet. The value of these habitats is limited by small patch sizes associated with previous clearing and fragmentation of habitats, and a lack of connectivity.

A small number of sites contain more extensive stands of remnant vegetation, but are adjacent to cleared areas. Of particular note are the forested portions of site 5 (Section 1) and site 2 (Section 2), which contain a range of significant habitat features suitable for threatened flora and fauna.

Two other sites, which were found to be mostly cleared, contained scattered low numbers of Koala feed trees and evidence of infrequent use by koalas via old scats (ie Section 3, site 9 and Section 5, site 6). Both sites occur adjacent to extensive areas of potential Koala habitat and the observed Koala use of the cleared sites may be either represented by a portion of the home range of an individual Koala or previous visitation by a dispersing individual.

Table 2-7 provides a summary of the survey findings for each assessed site including the presence of threatened species, populations or communities, fauna habitat resources and an indication of the potential use of each site by flora and fauna. Further notes and site photographs are provided as Appendix C. Figure 2-1 to Figure 2-19 illustrate the ecological values located on all ancillary facility sites.

Table 2-7 Overview of the field survey findings for ancillary facility sites

Site	Vegetation cover (condition)	Threatened ecological communities	Aquatic and wetland habitats	Fauna habitat resources	Fauna connectivity structures near site	Threatened species confirmed
Section 1						
Site 1a & 1b	Partial to light tree cover (with some heavy vegetation in parts and adjoining outside the site).(Regenerating)	Remnant elements of Subtropical Coastal Floodplain Forest (TSC Act)	Localised ponds and creek	Remnant trees, seasonal food resources (nectar feeding species), no hollow-bearing trees noted	No	None, low value for threatened fauna
Site 2	Areas of trees on aerial photograph very recently cleared (Cleared)	Absent	None	Limited by lack of trees and native vegetation, past disturbance at the site	No	None confirmed or expected
Site 3	Light tree cover (Cleared and Modified)	Absent	None	Limited by lack of trees and native vegetation. Only species tolerant of modified habitats expected.	No	None, low value for threatened fauna
Additional Site 5	Part heavily treed and aquatic habitat, (Remnant and high condition)	Swamp Sclerophyll Forest (TSC Act) dominates southern portions of site 2a associated with Cassons Creek	Large ponds (adjoining site) containing high quality areas of fringing vegetation. High quality aquatic habitats on Cassons creek for frogs, birds, reptiles. Fish survey completed and site considered unsuitable for Oxleyan Pygmy Perch	Abundant seasonal food resources (nectar feeding species), remnant trees with hollows present throughout forested parts but scarce over remainder of cleared areas. High structural and floristic diversity	Bridge over Cassons Creek	None confirmed from the survey, although potential habitat for several threatened fauna species including Green-thighed frog, Giant Barred Frog, Grey-headed Flying-fox, microbats, Powerful Owl. Habitat not optimum for Oxleyan Pygmy Perch and not recorded from targeted survey at the site.
Section 2						
Site 1a, 1b	Part heavily treed, (Modified)	Absent	Site 1a: Farm dam in south west corner. No saprophytes	Site1b: small number of hollow bearing trees and large remnant trees, disturbed and maintained understorey.	No	Absent, some value a shelter and food resources for wide-ranging species

Site	Vegetation cover (condition)	Threatened ecological communities	Aquatic and wetland habitats	Fauna habitat resources	Fauna connectivity structures near site	Threatened species confirmed
Site 2	Heavily treed, (Remnant and high condition)	Absent	Creek line (adjoining site) contains deep pools and riparian vegetation, moderate quality for range of dependent species. Fish survey conducted here and habitat considered unsuitable for Oxleyan Pygmy Perch, some chance for Giant Barred Frog	Numerous hollow-bearing trees and fallen timber habitats, high structural and floristic diversity. Abundant shelter, breeding and food resources for wide-range of species, particularly Rufous Bettong, Brush-tailed Phascogale, gliders and microbats.	No	Grey-headed Flying-fox, potential habitat for several other threatened fauna species including Squirrel Glider, Brush-tailed Phascogale, Rufous Bettong, microbats, Giant Barred Frog.
Site 3	Light tree cover(Planted)	Absent	Absent	Absent	No	Absent
Site 4	Light tree cover, cleared in south (Low)	Absent	Absent	Hollow bearing trees present inside the road corridor but absent outside corridor on remainder of the site. Potential shelter/nesting resource for hollow dependent species.	No	Absent, isolated hollow-bearing trees maybe used by threatened microbats
Site 5a	Scattered light cover. (Low)	Absent	Drainage line	Nectar resources for birds and Grey-headed Flying-fox	No	Square-fruited Ironbark (*Eucalyptus tetrapleura*) confirmed, potential foraging habitat for Grey-headed Flying-fox.
Section 3						
Site 2	Light tree cover with aquatic habitat. (Modified and disturbed)	Remnant elements of Subtropical Coastal Floodplain Forest (TSC Act)(disturbed)	Creek line within modified landscape, some scattered patches of riparian vegetation	Scattered remnant trees, some with hollows, grassy understory cover, common frog habitat	A 13 x 1.2 m box culvert adjacent to the site.	Grey-headed Flying-fox (*Pteropus poliocephalus*) Rufous Bettong on road adjacent to site (*Aepyprymnus rufescens*), potential for Grey-crowned Babbler

Site	Vegetation cover (condition)	Threatened ecological communities	Aquatic and wetland habitats	Fauna habitat resources	Fauna connectivity structures near site	Threatened species confirmed
Site 4	Partial tree cover (Modified)	Remnant elements of Subtropical Coastal Floodplain Forest (TSC Act)	Absent	Scattered low density of Koala food tree species present Glossy Black Cockatoo habitat to the south and off-site as a large patch of *Allocasuarina littoralis*. Scattered, mature hollow-bearing trees	No	Sandstone Rough-barked Apple (*Angophora robur*) Grey-crowned Babbler (*Pomatostomus temporalis temporalis*). Potential for Emu, glossy black-cockatoo and microbats. Glossy Black-Cockatoo observed flying over the site.
Site 5	Light tree cover (Low)	Absent	Small moist depressions and creek lines in open paddock	Two dead stags, very limited opportunities for roosting in these	A bridge structure for emus placed 50 metres south of this site. Site to remain cleared as attractant for emus	Absent, potential for Emu at this cleared site
Site 6a & 6b	Cleared (Low)	Absent	Small farm dam with no macrophytes, limited value	Limited seasonal nectar resources	A 3.6 X 2.4 metre box culvert adjacent to this site 50 metres north. Site to remain clear as attractant for emus	Sandstone Rough-barked Apple (*Angophora robur*), potential for Emu
Site 7b	Partially treed (Low)	Absent	Absent	One large hollow tree, potential roosting habitat for threatened microbats	No , bridge over Champions Creek, over 800 metres north	Slender Screw Fern (*Lindsaea incisa*) (on access trail from Bostock Road), not on the site, potential Emu
Site 8	Partially treed (Low)	Elements of Swamp Sclerophyll Forest (TSC Act) (Regeneration in the north east site boundary)	Absent	Scattered low number of hollow-bearing trees, potential roosting habitat for microbats	No	*Angophora robur* occurs along access track to this site and would be impacted by the construction corridor in this location. potential Slender Screw Fern (*Lindsaea incisa*) habitat (outside the north eastern site boundary) and off-site, potential Emu habitat

Site	Vegetation cover (condition)	Threatened ecological communities	Aquatic and wetland habitats	Fauna habitat resources	Fauna connectivity structures near site	Threatened species confirmed
Site 9	Scattered light tree cover on edges (Modified long history of grazing)	Elements of Swamp Sclerophyll Forest (TSC Act) (in adjacent areas)	Farm dam and adjoining drainage line	Scattered low number of Koala feed trees, which are abundant in adjoining areas off-site	No	Koala scats located under one tree at northwest corner, shows evidence of past use. Sandstone Rough-barked Apple (*Angophora robur*) *Maundia triglochinoides* (in adjacent areas). Potential Emu habitat
Section 4						
Site 4a, 4b & 4c	Scattered light cover (4a,4c), cleared (4b) (Low)	Absent	Absent	Two dead stags (potential hollows) and timber logs.	No	Absent, potential Emu habitat
Site 5	Cleared (Low)	Absent	Absent	Absent	No	Absent, no threatened flora present
Site 7a	Light tree cover (Low)	Absent	Artificial drainage channels	Absent	No	Absent
Section 5						
Site 1	Light tree cover (Low)	Elements of Swamp Sclerophyll Forest (TSC Act) (low condition)	Absent	Scattered low number of trees, no hollows	No	Absent
Site 6	Partial tree cover (6,6a,6b) dense tree cover (6c) (Low grazed paddock, regenerating swamp forest community)	Disturbed and scattered elements of Swamp Sclerophyll Forest (TSC Act) (regenerating and adjoining to the west, off-site)	Artificial and remnant drainage channel. Disturbed riparian vegetation	Very low number of Koala feed tree species. Potential Koala habitat based on the presence of Grey Gum (*E.propinqua*) and Tallowwood (*E.microcorys*) Large dead stag and hollow-bearing tree on edge of site Threatened fauna habitat: potential Koala and owls.	No	Koala (scats) found on site 6 along the western boundary, very limited resources for this species on site. Search of the adjoining Mororo Nature Reserve regular use by koalas and low abundance of Swamp Mahogany. Site habitat value low for Koala. Also potential for Grey-headed Flying-fox (nectar resources)

Site	Vegetation cover (condition)	Threatened ecological communities	Aquatic and wetland habitats	Fauna habitat resources	Fauna connectivity structures near site	Threatened species confirmed
Additional site 7	Dense tree cover (Moderate to high)	Absent	Absent	Low numbers of Koala feed tree species. Potential Koala habitat based on the presence of Grey Gum. No evidence of koalas. Mature trees and dense canopy presence, some hollow-bearing trees, food and shelter resources	No	None, potential Koala, Squirrel Glider
Additional site 8	Partial dense cover and partial cleared (Moderate)	Absent	Absent	Foraging, shelter resources, moderate structural complexity.	No	No, potential Koala, Squirrel Glider
Additional site 9	Partially cleared with vegetated creek line at southern end (Moderate in riparian areas, low in cleared areas)	Swamp Sclerophyll Forest along Mororo Creek	Mororo Creek, habitat assessment conducted and not suitable for Oxleyan Pygmy Perch	Aquatic habitat, deep pools suited to common fish and frogs, reptiles. Riparian corridor may be used by range of fauna. Lack of large or hollow-bearing trees.	No, small incidental structure, low fill height	No, potential for Koala, Squirrel Glider
Section 6						
Site 3a & 3b	Lightly treed (3a), heavily treed areas to be cleared for future works (3b) in project corridor (Low)	Subtropical Floodplain Forest (TSC Act) (intact and regenerating)	Ephemeral depression	Multiple hollow-bearing trees and dead stags Threatened fauna habitat: potential Koala, Masked Owl, Powerful Owl, Spotted Quoll, Brush-tailed Phascogale, gliders and microbats	No	Absent, however potential roosting/nesting habitat for hollow-dependent species
Section 7						
Site 3	Scattered light cover (Low)	Absent	Wetland (adjoining site in the north east), disturbed habitat with value for frogs and birds	Threatened and migratory bird habitat (north east) Koala primary food trees	No	Absent, potential Wallum Froglet, Koala

Site	Vegetation cover (condition)	Threatened ecological communities	Aquatic and wetland habitats	Fauna habitat resources	Fauna connectivity structures near site	Threatened species confirmed
Site 4	Scattered light cover (Low)	Elements of Swamp Sclerophyll Forest (TSC Act) (regenerating and intact on edges)	Ephemeral swamp in adjoining land	Limited to low density of trees with seasonal nectar resources	No	Absent, potential foraging habitat for Grey-headed Flying-Fox, Swift Parrot, Little Lorikeet
Section 8						
Site 2a,2b & 2c	Some lightly scattered trees (Low)	Adjoins Swamp Sclerophyll Forest off-site, very small portion occurs on site	Site 2a: Drainage channel. Site 2b: drainage line. Absent from 2c	Mostly absent, some low-lying wet areas may be used by frogs and birds.	No	Absent
Site 3	Cleared (Low)	Absent	Absent	Low density of logs present from previously clearing	No	Absent, Oxleyan Pygmy Perch known from creek to the south about 75 metres
Section 9						
Site 1	Heavy vegetation cover on eastern and western edges (Low to Moderate)	Remnant patches of Subtropical Coastal Floodplain Forest (TSC Act) (Intact at north east)	Man-made ponds and drainage channels	Ground logs and artificial material. Small dead stags. Koala food tree species present in northeast corner, no evidence of koalas.	Bridge over MacDonald's Creek 50 metres south of site	Wallum Froglet present in cleared lands, potential Koala foraging, and roosting/nesting habitat for hollow-dependent species.
Site 2	Some lightly scattered trees (Low)	Elements of Subtropical Coastal Floodplain Forest (TSC Act) (regenerating)	Wet ephemeral depressions, potential for Wallum Froglet	Wet ephemeral depressions suited to some frogs and bird species. Site	Bridge over MacDonald's Creek at the southern end of the site	Absent, potential Wallum Froglet
Site 3	Some lightly scattered trees (Low)	Absent on the site, small fragments of Swamp Oak EEC adjoining sites to west and south	Farm dam (offsite). A class 2 waterway occurs 50 metres south of the site, drains through cleared land. Bridged	Limited to seasonal nectar resources	Bridge and waterways 50 metres south consideration for managing run-off and sediment in south end of the site	Absent

Site	Vegetation cover (condition)	Threatened ecological communities	Aquatic and wetland habitats	Fauna habitat resources	Fauna connectivity structures near site	Threatened species confirmed
Section 10						
Site 1b	Some lightly scattered trees (Low)	Absent	Brackish drainage channel, low value	One fallen log, very limited resources	Adjacent to Richmond River bridge, potential for revegetation of this site to improve connectivity	Absent, not expected
Site 3a, & 3b	Some scattered trees (Low)	Absent	Small farm dam	Scattered low number of Koala feed trees	Viaduct 200 metres south, no issues at the site	Absent, some potential for Koala to occur as part of larger known populations in this area, although insufficient resources to sustain home range
Site 4	Cleared (Low)	Absent	Narrow creek lines	Limited to disturbed creek, potential for common frogs	Site lies adjacent to the proposed land bridge at station 156.1	Hairy Joint Grass (*Arthraxon hispidus*) confirmed
Site 5	Some scattered trees (Low)	Absent on the site but Lowland Rainforest occur in adjacent forest	Absent	Rocky habitats, scattered low number of trees, seasonal nectar resources (wide-ranging nectar feeding species)	No	Absent from the site, potential habitat for the Pink Underwing Moth occurs in adjacent habitats to the west and south.
Site 6	Some scattered trees (Low)	Two patches of Lowland Rainforest present and continues off-site to the west	Absent	Limited to scattered low number of trees, potential food resource (wide-ranging nectar feeding species)	No	Hairy Joint Grass (*Arthraxon hispidus*) confirmed over southern half of the property

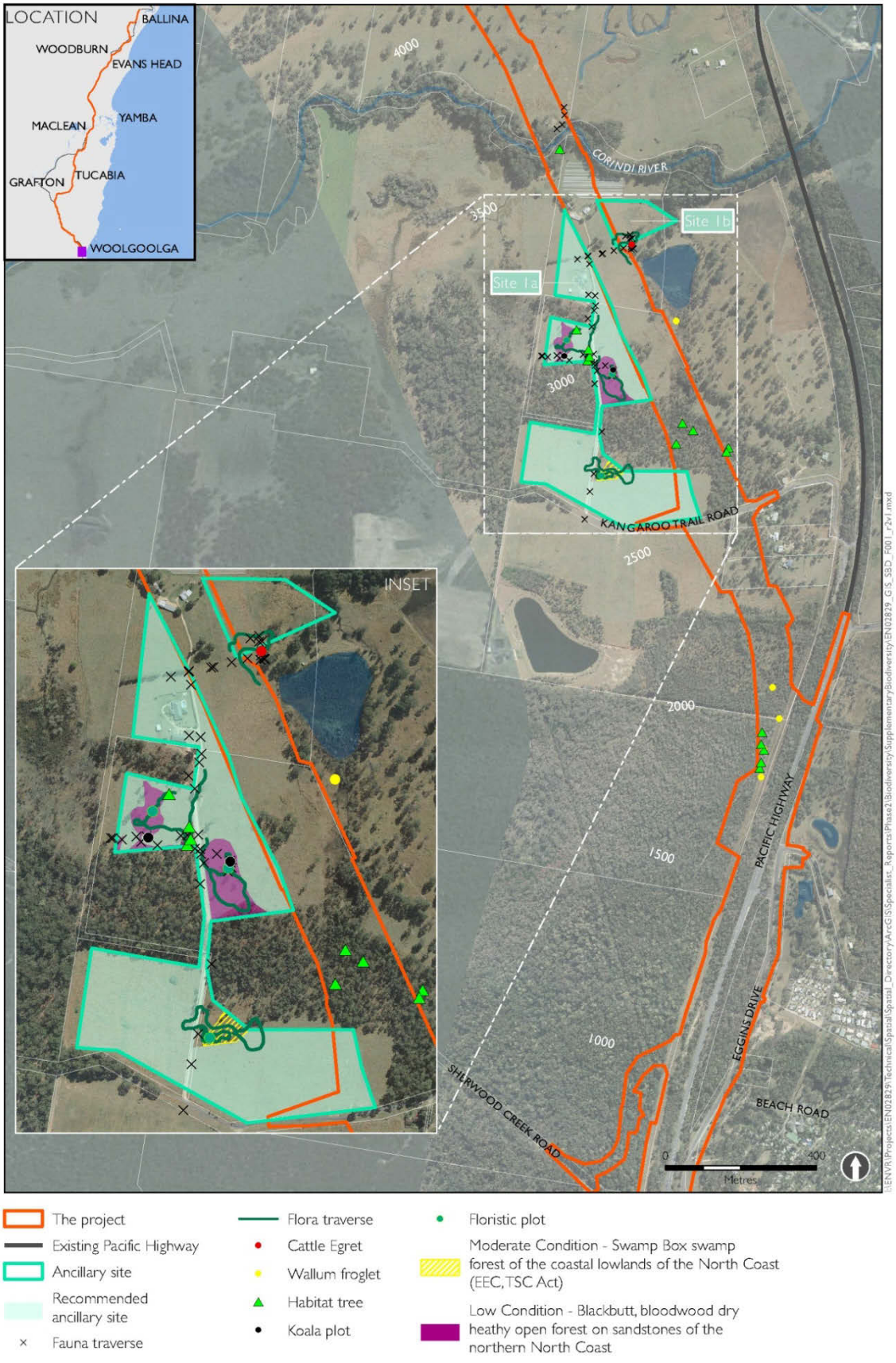

Figure 2-1 Ecological surveys and values (Section 1, Site 1a and 1b)

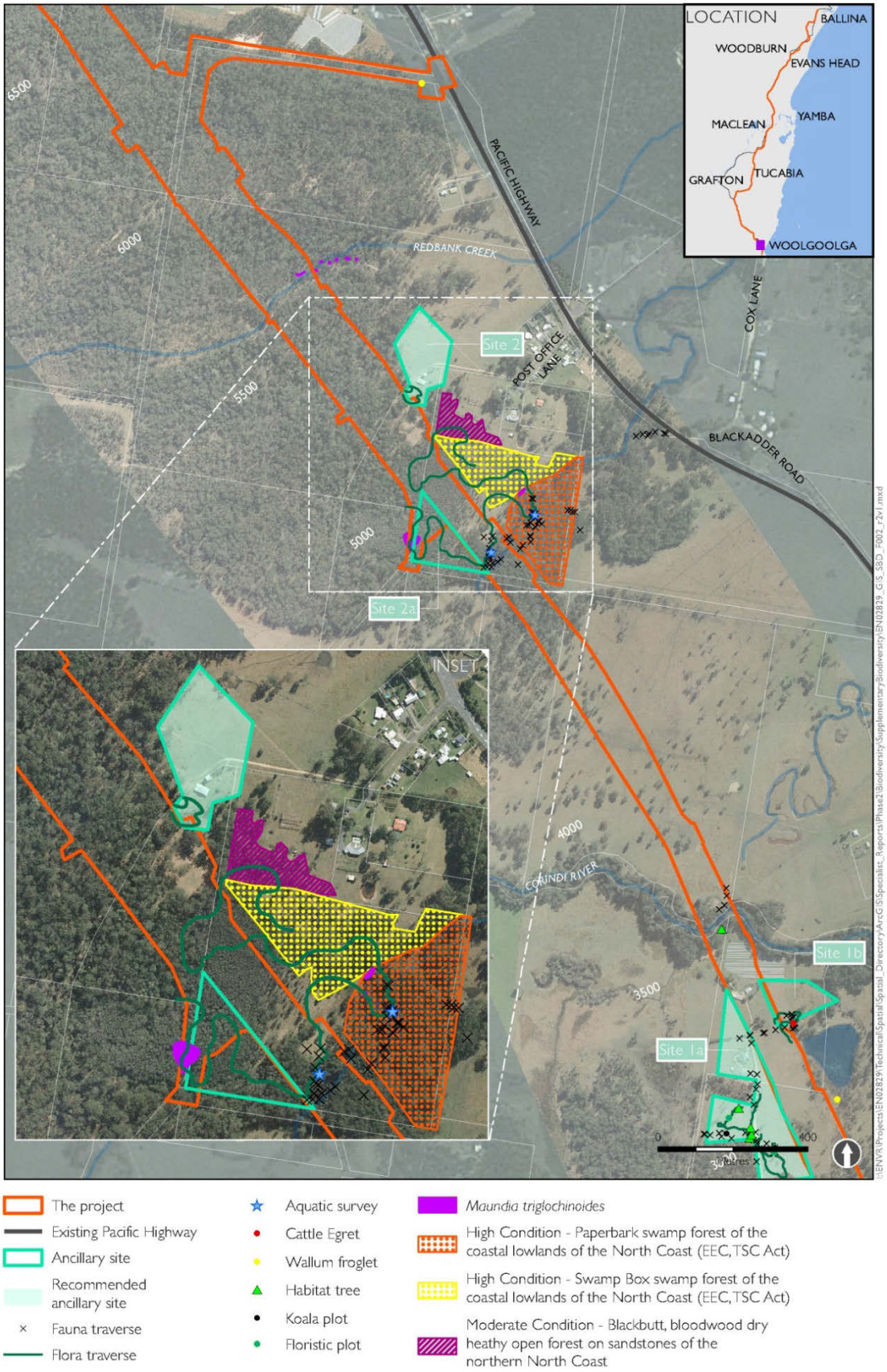

Figure 2-2 Ecological surveys and values (Section 1, Site 2a)

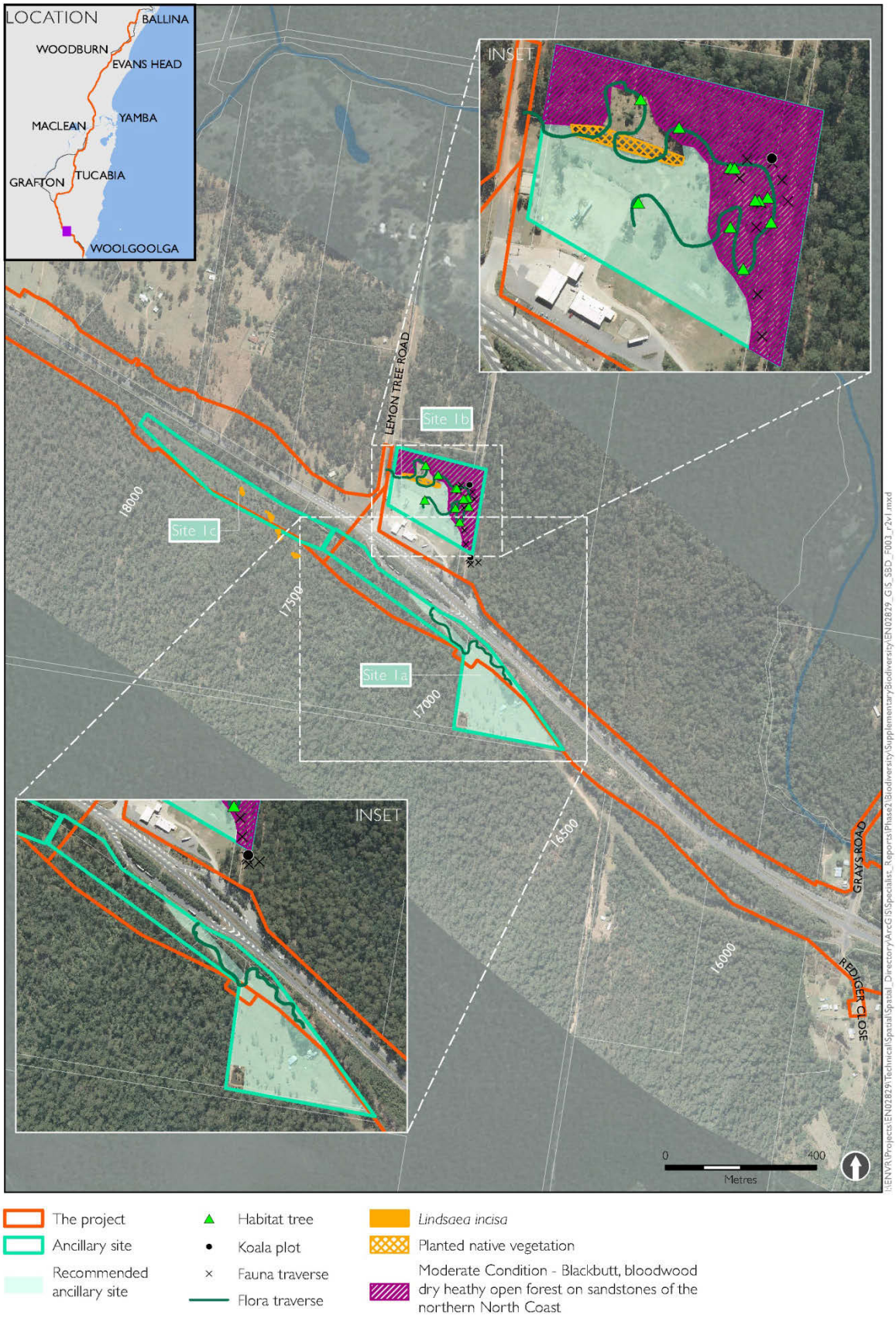

Figure 2-3 Ecological surveys and values (Section 2, Site 1a & 1b)

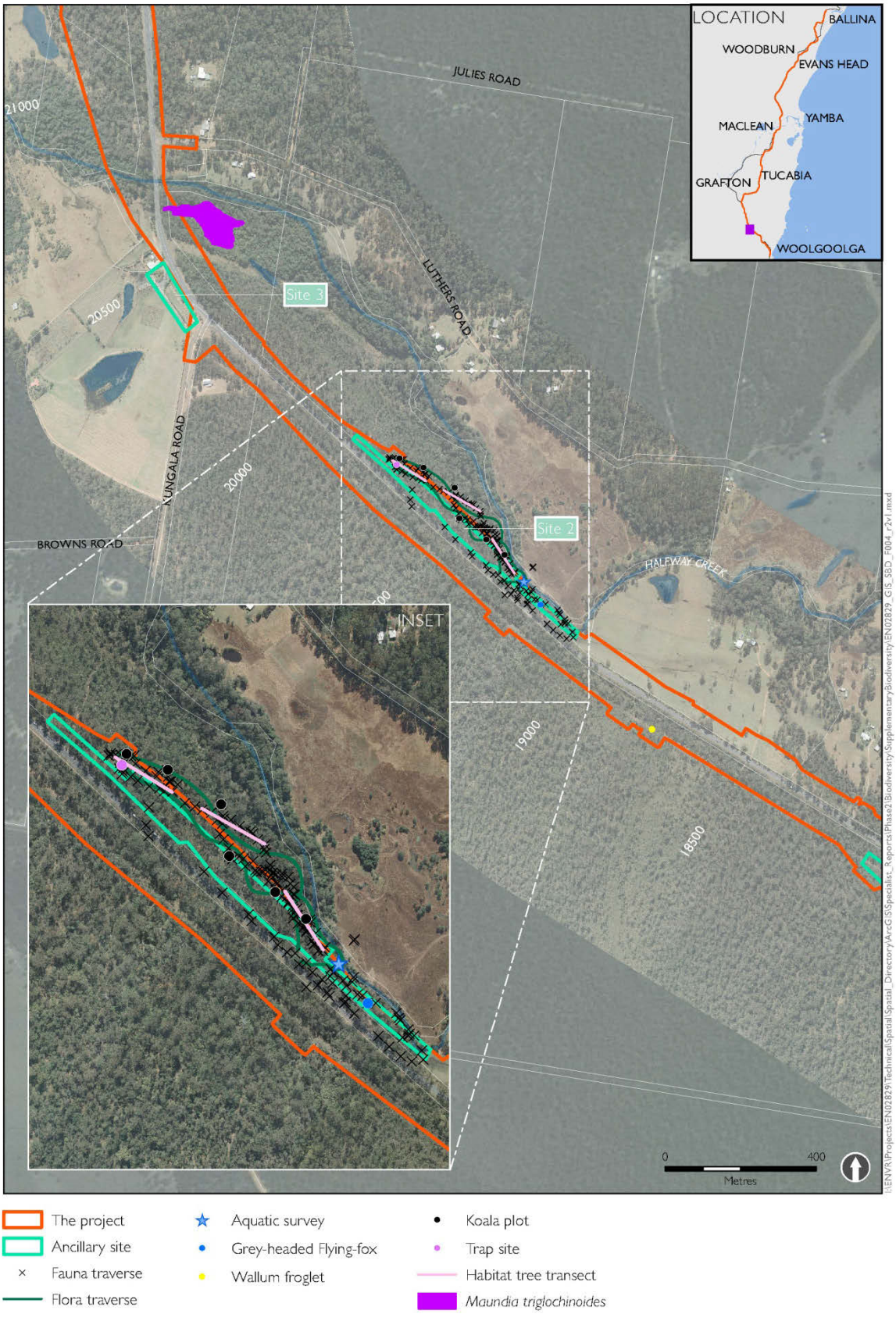

Figure 2-4 Ecological surveys and values (Section 2, Site 2)

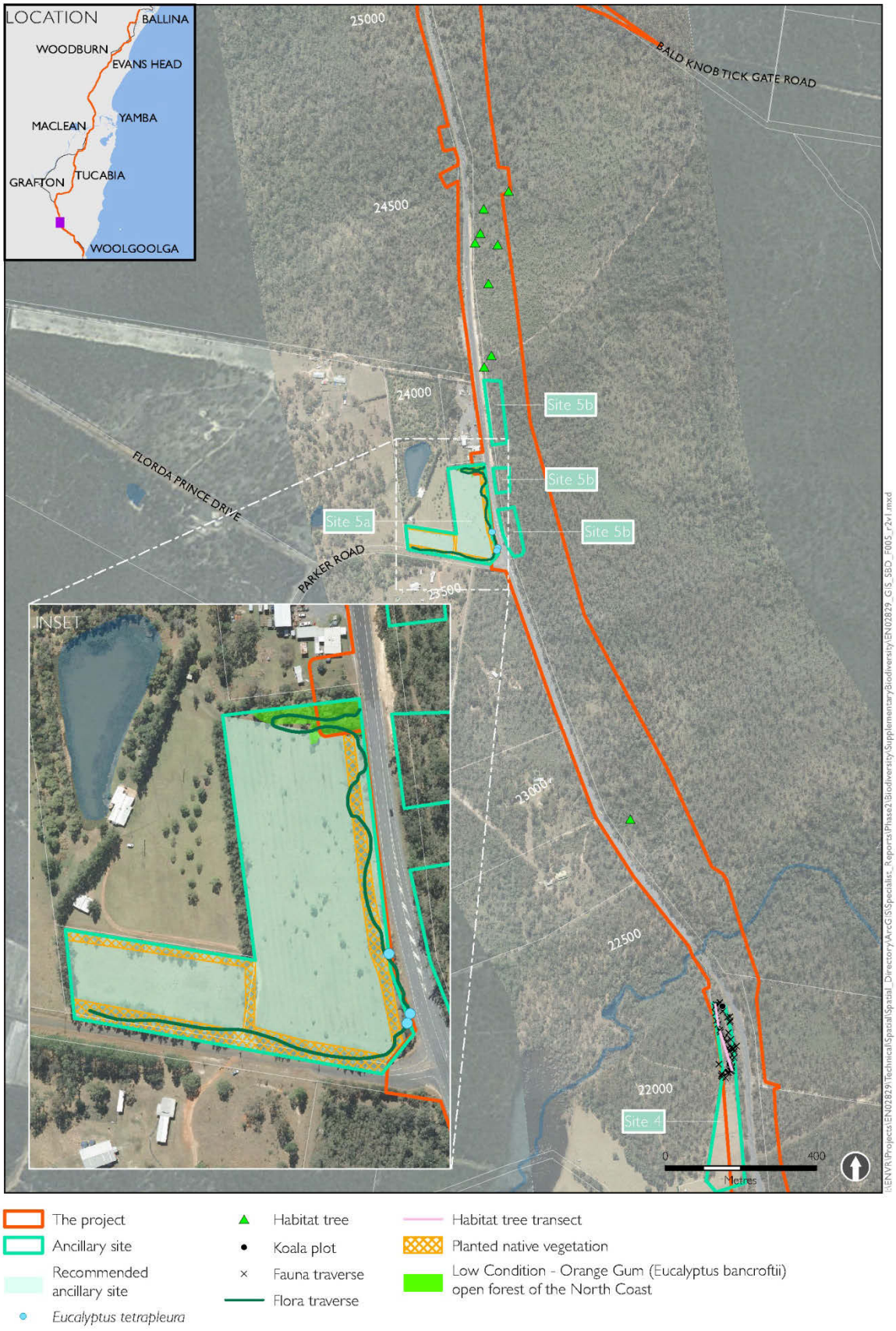

Figure 2-5 Ecological surveys and values (Section 2, Site 5a)

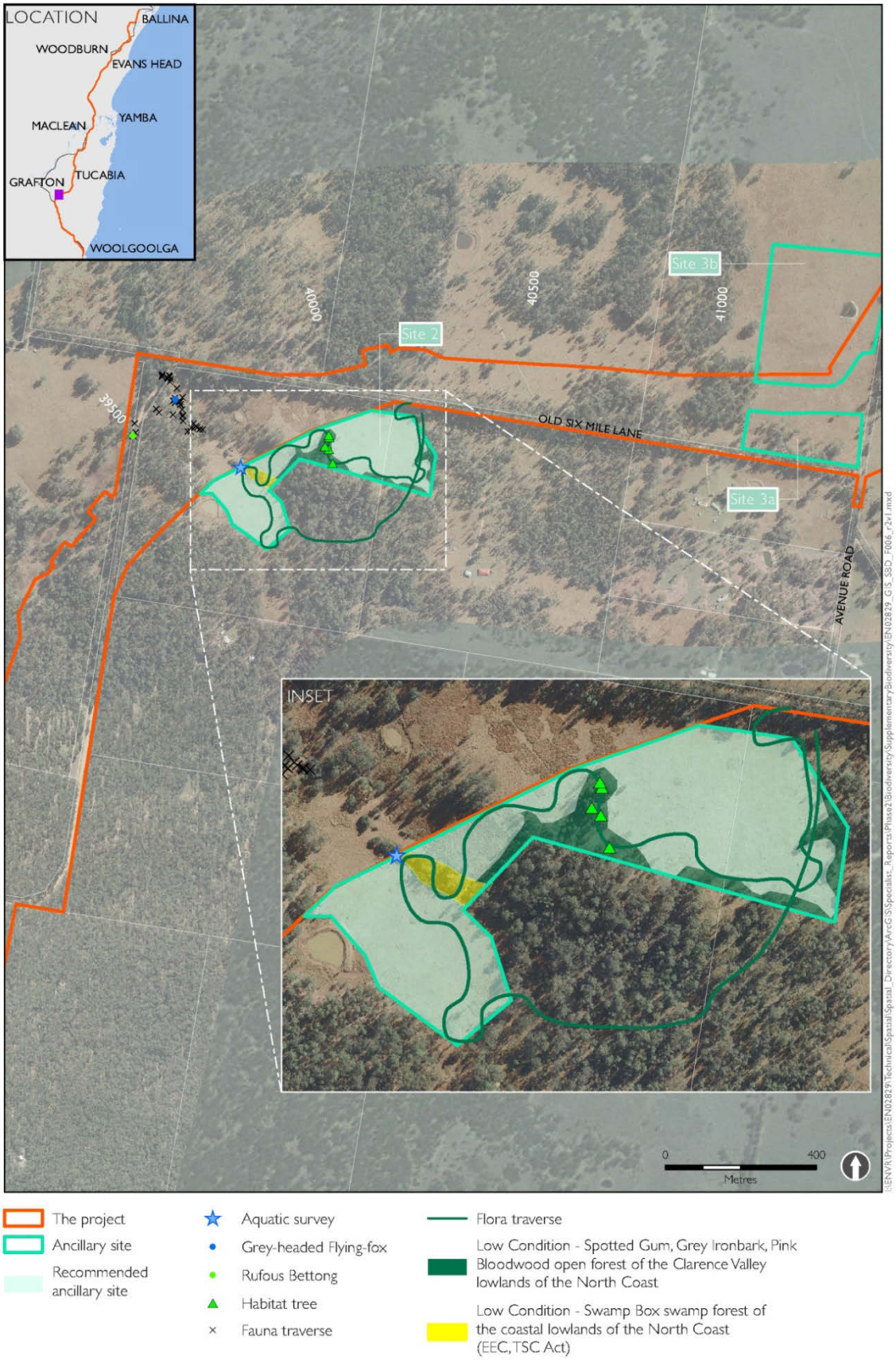

Figure 2-6 Ecological surveys and values (Section 3, Site 2)

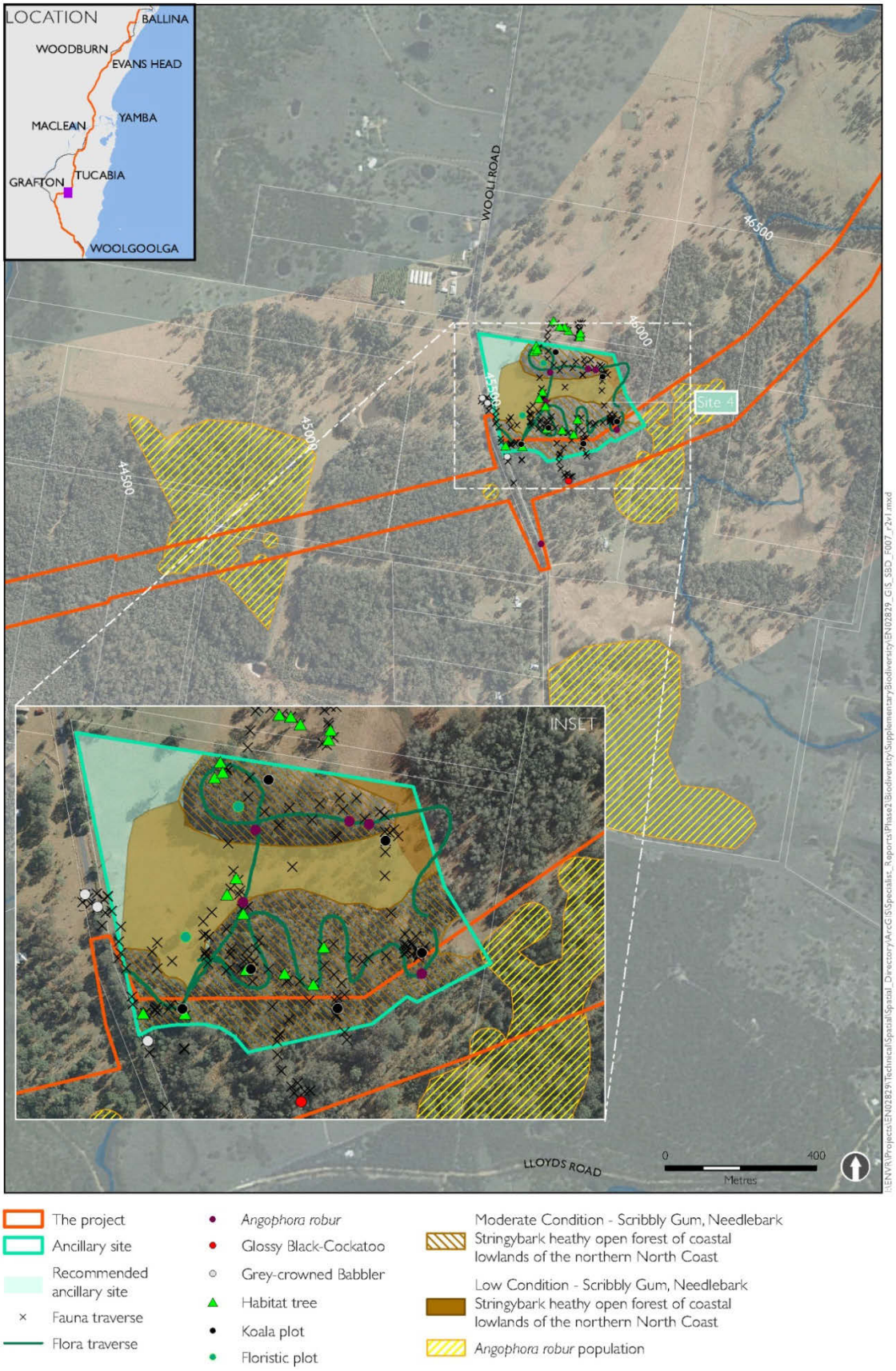

Figure 2-7 Ecological surveys and values (Section 3, Site 4)

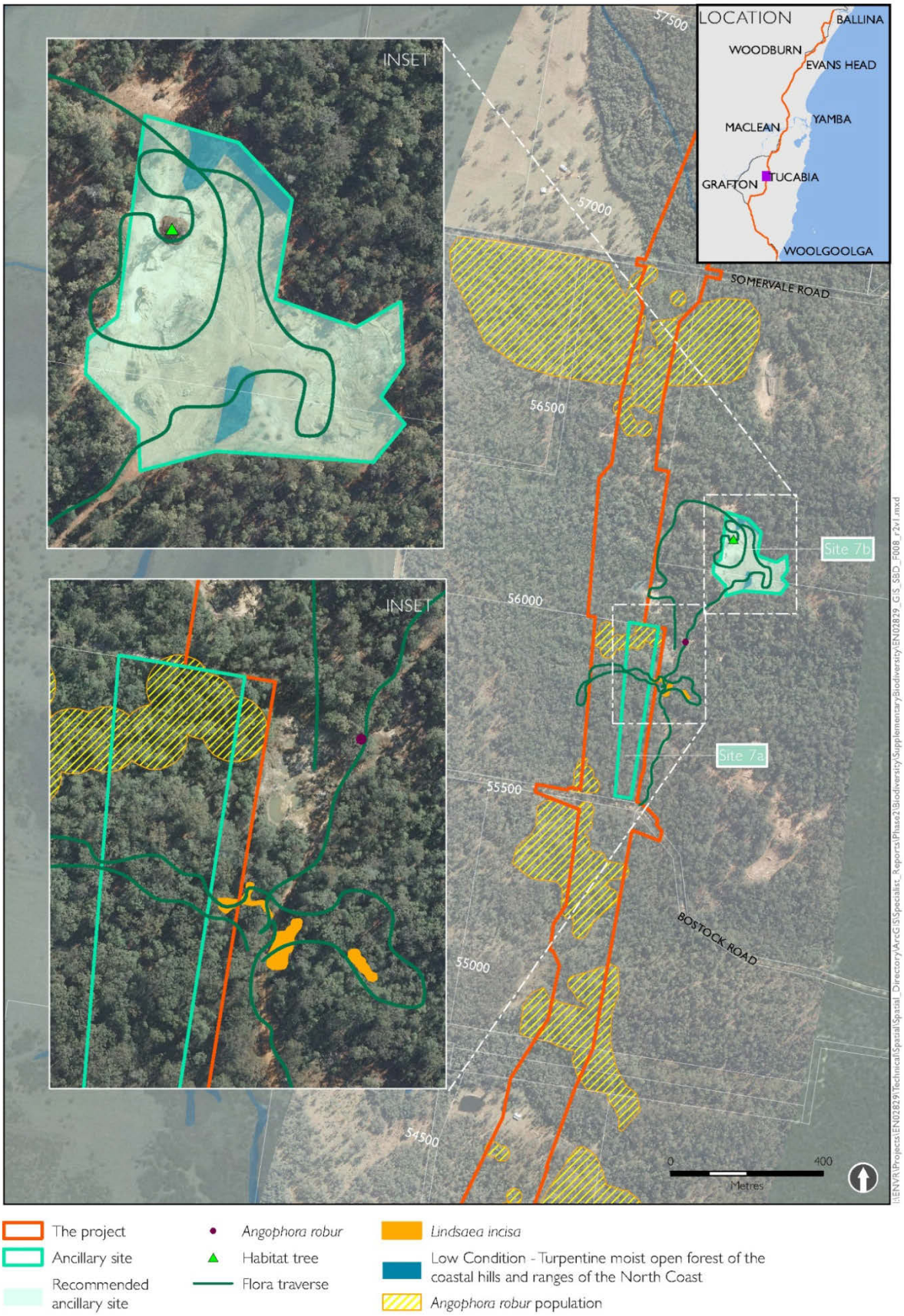

Figure 2-8 Ecological surveys and values (Section 3, Site 7b)

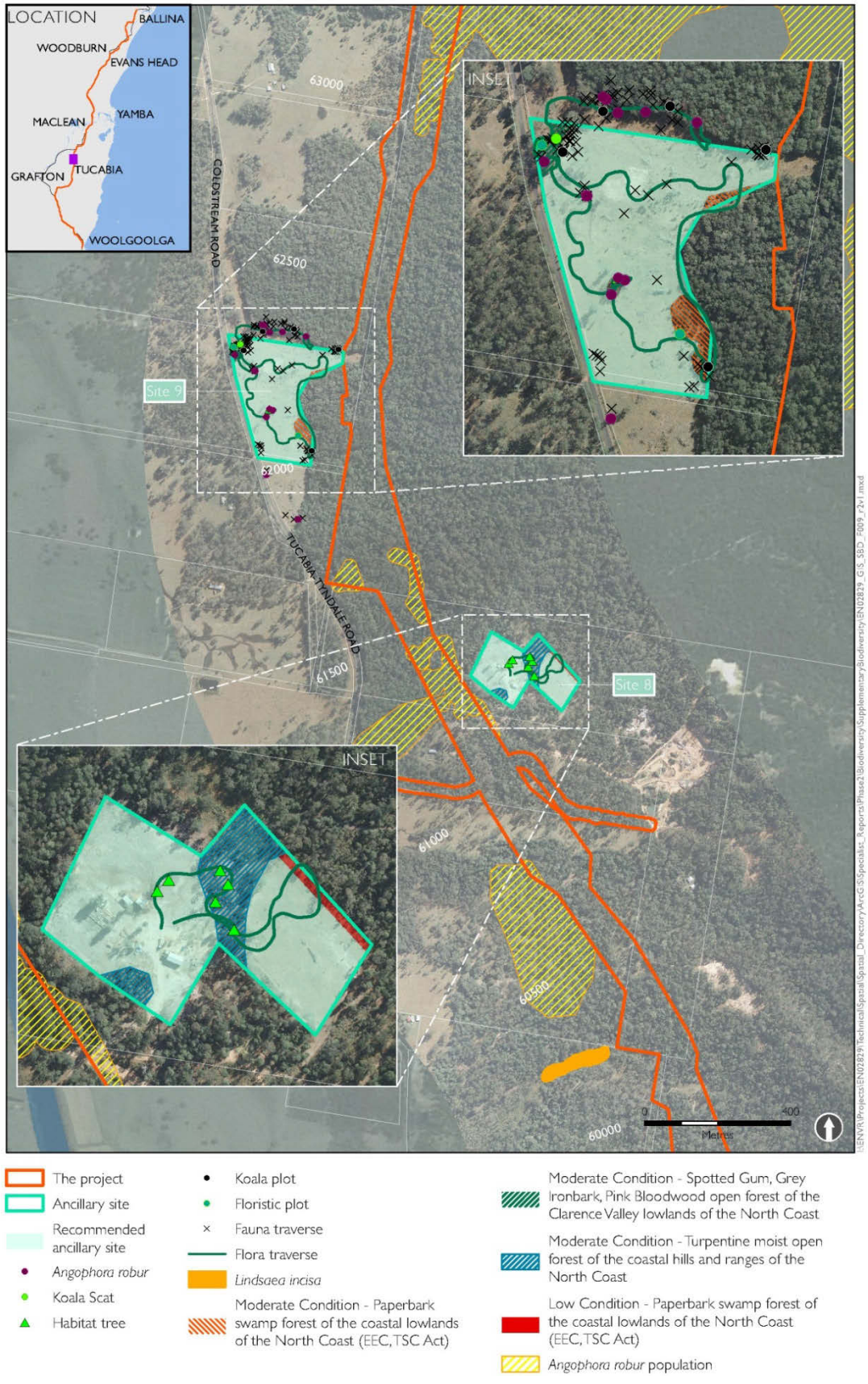

Figure 2-9 Ecological surveys and values (Section 3, Site 8 and Site 9)

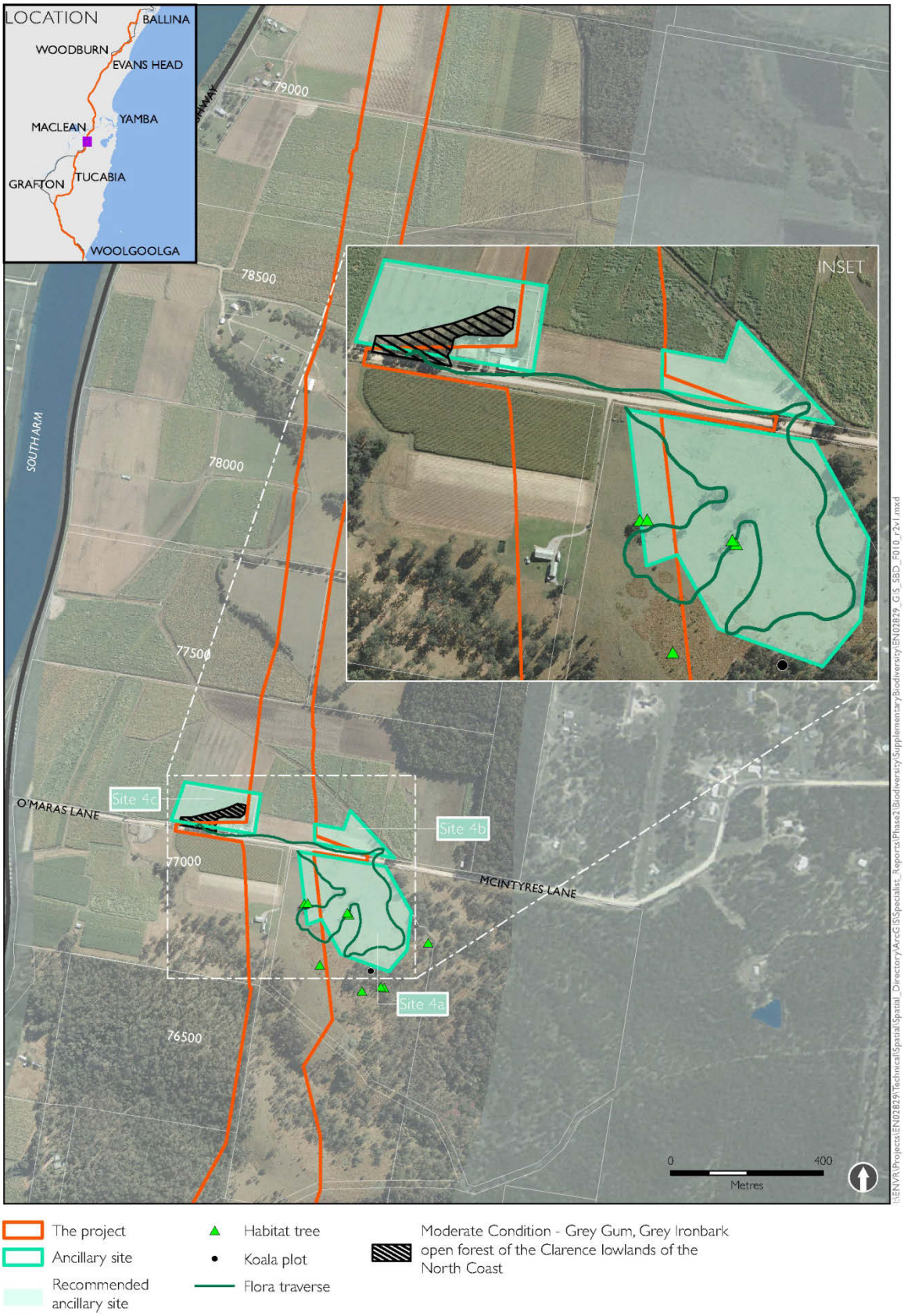

Figure 2-10 Ecological surveys and values (Section 4, Site 4a, 4b & 4c)

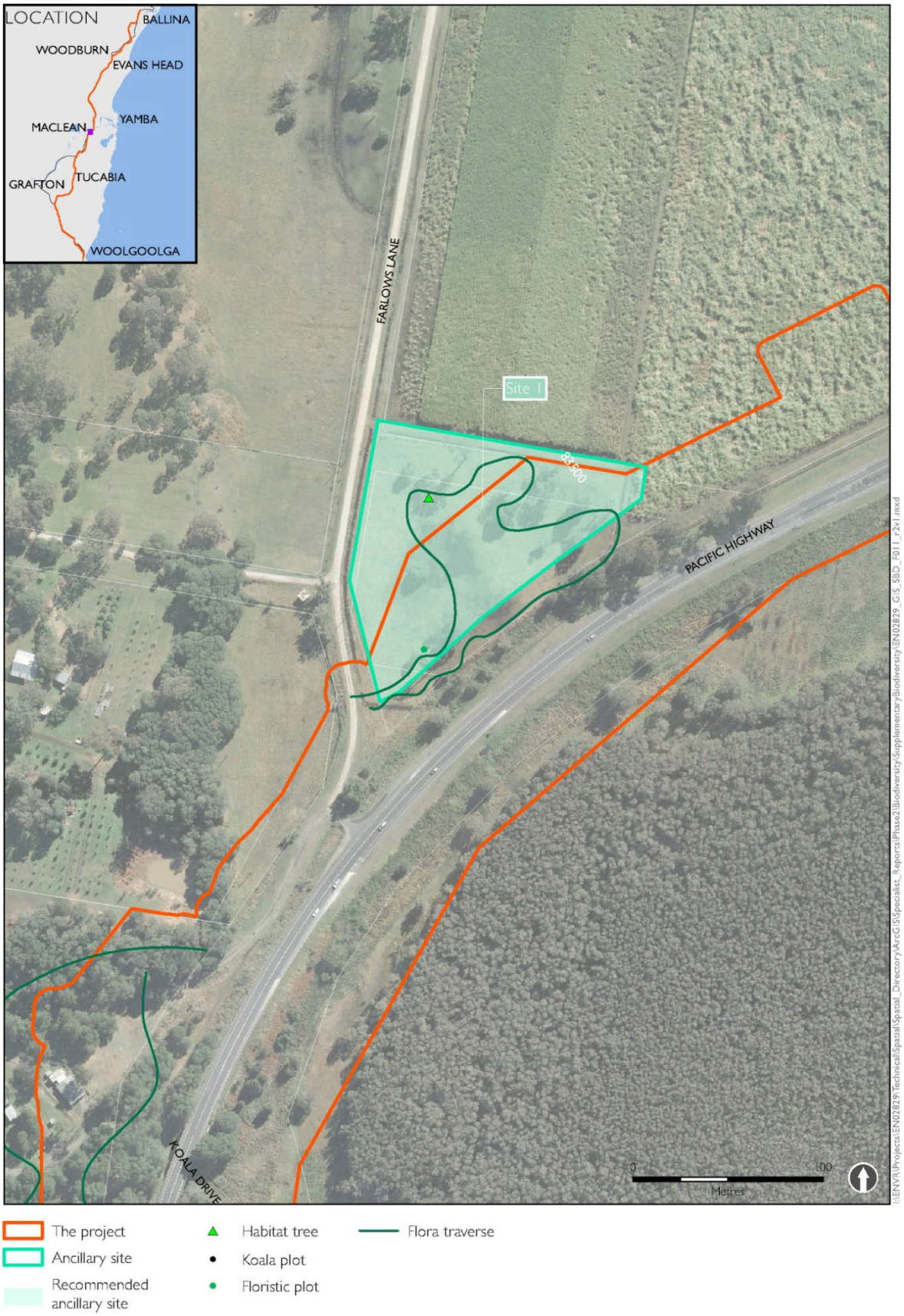

Figure 2-11 Ecological surveys and values (Section 5, Site 1)

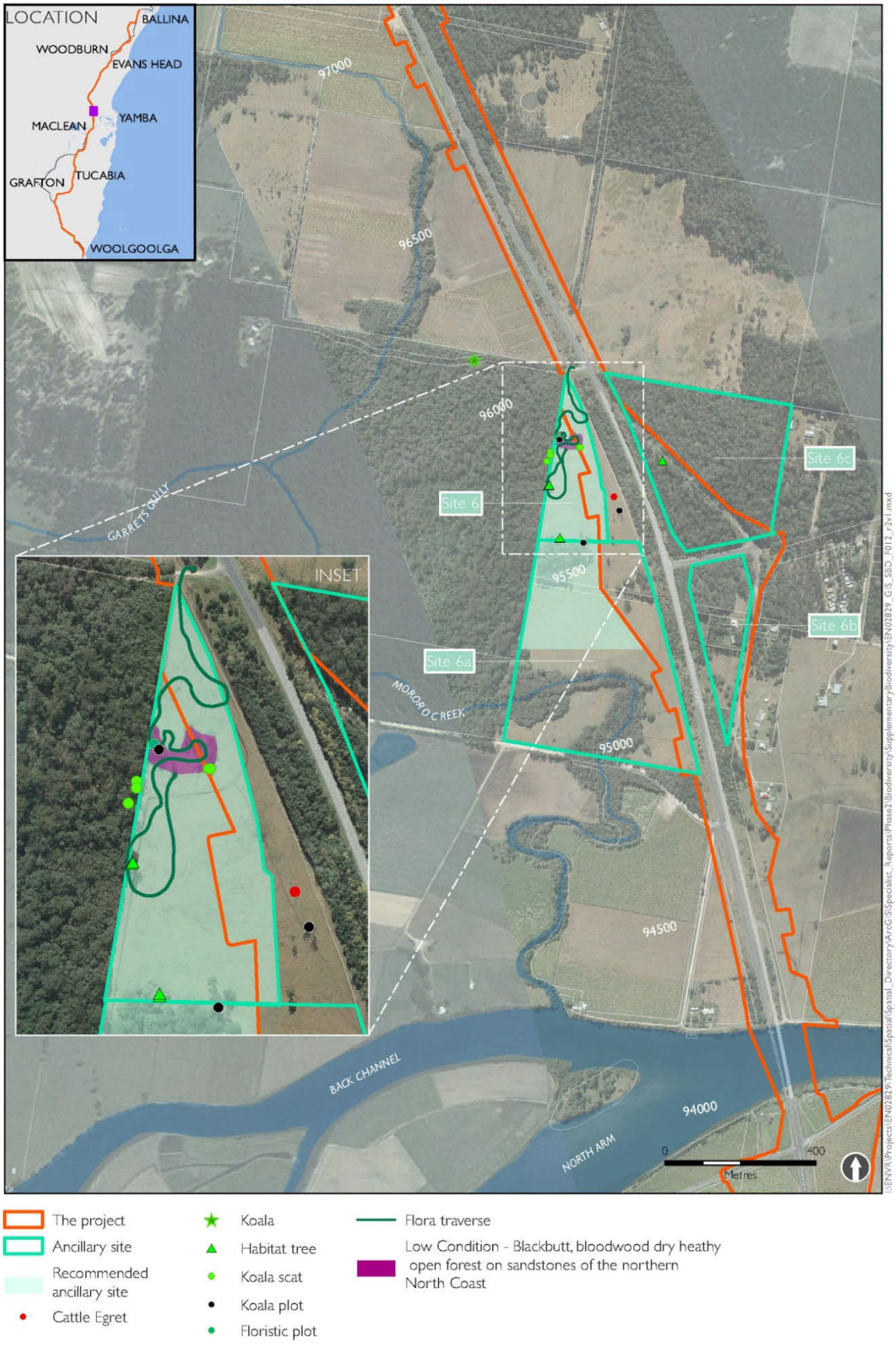

Figure 2-12 Ecological surveys and values (Section 5, Site 6, Additional Site 7, 8 and 9)

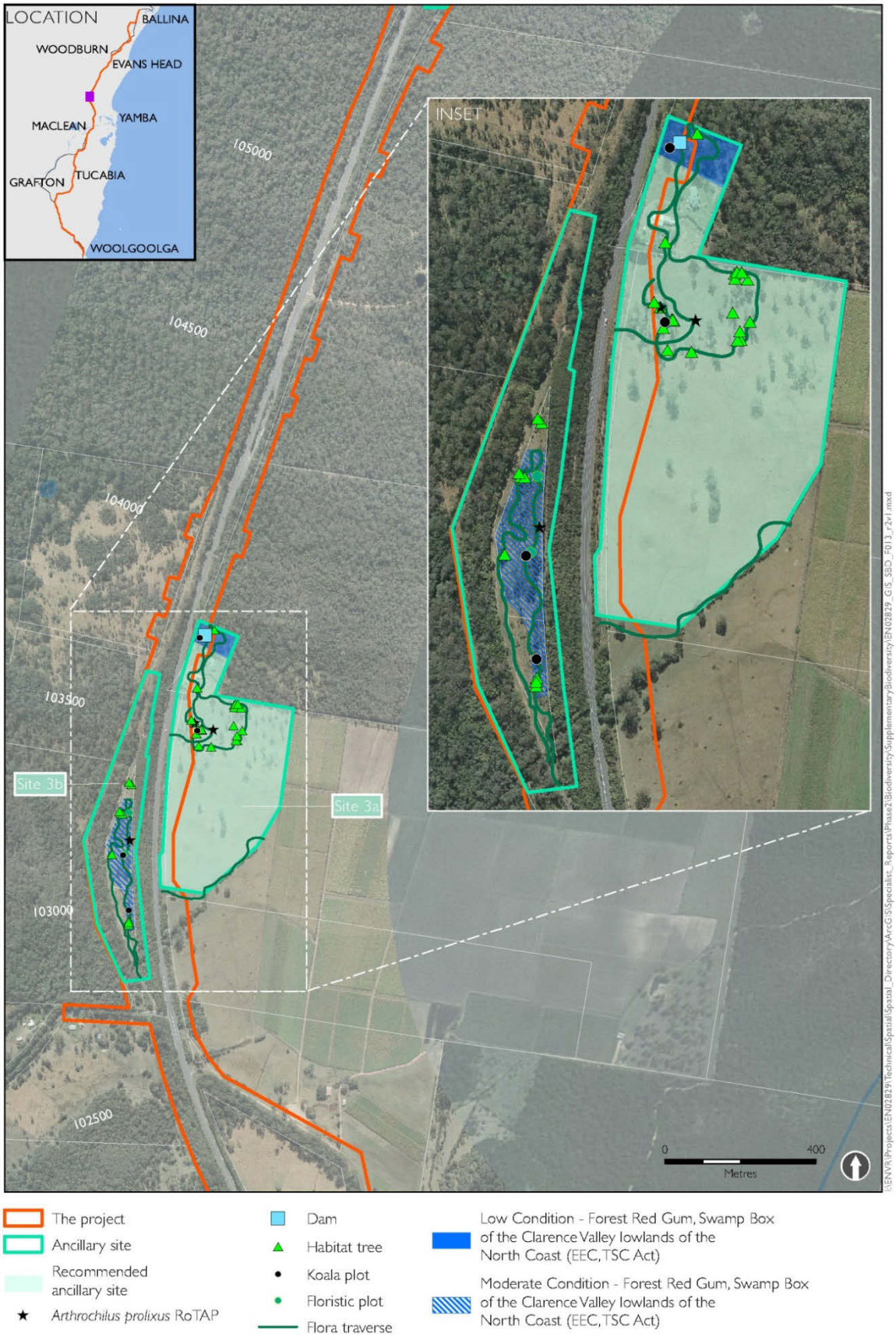

Figure 2-13 Ecological surveys and values (Section 6, Site 3a and 3b)

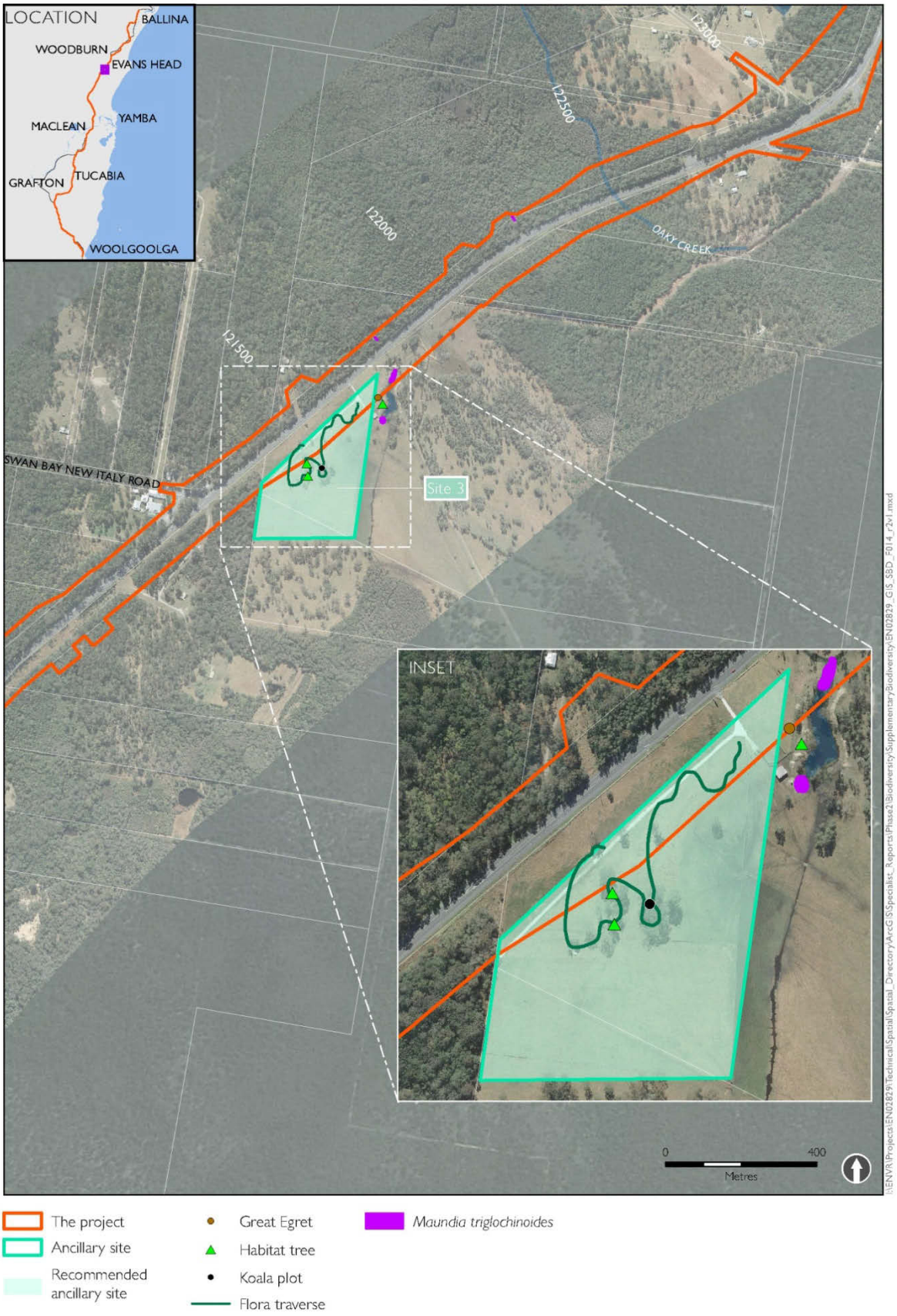

Figure 2-14 Ecological surveys and values (Section 7, Site 3)

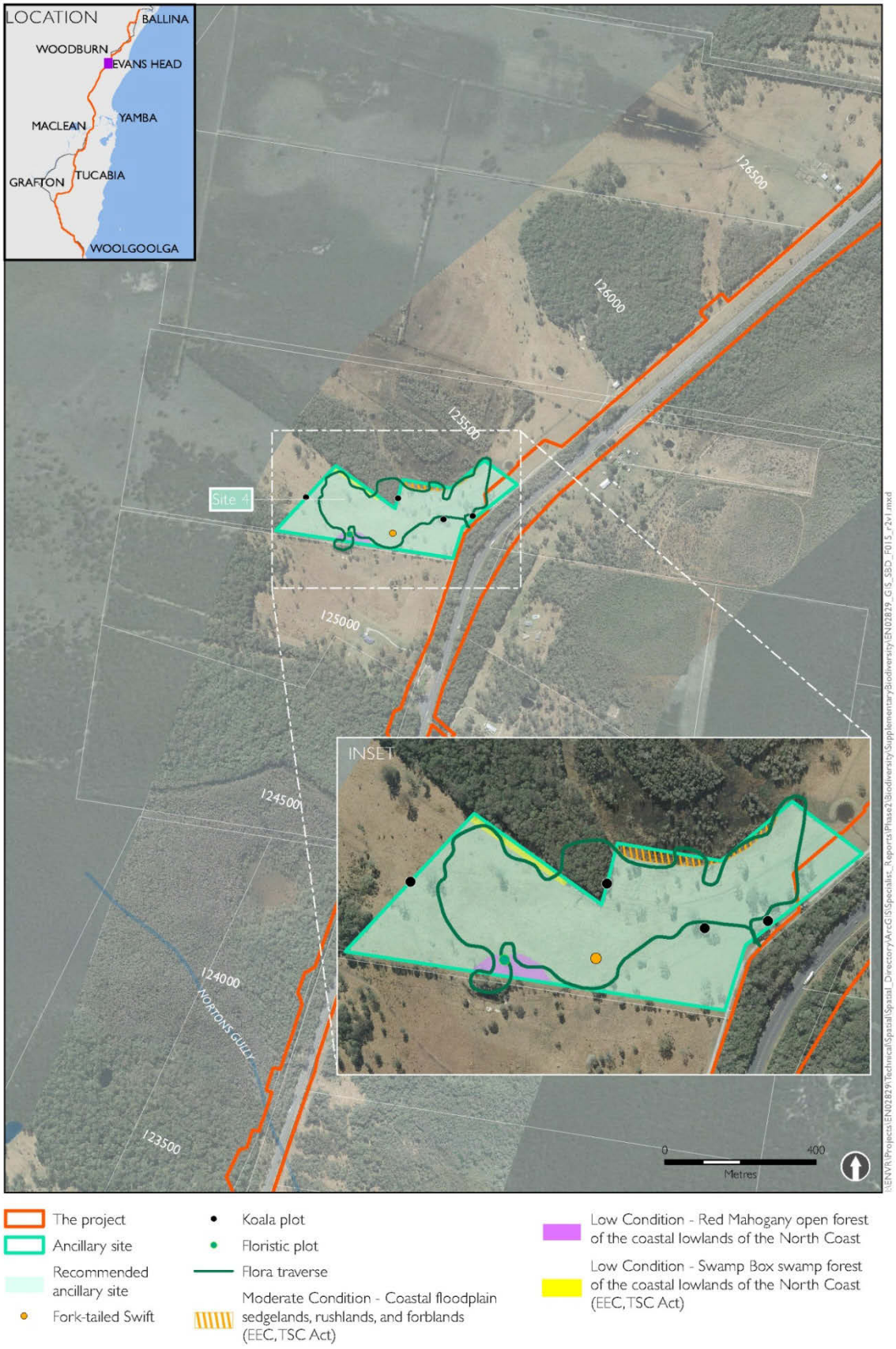

Figure 2-15 Ecological surveys and values (Section 7, Site 4)

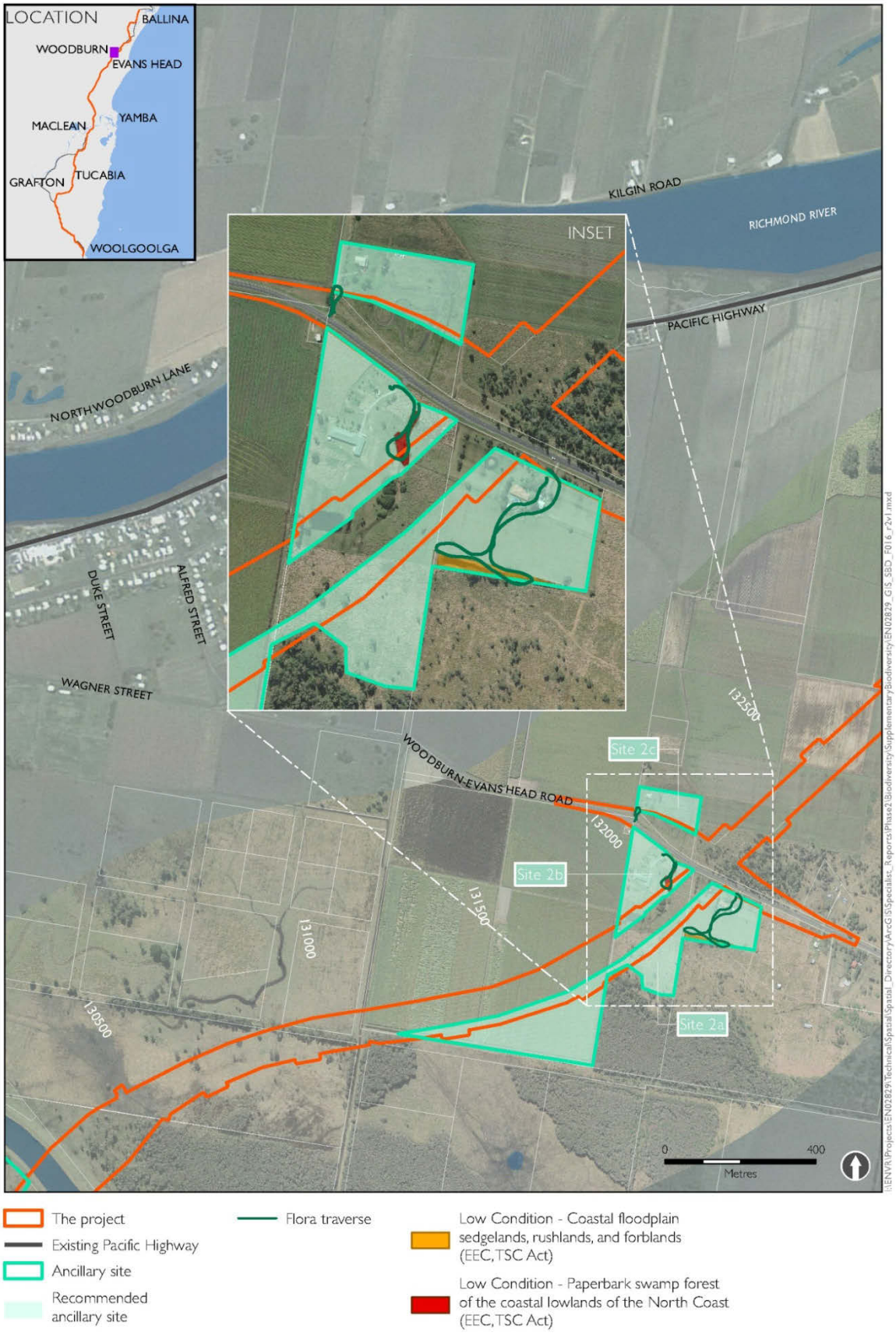

Figure 2-16 Ecological surveys and values (Section 8, Site 2a, 2b and 2c)

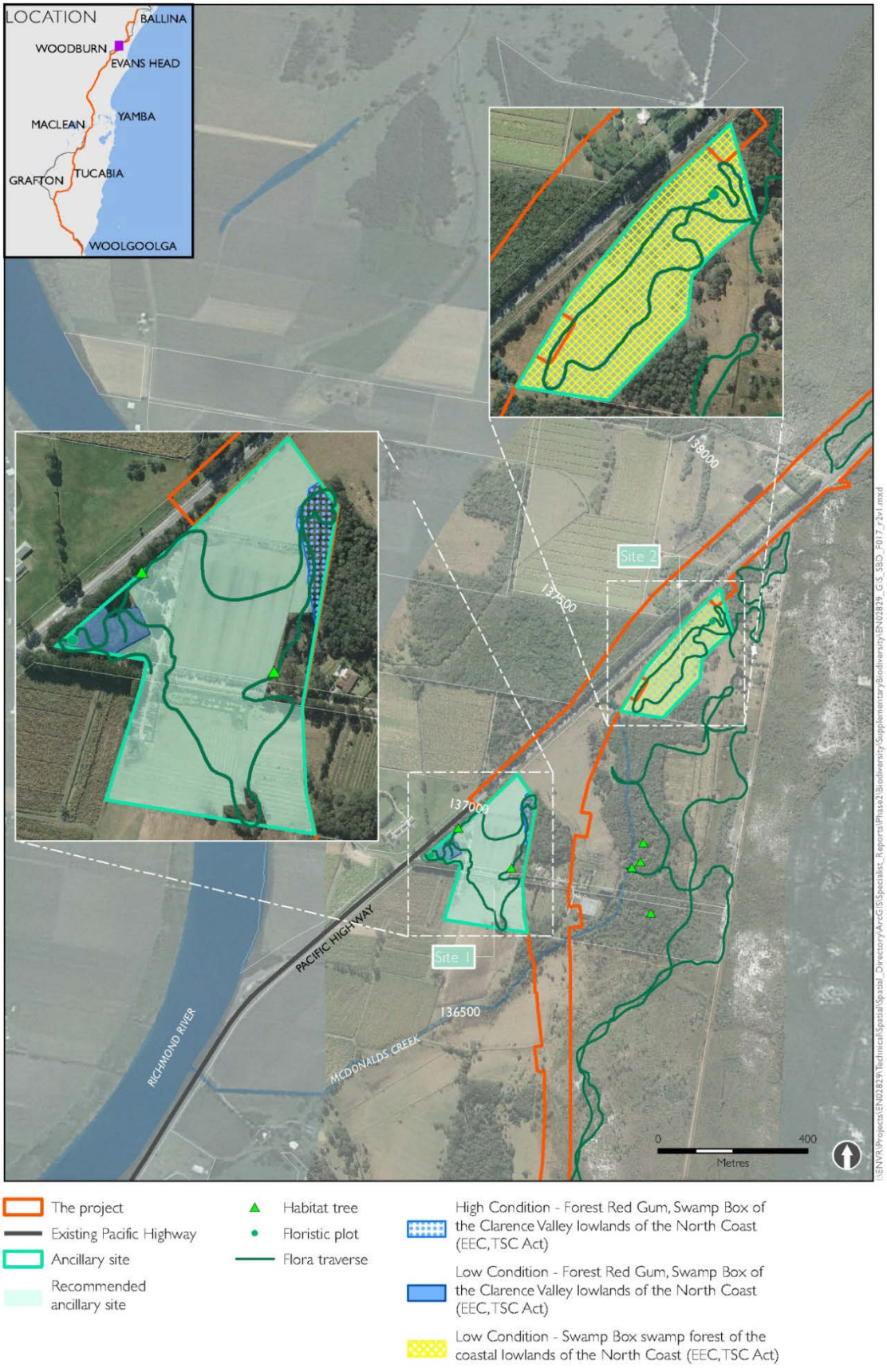

Figure 2-17 Ecological surveys and values (Section 9, Site 1 and Site 2)

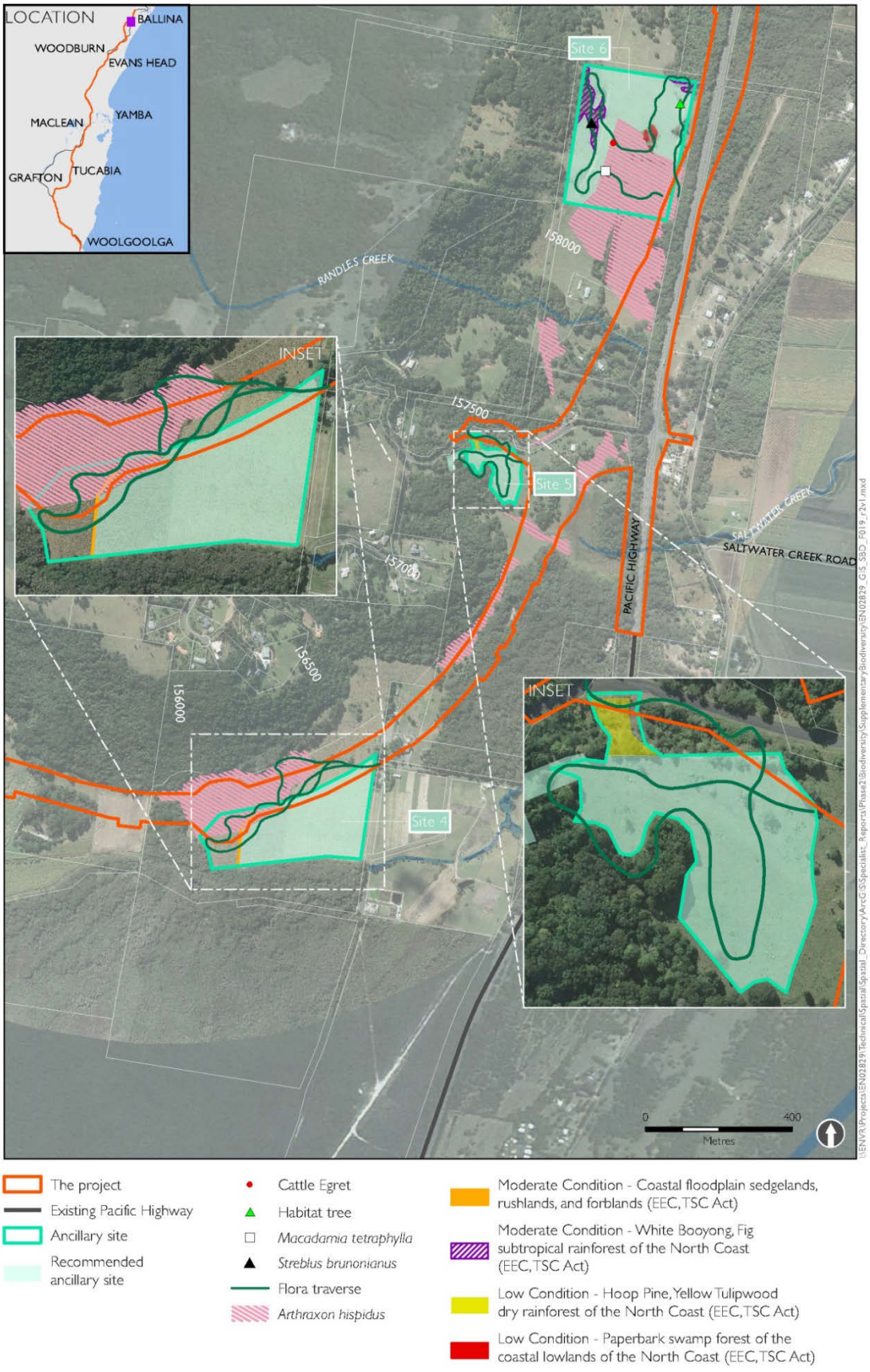

Figure 2-18 Ecological surveys and values (Section 10, Site 4 and Site 5)

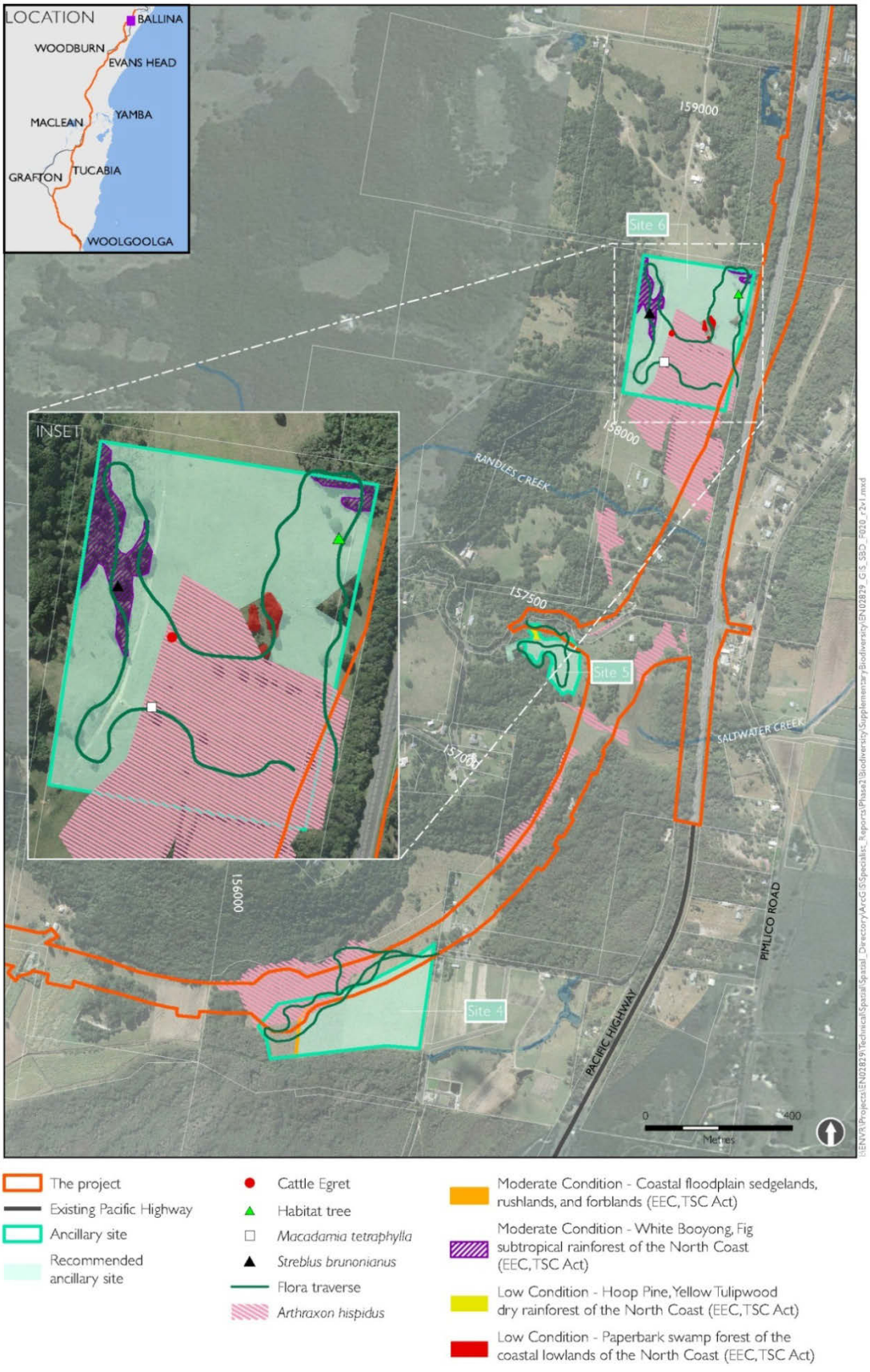

Figure 2-19 Ecological surveys and values (Section 10, Site 6)

2.4. Unsuitable sites to be avoided

Recommendations for all ancillary facility sites have been included in the Submissions / Preferred Infrastructure Report. These include either avoiding use of the ancillary facility site or additional management measures to guide the use of the site and protect environmental values on the site (refer to Chapter 3 of the Submissions / Preferred Infrastructure Report).

There are a number of sites that contain remnant vegetation over the entire site and are suitable for threatened species, or are constrained by the presence of both TECs and threatened species and therefore are unsuitable. These are:

- Section 1: Site 1b and Additional site 5.
- Section 2: Site 2.
- Section 5: Additional site 7 and Additional site 8.
- Section 10: Site 6

These sites containing high habitat values would not be used as ancillary facility sites. Specific recommendations for the other sites where important values were noted have been identified throughout the tables in the following sections.

2.5. Direct and indirect impacts

The selection of all ancillary facility sites using the desktop review aimed to avoid where possible biodiversity values, in particular the need for further loss of vegetation. Ancillary facility sites have also been sited with good access to the project corridor or local roads to minimise additional impacts on biodiversity through the need to construct access roads. In particular sites were located to avoid any further impacts on threatened species, ecologically valuable features for threatened species, remnant threatened ecological communities and wildlife corridors.

The focus of the field investigations undertaken for this assessment was to identify where ecologically important features were present and provide recommendations on the suitability of these sites for housing ancillary facilities.

2.5.1. Threatened ecological communities

The majority of the sites investigated contain cleared pasture or cropping land with occasional isolated remnant trees or small areas of vegetation regrowth. Some sites that have had low use in the recent past (such as light grazing) show early stages of natural regeneration of native plant species once grazing has been discontinued. This includes recent regrowth of vegetation showing elements of former threatened ecological communities, in particular low-lying swamp sclerophyll forest and floodplain eucalypt forest (TSC Act). This regrowth was found to be of low condition and suppressed in native species richness due to a depleted native seed bank and was subsequently dominated by hardy and early successional pioneer plant species. These small patches of TECs are already indirectly impacted by weeds and increased exposure over long periods.

The temporary use of the site would not be expected to exacerbate these indirect impacts. Lowland Rainforest community patches were found to be present at a small number of sites and these were of low condition due to past clearing and significant changes in the structure of the community and high weed

abundance. There is scope to retain vegetation on ancillary facility sites and this would ensure minimal direct or indirect impacts on the several small patches of TECs identified.

Three ancillary facility sites in Section 10 (sites 4, 5 and 6) occur on cleared land. However, fragments of the endangered Swamp Sclerophyll Forest (TSC Act) and Lowland Rainforest (TSC act and EPBC Act) occur near the boundaries of the site. Provided there are protective buffers around these communities as is recommended, then further edge effects are not expected. The sites that contain remnant or regrowth elements of threatened ecological communities are discussed in Table 2-8.

Table 2-8 Impacts to threatened ecological communities and site-specific mitigation

Site	Direct impacts	Indirect impacts	Site specific mitigation
Section 1			
Site 1a	Predominantly cleared only very small patches of low condition regenerating and remnant elements of Subtropical Coastal Floodplain Forest (SCFF) (TSC Act). Direct clearing of vegetation not expected to be required on this site.	Unlikely, these small fragments already low condition and impacted by edge effects	Apply general biodiversity measures from EIS.
Additional site 5	High condition Swamp Sclerophyll Forest (TSC Act) dominates southern portions of the site associated with Cassons Creek. Recommend avoid use of this site.	Cleared portion of this site is upslope from the TECs and there is potential for indirect impacts from run-off from the site, sediment and potential contamination of groundwater	Site to be avoided
Section 3			
Site 2	Low quality remnant and disturbed elements of Subtropical Coastal Floodplain Forest (TSC Act) along central creek line. Some direct clearing may occur, but only minimal; as sufficiently large areas of cleared land and good access would need to keep buffer along the creek.	Indirect impacts possible given the presence of a creek running centrally through the site and steep slope of the site, potential for run-off and contamination of waterway.	Would need to buffer creek and use appropriate mitigation (sediment fencing where required). Re-vegetated this site to improve connectivity after construction
Site 4	Very small areas of low quality remnant Subtropical Coastal Floodplain Forest (TSC Act). Sufficiently large areas of cleared land available and unlikely to need clearing	No indirect impacts expected, these small fragments are already of low condition and isolated.	Apply general biodiversity measures from EIS
Site 8	Small fragmented of low quality Swamp Sclerophyll Forest (TSC Act) (Regeneration in the north east site boundary). Clearing of TEC not expected and able to be avoided	Low quality TEC partially impacted from clearing to the edges and weed invasion. Further indirect impacts not expected	Apply general biodiversity measures from EIS
Site 9	Small fragments of low quality Swamp Sclerophyll Forest (TSC Act) (in adjacent areas), not directly on site. No direct clearing required.	Existing TECs adjoining the site are edge affected due to the past clearing right up to the edges.	Mitigation possible by avoiding activities up against the forest edge and buffering the surrounding forest.
Section 5			
Site 1	Very low condition elements of Swamp Sclerophyll Forest (TSC Act), clearing not expected	Site habitat already impacted by past clearing and land use activities; further indirect impacts are not expected. Very flat land, run-off not expected and weed	Apply general biodiversity measures from EIS

Site	Direct impacts	Indirect impacts	Site specific mitigation
		abundance currently high.	
Site 6	A small patch of low condition Swamp Sclerophyll Forest (TSC Act) (regenerating and adjoining to the west, off-site into Mororo Creek nature reserve. Scattered young regrowth of Melaleuca exists across the site will be cleared or disturbed by use of the site.	Area of vegetation on the site are low condition, there is a shallow constructed drain along the western boundary and the site is very flat and densely covered in exotic grass, run-off and sediment is not expected into adjoining reserve. No indirect impacts expected with low risk activities.	There is scope to avoid the small patch along the western boundary and this is proposed. Consult with OEH on future use of this site post-construction, which may be offset potential with assisted regeneration
Additional site 9	Moderate condition riparian vegetation along Mororo Creek in southern end of site, Swamp Sclerophyll Forest (TSC Act). The habitat would be buffered from any activity and no clearing expected. Direct impacts low. Remainder of site cleared with scattered young trees.	Indirect impacts from run-off and weed encroachment into the riparian areas. Low risk of indirect impacts	Buffer proposed on Mororo Creek and sediment fencing to protect riparian areas
Section 6			
Site 3a & 3b	Site 3b is within the construction boundary and will be directly cleared. There is a small patch remaining in the road reserve within an area of regenerating forest. Sufficient cleared areas to use this small site as a temporary stockpile. Site 3a adjoins to the east. There are small patches of disturbed low condition Subtropical Floodplain Forest (TSC Act) mostly at the northern end of the property and around house. This consists of large mature trees with a grazed understorey and no shrubs or groundcovers (intact and regenerating). No vegetation clearing expected, as sufficiently large portions of the site can be used for ancillary facilities without clearing.	Small disturbed drainage line along southern boundary to be avoided. Remnant vegetation on this site in low condition and log history of impacts associated with grazing. Scope to avoid placement of facilities under trees. Likely to indirectly impact young regrowth of Melaleuca sprouting across the property, however these are very resilient and readily grow as suckers and only short term impacts on small areas expected.	Apply general biodiversity measures from EIS
Section 7			
Site 4	Low quality elements of Swamp Sclerophyll Forest (TSC Act) (regenerating and intact on edges). Exists as isolated trees and small patches on the site and can easily be avoided given the existing access to the site and large areas of cleared land.	Wetland adjoins this site to the north and slightly downslope. Potential for run-off from ancillary site during heavy rain periods entering the wetland. Buffer required and mitigation measures would remove this risk. Remainder of the site only comprises scattered trees and very small patches that can be avoided and are currently impacted by weeds and grazing.	Ensure sediment fencing at north eastern end of the site to protect wetland to the north

Site	Direct impacts	Indirect impacts	Site specific mitigation
Section 8			
Site 2a,2b & 2c	Limited vegetation on these sites shows some regrowth indicative of Swamp Sclerophyll Forest (TSC Act), remnant forest surrounds site 2a to the east and south. Remaining sites surrounded by cane. Direct impacts not expected.	Very flat land, with low potential for run-off impacts. Existing edge effect noted along eastern boundary into the intact forest off-site, weeds blown in from cleared paddock. Edge effect pronounced and unlikely to be significantly increased over the short term through use of the site. Risk of groundwater contamination if spill occurs. Low risk activities acceptable.	Only low risk activities, no chemical or fuel storage on site. Recommend stockpile use only.
Site 3	No TECs on site, cleared land, no direct impacts.	Adjoins Swamp Sclerophyll Forest (TSC Act) on southern boundary, some weed impacts noted in this area. Edge effect pronounced and unlikely to increase through weed invasion. Potential for run-off impacts during heavy rain, site slopes to the south slightly towards remnant forest.	Mitigated through buffer and sediment fencing.
Section 9			
Site 1	Low to moderate condition remnant patches of Subtropical Coastal Floodplain Forest (TSC Act). Intact at north east mostly off-site. Sufficient access and land area to avoid direct clearing of vegetation and not expected.	Buffered by existing highway on western boundary and new highway on eastern boundary. Low risk of indirect impacts on vegetation. Potential for indirect impact on riparian vegetation along MacDonald's Creek adjoins southern boundary.	Able to be mitigated through buffer and sediment fencing at southern end. Potential groundwater impacts, low risk activities only. See Section 2.5.4 for further discussion on aquatic impacts.
Site 2	Low condition elements of Subtropical Coastal Floodplain Forest (TSC Act) (regenerating).Young trees scattered all over this property, and high likelihood of some clearing and removal to accommodate facility. Impacts only minimal and short term. High resilience and regrowth potential for Melaleuca on this.	Adjoins Swamp Sclerophyll Forest (TSC Act) on southern, eastern and northern boundary, some weed impacts noted in these area, but minimal due to low fertility soils. Low risk of impact from weeds Flat land on sandy soils, low potential for significant run-off and sediment impacts.	Apply general biodiversity measures from EIS
Site 3	Absent on the site, small fragments of Swamp Oak EEC adjoining sites to west and south. No direct impacts.	Land adjoining to the west and south contains remnant Swamp Oak Forest with high groundwater table, weed invasion evident from cleared edges along paddock. Further weed invasion expected naturally here over longer term and not exacerbated by short- term use of the site as facility.	Risk of run-off and sediment impacts off-site into adjoin areas able to be mitigated through buffer and sediment fencing where required.
Section 10			
Site 5	No TECs on site no direct impacts.	Lowland Rainforest adjoins this cleared site to the west and is upslope over hilly property, weeds abundant in edge areas. Very low risk of indirect impacts from run-off and weeds.	Apply general biodiversity measures from EIS

Site	Direct impacts	Indirect impacts	Site specific mitigation
Site 6	Low condition patches of Lowland Rainforest on the site in two small areas northern-eastern corner extending off-site to the north and western boundary on west side of vehicle tracks continues to the west upslope (Plate 2-1). Central portions of the site comprise scattered natives Melaleuca spp, Focus spp as well as exotic Camphor Laurel. Any clearing of trees in central portion would not significantly impact on adjoining rainforest patches which occur upslope and continues off-site to the west.	As the adjoining rainforest patches are both upslope from the site there is a low risk of indirect impacts. Weed invasion along edges evident particularly Camphor Laurel.	Limited opportunities on this site due to presence of Arthraxon hispidus, as discussed below in addition to the rainforest patches. Site to be avoided.

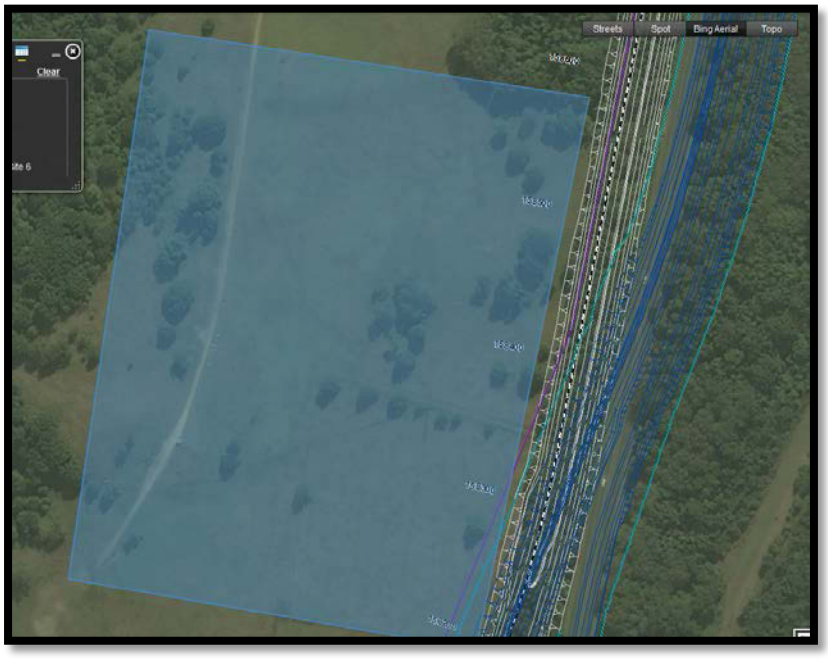

Plate 2-1. Section 10, site 6. Shows vehicle tracks running north–south and Lowland Rainforest to the west of this track and also in north-east corner.

2.5.2. Threatened flora

Five threatened flora species were identified from the site surveys and found to occur either directly on an ancillary facility site or immediately adjoining areas off site including access tracks. They have potential to be indirectly impacted. These species are:

- Hairy Joint Grass (*Arthraxon hispidus*): Vulnerable species EPBC Act and TSC Act.
- Sandstone Rough-barked Apple (*Angophora robur*): Vulnerable species EPBC Act and TSC Act.
- Square-fruited Ironbark (*Eucalyptus tetrapleura*): Vulnerable species EPBC Act and TSC Act.
- Slender Screw Fern (*Lindsaea incisa*): Endangered species TSC Act.
- *Maundia triglochinoides*: Vulnerable species TSC Act.

Table 2-9 lists the sites where threatened flora were recorded and potential direct and indirect impacts and site-specific mitigation measures, where required.

Table 2-9 Impacts to threatened flora and site-specific mitigation

Site	Vegetation condition	Direct impacts	Potential indirect impacts	Site specific mitigation
Section 2				
Site 5a	Low, mostly cleared	Cleared and regularly slashed site, with remnant trees around the fenced borders retained as windbreaks and property boundaries. Square-fruited Ironbark (*Eucalyptus tetrapleura*) recorded within these wind rows. Not expected to be directly cleared to use these sites and no direct impacts.	Indirect impacts not expected for short-term use of these sites. Trees occur in narrow linear strips that are edge affected and low risk of further weed invasion. Also compaction not expected around wind rows. Any isolated trees present on the property can be avoided.	Avoid isolated trees
Section 3				
Site 4	Modified condition, grazed understorey	Low density of scattered Sandstone Rough-barked Apple (*Angophora robur*) scattered throughout eastern two-thirds of the property, and identified as a no go area. No direct impacts. Only western third of this property suitable on the west side of access track.	Recommendations to only use western third of the property on western side of track will result in low risk of indirect impacts on this species which is well buffered by remnant vegetation. Currently impacts from weeds and grazing on low.	Use of site to be restricted to western third on the western side of the track
Site 6a & 6b	Low condition, cleared, grazed and slashed	Sandstone Rough-barked Apple (*Angophora robur*) recorded as isolated individuals in cleared and grazed paddocks. Some regular slashing occurring and impacts from grazing. Identified on site and sufficient space to avoid clearing of individuals when using both sites, no direct impacts expected.	Areas of known and potential habitat for Angophora robur surround these properties to the east. Weed abundance low due to poor fertility soils, some dispersal of weeds from paddocks into forest noted. Both sites slope to the west towards the road corridor and away from the adjoining forests.	Apply general biodiversity measures from EIS, particularly avoid isolated trees
Site 7b	Low condition, cleared and heavily disturbed	Slender Screw Fern (*Lindsaea incisa*) recorded on the access trail to this site leading from Bostock Road east of Station 55.8. Mitigation required to ensure access to site does not directly impact on this small population. Able to be mitigated by creating an alternate access from northern end of site 7a and would ensure no direct access.	High risk of direct and indirect impacts on this small population through construction vehicle movements along the access track and likely to result in mortality. If able to avoid directly the indirect impacts also high risk, from soil compaction, run-off and dust Recommend alternate access to site from construction corridor and ancillary site 7a and not from Bostock Road. This would avoid the direct and indirect impacts.	Recommend alternate access to site from construction corridor and ancillary site 7a and not from Bostock Road. This would avoid direct and indirect impacts.
Site 8	Low condition, heavily disturbed from past quarrying	Quarry site similar to Site 7b, potential for Slender Screw Fern (*Lindsaea incisa*) to occur in adjoining habitat (outside the north eastern site boundary) and potentially	Low potential for indirect impacts on *Lindsaea incisa*, as potential habitat occurs upslope in adjoining forest. Site already heavily disturbed and further indirect impacts not expected.	Mitigation measures apply in line with the threatened species

Site	Vegetation condition	Direct impacts	Potential indirect impacts	Site specific mitigation
	activities	access tracks to the site as the species colonises disturbed areas. Not located in the survey and currently no direct impacts expected. *Angophora robur* occurs along access track to this site and would be impacted by the construction corridor in this location. May be some loss associated with formalising access to the site for heavy vehicles. Difficult to quantify, but only low numbers along track edge.	Potential for indirect impacts on *Angophora robur* in formalising access tracks will require mitigation measures in line with species management pan, including flagging and exclusion fencing.	management plan and including flagging and exclusion zones. Identify and mark *Angophora robur* during pre-clearing and provide exclusion fencing.
Site 9	Modified and low, history of grazing	Small number of Sandstone Rough-barked Apple (*Angophora robur*) found as scattered individuals on the site, sufficient cleared area to avoid removal of these trees. *Maundia triglochinoides* (in adjacent areas) not directly impacted.	*Angophora robur* existing as isolated individuals on the site and able to be identified and avoided. Currently impacted by weeds and cattle grazing, low risk of further compaction impacts here by flagging and avoiding. Habitat for Maundia is downslope from the site to the east. Indirect impacts on adjoining habitat to the east would need to be mitigated through buffer and sediment fencing where appropriate.	Identify and mark *Angophora robur* during pre-clearing and provide exclusion fencing as per management plan Sediment fencing on eastern boundary where required
Section 10				
Site 4	Native vegetation absent	A cleared and formerly grazed and drained site, Hairy Joint Grass (*Arthraxon hispidus*) population confirmed over around 5.5 hectares. Majority of the population would be directly impacted by the road corridor and fauna overpass in this location. Some area will remain to the north and south of the corridor. Ancillary site occurs on south side and only very small areas remaining adjacent to the corridor, able to be identified and avoided where possible with large areas of site available for other uses.	High risk of indirect impacts from the road construction and operation itself as well as ancillary site. This would be associated with potential weed invasion, given the surrounding areas of farmland and number of vehicle movements likely. Proposal includes revegetation of the approach to land bridge may also indirectly impact on residual areas of Hairy Joint Grass adjacent to the road. Mitigation measures required on ancillary site to avoid indirect impacts.	Identify and mark residual areas of Arthraxon hispidus and use exclusion zones with 10 m buffer area.
Site 6	Low condition, currently impacted	Hairy Joint Grass (*Arthraxon hispidus*) confirmed over around one third of the property centred over the southern eastern corner. This site is also constrained by Lowland Rainforest. Direct impacts only avoidable if using northern half of the property.	Potential indirect impacts associated with run-off downslope and to the south. Able to be mitigated with appropriate identification and sediment fencing / exclusion zones in line with threatened plants management plan.	Site unsuitable for ancillary use

2.5.3. Threatened terrestrial fauna

General findings

The general findings of the survey are summarised below, and more site-specific information and mitigation measures are presented in Table 2-10.

- Most of the sites assessed in the field comprise scattered low densities of remnant trees, some mature and some young, which have been retained as paddock trees or along property boundaries. These include occasional dead trees and hollow-bearing trees providing habitat value as potential roost or nesting resources for fauna, mainly wide-ranging and highly mobile species such as microbats and birds. Associated with this scattering of trees is a potential food resource for nectivorous fauna in the form of seasonally available blossom. Spatially separated resources are accessed by wide-ranging and highly mobile threatened species such as the Grey-headed Flying-fox, Little Lorikeet and Swift Parrot. Of particular value for these nectarivores is the presence of winter-flowering tree species, but these resources were found to be scarce on the ancillary facility sites assessed. There is considerable scope to retain these important resources through careful planning and placement of infrastructure within the sites.
- Isolated paddock trees are known to provide foraging, breeding and refuge habitat for some fauna, and could also support a high diversity of insectivores (Gibbons & Boak, 2000). Wildlife may depend on these trees to cross and move between intact vegetation patches, especially if trees are primary food trees for koalas or contain hollows. The threatened Osprey is known to regularly construct nests in paddock trees and large dead trees where these occur close to waterbodies. While no large raptor nests were located in any of the proposed ancillary facility sites there is potential for these to occur.
- Cane farms occupy many sites and these have very limited ecological value except as potential foraging habitat for the endangered Coastal Emu population; some cane drains were found to the used by the threatened Wallum Froglet (*Crinia tinnula*, vulnerable TSC Act) and may be used by common frogs and birds.
- Some cleared ancillary sites border intact remnant vegetation on adjoining land, and it would be assumed that fauna populations within these large habitats may occasionally forage, roost or occupy small areas of habitat inside the boundaries of the ancillary facility site. Examples are Section 3 site 9 and Section 6 site 6, which were predominantly cleared but surrounded by open forest. A small number of trees on the cleared sites showed infrequent use by koalas. In both instances, the trees may constitute the edge of a home range area for a Koala, or were used by dispersing individuals.
- Aquatic and wetland habitats that intersect ancillary facility sites are generally in the form of narrow riparian areas, drainage lines, open farm dams and small swamp/wetland environments. Most of these are highly disturbed and varied in habitat value for amphibians and fish.
- A number of threatened fauna species were previously identified in the report as having at least a moderate likelihood of occurring on an ancillary site that contains scattered low densities of remnant trees. These fauna species are those that demonstrate tolerance to disturbed and cleared habitats. The species with a higher likelihood of occurring would include hollow-roosting bats which may use isolated remnant trees for roost sites and forage over cleared and modified habitats in conjunction with other cave-roosting microbats. A number of species identified as potentially occurring on the more densely forested sites include the Common Planigale, Spotted-tailed Quoll, Yellow-bellied Glider, Squirrel Glider and Square-tailed Kite. These species have only a low chance of occurring on

the cleared lands with scattered trees. The avoidance of the more densely forested sites, as proposed, would ensure that direct loss of habitat would not occur.

- The remaining species, which include Coastal Emu, Brush-tailed Phascogale, Masked Owl, Grey-crowned Babbler, Koala and Wallum Froglet, are known to occur in remnant and regrowth habitat and some cleared and modified sites provide essential habitat elements. These features, which include remnant trees and small fragments of vegetation, would be retained on site and the temporary use of these sites suggests that suitable habitat characteristics would remain post-construction and continued use of the site could be expected. No large hollows suited as nest sites for the Masked Owl were observed from the surveys and no large raptor nests, although a re-survey prior to the start of construction is recommended for Osprey nests, particularly in locations on the floodplain close to rivers and streams.

Details of the sites where threatened fauna could be expected to occur or evidence was recorded and potential direct and indirect impacts could occur are presented in Table 2-10, including site-specific mitigation measures. Impacts on fauna connectivity are discussed in Section 2.2.5.

Table 2-10 Impacts to threatened terrestrial fauna and site-specific mitigation

Site	Fauna habitat resources	Direct and indirect impacts	Site specific mitigation
Section 1			
Additional site 5	Abundant seasonal food resources (nectar feeding species), remnant trees with hollows present throughout forested parts but scarce over remainder of cleared areas. High structural and floristic diversity	Potential to directly remove habitat for several threatened fauna species including Green-thighed frog, Giant Barred Frog, Grey-headed Flying-fox, microbats, Powerful Owl. High risk of indirect impacts is using cleared portion of site which is upslope from habitat may include noise, weeds and run-off during high rainfall events	Site to be avoided
Section 2			
Site 1a, 1b	Site 1a, cleared with very limited habitat value, a small open farm dam. Under scrubbing and slashing around trees, and weed abundance throughout the site. Site1b: small number of hollow bearing trees and large remnant trees disturbed and maintained understorey. A large dam adjacent to Site 1b.	Low potential for resident fauna. Some tree removal likely at this site as scattered throughout. Hollows scarce. The potential impact is Some potential loss of shelter and food resources for wide-ranging species, such as microbats, Grey-headed Flying-fox	Site 1a Flag and avoid hollow-bearing trees
Site 2	Numerous hollow-bearing trees and fallen timber habitats, high structural and floristic diversity. Abundant shelter, breeding and food resources for wide-range of species, particularly Rufous Bettong, Brush-tailed	Potential habitat for Grey-headed Flying-fox, Squirrel Glider, Brush-tailed Phascogale, Rufous Bettong, microbats, Giant Barred Frog. Direct clearing will occur as part of the construction corridor here and use of this site outside of the construction corridor to be avoided. Clearing for this site has potential to directly impact on these threatened fauna through oss of critical resources (shelter, food) and potential breeding habitat	Site to be avoided outside of the construction corridor

Site	Fauna habitat resources	Direct and indirect impacts	Site specific mitigation
	Phascogale, gliders and microbats.		
Site 4	Hollow bearing trees present inside the road corridor but absent outside corridor on remainder of the site. Potential shelter/nesting resource for hollow dependent species.	Isolated hollow-bearing trees may be used by threatened microbats and these occur in low density, so much of the site is suitable with no direct or indirect impact expected. Narrow strip at the northern end between stations 22.0 to 22.2 contains several very large trees and some with hollows, also adjoins high quality habitat to the west and chance of threatened species occurring. Loss of habitat for fauna if this area used.	Avoid using northern end between stations 2200 to 22200.
Site 5a	Cleared and regularly slashed site, with remnant trees around the fenced borders retained as windbreaks and property boundaries. Nectar resources for birds and Grey-headed Flying-fox, refuge and temporary shelter, potential local small scale corridors.	Not expected to clear trees from the site, as sufficient space to accommodate facility. Existing edge effects on narrow linear strips of vegetation. Low risk of impacts on fauna habitat confirmed.	Flag and avoid hollow-bearing trees where possible
Section 3			
Site 2	Scattered remnant trees, some with hollows, grassy understorey cover, cleared and disturbed ephemeral creek habitat for common frogs and reptiles. Rufous Bettong observed near this site and likely to use the site.	Loss of potential nectar resources for Grey-headed Flying-fox (*Pteropus poliocephalus*). Rufous Bettong on road adjacent to site (*Aepyprymnus rufescens*), potential for Grey-crowned Babbler. Sufficiently large areas of the site may be used for ancillary facility including existing access. May be some loss of young trees or regrowth. Sloping site with potential for run-off into the creek. Moderate risk of a short term impact on local Rufous Bettong population. Indirect impacts to be managed.	Buffer of 50 metres minimum from creek and sediment fencing where required. Avoid mature trees.
Site 4	Scattered low density of Koala food tree species present. Glossy Black Cockatoo habitat to the south and off-site as a large patch of *Allocasuarina littoralis*. Scattered, mature hollow-bearing trees. No large hollows observed	A family group of Grey-crowned Babbler (*Pomatostomus temporalis*, vulnerable TSC Act) were observed along Wooli Road near station 45.5 in Section 3 and adjacent to site 4. The nest/dray was observed about 65 metres west of Site 4 and the small remnant patches of habitat on Site 4 are considered likely to be used by this group on occasion. This species is highly tolerant of modified landscapes and occurs at a number of locations in this area, including farmland and residential properties in Tucabia. The temporary use of this site is not expected to directly or indirectly impact on this family group provided avoidance of vegetation clearing as is proposed will be adopted. The site also provides potential grazing habitat for coastal Emu and small stands of *Allocasuarina littoralis* may be used as a food source for the Glossy Black-Cockatoo, however these are most extensive to the south of the site.	Restrict use of this site to the western side of the vehicle track only, adjacent to Wooli Road and do not clear mature trees

Site	Fauna habitat resources	Direct and indirect impacts	Site specific mitigation
Site 9	Scattered low number of Koala feed trees, which are abundant in adjoining areas off-site. Site is cleared but surrounded by high quality open forest to the north and east and contiguous with Pine Brush State Forest.	Koala scats located under one tree at northwest corner, shows evidence of past use. Direct removal of trees able to be avoided. Disturbance may cause short-term impact during construction, in terms of noise and increased activity. Potential Emu habitat would be placed temporarily out of use during construction, resulting in short term indirect impact.	Avoid and buffer Koala feed trees in the northwest corner of the site. Buffer required from edge of the forest to reduce edge effects, sediment fencing where required.
Section 5			
Site 6	Very low number of Koala feed tree species. Potential Koala habitat based on the presence of Grey Gum (*E.propinqua*) and Tallowwood (*E.microcorys*) Large dead stag and hollow bearing tree on edge of site Threatened fauna habitat: potential Koala and owls.	Koala (scats) found on boundary of Site 6 and Additional site 9 along the western boundary, very limited resources for this species on site. Search of the adjoining Mororo Nature Reserve regular use by koalas and low abundance of Swamp Mahogany. Site habitat value low for Koala. Also potential for Grey-headed Flying-fox (nectar resources). Able to avoid Koala habitat on site, as large expanse of cleared land, likely short-term impact during construction associated with noise and activity.	Flag and buffer habitat patch on southern boundary and avoid direct impacts. This site could be considered as potential addition to Mororo Creek Nature Reserve but would need assisted regeneration.
Additional site 7 and Additional site 8	Low numbers of Koala feed tree species. Potential Koala habitat based on the presence of Grey Gum. No evidence of koalas. Mature trees and dense canopy presence, some hollow-bearing trees, food and shelter resources	Mostly vegetated sites, very high weed abundance and disturbed, located between old highway and current highway. However, good canopy cover and moderate density of mature trees and hollow-trees. Potential Koala habitat as well as Squirrel Glider, Powerful Owl and microbats. Moderate risk of direct and indirect impacts. No clearing to be undertaken.	Sites to be avoided
Additional site 9	Aquatic habitat, deep pools suited to common fish and frogs, reptiles. Riparian corridor may be used by range of fauna. Lack of large or hollow-bearing trees,	Small patch of habitat at the northern end used infrequently by Koala, likely short-term direct impact during construction. Buffer on riparian vegetation, no direct or indirect impacts expected on Mororo Creek, very flat ground and buffer proposed.	Flag and buffer habitat patch on southern boundary and avoid direct impacts by buffering to riparian vegetation.
Section 6			
Site 3a & 3b	Multiple hollow-bearing trees and dead stags Threatened fauna habitat: potential Koala, Masked Owl, Powerful Owl, Spotted Quoll, Brush-tailed Phascogale, gliders and microbats	Site 3b within project corridor for service road is mostly cleared with exception of small area retained between service road and highway. Fragmentation and isolation of roadside vegetation which is formerly planted and low value. Site 3a potential direct impact on several senescent trees through compaction or removal. Potential direct and indirect impact on food and refuge resources for wide-ranging species. Potential roosting/nesting habitat for hollow-dependent species small dam in north-west corner adjoins drainage line and may be used by Green-thighed Frog. Able to be avoided and buffered. Koala feed tree species at northern end.	Mark and avoid small dam in north-west corner of site and buffer activities from a large remnant patch adjoining to the north. Avoid scattered mature trees where possible. Avoid clearing of vegetation north of the house site.

Site	Fauna habitat resources	Direct and indirect impacts	Site specific mitigation
Section 7			
Site 3	Threatened and migratory bird habitat (north east) and off site Koala primary food trees along creek off-site. Small isolated patch in centre of site.	No evidence of Koala use in central patch of site. Potential habitat off-site to the north east also, permanent waterhole may be used by common frogs and birds, including migratory species such as cattle egret and Great Egret, Latham's Snipe. A large embankment exists between the site and the creek and any indirect impacts associated with noise and activity would be short-term and only during construction. Potential impacts likely low, due to the heavily cleared and degraded nature of the site. Run-off not expected and may be limited to a few tree hollows from isolated trees. Likely that these can be avoided given the size of the cleared area.	Avoid central patch of mature trees if possible
Site 4	Limited to low density of trees with seasonal nectar resources, wetland in property to the north habitat value for birds and frogs may include migratory species	Presence of small number of scattered mature Eucalypts and Melaleuca provides potential foraging habitat for Grey-headed Flying-Fox, Swift Parrot, and Little Lorikeet, most of these should be avoided, only very minimal impact on these wide ranging species through cumulative loss of potential foraging resources. Hollows absent or low abundance. Some tree removal may be required, particularly young regrowth. Indirect impacts on habitats to the north possible due to sloping site and run-off during heavy ran periods, able to be mitigated. Direct impacts only minor and short-term.	Buffer of minimum 50 metres from the wetland on northern boundary and sediment fencing where required. Avoid tree removal where possible
Section 9			
Site 1	Ground logs and artificial material. Small dead stags. Koala food tree species present in northeast corner, no evidence of koalas.	Wallum Froglet present in cleared lands, potential Koala foraging, and roosting/nesting habitat for hollow-dependent species. Likely direct impact of flooded areas used by Wallum Froglet. Buffered by existing highway on western boundary and new highway on eastern boundary. Low risk of indirect impacts on habitat. Potential for indirect impact on riparian vegetation along MacDonald's Creek adjoins southern boundary. Able to be mitigated through buffer and sediment fencing at southern end. Potential groundwater impacts, low risk activities only.	Buffer at southern end and sediment fencing where required, low risk activities only.
Section 10			
Site 3a, & 3b	Scattered low number of Koala feed tree species of Site 3b, site 3a cleared	No evidence of Koala reported, however potential to occur as part of larger known important populations in this area, although insufficient resources to sustain home range. May be direct impact if tree removal conducted on Site 3b. Habitat predominantly cleared and not suited to Long-nosed Potoroo or optimum for other ground-dwelling threatened mammals which are not expected.	Map and avoid strip of trees along northern boundary of Site 3b
Site 4	Limited to disturbed creek, potential for common frogs, Koala habitat adjoin site to the south.	Potential for indirect impacts on Koala habitat to the south through noise and activity during construction, short-term only. Flat land with low potential for run-off, weeds evident in adjoining habitat and transported in from cleared paddock, unlikely to be exacerbated further.	Manage weeds as per the recommendations in the EIS

Site	Fauna habitat resources	Direct and indirect impacts	Site specific mitigation
Site 5	Rocky habitats (scattered basalt boulders throughout paddock), scattered low number of trees, seasonal nectar and fruiting resources (wide-ranging nectar feeding species) and large fruit doves may occasionally occur. small ephemeral stream, low value for threatened species	Potential and known habitat for the Pink Underwing Moth occurs in adjacent habitats to the west and south and upslope from the site. Low risk of direct and indirect impacts and these would be associated with dust impacts, although no host plant adjacent to the site, so low potential. Steep upper portions of the site not suited for ancillary use and would act as a buffer to rainforest areas. High abundance of Camphor Laurel in rainforest edges.	Management of weeds and dust as per the recommendations in the EIS.
Site 6	Small number of native figs, food resource for bats and fruit-doves in central part of site and western boundary. Low habitat values in disturbed rainforest in north-eastern corner and western boundary	Potential loss of figs would contribute to cumulative loss of resources for dependent fauna species, although may be avoided. Indirect impacts only low risk, as surrounding habitat is low condition, and able to be buffered.	Site to be avoided due to constraints from threatened flora and TECs.

2.5.4. Threatened aquatic fauna

None of the proposed ancillary facility sites would directly impact on known or potential habitat for the Oxleyan Pygmy Perch. The results of the surveys for the three creeks that are present within the boundaries of an ancillary facility site (sites within sections 2 and 3) confirmed that these habitats are not suitable for the Oxleyan Pygmy Perch. There would be no direct impact on habitat of the Oxleyan Pygmy Perch from the proposed ancillary facility site. There are, however, at least seven proposed ancillary facility sites, located in Sections 7, 8 and 9, which occur within proximity to known and potential habitat for Oxleyan Pygmy Perch as determined by targeted surveys. These are discussed in Table 2-11 including the potential indirect impacts of the activities proposed and appropriate site-specific mitigation measures.

The range of activities that may occur on the ancillary facility sites are described at the start of this chapter. The potential indirect impacts associated with sites in proximity to habitat for the species would be associated with the following high-risk activities:

- The removal of vegetation on the floodplain and the associated disturbance of soil and potential sediment runoff into waterways.
- Stockpiling of spoil storage or mulch in floodplain areas that is transported to a waterway during an unexpected flood event.
- Sites for treating water, where the option to directly discharge into waterways is not available, and there is potential for spillage of chemicals.

This assessment of impacts on the Oxleyan Pygmy Perch in relation to ancillary facility sites indicates that impacts are avoidable and can be mitigated through careful planning. The following are minimum recommendations for the sites listed in Table 2-11 (other site-specific measures are described in Table 2-11):

- Planning is needed to avoid stockpiling on the floodplain at these sites.
- Specific Environmental Works Methods Statements (EWMS) are required to support on-ground works.
- Vegetation clearing on these sites should be avoided or where clearing is required this should limit ground disturbance (for example, stumps and groundcovers should be left in place).
- Sediment fencing is required on sloping sites or where ground disturbance is likely.

Given the distance of the site from the habitat of the species and the low-risk activities expected to occur, the additional cumulative impacts on Oxleyan Pygmy Perch habitat are expected to be minimal and able to be mitigated.

Table 2-11 Oxleyan Pygmy Perch habitat near ancillary facility sites

Ancillary site	Location description	Distance of site to waterway	Potential indirect impacts on adjacent areas	Site specific mitigation
Section 7				
Site 1	Tabbimoble floodway	Site positioned between two waterways, one is 75 metres south and second around 315 metres north	**Potential habitat in proximity.** Distance to creeks in both instances are buffered by large area of cleared grazing land and considered low risk of run-off impacts. Potential risk during flooding for dispersal of spoil material from stockpiles or risk of contamination of waterway, particularly groundwater through spill. Use of the ancillary facility site for low risk activities is not expected to result in indirect impacts.	No high-risk activities as described above
Site 2a & 2b	Adjacent to Tabbimoble State Forest	Site 2a is positioned around 80 metres north of known habitat on western side of the highway. Habitat continues under the highway to the east around 100 metres south of Site 2b	**Known habitat in proximity.** Two small sites located within the project boundary, which will therefore be cleared for construction of the road. Surrounded by densely vegetated level land. Distance to creek would be buffered by dense vegetation. Use of the ancillary facility sites for low risk activities is not expected to result in additional impacts.	No high-risk activities.
Site 3	New Italy, eastern side of highway	Two creeks off-site, 60 metres and 160 metres east	**Potential habitat in proximity.** Habitat is only marginal, and a large earth mound occurs between the site and the creek at the northern end. Impacts from run-off expected to be very low risk. Two small waterways located to the east of the sites and buffered by cleared land and lightly vegetated grazing land. Drainage areas occur down slope of the site. Potential run-off from this site would need to be managed.	Sediment fencing along eastern boundary.

Ancillary site	Location description	Distance of site to waterway	Potential indirect impacts on adjacent areas	Site specific mitigation
Section 8				
Site 3	South of Lang Hill, on southern side of road	Creek around 75 metres south of site in densely vegetated land	**Known habitat in proximity**. Site has been placed on level cleared ground and adjoins large area of remnant vegetation to the south. Distance to creek is buffered by dense vegetation although likely occurs slightly down-slope of the site. It is proposed to place a bunded wall around the southern end of the site to contain and run-off. The site would be used for stockpiling of material and no storage of chemicals of fuel. Low risk of indirect impacts, able to be mitigated.	Bunded wall as proposed. No chemical storage
Section 9				
Site 1	Northwest side of MacDonald's Creek	Around 100 metres south east	**Known habitat in proximity**. Site occurs on cleared farmland and distance to creek buffered by cleared land and dense vegetation along the creek. Run-off impacts not expected, given that no clearing expected. Low risk activities and stockpile of spoil or mulch are only appropriate a northern end of the site or protected by sediment fencing.	Sediment fencing at southern end of site, stockpiling only at northern half, no chemical storage
Site 2	North east side of MacDonald's Creek	Around 20 metres south	**Known habitat in proximity**. Site occurs on cleared farmland and distance to creek buffered by cleared land and dense vegetation along the creek. Run-off impacts not expected, given that no clearing expected. Low risk activities and stockpile of spoil or mulch are only appropriate a northern end of the site or protected by sediment fencing	Sediment fencing at southern end of site, stockpiles only on northern half, no chemical storage.
Site 3	Unnamed class 2 waterway	Creek located 50 metres south of site	**Potential habitat in proximity.** Small waterway traversing cleared land provides marginal habitat for Oxleyan Pygmy Perch during flood periods. Run-off impacts not expected. High risk activities and stockpile of spoil or mulch not appropriate in southern end of the site.	Sediment fencing at southern end of site, stockpiles only on northern half, no chemical storage.

2.5.5. Connectivity for fauna

The location of connectivity mitigation measures was considered in the selection of ancillary facility sites. Hence the majority of sites would not be located near or block access to any dedicated or combined fauna crossing structures proposed for the project. Further, as these facilities are only intended to be temporary sites to be used during construction, there are no anticipated long-term impacts on the movements of fauna. A discussion on potential impacts on fauna connectivity from use of an ancillary facility site is provided in Table 2-12.

In a few cases a cleared ancillary facility site would be adjacent to a proposed connectivity structure. In some of these instances it is proposed to improve connectivity in this location by revegetating the site post-construction. This would occur in the road reserve or where the site is owned by Roads and Maritime. These sites are:

- Section 10, site 1b on the western side and adjacent to the bridge over the Richmond River.
- Section 3, site 2 along an unnamed tributary of Glenugie Creek. Rufous Bettong has been recorded in several places near this site and an underpass here would be provided for them.
- Section 2, site 1a. An arboreal crossing is proposed near this location to provide connectivity to Yuraygir State Conservation area. The proposed ancillary facility site is currently cleared, and completely surrounded by large expanses of remnant vegetation.

Table 2-12 Impacts on fauna connectivity from ancillary facility sites

Site	Fauna connectivity structures near site	Site specific mitigation
Section 1		
Additional site 5	Bridge over Cassons Creek	Site to be avoided
Section 3		
Site 2	A 13 x 1.2 m box culvert adjacent to the site, known habitat for Rufous Bettong in this area	Recommended revegetate this site post-construction, as a minimum the road reserve
Site 5a	A bridge structure for emus placed 50 metres south of this site	Site to remain cleared to benefit emus
Site 6a & 6b	A 3.6 x 2.4 metre box culvert adjacent to these sites 50 metres north.	Site to remain cleared to benefit emus
Section 9		
Site 1	Bridge over MacDonald's Creek 50 metres south of site, important fish passage	Manage run-off and sediment in southern end of the site as per previous recommendation
Site 2	Bridge over MacDonald's Creek at the southern end of the site, important fish passage	Manage run-off and sediment in southern end of the site as per previous recommendation
Site 3	Bridge and waterways 50 metres south, important fish passage	Manage run-off and sediment in southern end of the site as per previous recommendation
Section 10		
Site 1b	Adjacent to Richmond River bridge	Revegetation of this site or road reserve to improve connectivity
Site 4	Site lies adjacent to the proposed land bridge at station 156.1. This site is already cleared and it is proposed to revegetate the approaches to the fauna land bridge following completion of its construction, and this would be done after decommission of the ancillary site. This revegetation would improve connectivity in this area.	Revegetate site post-construction, focus on approaches to land bridge and avoid *Arthraxon hispidus*.

2.6. Summary and cumulative impacts

With the exception of the portions of five sites in which high biodiversity values were noted and recommendations made to avoid these sites, the remaining ancillary facility sites would add minimal cumulative impacts to the project. This is because:

- Any patches of threatened ecological communities noted were highly modified, with a low natural floristic and structural diversity. In most cases, there is scope to avoid vegetation removal through appropriate planning for ancillary facilities on the site.
- Vegetation on these sites is generally characterised by scattered small and fragmented patches or isolated trees in low condition and are well represented in the surrounding locality.
- There are scattered low densities of trees with some potential value as shelter or nesting resources for wide-ranging and highly mobile species such as the threatened Grey-headed Flying-fox and Swift Parrot. These species are capable of exploiting resources that occur over very large spatial areas. These resources are expected to remain on the site during construction and post-construction so that the current opportunity to use these resources would remain.
- Low evidence of Koala use was observed at two proposed sites adjacent to extensive areas of suitable habitat for koalas, suggesting the sites were of limited importance and may only contribute to a small portion of a home range or be used by dispersing individuals. These habitat features have been noted and would be protected.
- Any potential impacts resulting from the use of these ancillary facility sites could be mitigated through appropriate planning and consideration for the ecological values noted in this assessment.

Further, the proposed revegetation of a small number of cleared sites adjacent to proposed fauna connectivity structures would improve the connectivity around these structures for future use by fauna. This should occur as a minimum within the road reserve, and over the residual areas of the site where the property is owned by Roads and Maritime.

A summary of the mitigation measures for all sites discussed in this chapter is outlined in Table 2-13.

Table 2-13 Summary of mitigation measures for ancillary facility sites

Site	Recommended mitigation measures
Section 1	
Site 1a	Apply general biodiversity measures from EIS.
Site 1b	Avoid using site.
Site 2	Apply general biodiversity measures from EIS.
Site 3	Apply general biodiversity measures from EIS.
Additional site 5	Avoid using site
Section 2	
Section 2 site 1a	▪ Flag and avoid hollow bearing trees ▪ Revegetation of the section of the site in the road reserve or the entire site (if practicable).
Site 2	Avoid using site.
Site 5a	▪ Avoid isolated trees and flag and avoid hollow bearing trees where possible. Site to remain cleared to benefit emus.
6a and 6b	Site to remain clear (not vegetated) to benefit emus.
Section 3	
Site 1	▪ This was a cleared compound site that was used for the Glenugie Upgrade and has had some minor revegetation on the site post-construction. A site inspection and survey is required prior to construction to determine its suitability for future use as an ancillary site. ▪ Avoid mature trees.

Site	Recommended mitigation measures
	▪ Revegetation of the section of the site in the road reserve or the entire site (if practicable).
Site 2	▪ Would need to buffer creek and use appropriate mitigation (sediment fencing where required). ▪ Re-vegetated this site to improve connectivity after construction ▪ Buffer of 50 metres minimum from creek and sediment fencing where required. Avoid mature trees. ▪ Recommended revegetate this site post-construction, as a minimum the road reserve
Site 4	▪ Apply general biodiversity measures from EIS ▪ Use of site to be restricted to western third on the western side of the track ▪ Restrict use of this site to the western side of the vehicle track only, adjacent to Wooli Road and do not clear mature trees
Site 5	Apply general biodiversity measures from EIS.
Site 6a & 6b	Apply general biodiversity measures from EIS, particularly avoid isolated trees
Site 7b	Avoid using site.
Site 8	▪ Apply general biodiversity measures from EIS ▪ Mitigation measures apply in line with the threatened species management plan and including flagging and exclusion zones. ▪ Identify and mark *Angophora robur* during pre-clearing and provide exclusion fencing.
Site 9	▪ Mitigation possible by avoiding activities up against the forest edge and buffering the surrounding forest. ▪ Identify and mark *Angophora robur* during pre-clearing and provide exclusion fencing as per management plan ▪ Sediment fencing on eastern boundary where required ▪ Avoid and buffer Koala feed trees in the northwest corner of the site. Buffer required from edge of the forest to reduce edge effects, sediment fencing where required.
Section 4	
Site 4a, 4b & 4c	Apply general biodiversity measures from EIS.
Site 5	Apply general biodiversity measures from EIS.
Site 7a	Apply general biodiversity measures from EIS.
Section 5	
Site 1	Apply general biodiversity measures from EIS
Site 6	▪ There is scope to avoid the small patch along the western boundary and this is proposed. Consult with OEH on future use of this site post-construction, which may have offset potential with assisted regeneration and could be considered as a potential addition to Mororo Creek Nature Reserve ▪ Flag and buffer habitat patch on southern boundary and avoid direct impacts. ▪ This site could be considered as potential addition to Mororo Creek Nature Reserve but would need assisted regeneration.
Additional site 7	Avoid using site
Additional site 8	Avoid using site
Additional site 9	▪ Buffer proposed on Mororo Creek and sediment fencing to protect riparian areas Flag and buffer habitat patch on southern boundary and avoid direct impacts by buffering to riparian vegetation.
Section 6	
Site 3a & 3b	▪ Apply general biodiversity measures from EIS ▪ Mark and avoid small dam in north-west corner of site and buffer activities from a large remnant patch adjoining to the north. Avoid scattered mature trees where possible. Avoid clearing of vegetation north of the house site.
Site 5	▪ Site is currently being used as a compound site for the Devils Pulpit upgrade. On completion of construction for that project, the site would be stabilised with a quick growing cover crop to stabilise the site. ▪ A site inspection and survey is required prior to construction to confirm the suitability of the site. ▪ Site to be rehabilitated post- construction.
Section 7	
Site 1	No high-risk activities for OPP habitat
Site 2a & 2b	No high-risk activities for OPP
Site 3	▪ Avoid central patch of mature trees if possible ▪ Sediment fencing along eastern boundary.

Site	Recommended mitigation measures
Site 4	▪ Ensure sediment fencing at north eastern end of the site to protect wetland to the north ▪ Buffer of minimum 50 metres from the wetland on northern boundary and sediment fencing where required. Avoid tree removal where possible
Section 8	
Site 2a,2b & 2c	▪ Only low risk activities, no chemical or fuel storage on site. ▪ Recommend stockpile use only.
Site 3	▪ Mitigated through buffer and sediment fencing ▪ Bunded wall as proposed. No chemical storage
Section 9	
Site 1	▪ Provide buffer and sediment fencing at southern end. ▪ Provide sediment fencing at southern end of site, stockpiling only at northern half, no chemical storage
Site 2	▪ Apply general biodiversity measures from EIS ▪ Sediment fencing at southern end of site, stockpiles only on northern half, no chemical storage.
Site 3	▪ Risk of run-off and sediment impacts off-site into adjoin areas able to be mitigated through buffer and sediment fencing where required. ▪ Sediment fencing at southern end of site, stockpiles only on northern half, no chemical storage.
Section 10	
Site 1b	Revegetation of this site or road reserve to improve connectivity
Site 3a, & 3b	Map and avoid strip of trees along northern boundary of Site 3b
Site 4	▪ Identify and mark residual areas of *Arthraxon hispidus* and use exclusion zones with 10 m buffer area. ▪ Manage weeds as per the recommendations in the EIS ▪ Revegetate site post-construction, focus on approaches to land bridge and avoid *Arthraxon hispidus*
Site 5	▪ Apply general biodiversity measures from EIS Management of weeds and dust as per the recommendations in the EIS.
Additional site 6	Avoid using site