Newell Highway Heavy Duty Pavements, Narrabri to Moree

Addendum review of environmental factors

November 2020

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Executive summary

The proposed modification

Transport for NSW (TfNSW, formerly Roads and Maritime Services NSW) proposes to modify the Newell Highway Heavy Duty Pavements, Narrabri to Moree project as the detail design refinements and construction staging are anticipated to exceed the REF boundary (proposed modification).

Background

TfNSW proposes to carry out major road upgrades to five segments of the Newell Highway (the highway) between Narrabri and Moree in north west NSW, within the existing road corridor (the project).

The project forms part of the *Newell Highway Corridor Strategy* (Transport for NSW, 2015) to provide an efficient and sustainable corridor that caters for increasing growth and improves safety along the highway.

A review of environmental factors (REF) was prepared for the Newell Highway Heavy Duty Pavements, Narrabri to Moree project in June 2018 (referred to in this addendum REF as the project REF). The project REF was placed on public display between 22 June 2018 and 23 July 2018 for community and stakeholder comment. A submissions report (dated September 2018) was prepared to respond to issues raised. The project was determined on the 19 September 2018.

Need for the proposed modification

Chapter 2 of the project REF addresses the strategic need for the project and the project objectives. The proposed modification assessed in this addendum REF is consistent with the strategic need of the project.

The proposed modification is required for the change in project REF boundary to accommodate the detail design modifications and construction staging requirements (the project construction boundary).

Project objectives and development criteria

The objectives of the project are:

- Reduce vehicle operating costs on the Newell Highway
- Reduce the costs of maintaining the Newell Highway
- Improve the safety of the Newell Highway
- Improve flood reliability of the Newell Highway
- Reduce travel times on the Newell Highway.

Options considered

Section 2.4 of the project REF identifies the alternative and options considered for the project. Section 2.4 of the project REF also discussed the methodology and analysis of the options to select the preferred option for the project.

The options considered for the proposed modification in this addendum REF include:

- Option 1: Do nothing. The project REF boundary assessed in the project REF would not be extended and the 100 per cent detail design would be constrained by the project REF boundary
- Option 2: Extent the project REF boundary. This would allow the design to progress to include all detailed design refinements and allow for construction staging.

The preferred option is to extent the REF boundary to include all detailed design refinements and allow for construction staging (the project construction boundary). This would improve the constructability and safety of the project.

Statutory and planning framework

Clause 94 of State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) permits development, on any land, for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

As the proposed modification meets the definitions of 'road infrastructure facilities' provided for by clauses 93 and 94(2) of the ISEPP, and is being carried out by TfNSW, it is permissible without consent under the ISEPP. Accordingly, it can be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and development consent is not required.

This addendum REF fulfils TfNSW's obligations to consider the environmental impacts of the proposed modification under section 5.5 of the EP&A Act, and has been prepared in accordance with the provisions of clause 228 of the Environmental Planning and Assessment Regulation 2000. This REF also addresses the relevant considerations of the *Biodiversity Conservation Act 2016* (BC Act), *Fisheries Management Act 1994* (FM Act)*, Heritage Act 1977, National Parks and Wildlife Act 1974,* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Community and stakeholder consultation

No specific consultation regarding the proposed modification has been carried out to date. However ongoing consultation regarding the project has been carried out.

Since the determination of the project REF, consultation for the project has been with the communities of Bellata and Edgeroi. Consultation has also been carried out with directly affected property owners and landowners with land adjoining the proposed modification but not affected, via emails and phone calls.

In November 2019, TfNSW consulted with the Bellata and Edgeroi communities. A postcard with details of the project was letterbox dropped. The postcard outlined the benefits of the project, timing of the community information sessions, inviting submissions and comments on the detailed design.

TfNSW also consulted with the Bellata Police Station, Post Office and the BP Service Station to discuss parking changes.

Environmental impacts

The proposed modification would have some adverse impacts during construction and longer-term positive and adverse impacts during operation which would be managed by the implementation of mitigation measures and safeguards as described in Chapter 6 of the REF. These are summarised below.

Biodiversity

The proposed modification would remove about 77.92 hectares of native vegetation. This would include about 7.45 hectares of state listed threatened ecological communities (TEC) and about 28.97 hectares of nationally listed TECs. In many instances, the same patches of vegetation are part of both a state listed and a commonwealth listed TEC. An assessment of significance was carried out for threatened species and ecological communities that would be likely to occur in the project construction boundary. The assessments concluded that, the project (project REF and proposed modification combined) would not have a significant impact on any species, population or TEC listed under the NSW BC Act and FM Act.

However, the project (project REF and proposed modification combined) would have a significant impact on one TEC listed under the EPBC Act. As the proposed modification would require the removal of 16.22 hectares of the TEC Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland TEC which is listed as a critically endangered ecological community under the EPBC Act. About 15.5 hectares of this TECs to be removed would be in segment 5 (N2MS5) and about 0.7 hectares would be from N2MS3.

In September 2015, a "strategic assessment" approval was granted by the Federal Minister in accordance with the EPBC Act. The approval applies to TfNSW's'' activities being assessed under Division 5.1 of the EP&A Act with respect to potential impacts on nationally listed threatened species, ecological communities and migratory species. The strategic assessment approval means that most TfNSW Division 5.1 activities do not require referral to the Department of Agriculture, Water and the Environment provided that impacts

are assessed using Commonwealth guidelines and the avoid, mitigate and offset hierarchy applied through project determinations. This is the case, even if the activity is likely to have a significant impact.

Biodiversity impacts have been reduced through the adoption of a design and construction option that would affect less native vegetation. Impacts on threatened biodiversity would be avoided or further minimised through implementation of management and mitigation measures identified in the REF.

Biodiversity offsets would be required for residual impacts to threatened biodiversity in accordance with the EPBC Act strategic assessment approval and the Roads and Maritime *Guideline for Biodiversity Offsets (2016).*

Traffic and Transport

The construction of the segments would be programmed with the requirement of a travel delay of no more than 12 minutes. Provided that the cumulative delays of both this project and the North Moree project (NM) are kept below 12 minutes, the road user delays would be consistent with other Newell Highway road upgrade projects in the region.

Aboriginal heritage

The *Aboriginal and Historical Archaeological Survey Report: Newell Highway HD Pavements – Narrabri to North Narrabri* (OzArk, 2018) prepared for the project REF identified three Aboriginal Heritage Information Management System (AHIMS) items (modified trees) and one potential archaeological deposit (PAD) located near to the project during the 2017 and 2018 surveys.

The proposed modification would bring the project closer to the three modified trees. However, provided the mitigation measures in the project REF are implemented impacts to these items (modified trees) would be avoided.

PAD (BC-HW17-PAD1) is located within the project construction boundary. The archaeological test excavation did not confirm the presence of any Aboriginal objects or features within BC-HW17-PAD1 in the project construction boundary. Therefore no impacts to Aboriginal items would be expected during construction.

Non - Aboriginal heritage

Five locally listed historic heritage sites are located within N2MS3, all within the township of Bellata. During the field surveys carried out in December 2019 as for the addendum REF, one historic feature, a blaze tree (Newell Highway HS-01), was identified within N2MS4.

The proposed modifications impact on the five locally listed historic heritage sites would be consistent with the impacts identified in the project REF. The historic feature, a blaze tree in N2MS4, would now be impacted by the proposed modification. An application for its removal would be submitted prior to the construction works starting.

Hydrology and flooding

The flood modelling for the detailed design identified that the design has generally achieved 20 per cent Annual Exceedance Probability (AEP) flood immunity. Therefore, the proposed modification would provide better flood immunity than what current exists along the Newell Highway

Justification and conclusion

This addendum REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

The proposed modification as described in the addendum REF best meets the project objectives, but would still result in some impacts on biodiversity, traffic amenity, Aboriginal heritage and property acquisitions.

Safeguards and management measures as detailed in this addendum REF would ameliorate or minimise these expected impacts. The proposed modification would also improve safety, traffic and freight efficiency for vehicles using the highway. On balance the proposed modification is considered justified and the following conclusions are made.

This addendum REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity in accordance with Division 5.1 of the EP&A Act. The proposed modification would be unlikely to cause a significant impact on the environment. Accordingly, neither an environmental impact statement is required to be prepared, nor approval from the Minister for Planning under Division 5.2 of the EP&A Act.

While the proposed modification is likely to have a significant impact on matters of national environmental significance within the meaning of the EPBC Act, a referral to the Department of Agriculture, Water and the Environment is not required, because requirements for considering impacts to these biodiversity matters are the subject of a strategic assessment approval granted under the EPBC Act by the Australian Government in September 2015.

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1 Introduction

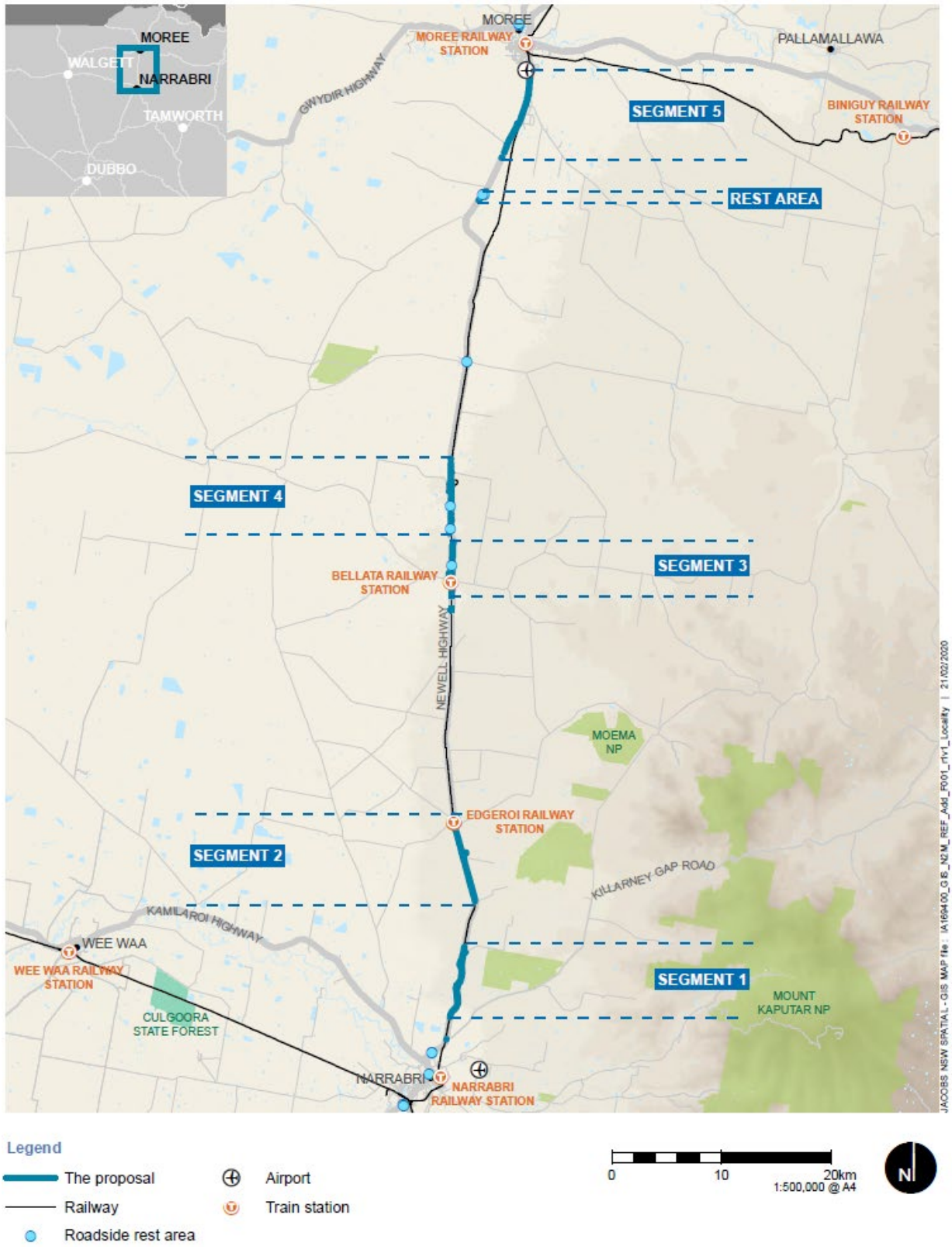
1.1 Proposed modification overview

Transport for NSW (TfNSW,) proposes to modify the Newell Highway Heavy Duty Pavements, Narrabri to Moree as the detail design refinements and construction staging are anticipated to exceed the review of environmental factors (REF) boundary (proposed modification).

The location of the proposed modification is shown in **Figure 1-1** and the proposed modification is shown in **Appendix A**. **Chapter 3** describes the proposed modification in more detail.

A REF was prepared for the *Newell Highway Heavy Duty Pavements, Narrabri to Moree* (the project) in June 2018 (referred to in this addendum REF as the project REF). The project REF was placed on public display between 22 June 2018 and 23 July 2018 for community and stakeholder comment. A submissions report (dated September 2018) was prepared to respond to issues raised. The project was determined on the 19 September 2018.

Figure 1-1: Location of the proposed modification



1.2 Purpose of the report

This addendum REF has been prepared by Jacobs on behalf of TfNSW Western region. For the purposes of these works, TfNSW is the proponent and the determining authority under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

This addendum REF is to be read in conjunction with the project REF and submissions report for the project. The purpose of this addendum REF is to describe the proposed modification, to document and assess the likely impacts of the proposed modification on the environment, and to detail mitigation and management measures to be implemented.

The description of the proposed modification and assessment of associated environmental impacts has been carried out in context of clause 228 of the Environmental Planning and Assessment Regulation 2000, Is an EIS Required? Best Practice Guidelines for Part 5 of the Environmental Planning and Assessment Act 1979 (Is an EIS Required? guidelines) (DUAP, 1995/1996), Roads and Road Related Facilities EIS Guideline (DUAP, 1996), the *Biodiversity Conservation Act 2016* (BC Act), the *Fisheries Management Act 1994* (FM Act), and the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

In doing so, the addendum REF helps to fulfil the requirements of Section 5.5 of the EP&A Act including that TfNSW examine and take into account to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

The findings of the addendum REF would be considered when assessing:

- Whether the proposed modification is likely to result in a significant impact on the environment and therefore the necessity for an environmental impact statement (EIS) to be prepared and approval to be sought from the Minister for Planning under Division 5.2 of the EP&A Act
- The significance of any impact on threatened species as defined by the BC Act and/or FM Act, in section 1.7 of the EP&A Act and therefore the requirement for a Species Impact Statement (SIS) or a Biodiversity Development Assessment Report (BDAR)
- The significance of any impact on nationally listed biodiversity matters under the EPBC Act, including whether there is a real possibility that the activity may threaten long-term survival of these matters, and whether offsets are required and able to be secured
- The potential for the proposed modification to significantly impact any other matters of national environmental significance or Commonwealth land and therefore the need to make a referral to the Australian Government Department of Agriculture, Water and the Environment for a decision by the Australian Government Minister for the Environment on whether assessment and approval is required under the EPBC Act.

1.2.1 Definitions

The following terms are used in this addendum REF:

- Project: The Newell Highway Heavy Duty Pavements, Narrabri to North Moree which will be delivered in five segments (N2MS1, M2NS2, N2MS3, N2MS4 and N2MS5) with a combined length of about 34 kilometres of upgrades along the Newell Highway. The five segments are outlined in **Table 1-1**.

Table 1-1 N2M Project segments

Segment	Location	Segment length (Kilometres)
N2MS1	6.5 kilometres to 13.3 kilometres north of Narrabri	6.8
N2MS2	17.9 kilometres to 25.9 kilometres north of Narrabri	8.0
N2MS3	46.4 kilometres to 50.9 kilometres north of Narrabri	4.5
N2MS4	51.8 kilometres to 58.2 kilometres north of Narrabri	6.4
N2MS5	88.4 kilometres to 96.2 kilometres north of Narrabri	7.8

- Project REF boundary. This is the project REF proposal area which refers to the area that would be directly impacted by the project as assessed in the project REF. This was based on the 50 per cent concept design plus a variable construction buffer
- Study area: refers to the area investigated during the preparation of the project REF and includes the wider area that may be indirectly impacted by the project
- Project construction boundary: The increased project boundary based on the detailed design and includes all the proposed modifications. This defines the impact area for the project as a whole, refer **Appendix A**
- Modified construction boundary: Adjusted project construction boundary which encompasses the 100 per cent detailed design, utilities and property infrastructure adjustments.

2 Need and options considered

This chapter describes the need for the proposed modification in terms of its strategic setting and operational need. It identifies the options considered and the selection of the preferred option for the proposed modification.

2.1 Strategic need for the proposed modification

Chapter 2 of the project REF addresses the strategic need for the project, the project objectives and the options that were considered. The proposed modification described and assessed in this addendum REF is consistent with the strategic need for the project.

The proposed modification is required for the change in project REF boundary to accommodate the detail design modifications and construction staging requirements as outlined in **Section 3.2.2**.

2.2 Project objectives and development criteria

Section 2.3 of the project REF identifies the projects objectives and development criteria that still apply to the proposed modification.

2.3 Alternatives and options considered

Section 2.4 of the project REF identifies the alternative and options considered for the project. Section 2.4 of the project REF also discussed the methodology and analysis of the options to select the preferred option for the project.

The options considered for he proposed modification in this addendum REF include:

- Option 1: Do nothing. The REF boundary assessed in the project REF would not be extended and the detail design would be constrained by the project REF boundary.
- Option 2: Extent the REF boundary. This would allow the design to progress to include all detailed design refinements and allow for construction staging.

2.4 Preferred option

The preferred option is to extend the REF boundary to include all detailed design refinements and allow for construction staging (the project construction boundary). This would improve the constructability and safety of the project.

3 Description of the proposed modification

3.1 The proposed modification

TfNSW proposes to modify the Newell Highway Heavy Duty Pavements, Narrabri to Moree project as the detail design refinements and construction staging are anticipated to exceed the project REF boundary. The proposed modification is shown in **Appendix A**.

The proposed modification is generally consistent with the determined project as described in the project REF and submissions report, and can be mostly accommodated within the project REF boundary as assessed in the project REF. Exceptions to this include further property acquisition and vegetation clearing required to accommodate the larger project construction boundary.

3.2 Design

3.2.1 Design criteria

The proposed modification has been developed in accordance with the guidelines and design criteria as identified in the project REF.

3.2.2 Main features of the modification

Since the display of the concept design in the project REF a series of design refinements have been made to the design of the determined project. The key modifications include:

- Increased property acquisition and vegetation clearing required for the larger project construction boundary
- Inclusion of construction compounds and provision for stockpile locations
- Design changes to updated interfacing, culvert levels and open channel drains
- Localised road level adjustments in some sections to allow for flooding immunity and afflux considerations
- Addition of culverts on side roads and driveways
- Introduction of kerbing through Edgeroi and Bellata with pit and pipe drainage
- An increase in the size of a number highway transverse of culverts to achieve acceptable levels of afflux in private properties next to the Newell Highway
- Updating utility locations based and progression of utility relocation designs
- Revision of private accesses to reflect TfNSW negotiations with land owners
- Replacement of all wire rope safety barriers with a steel barrier system, with the exception of large bridge size culverts where a high containment barrier system is proposed to reduce verge width
- Realignment and extension of the N2MS1 boundary by about 250 metres to reduce encroachment into the Mungindi rail corridor
- Extension of the south bound overtaking lane in N2MS2 to relocate the southern limit further south of Smithfield lane
- Updates to street lighting layouts in Edgeroi (N2MS2) and Bellata (N2MS3)
- Extension of the southern limit of N2MS2 south to the northern abutment of Bobbiwaa Bridge
- Replace barriers on northern side of Bobbiwaa Bridge

- Realignment of the northern end of N2MS3 and the southern end of N2MS4 following cancellation of the Bellata Overbridge project (separate project by Australian Rail Track Corporation (ARTC))
- Relocation and extension of the northbound overtaking lane in N2MS5 to the south and by about 700 metres, to avoid impact on Tapscott Road and to accommodate the Wallanol Road midway through the overtaking lane

3.3 Construction activities

This section provides a summary of the likely construction methodology, work hours, plant and equipment and associated activities that would be used to construct the proposed modification. For the purpose of this addendum REF, an indicative construction plan and methodology are provided. Detailed construction plans and methods would be confirmed following completion of the detail design.

The actual construction method may vary from the description in this chapter as a result of factors such as identification of on-site conditions during pre-construction activities, ongoing refinement of the design and consultation with property owners.

A contractor environmental management framework to manage and mitigate impacts is presented in **Chapter 7**. The final construction plan and methods chosen by the contractor would also be required to be consistent with this framework.

3.3.1 Work methodology

The general construction methodology, workforce, equipment and working hours would be the same as that of the approved activity as described in the project REF.

As described in the project REF, construction activities would be guided by a Construction Environmental Management Plan (CEMP) for each segment to ensure work is carried out to TfNSW specifications within the specified work area. Detailed work methodologies would be identified by the construction contractor.

The estimated construction period for each segment is provide in **Table 3-1**.

Table 3-1 Estimated construction period per segment

Segment	Duration (weeks)
N2MS1	62
N2MS2	75
N2MS3	29
N2MS4	52
N2MS5	63

The staging of construction would be sequenced so as to complete construction within the minimum possible timeframe, while maintaining traffic flow through the work areas at all times. The general approach would be to begin preliminary work as an early priority, before the main roadwork would begin.

The proposed modification would be constructed using conventional methods used on other road pavement upgrade projects. These methods may be modified or refined to respond to engineering and environmental constraints relevant to the project. The typical construction phases and activities are described in Table 3-1 of the project REF.

Staging

The updated indicative traffic staging for on and offline options for the construction of the new carriageway, is presented in **Table 3-2** and shown on **Figure 3-1** to **Figure 3-3**.

To maintain traffic flow at all times during the construction of the online sections, temporary pavement would be required to provide sufficient travel lane widths. Alternatively, a contra-flow arrangement could be adopted that does not require temporary pavement, however this would impact on road user travel times.

For the purposes of the indicative staging, the following constraints were adopted:

- Single direction traffic with stop-go control will be adopted locally around bridges and culverts if required.
- Reduced speed zone would be within the work area during construction. A speed zone of 60 or 80 kilometres per hour would be assumed for the entire segment, with 40 or 60 kilometres per hour next to construction work areas
- Reduced speed zone of 80 kilometres per hour are to be a maximum length of four kilometres, while a 40 kilometres per hour zone can only extend to a maximum of one kilometre
- The minimum width of traffic lanes during construction is 3.2 metres, with 0.5 metre minimum shoulder width
- Over size, over mass (OSOM) vehicles require a minimum width 5.6 metres in a single lane operation, this would include a 3.2 metre lane plus 1.2 metre sealed shoulders.
- The state of the existing road shoulder varies substantiality along the corridor and many sections may require reconstruction before traffic can be shifted to them in during the temporary staging. TfNSW is currently carrying out pavement condition testing to establish those sections with adequate remaining life. For the purposes of this the staging it has been assumed that in all cases the pavement would need reconstruction
- With the existing road being so narrow it would not be possible to avoid moving traffic to the shoulder during the staging, so in all staging cases (on and offline construction) would need to be a preparation stage where the road shoulder is reconstructed under one way traffic
- A minimum one metre “No Work Zone” has been adopted behind barriers adjacent to construction
- No allowance has been made for verge during temporary or construction scenarios
- Offline construction allows traffic to remain in the existing locations at normal speed.

Table 3-2 General construction activities

Stage	Proposed construction work
Offline construction	
1	• Traffic would be moved to the left slightly on the existing pavement to allow enough room to establish the work area on the right side of the road • Work area would be separate to the existing formation • The work area would be along the right side of the road. Work would consist of embankment construction, new culverts, new pavements, final wearing course and line marking • An intermediate stage may be necessary prior to Stage 2, to complete work between new and existing roads. This intermediate stage would split traffic, by placing a right hand traffic lane onto new the formation

Stage	Proposed construction work
	• Concrete barriers may be used along the edge of the existing pavement to maintain a higher speed zone next to the work area.
2	• Traffic would be moved onto the new pavement, maintaining two way traffic flow • The work area would be along left side of the road.
3	• Traffic would be in the final arrangement • The centreline would be shifted by generally 9.5 metres to allow two metre shoulders and one metre between travel lanes.
Online construction – one way traffic	
1	• Following improvement of the existing shoulder, traffic would be reduced to a single lane with north and southbound traffic controlled under stop/slow traffic control • Construction of pavement under traffic on the right hand side of road • Pavement and earthworks construction would be made wider than the final design to allow sufficient road width in Stage 2. The exact width of the over construction would vary depending upon the presence of overtaking lanes or turn lanes but generally will be in the order of 0.6 metres • Temporary batter would be steepened to avoid encroachment beyond the ultimate disturbance footprint.
2	• Traffic would be switched to the right onto the new/temporary pavement and traffic barriers would be shifted to accommodate new work zone • Work area would be along left side of road • The centreline would remain in its existing position.
3	• Traffic would be moved into final arrangement • Centreline would remain in its existing position while there is also 3.1 metres of extra pavement.
Online construction – two way traffic	
1	• Online construction would be via a temporary pavement to allow maintain a two way two lane arrangement • Widening would be on both sides of road to achieve new pavement width while maintaining the same centreline • Complex traffic staging with traffic switches would be required
2	• Traffic would be shifted onto the onto right side onto the new/temporary pavement • Traffic barriers shifted to establish work area on the left side.
3	• Traffic would be move into final arrangement • Centreline would remain in its original position with typically up to seven metres of extra pavement • Temporary pavements would be removed and batters trimmed to final layout.

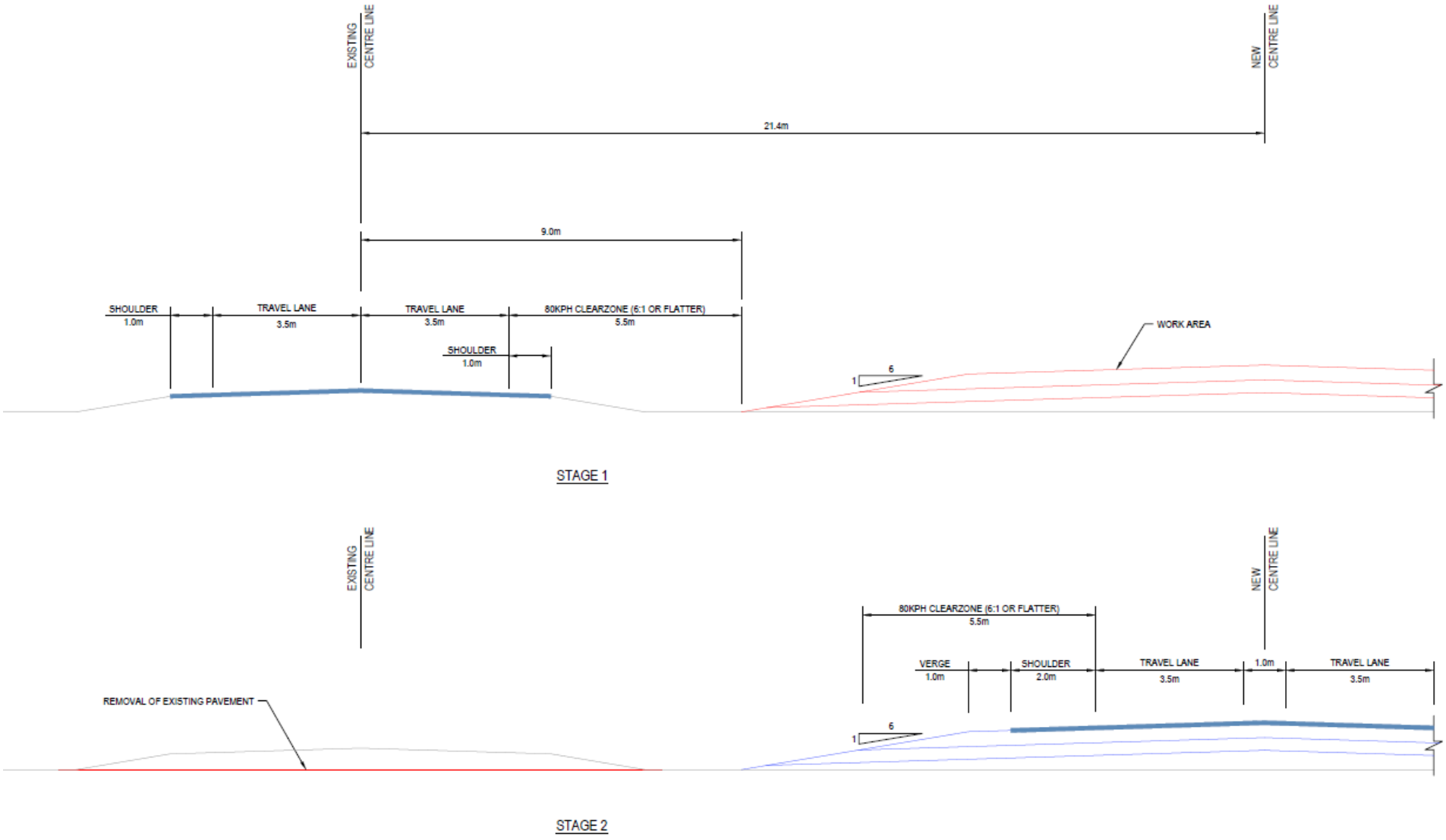


Figure 3-1 Stage 1 offline

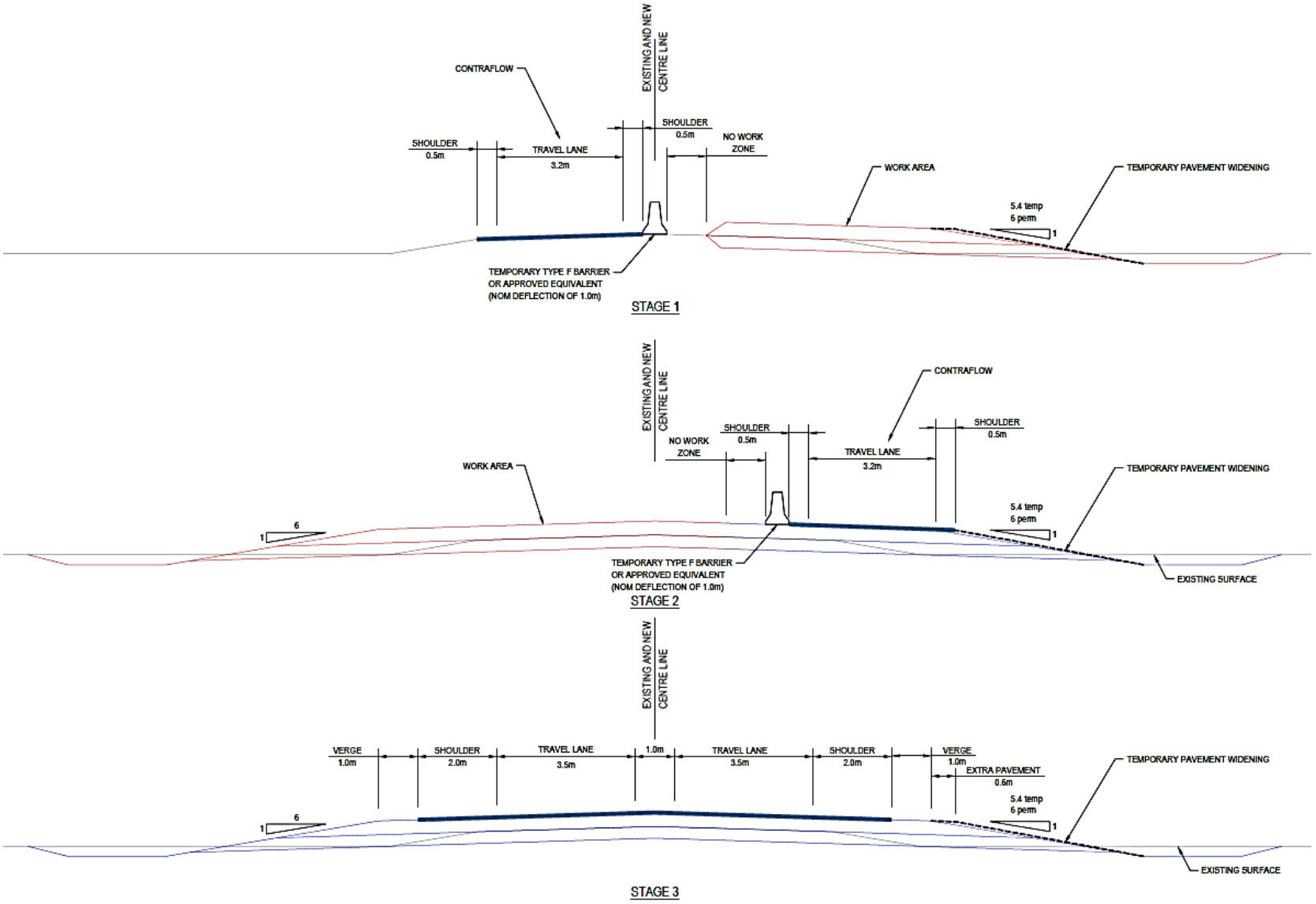


Figure 3-2 Stage 1 online – one way traffic

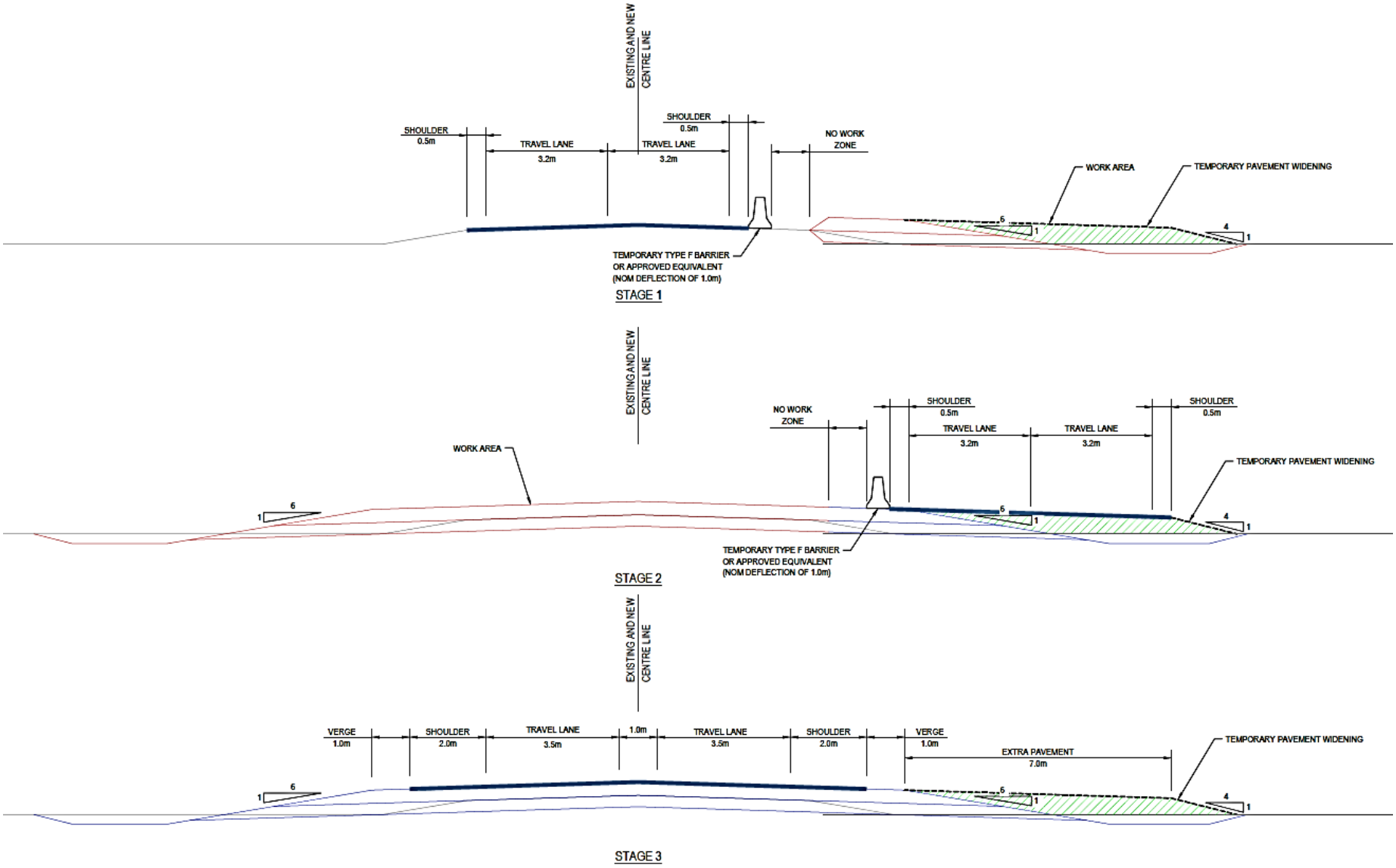


Figure 3-3 Stage 1 online – two way traffic

3.3.2 Plant and equipment

The required plant and equipment would be as per the project REF.

3.3.3 Earthworks

The proposed modification would involve earthworks, with the overall aim of maximising the re-use of material on site or between projects along the Newell Highway. Any remaining surplus material would be stockpiled in a suitable location for future use by TfNSW on future projects, or disposed of to an approved site following waste classification. Allowance would be made at the proposed ancillary sites for initial stockpiling of surplus material, either for re use elsewhere on the site, or prior to its disposal. Sufficient space exists across the proposed ancillary sites to accommodate material stockpiles, and these would be managed in accordance with the contractor's CEMP.

The estimated quantities of materials associated with earthworks are provided in **Table 3-3**. The estimates may change depending on the actual quality of material, the depth to bedrock, and the suitability of the material for reuse during construction.

Table 3-3 Indicative earthworks quantities

	Quantity				
Material (cubic metres)	**N2MS1**	**N2MS2**	**N2MS3**	**N2MS4**	**N2MS5**
Removal, Stockpiling and/ or On Site Disposal of Topsoil	19,586	17,292	11,163	15,200	22,160
General Earthworks - Cut	52,600	31,700	36,340	39,300	81,030
Imported Material	16,000	31,000	0	0	0

3.3.4 Source and quantity of materials

The quantity of materials required is provided in **Table 3-4**. The source of the materials is expected to be comparable to the project REF.

Table 3-4 Indicative material quantities for construction

Material	Quantity				
	N2MS1	**N2MS2**	**N2MS3**	**N2MS4**	**N2MS5**
Foamed bitumen pavement (m^3)	0	4,200	6,100	0	0
Lime stabilising agent (t)	0	90	130	0	0
Bound Pavement Course (m^3)	0	4,000	6,000	0	0
Supply and Place Subbase (m^3)	19,500	23,500	11,000	19,500	4,500
Supply and Place Base (m^3)	25,000	36,500	14,500	25,000	6,000
Selected Material - Imported (m^3)	39,000	46,500	24,000	27,500	11,000

Water is expected to be sourced from either Moree, Narrabri and/or Bellata town mains and transported to site. A dam is also located within N2MS3 (refer to **Appendix A**) which maybe potentially be used as an additional water source.

3.3.5 Traffic management and access

As described in the project REF, road traffic would be impacted throughout all stages of construction. The expected vehicle movements and traffic management and access arrangement are described in Section 3.3.7 of the project REF. The proposed modification does not change these management and access arrangements.

OSOM vehicle pull over bays would also be provided. These are described in **Section 3.4.4**.

3.4 Ancillary facilities

Construction of the proposed modification would require a number of ancillary facilities which would include:

- Stockpile and construction compound sites
- Asphalt batch plant
- Construction Sediment basins
- OSOM vehicle pull over bays.

These ancillary facilities are described below.

3.4.1 Stockpile and construction compound sites

TfNSW identified 15 potential stockpile/ compound sites that would potentially be used for the five segments, are shown on **Appendix A** and described in **Table 3-5**. These potential locations include areas that are:

- Existing stockpile sites
- Existing rest areas
- Devoid of native vegetation and would not require further vegetation removal
- Within the road corridor or on adjacent private property.

Typically, the facilities required at these sites would include any of the following:

- Main site compound including site offices, sheds, workshops, storage areas and a first aid post
- Arrival and departure of office staff, workforce and daytime deliveries to compound
- Plant storage, materials laydown and storage, stockpiling and construction parking
- Chemical storage and equipment refuelling
- Delivery of excavated material from site by tipper trucks
- General stockpile management and loading of final product into tipper trucks for delivery to site
- General delivery of other construction materials for storage
- Small satellite site compounds for stockpiling
- Truck water tank loading areas
- Asphalt, bitumen batching plants, crushing plants and material processing sites. This would be within N2M C2.

Table 3-5 Stockpile/ compound sites

Site ID	Location	Site description
Within or near to N2NS1		
N2M C1	Existing stockpile located near Bingara Road, about 4.5 kilometres north of Narrabri	Existing stockpile
N2M C2	Disturbed area located near Murrumbilla Lane, about 11.8 kilometres north of Narrabri	Private property cleared of vegetation and currently used for agriculture uses. This parcel of land is be acquired. The foam batch plant would also be located at this site
N2M C3	Disturbed area located near Murrumbilla Lane, about 11.9 kilometres north of Narrabri	On private land to be acquired
N2M C4	Disturbed area located near Murrumbilla Lane, about 12 kilometres north of Narrabri	Existing disturbed area.
Within or near to N2MS2		
N2M C5	Existing stockpile located near Smithfield Lane, about 22 kilometres north of Narrabri	Existing stockpile
N2M C6	Private property (Lot 1 DP1038813), about 22 kilometres north of Narrabri	Private property cleared of vegetation and currently used for agriculture uses.
Within or near to N2MS3		
N2M C7	Existing stockpile located about 44.60 kilometres north of Narrabri	Existing stockpile
N2M C8	Disturbed area located north of Gehan Creek just south of the southern limit of N2MS3 about 46.10 kilometres north of Narrabri	Disturbed area
N2M C9	Vacant land located about 47.2 kilometres north of Narrabri	Vacant land between park and service station
N2M C10	Existing rest area located about 48.7 kilometres north of Narrabri	Woolabrar Rest Area
Within or near to N2MS4		
N2M C11	Existing rest area located about 52.2 kilometres north of Narrabri	Tookey Creek Rest Area
N2M C12	Existing truck park area located about 54.3 kilometres north of Narrabri	Existing truck park area
N2M C13	Disturbed area about 58.5 kilometres north of Narrabri. This site is located to the north of N2MS4.	Disturbed area
Within or near to N2MS5		
N2M C14	Disturbed area near Clarkes Gully, located about 87.5 kilometres north of Narrabri. This site is located south of N2MS5.	Existing disturbed area
N2M C15	Existing stockpile located about 94 kilometres north of Narrabri north of Halls Creek	Existing stockpile

Ancillary facilities would predominantly be used during standard construction hours however in some instances these facilities may need to be used outside of standard construction hours to facilitate construction activities. In these instances, appropriate management measures would be implemented in accordance with the CEMP and consultation would occur with potentially impacted receivers to minimise impacts.

The compounds sites would be managed and secured as per the project REF.

The exact location and proposed use of ancillary sites would be confirmed by the construction contractor before the start of construction. Where amendments or additional ancillary facilities are identified during construction outside of the project construction boundary, the contractor would consult with TfNSW's lead environment advisor to confirm the suitability of the proposed amendment or additional facility, and whether any additional environmental assessment is required.

3.4.2 Asphalt batch plants

Asphalt would potentially be sourced from an asphalt plant situated at Johnstone Concrete and Landscape Suppliers (JCLS) at Narrabri or Moree Council Depot. The foam bitumen batch could potentially also be located at JCLS as well. The operation of the plant would be under JCLS Environment Protection Licence (EPL).

A foam bitumen batch plant would be located at N2M C2 (refer to **Appendix A**) for about 12 months. This foam bitumen batch plant was not assessed as part of the project REF. Noise impacts from this foam bitumen batch plant is considered in **Section 6.3.3**.

N2M C2 is already cleared of native vegetation and is currently used for agriculture purposes. Site establishment work for the batch plant within N2M C2 would typically comprise the following activities:

- Installation of sediment controls
- Installation of fencing
- Levelling and grading of the site
- Construction of water quality dams to capture runoff from batching facility operations
- First flush containment system
- Placement of fill and hardstand materials to form weather-proof hardstand areas, where required
- Establishment of testing pad including amenities, car park, chemical stores and site sheds
- Installation and erection of batching facility and service connections.

The batch plant would cover an area of about 1,000 square metres and accommodate the following facilities:

- Asphalt batch plant
- Material stockpile and processing areas
- Fenced testing pad area (including car park area, amenities, site shed, and chemical storages water quality basins.

The batch plant operations would be carried out in accordance with a project EPL. Any work outside of the approved hours would be carried out in accordance with the EPL and the Noise and Vibration Management Plan (NVMP).

3.4.3 Construction sediment basins

Construction of the proposed modification has the potential to affect water quality through erosion of exposed or disturbed areas and subsequent sedimentation of watercourses. To mitigate these effects, three temporary construction basins would be installed within N2MS5 to

trap sediments and other pollutants from disturbed areas. Additional soil and water management measures would also be developed and included in the CEMP.

The size or location of the basins was not determined during the concept design. The design criteria for the sedimentation basins are defined in the Blue Book (Soils and Construction, 2004 and 2008 Volume 2D Main Road) which requires that sediment basins be designed for the 85th percentile, five-day rainfall depth for basins located near sensitive receiving environments, and for the 80th percentile for non-sensitive receiving environments. The sediment basins would need to provide sufficient volume for settling and storage of sediments.

Typically, the construction basins would be in the order of 1,000 cubic metres (total basin volume) with a minimum water depth of 1.5 metres and length to width ratio of 3 to 1. The basins sizes have been estimated for high runoff potential soils (Type D, as per the blue book) and other design input parameters include, soil type, rainfall erosivity (which is a function of local rainfall intensity), soil hydrologic group, volumetric runoff coefficients and soil erodibility and the Blue Book design methodology.

The potential locations and sizes of temporary sediment basins for the construction phase are listed in **Table 3-6** and **Appendix A**.

Table 3-6 Temporary sediment basin details

Basin	Location	Catchment area (hectares)	Total volume (m^3)
SB01	Northbound side of the Newell Highway, at chainage 92160	7.1	1,162
SB02	Southbound side of the Newell Highway, at chainage 94120	7.6	1,240
SB03	Northbound side of the Newell Highway, at 94120	7.1	1,168

3.4.4 Over size and over mass vehicle pull over bays

A number of OSOM vehicle pull over bay would be required to facilitate works in each of the segments. The location of these pull over bays is not known at this stage. It is expected that that they would be combination of existing facilitates and potential locations for new site which are located in areas devoid of native vegetation within the road corridor or on adjacent private property under a leasing arrangement.

The pull over bays locations would be identified on the basis of:

- A pull over bay is at the start of the works in each direction
- The maximum spacing of nine kilometres between bays where a segment is greater than nine kilometres long
- They are no more than four kilometres before the start of works in the direction of travel
- The identified area has been previously disturbed and no additional clearing is required.

The exact location of the OSOM pull over bay locations would be confirmed by the construction contractor before the start of construction. Once the contractor has a preferred location for the OSOM vehicle pull over bay locations, they would consult with TfNSW's Environmental Officer before any work in those locations to identify if any additional environmental assessment is required.

3.5 Public utility adjustment

As described in the project REF, the following utilities may require relocation:

- Telecommunications – Telstra, NextGen, NBN and AARNet
- Electricity – Essential Energy

- Stormwater drainage – Moree Plains Shire Council
- Water and sewer – Narrabri Shire Council.

All utilities impacted by the proposed modification have been included in the project construction boundary which is considered as part of this addendum REF. Any further adjustments that extend beyond the project construction boundary show in **Appendix A** require a separate environmental assessment.

3.6 Property acquisition

TfNSW and Council aim to create a 60 metre minimum width road reserve corridor. The full acquisition details required for the project (project REF and proposed modification combined) is detailed in **Table 3-7**. Partial strip acquisition of about 80 hectares would be required from 26 private and eight publicly owned lands would be required.

All acquisitions would be conducted in accordance with the Roads and Maritimes' *Land Acquisition Policy*, and compensation would be based on the requirements of the *Land Acquisition (Just Terms) Compensation Act 1991.*

TfNSW would also require a part lease of land from one property which would potentially be used for an ancillary site (N2M C6 (Lot 1 DP1038813)), refer to **Section 3.4**. The need for lease arrangements would be confirmed by the construction contractor. Consultation regarding agreements would be carried out with the identified landowners and TfNSW prior to the start of construction.

This text has been removed for confidentiality purposes

4 Statutory and planning framework

The *Environmental Planning and Assessment Act 1979* (EP&A Act) and its associated regulation provide the framework for assessing the environmental impacts of proposed developments in NSW. The EP&A Act allows for the creation of environmental planning instruments (EPIs) including Local Environmental Plans (LEPs) and State Environmental Planning Policies (SEPPs). Presented below is a discussion on the approval process under the EP&A Act and the relevance of specific EPIs. Also discussed below are other legislative requirements of relevance to the proposed modification.

As outlined in **Chapter 1**, TfNSW is the determining authority under Division 5.1 of the EP&A Act. This REF has been prepared by Jacobs on behalf of TfNSW. The purpose of the REF is to describe the proposed modification, to document the likely impacts of the proposed modification on the environment, and to detail protective measures to be implemented.

The description of the proposed modification and associated environmental impacts has been carried out in context of clause 228 of the Environmental Planning and Assessment Regulation 2000 (summarised in **Appendix B**), the BC Act, the FM Act, and the EPBC Act. In doing so, the REF helps to fulfil the requirements of section 5.5 of the EP&A Act that TfNSW examine and take into account to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

The findings of the REF would be considered when assessing:

- Whether the proposed modification is likely to have a significant impact on the environment and therefore the necessity for an EIS to be prepared and approval to be sought from the Minister for Planning and Infrastructure under Division 5. 2 of the EP&A Act
- The significance of any impact on threatened species as defined by the BC Act and/or FM Act, in section 1.7 of the of the EP&A Act and therefore the requirement for a SIS or a BDAR.

4.1 Environmental Planning and Assessment Act 1979

4.1.1 State Environmental Planning Policies

State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to facilitate the effective delivery of infrastructure across the State.

Clause 94 of ISEPP permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

As the proposed modification is for the purposes of a road and associated road infrastructure facilities and is to be carried out on behalf of TfNSW, it can be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979*. Development consent from council is not required.

The proposed modification is not located on land reserved under the *National Parks and Wildlife Act 1974* (NPW Act) and does not affect land or development regulated by State Environmental Planning Policy No. 14 - Coastal Wetlands, State Environmental Planning Policy No. 26 - Littoral Rainforests, State Environmental Planning Policy (State and Regional Development) 2011 or State Environmental Planning Policy (Major Development) 2005.

Part 2 of the ISEPP contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain types of development. Consultation, including consultation as required by ISEPP (where applicable), is discussed in **Chapter 5** of this REF.

State Environmental Planning Policy No 44 – Koala Habitat Protection

The Narrabri and Moree Plains Local Government Areas (LGA) are identified under Schedule 1 of State Environmental Planning Policy No 44 – Koala Habitat Protection (SEPP 44). The SEPP encourages the conservation and management of natural vegetation areas that provide habitat for koalas to ensure that permanent free living populations would be maintained over their present range.

TfNSW is not bound by the provisions of SEPP 44 for Part 5 assessments. However, as SEPP 44 is applicable to the Narrabri and Moree Plains LGAs, the principles of conservation would be adopted for the proposed modification where applicable.

The biodiversity assessment carried out by Jacobs (Jacobs, 2018) as part of the project REF, found no conclusive evidence of Koala occupation within the study area, however Koalas were recorded north of Moree, during field surveys carried out for North Moree Heavy Duty Pavement upgrade.

4.1.2 Local Environmental Plans

The proposed modification is located within the Narrabri Shire and Moree Plains Shire LGAs, on land which is subject to the Narrabri Shire Local Environmental Plan 2012 (Narrabri Shire LEP) and Moree Plains Local Environmental Plan 2011 (Moree Plains LEP).

Narrabri Shire Local Environmental Plan 2012

The Narrabri Shire LEP applies to land within the Narrabri Shire LGA. In this LGA, the proposed modification is located within land zoned as RU1 Primary Production and RU5 Village. The land use objectives for these zones under the LEP, and the project's consistency with those objectives, is detailed in the project REF.

Moree Plains Local Environmental Plan 2011

The Moree Plains LEP applies to land within the Moree Plains Shire LGA. In this LGA, the proposed modification is located within land zoned as RU1 Primary Production, RU5 Village, SP2 Infrastructure, SP1 Air Transport Facility and B6 Enterprise Corridor Zones. The land use objectives for these zones under the LEP, and the proposed modifications consistency with those objectives, is detailed in the project REF.

The proposed modification, under ISEPP is permitted without the consent of council. Therefore, the consent requirements of the LEP do not apply and the proposed modification may be determined under Division 5.1 of the EP&A Act. Other relevant NSW legislation.

4.2 Other relevant NSW legislation

4.2.1 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) provides the legal framework for the management of air, noise, water and waste pollution. Under Section 48 of the POEO Act, scheduled activities (as defined in Schedule 1 of the Act) require an EPL.

As per the project REF, the proposed modification would still involve extractive activities, crushing, grinding or separating waste processing or storage. Therefore, the proposed modification is considered a scheduled activity for the purposes of clause 19 under Schedule 1 of the POEO Act and an EPL is required as described in the project REF.

4.2.2 Roads Act 1993

The *Roads Act 1993* (Roads Act) provides for the classification of roads. It also provides for the declaration of TfNSW and other public authorities as roads authorities for both classified and unclassified roads. It also regulates the carrying out of various activities in, on and over public roads.

Under Section 138(1) of the Roads Act, consent from the road authority is required for carrying out various activities in, on and over public roads. The Newell Highway is a classified road and requires consent from the road authority to proceed. Approval would be sought for a road occupancy licence for the temporary closure of traffic lanes and, if required, the movement of over-sized vehicles during construction. Consent to carry out works on classified roads is not required as per Schedule 2 clause 5(1) of the Roads Act. However, a Road Occupancy Licence (ROL) will need to be obtained as necessary prior to construction commencing.

The project is located on land which is mapped as crownland under the *Crown Lands Management Act 2016* (refer to **Section 4.2.8**), potentially requiring a licence for the project. TfNSW may take possession of land in accordance with Part 11, Division 2, Section 175(1)(a) of the Roads Act for the purpose of road work on a road or a proposed road. In accordance with Part 11, Division 2, Section 175(2) Transport for NSW would provide Department of Trade and Investment (Crown Lands Division) with at least seven days' written notice of its intention to exercise the power.

4.2.3 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) commenced on 25 August 2017 repealing the *Threatened Species Conservation Act 1995*. The BC Act seeks to conserve biological diversity and promote ecologically sustainable development (ESD); to prevent extinction and promote recovery of threatened species, populations and ecological communities; and to protect areas of outstanding biodiversity value. The BC Act provides a listing of threatened species, populations and ecological communities, areas of outstanding biodiversity value, and key threatening processes.

Part 7 of the BC Act requires that the significance of the impact on threatened species, populations and endangered ecological communities listed under the BC Act or FM Act, are assessed using a five-part test. Where a significant impact is likely to occur, a SIS or BDAR must be prepared in accordance with the Secretary's requirements.

In September 2015, a "strategic assessment" approval was granted by the Federal Minister in accordance with the EPBC Act. The approval applies to TfNSW activities being assessed under Division 5.1 of the EP&A Act with respect to potential impacts on nationally listed threatened species, ecological communities and migratory species.

As a result, TfNSW proposals assessed via an REF:

- Must address and consider potential impacts on nationally listed threatened species, populations, ecological communities and migratory species, including application of the "avoid, minimise, mitigate and offset" hierarchy
- Do not require referral to the Department of Agriculture, Water and the Environment for these matters, even if the activity is likely to have a significant impact.

TfNSW must consider impacts to nationally listed threatened species, ecological communities and migratory species as part of the approval process under the strategic assessment. To assist with this, assessments are required in accordance with the Matters of National Environmental Significance: Significant impact guidelines 1.1. *Environment Protection and Biodiversity Conservation Act 1999* (DoE 2013). Approval is not required under this act.

4.2.4 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) establishes fundamental functions of the NSW National Parks and Wildlife Service. These include the conservation of nature, objects, features, places and management of land reserved under this Act. The NPW Act also sets out to protect and preserve Aboriginal heritage values.

A portion of a potential archaeological deposit (PAD) is located within the project construction boundary. However the archaeological test excavation did not confirm the presence of any Aboriginal objects or features within the portion of the PAD located within the project construction boundary and an AHIP would not be required. This addendum REF considers potential impacts to native flora and fauna and Aboriginal heritage (refer to **Section 6.1** and **Section 6.4**).

4.2.5 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) aims to conserve, develop and share the fisheries resources of the State for the benefit of present and future generations, including conserving fish stocks and key fish habitats and promoting ecologically sustainable development. The FM Act applies to all waters within the limits of the State, except where Commonwealth legislation applies.

Part 7A Division 4 of the Act prohibits the carrying out, without a licence, of activities that damage habitats or harm threatened species, populations or ecological communities. In determining the significance of impacts, the determining authority must consider the matters listed in section 1.7 of the EP&A Act.

The proposed modification would not directly impact aquatic habitat or block the passage of fish as no bridges or large culverts would be upgraded, therefore notice to the Minister is not required.

4.2.6 Heritage Act 1997

The *Heritage Act 1977* (Heritage Act) aims to provide for the identification, registration and conservation of items of State heritage significance.

Investigations of the proposed modification's potential to interact with or impact on items of heritage significance are detailed in **Section 6.5**. The proposed modifications is not expected directly impact any heritage item, there for approval under the Heritage Act is not required. The mitigation measures provided in Section 7.2 would be implemented to avoid inadvertent impact to these items.

4.2.7 Land Acquisition (Just Terms Compensation) Act 1991

The proposed modification would require partial strip acquisition of private and publicly owned land. Details regarding property acquisition for the project are outlined in **Section 3.6**. All property acquisitions would be carried out in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*, which aims to guarantee just compensation terms for land that is acquired by an authority of the State.

TfNSW would continue to consult with affected landowners in relation to property acquisition.

4.2.8 Crown Lands Act

The *Crown Lands Act 1989* provides the legislative framework for the administration of land that is vested in the Crown in NSW. Division 5 of the *Crown Lands Act 1989* deals with matters related to the requirements for the creation of easements over Crown land.

A Community Engagement Strategy (CES) which is required to be exhibited for at least 28 days and approved by the Minister (lands and forestry) is required for any action affecting Crown land use including licences and leases, however is not required for acquisition of land.

Partial acquisition of Crown land would be required for the proposed modification (land acquisition details are provided in **Section 3.6**). TfNSW has consulted with the department of Crown Land in New South Wales and sent a formal letter stating interest in these parcels of land. In response the Crown Land in New South Wales acknowledged the letter and agreed to further discussion. TfNSW will consult further with Crown lands regarding any licence/lease requirements. The Crown land within and around the project is shown on Figure 4-2 of the project REF with land acquisition described in **Section 3.6**.

A license to occupy an area of crown land would be required prior to the start of construction for any ancillary facilities that would be located on crown land that is not to be acquired.

4.2.9 Native Title Act 1994 (NSW)

The *Native Title (NSW) Act 1994* was introduced to ensure that the laws of NSW are consistent with the Commonwealth *Native Title Act 1994*. It validates past and intermediate acts which may have been invalidated because of the existence of native title.

The Gomeroi People Aboriginal Land Claims (ALC) (NC2011/006); Federal Court file no. NSD37/2019 has registered over 11 million hectares of northern NSW, becoming one of the largest registered claims in Australia, and the second largest filed by NSW and Australian Capital Territory representative body (NTSCORP). The Gomeroi claimant group includes most of the Aboriginal population of the NSW North-West slopes and plains, represented by a procedural description of 114 apical ancestors. The Gomeroi claim are over the Crown land parcels in the following section:

- N2MS2 – ALCs 10611 and 44234
- N2MS3 – ALC 40866

- N2MS4 – ALCs 10420 and 10421
- N2MS5 – ALCs 28292 and 44093.

4.2.10 Aboriginal Land Rights Act 1983

The *Aboriginal Land Rights Act 1983* recognises the rights of Aboriginal people in NSW and provides a vehicle for the expression of self-determination and self-governance.

The purposes of the Act are:

- To provide land rights for Aboriginal persons in NSW
- To provide for representative Local Aboriginal Land Councils (LALC) in NSW
- To vest land in those LALCs
- To provide for the acquisition of land, and the management of land and other assets and investments, by or for those LALCs and the allocation of funds to and by those LALCs
- To provide for the provision of community benefit schemes by or on behalf of those LALCs.

4.2.11 Biosecurity Act 2015

The *Biosecurity Act 2015* (Biosecurity Act) and its subordinate legislation commenced on 1 July 2017. The Biosecurity Act replaces wholly or in part 14 separate pieces of biosecurity related legislation including the *Noxious Weeds Act 1993*. Under the Biosecurity Act, all plants, including weeds are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

The Biosecurity Act and regulations provide specific legal requirements for high risk activities and State level priority weeds. The study area contains substantial weed growth, mainly in close proximity to the existing Newell Highway and along minor roads and tracks. Weeds of particular concern include exotic perennial grasses such as Coolatai grass (*Hyparrhenia hirta*) and Guinea grass (*Megathyrsus maximus*) which were recorded in the study area.

4.2.12 Water Management Act

An approval under the *Water Management Act 2000* (WM Act) would be required if access to ground or surface water is required during construction, owing to the existence of the Water Sharing Plan for the Water Sharing Plan for the NSW Great Artesian Basin Groundwater Sources 2008. Some provisions of the WM Act (eg for stock and domestic uses and harvestable rights) enable some activities or works to be carried out without the need for licences, provided certain conditions are met.

Under the Water Management (General) Regulation 2018, TfNSW is exempt from requiring a license for accessing ground or surface water for the purpose of road maintenance and construction. If a new extraction point is required then the location of that new extraction point would need to be gazetted.

TfNSW, would consult with the NSW Office of Water to ensure that all applicable licences and/or approvals for any impacts to surface and ground water are obtained prior to construction.

4.2.13 Surveying and Spatial Information Act 2002

The *Surveying and Spatial Information Act 2002* is to make provision with respect to the functions of the Surveyor-General, the registration of surveyors, the control of surveys and the constitution and functions of the Board of Surveyors and Spatial Information.

Under this act TfNSW will need to prepare an application for any survey markers that are unable to be avoided by the project. As such an Application for Surveyor General Approval - Survey Mark(s) Removal will be submitted for removal of the blaze tree (Newell Highway HS-01).

4.3 Commonwealth legislation

4.3.1 Environment Protection and Biodiversity Conservation Act 1999

Under the EPBC Act a referral is required to the Australian Government for proposed actions that have the potential to significantly impact on matters of national environmental significance or the environment of Commonwealth land. These are considered in **Appendix B** and **Section 6** of the REF.

A referral is not required for proposed road activities, as described in this addendum REF and the project REF, that may affect nationally listed threatened species, populations, endangered ecological communities and migratory species. This is because requirements for considering impacts to these biodiversity matters are the subject of a strategic assessment approval granted under the EPBC Act by the Australian Government in September 2015.

Potential impacts to these biodiversity matters are also considered as part of **Section 6.1** and **Appendix B**.

The assessment of the proposed modification's impact on nationally listed threatened species, endangered ecological communities and migratory species found that there is likely to be a significant impact on relevant matters of national environmental significance. **Chapter 6.1.4** describes the safeguards and management measures to be applied to minimise or mitigate impacts. **Chapter 6.1.5** also details the Biodiversity Offset Strategy to be implemented to address residual significant impacts on nationally listed biodiversity matters.

4.3.2 Native Title Act 1993

The *Native Title Act 1993* provides the legislative framework that:

- Recognises and protects native title
- Establishes ways in which future dealings affecting native title may proceed, and to set standards for those dealings, including providing certain procedural rights for registered native title claimants and native title holders in relation to acts which affect native title
- Establishes the National Native Title Tribunal.

The National Native Title Tribunal has a number of functions under the Act including maintaining the Register of Native Title Claims, the National Native Title Register and the Register of Indigenous Land Use Agreements and mediating native title claims.

The project construction boundary as shown in **Appendix A** includes crownland currently subject to Native Title Claim by the Gomeroi People (Tribunal file no. NC2011/006; Federal Court file no. NSD37/2019.

4.4 Confirmation of statutory position

The proposed modification is categorised as development for the purpose of a road and is being carried out by or on behalf of a public authority. Under clause 94 of the ISEPP the proposed modification is permissible without consent. The proposed modification is not State significant infrastructure or State significant development. The proposed modification can be assessed under Division 5.1 of the EP&A Act.

TfNSW is the determining authority for the proposed modification. This REF fulfils TfNSW's obligation under clause 5.5 of the EP&A Act to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the activity.

TfNSW has formed the view that the proposed modification is not likely to significantly affect the environment and would not require the preparation of an EIS.

5 Consultation

This chapter discusses consultation carried out to date for the proposed modification and consultation proposed for the future.

5.1 Consultation strategy

Any further community consultation would be carried out in accordance with the Communication Engagement Plan (CEP) prepared and implemented for the Newell Highway Heavy Duty Pavements, North Moree Project, which forms part of the Newell Highway package of work. The CEP describes the communication and consultation approach and activities for the project to keep key stakeholders and the community informed during construction. A range of engagement tools and activities would be used before and throughout construction to provide information to, and receive feedback from, stakeholders and the local community.

5.2 Community involvement

No specific consultation regarding the proposed modification has been carried out to date. However ongoing consultation regarding the project has been carried out.

To date, consultation for the project has been with the communities of Bellata and Edgeroi. Consultation has also been carried out with directly affected property owners and landowners with land adjoining the project but not affected, via emails and phone calls.

In November 2019, TfNSW consulted with the Bellata and Edgeroi communities. A postcard with details of the project was letterbox dropped. The postcard outlined the benefits of the project, timing of the community information sessions, inviting submissions and comments on the detailed design. The postcard provided a link to the project website, and also provided contact details for the project team. Two sessions were held, located at:

- Bellata War Memorial Hall, Wilga Street Bellata on:
  - Wednesday 20 November 2019 between 4pm and 7pm
- Edgeroi Community Hall, Homestead Road Edgeroi on:
  - Thursday 21 November 2019 between 4pm and 7pm.

About 15 and 12 people attended the Bellata and Edgeroi drop in sessions respectively. Generally, the responses from the people who attended the drop in sessions were positive. There was concern about flooding and the left in/left out treatment at Queen Street South at Edgeroi. TfNSW responded that:

- The flooding modelling for the 100 percent detail would provide better flood immunity than what current exists along the Newell Highway and the project would also reducing the afflux impacts of the Newell in the Edgeroi village
- The Queen Street south intersection concerns were considered however the safety and access improvements for the other intersection would more than accommodate for the slight loss of convenience in being able to make a right turn into Queen Street South.

TfNSW also consulted with the Bellata Police Station, Post Office and the BP Service Station to discuss parking changes.

5.3 Aboriginal community involvement

TfNSW is committed to effective consultation with Aboriginal communities regarding TfNSW activities and their potential for impact on Aboriginal cultural heritage. Consultation with Aboriginal people has been carried out for the proposal in accordance with the *Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (PACHCI) (Roads and Maritime Services, 2011), the OEH *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* and the requirements of Clause 80C of the National Parks and Wildlife Regulation 2009. An outline of the PACHCI procedure is presented in **Table 5-1**.

Aboriginal community consultation commenced in February 2020 following the OEH *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (ACHCRs).

Table 5-1 Summary of TfNSW Procedure for Aboriginal Cultural Heritage Consultation and Investigation

Stage	Description
Stage 1	Initial desktop assessment to identify whether the proposal is likely to harm Aboriginal cultural heritage.
Stage 2	Further assessment and site survey with Aboriginal stakeholders to assess a proposal's potential to harm Aboriginal cultural heritage and to identify whether formal Aboriginal community consultation and an Aboriginal cultural heritage assessment report (ACHAR) is required.
Stage 3	Where Stages 1 and 2 have let to the preliminary view that harm to Aboriginal objects or places will occur or is likely to occur, formal consultation and preparation of an ACHAR must be completed. This stage may also involve archaeological test excavations.
Stage 4	Not required.

Aboriginal community consultation carried out to date has involved:

- A list of Aboriginal stakeholders with possible interest in the proposal was compiled and written correspondence was sent to relevant Government agencies on 6 March 2020
- An advertisement was placed in the *Narrabri Courier* on 9 April 2020 requesting registrations of interest in the proposal and provided 14 days to register interest
- Five registrations were received from the Narrabri LALC, Pilliga LALC, Wee Waa LALC, Gomeroi People Native Title Group (applicants) and Gomeroi Dreaming Pty Ltd
- The *Archaeological Test Excavation Methodology: Newell highway Heavy Duty Pavement – Narrabri to Moree. BC-HW17-PAD1 investigation* was issued to the Registered Aboriginal Parties (RAPs) for review and comment on 9 June 2020
- An Aboriginal focus Group (AFG) meeting was held on 18 June 2020 in Narrabri to allow comment on the archaeological test excavation methodology
- The archaeological test excavation was carried out on 14 July 2020 with representatives from the Narrabri LALC, Pilliga LALC, Gomeroi Dreaming Pty Ltd, Gomeroi People Native Title Group (applicants), archaeologists from OzArk and TfNSW.

The *Aboriginal and Historic Assessment Report Addendum - Newell Highway Heavy Duty Pavements – Narrabri to North Moree* (OzArk Environment & Heritage Management (OzArk, 2020)) (**Appendix C**) provides further details of the consultation carried out with Aboriginal stakeholders.

5.4 Consultation outcomes

During the development of the project, consultation has been carried out with the local community, the Aboriginal community as well as government and agency stakeholders. This consultation is documented in the project REF and submission report.

No additional consultation activities from those carried out for the project REF are expected for the proposed modification other than with directly impacted property owners.

Appendix D contains an ISEPP consultation checklist that documents how ISEPP consultation requirements have been considered. Further ISEPP consultation is not required.

Various government agencies and stakeholders have been consulted about the proposed modification including:

- Department of Trade and Investment (Crown Lands Division)
- Local Land Services
- Australian Rail Track Corporation (ARTC)

- Gomeroi People Native Title Group (applicants), Gomeroi Dreaming Pty Ltd, Narrabri, Pilliga and Wee Waa LALCs (see **Section 5.3**).

5.5 Ongoing or future consultation

Ongoing consultation would be required by the construction contractor and TfNSW to update local property owners, road users and other key stakeholders of the project (including these proposed modifications to the project REF boundary). Consultation activities would be carried out as per the project REF.

6 Environmental assessment

This section of the addendum REF provides a detailed description of the potential environmental impacts associated with the construction and operation of the proposed modification of the determined project. All aspects of the environment potentially impacted upon by the proposed modification are considered. This includes consideration of the factors specified in the guidelines *Roads and Related Facilities EIS Guideline* (DUAP, 1996) and *Is an EIS required?* (DUAP, 1999) as required under clause 228(1) of the Environmental Planning and Assessment Regulation 2000. The factors specified in clause 228(2) of the Environmental Planning and Assessment Regulation 2000 are also considered in **Appendix B**.

Site-specific safeguards and management measures are provided to ameliorate the identified potential impacts.

6.1 Biodiversity

The potential impacts of the proposed modification on biodiversity are assessed in the *Newell Highway - Heavy Duty Pavement Upgrade between Narrabri and Moree – Addendum Biodiversity Assessment Repor*t (ABAR) (AREA Environmental Consultants (AREA), 2020), provided in **Appendix E** and summarised below. The potential impacts, and any additional safeguards to mitigate them, are also summarised in this section.

6.1.1 Background

A biodiversity assessment report (BAR) was completed by Jacobs in May 2018 as part of the project REF. The BAR identified the potential for significant impact to the following entities listed under the EPBC Act:

- Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland which is a critically endangered ecological community (CEEC)
- Homopholis belsonii (Belson's Panic)
- Five-clawed Worm-skink (*Anomalopus mackayi*).

The supplementary biodiversity assessment carried out by AREA (AREA, 2018) sought to confirm the presence and extent of CEEC's and species habitat within the study area.

The BAR concluded the determined project would have a significant impact on the Natural grasslands CEEC through the removal of about 11.31 hectares within N2MS5. AREA concluded that challenging Jacobs determination of a significant impact to the Natural grasslands CEEC listed under the EBPC Act, would rely on at best subjective opinion because the evidence provided in the BAR is technically sound even after applying in-depth critique. Therefore, in the project REF, the project was considered likely to have a significant impact on the Natural Grasslands CEEC within N2MS5.

The supplementary biodiversity assessment (AREA, 2018) confirmed the presence of the EPBC Act listed *Homopholis belsonii* (Belson's Panic) in the study area. The supplementary biodiversity assessment for the project REF concluded that a significant impact to *Homopholis belsonii* (Belson's Panic) populations would only occur in one of the five segments (N2MS2) as opposed to the three segments (N2MS2, N2MS4 and N2MS5) originally assessed in the project REF. The determined project was still considered likely to have a significant impact on *Homopholis belsonii* (Belson's Panic) within N2MS2.

The determined project would require the removal of habitat listed as being associated with the Five-clawed Worm-skink (*Anomalopus mackayi*). This is consistent with the finding of the BAR. However, Gerry Swan (a subject matter expert commissioned by AREA) determined that much of the land in the road corridor is unsuitable habitat. In addition, any remaining areas of suitable habitat within the study area would likely to be modified by edge effects that may change the soil surface and microhabitat conditions, altering its suitability for this species. Based on the information available, AREA (AREA, 2018) concluded that the determined project was not at risk of causing a significant impact (as defined under the EPBC Act) on a viable local population of the Five-clawed Worm-skink (*Anomalopus mackayi*).

Since the determination of the project REF, Poplar Box Grassy Woodland on Alluvial Plains has been listed an endangered ecological community (EEC) under the EPBC Act.

6.1.2 Methodology

The BAR (AREA, 2020) was prepared to consider additional impacts from the proposed modification to meet the requirements of the EP&A Act. As part of this assessment a field survey were carried out over three days from 16 to 18 December 2019 for the additional land requiring assessment as well as targeted threatened species searches. The likelihood of occurrences for threatened species was also reviewed and updated database searches were completed. The impact of the proposed modification were determined and the significant assessments were updated.

6.1.3 Existing environment

The locality is located within the Brigalow Belt South Interim Biogeographically Regionalisation of Australia (IBRA) bioregion as defined by Thackway and Cresswell (1995).

The area surrounding the project is characterised by a rural environment which is predominately cleared of native vegetation and replaced with cropping and grazing. The retention of remnant vegetation has been greatest in the road reserve which has been traditionally used as a travelling stock reserve.

For the full description of the existing environment refer to the BAR (Jacobs, 2018) completed for the project REF.

6.1.4 Potential impacts

Construction

Removal of native vegetation

As outlined in **Section 3**, the proposed modification would result in an increased project construction boundary. These changes have been considered against the outcomes of the BAR (Jacobs 2018) that was carried out for the project REF and submissions report.

The project REF estimated that about 47 hectares of native vegetation clearing would be required for the project. The proposed modification identified that a total of about 75.92 hectares of native vegetation clearing would require for the project (project REF and proposed modifications combined). A summary of the vegetation loss for each segment is shown in **Table 6-1**.

Table 6-1 Native vegetation loss across each segment

Segment	Native vegetation loss (ha)	Loss of state listed EECs (mod-good quality) (BC Act)	Loss of national listed TECs (mod-good quality) (EPBC Act)	Confirmed threatened plant species impacted
N2MS1	21.44	0.3	0.3	
N2MS2	12.67	3.82	1.41	Yes
N2MS3	9.1	0.08	0.79	
N2MS4	12.61	3.51	11.21	Yes
N2MS5	20.1	0.01	15.53	Yes
TOTAL	**75.92**	**7.45**	**28.97**	

A breakdown of native vegetation removal in each Plant Community Types (PCT) and vegetation zone for the project (project REF and proposed modification combined) is shown in **Table 6.2**.

The project would also result in the removal of:

- Less than one hectare of planted eucalypts, consisting of a mix of locally native species and species which are unlikely to occur naturally in the study area
- About 31.85 hectares of non-native vegetation which consists mainly of grassland/ herbfield dominated (>50% of vegetation cover) by exotic species.

Table 6-2 Impacts on vegetation across whole project (proposed modification and Project REF) area including TECs

Plant community type (PCT)	Condition class	BC Act	EPBC Act	Project[1] (hectares)	Percent cleared[2]
Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions (55)	Moderate to Good (Relatively Intact)	EEC	EEC	1.93	75
	Moderate to Poor (Derived Grassland)	No	No	0.32	
Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt South Bioregion (445)	Moderate to Good (Relatively Intact)	EEC	EEC	1.47	90
	Moderate to Poor (Derived Grassland)	No	No	0.87	
Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion (628)	Moderate to Good (Relatively Intact)	EEC	No	3.04	90
	Moderate to Poor (Derived Grassland)	No	No	1.24	
Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion (147)	Moderate to Good (Relatively Intact)	EEC	EEC	0.11	83
Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW (56)	Moderate to Good (Relatively Intact)	No	EEC3	8.34	78
	Moderate to Poor (Derived Grassland)	No	No	0.42	
Poplar Box - White Cypress Pine shrub grass tall woodland of the Pilliga - Warialda region, Brigalow Belt South Bioregion (397)	Moderate to Good (Relatively Intact)	No	No	9.38	45
	Moderate to Poor (Derived Grassland)	No	No	17.26	
Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (52)	Moderate to Good (Relatively Intact)	No	CEEC	16.22	70
	Moderate to Poor (Derived Grassland - simplified)	No	No		
Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (27)	Moderate to Good (Relatively Intact)	EEC	EEC	0.9	86
	Moderate to Poor (Derived Grassland)	No	No	14.41	
Planted eucalypts	-	No	No	<1ha	-
Non-native vegetation	-	No	No	~30ha	-
Total clearing of BC Act listed threatened ecological communities					7.45
Total clearing of EPBC Act listed threatened ecological communities					28.97
Total clearing of native vegetation in moderate to good (relatively intact) condition					41.39
Total clearing of native vegetation in moderate to poor (derived grassland) condition					34.53
Total clearing of native vegetation					**75.92**

1- Area to be cleared based on ground-truthed vegetation mapping within the study area.
2- Based on the VIS classification database for the entire PCT

Removal of threatened ecological communities

The estimated clearing of TECs for the project (project REF and proposed modification combined) is shown in **Table 6-3** and **Table 6-4**.

Table 6-3 TECs impacted by the proposed modification (BC Act)

TEC (BC Act)	N2MS1 (ha)	N2MS2 (ha)	N2MS3 (ha)	N2MS4 (ha)	N2MS5 (ha)	Total (ha)	Impact on local viable population (1500m)	Residual local viable population (1500m) ha
Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions	-	-	-	2.04	-	2.04	<0.01%	51.47
Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions	-	-	-	1.47	-	1.47	2.78%	52.93
Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions	-	3.03	-	-	0.01	3.04	64.88%	4.67
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	0.03	0.79	0.08	-	-	0.9	<0.01%	386.06
TOTAL	**0.03**	**3.82**	**0.08**	**3.51**	**0.01**	**7.45**		

Table 6-4 TECs impacted by the proposed modification (EPBC Act)

Threatened Ecological Community (EPBC Act)	N2MS1 (ha)	N2MS2 (ha)	N2MS3 (ha)	N2MS4 (ha)	N2MS5 (ha)	Total (ha)	Impact on local viable population (1500m)	Residual local viable population (1500m) ha
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregion	-	-	-	2.04	-	2.04	<0.01%	51.47
Brigalow (*Acacia harpophylla* dominant and co-dominant)	-	-	-	1.47	-	1.47	2.7%	52.93
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	-	-	0.13	-	15.53	16.22	29.2%	39.26
Weeping Myall Woodlands	0.03	0.79	0.08	-	-	0.9	<0.01%	386.06
Poplar Box Grassy Woodland on Alluvial Plains	-	0.62	0.02	7.7	-	8.34	2.14%	380.28
TOTAL	**0.03**	**1.41**	**0.23**	**11.21**	**15.53**	**28.97**		

Threatened biodiversity

Vegetation that would be removed as part of the project provides suitable habitat for a range of threatened fauna and flora species listed under the BC Act and EPBC Act. As such, direct impacts to habitat for threatened species would occur during construction.

The direct impacts of the project (project REF and proposed modification combined) for threatened flora is provided in **Table 6-5** and for threatened fauna species is provided in **Table 6-6**.

Table 6-5 Summary of impacts on threatened flora species recorded

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act	
Digitaria porrecta	Finger Panic Grass	-	E	**Recorded** in the study areas of N2MS2, N2MS4 and N2MS5 during field surveys in a variety of PCTs (PCT 55, 27, 52). **Total known and potential habitat affected 49.17 hectares**
Homopholis belsonii	Belson's Panic	V	E	**Recorded;** found in the study areas of N2MS2 and N2MS4 during field surveys in a variety of PCTs (PCT 27, 35, 52, 55, 56). **Total known and potential habitat affected 28.86 hectares**
Desmodium campylocaulon	Creeping Tick-trefoil	-	E	**Recorded**; in the study area of N2MS5 during field surveys. Habitat, associated with the recorded locations, to be impacted includes: **Total known and potential habitat affected in N2MS5 = 31.54 hectares**

Table 6-6 Summary of habitat impacts on threatened fauna recorded

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act (or FM Act)	
Pomatostomus temporalis temporalis	Grey-crowned Babbler	-	V	**Recorded**; confirmed in the study areas of NMS1 NMS2 during field surveys. Also, highly likely to be present in N2MS3 and N2MS4. Habitat widespread. Associated habitat to be impacted includes: **Total known and potential habitat affected = 25.59 hectares**
Calyptorhynchus lathami	Glossy-black Cockatoo	-	V	**Recorded**; likely presence confirmed by chewed cones in roadside Belah in N2MS4 during field surveys. Belah habitat widespread. Associated habitat to be impacted includes: **Total known and potential habitat affected = 24.69 hectares**

Aquatic impacts

The aquatic impacts associated with the proposed modification are consisted consistent with the BAR (Jacobs, 2018) prepared for the project REF.

Injury and mortality

The injury and mortality impacts associated with the proposed modification are consisted consistent with the BAR (Jacobs, 2018) prepared for the project REF.

Groundwater dependent ecosystems

The impacts to groundwater dependent ecosystems associated with the proposed modification are consisted consistent with the BAR (Jacobs, 2018) prepared for the project REF.

Operation

The indirect / operation impacts such as wildlife connectivity, edge effects, noise and light impacts, fauna mortality invasion of weeds, pest and pathogens are consistent with the BAR (Jacobs, 2018) prepared for the project REF.

Cumulative impacts

The project REF considered the likely cumulative biodiversity impacts from recent projects available from the:

- North Moree Heavy Duty Pavement upgrade project
- Newell Highway Mungle Back Creek to Boggabilla heavy duty pavement project
- Previous Newell Highway upgrade projects.

The cumulative impacts of the proposed modification (proposed modification and Project REF) are provided in **Table 6-7**.

Table 6-7 Summary of potential cumulative impacts for endangered ecological communities and species recorded in the project construction boundary

Value impacted (area of community or species habitat)	Newell Highway Heavy Duty Pavement proposed modifications/projects – clearing in hectares			Other recent and future proposed modifications in the region	Cumulative impact
	Narrabri to Moree (this (proposed modification)	North Moree (planned proposed modification)	Mungle Back Creek to Boggabilla (proposed modification approved)		
Brigalow-Belah Woodland (Brigalow TEC; BC Act and EPBC Act)	1.45 ha	0 ha	17.5 ha	Unknown	18.95 ha
Weeping Myall open woodland (Weeping Myall TEC; BC Act and EPBC Act) (PCT 27)	0.9 ha	2.81 (BC Act / EPBC)	0	Unknown	3.71
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (EPBC Act CEEC) (PCT 52)	16.22 ha	9.62 ha	-.	Unknown	25.84
Homopholis belsonii (Belson's Panic)	28.86 ha	12.05	34 ha	Unknown	~50-100 ha
Desmodium campylocaulon (Creeping Tick-trefoil)	31.54 ha	14.37	41 ha	Unknown	~50-90 ha
Grey-crowned Babbler (*Pomatostomus temporalis*)	25.59 ha	6.44	34 ha	Unknown	~50-60 ha

Assessment of significance of impacts

Updated assessment of significance has been carried out for threatened species that have been positively identified within the project construction boundary or that are considered to have a moderate or high likelihood of occurring in the study area due to the presence of suitable habitat.

The assessments under the BC Act and FM Act concluded that, the proposed modification would not have a significant impact on the affected species and communities, within the meaning of the BC Act or FM Act and therefore a SIS is not required.

However, the assessment of relevant species and communities under the EPBC Act significance criteria identified a likely significant impact for one ecological community, as summarised below:

- *Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland* (Critically Endangered Act– EPBC): Almost entirely restricted to N2MS5. The proposed modification would remove 16.22 hectares of this community leaving a residual viable local population of 39.26 hectares

The ABAR found that the activity would not threaten the long term survival of nationally listed biodiversity matters and that suitable offset measures can be secured as set out in the Biodiversity Offset Strategy (BOS)for the project. Therefore, a referral is not required

EPBC Act Strategic Assessment

The strategic assessment is discussed in the BAR (Jacobs, 2018) where The *TfNSW Environment Protection and Biodiversity Conservation Act 1999 – Strategic Assessment policy* states biodiversity offsets are required when a significant impact is likely for threatened biodiversity entities listed under the EPBC Act (Transport for New South Wales 2005).

As the project may result in a significant impact upon one threatened ecological community listed under the EPBC Act; therefore, biodiversity offsets are required. The strategic assessment recommends that biodiversity offsets are calculated using the BC Act methodology. A BOS will be prepared for the project which will identify:

- The credits required under the BC Act to compensate for nationally listed threatened species, ecological communities and migratory species where a significant impact is likely; and
- Options available to meet the offset requirements for nationally listed matters on a ‘like-for-like’ basis.

6.1.5 Safeguards and management measures

No additional safeguards and management measure to those identified in the project REF for biodiversity have been identified.

6.1.6 Biodiversity offsets

Offset requirements

The BAR identified that the proposed modification is likely to have a significant impact on threatened biodiversity listed under EPBC Act, Therefore, TfNSW would provide biodiversity offsets or where offsets are not reasonable or feasible, supplementary measures for impacts that exceed the thresholds in **Table 6-8**.

Table 6-8 TfNSW offset thresholds

Description of activity or impact	Offsets required	Vegetation proposed to be offset
Activities in accordance with Transport for New South Wales Environmental assessment procedure: Routine and Minor Works (RTA 2011)	No	N/A
Works on cleared land, plantations, exotic vegetation where there are no threatened species or habitat present	No	None Applies to areas mapped as ‘not native’.
Works involving clearing of vegetation planted as part of a road corridor landscaping program	No	None Applies to the planted eucalypts vegetation only

Description of activity or impact	Offsets required	Vegetation proposed to be offset
(this includes where threatened species or species comprising listed ecological communities have been used for landscaping purposes)		
Works involving clearing of national or NSW listed critically endangered ecological communities (CEEC)	Where there is any clearing of a CEEC in moderate to good condition	Applies to the 16.22 hectares of *Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland* community (PCT 52) listed as Critically endangered under the EPBC Act.
Works involving clearing of nationally listed threatened ecological community (TEC) or nationally listed threatened species habitat	Where clearing >1 ha of a TEC or habitat in moderate to good condition	Applies to the following TECs: • Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (Critically Endangered – EPBC Act) (PCT 52 - 16.22 ha). • Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions (Endangered – EPBC & BC Act) (2.04 ha including PCT 147 – 0.11 ha and PCT 55 – 1.93 ha) • Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW (Preliminary Endangered – EPBC Act) 8.34 ha of PCT 64 Also applies to the following PCTs in moderate to good condition that are not TECs but are threatened species habitat: • Poplar Box - White Cypress Pine woodland (9.38 ha).
Works involving clearing of NSW endangered or vulnerable ecological community	Where clearing > 5 ha or where the ecological community is subject to an SIS	Does not apply.
Works involving clearing of NSW listed threatened species habitat where the species is a species credit species as defined in the OEH Threatened Species Profile Database (TSPD)	Where clearing >1 ha or where the species is the subject of an SIS	Applies to the habitat of multiple species and includes the TECs and some better condition areas of non-threatened vegetation types. • Belah woodland (1.93 ha - intact, 0.32 ha - derived) • Brigalow viney scrub open forest (1.47 ha - intact, 0.87 -derived) • Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact) • Weeping Myall open woodland (0.9 ha - intact, 14.42 ha - derived).
Works involving clearing of NSW listed threatened species habitat where the species is an ecosystem credit species as defined in the OEH TSPD	Where clearing >5 ha or where the species is the subject of an SIS	Applies to the habitat of multiple species and includes the TECs and some better condition areas of non-threatened vegetation types: • Belah woodland (1.93 ha - intact) • Brigalow viney scrub open forest (1.47 ha - intact) • Mock Olive - Wilga - Peach Bush - Carissa (0.11 ha) • Poplar Box - Belah woodland (8.34 ha - intact) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) • Queensland Bluegrass +/- Mitchell Grass (16.22 ha) • Weeping Myall open woodland (3.17 ha - intact).
Type 1 or Type 2 key fish habitats (as defined by NSW Fisheries)	Where there is any net loss of habitat	Applies to predicted habitat of the Purple Spotted Gudgeon and Eel-tailed Catfish. To be calculated based on the detailed design. Estimated at around 0.03 ha in total based on

Description of activity or impact	Offsets required	Vegetation proposed to be offset
		around 50 square metres of net loss of habitat at each of six culvert extension locations affecting predicted habitat for the Purple Spotted Gudgeon.

Biodiversity offsets

The offset requirement for the whole project (project REF and proposed modification combined) would be:

- Loss of threated ecological community 4:1 (for offset areas in moderate to good condition) or 8:1 for offset areas in poor condition). See **Table 6-7** for TEC / EECs triggering consideration for offsetting
- Loss of threatened fauna species 3:1. See **Table 6-7** for triggering consideration of fauna habitat for offsetting
- Loss of threatened flora species 3:1. Forty-eight Belson's Panic (*Homopholis belsonii*) and seven Finger Panic Grass (*Digitaria porrecta*) within the project construction boundary.

A BOS is required to document how the offsetting will be delivered.

Availability of offsets

The biodiversity offsets for the project (project REF and proposed modification combined) will be dependent on whether or not there are areas containing the relevant species and communities available in the relevant bioregions for dedication as offsets. Such land may include:

- Lands under the control of Transport for New South Wales
- Travelling Stock Reserves
- Pastoral leasehold lands.

Opportunities for undertaking supplementary actions

There may be opportunities to undertake supplementary actions to benefit some of the affected species. Such activities may include:

- Seed collection and germination
- Strategic restoration of native vegetation to enhance local and regional scale habitat connectivity, eg on crown lands (e.g. travelling stock reserves and roadsides) and on private land (eg along waterways)
- Carrying out research on the distribution and ecology of poorly-known species.

6.2 Traffic and transport

A high level road user delay assessment was carried out based on the time and location construction schedule for each project segment as summarised in in the *Newell Highway Heavy Duty Pavement Detailed Design - Road User Delay Report* (GHD, 2019).

6.2.1 Methodology

The assessment considered the existing travel time on the Newell Highway and compared this to the travel time during construction of the project. Each segment of the project was assessed based on segments consisting of:

- A 60 kilometre per hour speed limit
- Stop/slow traffic management, with a 40 kilometre per hour speed limit.

6.2.2 Existing environment

The project REF detailed the existing traffic condition along the Newell Highway north of Moree.

6.2.3 Potential impacts

Construction

The road users delay assessment (GHD, 2019) has considered in some detail the construction staging in each of the three sections based on the traffic management assumptions and constraints detailed in the **Section 3.3.6**.

The individual average delay per trip is calculated based on what traffic control is in place during that week and a detailed weekly breakdown of the peak delay calculated within each segment is presented in the *Newell Highway Heavy Duty Pavement Detailed Design - Road User Delay Report* (GHD, 2019).

A summary of the peak delays at each segment is summarised in **Table 6-9**. In addition to the general road user delay, the peak delays from OSOM vehicle movements are also presented in this table. As shown in **Table 6-9**, the introduction of OSOM has a substantial impact on peak delay. The updated traffic modelling (GHD, 2019) completed for the proposed modification indicates a substantial increase in potential for road user delays from the project REF. However, the impacts from these delays would be consistent with the project REF.

Table 6-9 Estimated peak road user delay per segment

Segment	Duration (weeks)	Peak road user delay (mm:ss)	Peak road user delay with OSOM (mm:ss)
N2MS1	62	4:40	6:44
N2MS2	75	4:44	6:27
N2MS3	39	3:15	4:57
N2MS4	52	7:19	9:22
N2MS5	63	8:07	11:34

The construction of the segments would be programmed with the requirement of a travel delay of no more than 12 minutes.

Provided that the cumulative delays of both this project and the N2M project are kept below 12 minutes, the road user delays would be consistent with other Newell Highway road upgrade projects in the region.

Operation

The operation impacts of the proposed modification are expected to be consistent with the project REF.

6.2.4 Safeguards and management measures

Additional safeguards and management measure to those identified in the project REF for traffic and transport are provided in are presented in **Table 6-10**.

Table 6-10 Summary of mitigation measures – Traffic and Transport

Impact	Environmental safeguards	Responsibility	Timing	Reference
Road user delay	The final construction scenarios for each delivery groups of segments will have a travel delay of no more than 12 minutes.	TfNSW	Prior to construction	Additional safeguard

6.3 Noise and vibration

The potential noise and vibration impacts on sensitive receivers during construction and operation of the project were assessed as part of the Newell Highway - *Heavy Duty Pavement Upgrade between Narrabri and Moree - Noise and Vibration Assessment Report* (NVA) (Jacobs, 2018a) provided in **Appendix F** of the REF.

6.3.1 Methodology

The noise impacts of the proposed modification which includes the foam bitumen batch plant were assessed using the *Roads and Maritime Construction Noise Estimator* (CNE).

6.3.2 Existing environment

The project REF identified that background noise was primarily influenced by road traffic noise with maximum noise levels being generated by heavy vehicles using the highway and agricultural activities. This is the same for the proposed modification.

The proposed modification is located within a sparsely developed areas with only a small number of surrounding sensitive receivers, though portions of N2MS2, N2MS3 and N2MS5 have more populated areas. About 238 rural residential properties are located within the study area, with the nearest receiver located about 15 metres from the proposed modification within Bellata in N2MS3.

6.3.3 Potential impacts

Construction

The results of the project REF NVA concluded that during construction, there would be noise impacts at some nearby sensitive receivers near the highway, where noise management levels (NMLs) are predicted to be exceeded. For these receivers' noise impacts during some stages of construction may be in the moderate to high range. Where activities involving vibration-generating equipment such as compaction plant occur within the vicinity of residents and other sensitive areas, work methods have been developed to avoid the potential for human discomfort and any building damage. Noise from additional traffic generated during construction was also assessed and determined to be negligible.

The proposed modification construction activities and the equipment used are generally consistent with those assessed in the project REF, with the exception of the foam bitumen batch plant located with N2M C2.

Foam bitumen batch plant

A foam bitumen batch plant would be located at N2M C2 (refer to **Appendix A**) for about 12 months. The closest sensitive receivers are residential receivers located about one kilometre to the south of the N2M C2 within N2MS1.

Nearby background noise monitoring was completed for the project REF as part of the NVA (Jacobs, 2018a). These background noise levels are expected to be indicative of background noise levels near N2M C2 within N2MS1.

The following construction NMLs were established in the Section 6.5.3 of the REF, as outlined in **Table 6-11**.

Table 6-11 Construction noise management levels

Noise catchment area	Applies to	Noise management level (NML) $L_{eq\ 15\ minute}$ dB(A)			
		Standard hours of construction	Outside recommended standard hours of construction		
			Day (1pm to 6pm Saturday and 8am to 6pm Sunday)	Evening (6pm to 10pm)	Night (10pm to 7am 8am on weekends])
NCA01	Receivers in developed areas and within 200m of project	49	45	45	42
NCA02	Remote receivers	40	40	40	36

The nearest sensitive receiver is within NCA 02 as described in **Table 6-11**. The NMLs associated with NCA 02 were manually entered into the CNE.

Using the CNE, resulting sound power levels of about 119 dB(A) would be expected during operation of the foam bitumen batch plant. These levels and the distance to the nearest receivers have been estimated to generate a sound pressure levels of around 37 dB(A) at the nearest receiver, and represents a worst case scenario (refer to **Appendix F**). As the nearest sensitive receivers is about one kilometre away from the foam bitumen batch plant work associated with the proposed modification would not be expected to cause major noise disturbance impacts and noise levels would not be expected to exceed the NMLs (refer to **Table 6-11**) during standard hours and evening hours. Noise exceedance of about one dB(A) would be expected during night works.

Landowners would be informed of potential noise impacts from the project during the consultation phase in accordance with the *Construction Noise and Vibration Guideline* (Roads and Maritime, 2016).

Operational

The operational impacts are expected to be consistent with the project REF.

6.3.4 Safeguards and management measures

Additional safeguards and management measure to those identified in the project REF for noise and vibration are presented in **Table 6-12**.

Table 6-12 Summary of mitigation measures – Noise and vibration

Impact	Environmental safeguards	Responsibility	Timing	Reference
Foam bitumen batch plant	The foam bitumen batch is to be located as far as possible from sensitive receivers	TfNSW /Contractor	Prior to construction	Additional safeguard

6.4 Aboriginal heritage

The potential impacts of the proposed modification on Aboriginal heritage is assessed in the *Aboriginal and Historic Assessment Report Addendum - Newell Highway Heavy Duty Pavements – Narrabri to North Moree* (OzArk, 2020) and the *Aboriginal Archaeological Test Excavation Report - Newell Highway Heavy Duty Pavements – Narrabri to Moree* (OzArk, 2020a). These assessments are provided in **Appendix C** and summarised below. The potential impacts, and any additional safeguards to mitigate them, are also summarised in this section.

6.4.1 Methodology

The assessment has been completed as an addendum report to the *Aboriginal and Historic Archaeological Survey Report: Newell Highway HD Pavements – Narrabri to North Moree, Moree LGA, NSW* which reports on the results of the March 2017 and January 2018 fieldwork assessments completed by OzArk (OzArk, 2018) for the project REF.

The Aboriginal archaeological assessment has followed the *Code of Practice for the Investigation of Aboriginal Objects in New South Wales* (Code of Practice) (DECCW, 2010), PACHCI (Roads and Maritime, 2011) and the *Cultural Heritage Guidelines* (Roads and Maritime, 2015). The archaeological test excavations were conducted in accordance with Stage 3 of the PACHCI (Roads and Maritime, 2011).

The fieldwork component of the addendum report was carried out by a Senior Archaeologist from OzArk on Tuesday 3 December 2019.

The archaeological test excavation was carried out on Tuesday 14 July 2020 by Archaeologists from OzArk and representatives from the Narrabri and Pilliga LALCs, Gomeroi Dreaming Pty Ltd and Gomeroi People Native Title Group and TfNSW.

6.4.2 Existing environment

The *Aboriginal and Historical Archaeological Survey Report: Newell Highway HD Pavements – Narrabri to North Narrabri* (OzArk, 2018) prepared for the project REF identified three Aboriginal Heritage Information Management System (AHIMS) items (modified trees) and one potential archaeological deposit (PAD) located near to the project. These items are summarised in **Table 6-13**.

The PAD (BC-HW17-PAD1) was recorded on the northern bank of Bobbiwa Creek and the eastern side of the Newell Highway at the southern extent of N2MS2, refer to **Figure 6-1**.

Table 6-13 Summary of recorded Aboriginal sites within the study area

Segment	Site ID	Features	Land form	AHMIS No.
N2MS2	BC-HW17-PAD1	PAD	Bobbiwaa Creek -Stream bank	-
N2MS2	BC-HW17-ST1	Modified tree	Plain	19-3-0159
N2MS3	BL-HW17-ST1	Modified tree	Plain	10-6-0049
N2MS4	TC-HW17-ST1	Modified tree	Plain	10-6-0050

BC-HW17-PAD1

BC-HW17-PAD1 is located on the northern bank of Bobbiwaa Creek within an alluvial plain supporting a highly modified open woodland and riparian habitat (refer to Figure 6 1). The PAD extends for about 100 metres (east–west) by 110 metres (north–south) encompassing a flat, slightly raised landform above the creek bank. The PAD includes a point bar deposit on the inner bank of Bobbiwaa Creek and the landform encompassed by the PAD has a slightly elevated topography relative to the surrounding alluvial plain.

Vegetation clearance, animal grazing and trampling, fencing, the construction and maintenance of the Newell Highway and the bridge over Bobbiwaa Creek, as well as, ploughing are likely to have affected the integrity of any archaeological deposits.

The identification of BC-HW17-PAD1 was based upon the prediction that artefact scatters (also termed open camp sites) in the Northern Outwash subregion are likely to occur within a few hundred metres of major watercourses, particularly on raised landforms next to those watercourses. These landforms are relatively infrequently inundated compared to the more frequently flooded plains.

Figure 6-1 Location of BC-HW17-PAD1 in relation to N2MS2 (OzArk, 2020)

Database searches

Updated AHIMS searches were completed in December 2019 to identify if any additional records have been added since the searches completed in 2018.

The AHIMS search with a 500 metre buffer on the construction boundary, returned ten records for Aboriginal heritage sites within the search area. The three closest records are the previously identified modified trees (AHIMS 19-3-0159, 10-6-0049 and 10-6-0050), refer to **Figure 6-2** to **Figure 6-5**.

Since the completion of the survey carried out as part of the archaeological survey report prepared by OzArk in 2018, Umwelt (Australia) Pty Ltd (Umwelt) prepared the *Aboriginal Cultural Heritage and Archaeological Assessment: Inland Rail Programme, Narrabri to North Star Project*. The study area for this project was the existing railway line corridor which is generally parallel to the proposed modification. A total of 19 new sites were identified during these projects survey. Except for two sites, all comprise isolated finds or artefact scatters with less than five artefacts. None of these new sites are located within or extend into the project construction boundary. However, five of the 19 sites are within 200 metres of the proposed modification.

As described in the project REF, the study area includes land currently subject to Native Title Claim by the Gomeroi People (Tribunal file no. NC2011/006; Federal Court file no. NSD37/2019).

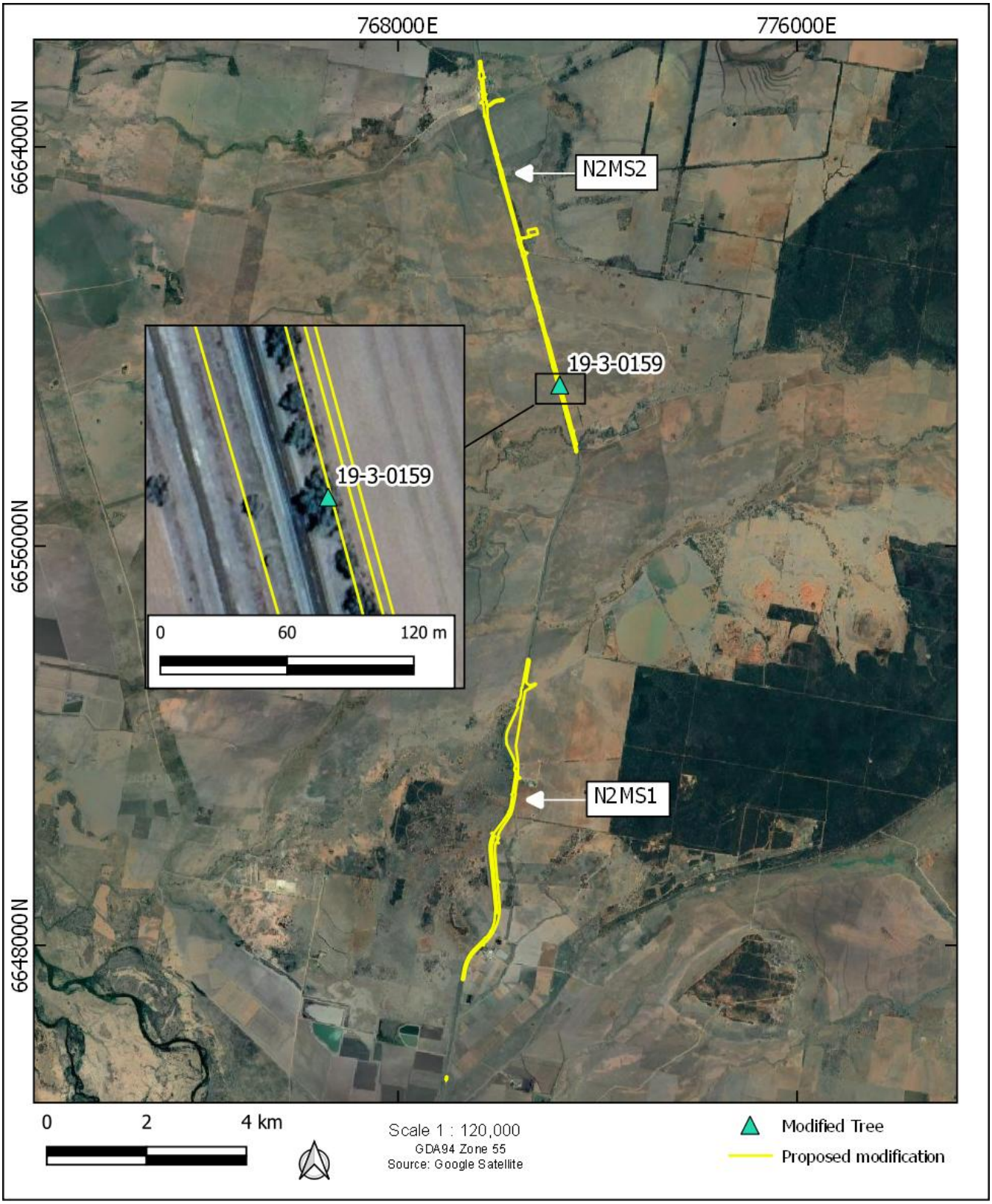


Figure 6-2 Location of previously recorded AHIMS sites in relation to the N2MS1 to N2MS2 (OzArk, 2020)

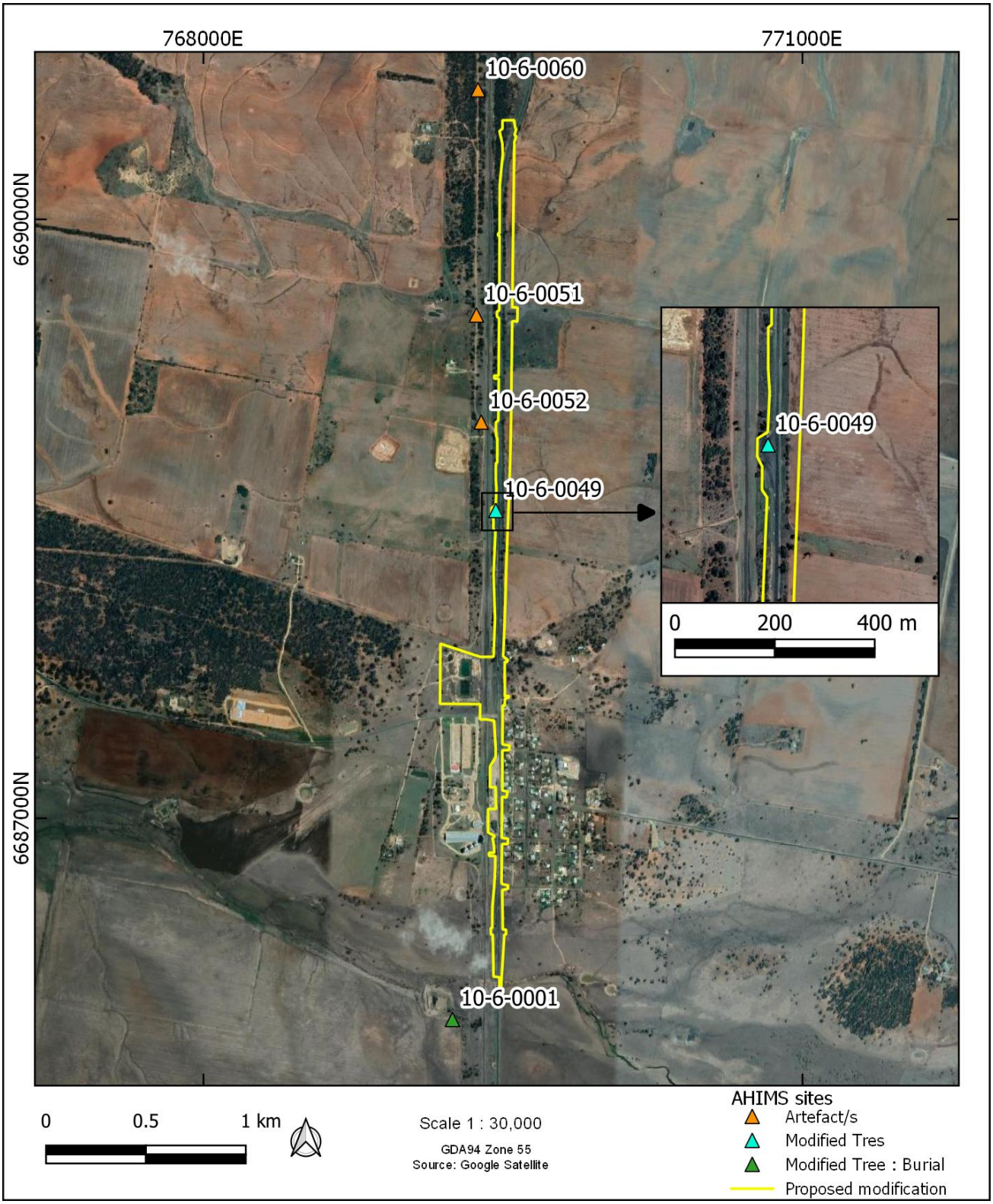


Figure 6-3 Location of previously recorded AHIMS sites in relation to N2MS3 (OzArk, 2020)

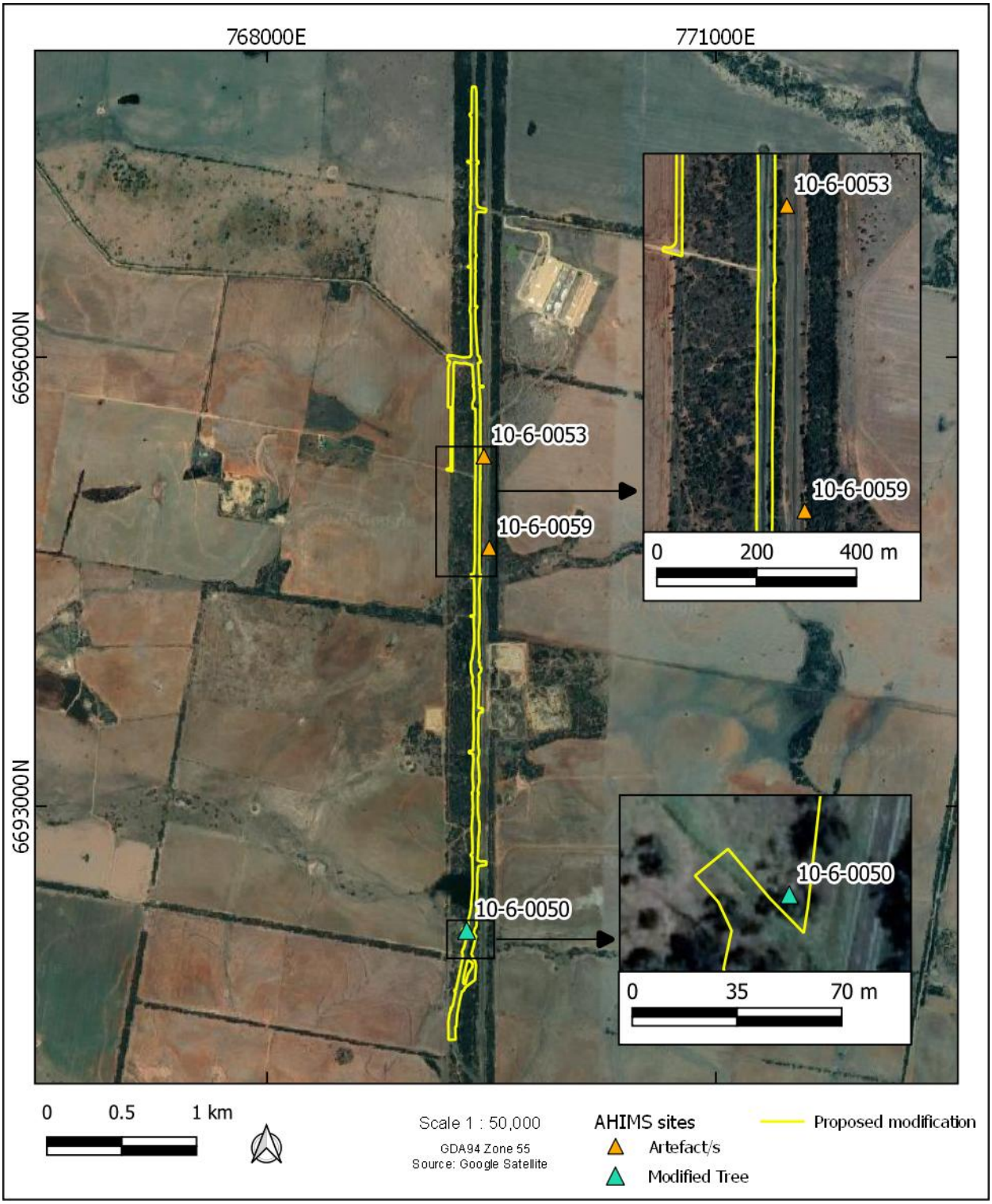


Figure 6-4 Location of previously recorded AHIMS sites in relation to N2MS4 (OzArk, 2020)

Figure 6-5 Location of previously recorded AHIMS sites in relation to N2MS5 (OzArk, 2020)

Field survey

No previously unrecorded Aboriginal sites were identified during the field survey carried out for the addendum assessment, and none of the landforms present within the project construction boundary are considered to have increased archaeological potential.

Test excavation

The results of the archaeological test excavation did not confirm the presence of any Aboriginal objects or features within BC-HW17-PAD1.

6.4.3 Potential impacts

Construction

The proposed modification would bring the project closer to the modified tree (AHIMS 19-3-0159) located near to N2MS2. However, this tree is still located outside the project construction boundary. Modified tree (AHIMS 10-6-0050) is located just outside the project construction boundary of N2MS4. While modified tree (AHIMS 10-6-0049) is still located within N2MS3 and would require protection as described in the project REF.

As shown in **Figure 6-1**, the PAD (BC-HW17-PAD1) partially overlaps with the N2MS2 project construction boundary. The archaeological test excavation did not confirm the presence of any Aboriginal objects or features within BC-HW17-PAD1 in the project construction boundary. Therefore no impacts to Aboriginal items would be expected during construction.

As no Aboriginal objects or features were identified during archaeological test excavation, an AHIP is not required and the proponent may proceed with the proposal without any further constraints on the grounds of Aboriginal cultural heritage at the location of BC-HW17-PAD1.

In order to ensure the remaining portion of BC-HW17-PAD1 is not impacted by the proposal a temporary 'no-go' zone would be erected along the project construction boundary next to the PAD (**Figure 6-1**).

Figure 6-6 Revised extent of BC-HW17-PAD1 and the proposed 'no-go' zone fencing

Operation

The operational impacts are expected to be consistent with the project REF.

6.4.4 Safeguards and management measures

Additional safeguards and management measures to those identified in the project REF, for Aboriginal heritage are presented in **Table 6-14**.

Table 6-14 Summary of mitigation measures – Aboriginal heritage

Impact	Environmental safeguards	Responsibility	Timing	Reference
Impacts to BL-HW17-ST1	During construction, BL-HW17-ST1 will be demarcated using high visibility ground markers to delineate the site perimeter (ie staking and flagging) encompassing the tree canopy.	TfNSW /Contractor	Prior to construction	Additional safeguard
Impacts to BC-HW17-PAD1	Erect a 'no-go' zone along the construction boundary next to BC-HW17-PAD1 to ensure the reminder of the PAD is not impacted by the proposal (**Figure 6-6**).	TfNSW /Contractor	Prior to construction	Additional safeguard

6.5 Non-Aboriginal heritage

The potential impacts of the proposed modification on non-Aboriginal heritage are assessed in the *Aboriginal and Historic Assessment Report Addendum - Newell Highway Heavy Duty Pavements – Narrabri to North Moree* (OzArk, 2019). This assessment is provided in **Appendix C** and summarised below. The potential impacts, and any additional safeguards to mitigate them, are also summarised in this section.

6.5.1 Methodology

The non-Aboriginal heritage assessment applies the Heritage Council's Historical Archaeology Code of Practice (Heritage Council 2006) in the completion of a historic heritage assessment.

The fieldwork component of the addendum report was carried out by a Senior Archaeologist from OzArk on Tuesday 3 December 2019.

6.5.2 Existing environment

Database searches

Five locally listed historic heritage sites are located within N2MS3, all within the township of Bellata. These items include:

- AB Meppem & Co
- Bellata Post Office
- Oldhams Smallgoods
- Bellata Police Station and Official Residence
- LS Rowe Stock and Station Agents.

Updated heritage database searches in December 2019 did not return any new heritage items within the project construction boundary.

Field survey

During the field surveys carried out as part of the addendum assessment, one historic feature, a blaze tree (Newell Highway HS-01), was identified within N2MS4 as shown in **Photo 6-1**.

The blaze tree is located at an intersection of the Newell Highway and an unnamed road on the eastern side, about 5.3 kilometres north of Bellata, refer to **Figure 6-6**.

A search of the Survey Control Information Management System (SCIMS) database does not list the location of the blaze tree (Newell Highway HS-01), however, consultation with the SCIMS confirmed that the markings on the heartwood include levels and is likely a witness tree for permanent marker (PM) 3923, located to the southeast. While this item may not have heritage values it must not be disturbed without permission.

The blaze tree (Newell Highway HS-01), while being important for surveying purposes, does not meet the criteria for local, state or national heritage significance.

Photo 6-1 Detail of markings on the heartwood of the blaze tree (OzArk, 2020)

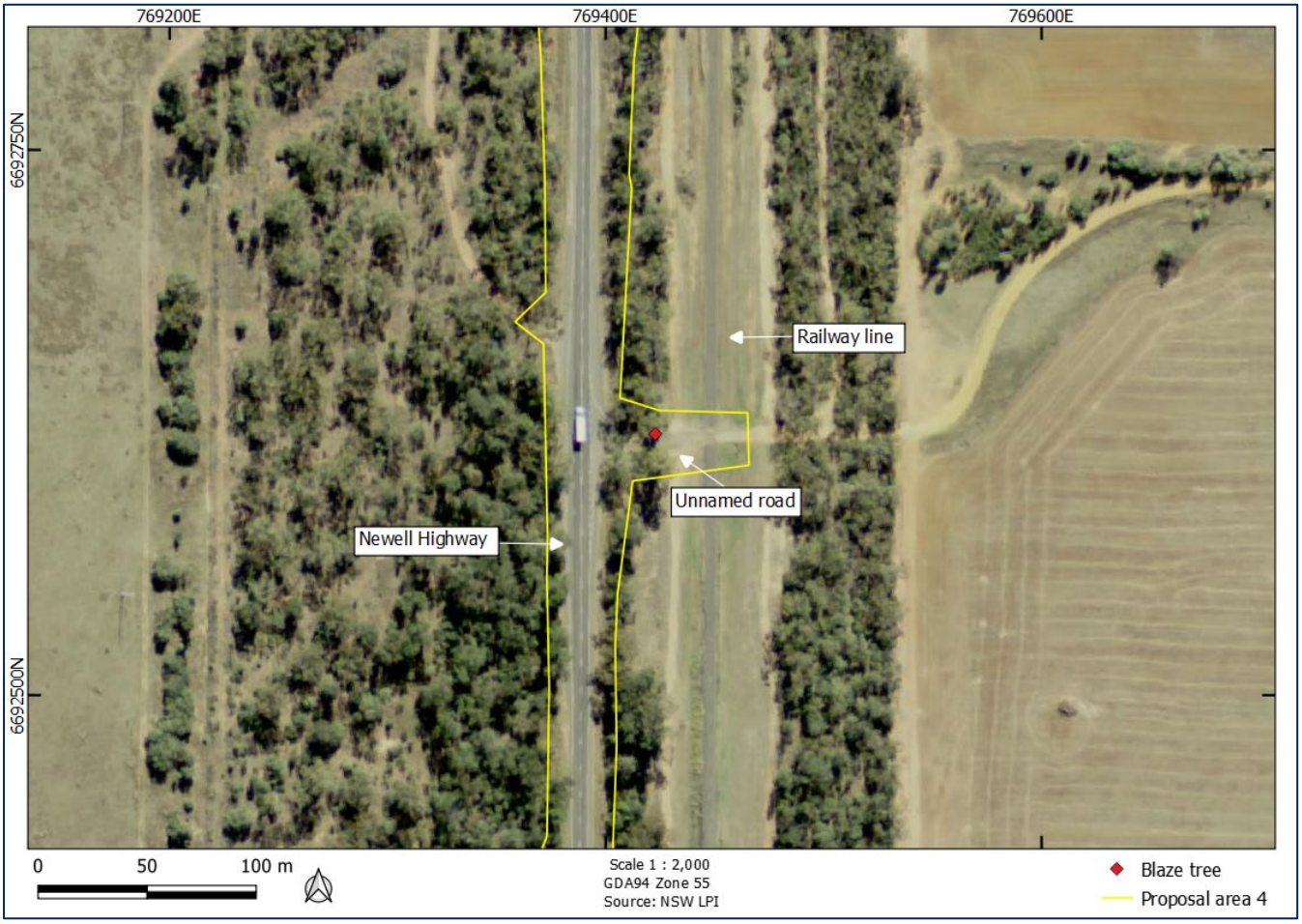


Figure 6-7 Location of the blaze tree within N2MS4 (OzArk, 2020)

6.5.3 Potential impacts

Construction

The proposed modifications impact would be consistent with the impacts identified in the project REF. As per the project REF the specific mitigation measures provided in **Section 7.2** would be implemented to avoid inadvertent impact to these items.

The blaze tree (Newell Highway HS-01), is located within N2MS4 and is likely to be impacted by the proposed modification. An application for its removal would be submitted prior to construction works starting in this segment.

Operation

There are no operation impacts expected on any known heritage items in the vicinity of the proposed modification.

6.5.4 Safeguards and management measures

Additional safeguards and management measure to those identified in the project REF for non-Aboriginal heritage are presented in **Table 6-15**.

Table 6-15 Summary of mitigation measures – non Aboriginal heritage

Impact	Environmental safeguards	Responsibility	Timing	Reference
Impacts to the blaze tree (Newell	If the blaze tree (Newell Highway HS-01) or any additional survey markers are unable to be avoided by the proposed modification, TfNSW proponent will prepare an application	TfNSW	Detail design	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
Highway HS-01)	for their removal under the *Surveying and Spatial Information Act 2002*.			
Impacts to local heritage items at Bellata	Management measures for the five locally listed items at Bellata within N2MS3 outlined in Section 6.5.5 of the project REF must be followed to ensure they are not impacted.	TfNSW/ Construction contractor	Construction	Additional safeguard

6.6 Hydrology and flooding

The updated flood modelling carried out for the detailed design is detailed in the *Newell Highway Upgrade - Detailed Design Flood Study* (GHD, 2020) and summarised below.

6.6.1 Methodology

The modelling consisted of compiling separate hydrological and hydraulic models. These models were used to calculate flood hydrographs. The hydrographs were used as input to TUFLOW hydraulic models which simulated the conveyance of flood waters at the Newell Highway road alignment for the detail design.

6.6.2 Existing environment

The project REF provides a detailed description of the hydrological environment and flooding risks.

The majority of the proposed modification is located on relatively flat, low lying land, comprising of floodplains for the Gwydir and Mehi Rivers within the Gwydir River catchment which has a long history of flooding.

6.6.3 Potential impacts

Construction

The updated flood modelling identified that construction impacts are expected to be consistent with the project REF.

Operation

The updated flood modelling determined that the design has generally achieved a 20 per cent Annual Exceedance Probability (AEP) flood immunity. This immunity has been achieved through a combination of raising road levels and changes to culvert sizes and the addition of new culverts. The proposed modification would provide better flood immunity than what currently exists along the highway as assessed in the project REF.

The key measure of flood impact for this project is afflux. Afflux is the potential increase in flood level upstream of culverts and bridges. The project has a requirement to minimise positive afflux where reasonable and feasible. Areas of substantial positive afflux were identified during the concept design development. The updated flood modelling indicates that the detailed design has reduced or eliminated all areas where afflux was found to be unacceptable. This was achieved generally through culvert upsizing, but in some instances changes to road elevation were made.

There may still be some areas of minor afflux which would be typically confined to existing drainage channels, paddocks or road corridor. The positive afflux range is between less than 0.1 metres to just over 0.2 metres. Any afflux on private property is considered extremely minor and not requiring remediation action.

6.6.4 Safeguards and management measures

No additional safeguards are proposed to those detailed in the project REF.

6.7 Other impacts

6.7.1 Existing environment and potential impacts

Environmental factor	Existing environment	Potential impacts
Socio-economic	The project REF provided a detailed description of the socio-economic environment on a local and regional scale. The proposed modification is located within the Moree Plains LGA. There are limited community facilities, social infrastructure or businesses within the project construction boundary. The Newell Highway serves as an important link for local communities in the study area. The proposed modification is surrounded by agricultural land which is primarily used for agricultural and grazing activities, such as cotton, wheat and livestock industries.	Socio-economic impacts associated with the project are generally associated with traffic delays and disruptions for motorists and other road users along the Newell Highway due to the implementation of traffic management measures, such as temporary lane closures or stoppages and reductions in speed limits. During construction, temporary adverse changes in local amenity may be experienced by communities and businesses near the proposed modification due to increased noise, dust and construction traffic. The proposed modification impacts are consistent with those identified in the project REF.
Landscape character and visual impacts	The area surrounding the proposed modification is characterised by a rural environment which has been predominately cleared of native vegetation and replaced with cropping and grazing. The retention of remnant vegetation has been greatest in the road reserve which has been traditionally used as a travelling stock route. The existing landscape character is descripted in Section 6.8.2 of the project REF. The landscape character was divided into five landscape character zones (LCZ) as follows: • Intensive agricultural LCZ • Broad Scale Agriculture LCZ which comprised of – Open woodland LCZ – Grassland LCZ • Remnant Woodland or Screening Vegetation LCZ • Rural village LCZ • Industrial and Airport Precinct LCZ.	The proposed modification would not alter the overall magnitude of the project's landscape character impacts. The proposed modification would be managed in accordance with project REF mitigation measures.

Environmental factor	Existing environment	Potential impacts
Geology and soils	Typically, soils encountered along the proposed modifications length are composed of medium to heavy clays with a varying sand content. Soils are typically developed on alluvial sediments and/or clay and are typically poorly drained with low permeability.	The potential impacts to soil and geology are expected to be consistent with those in the project REF.
Waste and resource management	The project REF identified that the project would generate waste streams, including: • Green waste from cleared vegetation • Excess fill material from any excavation of soils and fill embankments during construction • Concrete waste. Any remaining surplus material would be stockpiled in a suitable location for use by TfNSW on future projects, or disposed of to a licenced facility following validation assessment of the type of spoil waste classification.	The proposed modification would generate waste streams consistent with the waste streams identified in the project REF. The proposed modification would not substantially increase the impact of the approved activity on waste minimisation and management. Construction and operation waste impacts are consistent with those identified in the project REF.
Air quality and greenhouse gas	The project REF identified that ambient air quality is influenced by local sources including traffic along the Newell Highway, as well as regional influences arising from agricultural activities, dust from the operation of the grain storage and handling facilities in the study area, and other road traffic.	Air quality impacts during construction identified within the project REF would largely result from dust generated during vegetation clearing and slope stabilisation work. The air quality construction impacts of the proposed modification would be consistent with those identified in the project REF and would not increase the impact of the approved activity on air quality. The operation of the foam bitumen batch plan at N2M C2 would produce odours. However, as the nearest sensitive receiver (from batch plant) is over one kilometre away, odours would be expected to diffuse before reaching the receiver.

6.7.2 Safeguards and management measures

No additional safeguards are proposed other than those detailed in the project REF.

6.8 Cumulative impacts

Cumulative impacts as a result of the determined project are outlined in Section 6.11 of the REF. The determined project originated as part of a wider program of work to upgrade the Newell Highway. As a result, the construction of several upgrade projects would be carried out at similar times along the Newell Highway resulting in delays to road users. The project REF identified that the cumulative delay would be the greatest when a number of the projects would be under construction at the same time.

The proposed modification is not considered to increase any cumulative impacts as a result of the determined project.

6.8.1 Safeguards and management measures

No additional safeguards are proposed other than those detailed in the project REF.

7 Environmental management

7.1 Environmental management plans

A number of safeguards and management measures have been identified to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result of the proposed modification. Should the proposed modification proceed, these management measures would be addressed if required during detailed design and incorporated into the CEMP and applied during the construction and operation of the proposed modification.

7.2 Summary of safeguards and management measures

Environmental safeguards and management measures for the Newell Highway Heavy Duty Pavements, North Moree are summarised in **Table 7-1**. Additional safeguards and management measures identified in this addendum REF are included in **bold** and *italicised font*. The safeguards and management measures will be incorporated into the detailed design phase of the proposed modification, the CEMP and implemented during construction and operation of the proposed modification, should it proceed. These safeguards and management measures will minimise any potential adverse impacts arising from the proposed works on the surrounding environment.

Table 7-1 Summary of safeguards and management measures

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing	Reference
GEN1	General - minimise environmental impacts during construction	A CEMP will be prepared for each segment and submitted for review and endorsement of the TfNSW's Environment Manager prior to commencement of the activity. As a minimum, the CEMP will address the following: • Any requirements associated with statutory approvals • Details of how the project will implement the identified safeguards outlined in the REF • Issue-specific environmental management plans • Roles and responsibilities • Communication requirements • Induction and training requirements • Procedures for monitoring and evaluating environmental performance, and for corrective action • Reporting requirements and record-keeping • Procedures for emergency and incident management • Procedures for audit and review. The endorsed CEMP will be implemented during the undertaking of the activity.	Contractor / TfNSW project manager	Pre-construction / detailed design	Core standard safeguard
GEN2	General - notification	All businesses, residential properties and other key stakeholders (eg schools, local councils) affected by the activity will be notified at least five days prior to commencement of the activity.	Contractor / TfNSW project manager	Pre-construction	Core standard safeguard

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing	Reference
GEN3	General – environmental awareness	All personnel working on site will receive training to ensure awareness of environment protection requirements to be implemented during the project. This will include up-front site induction and regular "toolbox" style briefings. Site-specific training will be provided to personnel engaged in activities or areas of higher risk. These include: • Areas of Aboriginal heritage sensitivity • Threatened species habitat • Aboriginal heritage management including unexpected finds procedures • Threatened species habitat and EEC.	Contractor / TfNSW project manager	Pre-construction / detailed design	Core standard safeguard
GEN4	Utilities	Prior to the commencement of works: • The location of existing utilities and relocation details will be confirmed following consultation with the affected utility owners • If the scope or location of proposed utility relocation works falls outside of the assessed ***project*** scope and footprint, further assessment will be carried out.	Contractor	Detailed design / pre-construction	Core standard safeguard
GEN5	Hazards and risk management	A Hazard and Risk Management Plan (HRMP) will be prepared and implemented as part of the CEMP. The HRMP will include, but not be limited to: • Details of hazards and risks associated with the activity • Measures to be implemented during construction to minimise these risks • Record keeping arrangements, including information on the materials present on the site, material safety data sheets, and personnel trained and authorised to use such materials • A monitoring program to assess performance in managing the identified risks • Contingency measures to be implemented in the event of unexpected hazards or risks arising, including emergency situations.	Contractor	Detailed design / pre-construction	Core standard safeguard

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing	Reference
		The HRMP will be prepared in accordance with relevant guidelines and standards, including relevant Safe Work Australia Codes of Practice, and EPA or Office of Environment and Heritage publications.			
GEN6	General – environmental awareness	The ***TfNSW*** Project Manager will notify the ***TfNSW*** Environment Manager at least five days prior to the commencement of the activity. The notification will include a copy of any local community notification undertaken (GEN2).	Contractor	Pre-construction / detailed design	Additional safeguard
GEN7	General – environmental awareness	Standard construction hours: • Monday to Friday 7.00 am to 6.00 pm • Saturdays 8.00 am to 1.00 pm • No construction on Sundays or Public Holidays. Works outside standard construction hours (including those detailed within this REF) will be undertaken in accordance with the management and mitigation measures detailed within the ***NVMP***.	Contractor	Construction	Core standard safeguard
Biodiversity					
B1	Biodiversity	A Flora and Fauna Management Plan will be prepared in accordance with Roads and Maritimes' *Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects* (RTA, 2011) and implemented as part of the CEMP. It will include, but not be limited to: • Plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas • Requirements set out in the *Landscape Guideline* (RTA, 2008) • Pre-clearing survey requirements in accordance with Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011) • Procedures for unexpected threatened species finds and fauna handling	Contractor	Detailed design / pre-construction	Section 4.8 of QA *G36 Environment Protection*

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing	Reference
		• Procedures addressing relevant matters specified in the *Policy and guidelines for fish habitat conservation and management* (DPI Fisheries, 2013) • Protocols to manage weeds and pathogens.			
B2	Biodiversity	Measures to further avoid and minimise the construction footprint and native vegetation or habitat removal will be investigated during detailed design and implemented where practicable and feasible.	Contractor	Detailed design / pre-construction	Core standard safeguard
B3	Removal of native vegetation	• Vegetation removal would be carried out in accordance with Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA, 2011) • Native vegetation would be re-established in accordance with Guide 3: Re-establishment of native vegetation of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011) • Exclusion zones would be set up at the limit of clearing (i.e. the edge of the impact area) in accordance with *Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Detailed design / pre-construction	Additional safeguard
B4	Removal of threatened species habitat and habitat features	• Habitat would be replaced or re-instated in accordance with Guide 5: Re-use of woody debris and bushrock and Guide 8: Nest boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011) • The unexpected species find procedure is to be followed under *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) if threatened fauna, not assessed in the biodiversity assessment, are identified in the ***project construction boundary***.	Contractor	Detailed design / pre-construction	Additional safeguard
B5	Aquatic impacts	Aquatic habitat would be protected in accordance with *Guide 10: Aquatic habitats and riparian zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) and Section 3.3.2	Contractor	Construction	Additional safeguard

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing	Reference
		Standard precautions and mitigation measures of the Policy and guidelines for fish habitat conservation and management Update 2013 (DPI (Fisheries NSW) 2013).			
B6	Injury and mortality of fauna	• Fauna would be managed in accordance with Guide 9: Fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011) • Investigate the potential benefits and drawbacks of installing fauna fencing in N2MS4.	Contractor	Construction and operation	Additional safeguard
B7	Invasion and spread of weeds	• Weed species would be managed in accordance with Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011). • Pest species would be managed within the ***project construction boundary***.	Contractor	Construction	Additional safeguard
B8	Invasion and spread of pathogens and disease	Pathogens would be managed in accordance with *Guide 2: Exclusion zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Contractor	Construction	Additional safeguard
B9	Noise, light and vibration	Shading and artificial light impacts would be considered and minimised where possible through detailed design.	Contractor	Detailed design	Additional safeguard
B10	Biodiversity offsets	The final design impact area will be ground-truthed and offsets will be calculated and implemented as per *Guideline for Biodiversity Offsets* (November 2016)	TfNSW	Detailed design	Additional safeguard
Hydrology and flooding					
HF1	Soil and water	A Soil and Water Management Plan (SWMP) will be prepared for each segment and implemented as part of the CEMP. The SWMP will identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks will be addressed during construction.	Contractor	Detailed design/pre-construction	Section 2.1 of QA G38 *Soil and Water Management*

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing	Reference
HF2	Soil and water	• A site specific Erosion and Sediment Control Plan/s (ESCP) will be prepared for each segment and implemented as part of the Soil and Water Management Plan. • The plan will include arrangements for managing wet weather events, including monitoring of potential high risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.	Contractor	Detailed design/Pre-construction	Section 2.2 of QA G38 *Soil and Water Management*
HF3	Contaminants entering receiving environments during construction	Control measures to minimise the risk of water pollution will be implemented including: • All fuels, chemicals, and liquids will be stored at least 40 metres away from the existing stormwater drainage system and stored in an impervious bunded area within the compound site • Plant and maintenance machinery will be refuelled in impervious bunded areas in the designated compound area • Vehicle wash downs and/or concrete truck washouts would be undertaken within a designated bunded area of an impervious surface or carried out off-site.	Construction contractor	Construction	Additional safeguard
HF4	Extraction of water	Non potable water sources (including the potential for waterway, borehole extraction and sourcing from private landowners) would be investigated during detailed design to minimise reliance on potable water where feasible.	TfNSW / Construction contractor	Construction	Additional safeguard
HF5	Hydrology and flood management	A Flood Management Plan will be prepared prior to the work starting. This plan would include: • Review and coordination with existing local flood plans and evacuation procedures • Flood emergency preparation, response, and recovery measures which will implemented during construction • Procedure for daily review of The Bureau of Meteorology website • Site protection measures to be implemented prior to and in the event of flooding	Construction contractor	Construction	Additional safeguard

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing	Reference
		• Procedure for monitoring and maintenance of protection measures during heavy rainfall events.			
HF6	Flooding	The CEMP will consider the potential impacts of temporary construction works including trenching, solid traffic barriers and stockpiles on overland flows and incorporate appropriate management measures to address these issues.	Contractor	Construction	Additional safeguard
Soils and contamination					
SC1	Contaminated land	If contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All other works that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the TfNSW Environment Manager and/or EPA if required.	Contractor	Detailed design/Pre-construction	Section 4.2 of QA *G36 Environment Protection*
SC2	Accidental spill	A site specific emergency spill plan will be developed and include spill management measures in accordance with the Roads and Maritimes' *Code of Practice for Water Management* (RTA, 1999) and relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including TfNSW and EPA officers).	Contractor	Detailed design/Pre-construction	Section 4.3 of QA *G36 Environment Protection*
SC3	Stockpile management	Stockpiles will be designed, established, operated and decommissioned in accordance with the Roads and Maritimes' *Stockpile Site Management Guideline 2015*.	Construction contractor	Construction	Additional safeguard
SC4	Soil stabilisation and restoration	The rehabilitation of disturbed areas will be carried out progressively as construction stages are completed, and in accordance with: • Landcom's Managing Urban Stormwater: Soils and Construction series • RTA Landscape Guideline • Roads and Maritimes' Guideline for Batter Stabilisation Using Vegetation (2015).	Construction contractor	Construction	Additional standard safeguard

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing	Reference
SC5	Pollution from run-off	The ancillary facilities will be managed within the ESCP. The following measures will be included to limit sediment and other contaminations entering receiving waterways: • Chemicals will be stored within a sealed or bunded area • Appropriate controls will be in place where plant is stored • Run-off from ancillary sites will be controlled and treated before discharging into downstream waterways • Vehicle movements will be restricted to designated pathways where feasible • Areas that will be exposed for extended periods, such as car parks and main access roads, will be stabilised where feasible.	Construction contractor	Construction	Additional safeguard
Traffic and transport					
TT1	Traffic and transport	A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will be prepared in accordance with the Roads and Maritimes' *Traffic Control at Work Sites Manual* (RTA, 2010) and *QA Specification G10 Control of Traffic* (Roads and Maritime, 2008). The TMP will include: • Confirmation of haulage routes • Measures to maintain access to local roads and properties • Site specific traffic control measures (including signage) to manage and regulate traffic movement • Measures to maintain pedestrian and cyclist access • Requirements and methods to consult and inform the local community of impacts on the local road network • Access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads. • A response plan for any construction traffic incident • Consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic • Monitoring, review and amendment mechanisms.	Contractor	Detailed design/Pre-construction	Section 4.8 of QA *G36 Environment Protection*

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing	Reference
TT2	Property access - pre-construction	Requirements for any changes to local access arrangements will be confirmed during detailed design in consultation with the local road authority and any affected landowners.	TfNSW	Pre-construction /detailed design	Additional standard safeguard
TT3	Notifications to landowners	Disruptions to property access and traffic will be notified to landowners at least five in accordance with the relevant community consultation processes outlined in the TMP.	TfNSW and Construction Contractor	Construction	Additional standard safeguard
TT4	Property access - during construction	Access to properties will be maintained during construction. Where that is not feasible or necessary, temporary alternative access arrangements will be provided following consultation with affected landowners and the relevant local road authority.	TfNSW and Construction Contractor	Construction	Additional standard safeguard
TT5	Reduce speeds, traffic delays and disruptions during construction	Road users, local communities and the freight industry will be provided with timely, accurate, relevant and accessible information about changed traffic arrangements and delays owing to construction activities.	TfNSW and Construction Contractor	Construction	Additional standard safeguard
TT6	Disruption to public transport, including school bus services	Access for public transport services, including school bus services, will be maintained. The requirements for any temporary changes will be confirmed following consultation with local bus operators and the community.	TfNSW and Construction Contractor	Construction	Additional standard safeguard
TT7	Impacts of the regional road network	Where possible, the most disruption work (such as work that requires lane closures) will be carried out at night to minimise potential impacts on the regional road network. This, combined with temporary effective traffic management, will assist in minimising impacts to traffic and transport using the Newell Highway.	TfNSW and Construction Contractor	Construction	Additional safeguard
TT7	***Road user delay***	***The final construction scenarios for each delivery groups of segments will have a travel delay of no more than 12 minutes.***	***TfNSW***	***Prior to construction***	***Additional safeguard***

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing	Reference
Noise and vibration					
NV1	Noise and vibration	A ~~Noise and Vibration Management Plan (~~NVMP~~)~~ will be prepared and implemented as part of the CEMP. The NVMP will generally follow the approach in the Interim Construction Noise Guideline (ICNG) (DECC, 2009) and identify: • All potential significant noise and vibration generating activities associated with the activity • Feasible and reasonable mitigation measures to be implemented, taking into account *Beyond the Pavement: urban design policy, process and principles* (Roads and Maritime, 2014). • A monitoring program to assess performance against relevant noise and vibration criteria • Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures • Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria.	Contractor	Detailed design / pre-construction	Section 4.6 of *QA G36 Environment Protection*
NV2	Noise and vibration	All sensitive receivers (eg schools, local residents) likely to be affected will be notified at least [insert no. of days] prior to commencement of any works associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of: • The project • The construction period and construction hours • Contact information for project management staff • Complaint and incident reporting • How to obtain further information.	Contractor	Detailed design / pre-construction	Core standard safeguard N
NV3	Site induction	All personnel working on site will receive training to ensure awareness of requirements of the NVMP. Site-specific training will be given to personnel when working in the vicinity of sensitive receivers.	Contractor	Pre-construction / construction	Additional safeguard

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing	Reference
NV4	Noise and vibration	Where possible, works outside of standard construction hours will be planned so that noisier works are carried out in the earlier part of the evening or night time.	Contractor	Pre-construction / construction	Additional safeguard
NV5	Noise and vibration	Where there are complaints about noise from an identified work activity, the work activity will be reviewed, and where feasible and reasonable, action additional control measures. This may include monitoring to confirm that predicted impacts are in line with levels predicted in this assessment.	Contractor	Construction	Addition safeguard
NV6	Reducing Vibration impacts	• Choosing alternative, lower-impact equipment or methods wherever possible • Scheduling the use of vibration-causing equipment at the least sensitive times of the day (wherever possible) • Locating high vibration sources as far away from sensitive receiver areas as possible • Sequencing operations so that vibration-causing activities do not occur simultaneously. • Keeping equipment well maintained • Do not conduct vibration intensive works within the building damage distances outlined in Table 6.40 of the project REF. Where possible, avoid the use of vibration intensive plant within the nominated human comfort distances. Where this isn't possible, an attendee should be present during the works to suspend activities in the instance of any issues or complaints. • Wherever practical, static compaction techniques should be utilised for compaction required within the applicable setback distances recommended to avoid human comfort impacts	Construction contractor	Construction	Additional safeguard
NV7	Vibration impacts on buildings and heritage items	• Building condition inspection reports must be completed in accordance with QA Specification G36 for all heritage structures in the ***project construction boundary*** and any other nearby structures or buildings at risk from vibration impacts.	Construction contractor	Pre-construction and during construction as required	Additional safeguard

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing	Reference
		• A follow up building condition inspection of all heritage structures in the work area will be carried out when all the construction work is complete.			
NV8	Vibration impacts to Heritage items	The use of high intensity vibratory compaction equipment near underground services will be limited. If vibration-intensive plant and equipment change from that which has been in the Noise and Vibration Assessment (Jacobs, 2018a), a review will be carried out prior to commencing work.	Construction contractor	Construction	Additional safeguard
NV9	***Foam bitumen batch plant***	***The foam bitumen batch is to be located as far as possible from sensitive receivers***	***TfNSW /Contactor***	***Prior to constructio n***	***Additional safeguard***
Aboriginal heritage					
AH1	Aboriginal heritage	An Aboriginal Heritage Management Plan (AHMP) will be prepared in accordance with the *Procedure for Aboriginal cultural heritage consultation and investigation* (Roads and Maritime, 2012) and *Standard Management Procedure - Unexpected Heritage Items* (Roads and Maritime, 2015) and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented for managing impacts on Aboriginal heritage.	Contractor	Detailed design/pre-construction	Section 4.9 of QA *G36 Environment Protection*
AH2	Aboriginal heritage	• The *Standard Management Procedure - Unexpected Heritage Items* (Roads and Maritime, 2015) will be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction. • Work will only re-commence once the requirements of that procedure have been satisfied.	Contractor	Detailed design/pre-construction	Section 4.9 of QA *G36 Environment Protection*
AH3	Impacts to Aboriginal heritage	If impact to Aboriginal heritage items are unavoidable then the Aboriginal cultural heritage investigation must proceed to PACHCI Stage 3 (Roads and Maritime, 2011).	***TfNSW***	Detailed design/pre-construction	Additional safeguard
AH4	Aboriginal heritage	Any further changes to the ***project construction boundary*** outside the survey area will be assessed by a suitably qualified heritage professional.	***TfNSW***	Detailed design/pre-construction	Additional safeguard

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing	Reference
AH5	Minimise risks to Aboriginal cultural heritage during construction	All personnel working on site will receive training to ensure awareness of requirements of the Aboriginal Heritage Management Plan and relevant statutory responsibilities. Site-specific training will be given to personnel when working in the vicinity of identified Aboriginal heritage items.	Contractor	Detailed design/pre-construction	Additional standard safeguard A
AH7	Aboriginal heritage items BC-HW17-ST1	• During construction, BC-HW17-ST1 will be demarcated using high visibility ground markers to delineate the site perimeter (ie staking and flagging) encompassing the tree canopy • The ground markers will be visible to any person in the vicinity of the site, whether on foot or in a vehicle • BC-HW17-ST1 will be mapped on the CEMP and detailed design plans and the canopy extent demarcated as a 'no-go' and 'no-harm' area • Vehicles will not be driven on, or in the immediate vicinity of, the BC-HW17-ST1 site extent • If required, appropriate sediment control measures will be installed, operated and maintained to prevent sediment moving onto the site extent during the construction of the ***proposed modificatio***n.	Contractor	Detailed design /pre-construction	Additional safeguard
AH8	Aboriginal heritage item BL-HW17-ST1	• During construction, BL-HW17-ST1 will be demarcated using high visibility ground markers to delineate the site perimeter (ie staking and flagging) encompassing the tree canopy • If the bitumen currently surrounding BL-HW17-ST1 is to be removed as part of the ***proposed modification***, this will be done without harming the tree's absorption roots • The area surrounding the tree will not subsequently be built upon, providing an area large enough to allow adequate moisture to reach the tree's absorption roots. Minimally, this area will fully encompass the tree canopy extent and this area must be excluded from bitumen cover and compaction	Contractor	Construction	Additional safeguard

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing	Reference
		• Sufficient distances will be provided to allow vehicles to access the rest area where the tress is located, without colliding with or damaging the tree • If a significant residual risk of collision remains, steps will be taken to minimise that risk (eg installation of bollards and/or permanent high visibility barriers).			
AH9	***Impacts to BC-HW17-PAD***	• ***A 'no-go' zone should be erected along the construction boundary adjacent to BC-HW17-PAD1 to ensure the reminder of the PAD is not impacted by the proposal (Figure 6-6).***	***TfNSW/Contractor***	***Prior to construction***	***Additional safeguard***
Non-Aboriginal heritage					
NH1	Non-Aboriginal heritage	A Non-Aboriginal Heritage Management Plan (NAHMP) will be prepared and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented to avoid and mitigate impacts on non-Aboriginal heritage.	Contractor	Detailed design/pre-construction	Section 4.10 of QA *G36 Environment Protection*
NH2	Non-Aboriginal heritage	• The Standard Management *Procedure – Unexpected Heritage Items* (Roads and Maritime, 2015) will be followed in the event that any unexpected heritage items, archaeological remains or potential relics of non-Aboriginal origin are encountered • Work will only re-commence once the requirements of that Procedure have been satisfied.	Contractor	Detailed design/pre-construction	Section 4.10 of QA *G36 Environment Protection*
NH3	Non-Aboriginal heritage	Non-Aboriginal heritage awareness training must be provided for all contractors and personnel prior to commencement of construction to outline the identification of potential heritage items and associated procedures to be implemented in the event of the discovery of non-Aboriginal heritage materials, features or deposits (that is, unexpected finds), or the discovery of human remains.	Contractor	Pre-construction	Additional safeguard
NH4	AB Meppem & Co, Bellata Post Office, Oldhams Smallgoods,	• All heritage items will be demarcated during the construction of ***project*** using high visibility ground markers to delineate historic site extent along the western boundary next to the Newell Highway	Contractor	Pre-construction	Additional safeguard

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing	Reference
	Bellata Police Station and LS Rowe Stock and Station Agents	• The demarcation method will be developed in consultation with property owners and/or tenants to ensure that the method is practical and fit for purpose • The ground markers used must be visible to any person in the vicinity of the site, whether on foot or in a vehicle • A 'no-go' and 'no-harm' area must be mapped on the CEMP and detailed design plans encompassing the historic site extent as shown in section 9 of the *Aboriginal and Historical Archaeological Survey Report: Newell Highway HD Pavements – Narrabri to Moree* (OzArk, 2018) provide in Appendix D of the project REF. • All ground-disturbing work will be confined to areas, outside of the identified historic site extends and 'no-go' and 'no-harm' areas • ~~Once the nature and extent of the proposal in the vicinity of the heritage buildings has been finalised, a condition assessment may be required to determine how structurally sound the building is and whether or not and a vibration assessment may be required.~~			
NH5	***Impacts to local heritage items at Bellata***	***Management measures for the five locally listed items at Bellata within N2MS3 outlined in Section 6.5.5 of the project REF must be followed to ensure they are not impacted.***	***TfNSW/ Construction contractor***	***Constructio n***	***Additional safeguard***
Landscape character and visual impacts					
LC1	Landscape character and visual impact	An Urban Design Plan will be prepared to support the final detailed project design and implemented as part of the CEMP. The Urban Design Plan will present an integrated urban design for the project, providing practical detail on the application of design principles and objectives identified in the environmental assessment. The Plan will include design treatments for: • Location and identification of existing vegetation and proposed landscaped areas, including species to be used • Built elements including retaining walls and bridges • Fixtures such as seating, lighting, fencing and signs	Contractor	Detailed design/pre-construction	Core standard safeguard

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing	Reference
		• Details of the staging of landscape works taking account of related environmental controls such as erosion and sedimentation controls and drainage • Procedures for monitoring and maintaining landscaped or rehabilitated areas. The Urban Design Plan will be prepared in accordance with relevant guidelines, including: • Beyond the Pavement urban design policy, process and principles (Roads and Maritime, 2014) • Landscape Guideline (RTA, 2008) • *Bridge Aesthetics* (Roads and Maritime 2012).			
LC2	Landscape character and visual impact	Limit vegetation loss - either through revisions to alignment or scale of proposed cross section.	Contactor	Detailed design / pre-construction	Additional safeguard
LC3	Landscape character and visual impact	Provide screening to properties which have been impacted by the ***proposed modification*** through the opening up of views to the proposed alignment.	Contactor	Detailed design / pre-construction	Additional safeguard
LC4	Landscape character and visual impact	Provide definition to the changing land uses associated with the townships through which the highway passes.	Contactor	Detailed design / pre-construction	Additional safeguard
LC5	Landscape character and visual impact	Providing interest to the motorist along their journey in an effort to breakdown the sense of distance and provide a sense of progression and connection to context.	Contactor	Detailed design / pre-construction	Additional safeguard
Property, land use and socio-economic					
SE1	Consultation	A Project Communications Plan (CP) will be prepared and implemented as part of the CEMP	Contractor	Detailed design/pre-construction	Section 3.7 of QA *G36 Environment Protection*

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing	Reference
SE2	Consultation	Individual project CPP will be prepared and implemented to help provide timely and accurate information to the community during construction. The CPs will include (as a minimum): • Mechanisms to provide details and timing of proposed activities to affected residents and businesses, including changed traffic and access conditions • Contact name and number of complaints • The CPs will be prepared in accordance with the *Community Involvement and Communications Resource Manual* (RTA, 2008).	TfNSW	Pre-construction and construction	Core standard safeguard
SE3	Consultation	Early and ongoing consultation and communication should be carried with local accommodation providers and tourism industry representatives to ensure that demands on short-term accommodation are appropriately managed, particularly during peak tourist times.	TfNSW	Pre-construction and construction	Additional safeguard
SE4	Emergency vehicle access	Access for emergency vehicles will be maintained at all times during construction. Any site-specific requirements will be determined in consultation with the relevant emergency services agency.	TfNSW	Pre-construction and construction	Additional safeguard
Waste and resource management					
WR1	Generation of construction waste	A Waste Management Plan will be prepared and implemented as part of the CEMP. The WMP will include but not be limited to: • Measures to avoid and minimise waste associated with the project • Classification of wastes generated by the project and management options (re-use, recycle, stockpile, disposal) • Classification of wastes received from off-site for use in the project and management options • Identifying any statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions • Procedures for storage, transport and disposal	Contractor	Pre-construction / detailed design	Section 4.2 of QA *G36 Environment Protection*

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing	Reference
		• Monitoring, record keeping and reporting, including any documentation management obligations arising from resource recovery exemptions. The Plan will be prepared taking into account the Roads and Maritimes' *Environmental Procedure - Management of Wastes on Roads and Maritime Services Land* and relevant Roads and Maritimes' *Waste Fact Sheets,* as well as the adopting the Resources Management Hierarchy principles of the WARR Act.			
WR2	Existing condition of ancillary sites	Prior to land being used for ancillary construction purposes (compounds, storage, parking, etc.) a pre-construction land assessment will be carried out to identify the presence of any pre-existing wastes.	Contractor	Pre-construction / detailed design	Core standard safeguard W
WR3	Final condition of ancillary sites	A post-construction land assessment will be carried out of land that was used for ancillary construction purposes (compounds, storage, parking, etc.) to determine the suitability for hand-back to the landowner.	Contractor	Post construction / operation	Additional standard
Air quality, climate change and greenhouse gas					
AQ1	Impacts on air quality during construction	An Air Quality Management Plan (AQMP) will be prepared and implemented as part of the CEMP. The AQMP will include, but not be limited to: • Potential sources of air pollution • Air quality management objectives consistent with any relevant published EPA and/or OEH guidelines • Mitigation and suppression measures to be implemented • Methods to manage work during strong winds or other adverse weather conditions • A progressive rehabilitation strategy for disturbed areas.	Contractor	Detailed design/pre-construction	Core standard safeguard Section 4.4 of QA *G36 Environment Protection*
AQ2	Impacts on climate change during construction	During construction, the following measures will be considered and implemented where possible: • Plant and equipment will be switched off when not in use	Construction contractor	Construction	Additional safeguard

No.	Impact	Environmental safeguards and management measures	Responsibility	Timing	Reference
		• Vehicles, plant and construction equipment will be appropriately sized for the task and properly maintained so as to achieve optimum fuel efficiency • Materials will be delivered with full loads and will come from local suppliers, where possible • Energy efficiency and related carbon emissions will be considered when selecting vehicles and equipment • Vegetation clearing will be reduced as much as feasible, and re-established in suitable areas when construction is completed • Waste will be reduced and recycled as a preference before disposing to landfill.			

7.3 Licensing and approvals

All relevant licenses, permits, notifications and approvals needed for the Newell Highway Heavy Duty Pavements, Narrabri to Moree and when they need to be obtained are listed in **Table 7-2**. Additional or changed licenses and approval requirements identified in this addendum REF are indicated by underlined and/or struck out font.

Table 7-2 Summary of licensing and approval required

Instrument	Requirement	Timing
Protection of the Environment Operations Act 1997	EPL for scheduled activities (road construction / extractive activities / crushing, grinding or separating waste processing or storage) >150,000t/pa from the EPA.	Prior to start of the activity.
Roads Act 1993	ROL will need to be obtained as necessary under section 138 of the *Roads Act 1993*.	Prior to start of the activity.
National Parks and Wildlife Act 1974 (s90)	Aboriginal heritage impact permit from the Chief Executive of OEH.	Prior to start of the activity.
Permission from private landowners and residents	Permission from private landowners and residents must be obtained to access proposal work sites. This would likely be obtained through temporary lease.	Before accessing any private property.
Crown Land Management Act 2016	Licence to occupy areas of Crown land. A Community Engagement Strategy which has been exhibited for at least 28 days and approved by the Minister (Lands and Forestry) is required for any action affecting Crown land use including licences and leases.	Prior to start of the activity
Surveying and Spatial Information Act 2002.	Application for Surveyor General Approval - Survey Mark(s) Removal will be submitted their removal under the Surveying and Spatial Information Act 2002 the removal of the blaze tree (Newell Highway HS-01).	Prior to start of the activity.

8 Conclusion

8.1 Justification

TfNSW, proposes to modify the Newell Highway Heavy Duty Pavements, Narrabri to Moree project (proposed modification) as the detail design refinements and construction staging are anticipated to exceed the REF boundary. This modification is required for the change in project REF boundary to accommodate the detail design modifications and construction staging requirements.

A REF was prepared for the Newell Highway Heavy Duty Pavements, Narrabri to Moree project in June 2018. The project and the activities described in the Project REF were determined by TfNSW in September 2019.

This addendum REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

The proposed modification as described in the addendum REF best meets the project objectives, but would still result in some impacts on biodiversity, traffic amenity, Aboriginal heritage and property acquisitions.

Safeguards and management measures as detailed in this addendum REF would ameliorate or minimise these expected impacts. The proposed modification would also improve safety, traffic and freight efficiency for vehicles using the highway. On balance the proposed modification is considered justified and the following conclusions are made.

8.1.1 Social factors

The proposed modification would have some minor short-term negative social impacts as a result of the disturbance and change that would occur during construction. The combined effect of construction noise, dust, local access changes, and general disturbance caused by construction activity, construction traffic and machinery movements would result in a general loss of amenity for residents, motorists, workers and others who live near and visits the area on a regular basis during construction.

However, the long-term effect would be an overall social benefit, through improved safety and efficiency of the highway.

8.1.2 Biophysical factors

The proposed modification involves widening five segments of the existing highway along or close to its existing alignment. The project would therefore minimise the amount of land required for its development and the consequential impact on adjoining land uses and ecosystems. The project would generally follow the existing topography and existing alignment and would thereby minimise the need for major earthworks.

Some clearing of native vegetation would be required to construct the project. As discussed in **Section 6.1**, the project (project REF and proposed modifications combined) would require the clearing of about 76.92 hectares of native vegetation. This would include about 7.45 hectares of TEC listed under the BC Act and about 28.97 hectares of TEC listed under the EPBC Act. In many instances, the same patches of vegetation are part of both a state listed and a commonwealth listed TEC. An assessment of significance was carried out for threatened species and ecological communities that would be likely to occur in the projection construction boundary. The assessments concluded that, the project would not have a significant impact on any species, population or TEC listed under the NSW BC Act and FM Act.

However, the project (project REF and proposed modifications combined) may have a significant impact on one TEC listed under the EPBC Act. As the proposed modification would

require the removal of about 16.22 hectares of the TEC Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland TEC which is listed as a critically endangered ecological community under the EPBC Act. About 15.5 hectares of this TECs to be removed would be from N2MS5 and about 0.7 hectares would be from N2MS3.

The project has also been designed to avoid impacting the three modified trees located near to the project construction boundary. Archaeological test excavation did not confirm the presence of any Aboriginal objects or features within BC-HW17-PAD1 in the project construction boundary. Therefore no impacts to Aboriginal items would be expected during construction refer to **Section 6.4**.

The proposed modification would generally achieve 20% AEP flood immunity.

8.1.3 Economic factors

The proposed modification would be constructed largely within the existing road corridor, with minimal land acquisition required. The upgrade of an existing road corridor would minimise long-term disruption and economic impacts on residents, businesses and motorists.

The project would deliver long-term economic benefits on its own and as part of the broader Newell Highway Corridor Strategy. It would improve traffic conditions and reduce travel times for the Newell Highway road users between Narrabri to Moree.

8.1.4 Public interest

The public interest is best served through the equitable distribution of resources, and investment in public infrastructure that fulfils the needs of the majority. The project represents a cost-efficient investment in public infrastructure that would maximise the long-term social and economic benefits, while minimising the long-term negative impacts on communities and the environment. By improving local and regional transport facilities, the project would better enable the movement of people, goods and services.

Although the project, during the construction phase, would result in some short-term impacts on amenity, accessibility and transport efficiency, these impacts would be outweighed by the long-term benefits once the project is operational.

As a result, the project is considered to be in the public interest.

8.2 Objects of the EP&A Act

Object	Comment
1.3(a) To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources.	The proposed modification would assist the project in improving the social and economic welfare of the community by improving the road safety on this section of the Newell Highway. The design, impact, safeguards and management measures detailed in this REF allow for the proper management, development and conservation of natural and artificial resources.
1.3(b) To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment.	Ecologically sustainable development is considered in **Sections 8.2.1** to **Section 8.2.4**.

Object	Comment
1.3(c) To promote the orderly and economic use and development of land.	The project is not expected to impact on the economic use of land. However, the project would improve the economic use of the road by improving freight efficiency for t freight industry.
1.3(d) To promote the delivery and maintenance of affordable housing.	Not relevant to the proposed modification.
1.3(e) To protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats.	Impacts to native animals and plants, including threatened species, populations and ecological communities and their habitats were considered in **Section 6.1.4**.
1.3(f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	This clause is not relevant to the proposed modification.
1.3(g) To promote good design and amenity of the built environment.	Not relevant to the proposed modification.
1.3(h) To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.	Not relevant to the proposed modification.
1.3(i) To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State.	This clause is not relevant to the proposed modification.
1.3(j) To provide increased opportunity for community participation in environmental planning and assessment.	The project development process has involved consultation with relevant stakeholders. Consultation carried out and proposed is outlined in **Chapter 5**.

8.2.1 The precautionary principle

This principle states: “if there are threats of serious or irreversible damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation”.

The evaluation and assessment of alternative options within the determined project and proposed modification have also aimed to reduce the risk of serious and irreversible impact on the environment as a result of the project.

The determined project and proposed modification has sought to take a precautionary approach to minimising environmental impact. This has been applied through the development of a range of environmental safeguards, as summarised in **Chapter 7**. These safeguards would be implemented during construction and operation of the project.

No safeguards have been postponed as a result of lack of scientific certainty. The selected construction contractor would be required to prepare a CEMP before commencing construction. No mitigation measures or management mechanisms would be postponed as a result of a lack of information.

8.2.2 Intergenerational equity

The principle states: “the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations”.

The proposed modification would not result in any impacts that are likely to adversely impact on the health, diversity or productivity of the environment for future generations.

The proposed modification together with other planned road upgrades under the Newell Highway Corridor Strategy would cater for traffic growth in the region. The project would benefit future generations by addressing the future increases in traffic volumes and traffic congestion associated with movement of traffic, including road freight north of Moree, Dubbo, central western and far western NSW. While the project would have some adverse impacts, they are not considered to be of a nature or extent that would result in disadvantage to any specific section of the community or to future generations.

Should the project not proceed, the principle of intergenerational equity may be compromised, as future generations would inherit a highway with caravans, heavy and oversize vehicle travelling slowly with impacts on average travel speeds and decreases productivity of the route.

8.2.3 Conservation of biological diversity and ecological integrity

This principle states: “the diversity of genes, species, populations and communities, as well as the ecosystems and habitats to which they belong, must be maintained and improved to ensure their survival”.

The proposed modification is located in an area that has previously been modified as a result of the construction of the existing Newell Highway and nearby agricultural activities. However, remnant areas of native vegetation and associated habitats remain next to the existing highway.

A key objective of the project is to minimise adverse impacts on the environmental values of the area. Conservation of biological diversity and ecological integrity has been considered during all stages of the project’s development. Potential impacts have been avoided where possible and safeguards and management measures have been included where necessary.

The biodiversity assessment (refer to **Section 6.1** and the ABAR in **Appendix E**) concluded that the proposed modification would not have a significant impact on any species, population or TEC listed under the BC Act and FM Act. However, the proposed modification may have a have significant impact, as defined under the EPBC Act on the Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales NSW and southern Queensland. The findings of the biodiversity assessments indicate that the potential impacts would be acceptable and minimised through the proposed safeguards (refer to **Chapter 7**).

8.2.4 Improved valuation, pricing and incentive mechanisms

This principle is defined as:

improved valuation, pricing and incentive mechanisms, namely, that environmental factors should be included in the valuation of assets and services, such as:

(i) polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,

(ii) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,

(iii) environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

Environmental and social issues were considered in the strategic planning and establishment of the need for the determined project and proposed modification, and in consideration of various project options. The value placed on environmental resources is evident in the extent of the planning and environmental investigations, and in the design of the proposed mitigation measures and safeguards.

Implementation of these mitigation measures and safeguards would result in an economic cost to TfNSW, which would be included in both the capital and operating cost of the proposed modification

8.3 Conclusion

This addendum REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

This has included consideration where relevant, of conservation agreements and plans of management under the NPW Act, biodiversity stewardship sites under the BC Act, wilderness areas, areas of outstanding value, impacts on threatened species, populations and ecological communities and their habitats and other protected fauna and native plants. It has also considered potential impacts to matters of national environmental significance listed under the Federal EPBC Act.

A number of potential environmental impacts from the proposed modification have been avoided or reduced during the design development and options assessment. The proposed modification as described in the addendum REF best meets the project objectives, but would still result in some impacts on biodiversity, traffic amenity, Aboriginal heritage and property acquisitions. Safeguards and management measures as detailed in this addendum REF would ameliorate or minimise these expected impacts. The proposed modification would also improve safety, traffic and freight efficiency for vehicles using the highway. On balance the proposed modification is considered justified and the following conclusions are made.

Significance of impact under NSW legislation

The proposed modification would not result in a change to the findings of the project REF and would be unlikely to cause a significant impact on the environment. Therefore, it is not necessary for an EIS to be prepared and approval to be sought from the Minister for Planning under Division 5.2 of the EP&A Act. A BDAR or SIS is not required. The proposed modification is subject to assessment under Division 5.1 of the EP&A Act. Consent from Council is not required.

Significance of impact under Australian legislation

The proposed modification is likely to significantly impact on a threatened ecological community within the meaning of the EPBC Act. This addendum REF has considered the consistency of the activity with relevant recovery plans, threat abatement plans, conservation advices and guidelines provided by the Australian Government. The REF finds that the activity will not threaten the long term survival of nationally listed biodiversity matters and that suitable offset measures can be secured as set out in the Biodiversity Offset Strategy for the project.

This addendum REF has been prepared to meet the requirements of the EPBC Act strategic assessment approval for TfNSW Division 5.1 road activities. A referral to the Australian Government Department of Agriculture, Water and the Environment is not required.

9 Certification

This addendum review of environmental factors provides a true and fair review of the proposed modification in relation to its potential effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposed modification.

Tina Donovan

Senior Environmental Scientist

Jacobs

Date: 6/11/2020

I have examined this addendum review of environmental factors and accept it on behalf of TfNSW.

David Ledlin

Environmental Manger SaWPO

Date:

9.1 References

AREA, 2020. *Newell Highway - Heavy Duty Pavement Upgrade between Narrabri and Moree – Addendum Biodiversity Assessment Report*

AREA, 2018. *Supplementary biodiversity assessment carried out by AREA Environmental Consultants*

DECC, 2009. *Interim Construction Noise Guideline (ICNG)*

DECCW, 2010. *Code of Practice for the Investigation of Aboriginal Objects in New South Wales* (Code of Practice)

DPI Fisheries, 2013. *Policy and guidelines for fish habitat conservation and management*

GHD, 2019. *Newell Highway Heavy Duty Pavement Detailed Design - Road User Delay Report*.

GHD, 2020. *Highway Upgrade- Detailed Design Flood Study*

Jacobs, 2018. *Heavy Duty Pavement Upgrade between Narrabri and Moree - Biodiversity Assessment Report*

Jacobs, 2018a. *Heavy Duty Pavement Upgrade between Narrabri and Moree - Noise and Vibration Assessment Report (NVA)*

OzArk, 2020. *Aboriginal and Historic Assessment Report Addendum- Newell Highway Heavy Duty Pavements – Narrabri to North Moree*

OzArk, 2020a. *Aboriginal Archaeological Test Excavation Report - Newell Highway Heavy Duty Pavements – Narrabri to Moree*

OzArk, 2018. *Aboriginal and Historical Archaeological Survey Report: Newell Highway HD Pavements – Narrabri to North Narrabri*

OzArk, 2020. *Aboriginal and Historic Assessment Report Addendum - Newell Highway Heavy Duty Pavements – Narrabri to North Moree*

Roads and Maritime, 2018, *Newell Highway Heavy Duty Pavements, Narrabri to Moree Review of Environmental Factors*

Roads and Maritime, 2016. *Construction Noise and Vibration Guideline*

Roads and Maritime, 2015. *Cultural Heritage Guidelines*

Roads and Maritime, 2015. *Standard Management Procedure - Unexpected Heritage Items*

Roads and Maritime, 2014. *Beyond the Pavement: urban design policy, process and principles*

Roads and Maritime, 2011. *Procedure for Aboriginal Cultural Heritage Consultation and Investigation*

Roads and Maritime, 2008. *QA Specification G10 Control of Traffic*

RTA, 2011. *Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects*

RTA, 2010. *Traffic Control at Work Sites Manual*

RTA, 2008. *Landscape Guideline*

RTA, 2008. *Community Involvement and Communications Resource Manual.*

Transport for NSW, 2015. *Newell Highway Corridor Strategy*

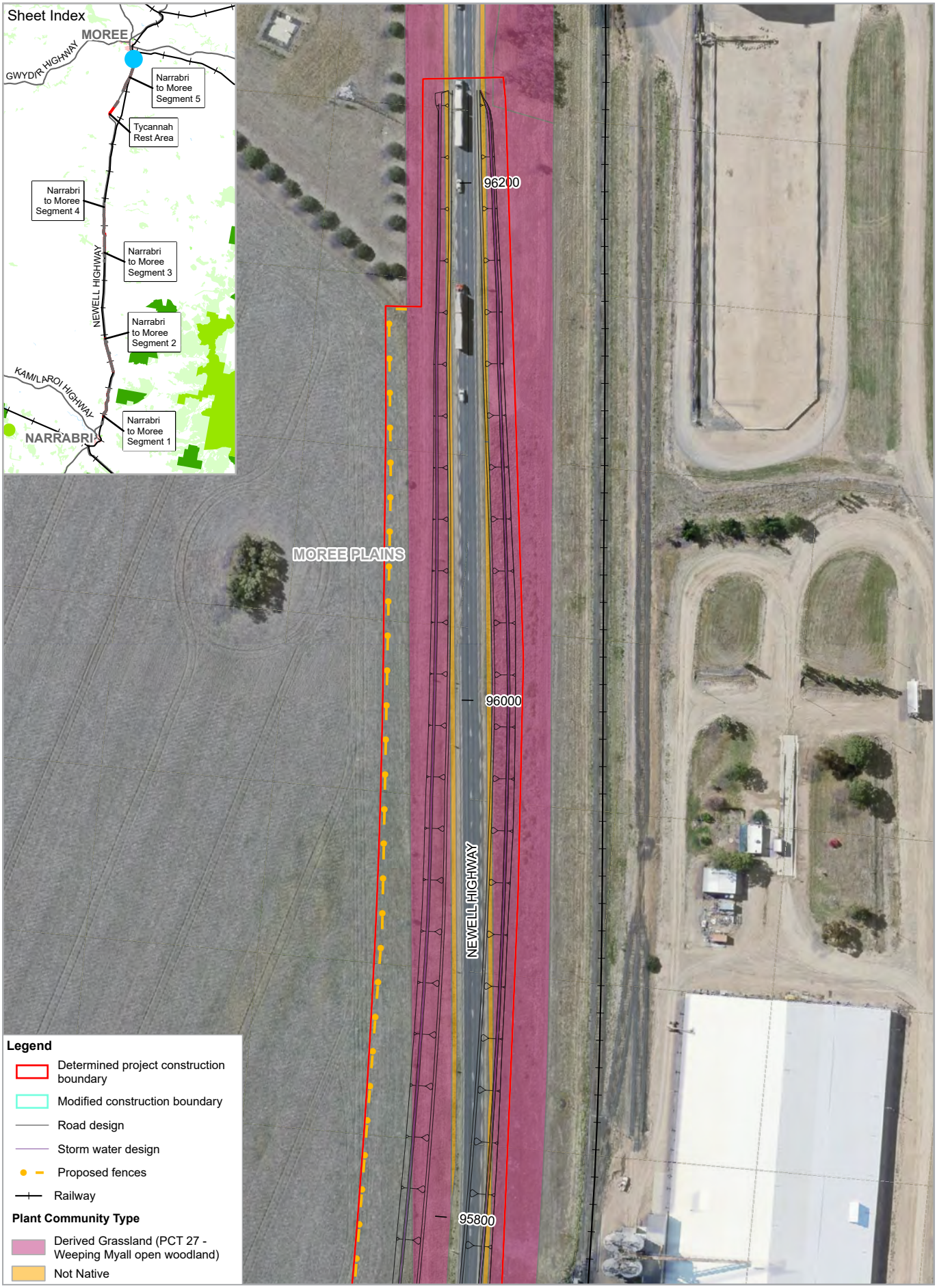
Terms and acronyms used in this addendum REF

Term / Acronym	Description
ACHAR	Aboriginal cultural heritage assessment report
AEP	The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal heritage impact permit
AHMP	Aboriginal Heritage Management Plan
AQMP	Air Quality Management Plan
ARTC	Australian Rail Track Corporation
ASRIS	Australian Soil Resource Information System
ASS	Acid sulphate soil
AUL	Auxiliary left turn
AUR	Auxiliary right turn
AWS	Automatic Weather Station
BAL	Basic left turn
BAR	Basic right-turn
CEMP	Construction Environmental Management Plan
CEP	Communications Engagement Plan
CHL	Commonwealth Heritage List
CHR	Channelised right turn
CMA	Catchment Management Authority
DPE	Department of Planning and Environment
DPI	Department of Primary Industries
EEC	Endangered ecological community
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EP&A Act	Environmental Planning and Assessment Act 1979 (NSW). Provides the legislative framework for land use planning and development assessment in NSW
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth). Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process.
EPL	Environmental Protection License
ESCP	Erosion and Sediment Control Plan

Term / Acronym	Description
ESD	Ecologically sustainable development. Development which uses, conserves and enhances the resources of the community so that ecological processes on which life depends, are maintained and the total quality of life, now and in the future, can be increased
FM Act	*Fisheries Management Act 1994 (NSW)*
Heritage Act	*Heritage Act 1977 (NSW)*
HRMP	Hazard and Risk Management Plan
ICNG	Interim Construction Noise Guideline
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
LALC	Local Aboriginal Land Council
LCZ	Landscape Character zone
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act.
LGA	Local Government Area
LOS	Level of Service. A qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers.
NAHMP	Non-Aboriginal Heritage Management Plan
NES	Matters of national environmental significance under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999.
NHL	National Heritage List
NPW Act	*National Parks and Wildlife Act 1974 (NSW)*
NSW	New South Wales
NTAR	National Trust of Australia Register (NSW)
NTCG	Native Title Claim Group
NVMP	Noise and Vibration Management Plan
OEH	Office of Environment and Heritage
PACHCI	Procedure for Aboriginal Cultural Heritage Consultation and Investigation
PAD	Potential Archaeological Deposit
PEMP	Project Environmental Management Plan
POEO	*Protection of the Environment Operations Act 1997*
QA Specifications	Specifications developed by Roads and Maritime Services for use with road work and bridge work contracts let by Roads and Maritime Services.
REF	Review of Environmental Factors
Roads and Maritime	Roads and Maritime Services, now Transport for NSW (TfNSW)

Term / Acronym	Description
RNE	Register of the National Estate
SEPP	State Environmental Planning Policy. A type of planning instrument made under Part 3 of the EP&A Act.
SHI	State Heritage Inventory
SHR	State Heritage Register
SIS	Species Impact Statement
SOHI	Statement of Heritage Impact
SWMP	Soil and Water Management Plan
TMP	Traffic Management Plan
VMS	Variable message signs
WARR	*Waste Avoidance and Resource Recovery Act 2001*
WHL	World Heritage List
WHS	Work Health and Safety
WMP	Waste Management Plan

Appendix A Proposed modification figure



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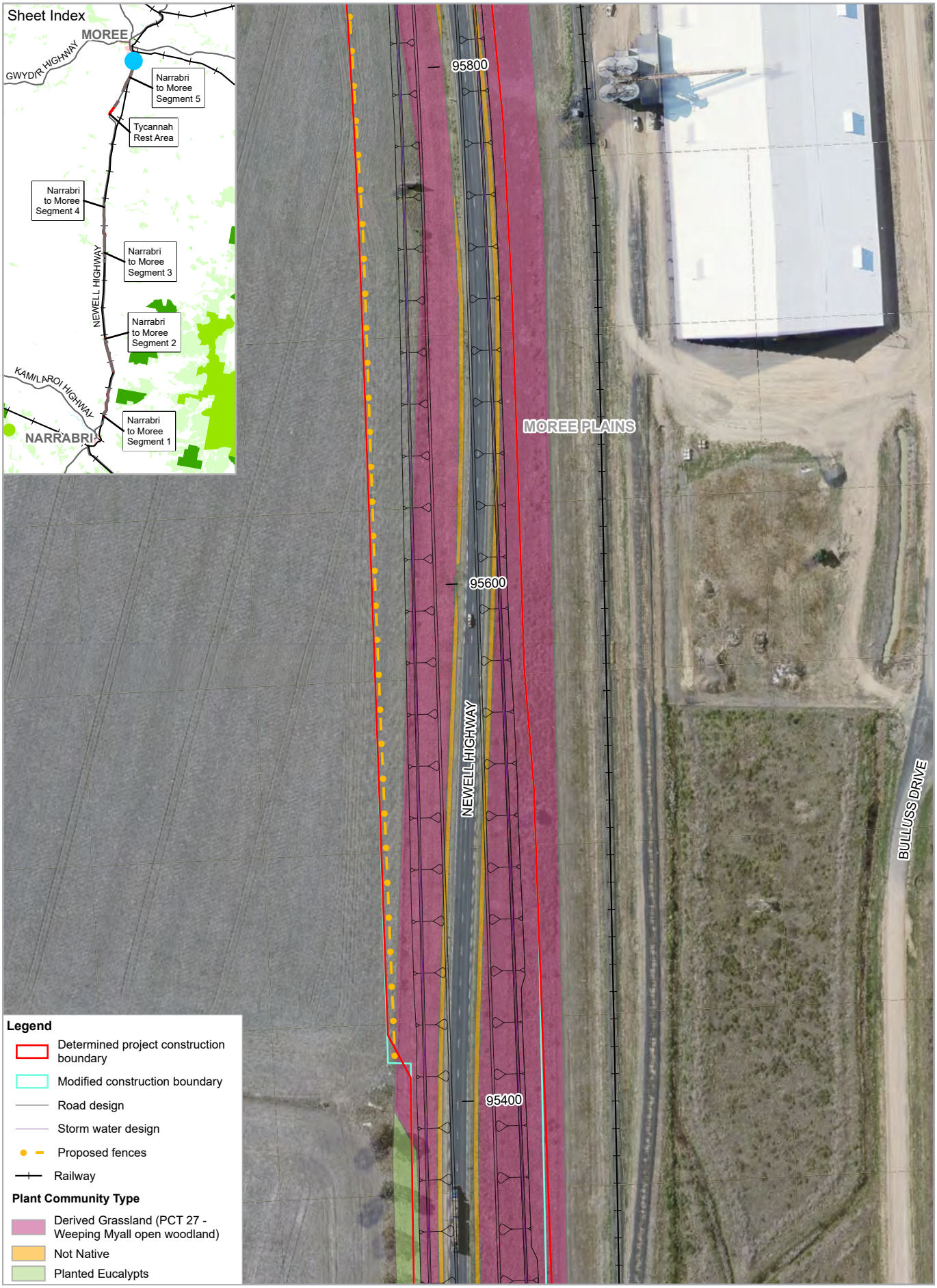

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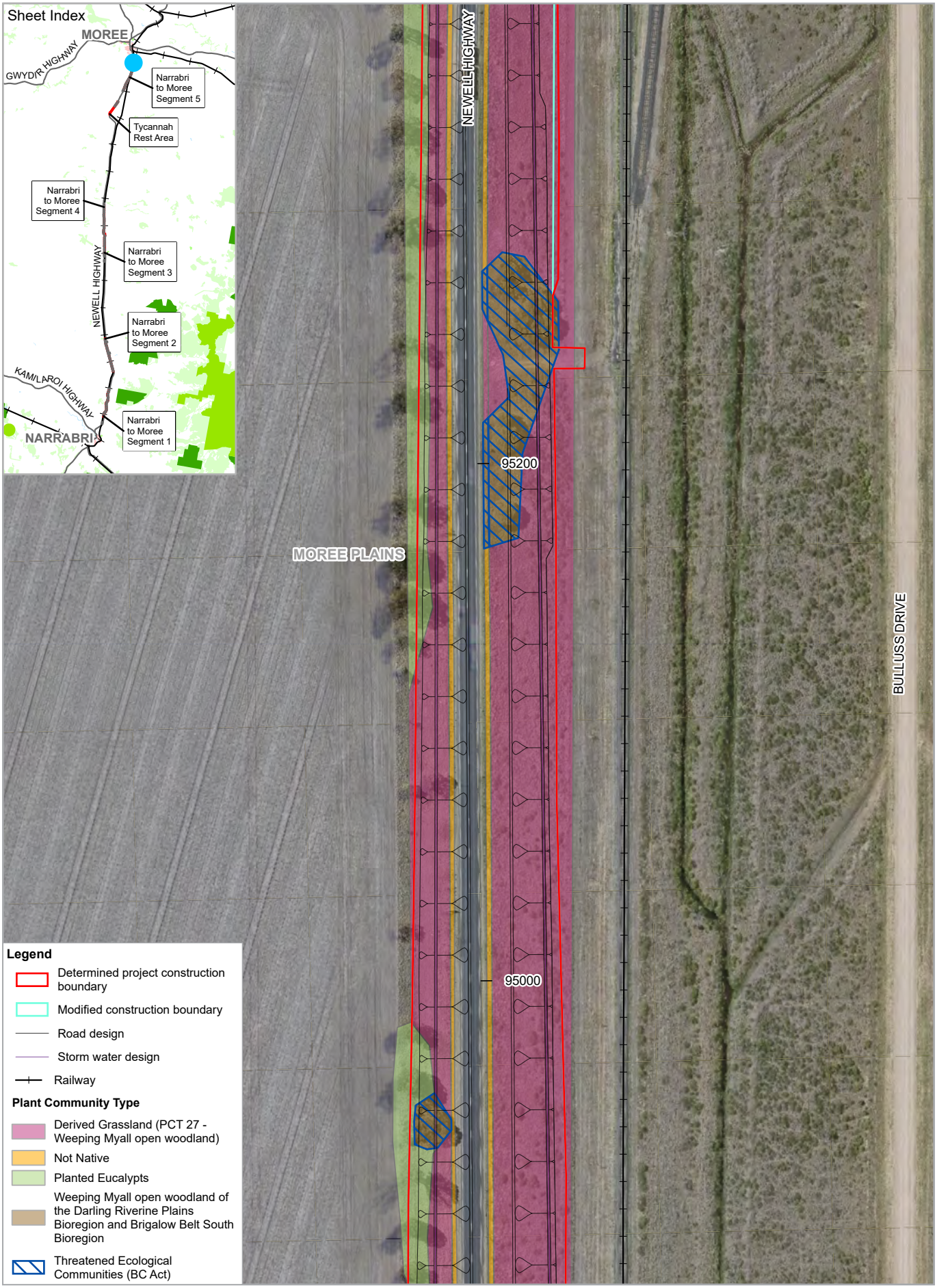

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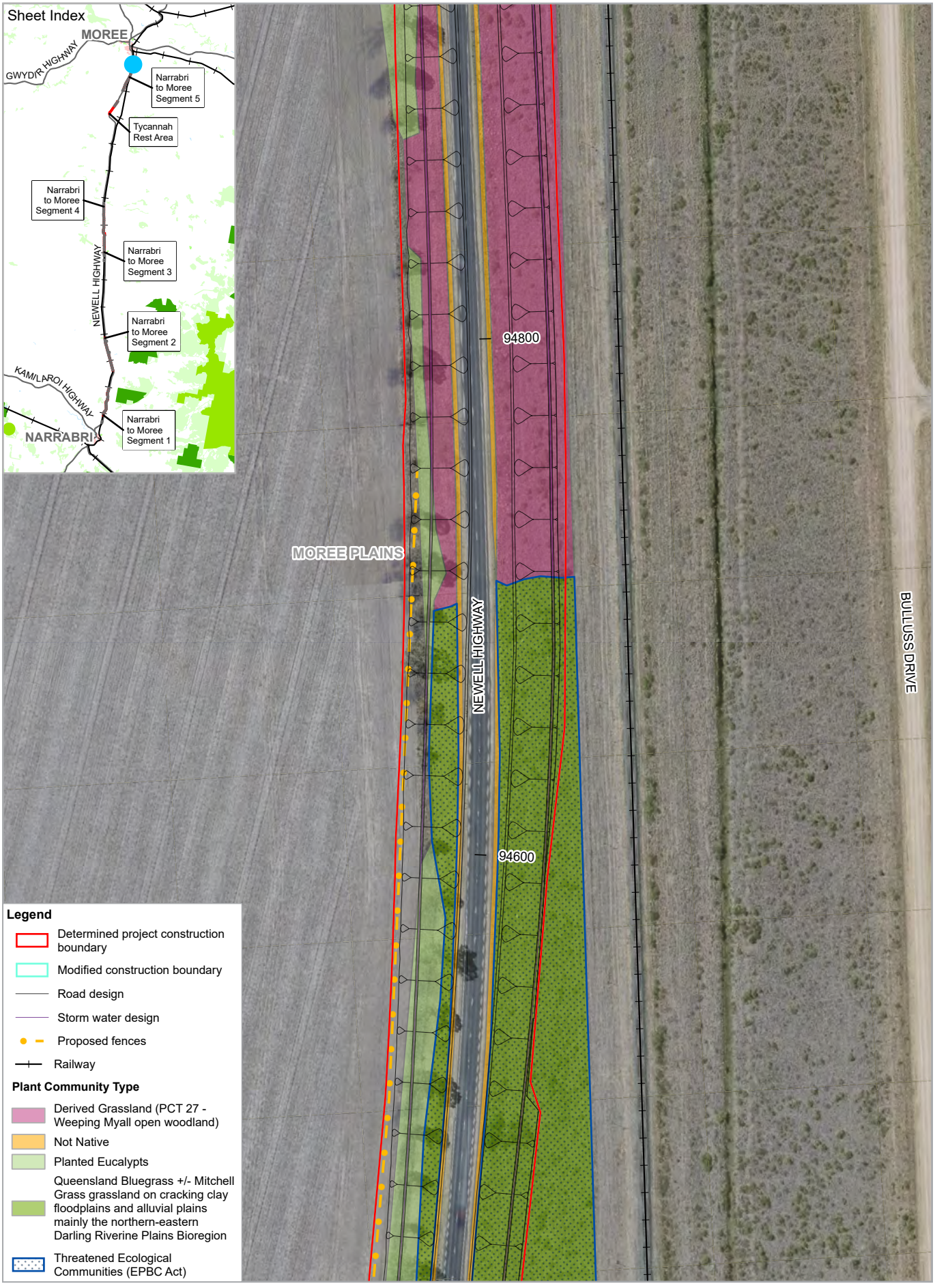

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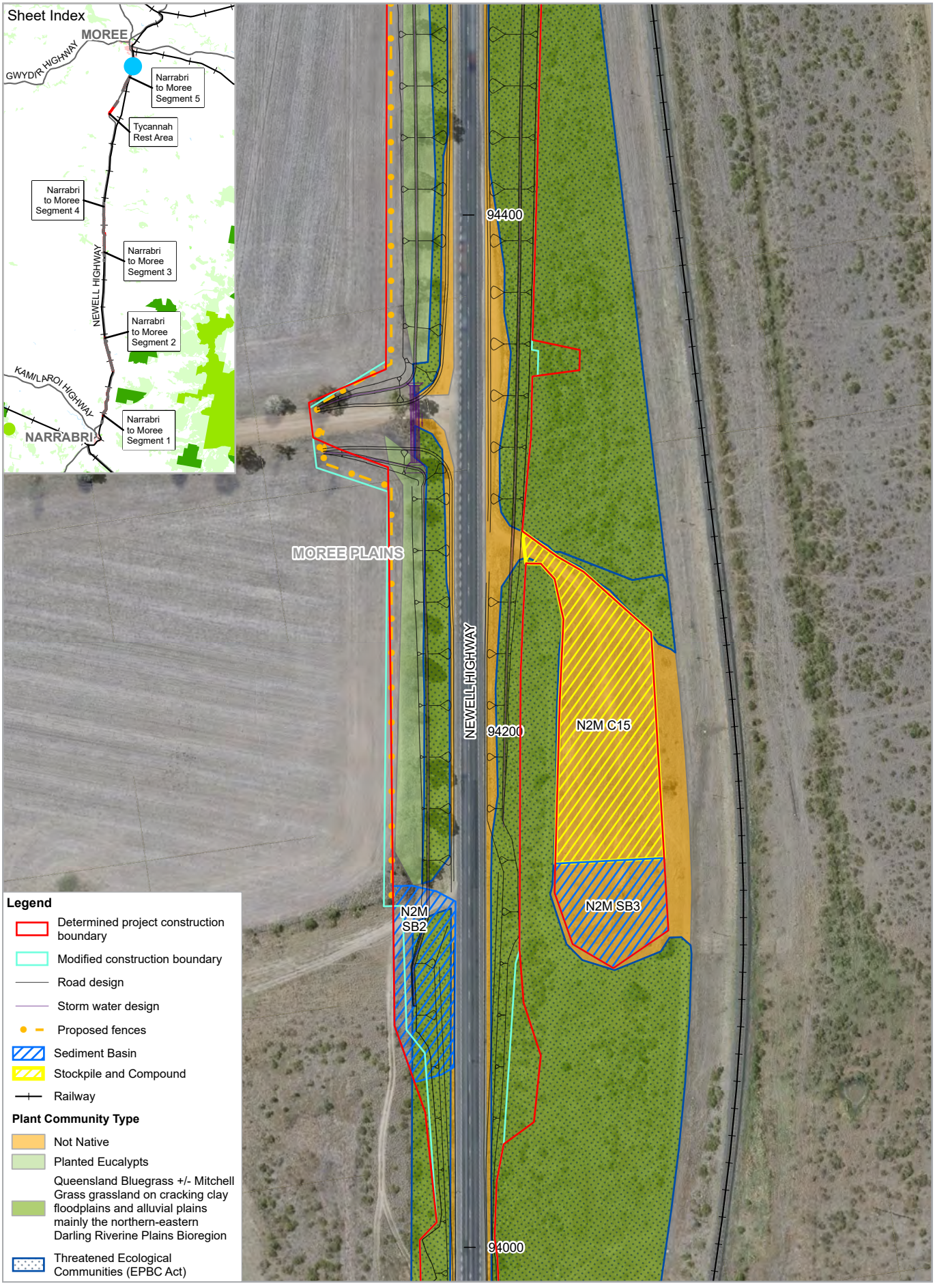

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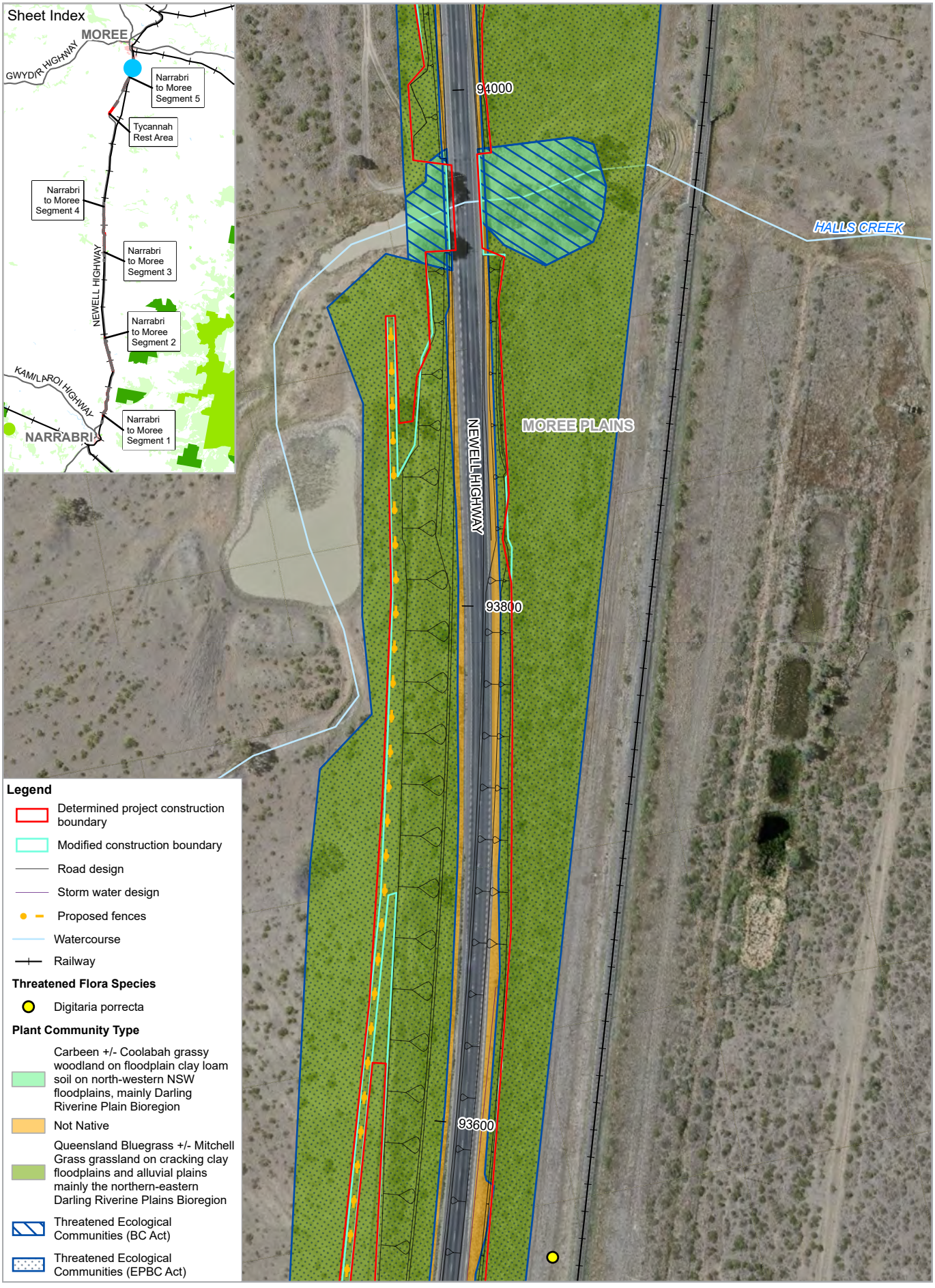

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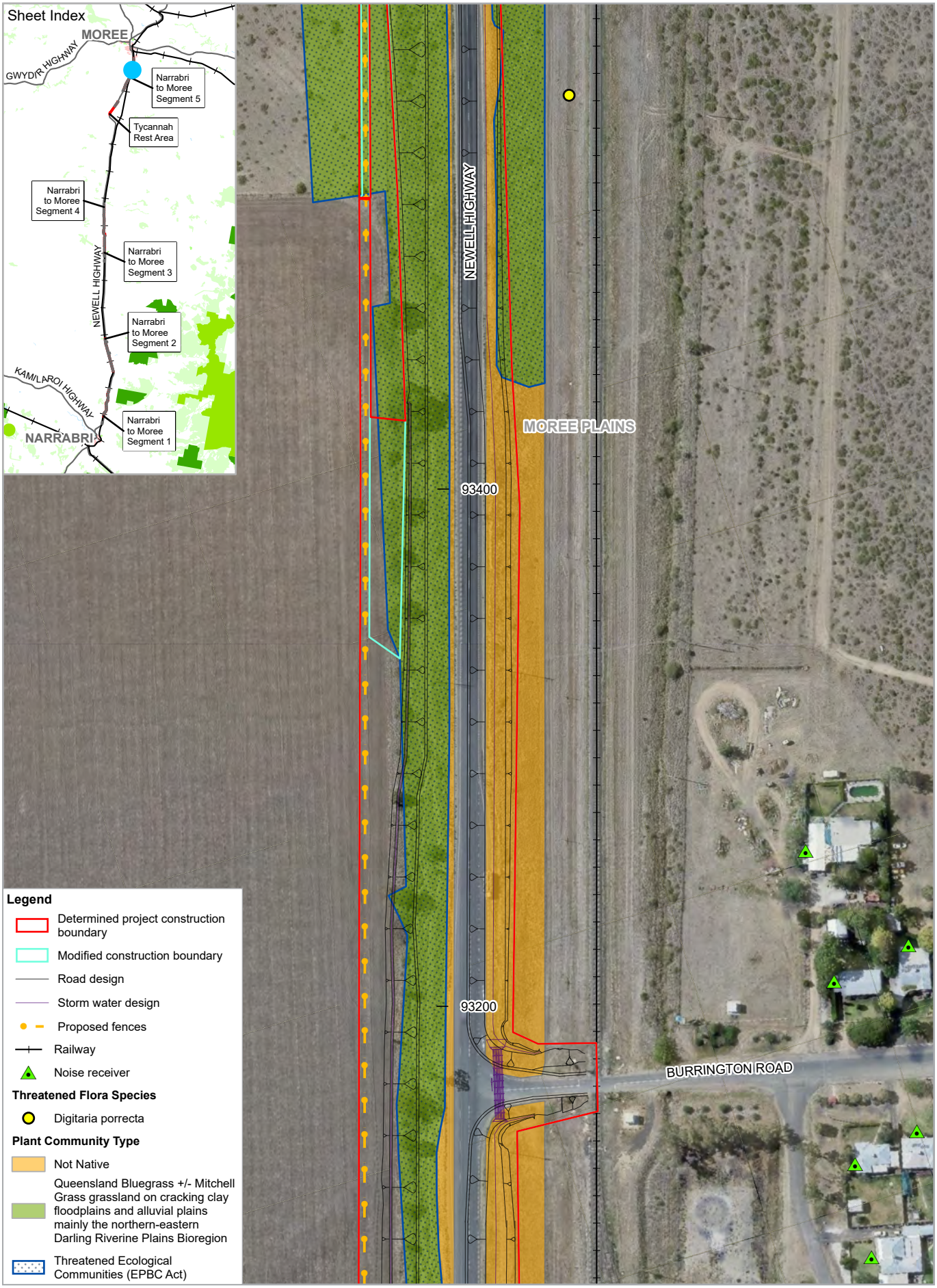

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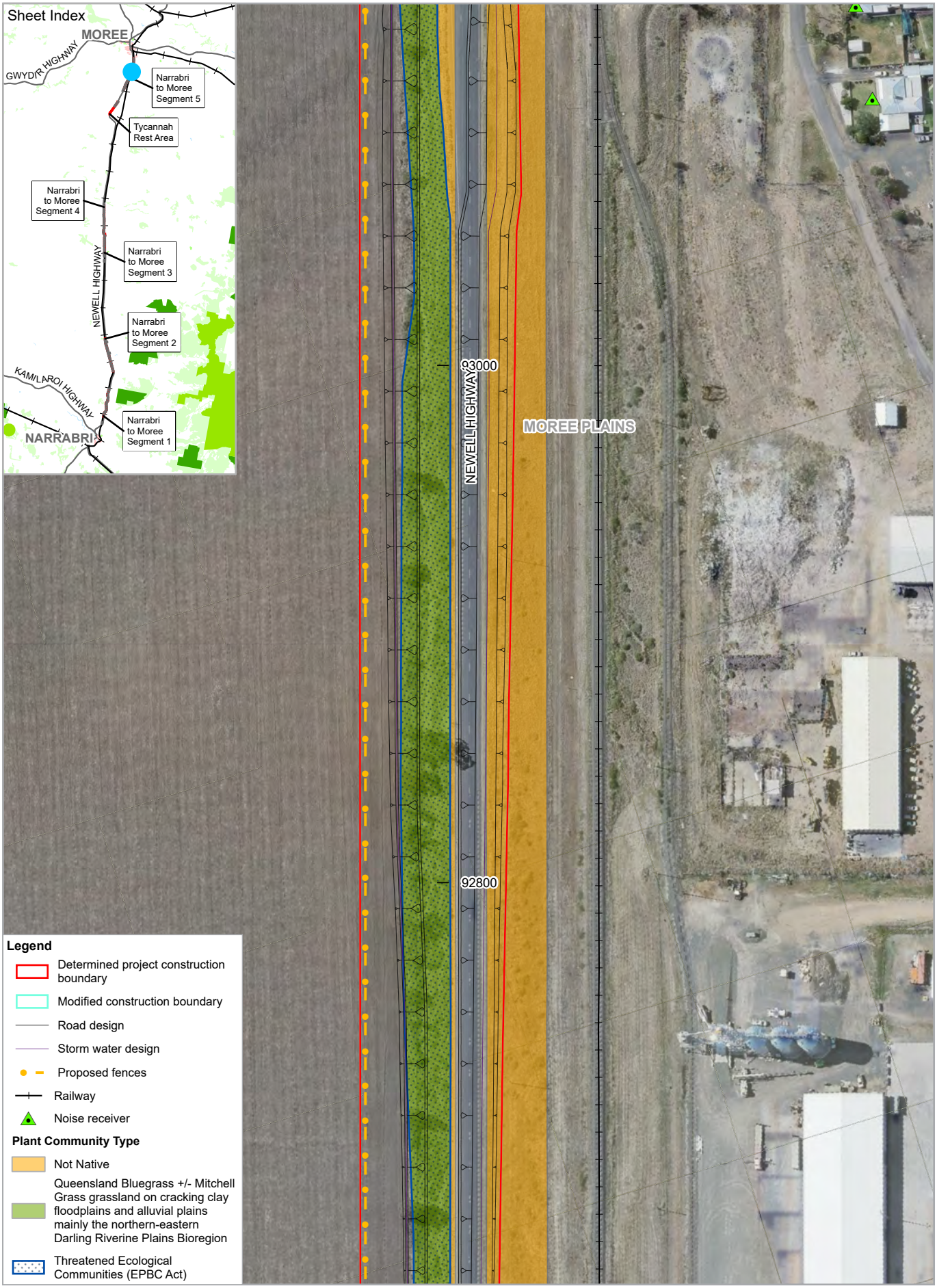

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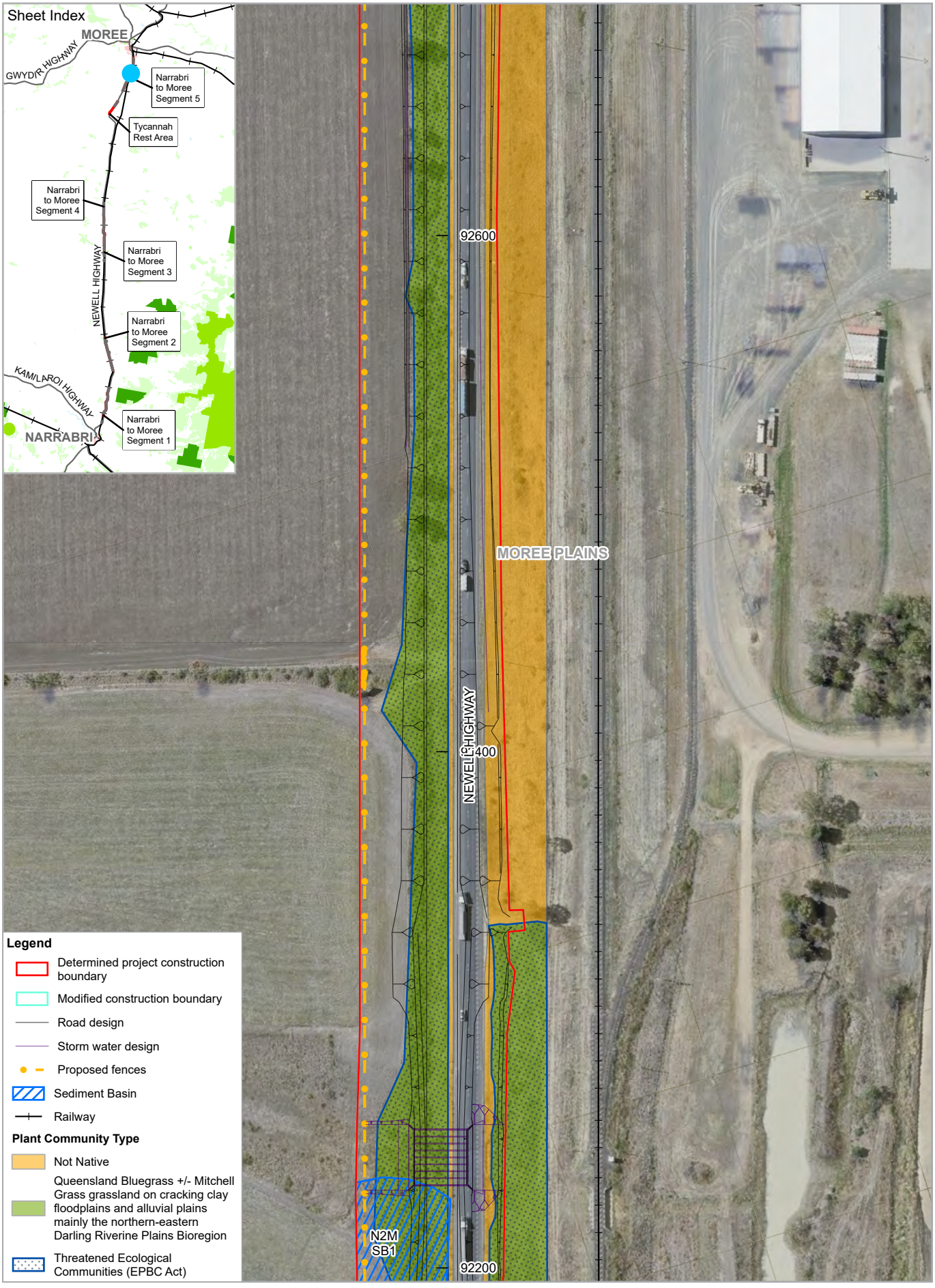

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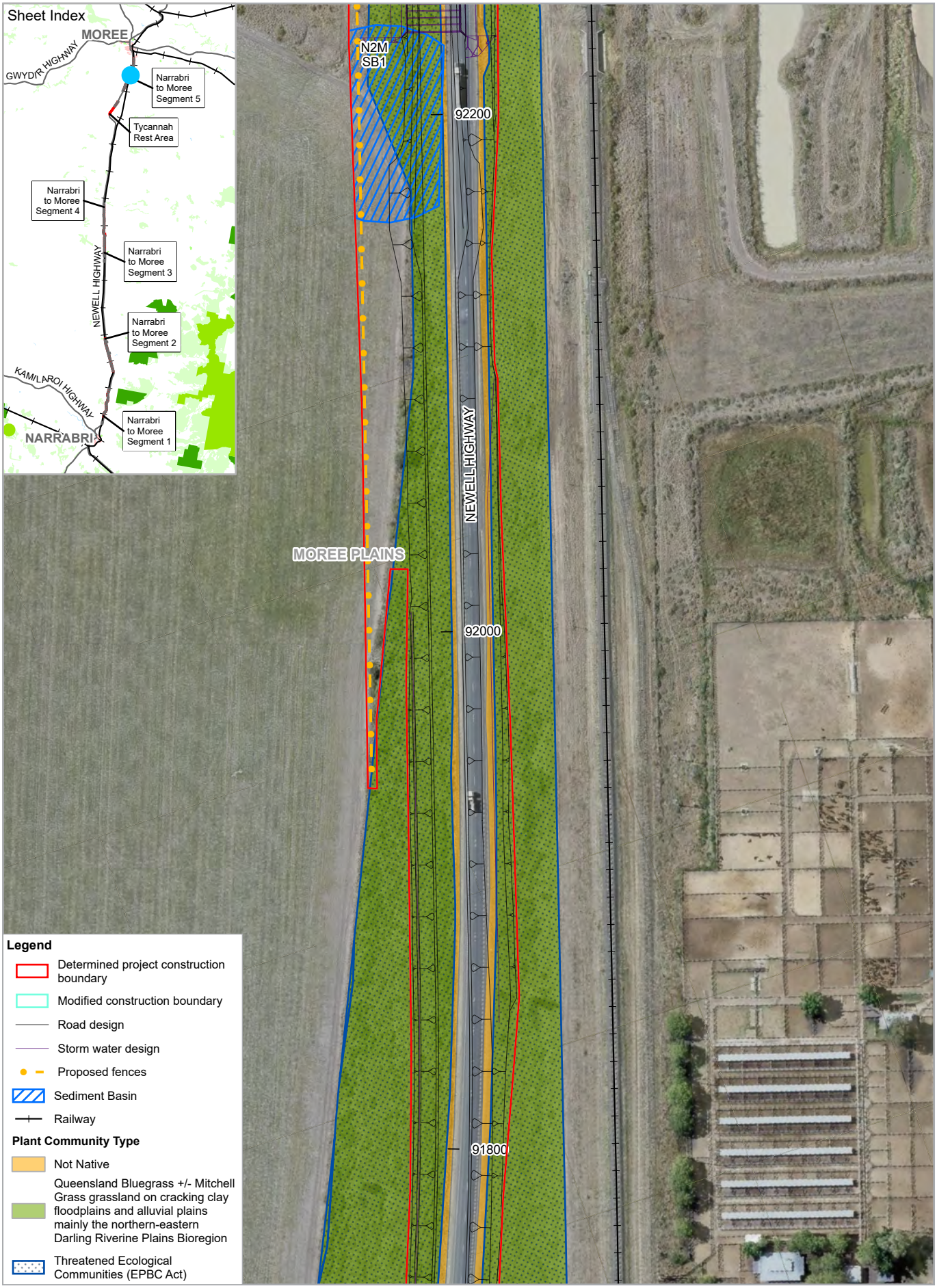

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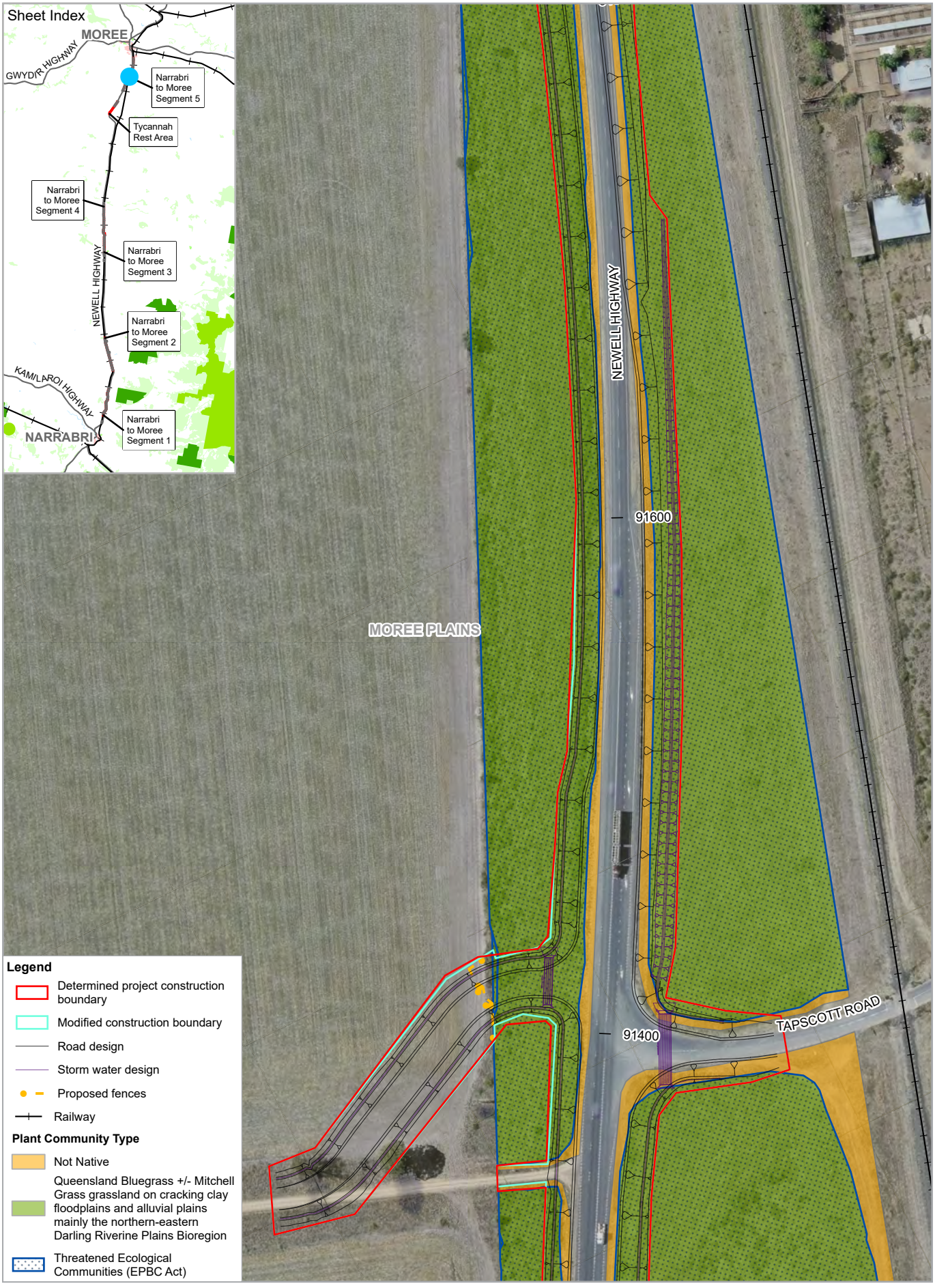

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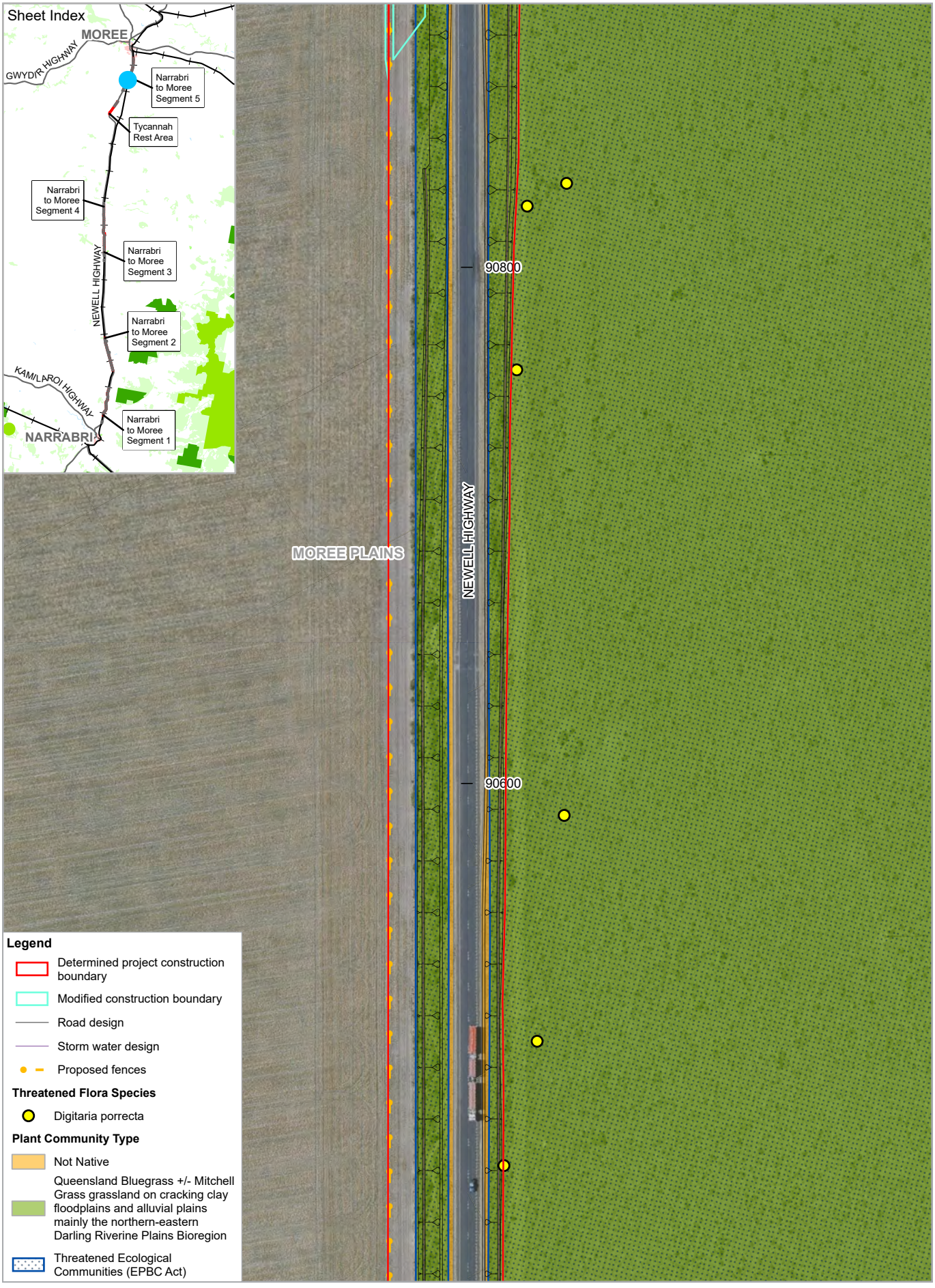

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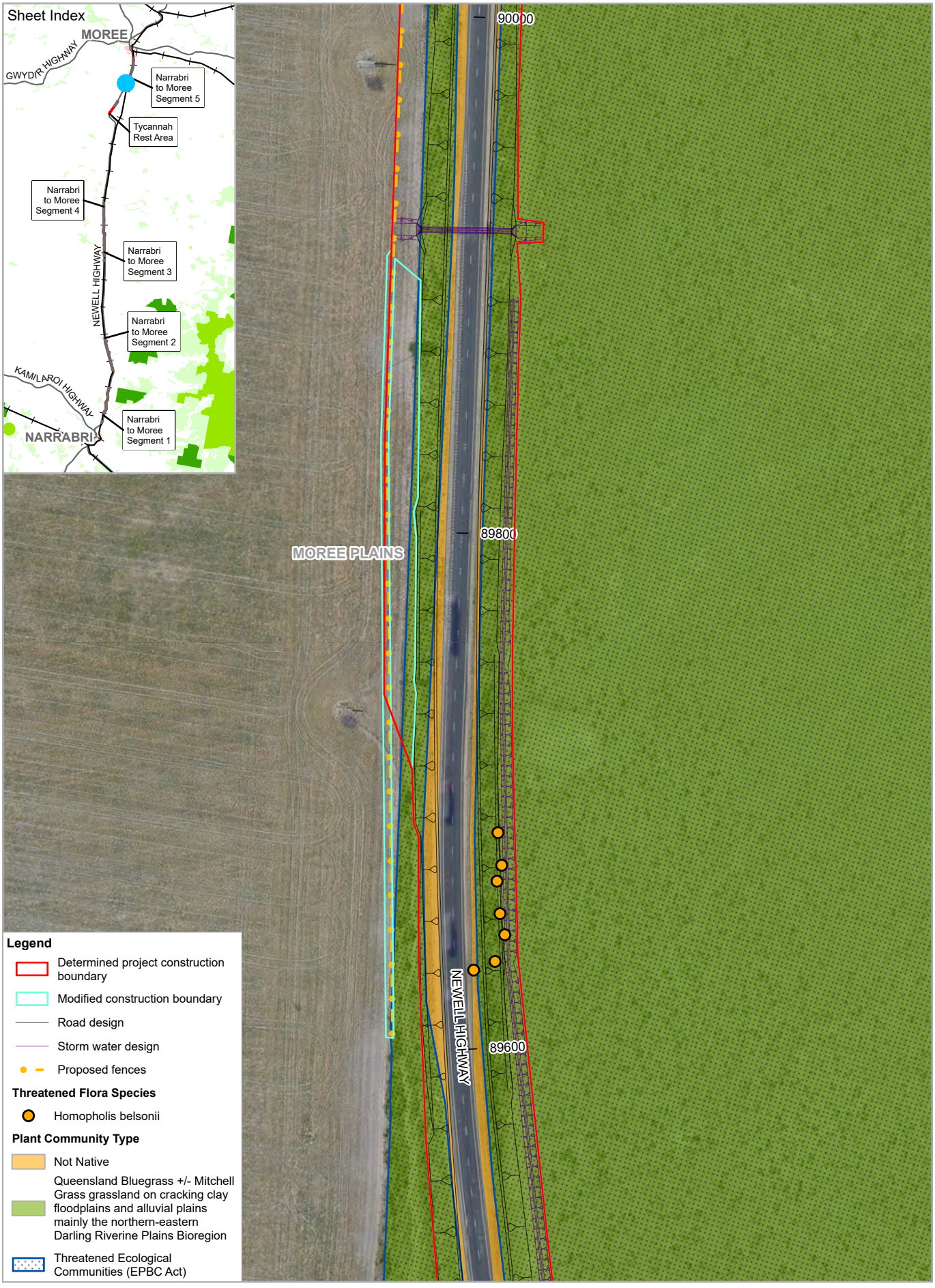

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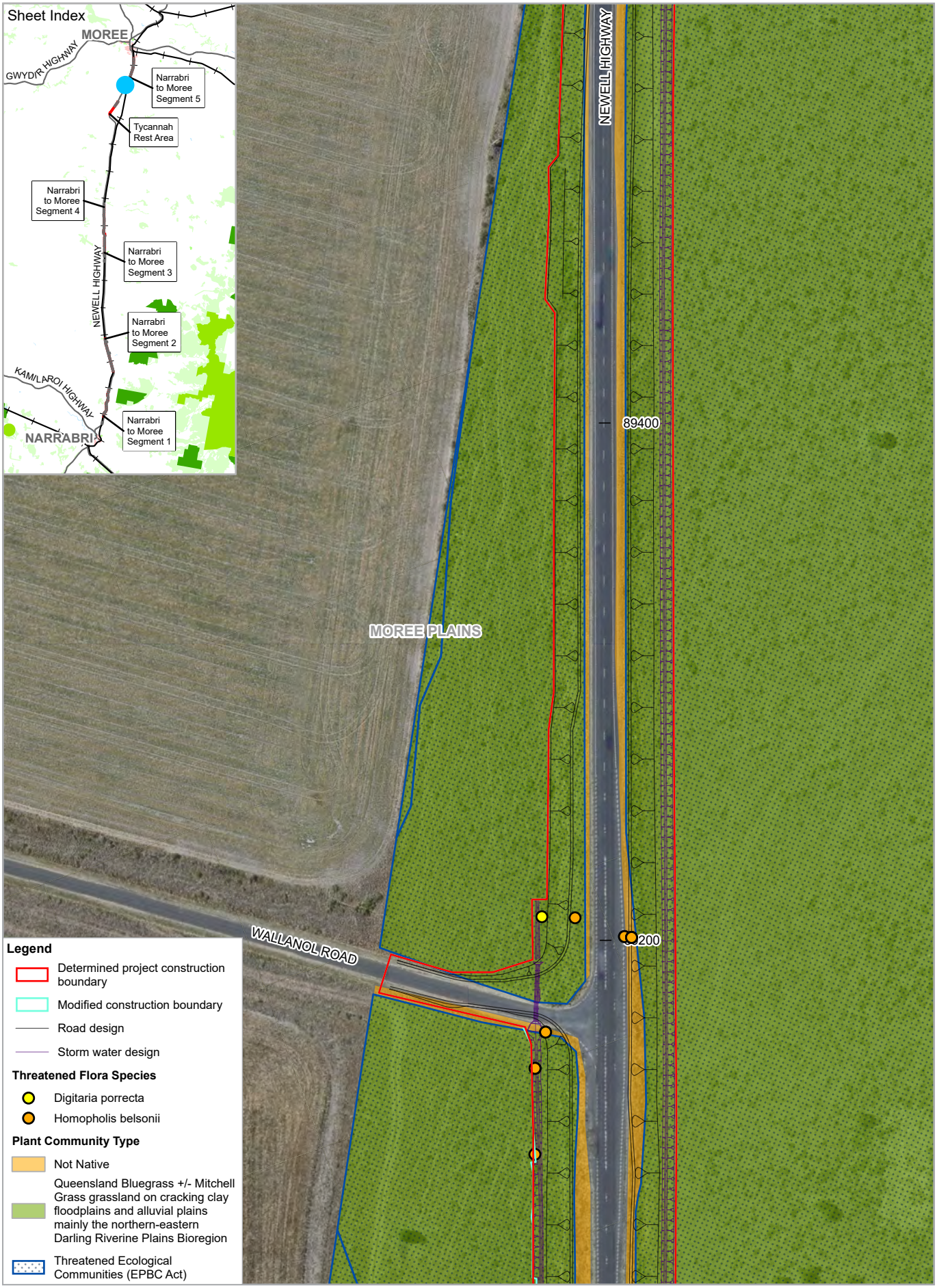

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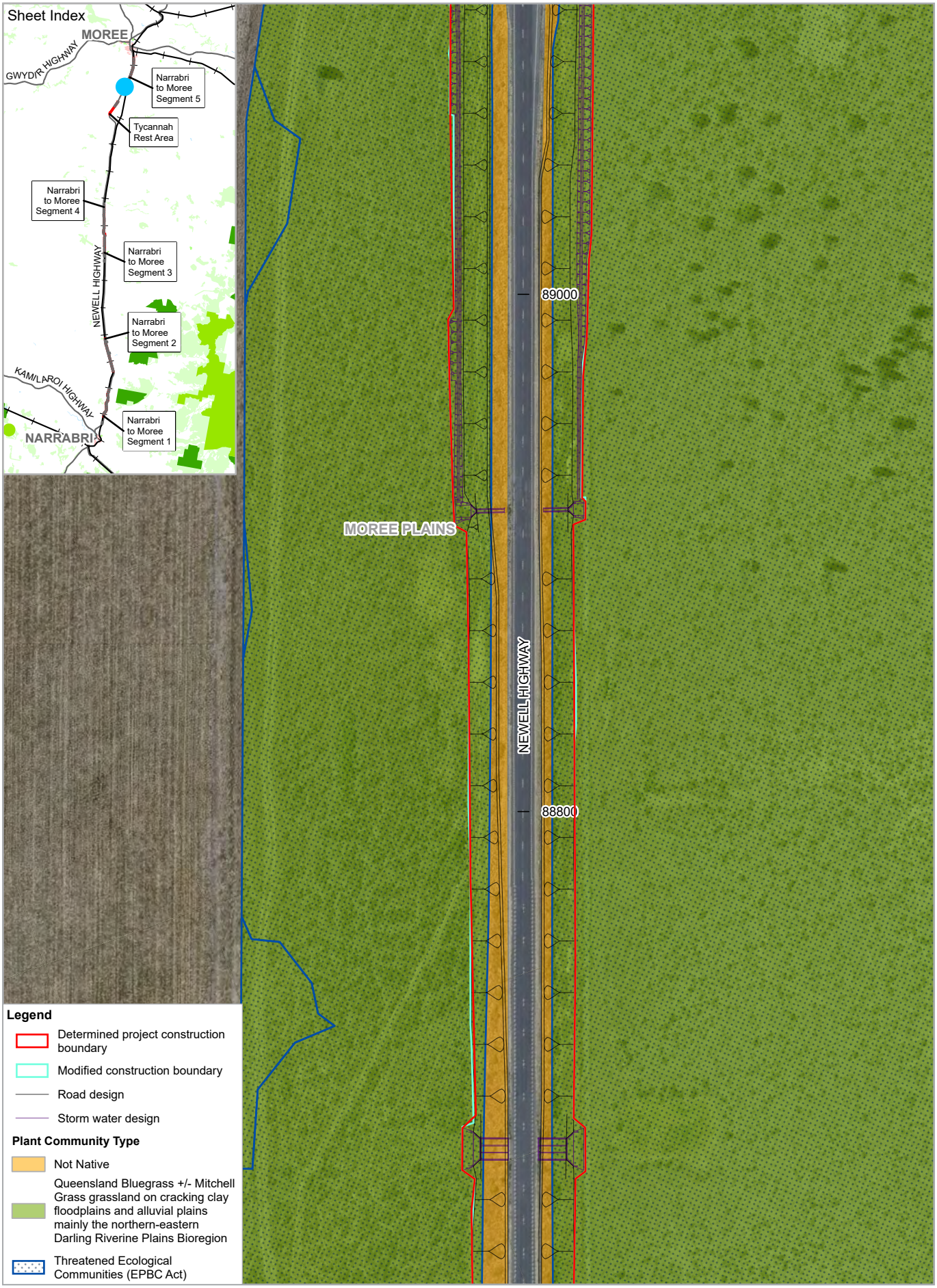

Paper Size ISO A4

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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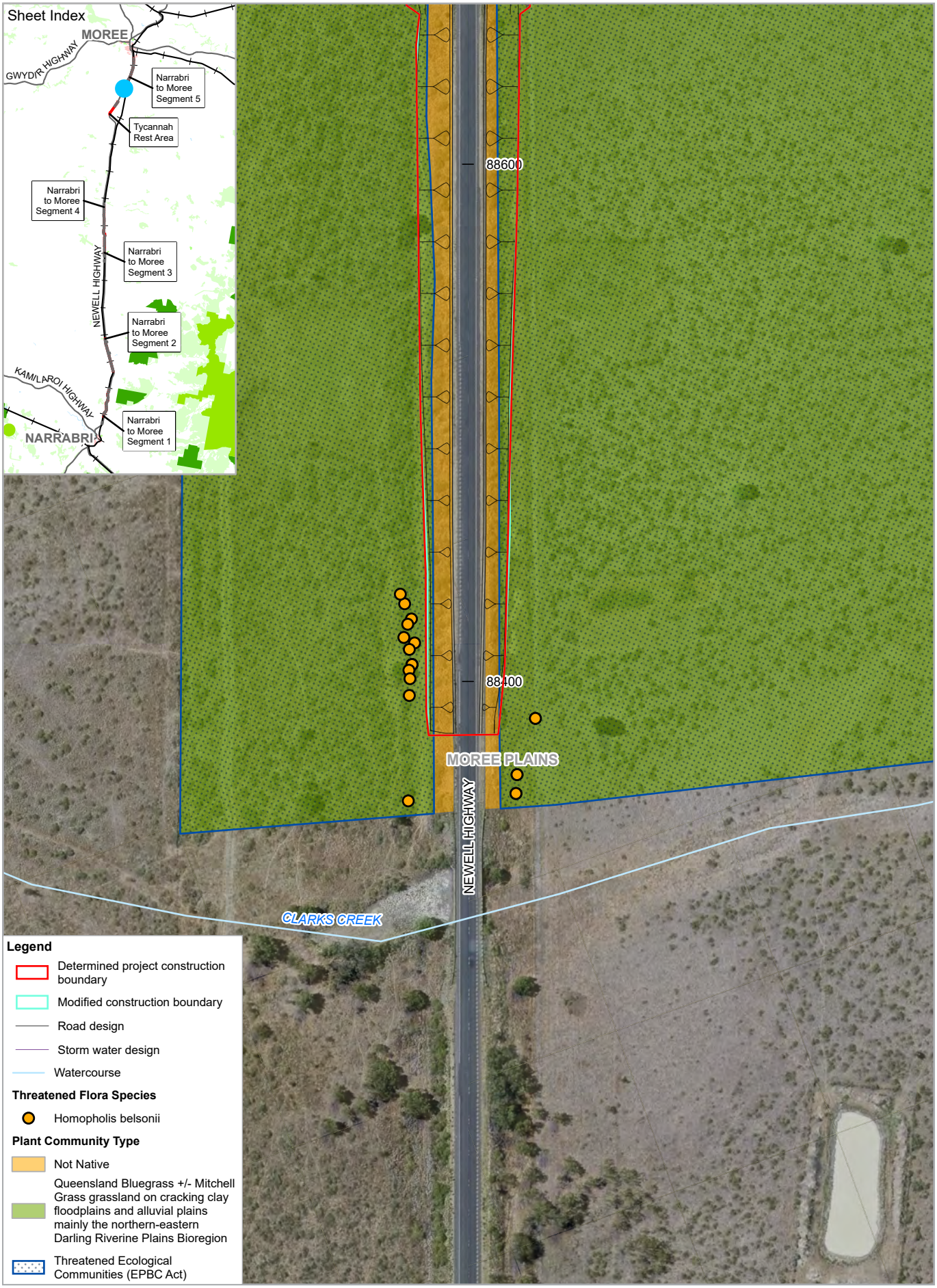
G:\22\20010\GIS\Maps\2220010_NewellHighway_DD\REFCR_B.aprx\2220010_REFCR001_ProposedModifications_A
Print date: 28 Jul 2020 - 17:03



Paper Size ISO A4

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

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Paper Size ISO A4

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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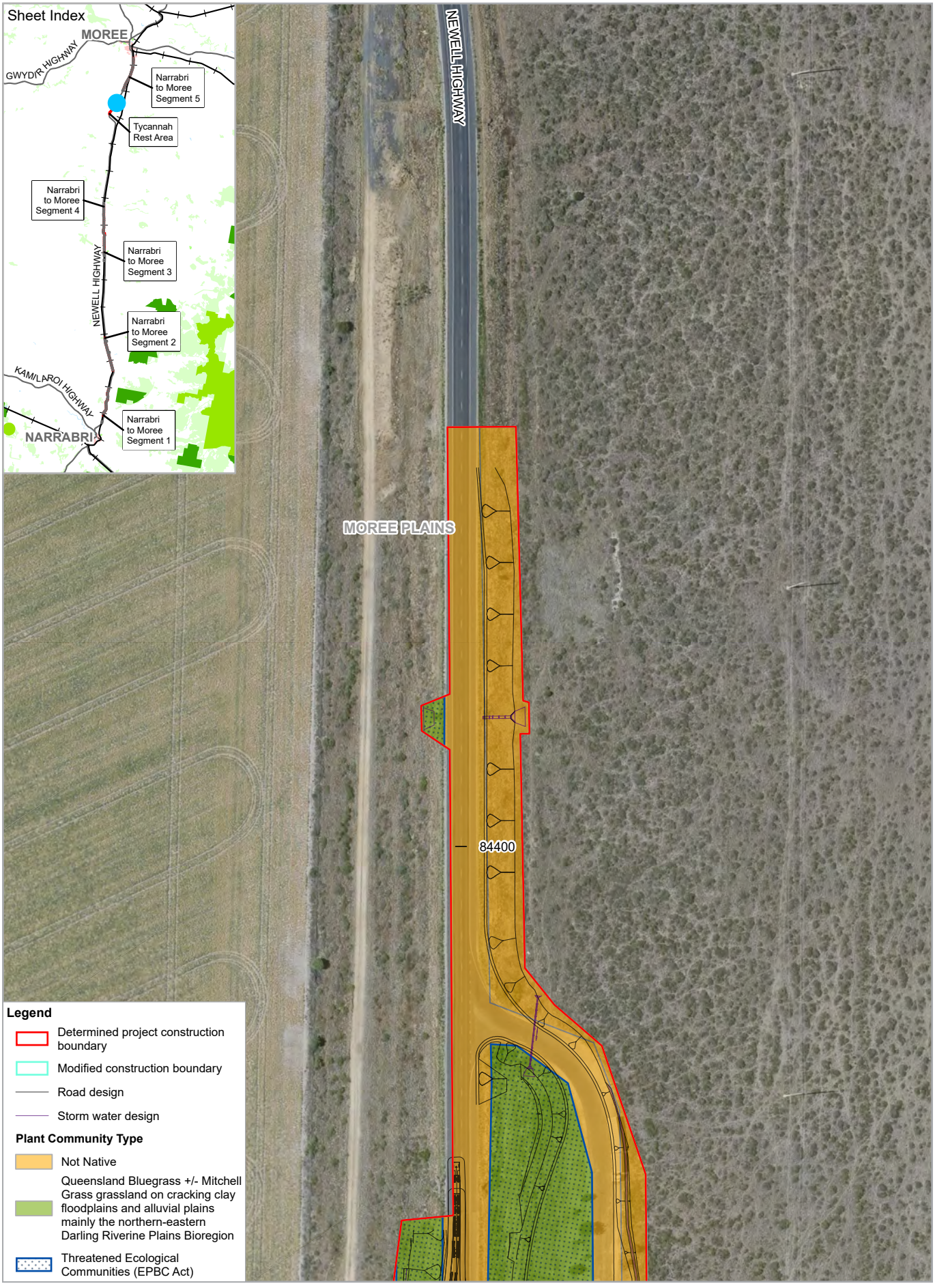

Paper Size ISO A4

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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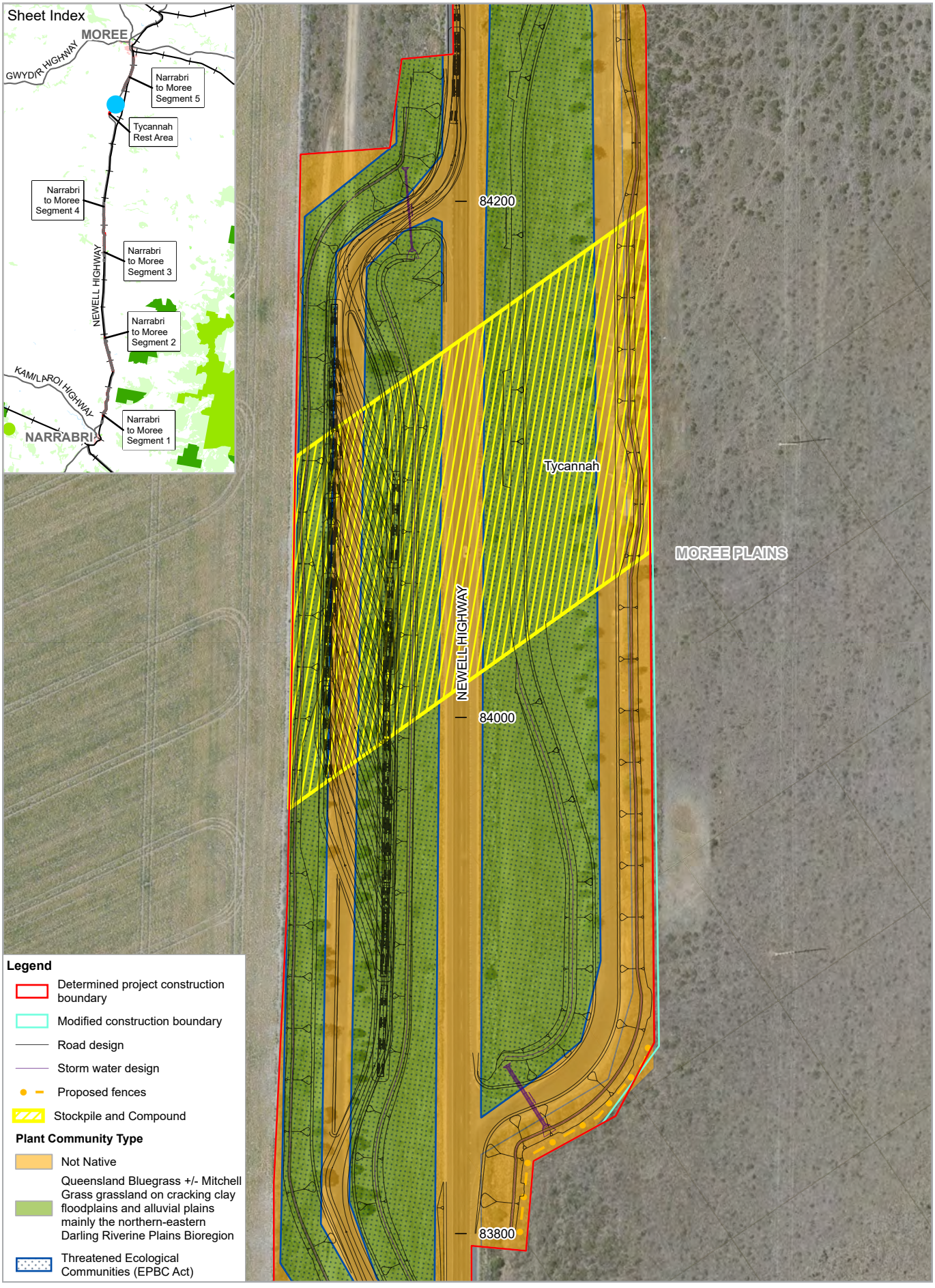

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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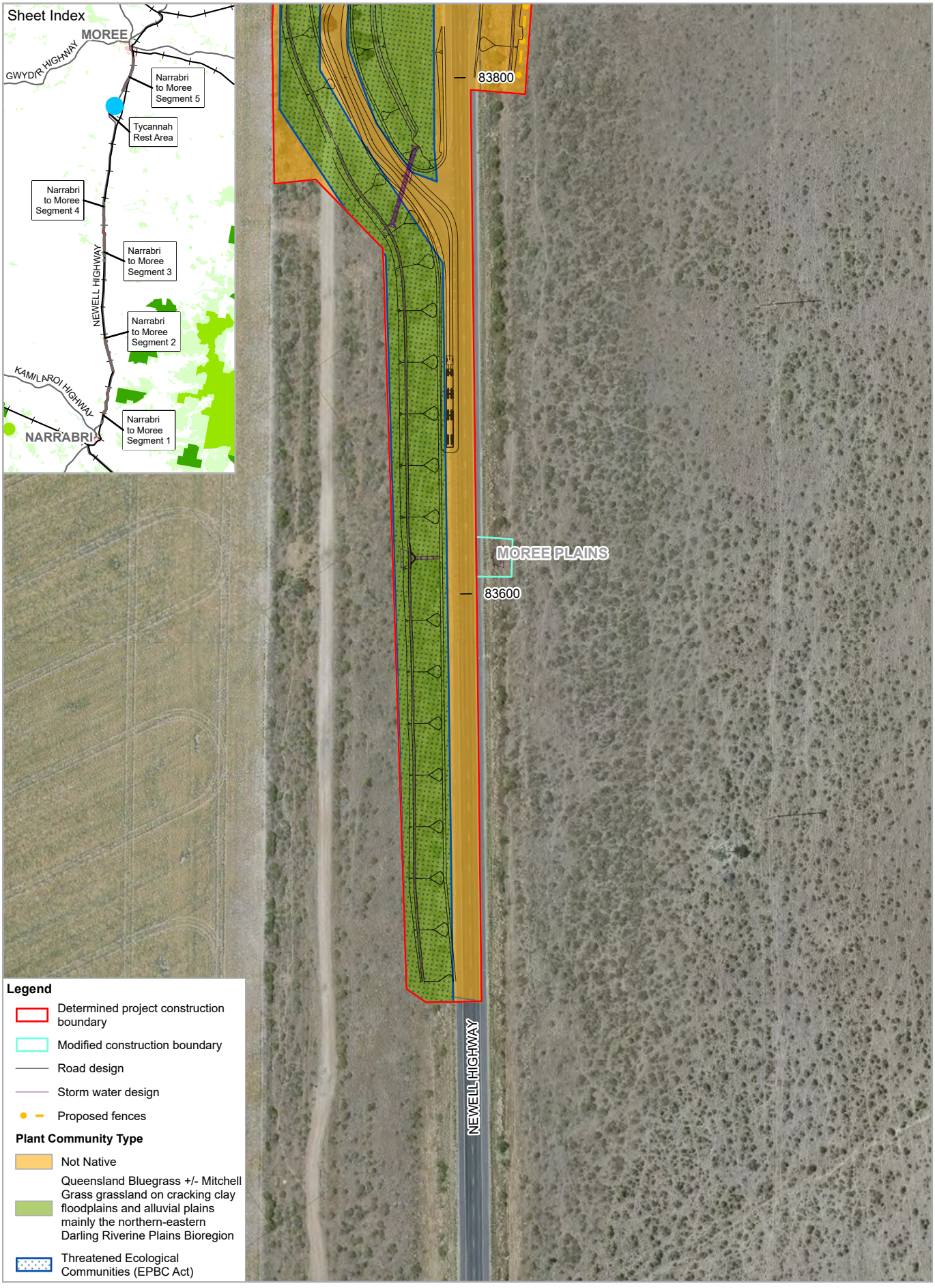

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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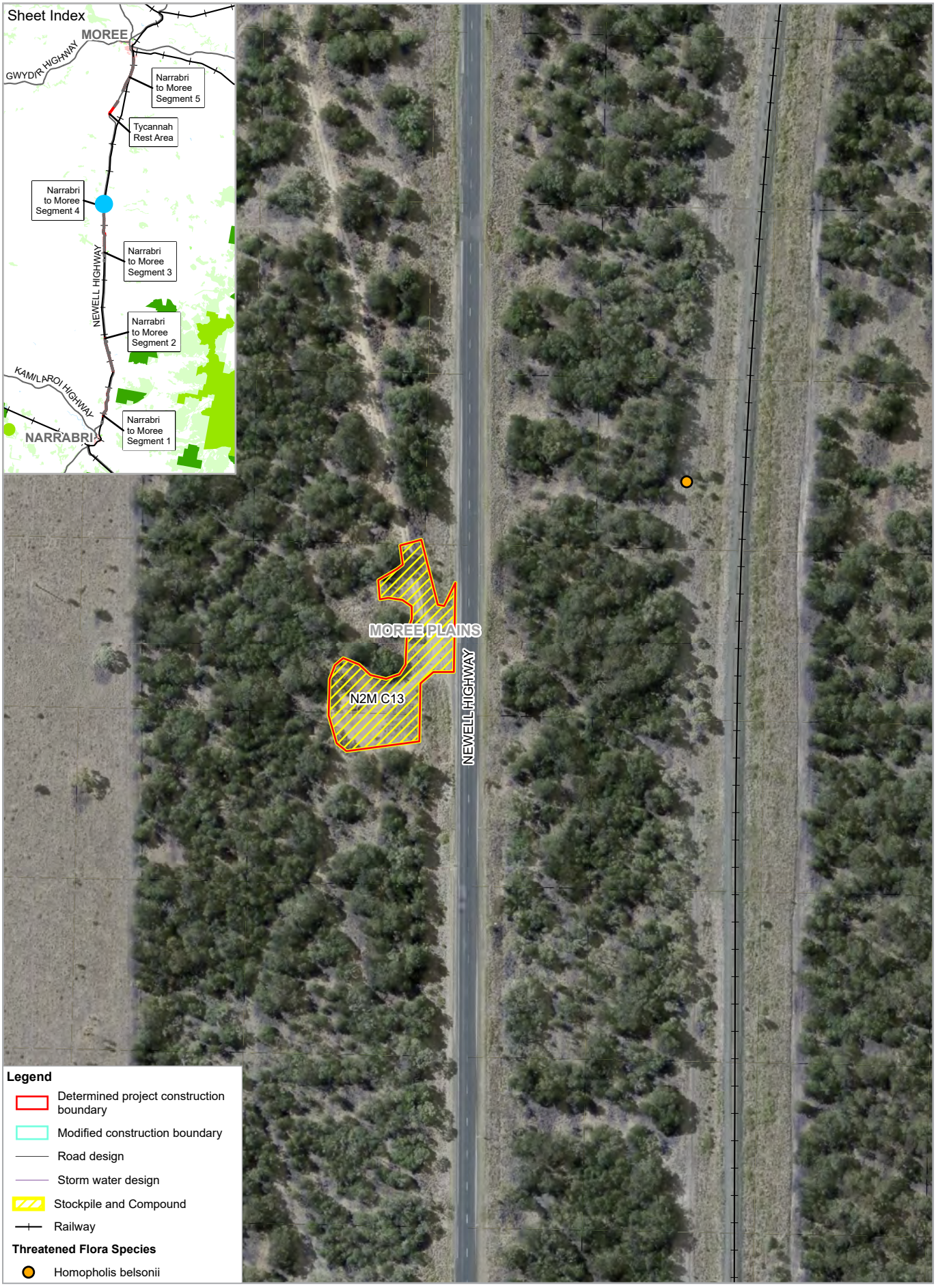

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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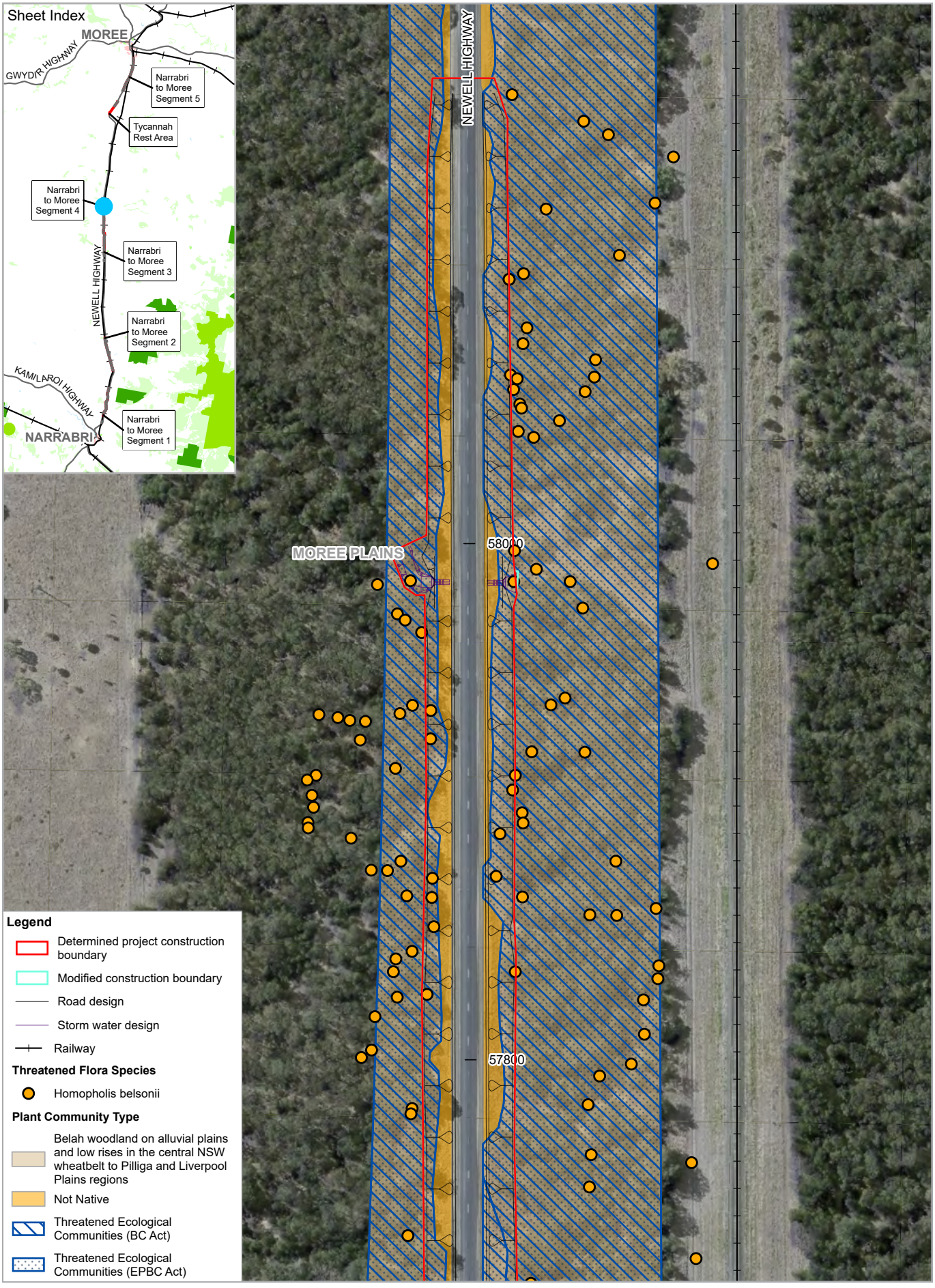

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

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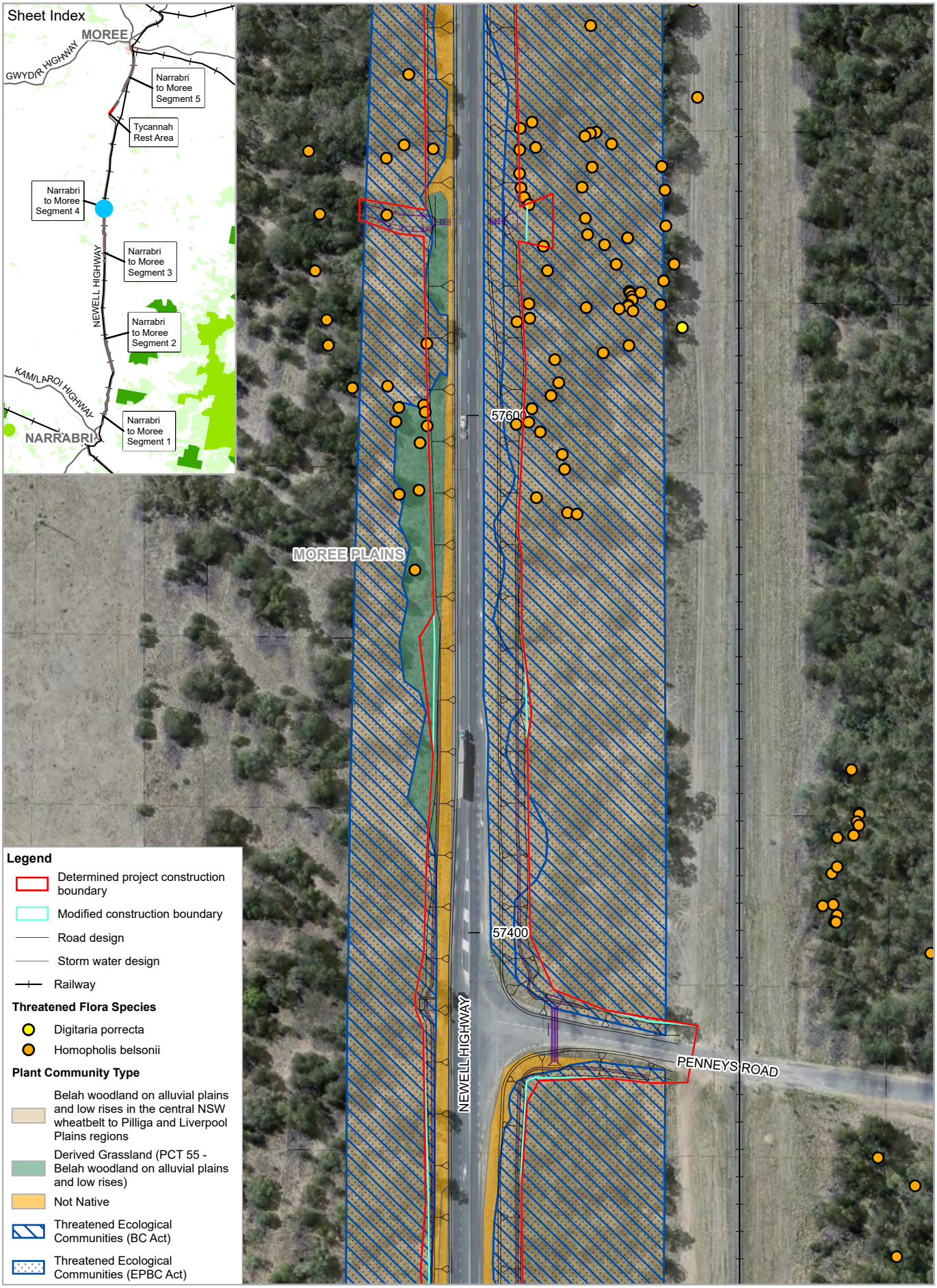

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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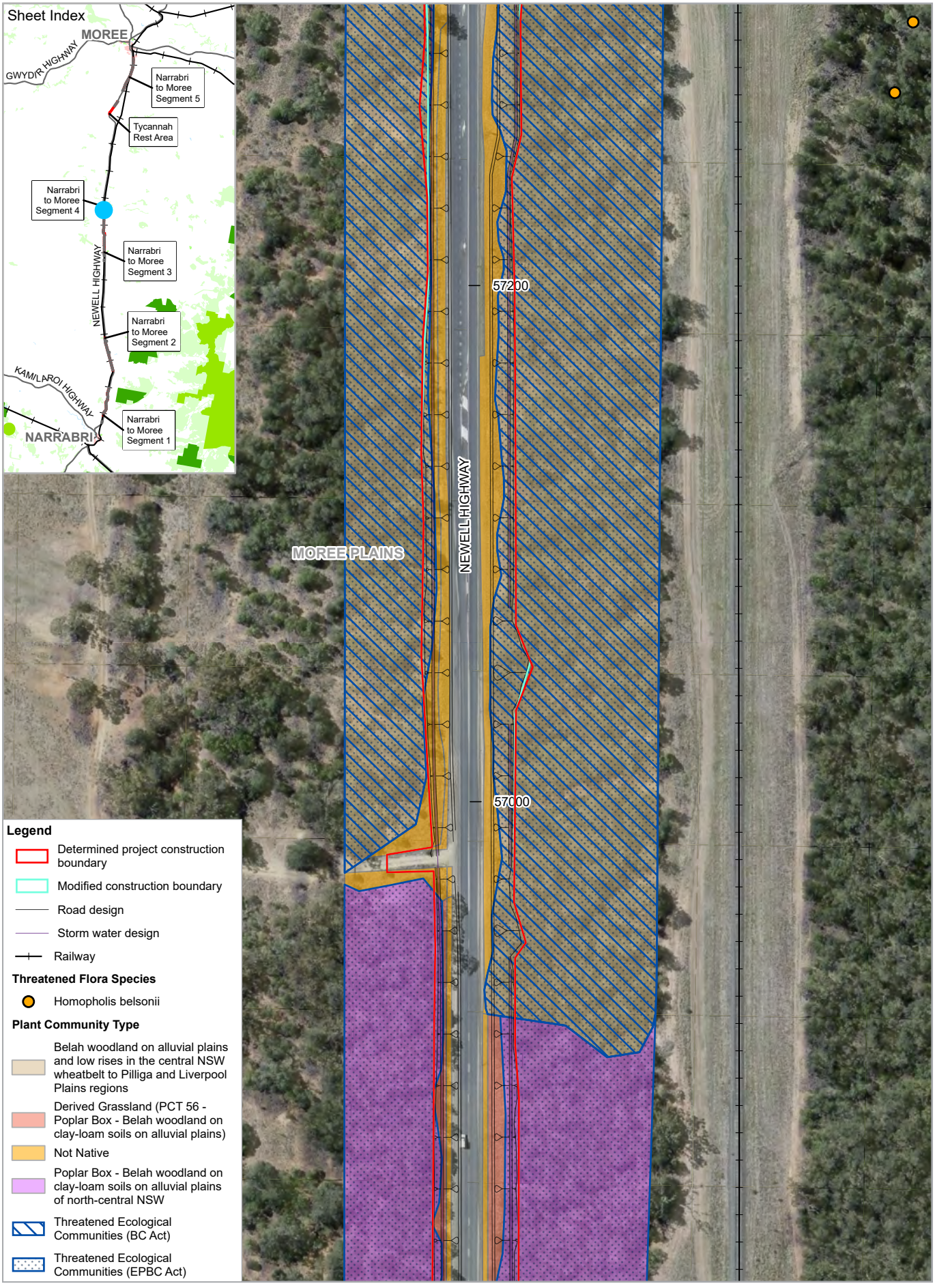

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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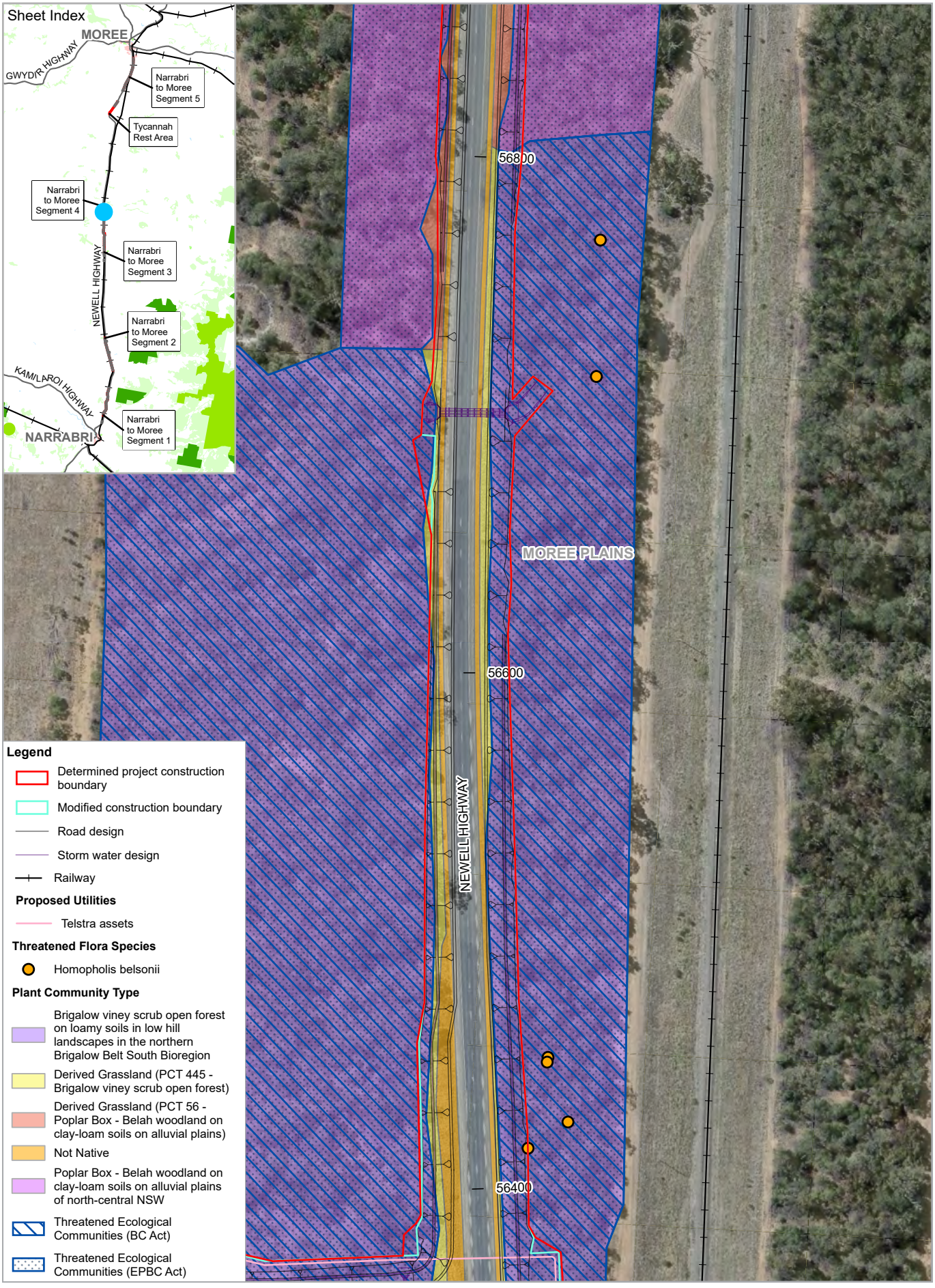

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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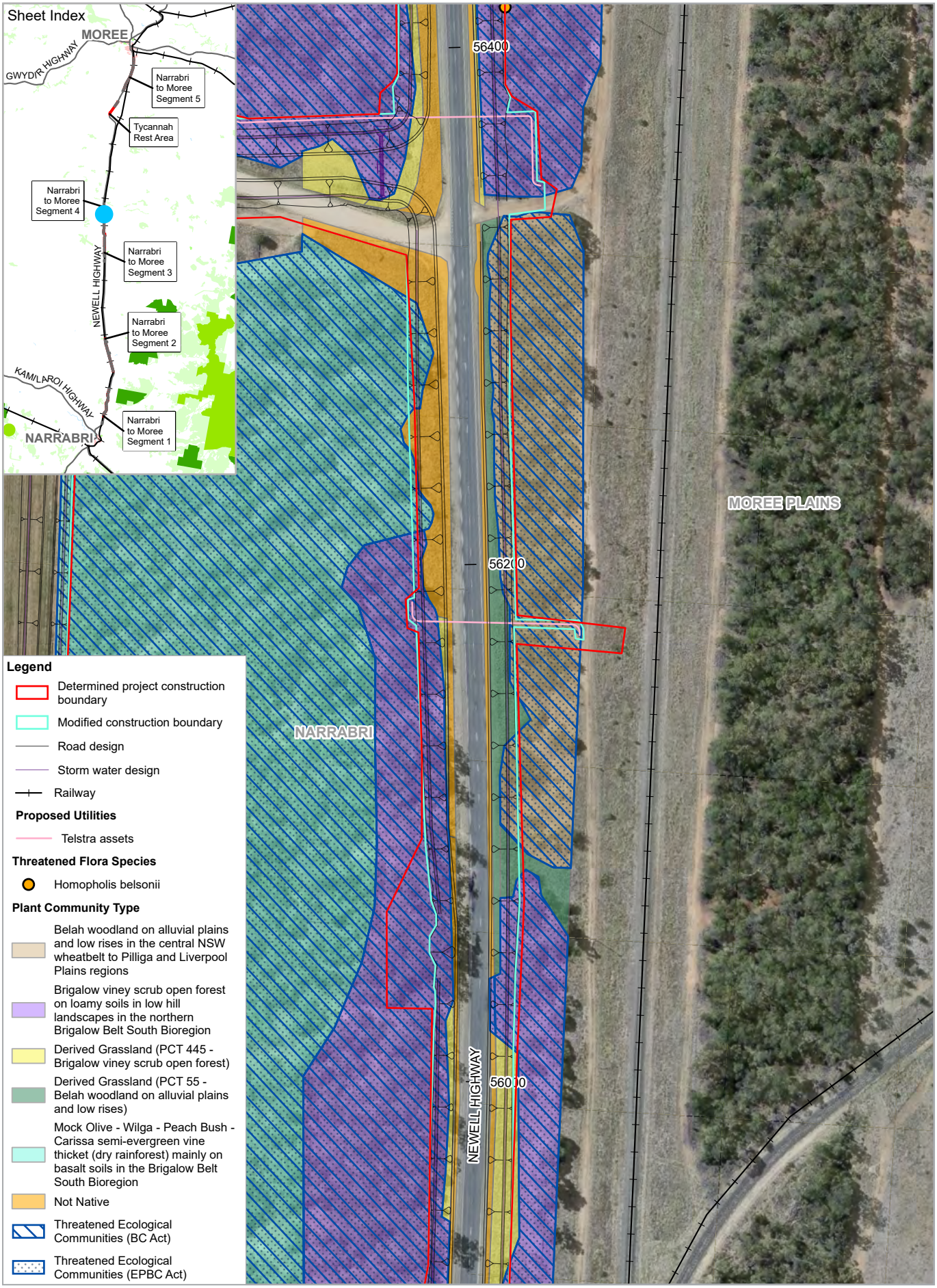

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Map Projection: Transverse Mercator
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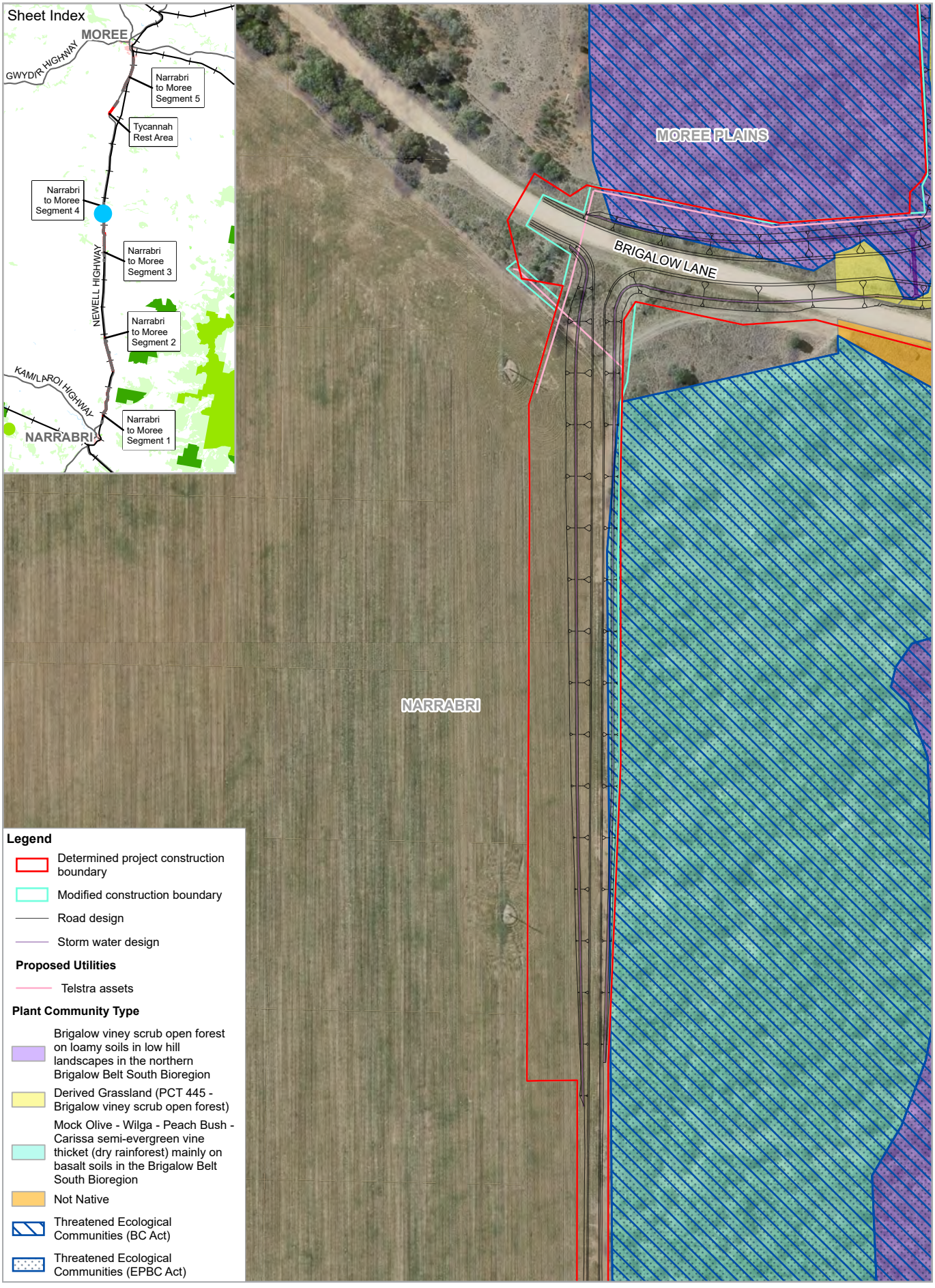

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Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 55

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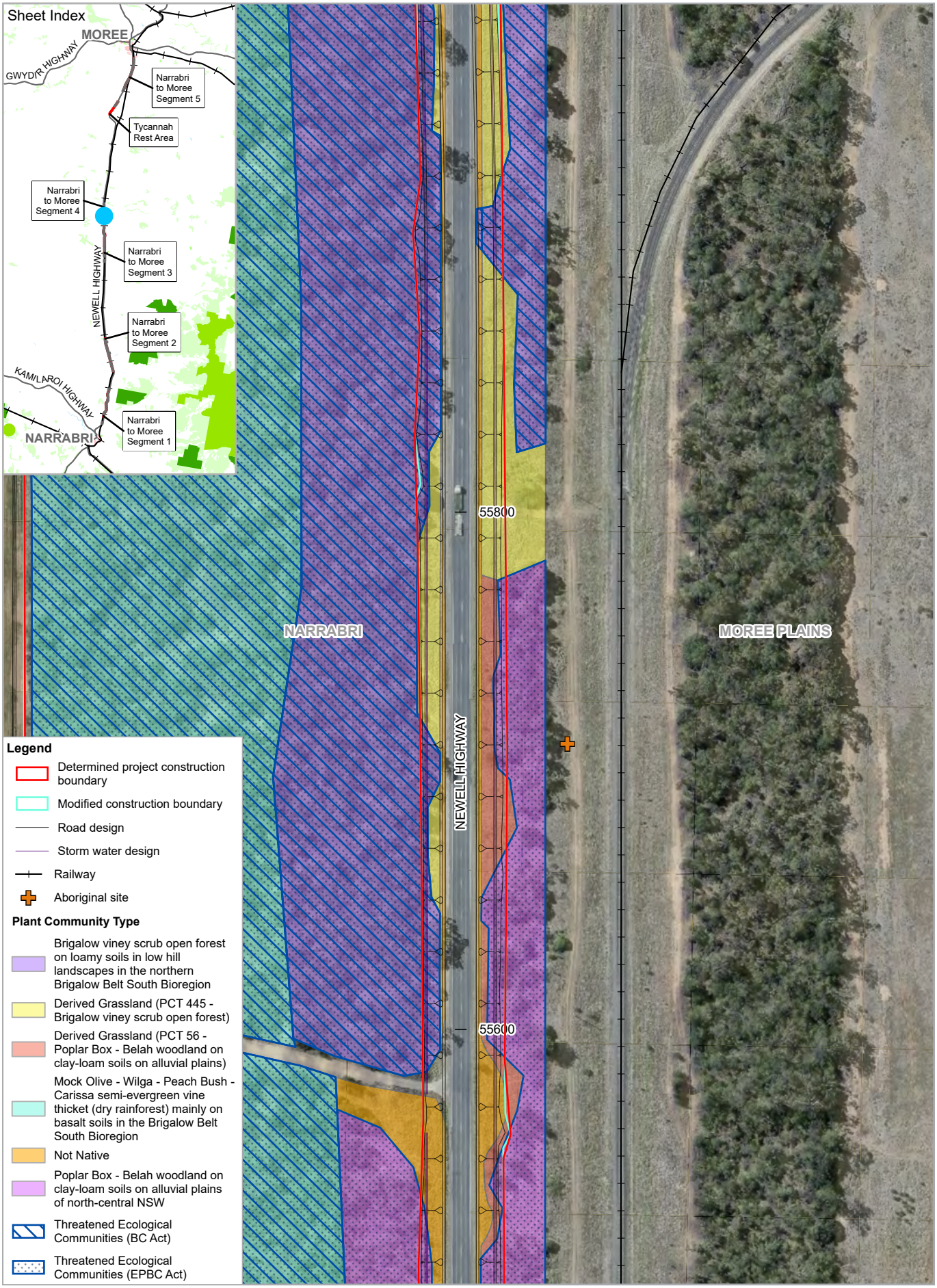

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Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 55

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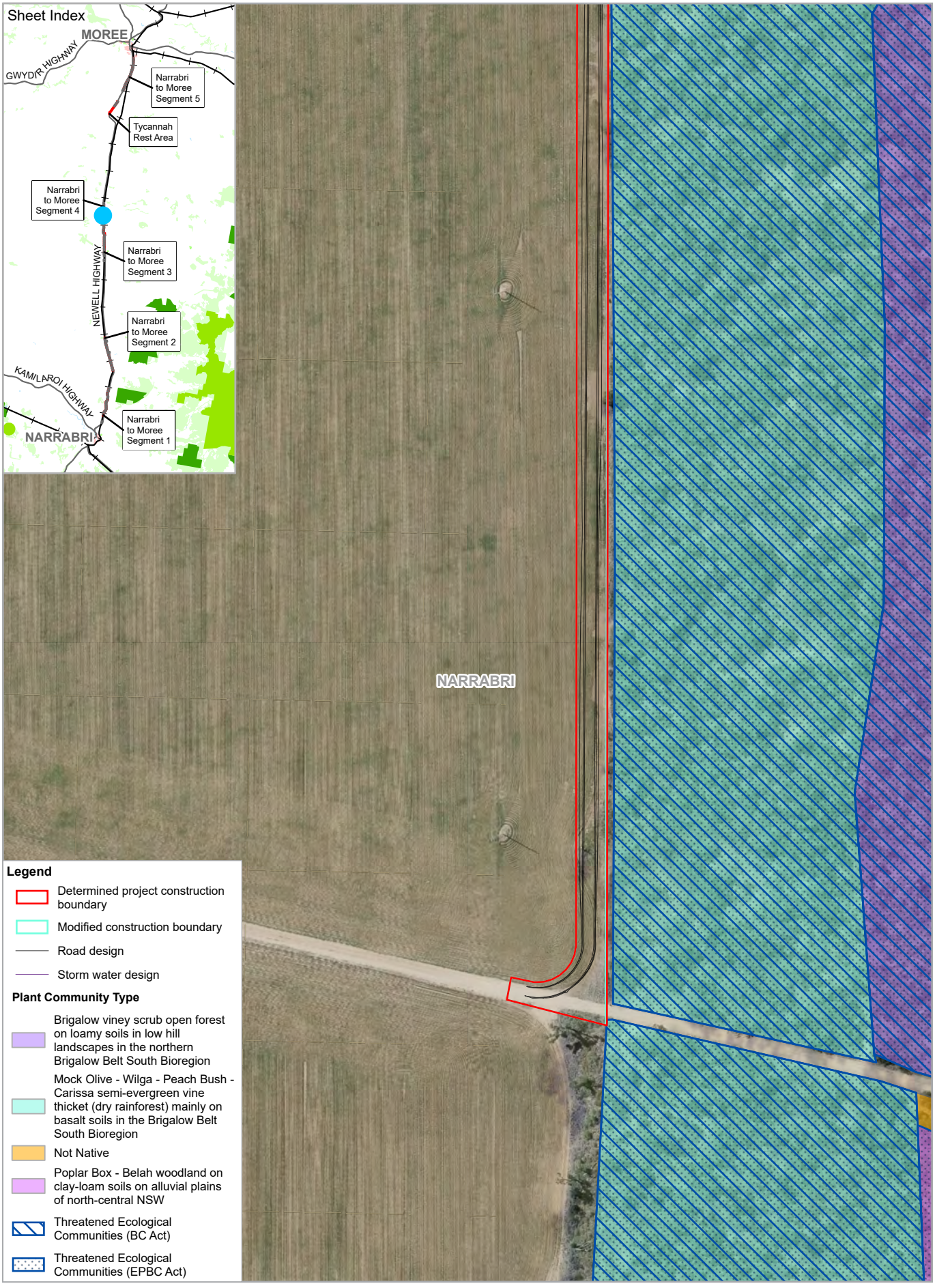

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Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 55

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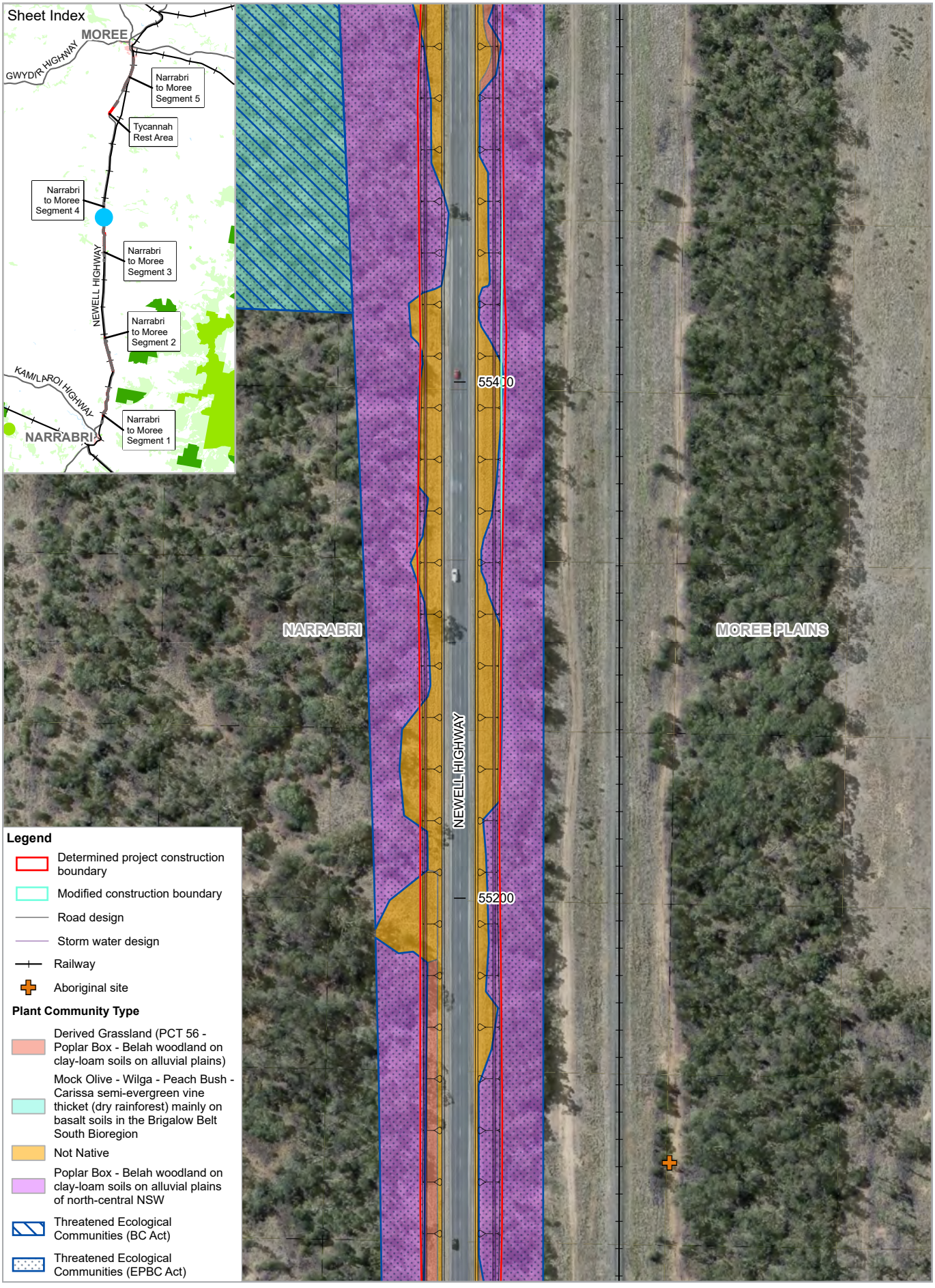

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

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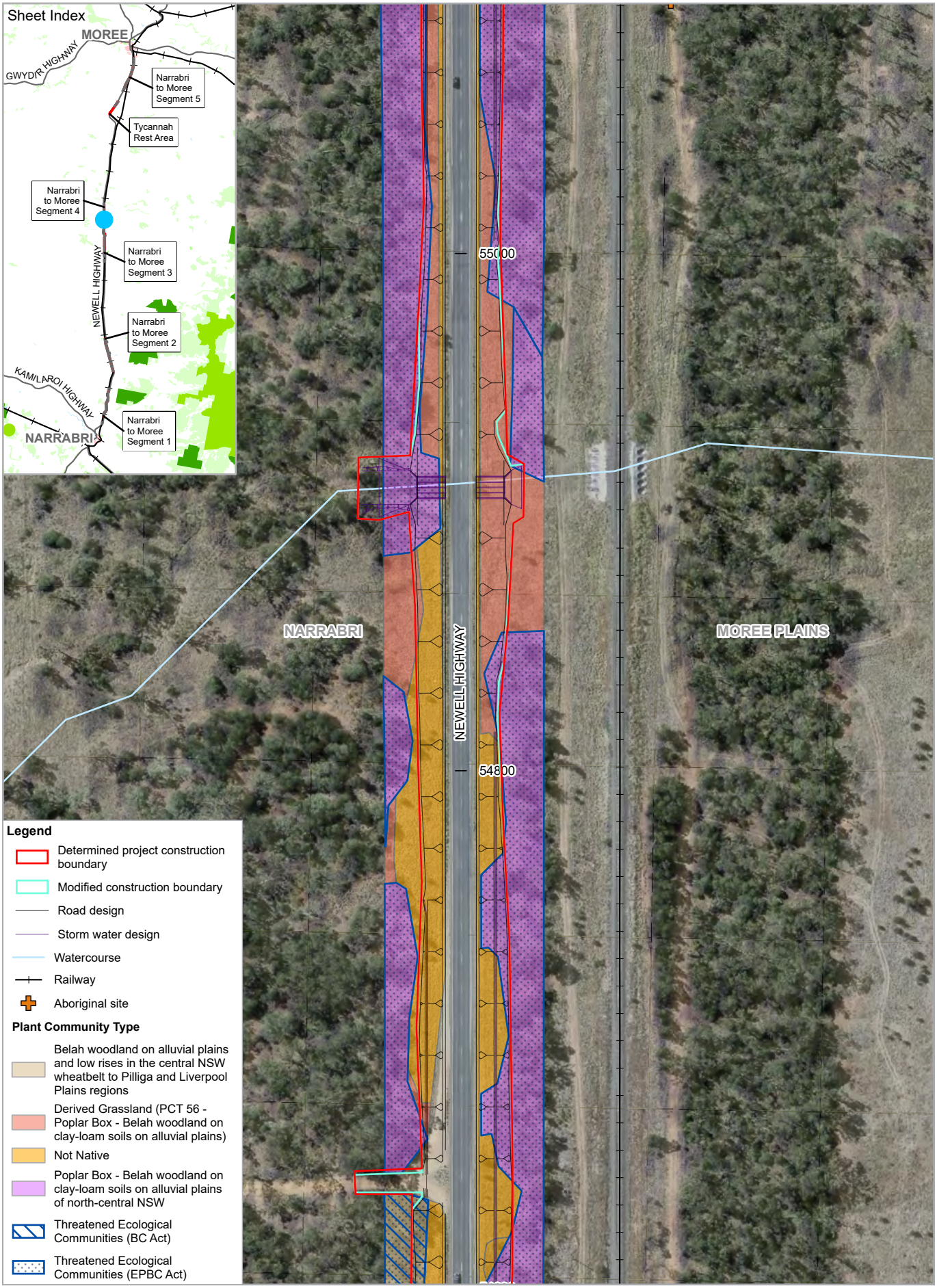

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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G:\22\20010\GIS\Maps\2220010_NewellHighway_DD\REFCR_B.aprx\2220010_REFCR001_ProposedModifications_A
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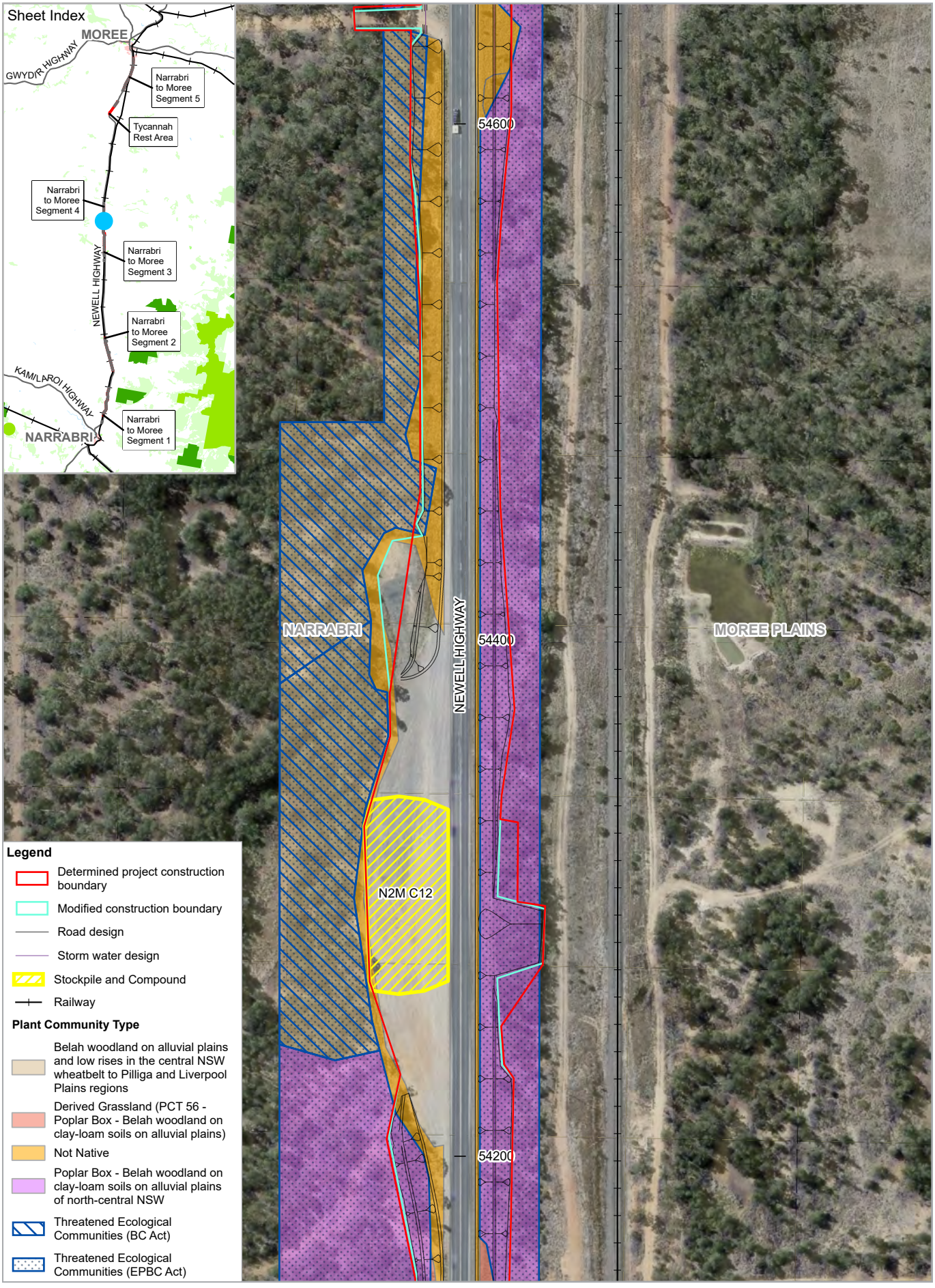

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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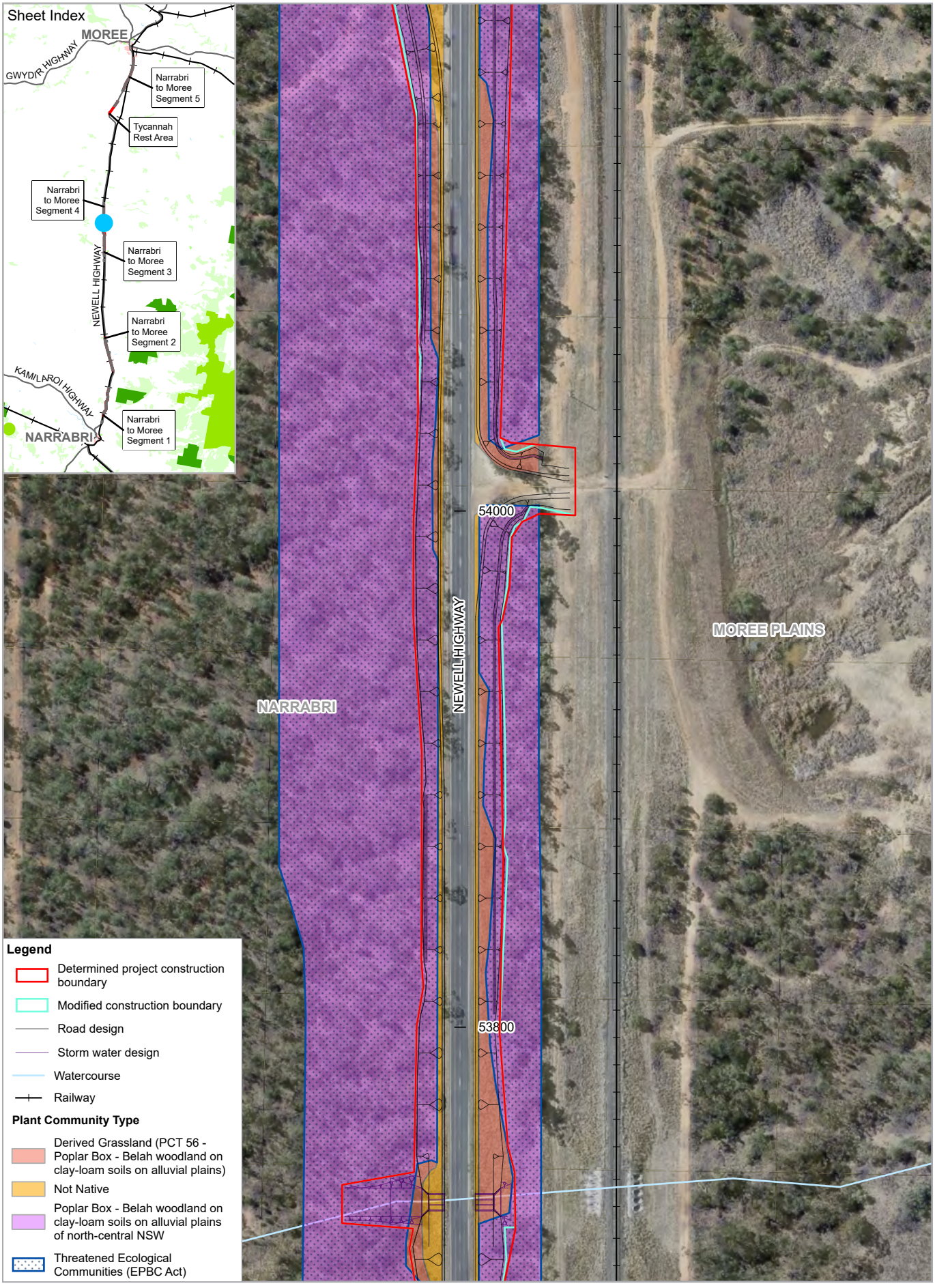

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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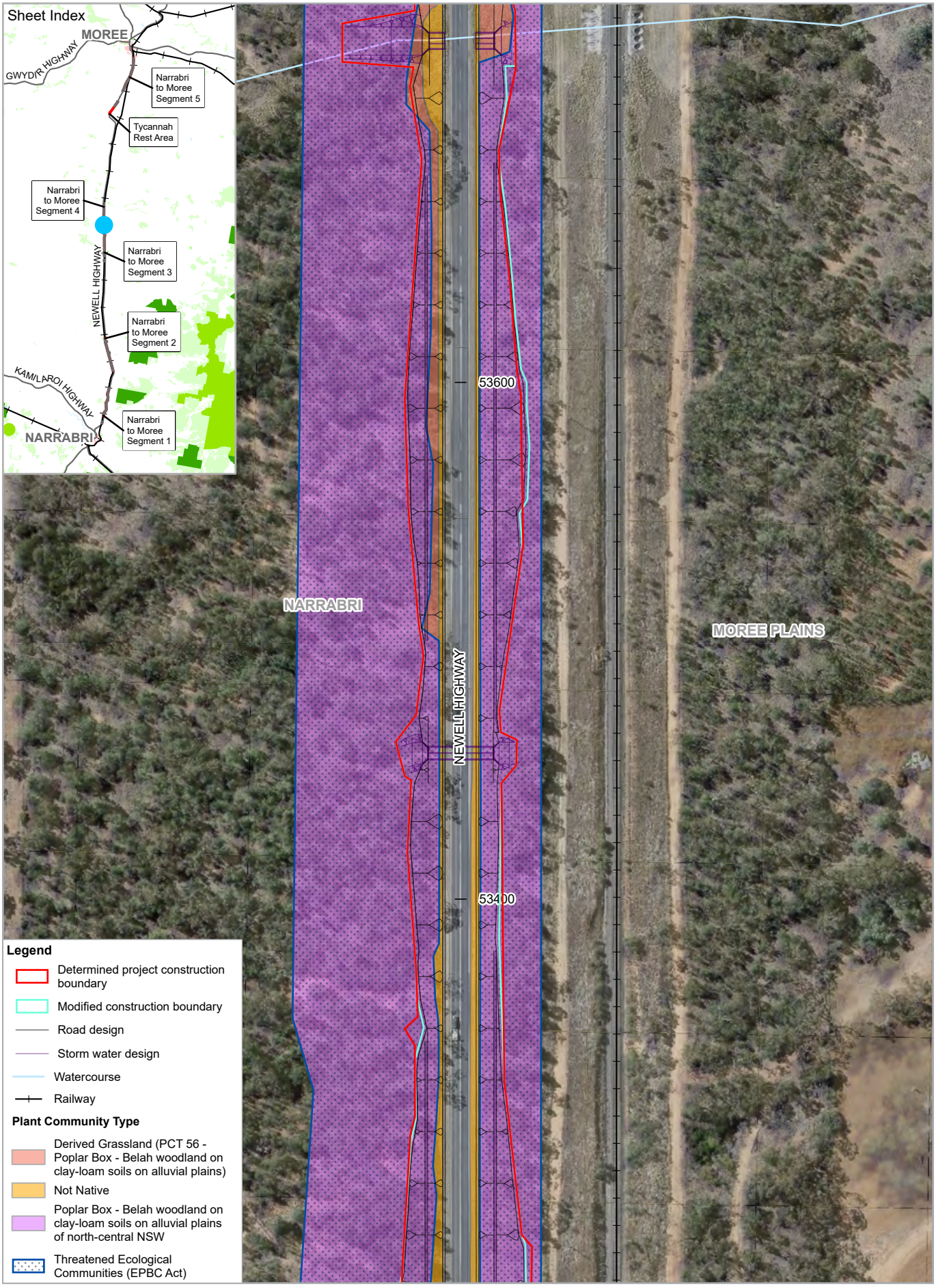

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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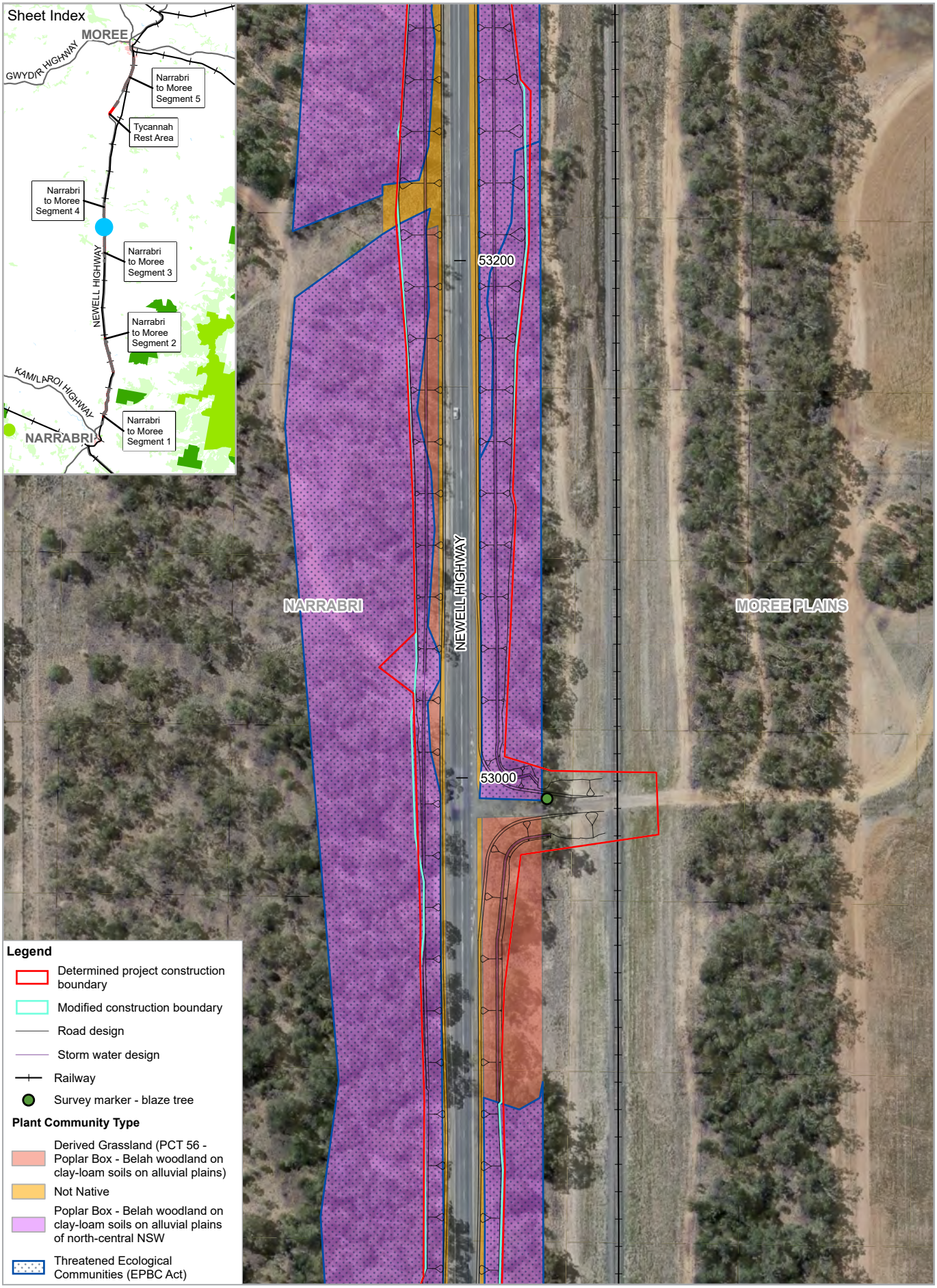

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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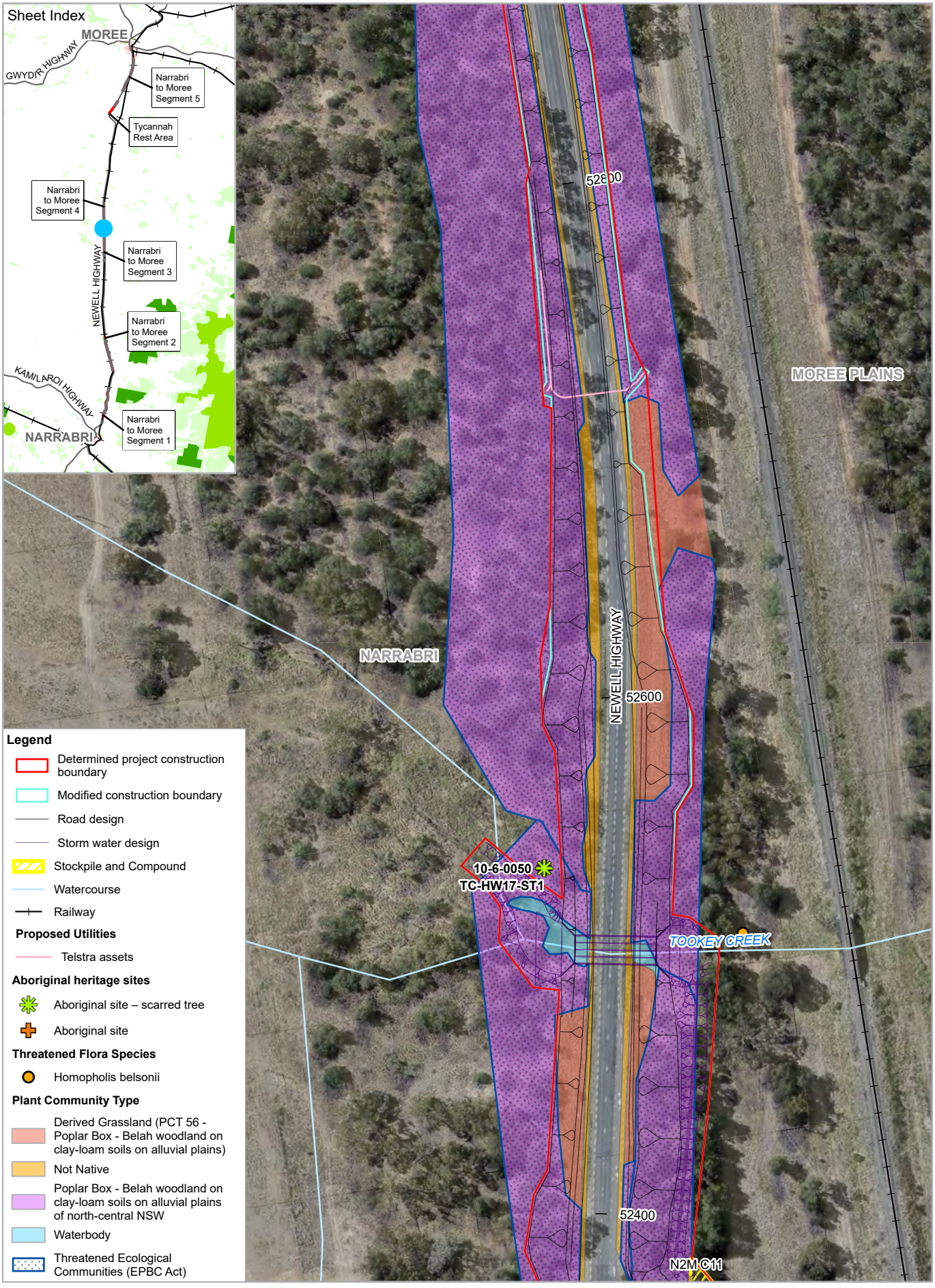

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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GHD

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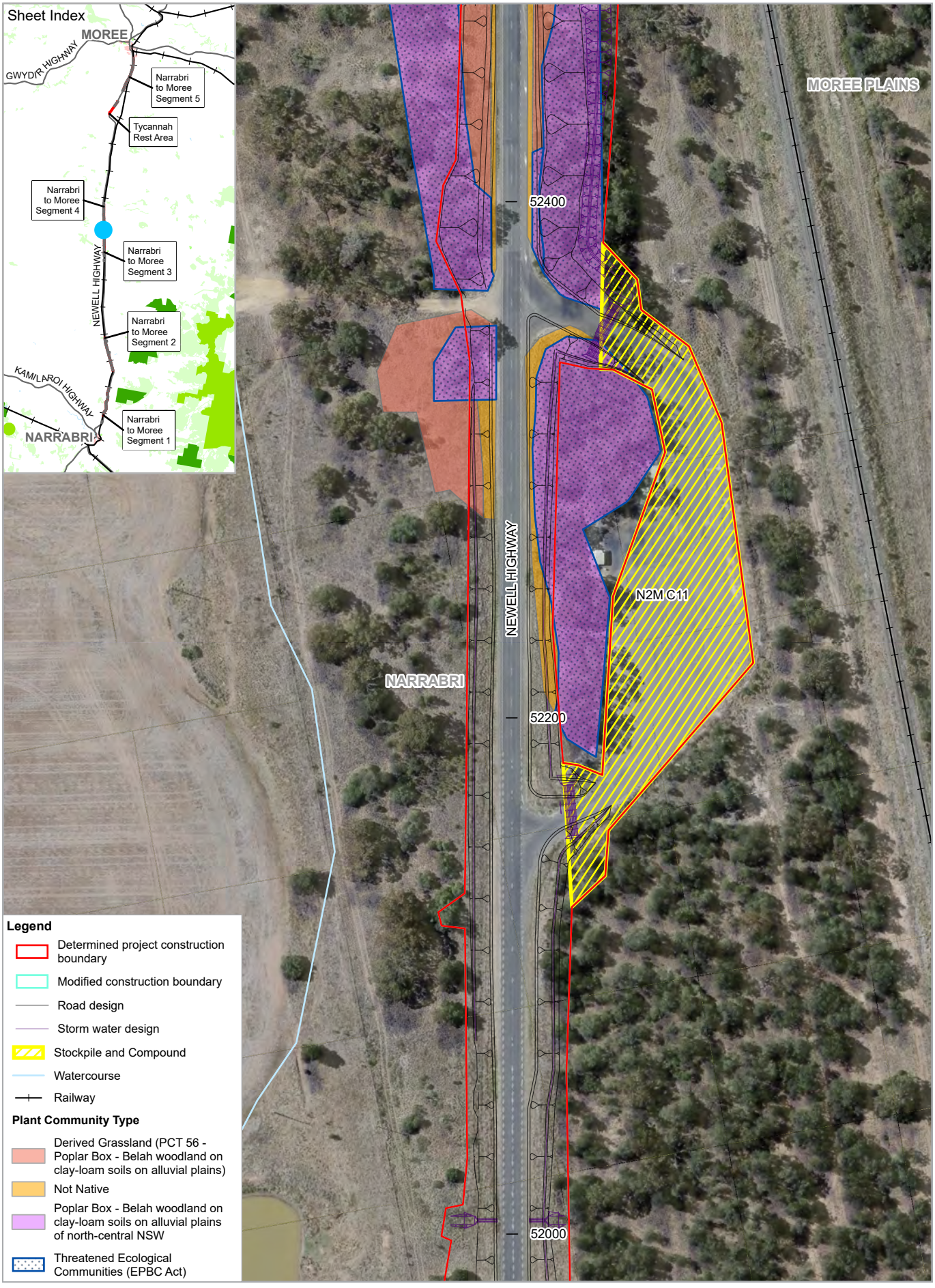

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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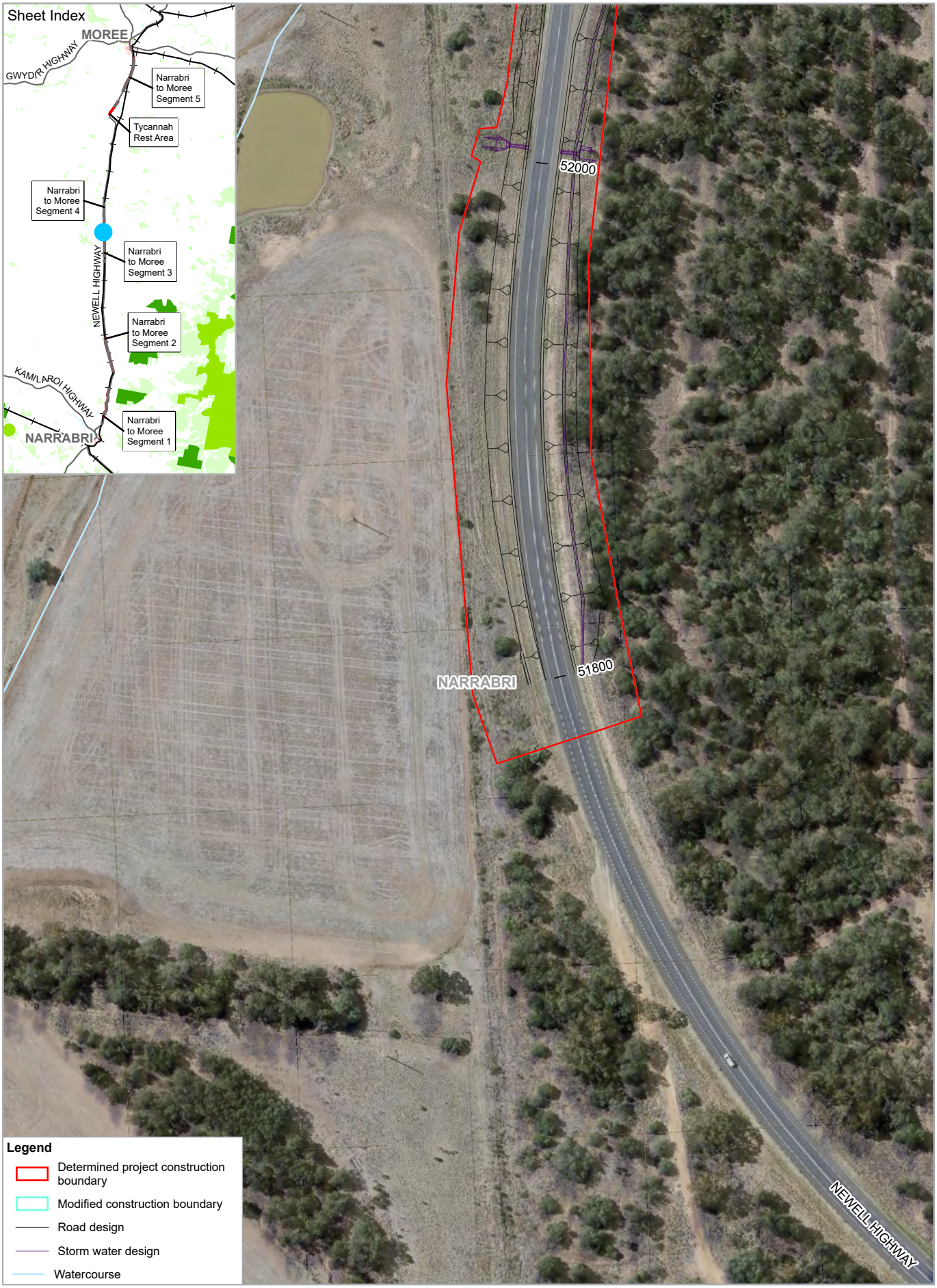

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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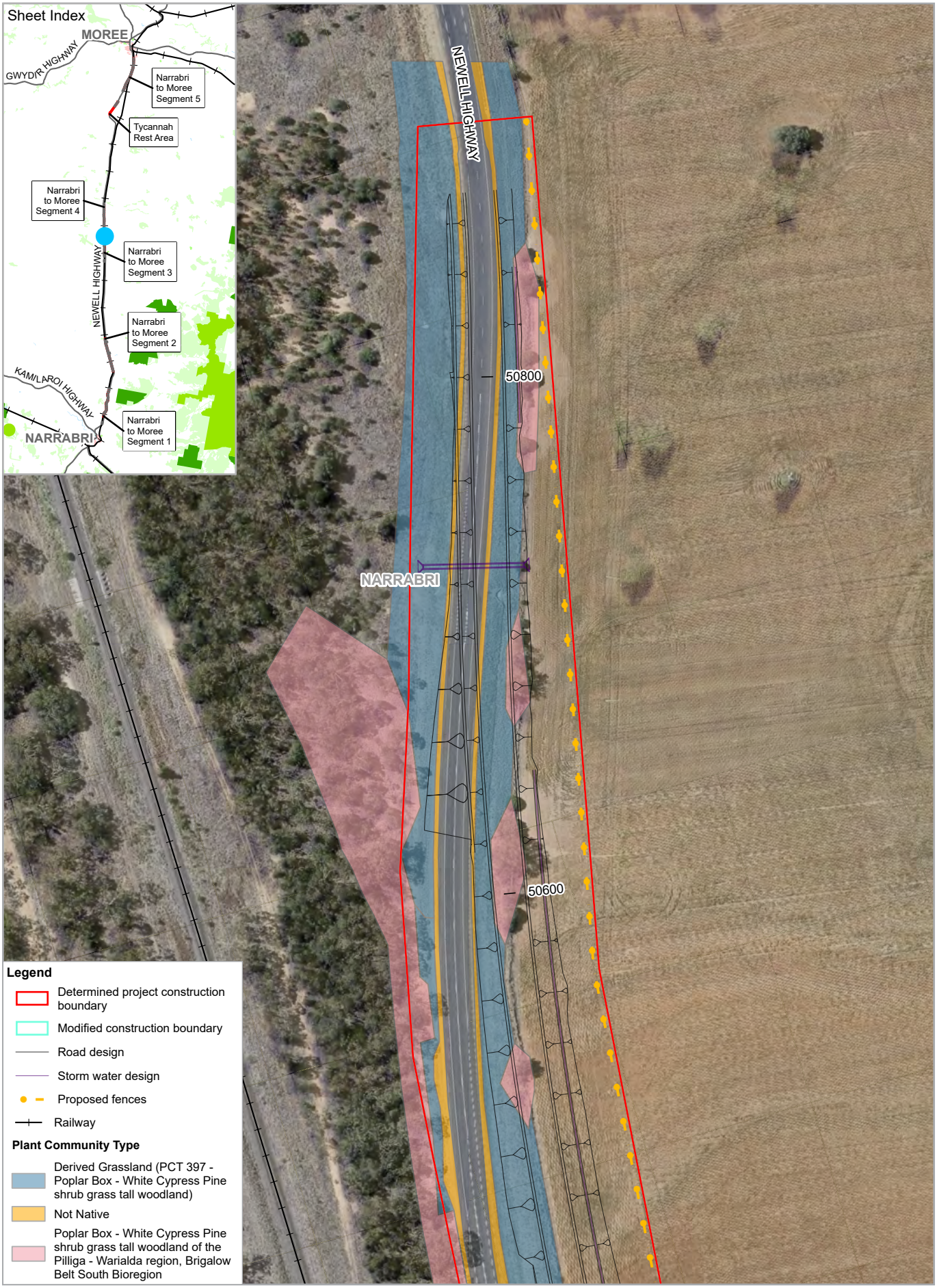

Paper Size ISO A4

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

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G:\22\20010\GIS\Maps\2220010_NewellHighway_DD\REFCR_B.aprx\2220010_REFCR001_ProposedModifications_A
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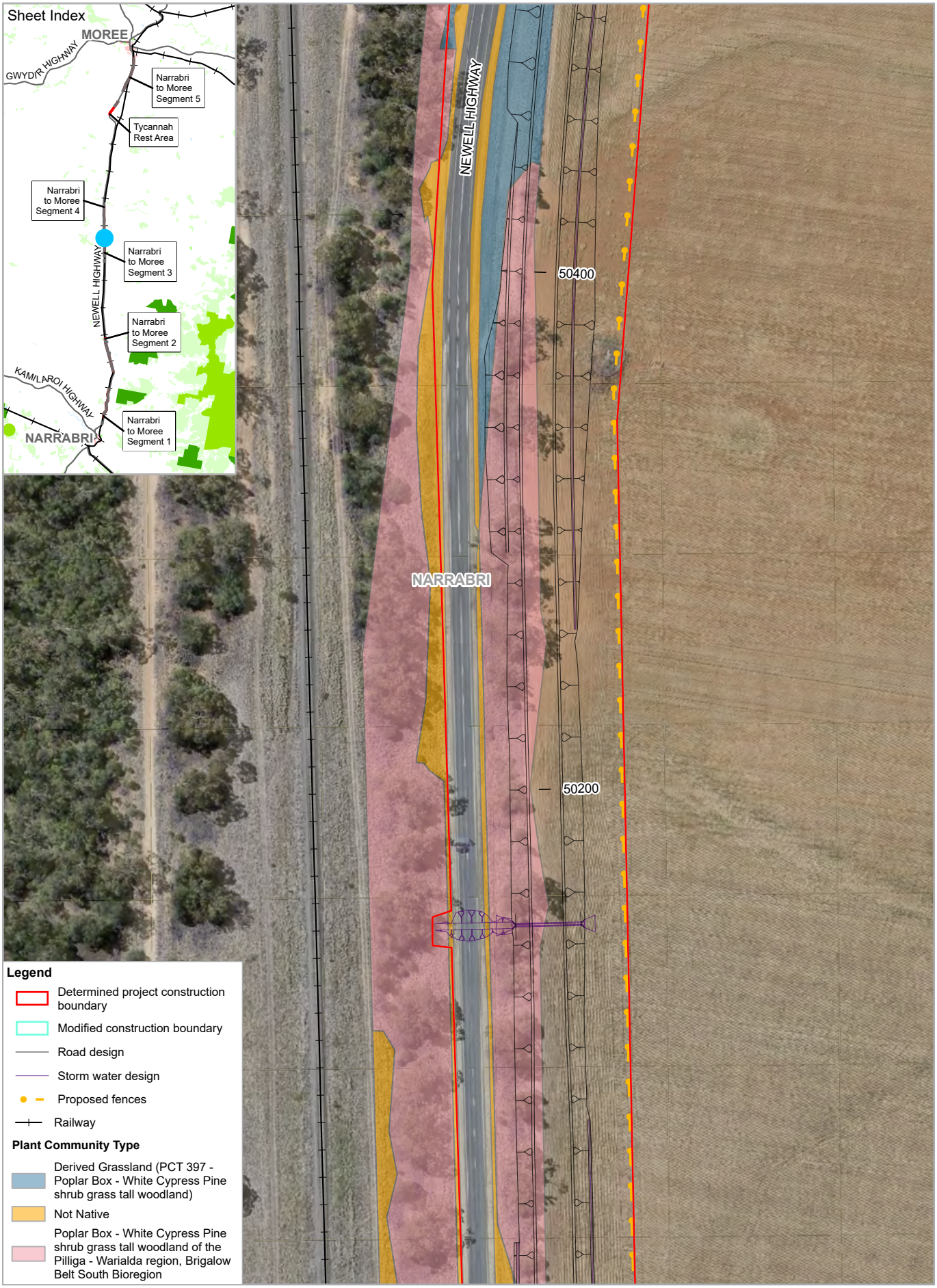

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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G:\22\20010\GIS\Maps\2220010_NewellHighway_DD\REFCR_B.aprx\2220010_REFCR001_ProposedModifications_A
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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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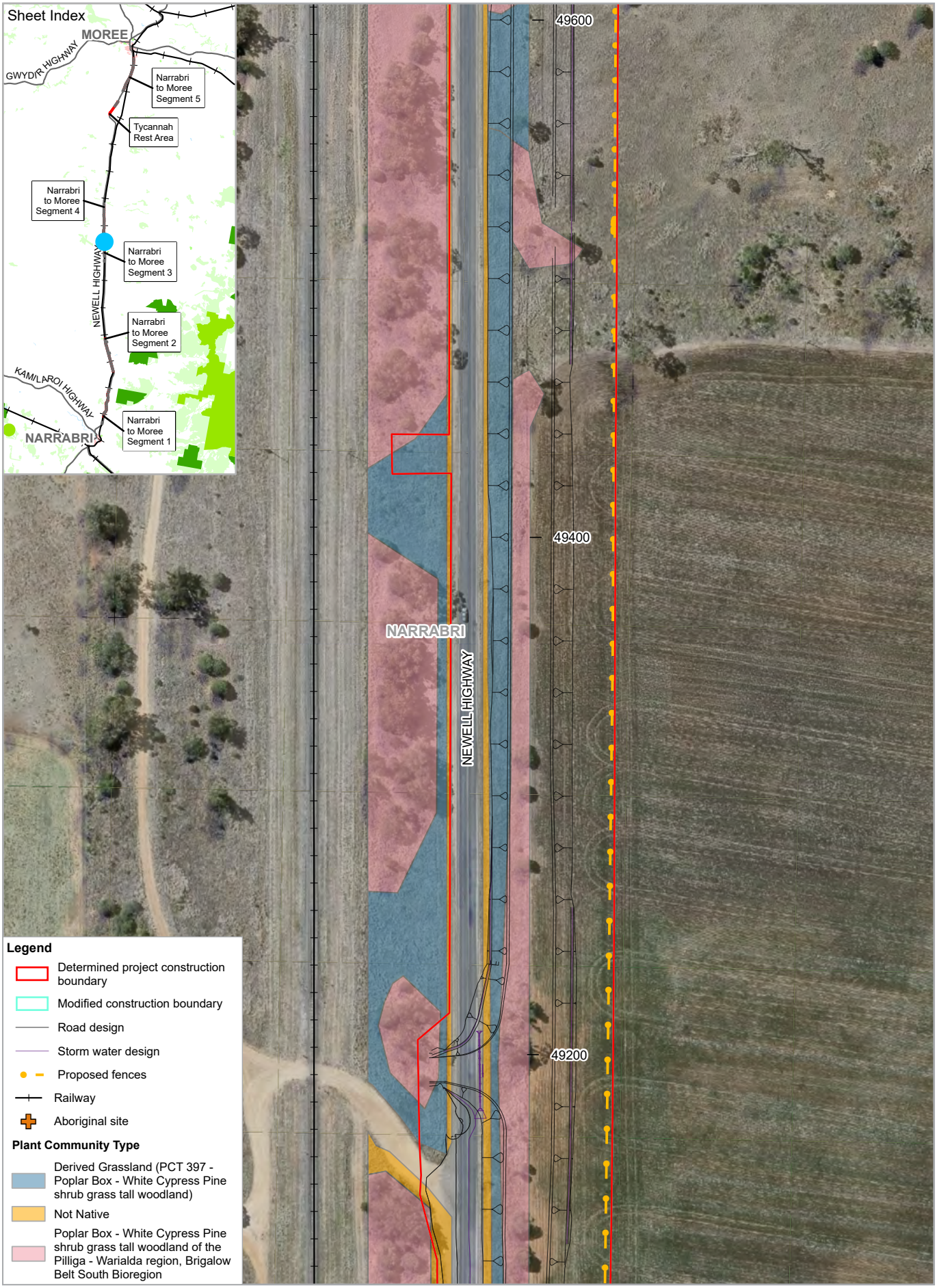

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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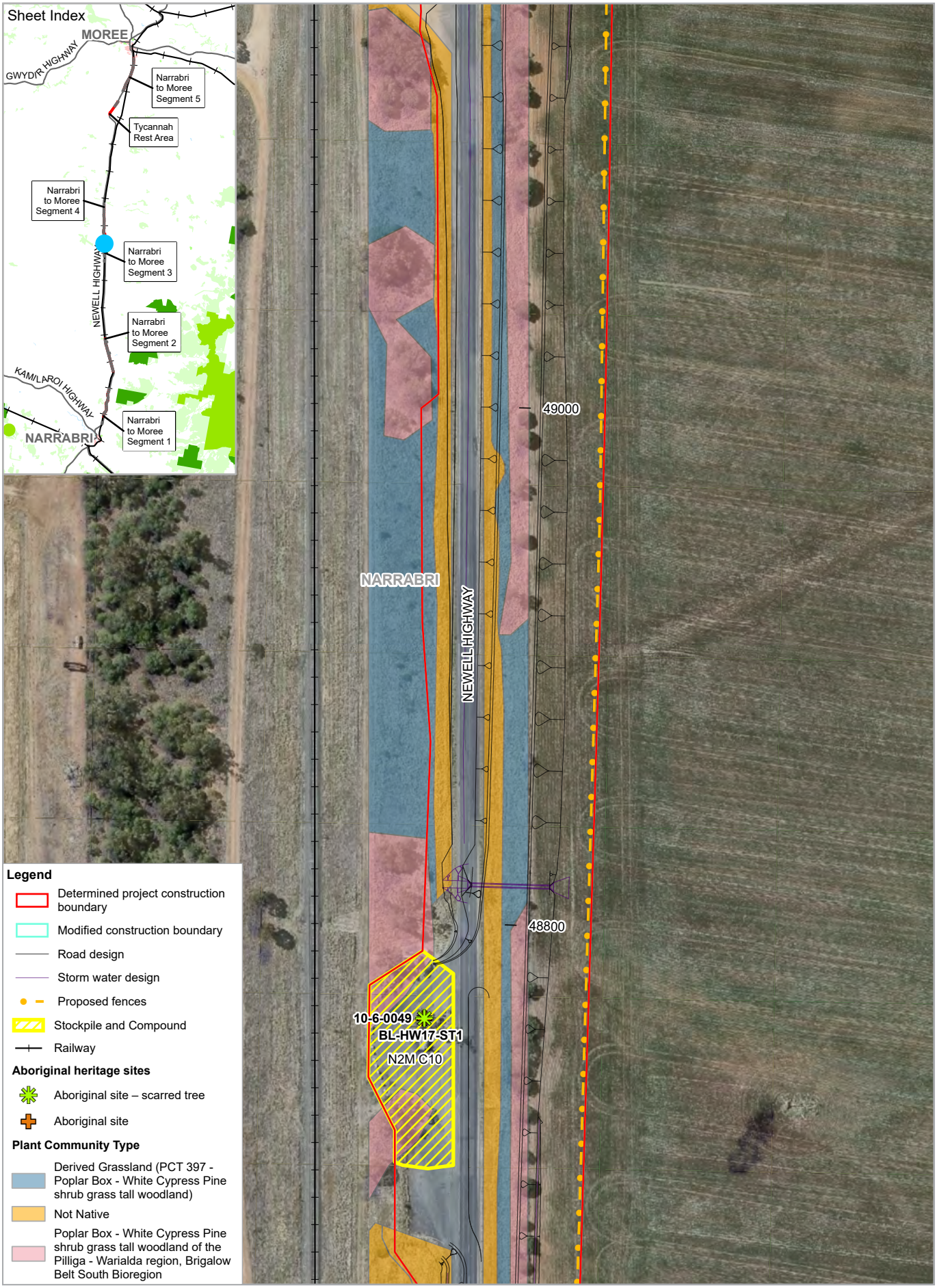

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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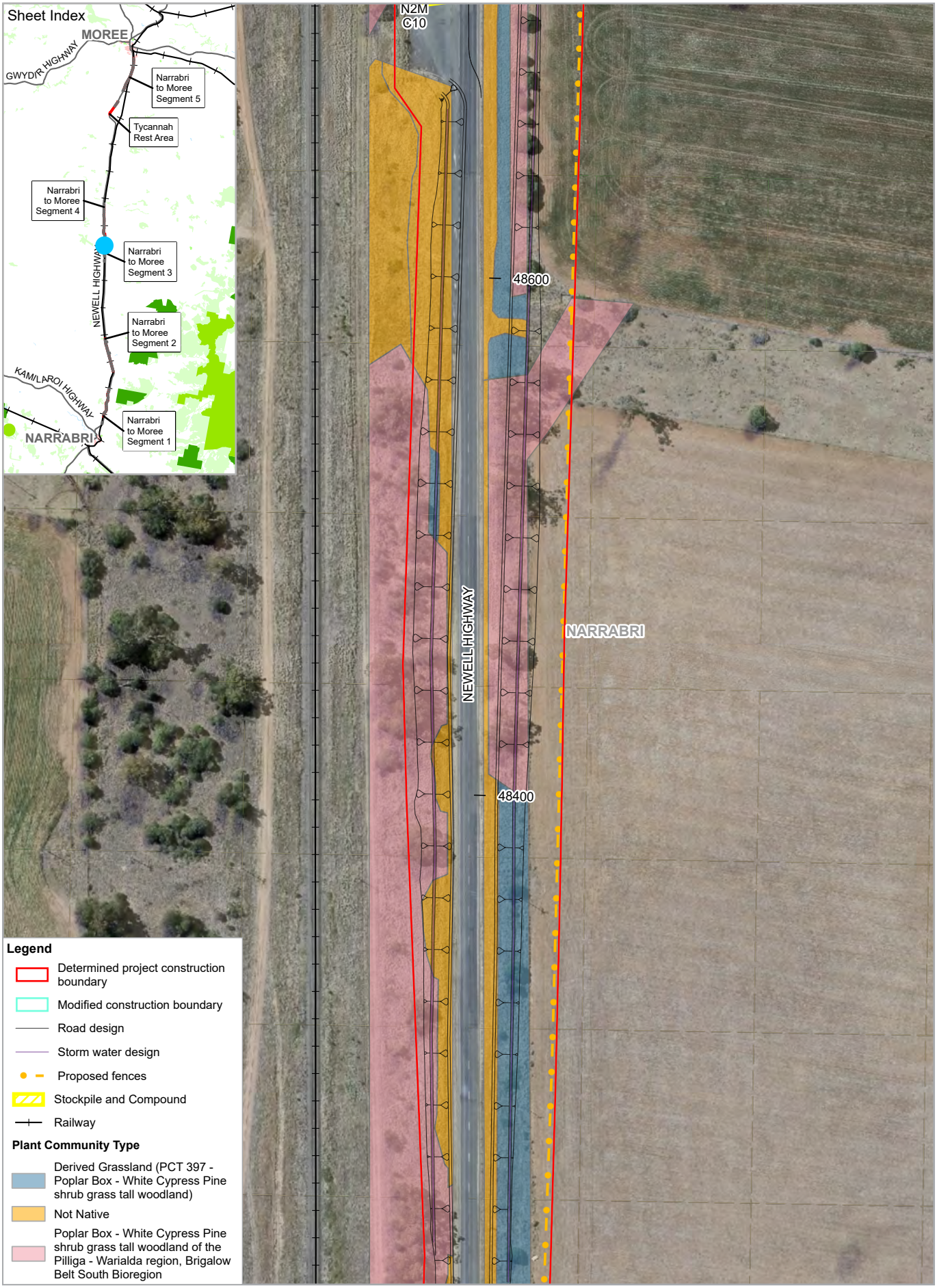

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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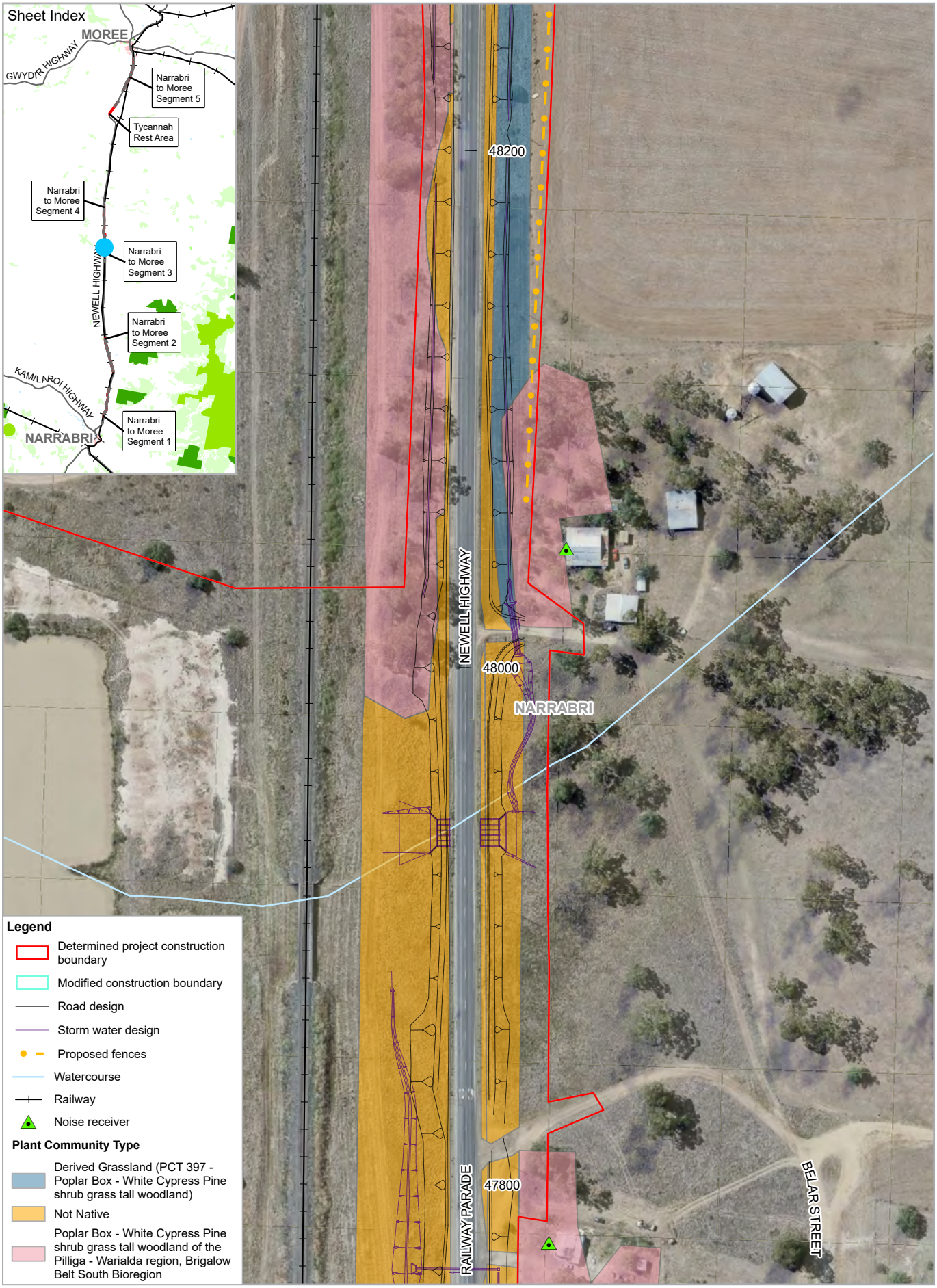

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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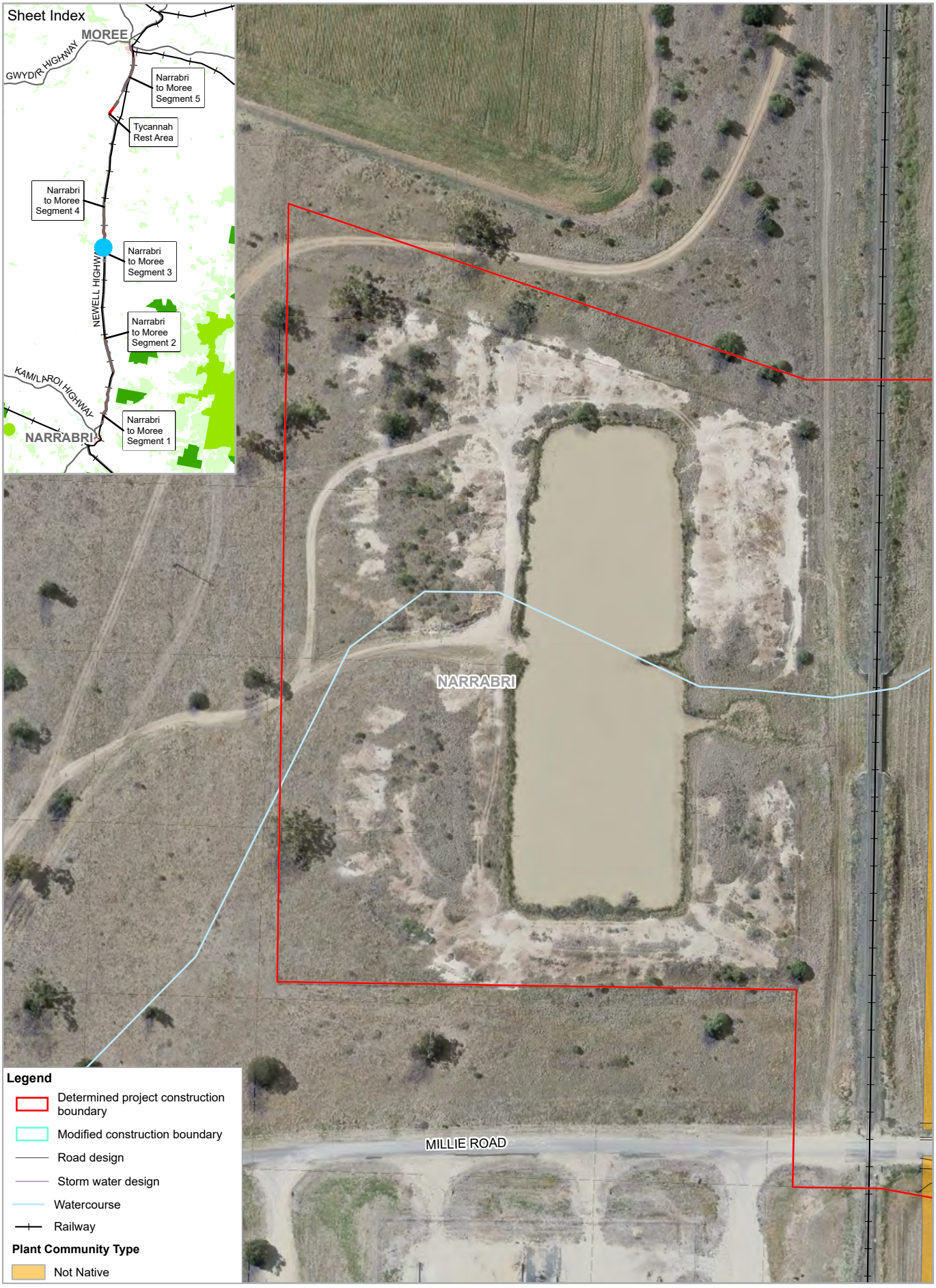

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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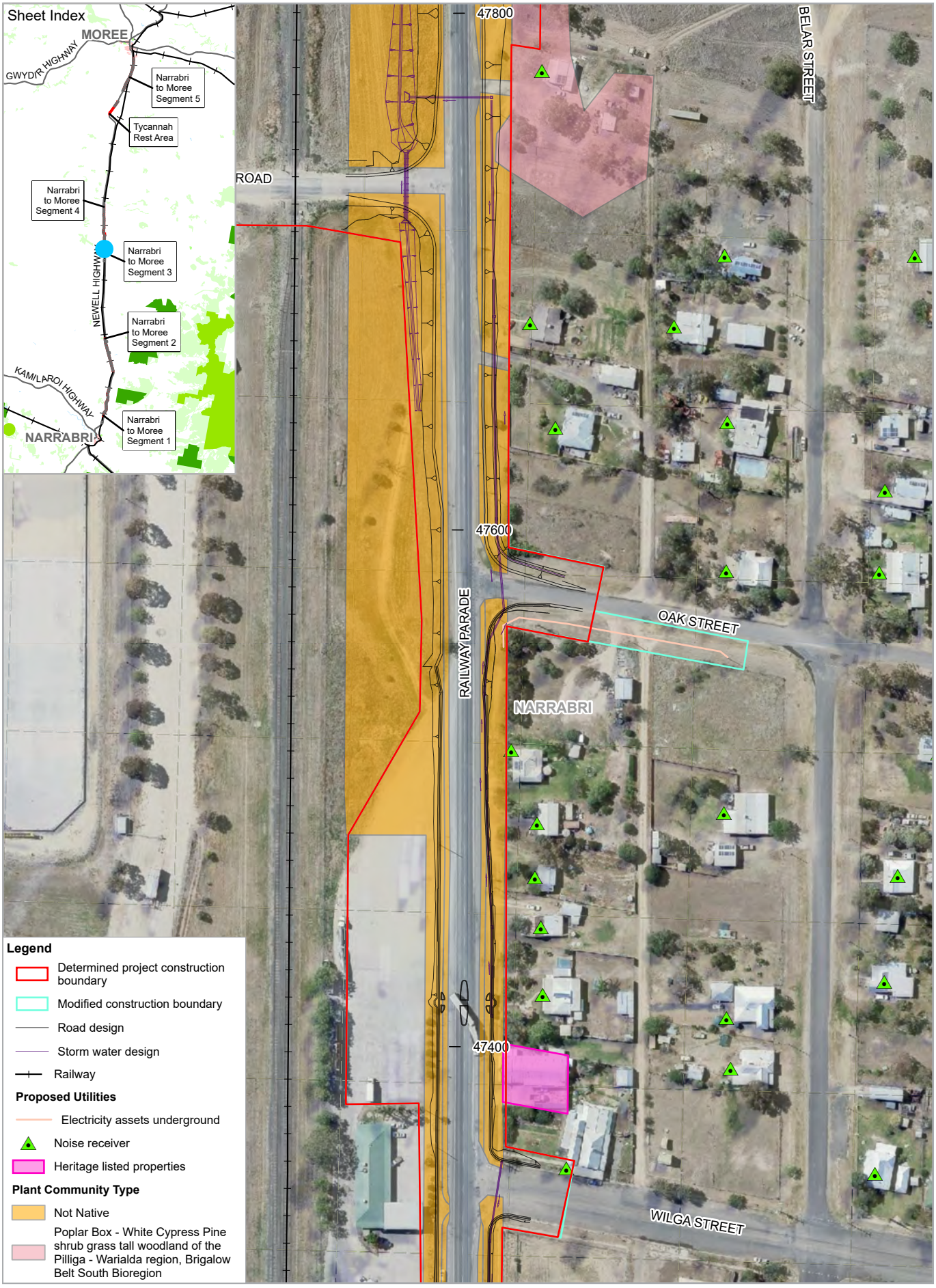

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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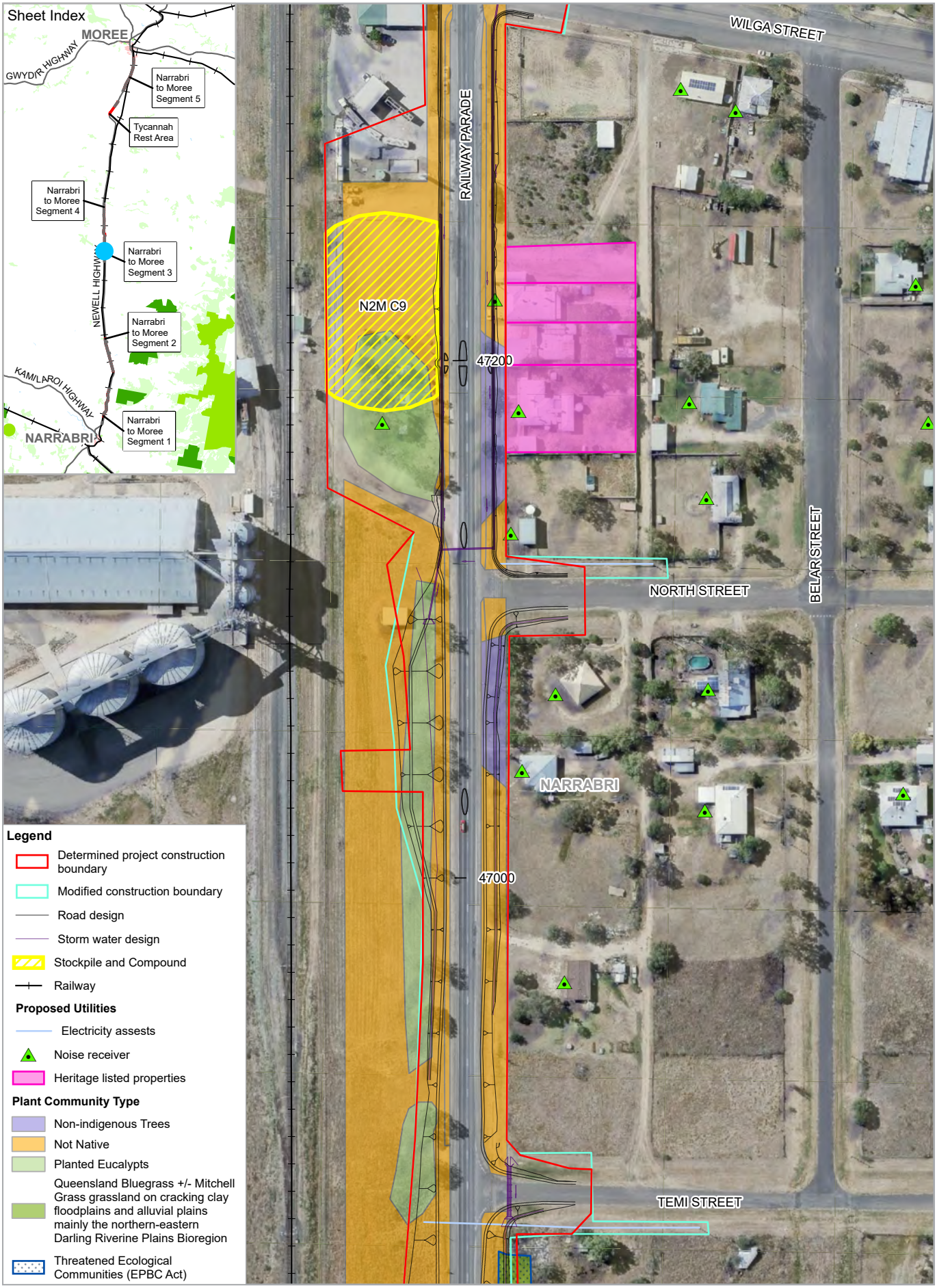

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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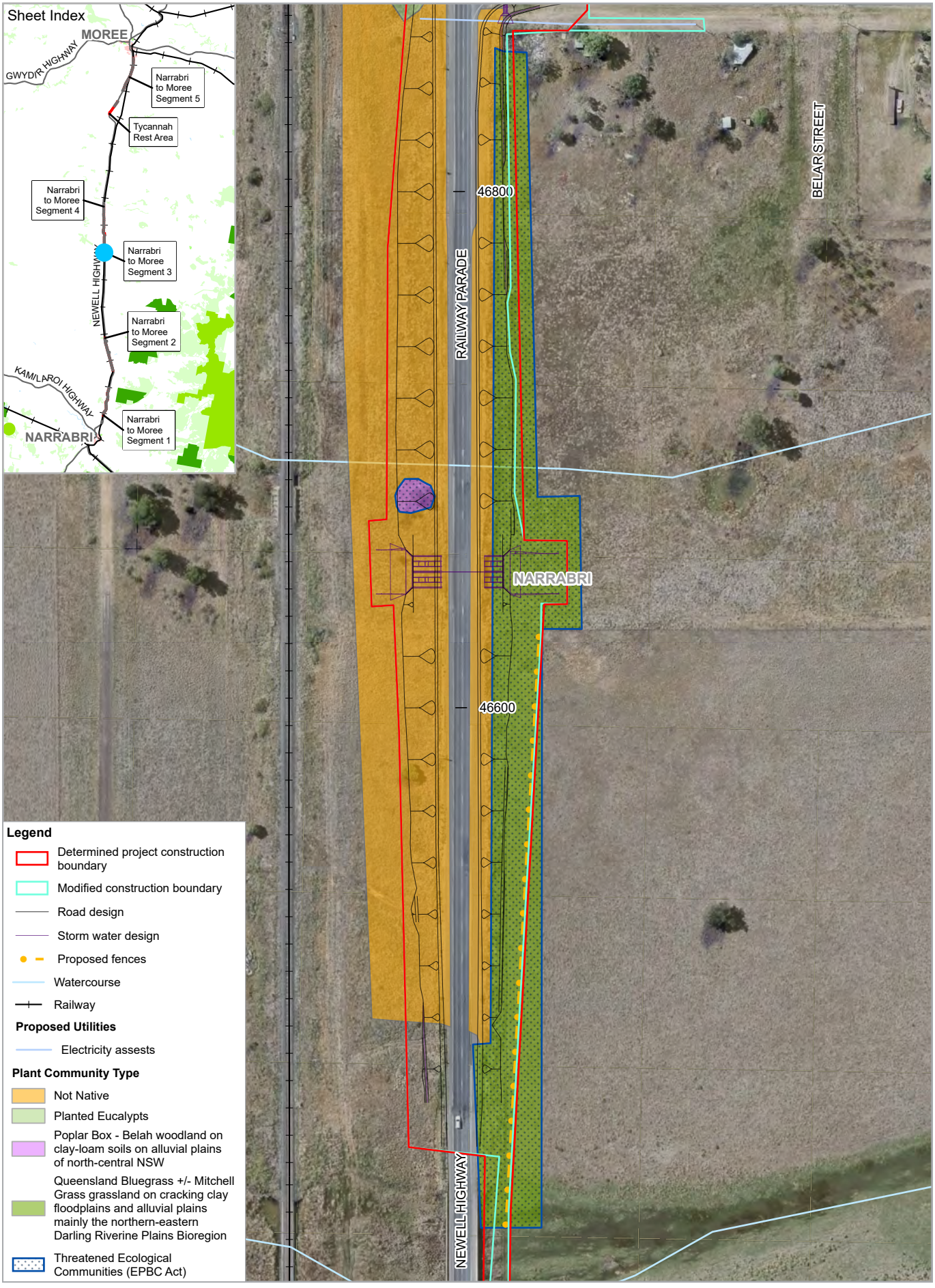

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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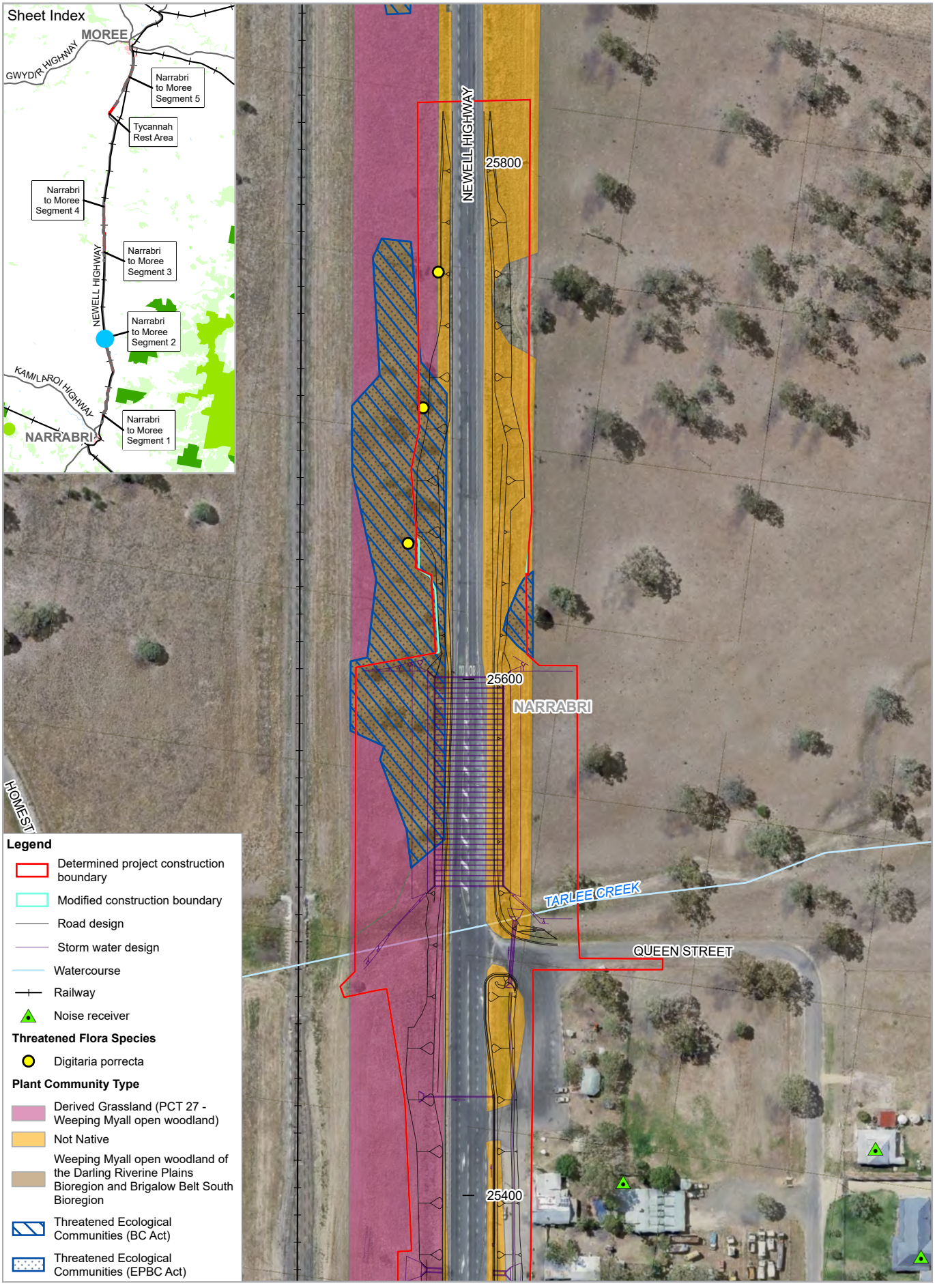

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Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 55

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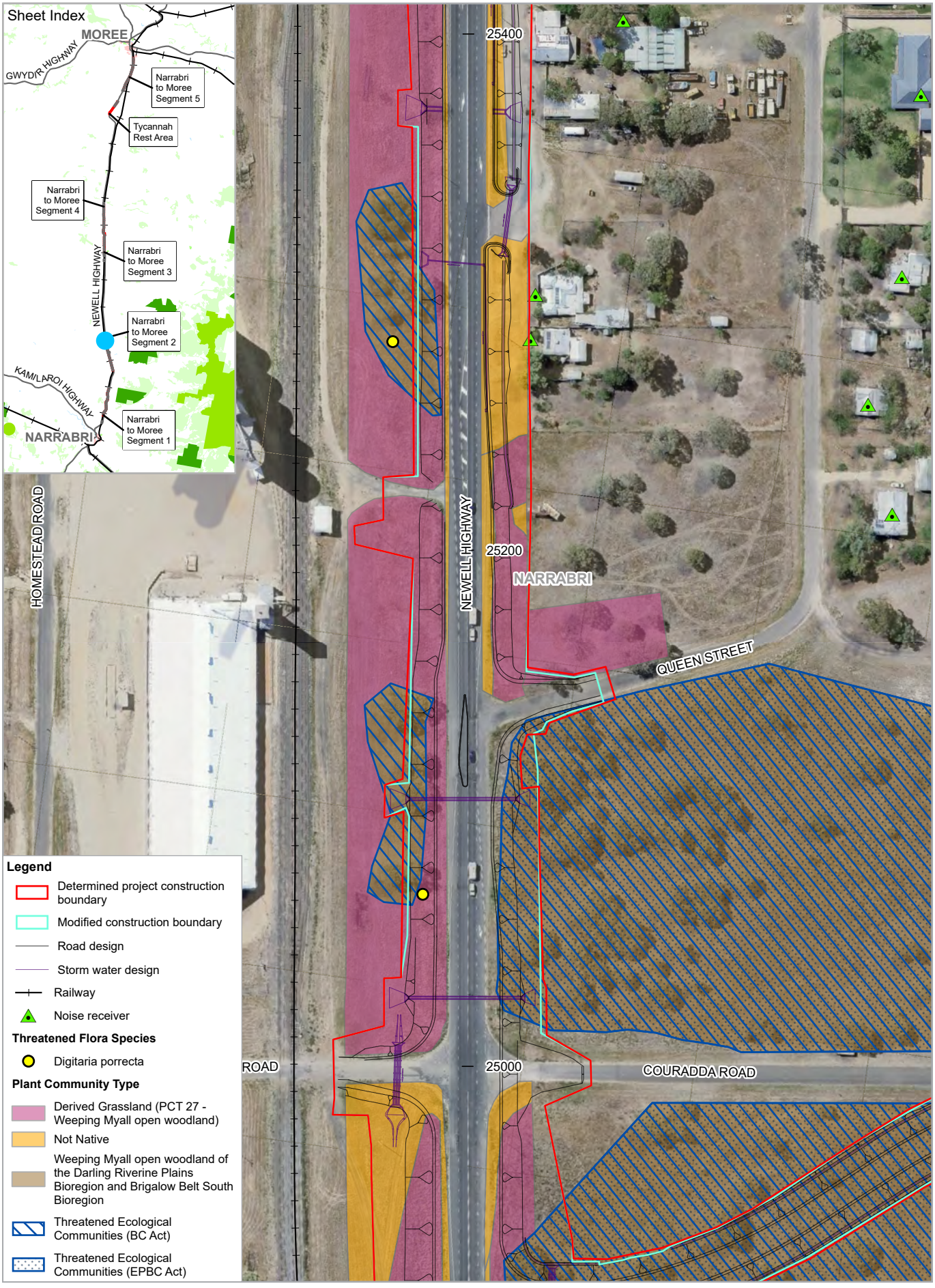

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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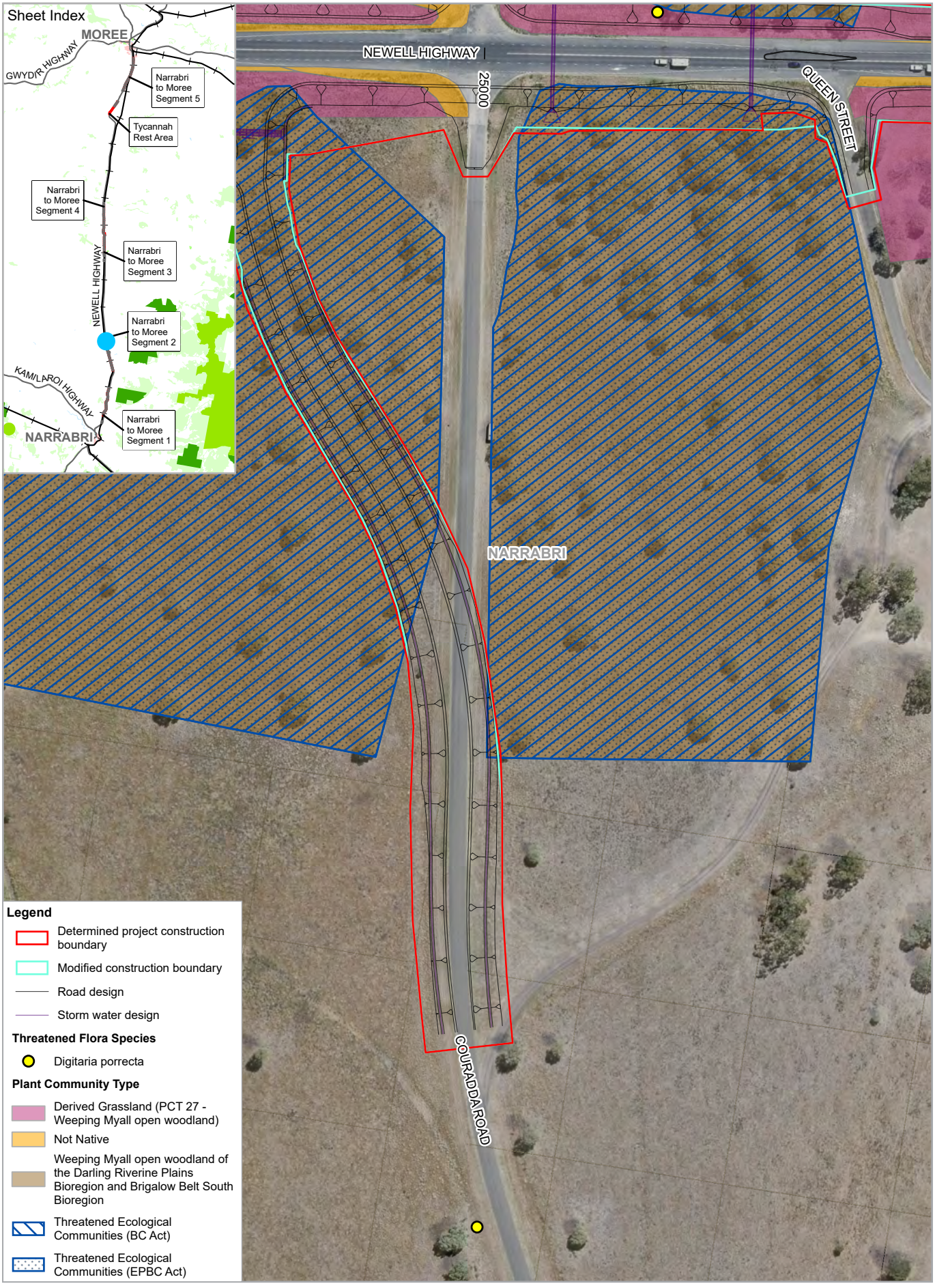

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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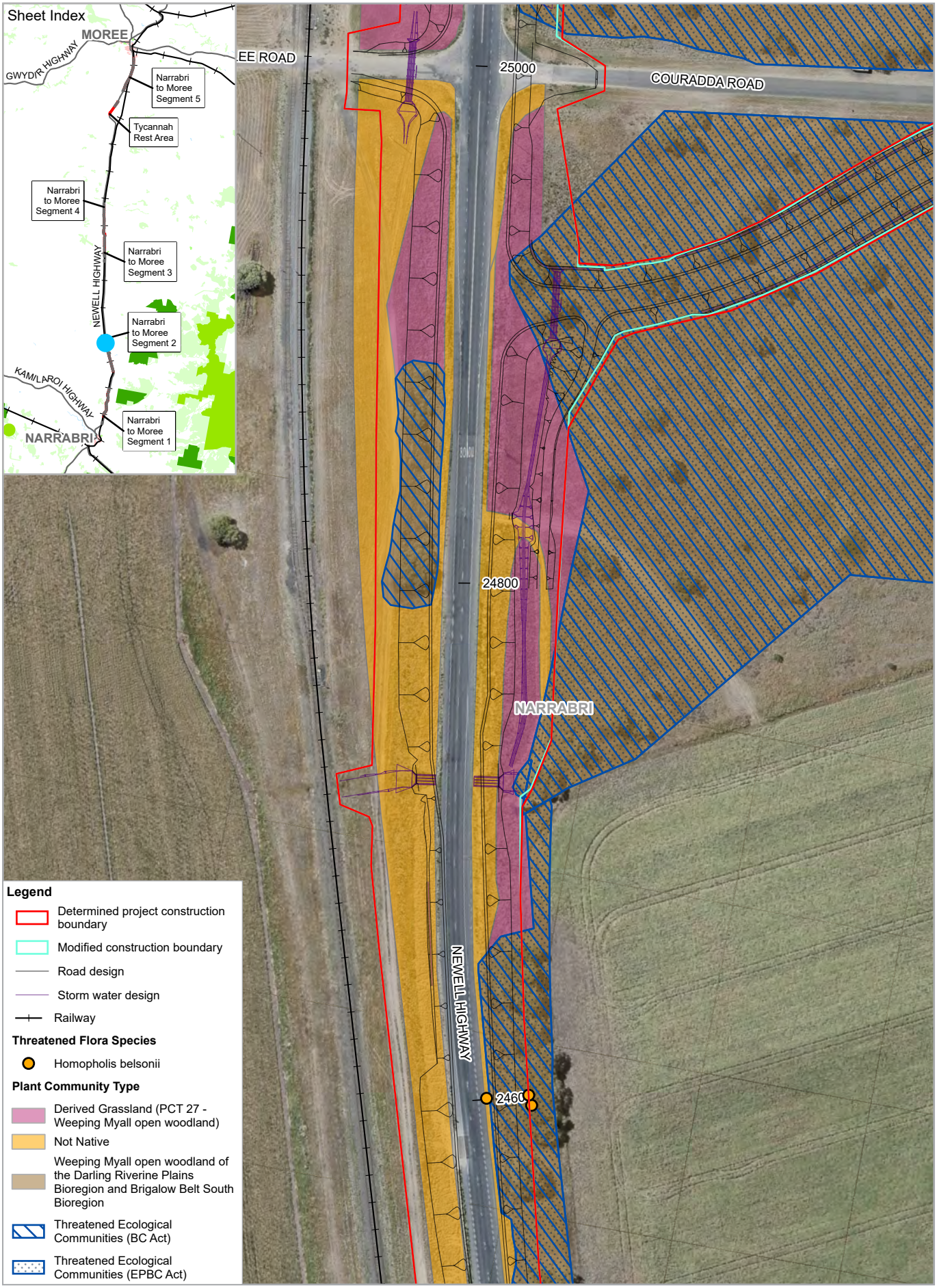

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

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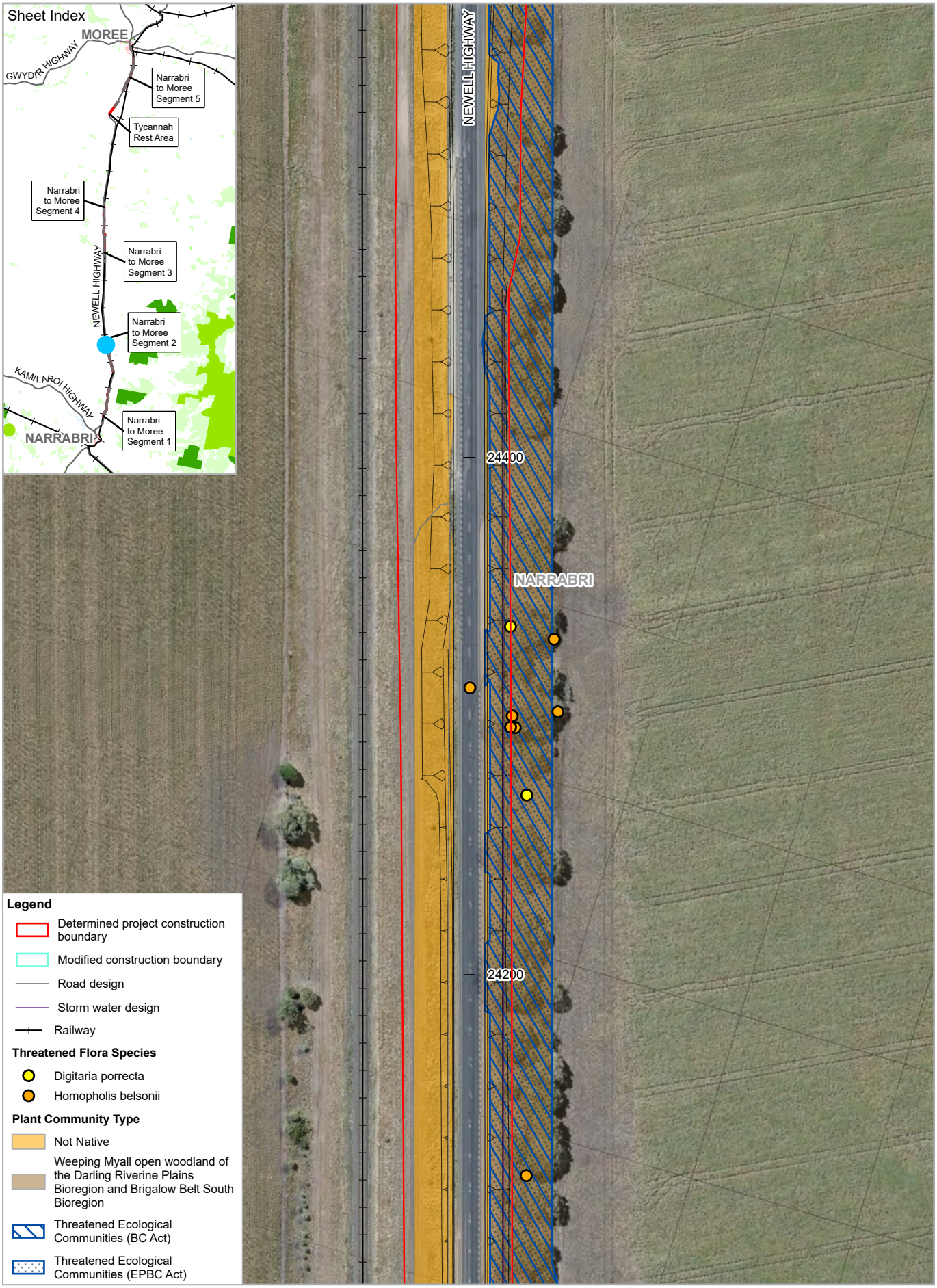

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Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 55

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Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 55

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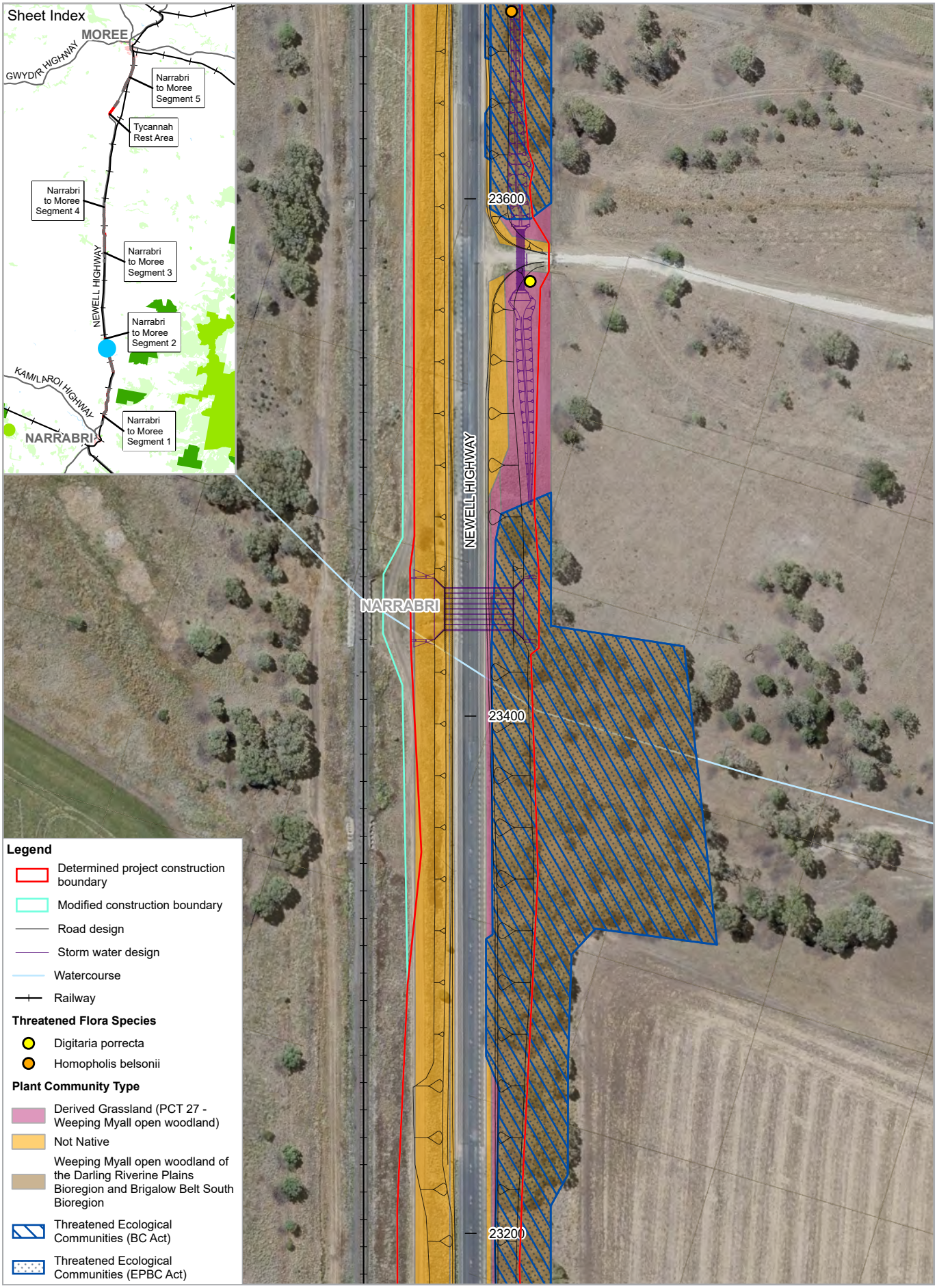

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Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 55

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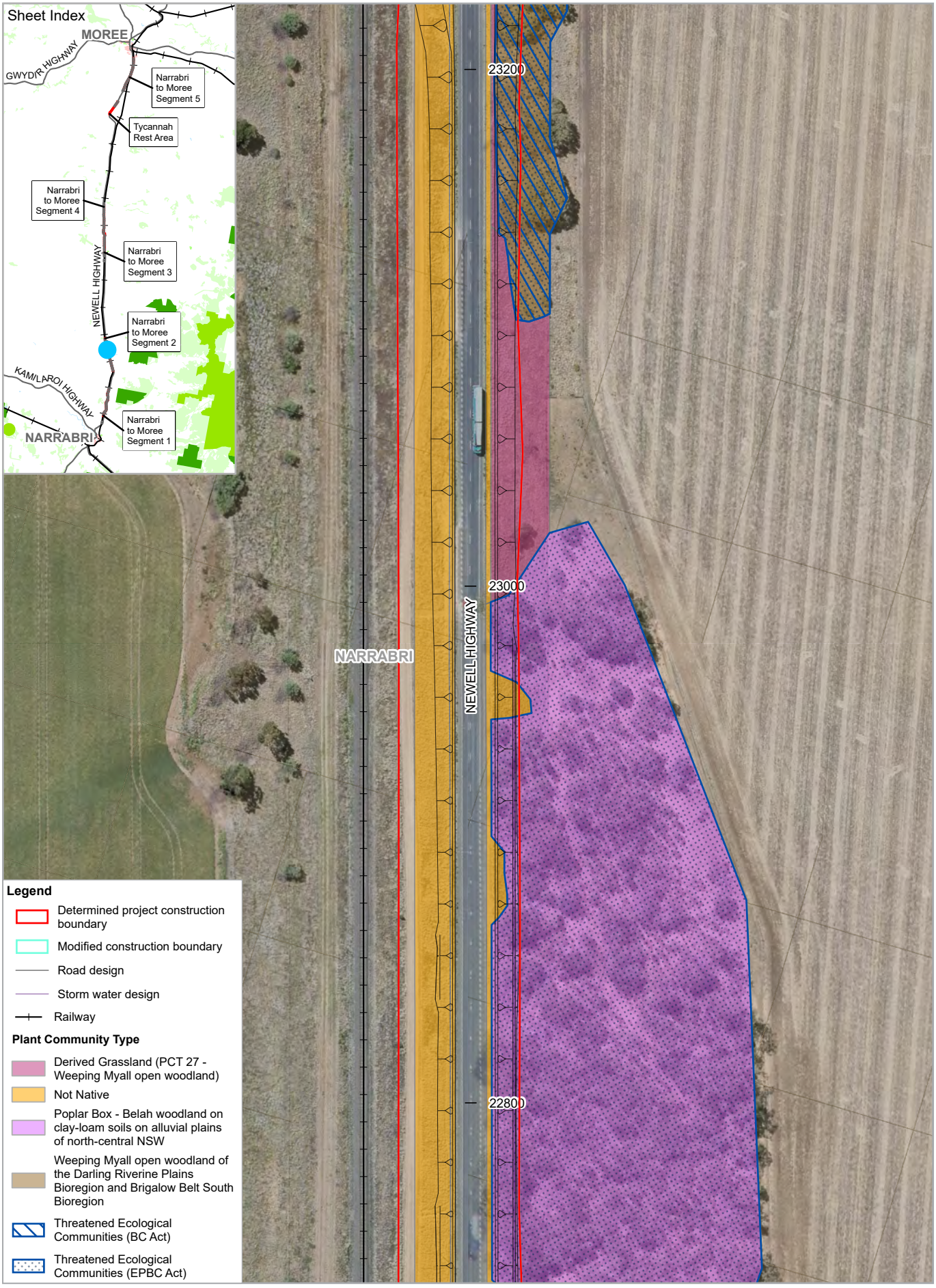

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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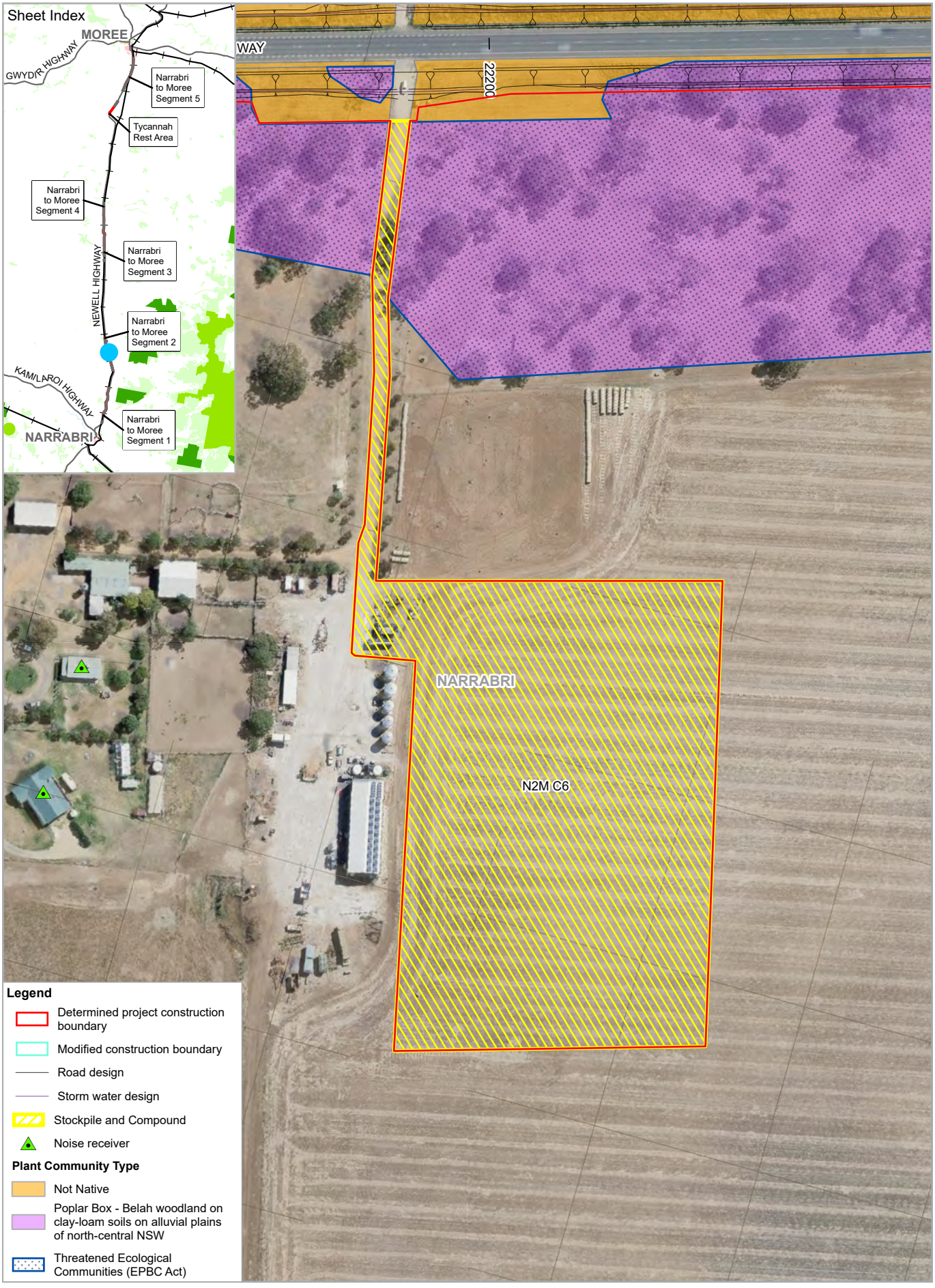

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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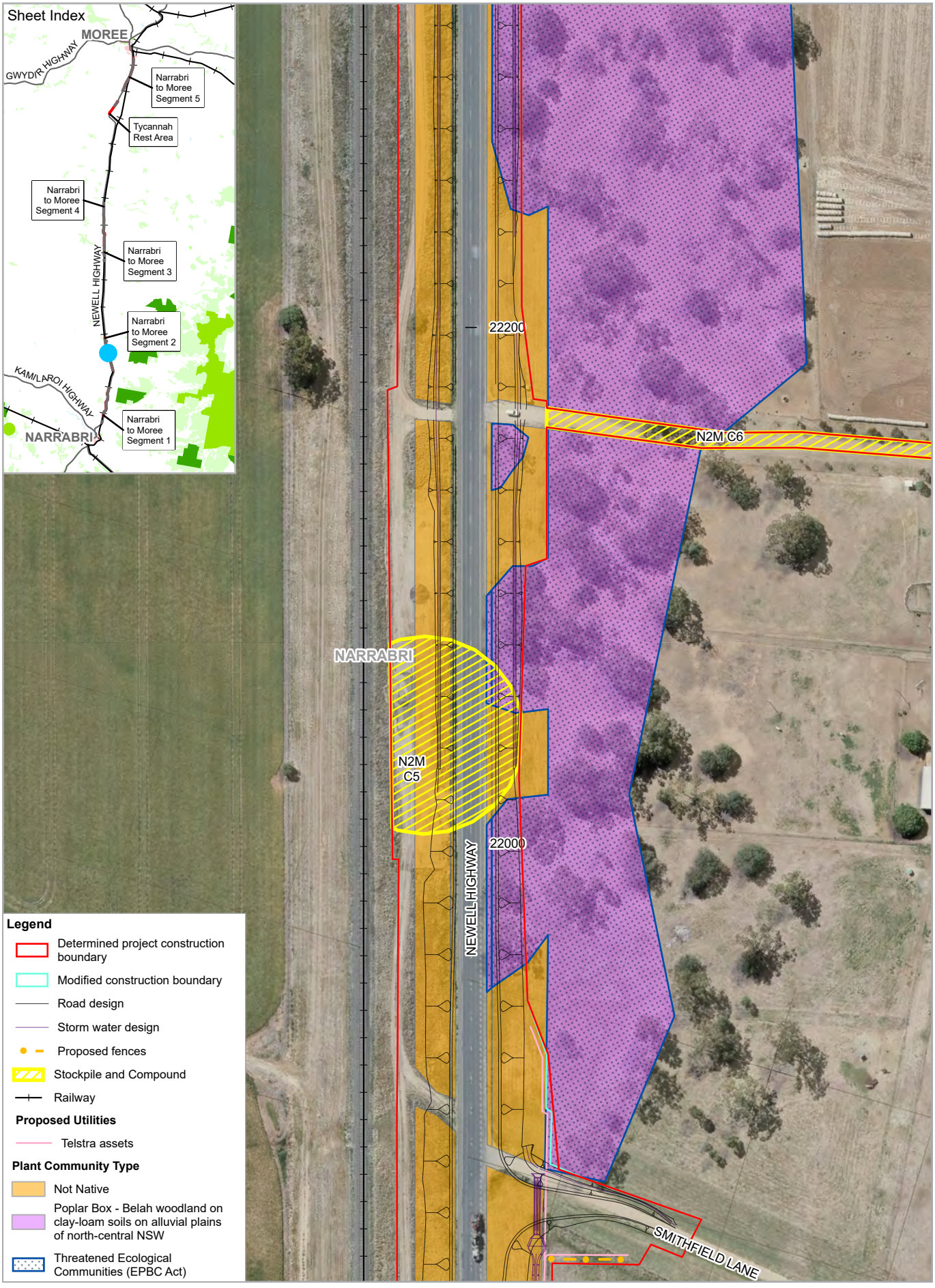

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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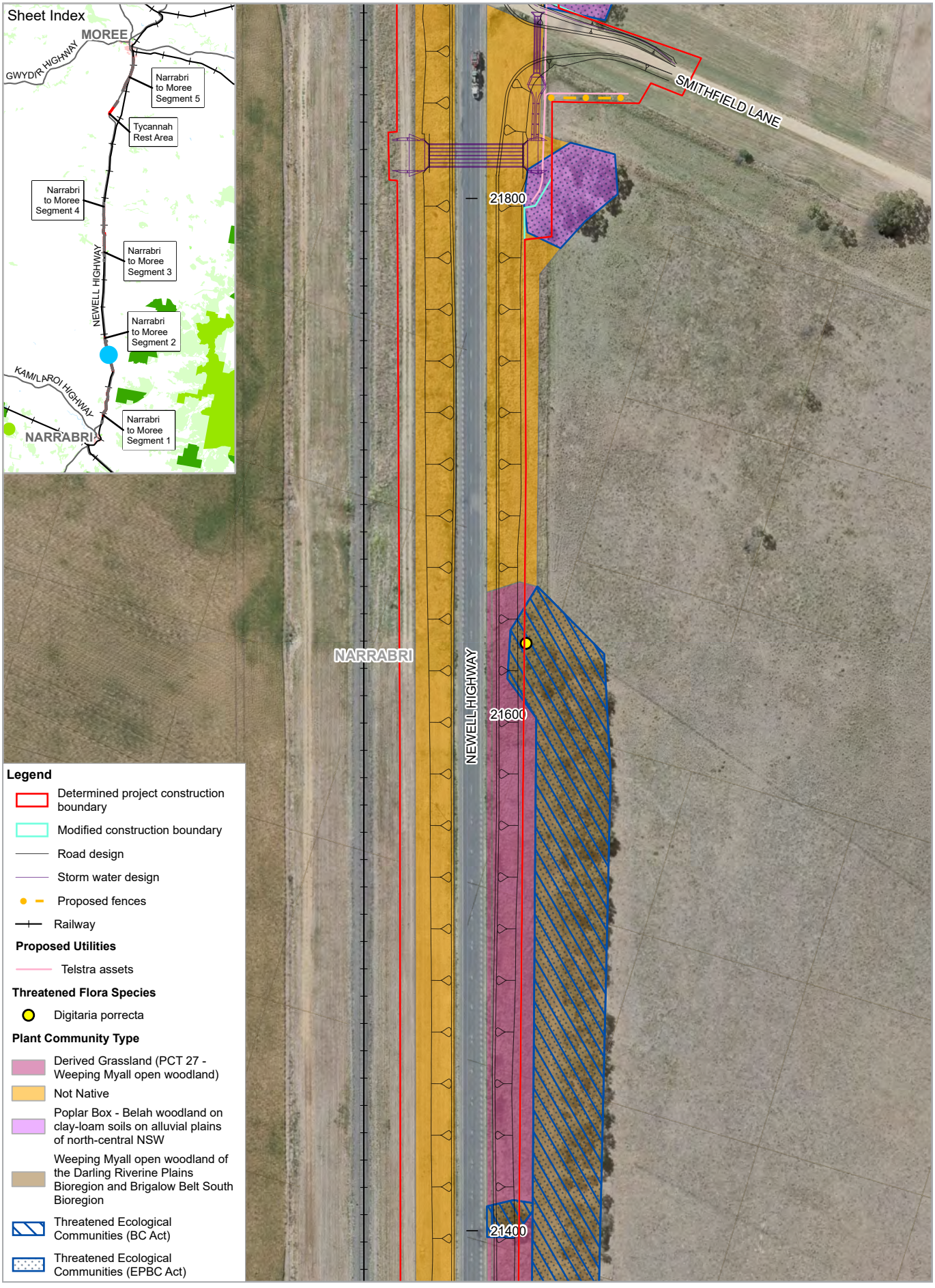

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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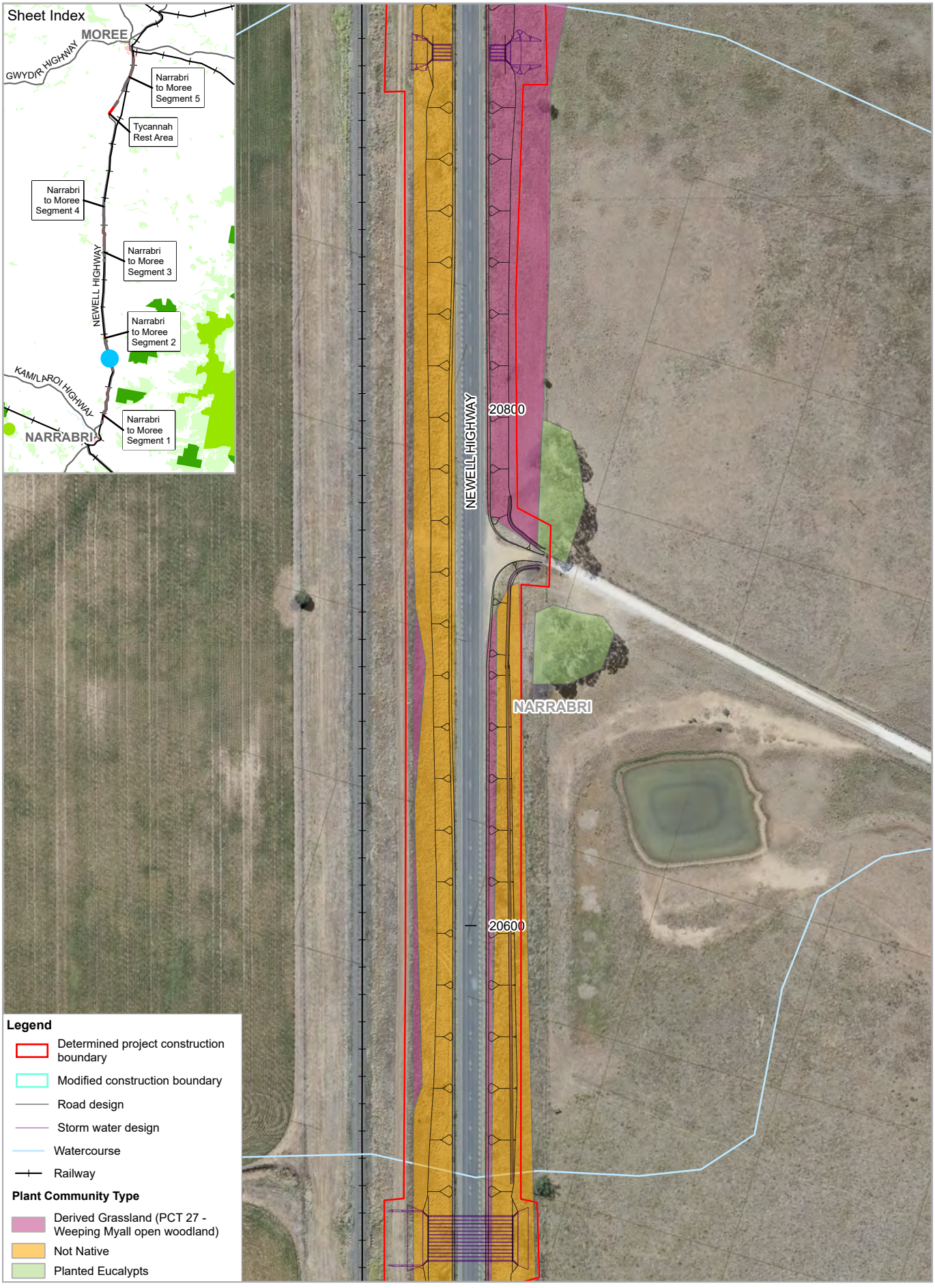

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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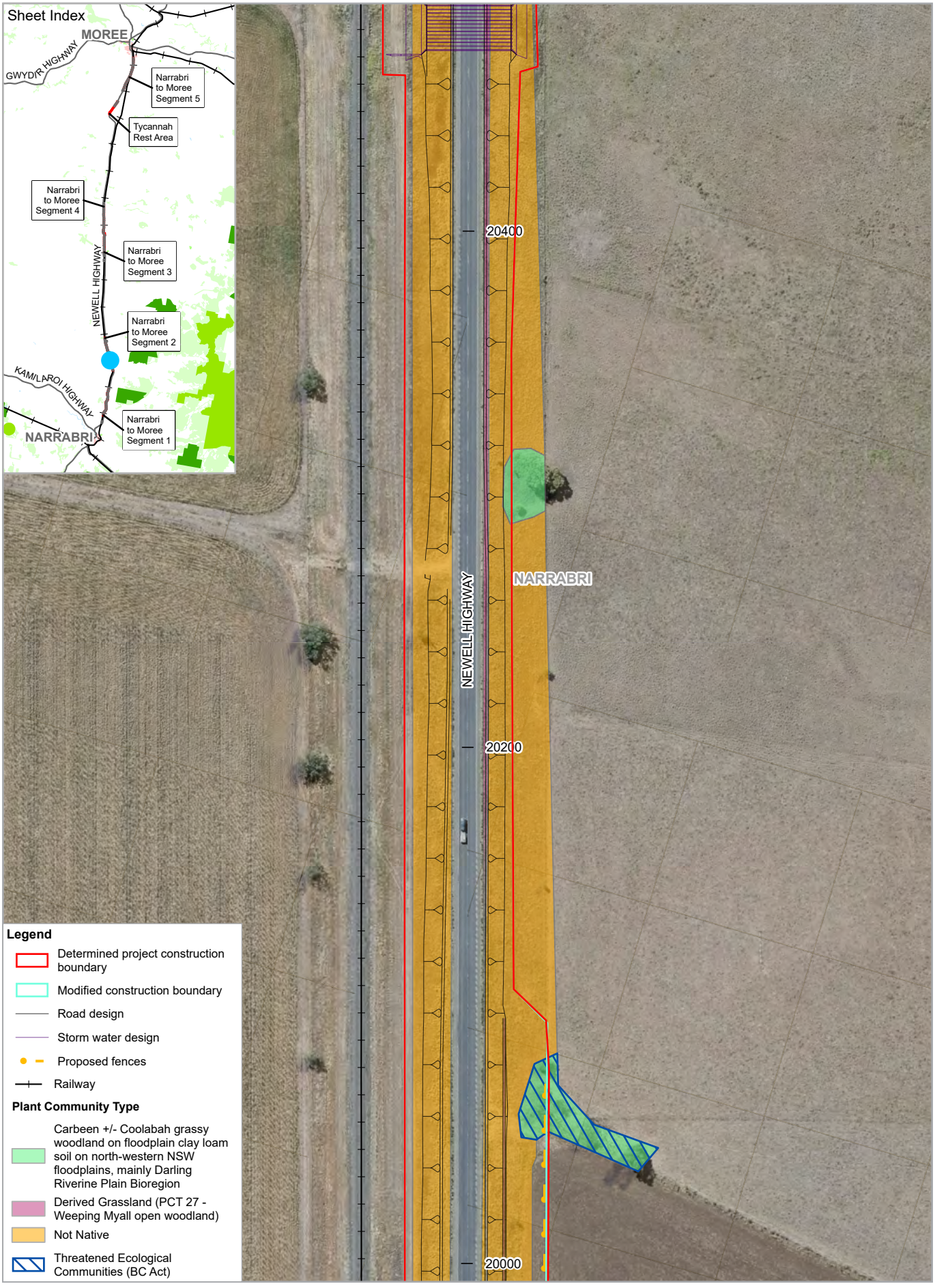

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Meters

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Grid: GDA 1994 MGA Zone 55

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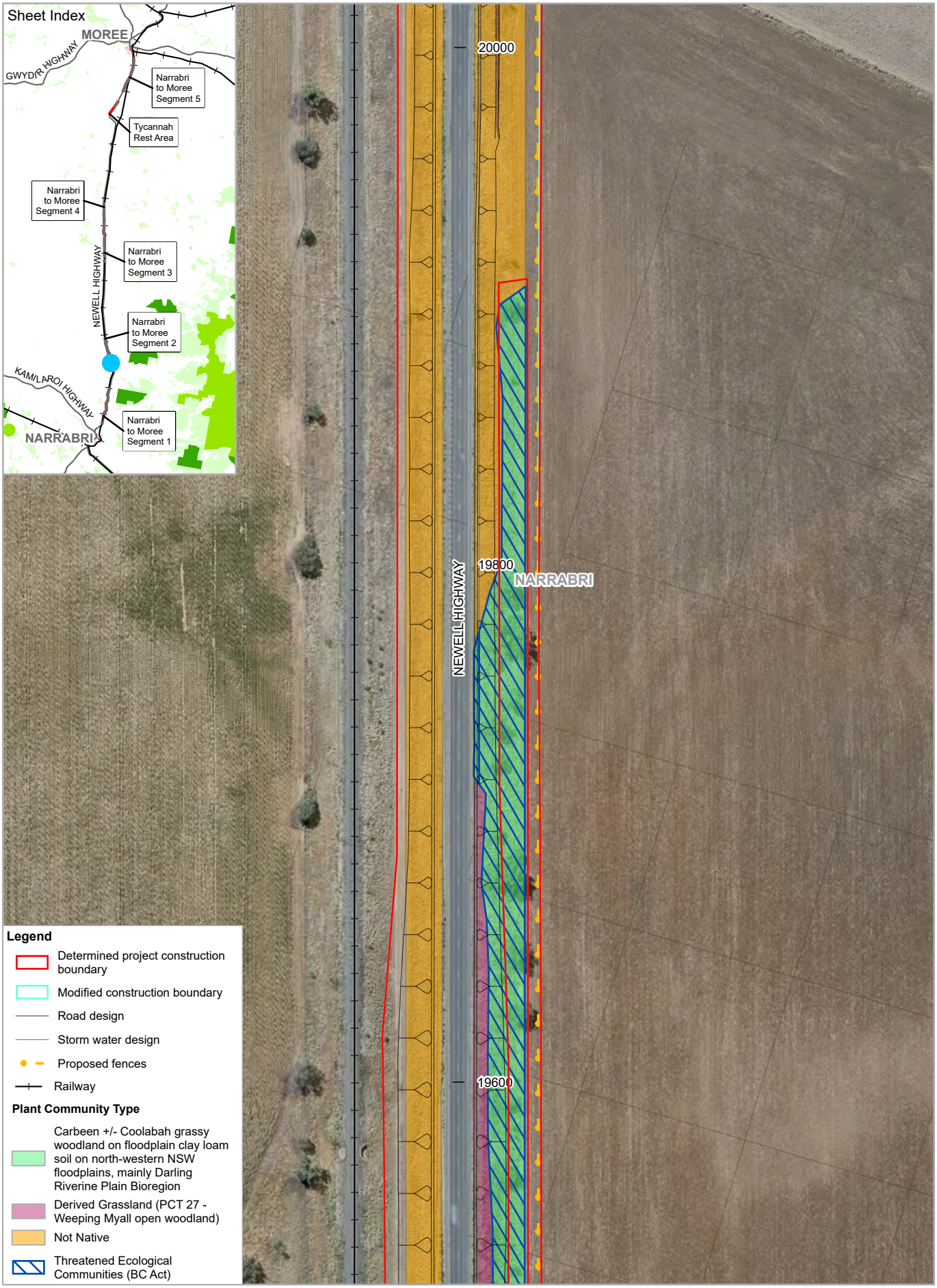

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Grid: GDA 1994 MGA Zone 55

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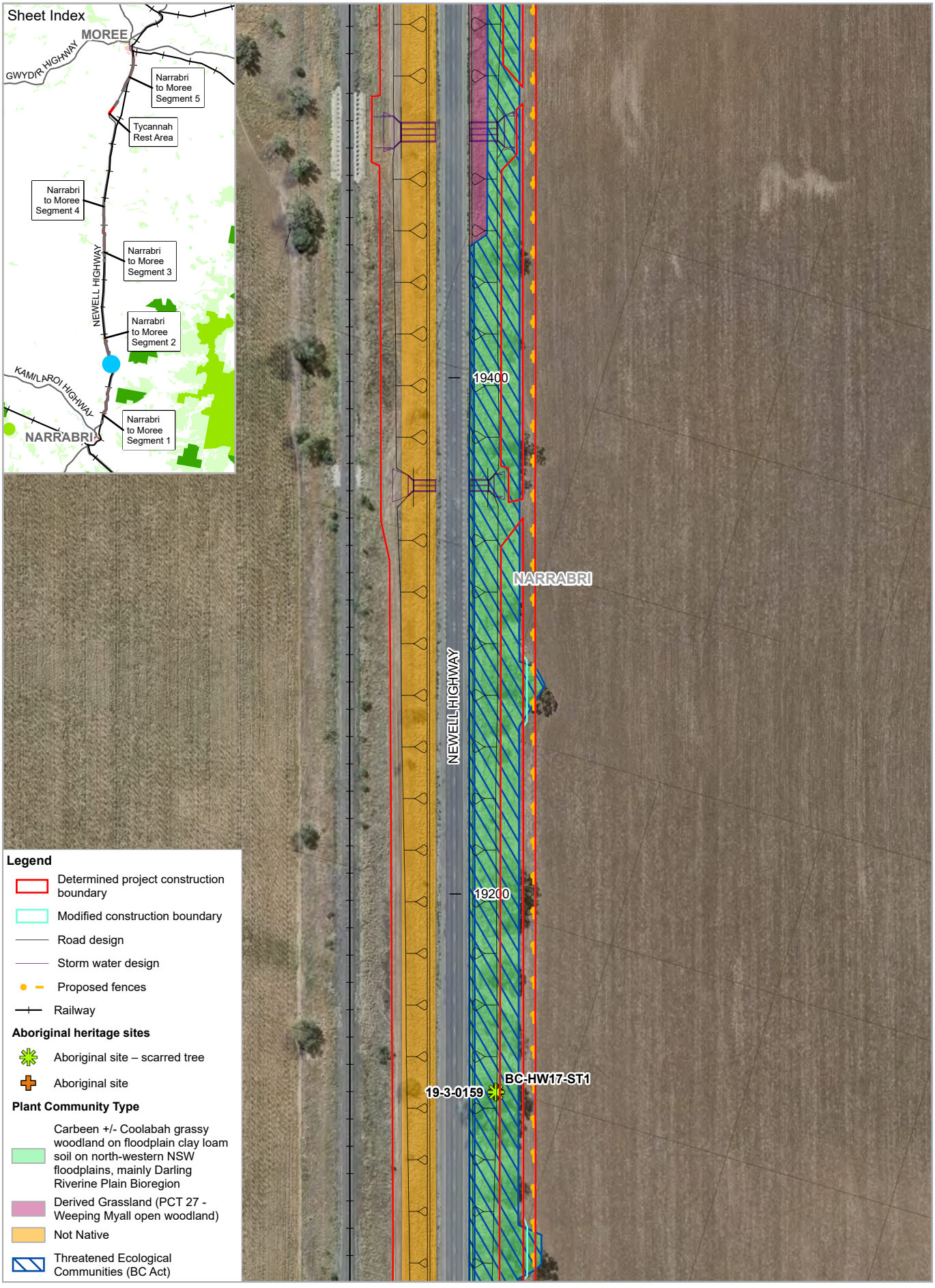

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Grid: GDA 1994 MGA Zone 55

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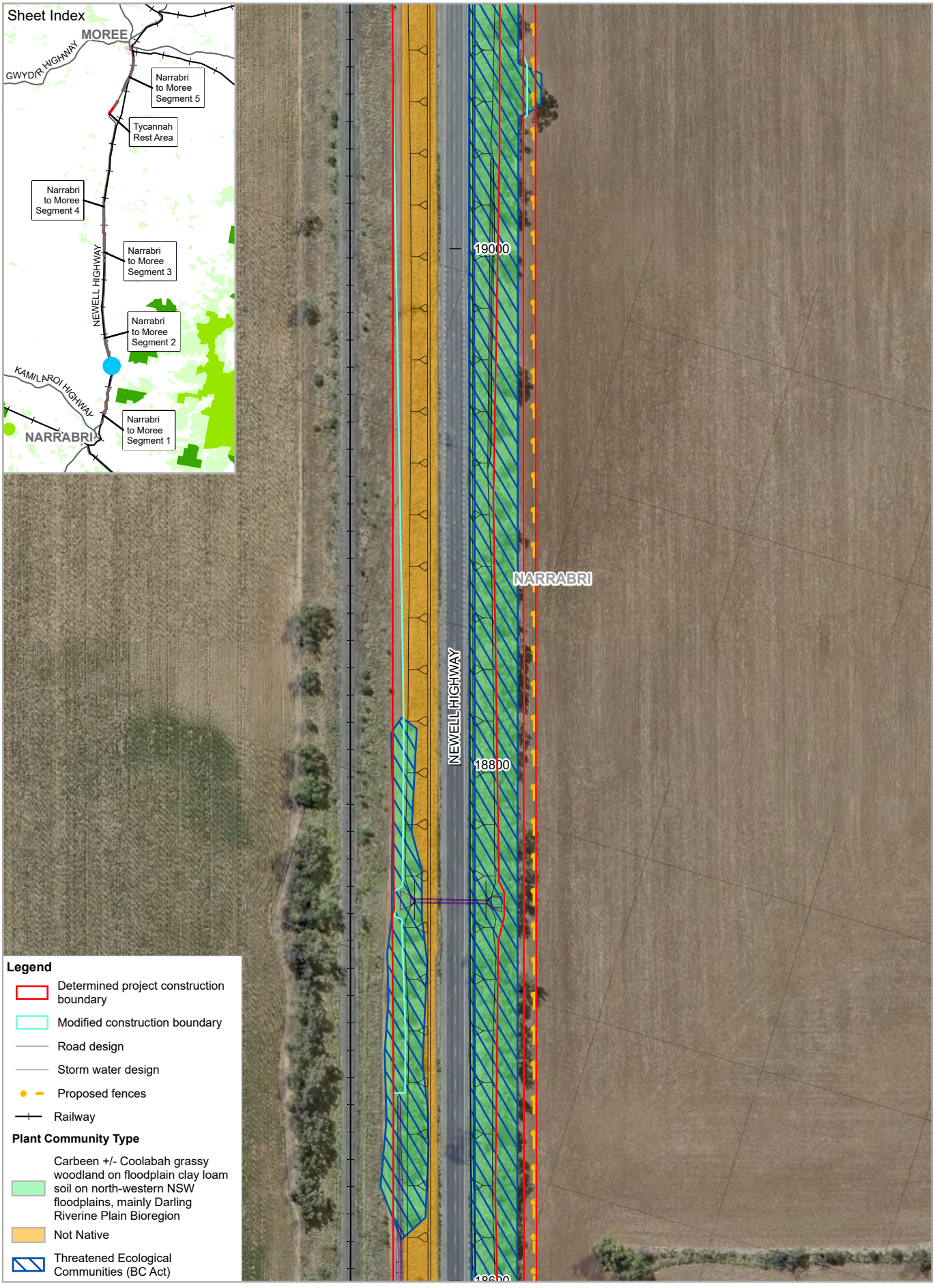

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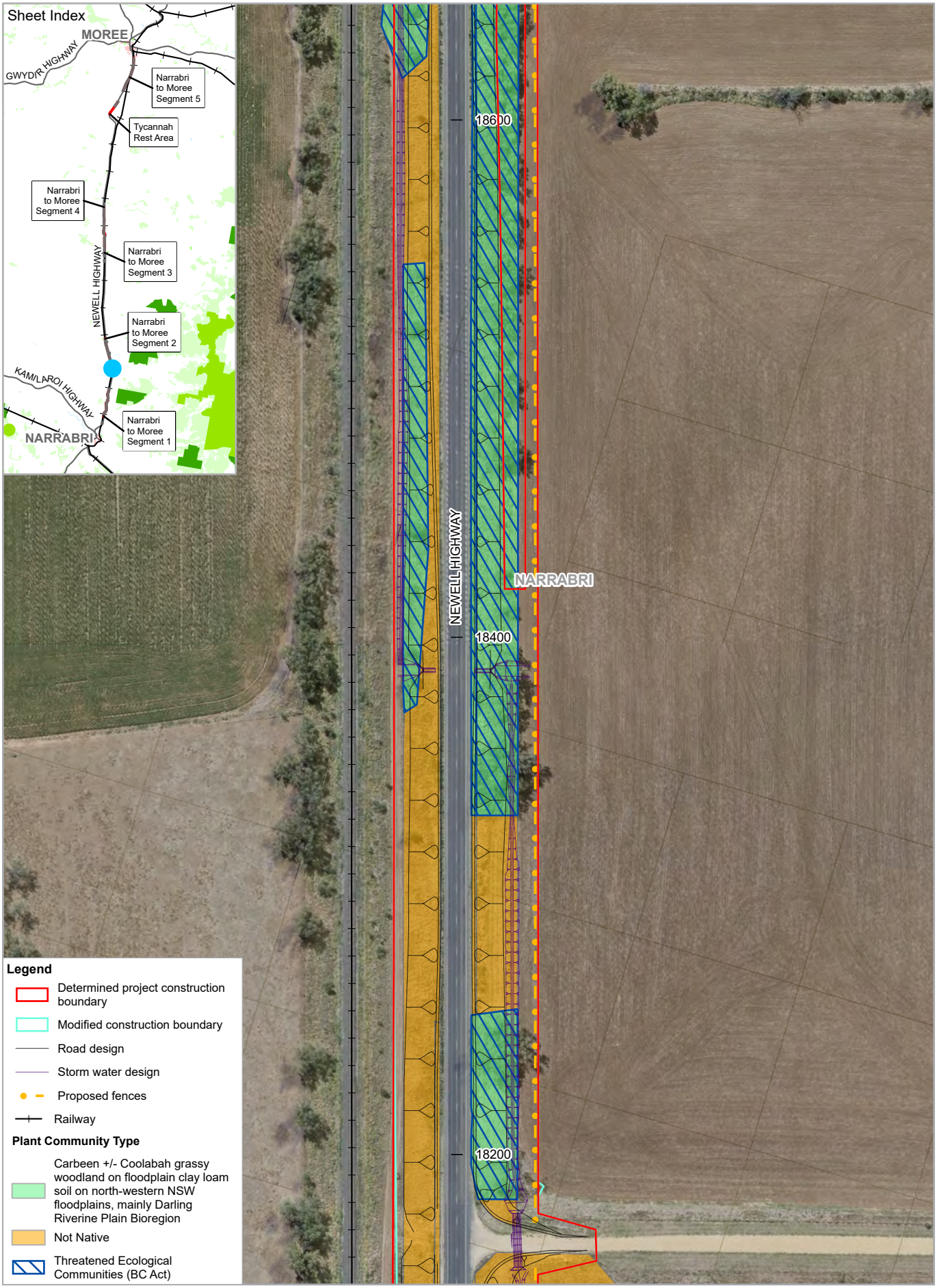

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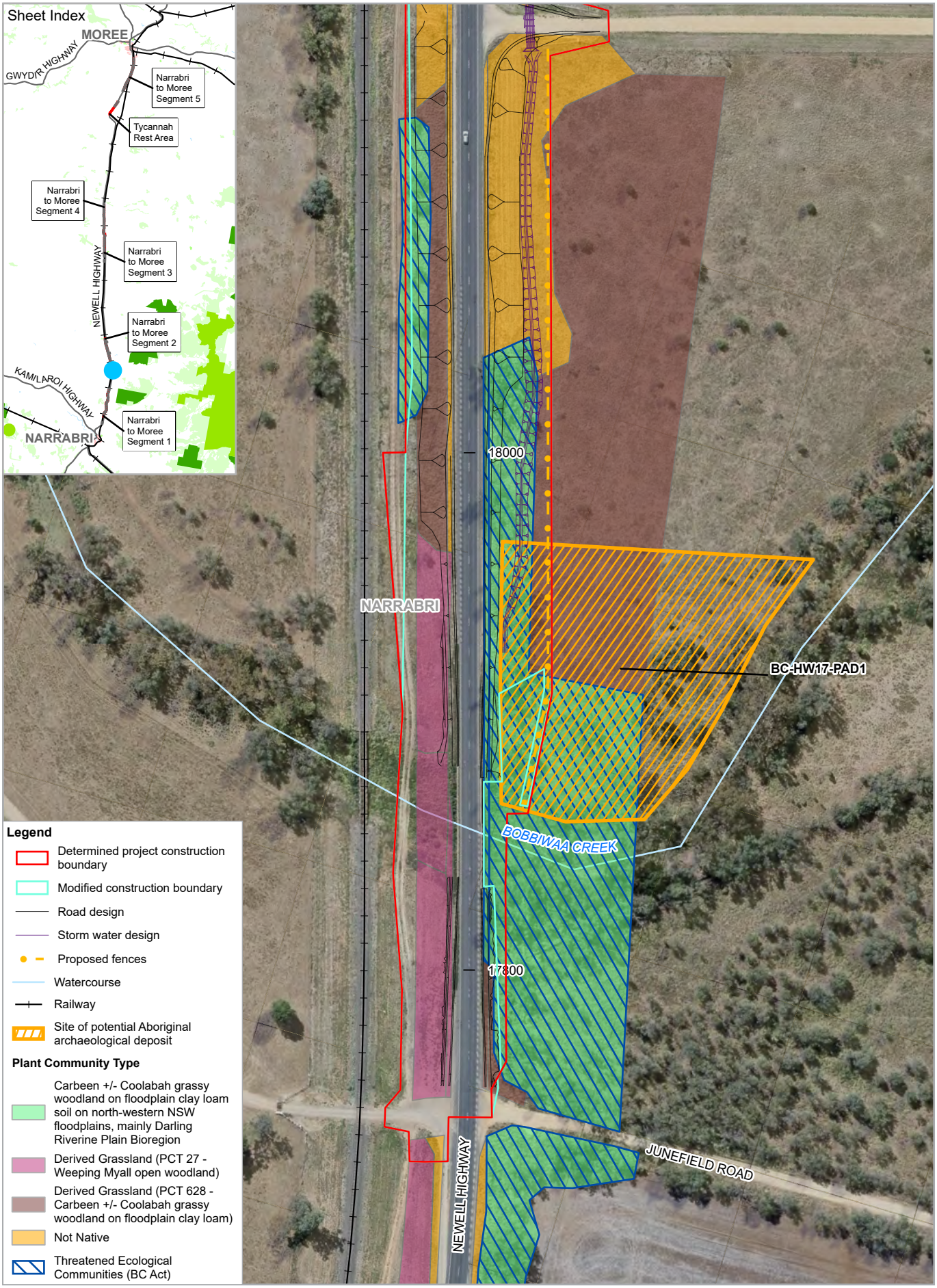

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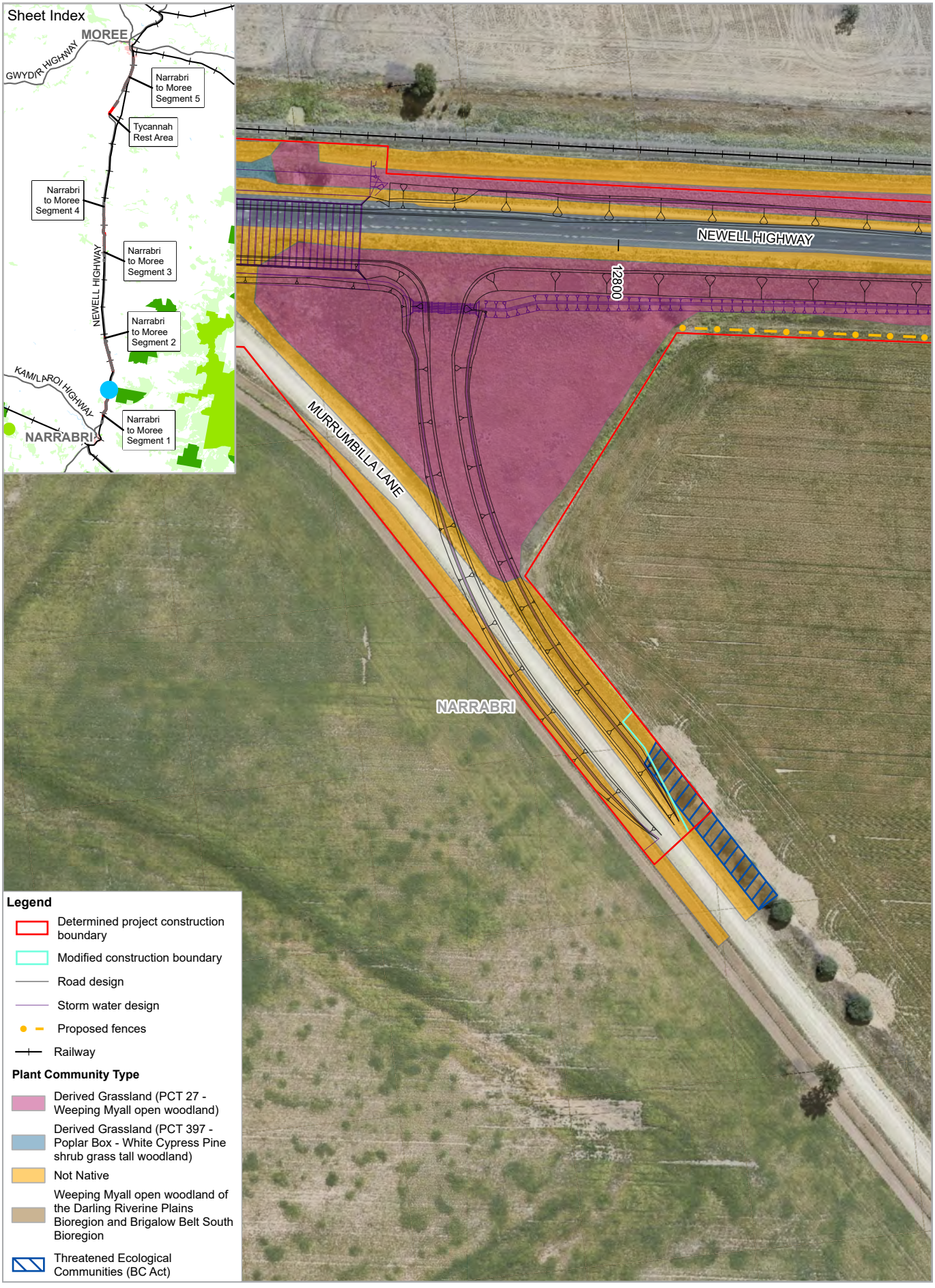

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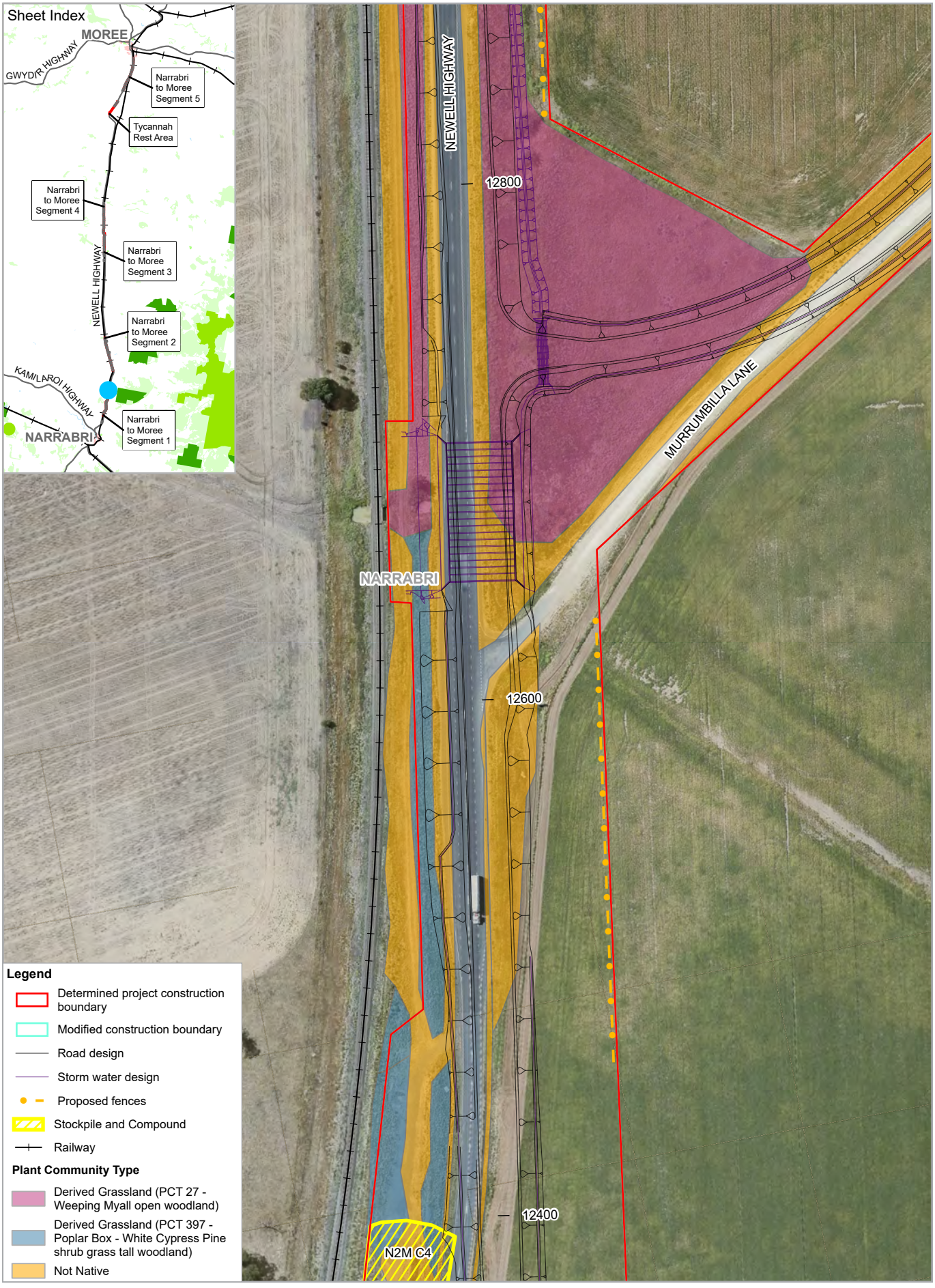

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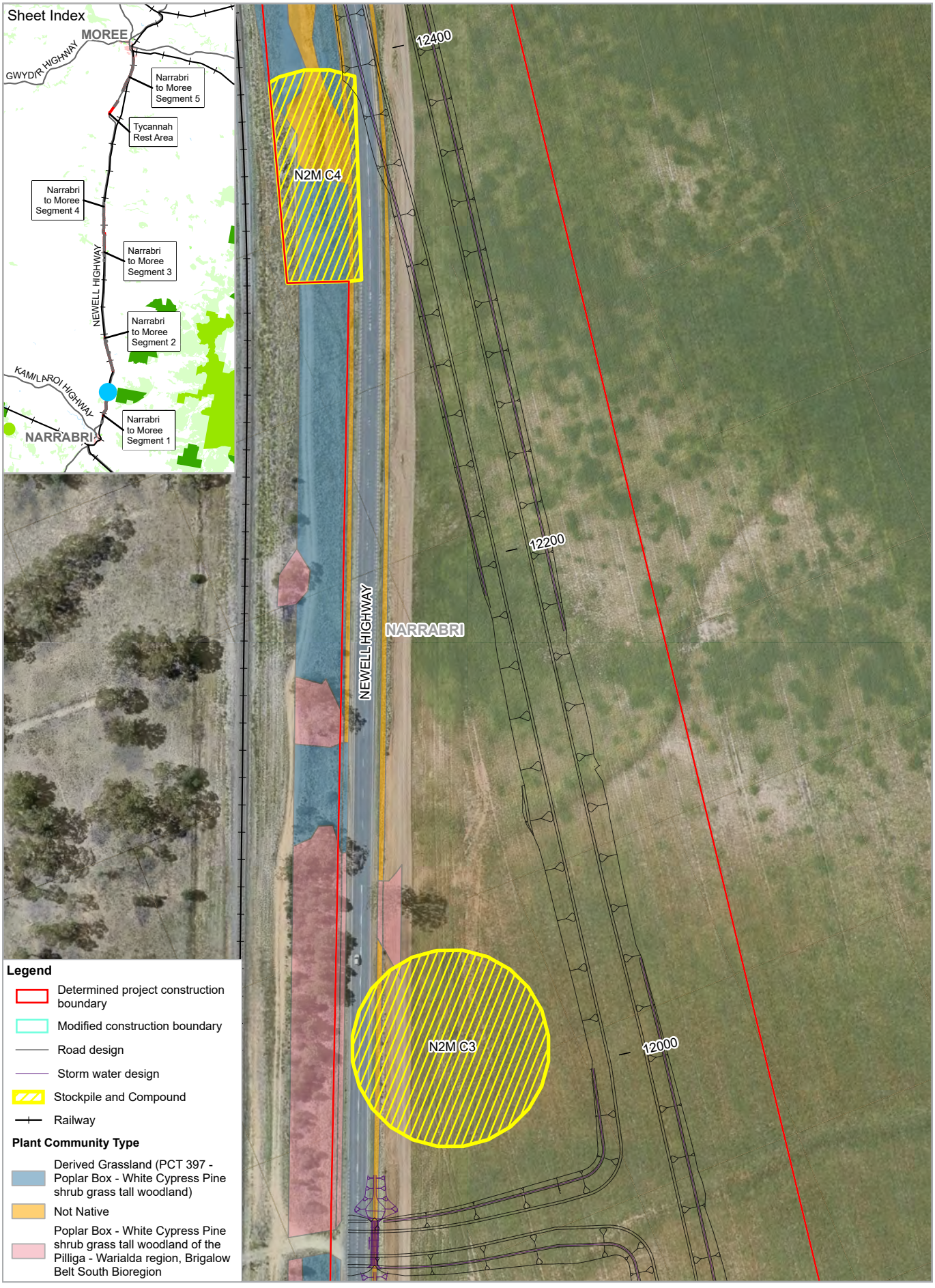

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
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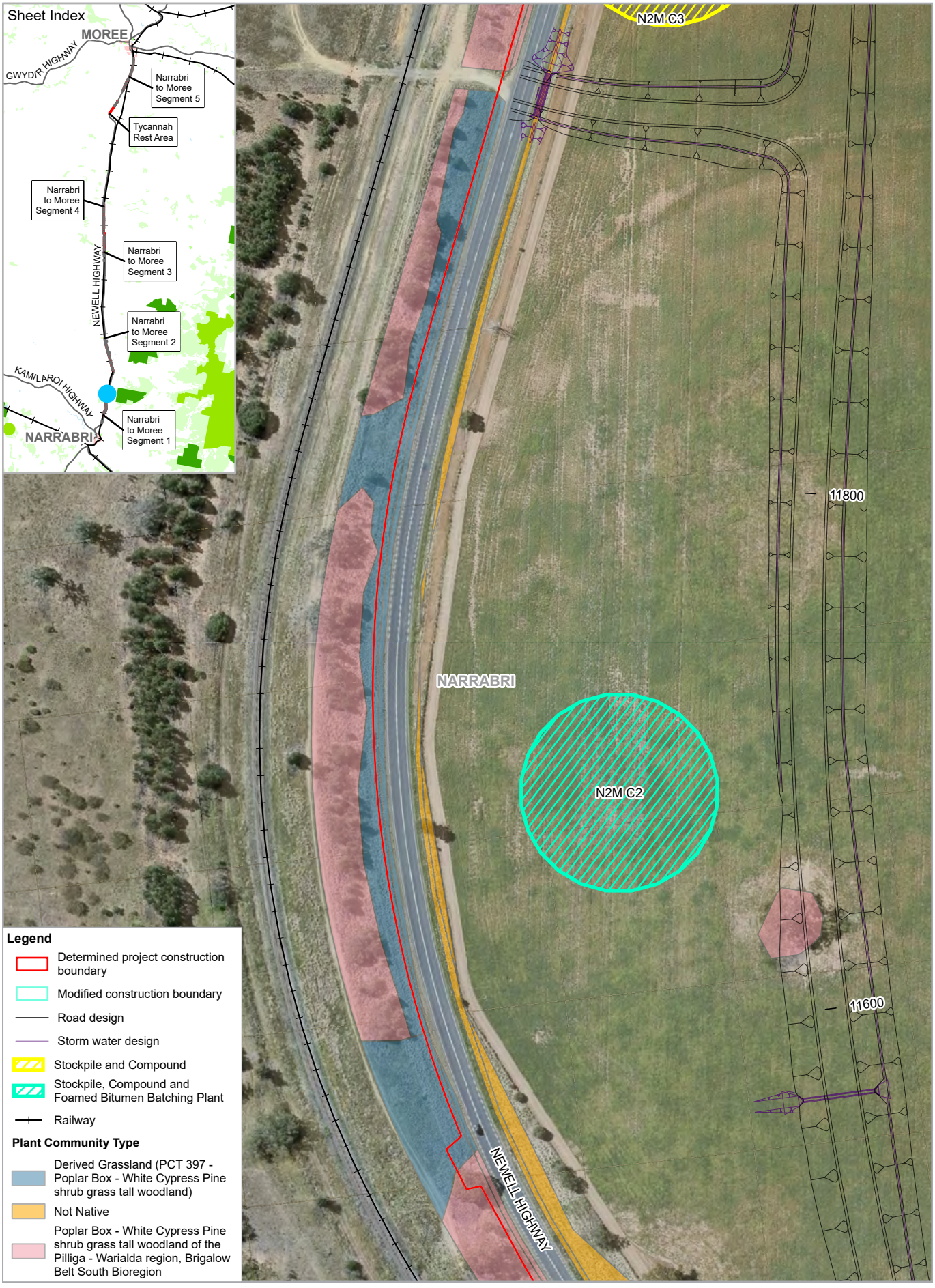

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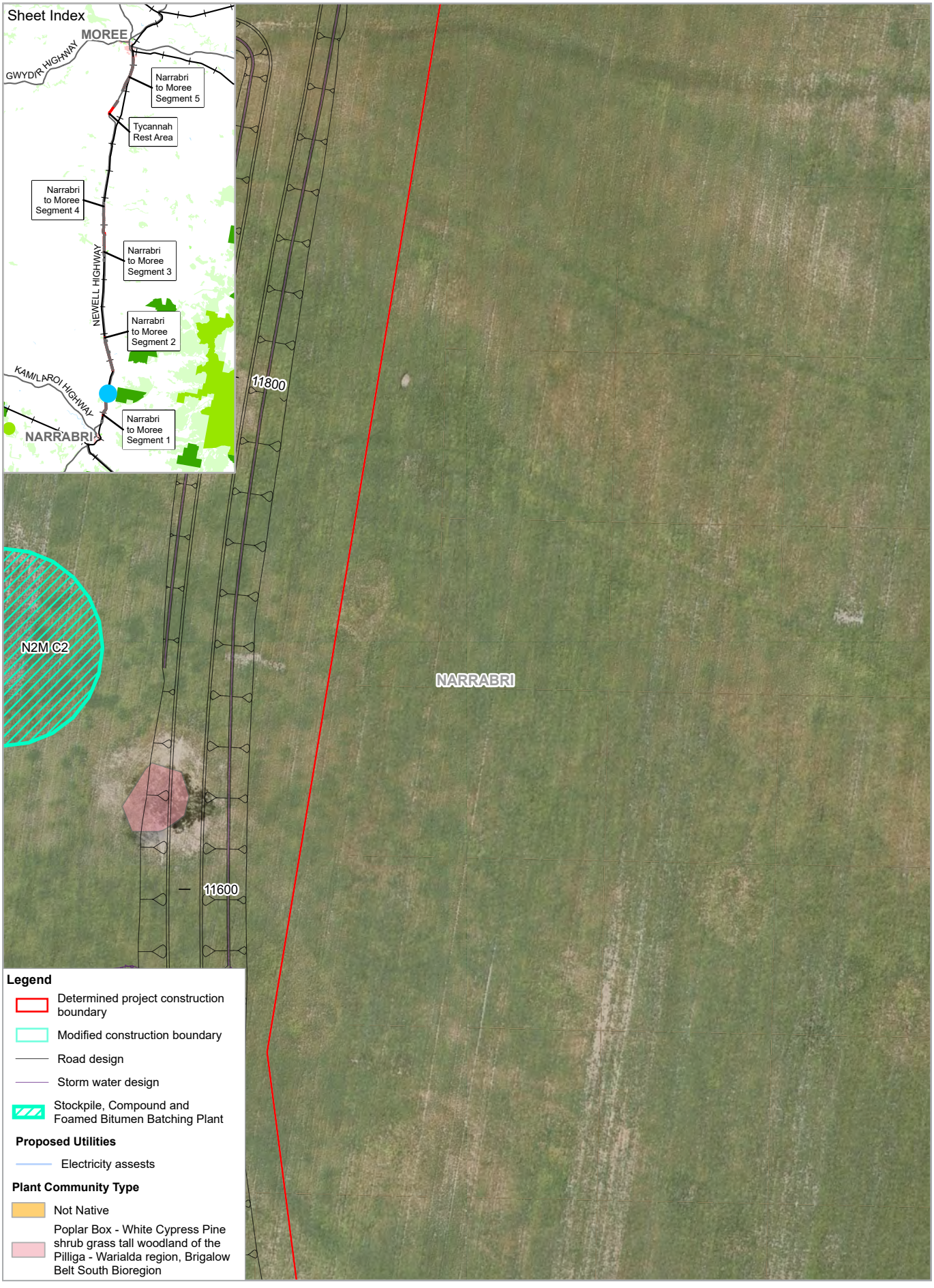

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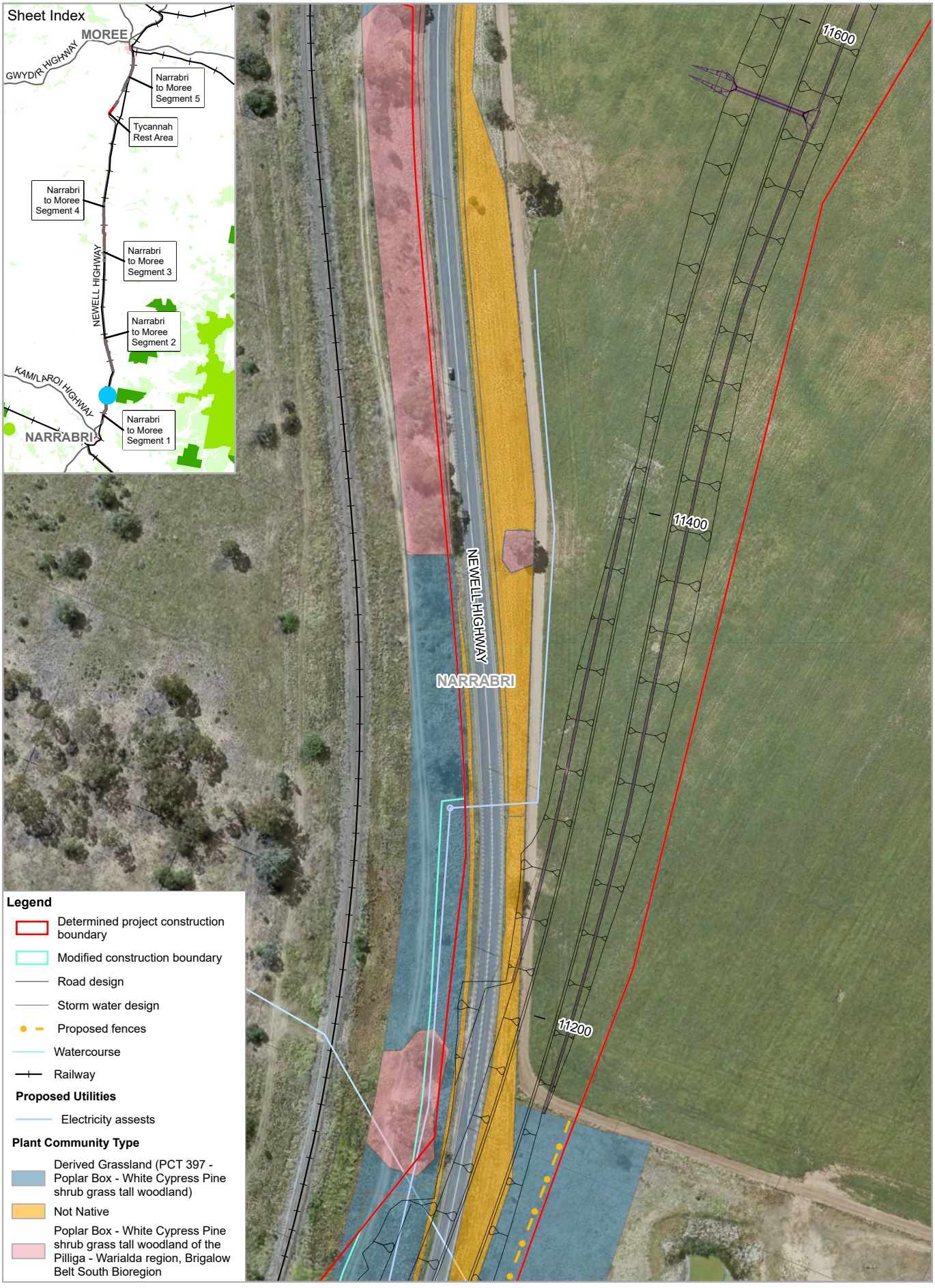

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Map Projection: Transverse Mercator
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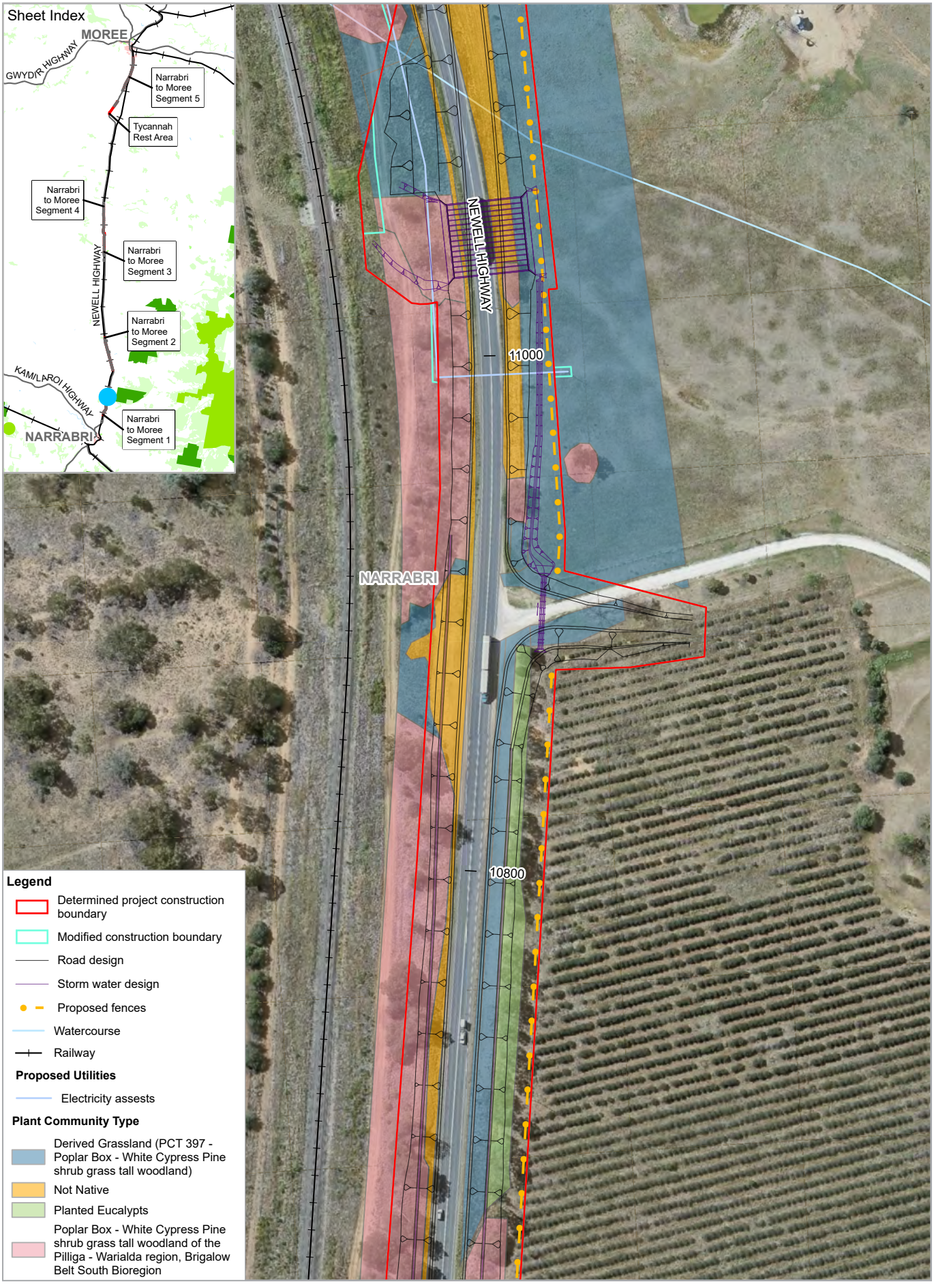

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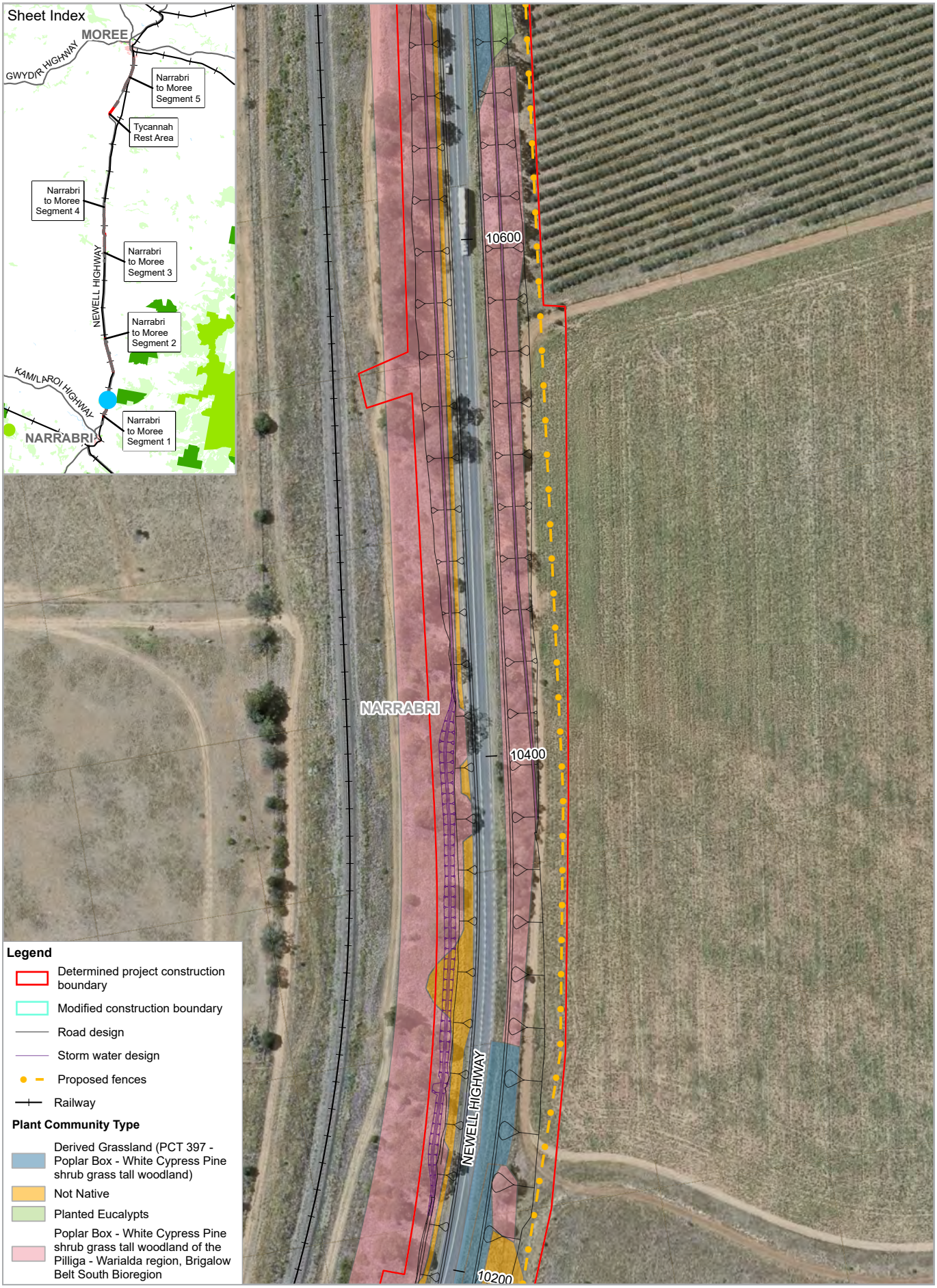

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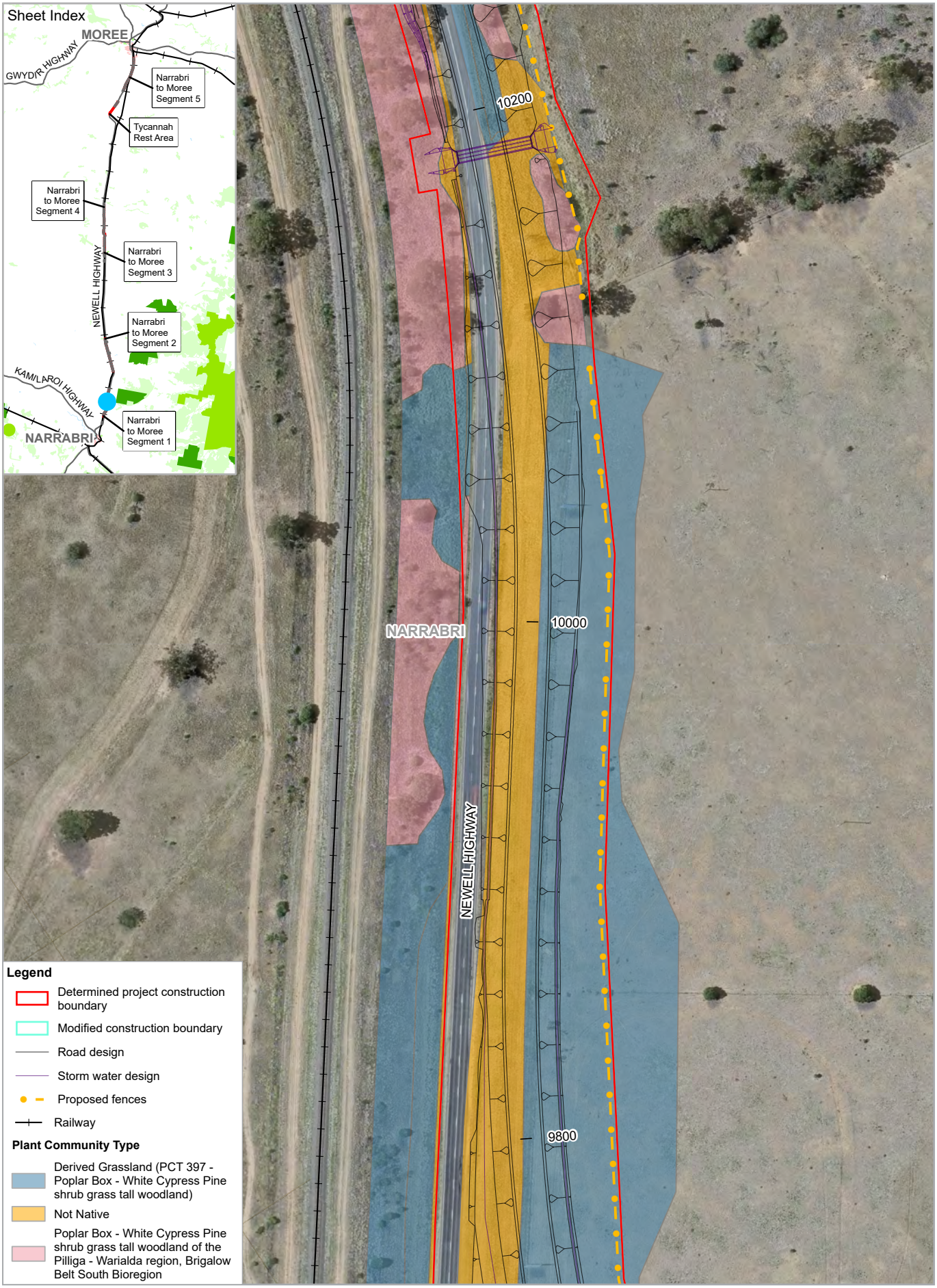

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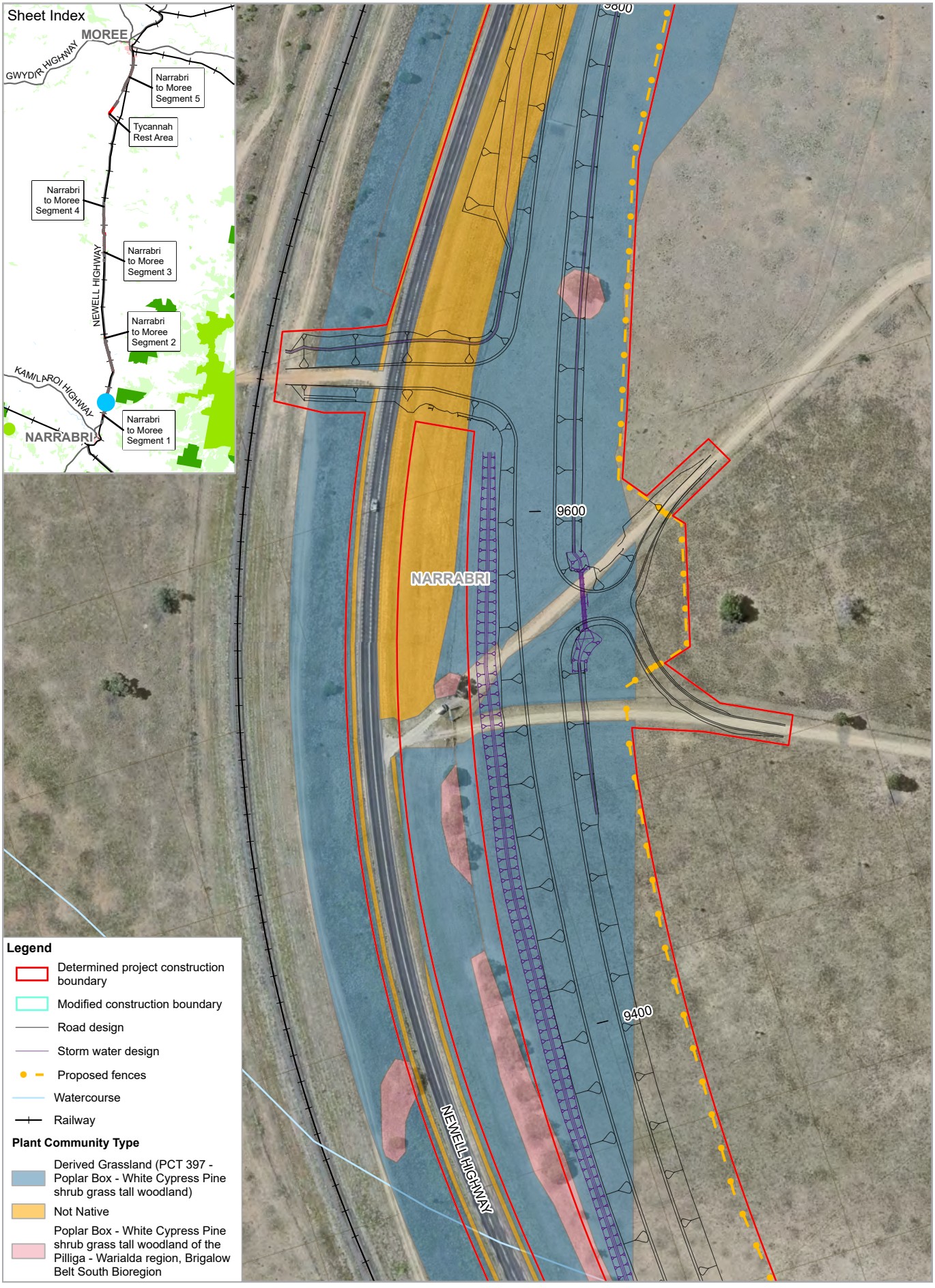

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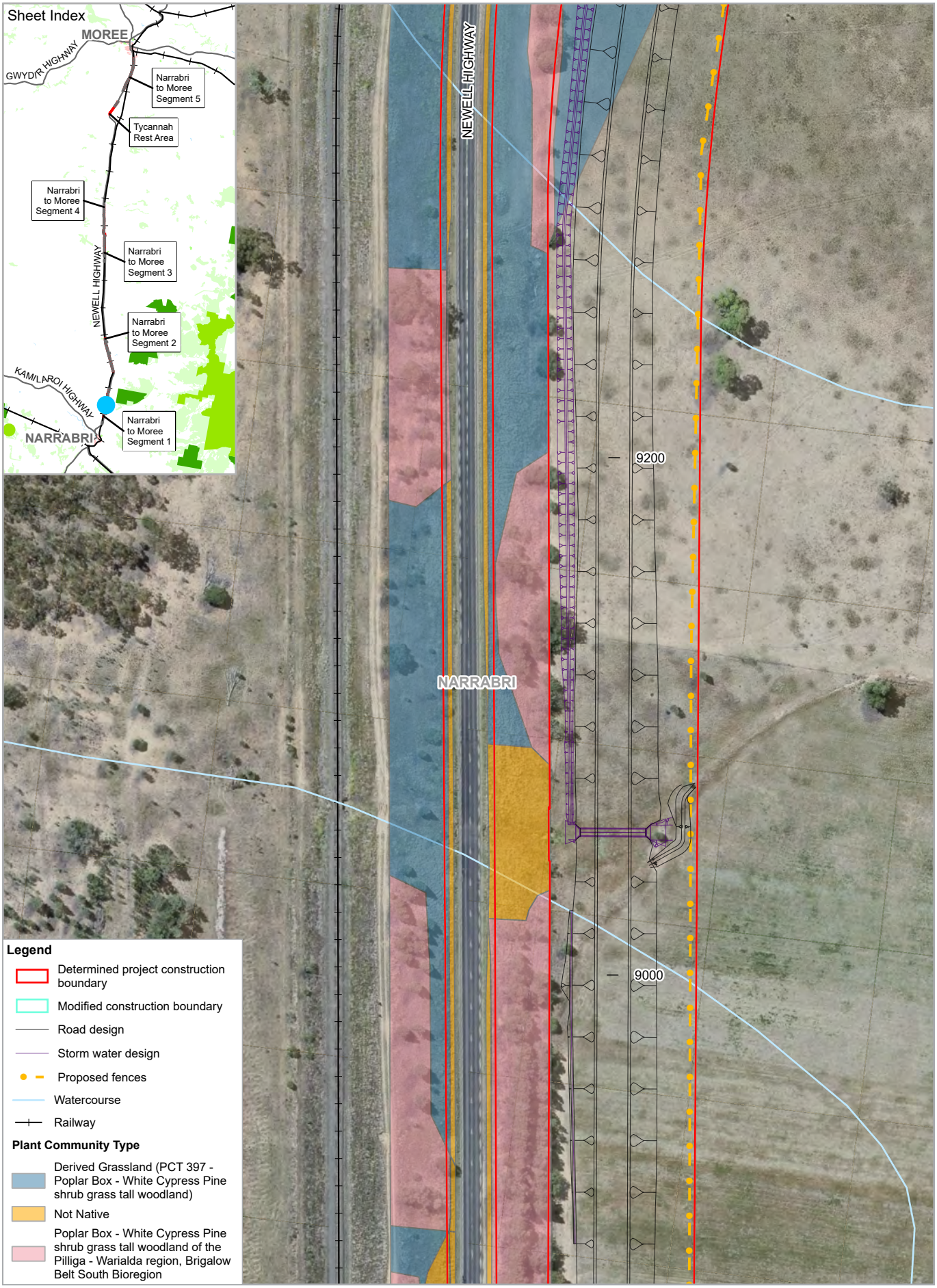

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Map Projection: Transverse Mercator
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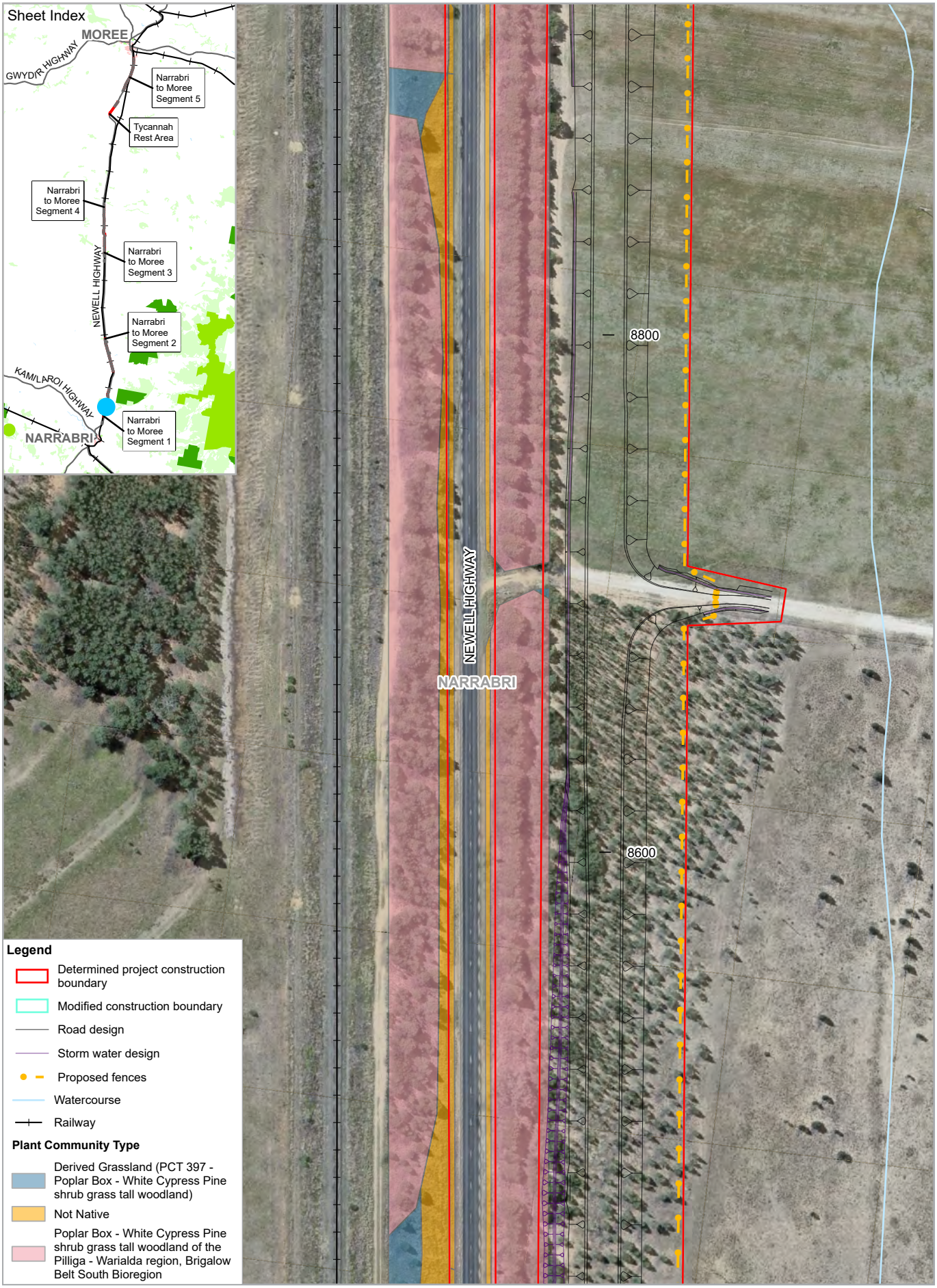

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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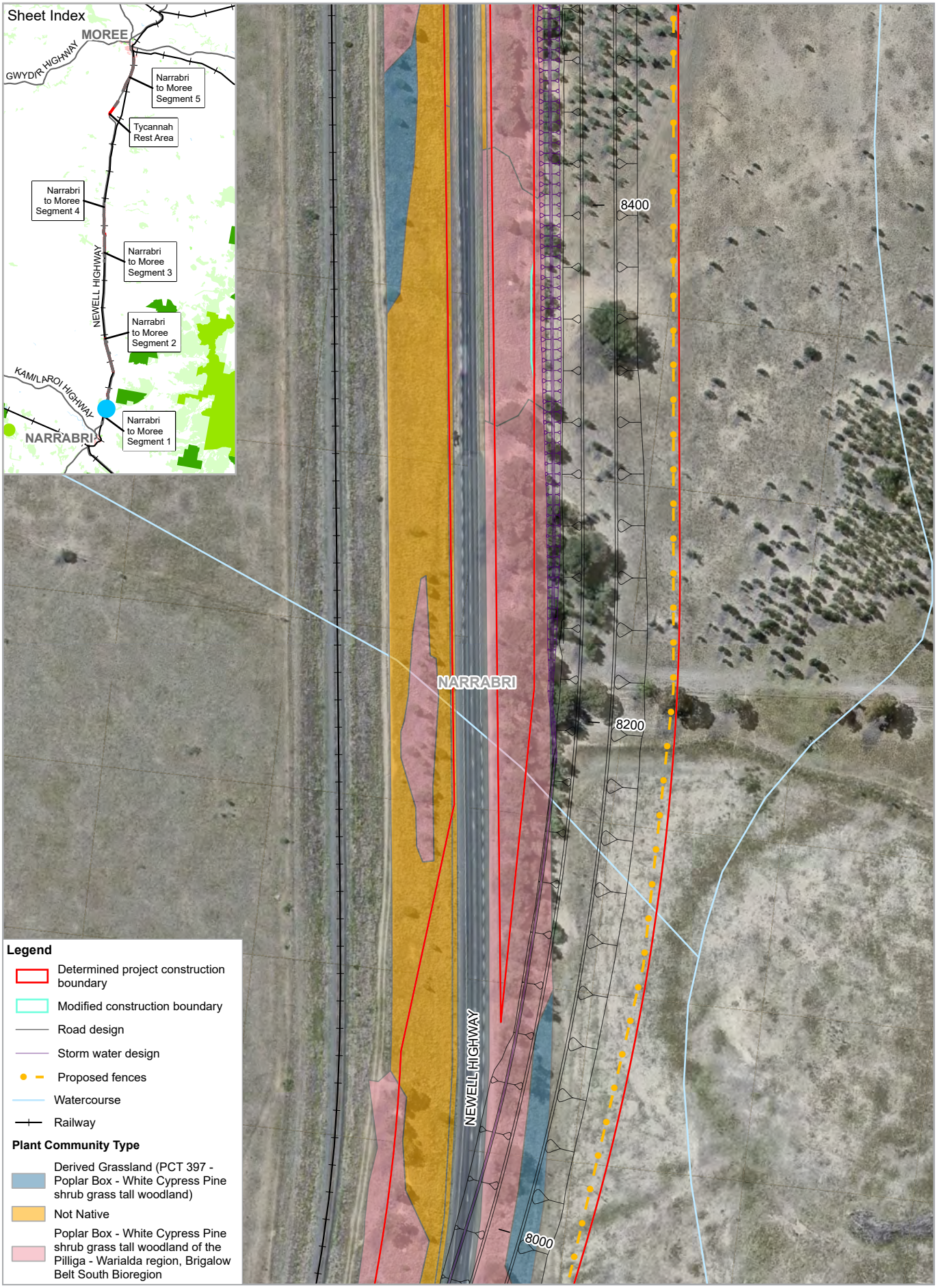

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Horizontal Datum: GDA 1994
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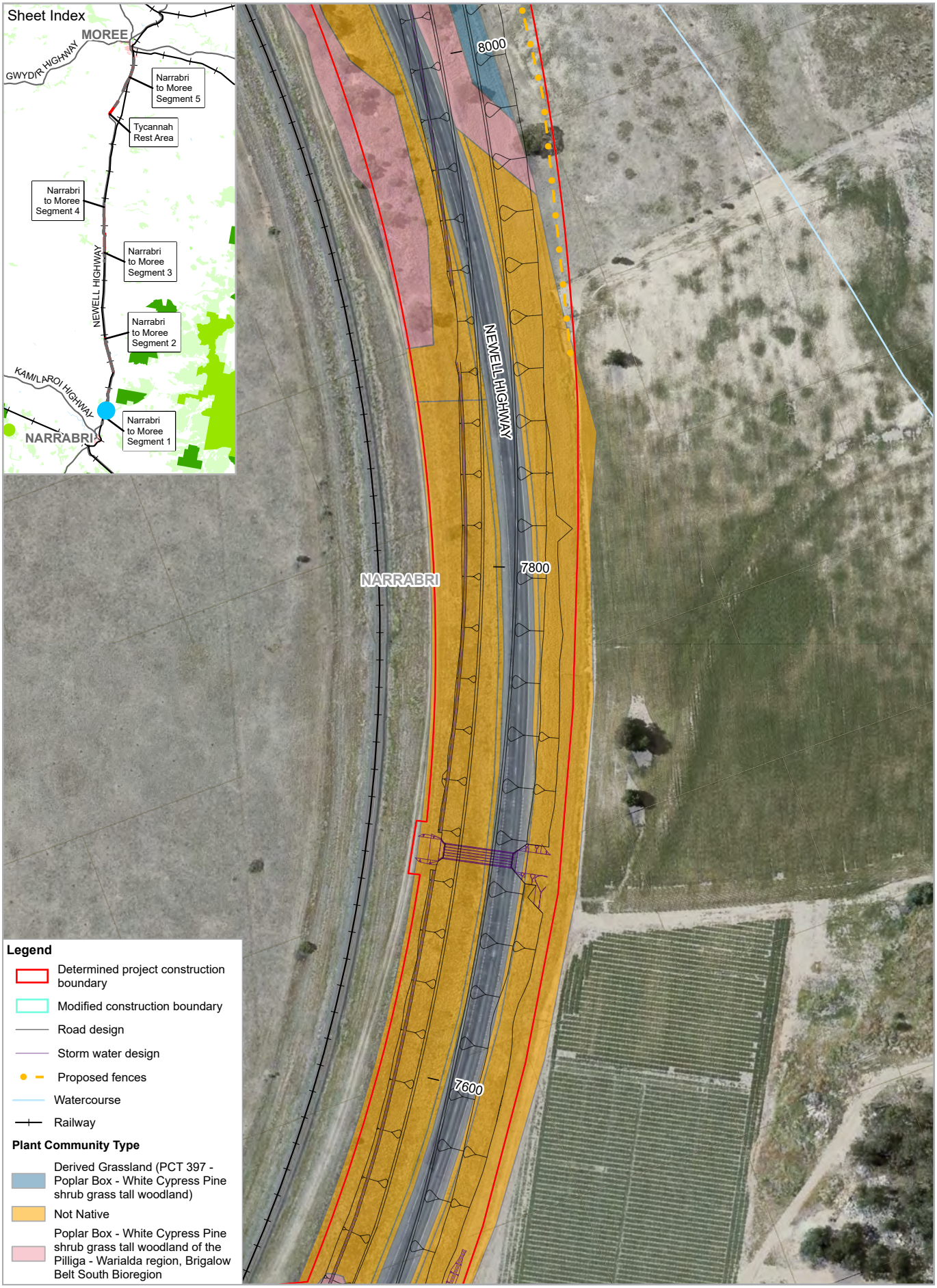

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
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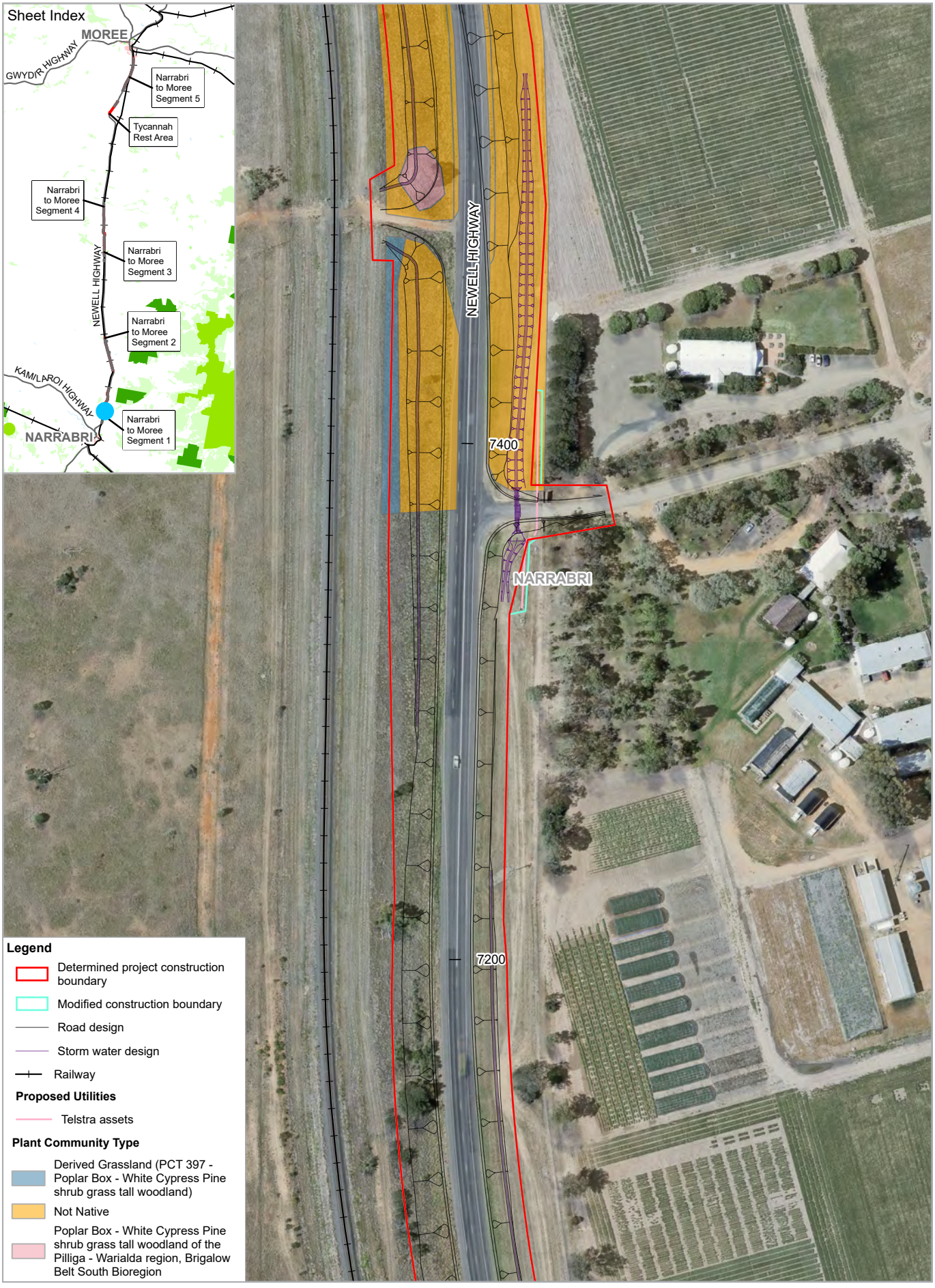

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Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 55

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Map Projection: Transverse Mercator
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Print date: 28 Jul 2020 - 17:28

Appendix B Consideration of clause 228(2) factors and matters of national environmental significance

Clause 228(2) Checklist

In addition to the requirements of the *Is an EIS required?* (1995/1996) guideline and the *Roads and Related Facilities EIS Guideline* (DUAP, 1996) as detailed in the addendum REF, the following factors, listed in clause 228(2) of the Environmental Planning and Assessment Regulation 2000, have also been considered to assess the likely impacts of the proposed modification on the natural and built environment.

Factor	Impact
a. Any environmental impact on a community?	
Construction of the proposed modification would result in some short-term negative impacts, such as visual amenity impact, traffic and access disruptions, in addition to potential noise and air emissions impacts, which could impact negatively on the local community. These impacts on the community would be consistent with the project REF.	Short term negative
The primary long-term positive impact of the proposed modification would be consistent with the project REF, as it would include improved road safety, travel reliability and travel times, as well as help reduce the cost of maintaining the highway.	Long-term, minor, positive
b. Any transformation of a locality?	
Construction of the proposed modification would temporarily impact the existing locality, predominantly through negative visual impact, associated with the placement and movement of construction plant and equipment and stockpile areas. These impacts on the community would be consistent with the project REF.	Short term minor negative
In the longer term, the proposed modification would not result in a substantial transformation of the locality as the majority of it would be located within the existing road corridor.	
c. Any environmental impact on the ecosystems of the locality?	
As discussed in **Section 6.1**, the proposed modification would require the clearing of about 75.92 hectares of native vegetation. This would include about 7.45 hectares of TEC listed under the BC Act and about 28.97 hectares of TECs listed under the EPBC Act. Around 16 hectares of the TEC Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland TEC which is listed as a critically endangered ecological community under the EPBC Act. About 15.5 hectares of this TECs to be removed would be from N2MS5 and about 0.7 hectares would be from N2MS3.	
An assessment of significance has been carried out for the EEC in the ABAR (AREA, 2020) (**Appendix E**).	
A BOS is required to be prepared for the project. The recommended offset strategy is documented in **Section 6.1.6**.	
d. Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality?	Short-term negative
During construction, the proposed modification would have the potential to create a reduction in the overall aesthetic quality of the location due to the equipment associated with the construction worksite, dust and noise generation as well as traffic and access disruption. These impacts on the community would be consistent with the project REF. Impacts would be	

Factor	Impact
minimised as far as practicable through the implementation of safeguards outlined in **Section 7.2**. No recreational or scientific qualities of the project construction boundary are anticipated to be impacted during the construction or operation of the project.	
e. Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations?	
The proposed modification would bring the project closer to the modified tree (AHIMS 19-3-0159) located near to N2MS2. However, this tree is still located outside the project construction boundary. Modified tree (AHIMS 10-6-0050) is located just outside the project construction boundary of N2MS4. While modified tree (AHIMS 10-6-0049) is still located within N2MS3 and would require protection as described in the project REF.	Short-term negative
PAD (BC-HW17-PAD1) within N2MS2 is located within the project construction boundary and would be impacted by ground disturbance work. However the results of the archaeological test excavation did not confirm the presence of any Aboriginal objects or features within BC-HW17-PAD1 in the project construction boundary. Therefore no impacts to Aboriginal items would be expected during construction.	Short-term negative
f. Any impact on the habitat of protected fauna (within the meaning of the *National Parks and Wildlife Act 1974*)?	
The proposed modification would remove about 75.92 hectares of native vegetation which would include habitat for fauna species. This would include habitat for the threatened Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) Glossy-black (*Calyptorhynchus lathami*). Both of which were recorded in the study area. An assessment of significance was carried out for threatened species and ecological communities that would be likely to occur in the project construction. The assessments concluded that, the project (project REF and proposed modifications combined) would not have a significant impact on any species, population or TEC listed under the BC Act and FM Act. However, the project (project REF and proposed modifications combined) may have a significant impact on one TEC (natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland) listed under the EPBC Act (refer to **Section 6.1**). Impacts on threatened fauna would be further minimised the implementation of management and mitigation measures identified in the REF, including avoidance through design.	Short-term negative
g. Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air?	
The vegetation that be removed as part of the project provides suitable habitat for a range of threatened fauna and flora species listed under the BC Act and EPBC Act. The significant assessments concluded that, the project would not have a significant impact on any species, population or TEC listed under the BC Act and FM Act. However, the project may have a significant impact, on one TEC (natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland) listed under the EPBC Act (refer to **Section 6.1**).	Long term negative

Factor	Impact
h. Any long-term effects on the environment?	
The proposed modification would have an overall moderate negative long-term impact on the existing environment through the permanent clearance of up about 75.92 hectares of native vegetation. This would include about 7.45 hectares of TEC listed under the BC Act and about 28.97 hectares of TEC listed under the EPBC Act. Around 16.22 hectares of the TEC Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland TEC would be directly impacted. About 15.5 hectares of this TECs to be removed from N2MS5 and about 0.7 hectares would be from N2MS3.	Long term negative
The project would have positive long-term effects on the environment due to improved safety for road users	Long term positive
i. Any degradation of the quality of the environment?	
The proposed modification has the potential to degrade the quality of the environment through accidental spills and erosion and sediment during construction. An Erosion and Sediment Control Plan would be implemented to mitigate the impact.	Short-term, minor, negative
j. Any risk to the safety of the environment?	
Construction activities has the potential to temporarily decrease safety along the Newell Highway and local roads within project construction boundary due to road work and movement of construction plant.	Short-term, minor, negative
Operation of the project would improve road safety through addition over taking lane, improved pavement and flood immunity.	Positive impacts
k. Any reduction in the range of beneficial uses of the environment?	
The **project** would result in traffic impacts during construction which would include an increase in the volume of heavy vehicles, interruption of traffic flow and temporary change in speed limit. These impacts would reduce the beneficial use of highway during construction.	Short-term, minor, negative
In the long-term, the **project** would be consistent with future uses and there would be no reduction in the range of beneficial uses of the environment that do not currently exist.	Nil impacts
l. Any pollution of the environment?	
As described in the project REF, the project would have the potential to result in some minor negative short-term water pollution risks including from sediments, soil nutrients, waste, and spillage of fuels and chemicals. The proposed modification would be consistent with these potential impacts. Management of water quality impacts would be carried out in accordance with the safeguards and management measures outlined in **Section 7.2**.	Short-term, minor, negative
Short-term noise and air quality impacts (dust and exhaust emissions) would be expected during the construction of the project. Management of noise and air quality impacts would be carried out in accordance with the safeguards and management measures summarised in **Section 7.2**.	Long-term, minor, positive
The operation of the proposed modification would be unlikely to substantially alter the air quality from the existing conditions. Some minor long-term benefits to air quality could occur through reduced vehicle emissions generated by improved travel times.	

Factor	Impact
m. Any environmental problems associated with the disposal of waste? Contaminated waste is not anticipated as a result of the project. Ancillary sites would be managed in a way that minimise waste on site and manage excess materials. Waste associated with the project would be managed in accordance with the *Waste Avoidance and Resource Recovery Act 2001* and recycled where possible. Issues associated with the disposal of waste are not expected.	Nil
n. Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply? The proposed modification would require a number of resources as described in Section 6.10 of the project REF. None of these resources are or are likely to become in short supply as a result of the project. Resource use management measures are provided which would include reuse and recycling when feasible.	Nil
o. Any cumulative environmental effect with other existing or likely future activities? The proposed modification forms part of wider Newell Highway Corridor Strategy package of works designed to improve road safety and freight efficiency along the highway. As part of this strategy a number of road improvement projects would be carried out along the Newell Highway over the next few years. A number of cumulative impacts are expected as a result of these projects. These impacts would include impacts on traffic, noise, vibration, air quality and biodiversity. These would, however, be temporary and would be managed through construction work staging and the implementation of project specific controls. In the long term, the cumulative environmental effects would be positive. These would include an improvement in the road safety, reliability and travel times along the Newell Highway.	Short term major negative Long term minor positive
p. Any impact on coastal processes and coastal hazards, including those under projected climate change conditions? The proposed modification is not located within a coastal area and would not result in any impact on coastal processes and coastal hazards.	Nil

Matters of National Environmental Significance

Under the environmental assessment provisions of the EPBC Act, the following matters of national environmental significance and impacts on Commonwealth land are required to be considered to assist in determining whether the proposed modification should be referred to the Australian Government Department of the Environment.

Under the EPBC Act strategic assessment approval a referral is not required for proposed road actions that may affect nationally listed threatened species, populations, endangered ecological communities and migratory species. Impacts on these matters are assessed in detail as part of this addendum REF in accordance with Australian Government significant impact criteria and taking into account relevant guidelines and policies.

Factor	Impact
a. Any impact on a World Heritage property?	Nil change to the determined project.
b. Any impact on a National Heritage place?	Nil change to the determined project.
c. Any impact on a wetland of international importance?	Nil change to the determined project.
d. Any impact on a listed threatened species or communities? The BAR (Area, 2020) identified the project (project REF and proposed modifications combined) would require the removal of vegetation which provides habitat for a range of threatened flora and fauna species as outlined in **Section 6.1**. However, the tests of significance found no significant impact to these species as a result of the proposed modification. The project (project REF and proposed modifications combined) may have a significant impact on one TEC listed under the EPBC Act. As the proposed modification would require the removal of 16.22 hectares of the TEC Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland TEC which is listed as a critically endangered ecological community under the EPBC Act. About 15.5 hectares of this TECs to be removed would be from N2MS5 and about 0.7 hectares would be from N2MS3. This is a reduced impact from the submission report and supplementary biodiversity assessment (AREA, 2018a) which concluded that a significant impact to Homopholis belsonii (Belson's Panic) populations would occur in N2MS2 and the TEC Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland TEC within N2M5. Safeguards and mitigation measures to manage images to these species are summarised in **Section 7.2.**	Slight reduction to the determined project
e. Any impacts on listed migratory species? The proposed modification would break apart continuous habitats into separate smaller 'fragments'. The isolation that may be caused by the proposed modification is consistent with the determined REF and as is not likely to have an appreciable impact on nomadic or migratory species such as many species of birds and bats.	Nil change to the determined project.

f. Any impact on a Commonwealth marine area?	Nil change to the determined project.
g. Does the proposed modification involve a nuclear action (including uranium mining)?	Nil change to the determined project.
Additionally, any impact (direct or indirect) on Commonwealth land?	
TfNSW and Council aim to create a 60 metre minimum width road reserve corridor. Therefore, the proposed modification would require partial acquisition of private and publicly owned land. Much of the publicly own land would be crown land.	Nil change to the determined project.

Appendix C Aboriginal and Historical Assessment

View south along the corridor of the Newell Highway, south of Edgeroi.

ABORIGINAL AND HISTORIC ASSESSMENT REPORT ADDENDUM

NEWELL HIGHWAY HEAVY DUTY PAVEMENTS – NARRABRI TO MOREE

NARRABRI AND MOREE LOCAL GOVERNMENT AREA

APRIL 2020

Report prepared by

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for Transport for NSW

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Acknowledgement

OzArk acknowledge Traditional Owners of the area on which this assessment took place and pay respect to their beliefs, cultural heritage and continuing connection with the land. We also acknowledge and pay respect to the post-contact experiences of Aboriginal people with attachment to the area and to the elders, past and present, as the next generation of role models and vessels for memories, traditions, culture and hopes of local Aboriginal people.

EXECUTIVE SUMMARY

Transport for NSW (TfNSW, formerly Roads and Maritime Services NSW) proposes to modify the approved Newell Highway Heavy Duty Pavements, Narrabri to Moree project (the proposed modification) as the detail design refinements and construction staging are anticipated to exceed the *Newell Highway Heavy Duty Pavements, Narrabri to North Moree* project review of environmental factors (REF) boundary.

OzArk Environment & Heritage Management (OzArk) has been engaged by Jacobs, on behalf of TfNSW (the proponent) to complete an Aboriginal archaeological assessment according to the *Procedure for Aboriginal cultural heritage consultation and investigation* (PACHCI) (RMS 2011). This report also includes a historic heritage assessment. The assessments relate to additional areas of land surrounding the approved Narrabri to Moree Heavy Duty (HD) Pavement Project, NSW, (the proposed modification).

This assessment has been completed as an addendum report to the *Aboriginal and Historic Archaeological Survey Report: Newell Highway HD Pavements – Narrabri to Moree, Moree and Narrabri LGA, NSW* which reports on the results of the March 2017 and January 2018 fieldwork assessments completed by OzArk (OzArk 2018).

The Aboriginal archaeological assessment follows the *Code of Practice for the Investigation of Aboriginal Objects in New South Wales* (DECCW 2010) (DECCW 2010), Stage 2 of the PACHCI (RMS 2011) and the *Cultural Heritage Guidelines* (RMS 2015). This assessment applies the Heritage Council's *Historical Archaeology Code of Practice* (Heritage Council 2006) in the completion of a historic heritage assessment.

The fieldwork component of this assessment was undertaken by OzArk on Tuesday 3 December 2019. No previously unrecorded Aboriginal sites were identified and none of the landforms present within the project construction boundary, however three previously recorded sites are present. Two previously recorded scarred trees, 19-3-0159 and 10-6-0049, and a PAD, BC-HW17-PAD1, are located within the project construction boundary.

Management measures outlined section 6.2 of OzArk (2018) must be followed to ensure 19-3-0159 and 10-6-0049 are not inadvertently impacted by the proposed modification.

The portion of BC-HW17-PAD1 located within the project construction boundary is unable to be avoided by the proposed modification and therefore, archaeological test excavation will be required in accordance with the Code of Practice and Stage 3 of the PACHCI as outlined in (**Section 5.2**).

No further recommendations than those described in Section 9.1 of OzArk 2018 for the project are required to ensure the protection to the area's Aboriginal cultural heritage values.

One previously unrecorded historic heritage site, a blaze tree, was recorded during the assessment. None of the five locally listed historic heritage items within N2MS3 were reassessed. Blaze tree, Newell Highway HS-01, while being significant for surveying purposes, does not meet the criteria for local, state or national heritage significance.

Should Newell Highway HS-01 or any additional survey markers be unable to be avoided by the proposed modification, the proponent should prepare an application for their removal under the *Surveying and Spatial Information Act 2002.*

Management measures for the five locally listed heritage items within N2MS3 outlined in Section 8.2 of the *Heavy Duty Pavement Upgrade between Narrabri and Moree - Noise and Vibration Assessment Report* (Jacobs 2018) must be followed to ensure they are not impacted by vibration during the proposed modification.

No further recommendations than those described in Section 9.2 of OzArk 2018 for the project are required for the proposed modification in relation to historic heritage.

CONTENTS

FIGURES

TABLES

1 INTRODUCTION

1.1 DESCRIPTION OF THE PROPOSED MODIFICATION

Transport for NSW (TfNSW, formerly Roads and Maritime Services NSW) proposes to modify the approved Newell Highway Heavy Duty Pavements, Narrabri to Moree project (the proposed modification) as the detail design refinements and construction staging are anticipated to exceed the *Newell Highway Heavy Duty Pavements, Narrabri to North Moree* Project review of environmental factors (REF) boundary.

OzArk Environment & Heritage Management (OzArk) has been engaged by Jacobs (the client), on behalf of Transport for NSW (TfNSW; the proponent; formerly Roads and Maritime Service) to complete an Aboriginal archaeological assessment according to the *Procedure for Aboriginal cultural heritage consultation and investigation* (PACHCI) (Roads and Maritime Service 2011). This report also includes a historic heritage assessment. The assessments relate to additional areas of land surrounding the proposed Narrabri to Moree Heavy Duty (HD) Pavement Project, NSW (the proposed modification).

This assessment has been completed as an addendum report to the *Aboriginal and Historic Archaeological Survey Report: Newell Highway HD Pavements – Narrabri to Moree, Moree and Narrabri LGA, NSW* which reports on the results of the March 2017 and January 2018 assessments completed by OzArk (OzArk 2018).

1.2 BACKGROUND

OzArk (2018) completed an Aboriginal and historic assessment of the REF proposal area in accordance with Stage 2 of the PACHCI. The initial fieldwork component of the assessment was completed on 31 May 2017, and a subsequent field assessment was completed on 15 to 17 January 2018.

Three Aboriginal sites, all scarred trees, and one potential archaeological deposit (PAD), were recorded during the surveys:

- 10-6-0049 (BL-HW17-ST1)
- 19-3-0159 (BC-HW17-ST1)
- 10-6-0050 (TC-HW17-ST1)
- BC-HW17-PAD1.

Five locally listed historic heritage sites were located, all within the township of Bellata at N2MS3. These buildings include the following:

- AB Meppem & Co
- Bellata Post Office

- Oldhams Smallgoods
- Bellata Police Station and Official Residence
- LS Rowe Stock and Station Agents.

The assessment found that harm to the recorded Aboriginal scarred trees can be avoided via the implementation of management strategies. Proposed management measures were also outlined for BC-HW17-PAD1 as the impacts in this area had not yet been confirmed. OzArk (2018) recommended the Aboriginal scarred trees and historic heritage items be demarcated using high visibility ground markers to delineate the site perimeter (i.e. staking and flagging). Depending on the proposed work near BC-HW17-PAD1 recommendations were either to fence the extent of the PAD if it could be avoided or complete a test excavation program if impacts couldn't be avoided. Additionally, depending on the proposed work near the locally listed heritage items at Bellata, it was recommended that a vibration assessment may be required.

Since the completion of the Aboriginal and historic assessment, the REF proposal area has been amended. This addendum assessment has been completed to assess those portions of the project construction boundary outside of the 2017 and 2018 REF proposal area. Details of the proposed modification are detailed in **Section 1.3**.

1.3 PROPOSED WORK AND PROJECT CONSTRUCTION BOUNDARY

TfNSW proposes to modify the approved Newell Highway HD Pavements, Narrabri to Moree Project as the detail design refinements and construction staging are anticipated to exceed the approved project REF boundary.

The proposed modification will include:

- Increased property acquisition and vegetation clearing required for the larger project construction boundary
- Inclusion of construction compounds and provision for stockpile locations
- Design changes to updated interfacing, culvert levels and open channel drains
- Localised road level adjustments in some sections to allow for flooding immunity and afflux considerations
- Addition of culverts on side roads and driveways
- Introduction of kerbing through Edgeroi and Bellata with pit and pipe drainage
- An increase in the size of a number highway transverse of culverts to achieve acceptable levels of afflux in private properties next to the Newell Highway
- Updating utility locations based and progression of utility relocation designs
- Revision of private accesses to reflect TfNSW negotiations with land owners

- Relocation and extension of the northbound overtaking lane in N2MS5 to the south and by about 700 metres, to avoid impact on Tapscott Road and to accommodate the Wallanol Road midway through the overtaking lane
- Extension of south bound overtaking lane in N2MS2 to relocate the southern limit further south of Smithfield lane
- Realignment and extension of the N2MS1 boundary by about 250 metres to reduce encroachment into the Mungindi rail corridor
- Updates to street lighting layouts in Edgeroi (N2MS2) and Bellata (N2MS3)
- Extension of southern limit of N2MS2 south to the northern abutment of Bobbiwaa Bridge.
- Replace barriers on northern side of Bobbiwaa Bridge
- Replacement of all wire rope safety barriers with a steel barrier system, with the exception of large bridge size culverts where a high containment barrier system is proposed to reduce verge width.

The project construction boundary are shown in **Figure 1-1** to **Figure 1-4**.

Figure 1-1: Map showing the project construction boundary: N2MS1.

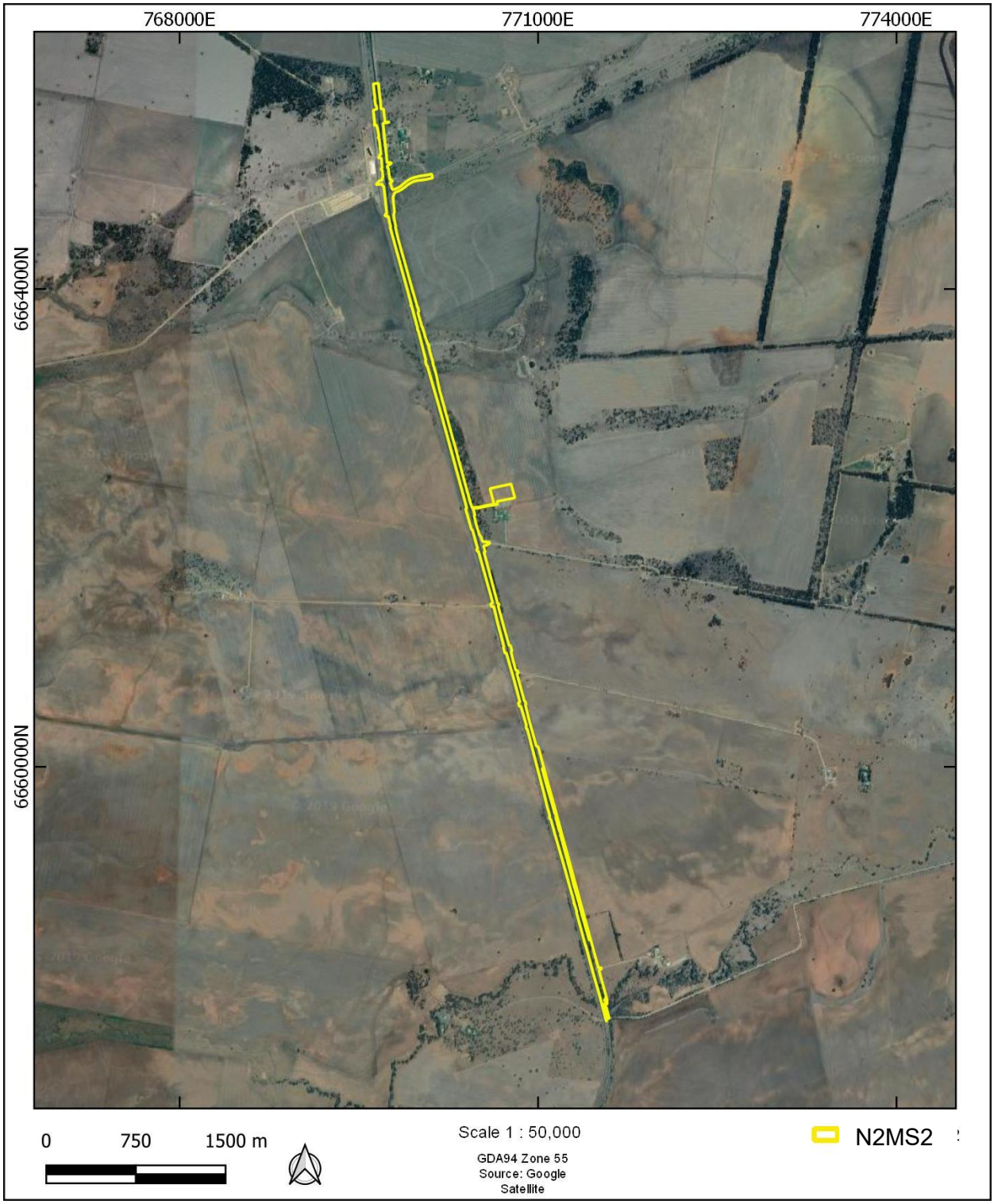

Figure 1-2: Map showing the project construction boundary: N2MS2.

Figure 1-3: Map showing the project construction boundary: N2MS3.

Figure 1-4: Map showing the project construction boundary: N2MS4.

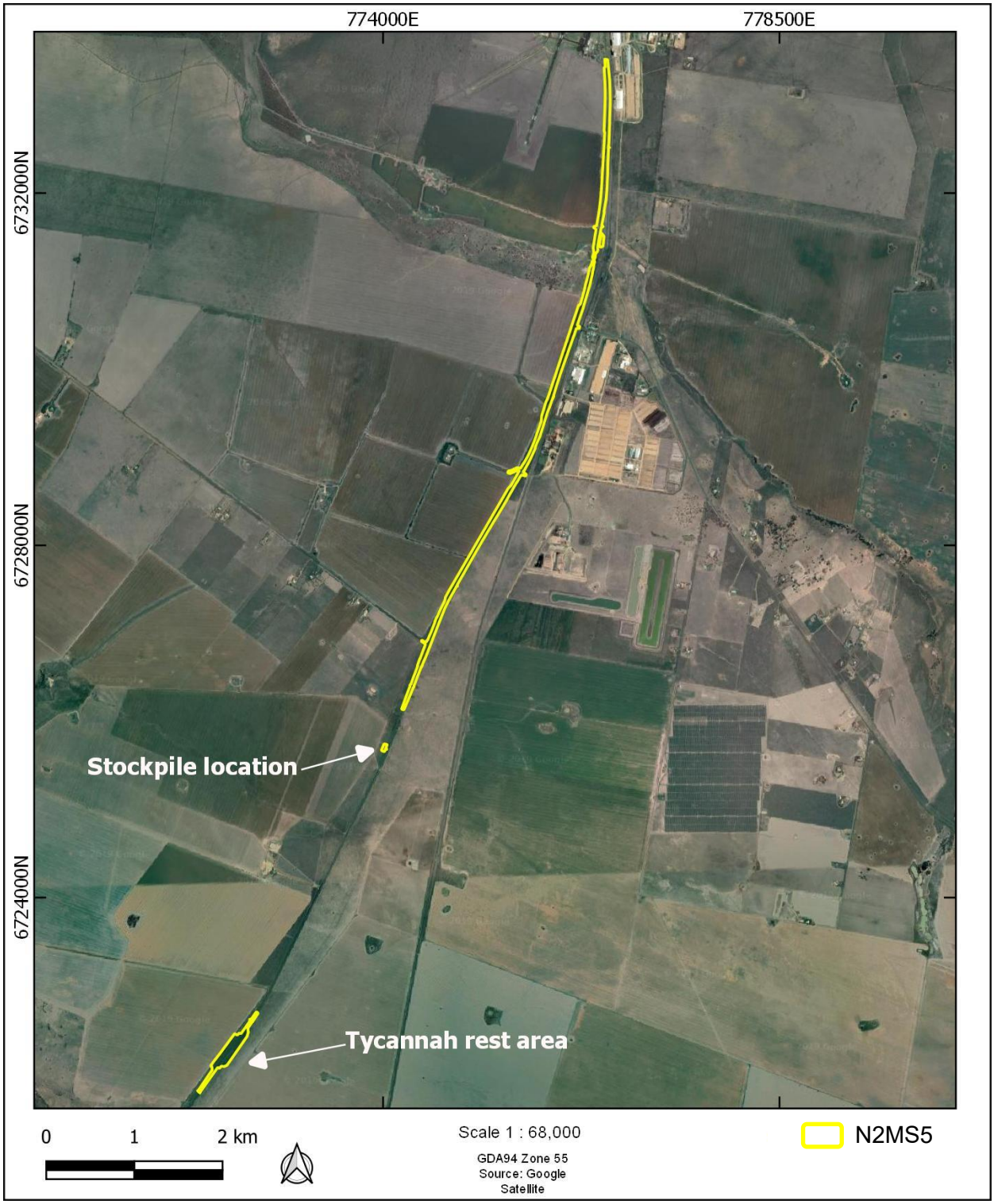

Figure 1-5: Map showing the project construction boundary: N2MS5.

2 ASSESSMENT INTRODUCTION

2.1 PURPOSE AND OBJECTIVES

The purpose of the current study is to identify and assess heritage constraints relevant to the proposed modification.

2.1.1 Aboriginal archaeological assessment objectives

The current assessment will apply Stage 2 of the PACHI and the *Code of Practice for the Investigation of Aboriginal Objects in New South Wales* (Code of Practice; DECCW 2010) in the completion of an Aboriginal archaeological assessment, in order to meet the following objectives:

Objective one: Identify and record Aboriginal objects, sites and sensitive landforms within the project construction boundary

Objective two: Assess the likely impacts of the proposed modification to any recorded sites and provide management recommendations.

2.1.2 Historic archaeological assessment objectives

The current assessment will apply the Heritage Council's *Historical Archaeology Code of Practice* (Heritage Council 2006) in the completion of a historical heritage assessment, including field investigations, to meet the following objectives:

Objective one: To identify whether historical heritage items or areas are, or are likely to be, present within the project construction boundary

Objective two: To assess the significance of any recorded historical heritage items or areas

Objective three: Determine whether the proposed modification is likely to cause harm to recorded historical heritage items or areas and provide management recommendations and options for mitigating impacts.

2.2 DATE OF ARCHAEOLOGICAL ASSESSMENT

The fieldwork component of this assessment was undertaken by OzArk on Tuesday 3 December 2019.

2.3 OZARK INVOLVEMENT

2.3.1 Field assessment

The fieldwork component of the heritage assessment was undertaken by:

- Archaeologist: Stephanie Rusden (OzArk Senior Archaeologist; BSc University of Wollongong and BA (Archaeology) University of New England).

2.3.2 Reporting

The reporting component of the heritage assessment was undertaken by:

- Report author: Stephanie Rusden
- Reviewer: Ben Churcher (OzArk Principal Archaeologist; BA[Hons], Dip Ed).

2.4 ASSESSMENT APPROACH

Aboriginal cultural heritage

The Aboriginal archaeological assessment follows the Code of Practice (DECCW 2010), Stage 2 of the PACHCI (RMS 2011) and the *Cultural Heritage Guidelines* (RMS 2015).

Historic heritage

This assessment applies the Heritage Council's *Historical Archaeology Code of Practice* (Heritage Council 2006) in the completion of a historic heritage assessment.

ABORIGINAL CULTURAL HERITAGE ASSESSMENT

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3 ABORIGINAL ARCHAEOLOGY BACKGROUND

Refer to Section 4 of the *Aboriginal and Historic Archaeological Survey Report: Newell Highway HD Pavements – Narrabri to North Moree, Moree and Narrabri LGA, NSW* (OzArk 2018) for a review of ethno-historic sources and regional Aboriginal context.

3.1 LOCAL ARCHAEOLOGICAL CONTEXT

3.1.1 Desktop database searches conducted

A desktop search was conducted on the following databases to identify any potential previously recorded heritage within the project construction boundary since the 2018 searches were completed. The results of this search are summarised in **Table 3-1** and presented in detail in **Appendix 1**.

Table 3-1: Aboriginal cultural heritage: desktop-database search results.

Name of Database Searched	Date of Search	Type of Search	Comment
Commonwealth Heritage Listings	2/12/19	NSW	No places listed are located within the proposed modification.
NSW Heritage Office State Heritage Register (SHR) and State Heritage Inventory (SHI)	2/12/19	Narrabri and Moree LGA	No Aboriginal places listed on the SHR or SHI are located within the proposed modification.
National Native Title Claims Search	2/12/19	NSW	Gomeroi People (Tribunal file no. NC2011/006; Federal Court file no. NSD2308/2011); accepted for registration.
Aboriginal Heritage Information Management System (AHIMS)	2/12/19	Proposed modification areas with a 500-metre buffer either side of the Newell Highway from north of Narrabri to south of Moree	10 Aboriginal sites within the search area.
Local Environment Plan (LEP)	2/12/19	Narrabri LEP of 2012 and Moree LEP of 2011	None of the Aboriginal places listed are near the proposed modification.

A search of the Aboriginal Heritage Information Management System (AHIMS) database returned 10 records for Aboriginal heritage sites within 500 m of the project construction boundary. **Figure 3-1** shows the location of the AHIMS sites that have been recorded within and near the project construction boundary.

Previously recorded scarred trees 19-3-0159 and 10-6-0049 are located within N2MS2 and N2MS3 (**Figure 3-1** and **Figure 3-2**). The proposed modification will bring the road closer to 19-3-0159, however, the scarred tree will be outside the project construction boundary. Scarred tree 10-6-0050 is located just outside the project construction boundary of N2MS4 (**Figure 3-3**). BC-

HW17-PAD1 was recorded on the northern bank of Bobbiwa Creek and the eastern side of the Newell Highway at the southern extent of N2MS2. The project construction boundary partially extends into the extent of BC-HW17-PAD1 (**Figure 3-5**). These sites were recorded either during the 2017 and 2018 surveys (**Section 1.2**).

Since the completion of the previous survey, Umwelt (Australia) Pty Ltd (Umwelt) prepared the *Aboriginal Cultural Heritage and Archaeological Assessment: Inland Rail Programme, Narrabri to North Star Project*. The study area for the project was the existing railway line corridor generally parallel to the project construction boundary. A total of 19 new sites were identified during the survey, however, only five of the 19 sites are within 200 m of the project construction boundary. These five sites include 10-6-0051, 10-6-0052, 10-6-0053, 10-6-0056, 10-6-0059 and 10-6-0060. The five sites recorded within 200 m of the project construction boundary are recorded on AHIMS with the same coordinates (**Appendix 1**). As such, figures within the Umwelt report were used to confirm that none of the sites are located within or extend into the project construction boundary[1]. **Figure 3-2** and **Figure 3-3** show the locations of these AHIMS sites based on the figures in Umwelt (2017).

[1] Umwelt was notified of the coordinate issue on 2 December 2019 in order to rectify their locations on AHIMS.

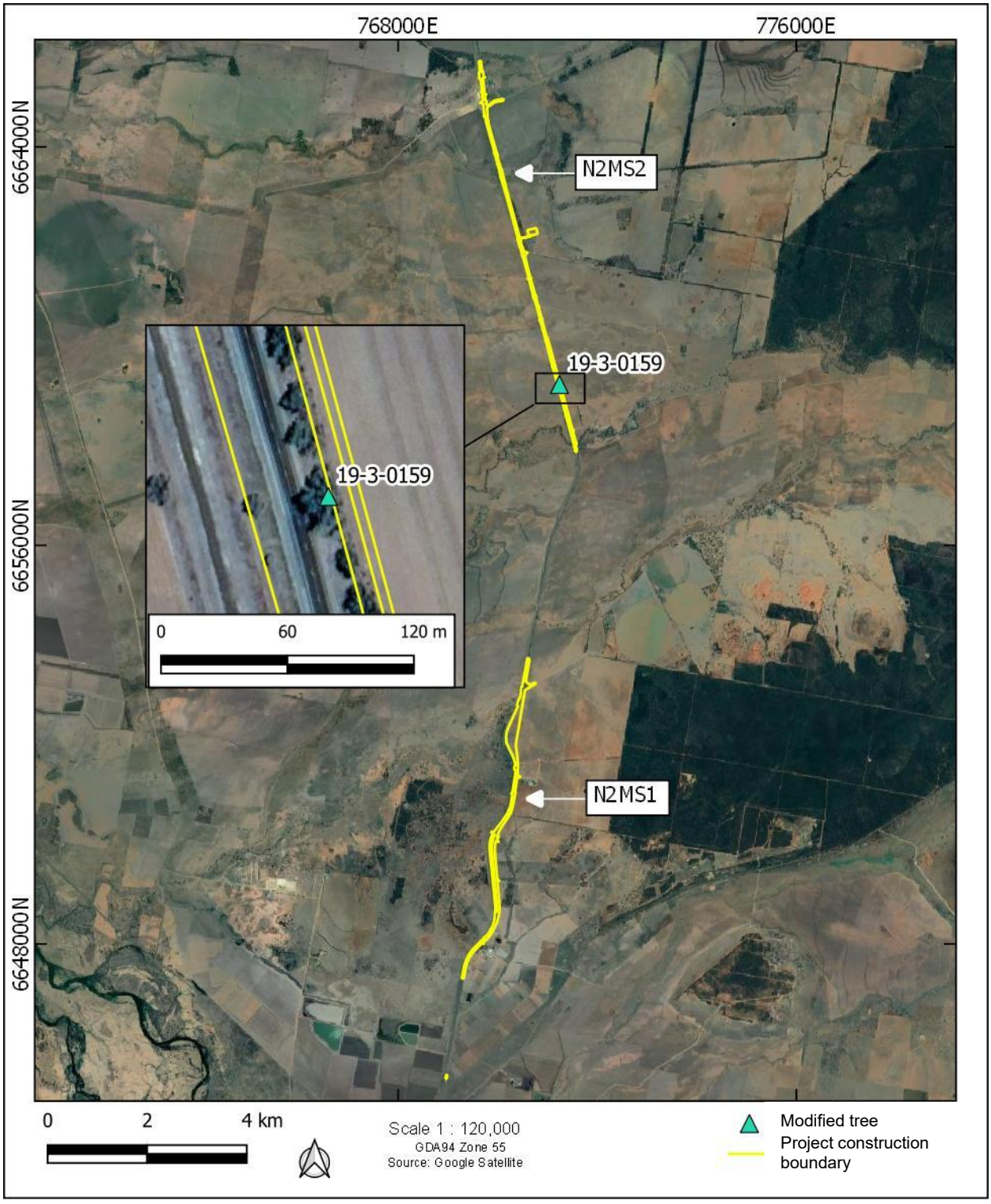

Figure 3-1: Location of previously recorded AHIMS sites in relation to the N2MS1 to N2MS2.

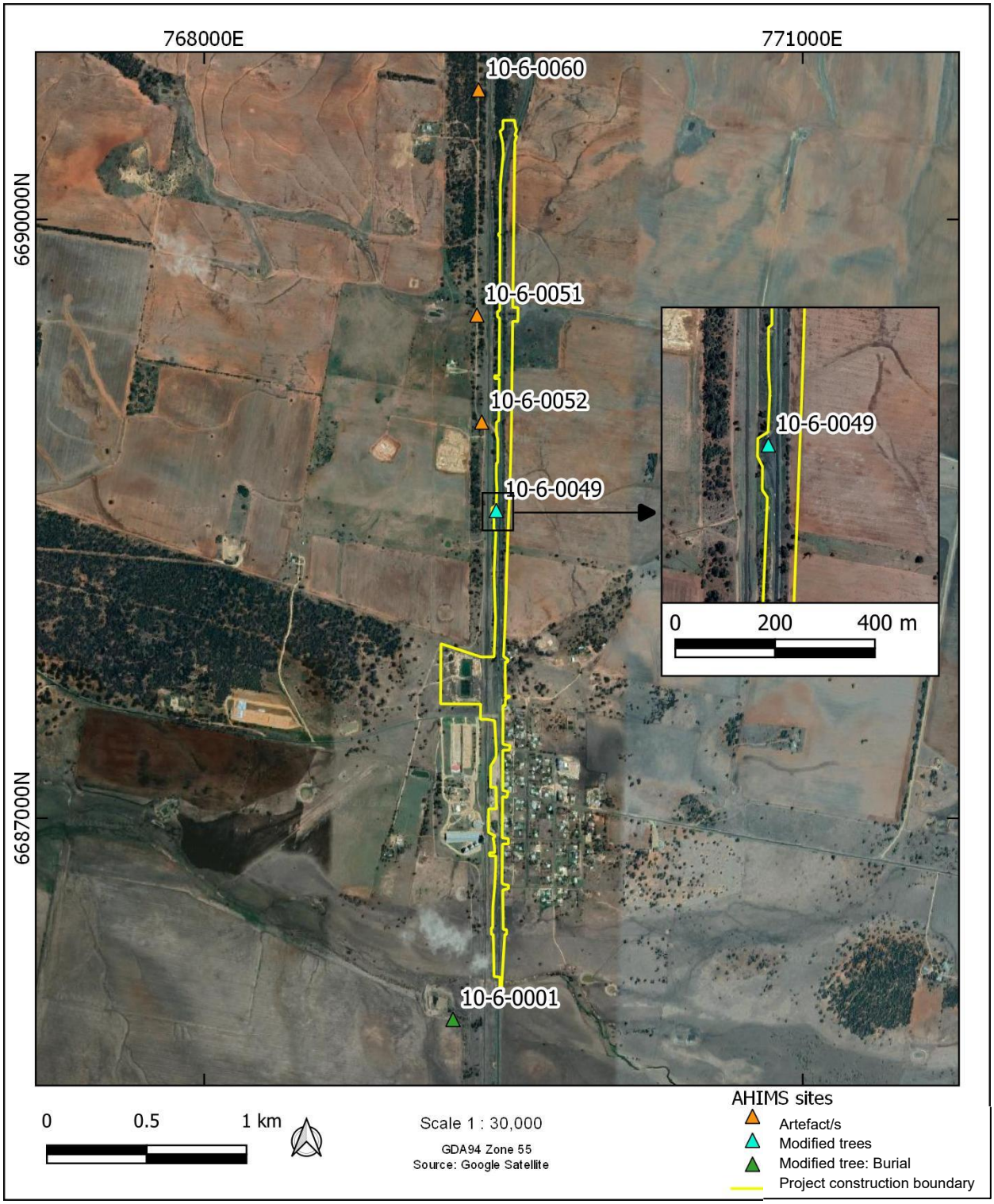

Figure 3-2: Location of previously recorded AHIMS sites in relation to N2MS3.

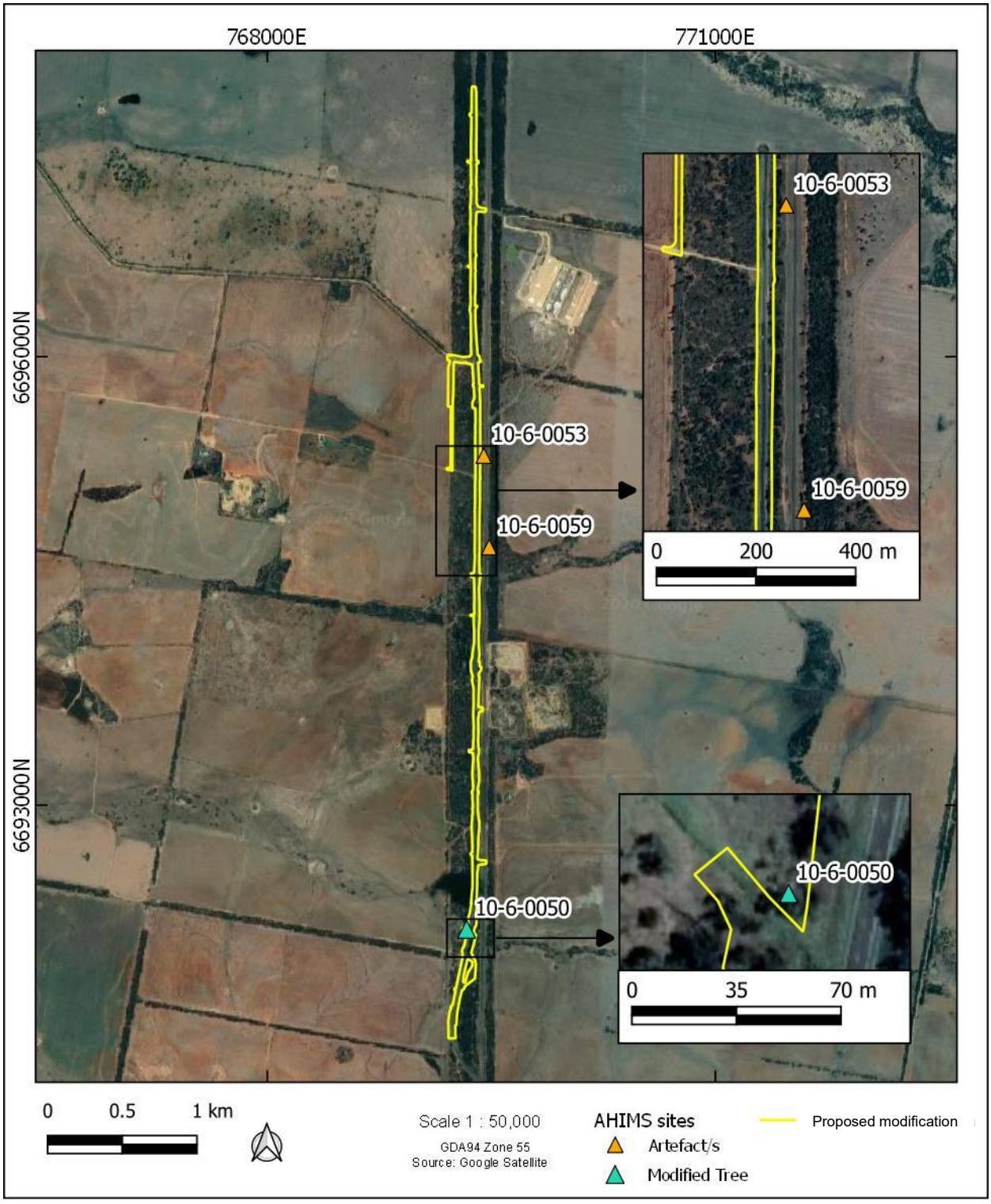

Figure 3-3: Location of previously recorded AHIMS sites in relation to N2MS4.

Figure 3-4: Location of previously recorded AHIMS sites in relation to N2MS5.

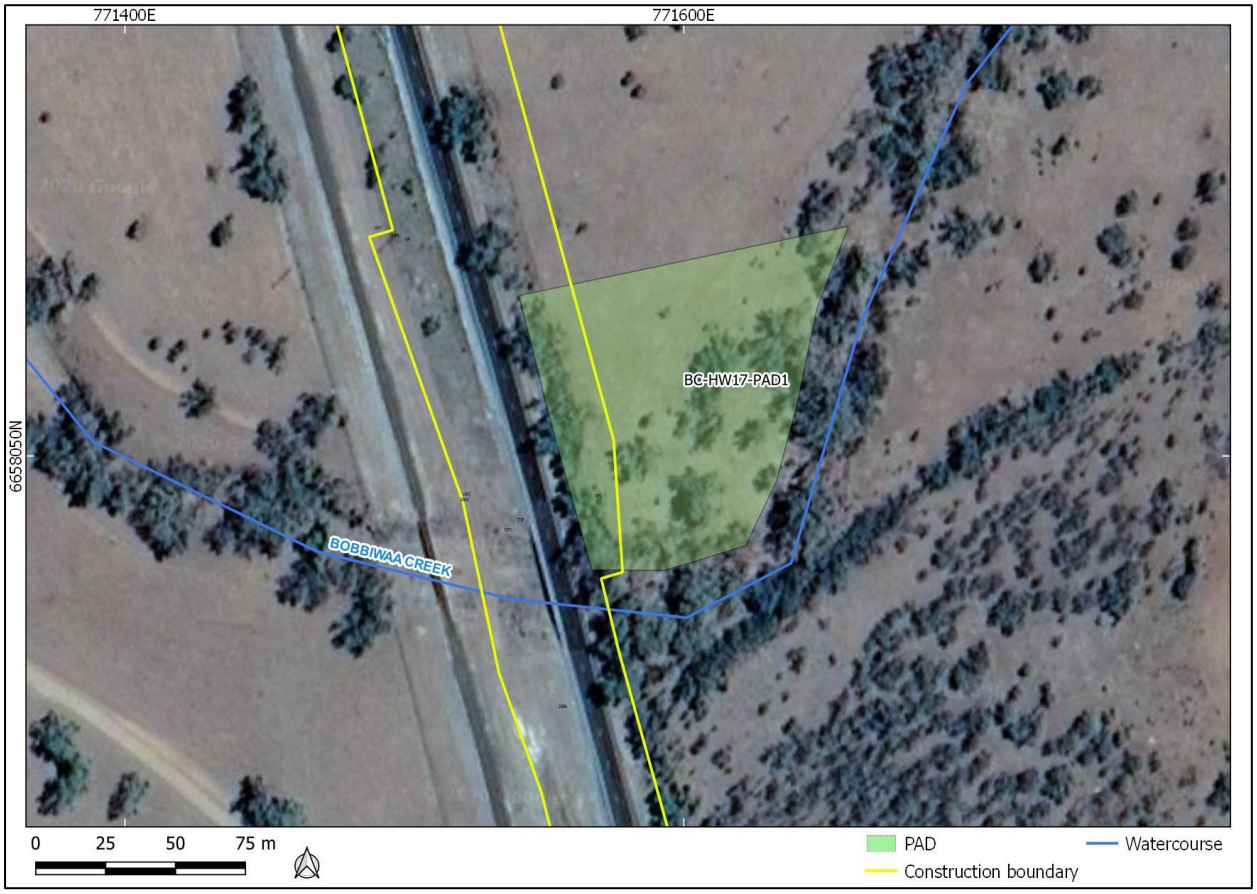

Figure 3-5: Location of BC-HW17-PAD1 in relation to N2MS2.

3.2 PREDICTIVE MODEL FOR SITE LOCATION

A predictive model for site types likely to be located in the Narrabri and Moree regions is presented in Section 4.4 of OzArk 2018 following review of past archaeological assessments completed at a regional and local level. The following comprises a summary of the predictions presented in OzArk (2018):

- Isolated finds: can occur anywhere, particularly within disturbed contexts, it is predicted that this site type could be recorded within the proposed modification.
- Artefact scatters: on the alluvial plain and floodplain landforms comprising N2MS1 to N2MS5, artefact scatters are predicted to occur within a few hundred metres of major watercourses, particularly on raised landforms (e.g. river terraces or source bordering dunes) adjacent to watercourses, where erosion is likely to have created lag deposits. Small in situ deposits or secondary deposits are possible within active floodplains but will be generally difficult to detect due to aggradation within the floodplain and the self-mulching character of black earth floodplain soils. Archaeological deposits on alluvial landforms are likely to have been destroyed by intensive agricultural practices. Artefact scatters are possible on palaeochannel landforms, although these sediments have, in general, been destroyed by sand mining.
- Scarred trees: are relatively common in the area and is likely to occur wherever trees of suitable age and species for cultural modification occur, with increased likelihood near major watercourses.

- Quarry and stone procurement sites: are unlikely due to a lack of outcropping stone in the project construction boundary but could be recorded where suitable rock outcrops exist.
- Grinding grooves: are unlikely to be recorded due to a lack of suitable outcropping sandstone.
- Burials: could be found within the project construction boundary particularly near major watercourses, burials are a rare site type, particularly considering the high levels of disturbance within the project construction boundary.

Overall, as landforms adjacent to the proposed modification have been previously assessed in 2017 and 2018, the likelihood of previously unrecorded Aboriginal sites being identified is low.

4 RESULTS OF ABORIGINAL ARCHAEOLOGICAL ASSESSMENT

4.1 SAMPLING STRATEGY AND FIELD METHODS

Standard archaeological field survey and recording methods were employed in this study (Burke & Smith 2004). A sampling strategy was developed in accordance with the predictive model developed in **Section 3.2**.

Vehicle traverses were utilised during the field assessment for reconnaissance observation of the project construction boundary in order to identify areas to be sampled via pedestrian transect. Pedestrian transects were used to sample and assess undisturbed parts of the project construction boundary with good GSV containing landforms possessing Aboriginal archaeological potential. Survey priority was afforded to; areas within several hundred metres of the major watercourses; areas containing mature trees, particularly eucalypts; and relatively undisturbed areas outside of the Newell Highway road formation.

Figure 4-1 to **Figure 4-5** show GPS track data for pedestrian transects during the 2019 survey. Tracks from the 2017 and 2018 surveys have also been included.

Figure 4-1: Map showing the pedestrian transects undertaken in N2MS1.

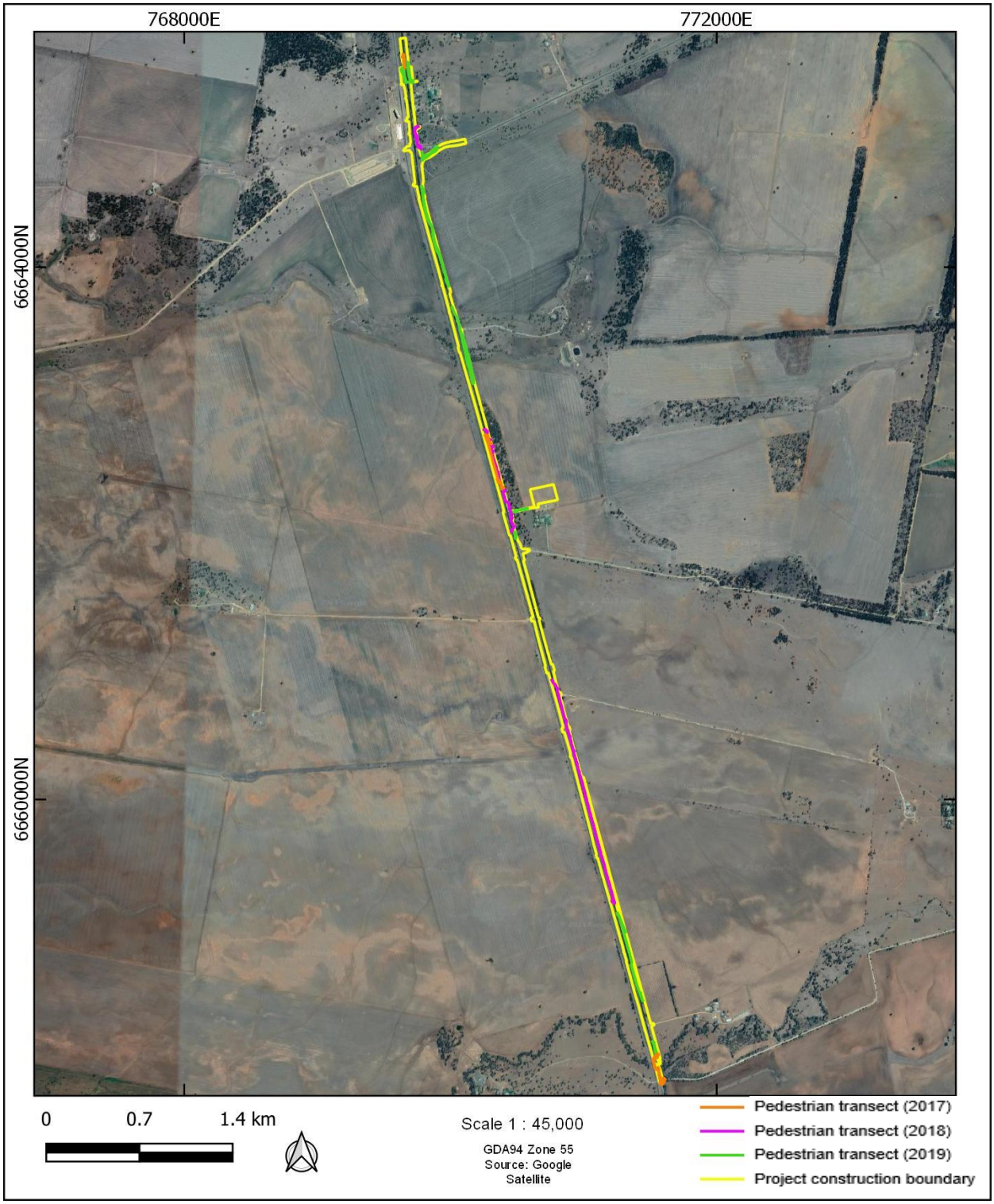

Figure 4-2: Map showing the pedestrian transects undertaken in N2MS2.

Figure 4-3: Map showing the pedestrian transects undertaken in N2MS3.

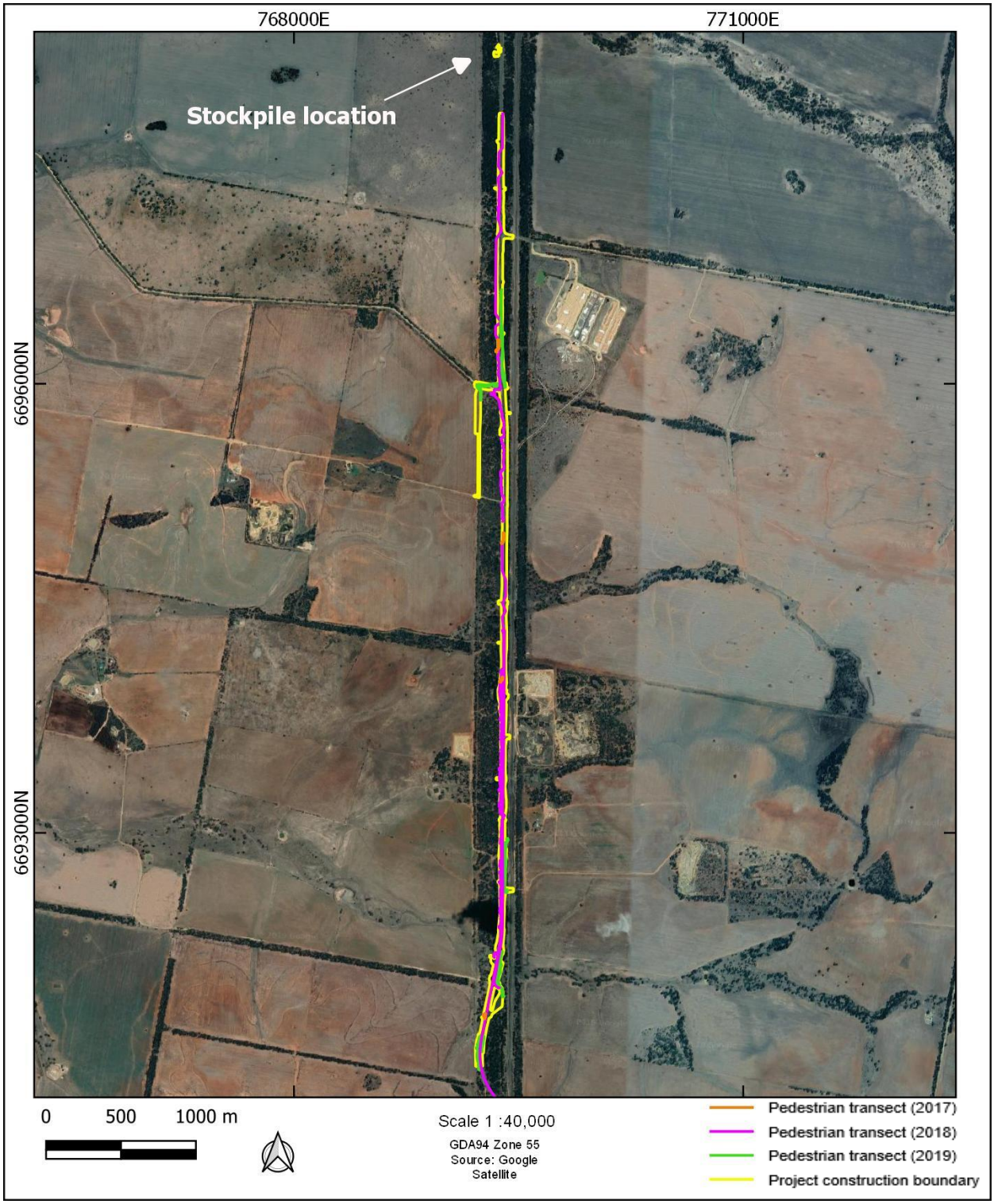

Figure 4-4: Map showing the pedestrian transects undertaken in N2MS4.

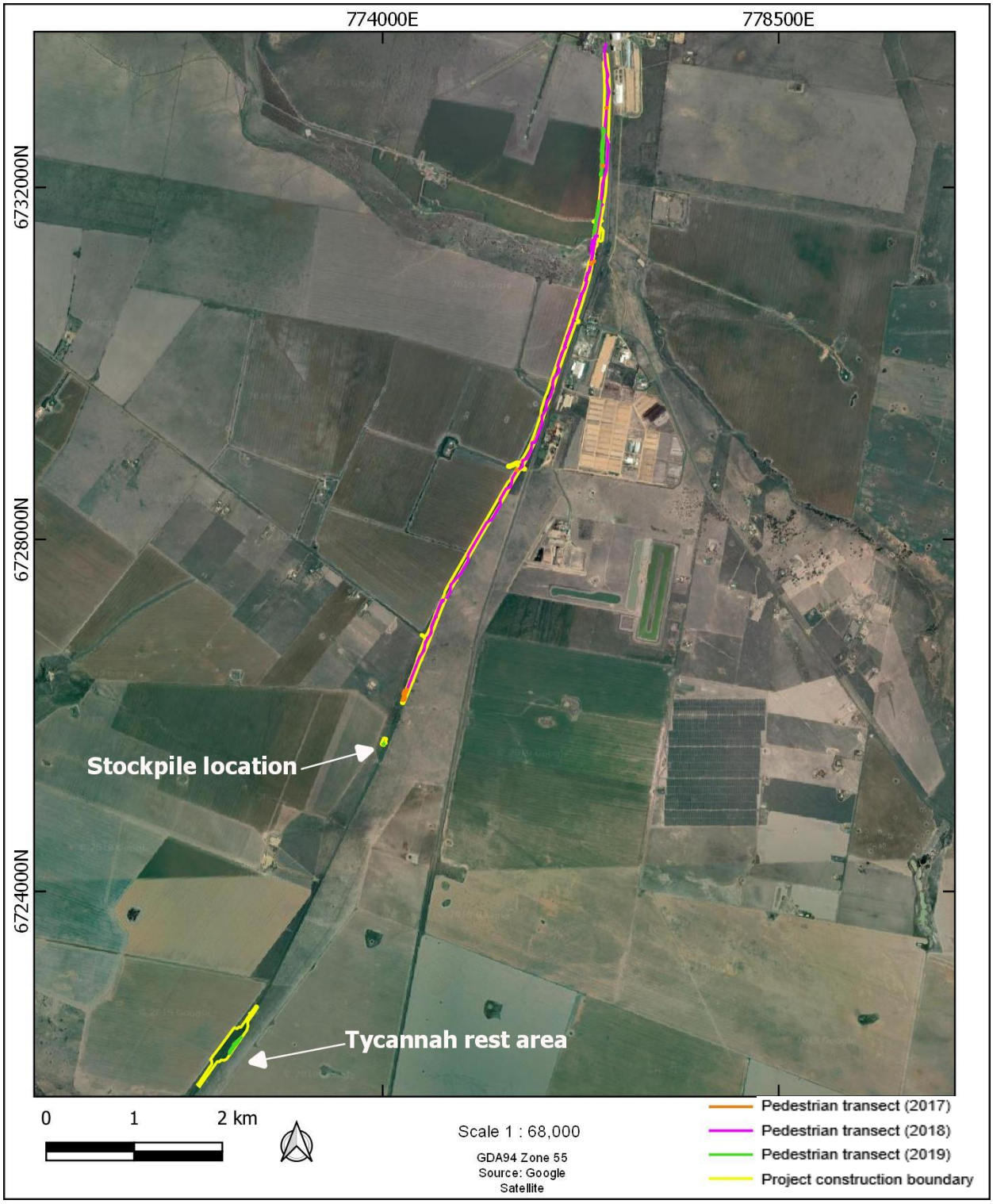

Figure 4-5: Map showing the pedestrian transects undertaken in N2MS5.

4.2 EFFECTIVE SURVEY COVERAGE

Two of the key factors influencing the effectiveness of archaeological survey are GSV and ground surface exposure (GSE). These factors are quantified to ensure that the survey data provides adequate evidence for the evaluation of the archaeological materials across the landscape. For the purposes of the current assessment, these terms are used in accordance with the definitions provided in the Code of Practice.

GSV is defined as:

> *… the amount of bare ground (or visibility) on the exposures which might reveal artefacts or other archaeological materials. It is important to note that visibility, on its own, is not a reliable indicator of the detectability of buried archaeological material. Things like vegetation, plant or leaf litter, loose sand, stone ground or introduced materials will affect the visibility. Put another way, visibility refers to 'what conceals'* (DECCW 2010: 39).

GSE is defined as:

> *… different to visibility because it estimates the area with a likelihood of revealing buried artefacts or deposits rather than just being an observation of the amount of bare ground. It is the percentage of land for which erosion and exposure was sufficient to reveal archaeological evidence on the surface of the ground. Put another way, exposure refers to 'what reveals'* (DECCW 2010: 37).

Table 4-1 calculates the effective survey coverage within the project construction boundary. In general, **Table 4-1** presents an approximation of the amount of ground surface able to be seen at any location within particular landform units. For example, at any one location within the plain landforms of the project construction boundary approximately 11 per cent of the ground surface could be seen, while along the drainage lines, only five per cent was visible. Exposures in these landforms were afforded by bare patches due to the drought affecting vegetation growth, along tracks and table drains adjacent to the Newell Highway and in areas of stock trampling around gates and along fences. Past bushfires in areas also provided high GSV, particularly at N2MS4. Drainage lines have lower GSV and exposures due to greater vegetation cover.

Figure 4-6 to **Figure 4-10** provide representative examples of the survey units across the project construction boundary.

Table 4-1: Effective survey coverage within the project construction boundary.

Survey Unit	Landform	Survey Unit Area (sq m)	Visibility %	Exposure %	Effective Coverage Area (sq m) (= Survey Unit Area x Visibility % x Exposure %)	Effective Coverage % (= Effective Coverage Area / Survey Unit Area x 100)
1	Stream bank	4,100	50	10	205	5%
2	Plain	53,700	75	15	6041	11%

	
1. View southwest along the road corridor from GDA2020 Zone 55 769750E 6648152N.	2. View north along the road corridor fence line from GDA2020 Zone 55 769974E 6648871N.
	
3. View north along the road corridor fence line from GDA2020 Zone 55 769955E 6649064N.	4. View north along the northern extent of N2MS1 (GDA2020 Zone 55 770568E 6653367N).

Figure 4-6: Sample of survey areas through N2MS1.

	
1. View north along the road corridor from GDA2020 Zone 55 769956E 6663839N.	2. View south across the road corridor from GDA2020 Zone 55 769775E 6664622N.
	
3. View south along the corridor of the Newell Highway, south of Edgeroi (GDA2020 Zone 55 769787E 6664832N).	4. View northeast from Couradda Road towards the Newell Highway at Edgeroi (GDA2020 Zone 55 769769E 6664901N).

Figure 4-7: Sample of survey areas through N2MS2.

	
1. View north towards vegetation surrounding the stockpile location at Bellata GDA2020 Zone 55 769229E 6687520N).	2. View northwest towards vegetation surrounding the stockpile location at Bellata (GDA2020 Zone 55 769283E 6687567N).
	
3. View north towards vegetation in the corridor north of Bellata (GDA2020 Zone 55 769451E 6687800N).	4. View northeast towards a culvert (GDA2020 Zone 55 769465E 6689519N).
	
5. View north of dense vegetation along the western road corridor (GDA2020 Zone 55 769504E 6690356N).	6. View north vegetation along the western road corridor (GDA2020 Zone 55 769519E 6690461N).

Figure 4-8: Sample of survey areas through N2MS3.

	
1. View north from the southern extent of N2MS4 (GDA2020 Zone 55 769230E 6691464N).	2. View north along the western corridor (GDA2020 Zone 55 769222E 6691551N).
	
3. View south along the eastern corridor (GDA2020 Zone 55 769266E 6691641N).	4. View south along the eastern corridor with high GSV due to bushfires (GDA2020 Zone 55 769399E 6692594N).

Figure 4-9: Sample of survey areas through N2MS4.

	
1. View south towards Halls Creek from GDA2020 Zone 55 776393E 6731318N.	2. View southeast across the Tycannah rest area (GDA2020 Zone 55 772384E 6722325N).

Figure 4-10: Sample of survey areas through N2MS5.

4.3 ABORIGINAL SITES RECORDED

No previously unrecorded Aboriginal sites were identified and none of the landforms present within the project construction boundary are considered to have increased archaeological potential.

4.4 DISCUSSION

The predictive model summarised in **Section 3.2** noted the most likely site types to be identified included stone artefact sites (isolated or scatters) and scarred trees, although the likelihood of encountering sites would be low. No previously unrecorded Aboriginal sites were identified during the survey which can largely be attributed to the level of previous assessments completed through much of the project construction boundary. The lack of landforms with increased archaeological potential, particularly those landforms adjacent to watercourses, can be attributed to the absence of any defined landforms that might be described as sensitive i.e. elevated, well-drained terraces, and / or high levels of previous disturbance.

4.5 LIKELY IMPACTS TO ABORIGINAL HERITAGE FROM THE PROPOSED MODIFICATION

Scarred trees 19-3-0159 and 10-6-0049 are located within N2MS2 and N2MS3 (**Figure 3-1** and **Figure 3-2**) and a PAD, BC-HW17-PAD1, partially overlaps with N2MS2.

The proponent will avoid impact to the sites 19-3-0159 and 10-6-0049 for the proposed modification. To ensure neither of the sites are inadvertently impacted by the proposed modification, the management measures outlined in section 6.2 of OzArk (2018) must be followed. These proposed management measures involve demarcating the site during the proposed work using high visibility ground markers.

BC-HW17-PAD1 is partially within the project construction boundary at N2MS2 (**Figure 3-5**). The portion of BC-HW17-PAD1 within the project construction boundary will be impacted by the following:

- Clearing and grubbing
- Removal of the existing fence
- Installation of a new fence
- Utility works (relocation of Telstra cables)
- Installation of a new safety barrier on Bobbiwaa Creek bridge and its approaches
- Earthworks and paving
- Construction of a new table drain.

As BC-HW17-PAD1 will be impacted by the proposed modification further investigation needs to take place to establish whether Aboriginal objects exist in the BC-HW17-PAD1 area (**Section 5.2**).

5 MANAGEMENT AND MITIGATION: ABORIGINAL HERITAGE

5.1 GENERAL PRINCIPLES FOR THE MANAGEMENT OF ABORIGINAL SITES

Appropriate management of cultural heritage items is primarily determined on the basis of their assessed significance as well as the likely impacts of the proposed development. The following management options are general principles, in terms of best practice and desired outcomes, rather than mitigation measures against individual site disturbance.

- Avoid impact by altering the project construction boundary or in this case by avoiding impact to a recorded Aboriginal site or PAD. If this can be done, then a suitable curtilage around the site or PAD must be provided to ensure its protection both during the short-term construction phase of development and in the long-term use of the area. If plans are altered, care must be taken to ensure that impacts do not occur to areas not previously assessed.

- If impact to an Aboriginal PAD is unavoidable then the Aboriginal cultural heritage investigation must proceed to PACHCI Stage 3 (RMS 2011). Archaeological test excavation will be required in accordance with the Code of Practice. Aboriginal community consultation will also need to occur following the OEH *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (ACHCRs). If the test excavation concludes that Aboriginal objects are present in the PAD area at risk of harm, then an AHIP will be required to harm the site.

5.2 MANAGEMENT OF BC-HW17-PAD1

BC-HW17-PAD1 cannot be avoided by the proposed modification. Therefore, archaeological test excavation is required in accordance with the Code of Practice and Stage 3 of the PACHCI. This includes:

- Aboriginal community consultation in accordance with ACHCRs, Requirement 15a of the Code of Practice and Stage 3 of the PACHCI[2]

- The development of a test excavation sampling strategy for the BC-HW17-PAD1 area at risk of harm in accordance with Requirement 15b of the Code of Practice

- Notification to the Biodiversity and Conservation Division (BCD) of the Department of Planning Industry and Environment (DPIE) at least 14 days before undertaking test excavations, including a copy of the proposed sampling strategy, in accordance with Requirement 15c of the Code of Practice

- Undertake test excavations in compliance with the test excavation methodology developed in accordance with Requirement 16 and 17 of the Code of Practice

[2] The ACHCRs commenced in February 2020 and are being completed by TfNSW.

- Reporting of the test excavation results in a Cultural Heritage Assessment Report (CHAR)

If the test excavation concludes that Aboriginal objects are present in the PAD area at risk of harm, then an AHIP will be required to harm the site. The AHIP may include requirements for salvage excavation and/or community collection in the area at risk of harm, depending upon the significance of any archaeological deposits and/or surface artefacts identified within the PAD area. If the test excavation concludes that no archaeological deposits, Aboriginal objects or PADs are present in the area at risk of harm, then work can proceed in the area, provided any management recommendations to avoid harming the remaining portions of BC-HW17-PAD1 area are followed.

HISTORIC HERITAGE ASSESSMENT

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6 HISTORIC HERITAGE ASSESSMENT: BACKGROUND

6.1 BRIEF DESCRIPTION OF THE PROJECT CONSTRUCTION BOUNDARY

Please refer to **Section 1** for a description of the prosed works for the project construction boundary.

6.2 LOCAL CONTEXT

Refer to Section 8.1 of the *Aboriginal and Historic Archaeological Survey Report: Newell Highway HD Pavements – Narrabri to Moree, Narrabri and Moree LGA, NSW* (OzArk 2018) for a brief history of North-Central NSW.

6.2.1 Desktop database searches conducted

A desktop search was conducted on the following databases to identify any potential previously recorded heritage within the project construction boundary since the 2018 searches were completed. The results of this search are summarised in **Table 6-1**.

Table 6-1: Historic heritage: desktop-database search results.

Name of Database Searched	Date of Search	Type of Search	Comment
National and Commonwealth Heritage Listings	2/12/19	NSW	No items listed are located within the proposed modification
SHR and SHI listings	2/12/19	Narrabri and Moree LGA	No items listed on the SHR or SHI are located within or close to the proposed modification
LEP	2/12/19	Narrabri LEP of 2012 and Moree LEP of 2011	No items listed on the Moree LEP are located close to the proposed modification. Five items listed on the Narrabri LEP are near N2MS3 in Bellata.

Five locally listed historic heritage sites are located within N2MS3, all within the township of Bellata (**Section 1.2**) (OzArk 2018).

7 RESULTS OF HISTORIC HERITAGE ASSESSMENT

7.1 SURVEY METHODOLOGY

Standard archaeological field survey and recording methods were employed in this study (Burke & Smith 2004) to ground-truth existing levels of disturbance and to assess whether any other historic heritage items exist, or are likely to exist, in the project construction boundary. A combination of pedestrian transects and vehicle traverses were used to inspect the project construction boundary. Survey coverage for the historic assessment occurred concurrently with the Aboriginal archaeological assessment and therefore, was the same as that reported in **Section 4.2**.

7.2 RESULTS OF THE HISTORIC HERITAGE ASSESSMENT

One historic feature, a blaze tree (Newell Highway HS-01), was identified within N2MS4 (**Figure 7-1** and **Figure 7-2**). The site is located at an intersection of the Newell Highway and an unnamed road on the eastern side, 5.3 kilometres north of Bellata. Newell Highway HS-01 is located at GDA Zone 55 769422E 6692619N.

A search of the Survey Control Information Management System (SCIMS) database does not list the location of the blaze tree, however, consultation with the SCIMS has confirmed that the markings on the heartwood include levels and is likely a witness tree for permanent marker (PM) 3923, located to the southeast.

None of the previously recorded historic heritage items within N2MS3 were reassessed during the current assessment as they have been assessed in OzArk 2018.

1. View east from an unnamed road towards the blaze tree and the Newell Highway (GDA2020 Zone 55 769440E 6692612N).

2. Detail of markings on the heartwood of the blaze tree.

Figure 7-1: View of blaze tree identified within N2MS4.

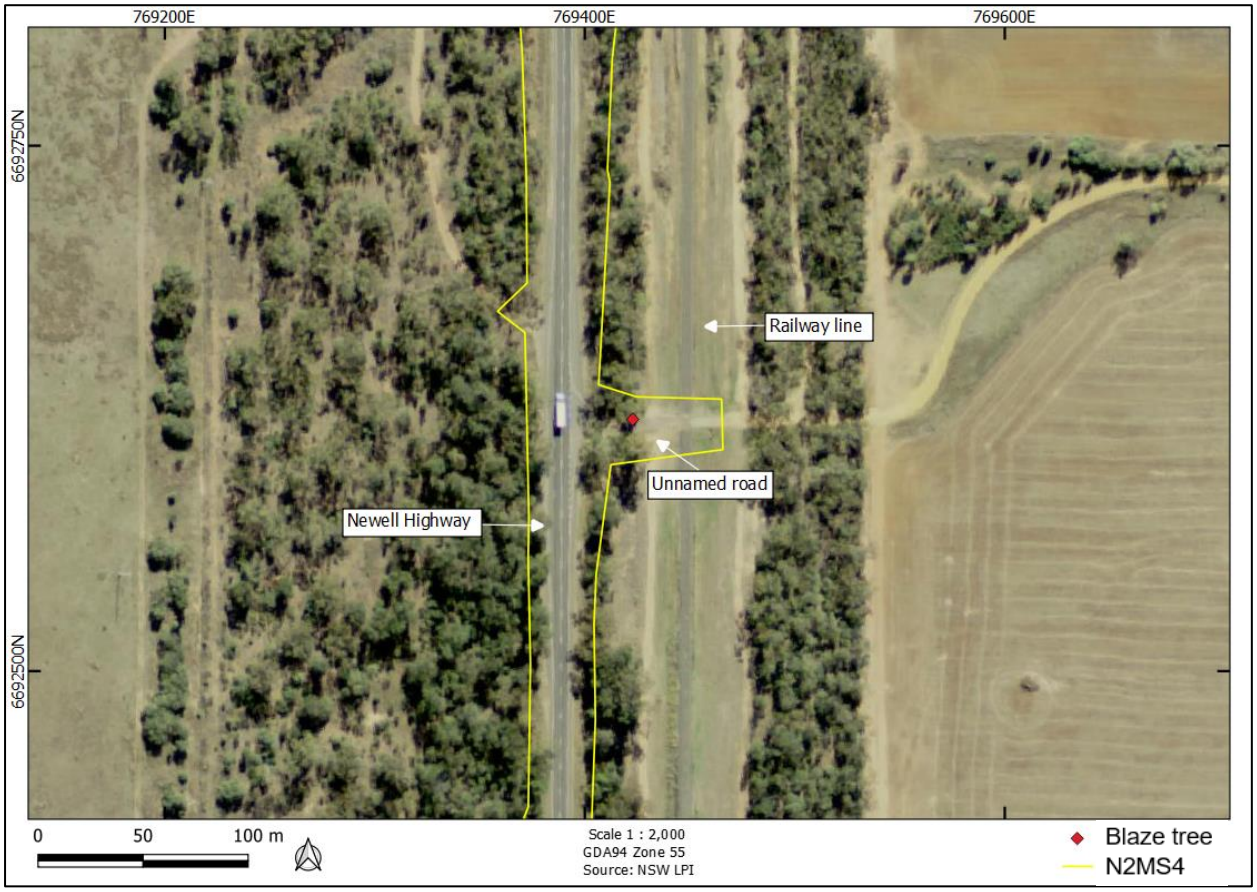

Figure 7-2: Location of the blaze tree within N2MS4.

7.3 ASSESSMENT OF HISTORIC HERITAGE SIGNIFICANCE

7.3.1 Assessment of significance-general principles

The current assessment will evaluate the heritage significance of the historic heritage sites identified within the study area in accordance with the NSW Heritage Office guidelines for *Assessing Heritage Significance* (Heritage Office 2001). A historic heritage site must satisfy at minimum one of the following criteria to be assessed as having heritage significance:

Criterion (a): *An item is important in the course, or pattern, of NSW's cultural or natural history (or the cultural or natural history of the local area).*

Criterion (b): *An item has a strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the cultural or natural history of the local area).*

Criterion (c): *An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area).*

Criterion (d): *An item has strong or special association with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons.*

Criterion (e): *An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area).*

Criterion (f): *An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area).*

Criterion (g): *An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places; or cultural or natural environments (or a class of the local area's cultural or natural places; or cultural or natural environments).*

Significance assessments are carried out on the basis that decisions about the future of heritage items must be informed by an understanding of these items' heritage values. The *Australia ICOMOS Burra Charter* (Australia ICOMOS 2013) recognises four categories of heritage value: historic, aesthetic, scientific, and social significance

Items are categorised as having local or state level, or no significance. The level of significance is assessed in accordance with the geographical extent of the item's value. An item of state significance is one that is important to the people of NSW whilst an item of local significance is one that is principally important to the people of a specific LGA.

7.3.2 Assessment of significance of historic items

Table 7-1 details the assessed significance of Newell Highway HS-01 in accordance with the NSW Heritage Office guidelines and the *Burra Charter* (Australia ICOMOS 2013).

Table 7-1: Historic heritage: assessment of significance.

Site Name	Level of Significance
Newell Highway HS-01	Nil

Table 7-2 assesses Newell Highway HS-01 against the assessment criteria established in the Heritage Office publication, *Assessing Heritage Significance* (Heritage Office 2001). Newell Highway HS-01 is a survey blaze tree.

Table 7-2: Assessment of heritage significance – Newell Highway HS-01.

Criteria	Comments	Significance
a	The site does not show evidence of a significant human activity.	Nil
b	There are no known associations of the sites with a significant event, person or group of persons.	Nil
c	The site is typical of survey marker trees from the late 19th Century to the mid-20th Century.	Nil
d	There are no known associations of the site with an identifiable group or a community's sense of place.	Nil
e	The site has little potential for further scientific and/or archaeological information. It does not have the qualities of an important benchmark or reference site or type.	Nil

Criteria	Comments	Significance
f	The site is not a rare site type for the Narrandera region or NSW.	Nil
g	The site does not represent well the characteristics of the site type.	Nil

7.4 DISCUSSION

One previously unrecorded historic heritage item, a blaze tree, otherwise known in surveying terms as a 'feature tree', was identified during the survey. Blaze tree, Newell Highway HS-01, while being significant for surveying purposes, does not meet the criteria for local, state or national heritage significance.

7.5 LIKELY IMPACTS TO HISTORIC HERITAGE FROM THE PROPOSED MODIFICATION

Newell Highway HS-01, is located within N2MS3 and is likely to be impacted by the proposed modification.

A vibration assessment was completed by Jacobs in 2018. As part of the assessment, each of the five locally listed items in Bellata identified in Section 1.2 were vibration-sensitive receivers. The impact assessment assessed peak particle velocities determined for different setback distances from different sizes of vibratory rollers and operating settings were predicted using the methods detailed in *British Standard BS 5228-1:2009 Code of practice for noise and vibration control on construction and open sites* (BS 5228-1: 2009) (Jacobs 2008: 23). The assessment concluded that should the setback distance be adhered to (as per Table 7-8 of Jacobs 2018:23), then vibration-related impacts to the locally listed items would be avoided.

7.6 MANAGEMENT AND MITIGATION

7.6.1 General principles for the management of historic sites

Appropriate management of heritage items is primarily determined on the basis of their assessed significance as well as the likely impacts of the proposed modification.

In terms of best practice and desired outcomes, avoiding impact to any historical item is a preferred outcome, however, where a historical site has been assessed as having no heritage value, impacts to these items does not require any legislated mitigation.

7.6.2 Management and mitigation of recorded historic sites

The removal or destruction of survey marks is costly to the community. Section 24(1) of the *Surveying and Spatial Information Act 2002* states that a person must not remove, damage, destroy, displace, obliterate or deface any survey mark unless authorised to do so by the Surveyor General. A person found guilty of breaching the Act by a Court, may be required to pay a penalty up to $20,000. Therefore, while the item may not have heritage values (see **Section 7.3.2**), it must not be disturbed without permission.

Should the feature need to be impacted, the proponent should email LPI Survey Services at SCIMS@customerservice.nsw.gov.au, detailing the mark type and number, proposed scope of works and scheduling.

Management measures for the five locally listed items at Bellata within N2MS3 outlined in Section 8.2 of Jacobs (2018) must be followed to ensure they are not impacted by vibration during the proposed modification. These follow the general guidance for limiting vibration impacts as per the *Assessing Vibration: a technical guideline* (DECC 2006) which include:

- Choosing alternative, lower-impact equipment or methods wherever possible
- Scheduling the use of vibration-causing equipment at the least sensitive times of the day
- Locating high vibration sources as far away from sensitive receiver areas as possible
- Sequencing operations so that vibration-causing activities do not occur simultaneously
- Keeping equipment well maintained
- Do not conduct vibration intensive works within the building damage distance.

8 CONCLUSION AND RECOMMENDATIONS

8.1 ABORIGINAL CULTURAL HERITAGE

No previously unrecorded Aboriginal sites were identified and none of the landforms present within the project construction boundary are considered to have increased archaeological potential.

Two previously recorded scarred trees, 19-3-0159 and 10-6-0049 are located within the project construction boundary, however, the sites will not be impacted by the proposed modification. Management measures outlined section 6.2 of OzArk (2018) must be followed to ensure 19-3-0159, 10-6-0049 are not inadvertently impacted by the proposed modification.

Archaeological test excavation is required in accordance with the Code of Practice and Stage 3 of the PACHCI for the portion of BC-HW17-PAD1 within the project construction boundary (**Section 5.2**). The ACHCRs commenced in February 2020 per Requirement 15a of the Code of Practice and Stage 3 of the PACHCI. If the test excavation concludes that Aboriginal objects are present in the PAD area at risk of harm, then an AHIP will be required to harm the site. The AHIP may include requirements for salvage excavation and/or community collection in the area at risk of harm, depending upon the significance of any archaeological deposits and/or surface artefacts identified within the PAD area. If the test excavation concludes that no archaeological deposits, Aboriginal objects or PADs are present in the area at risk of harm, then work can proceed in the area, provided any management recommendations to avoid harming the remaining portions of BC-HW17-PAD1 area are followed.

No further recommendations than those described in Section 9.1 of OzArk 2018 for the proposed modification are required to ensure the protection to the area's Aboriginal cultural heritage values.

8.2 HISTORIC HERITAGE

One previously unrecorded historic heritage item, a blaze tree, was identified during the survey. Blaze tree, Newell Highway HS-01, while being significant for surveying purposes, does not meet the criteria for local, state or national heritage significance.

Should Newell Highway HS-01 or any additional survey markers be unable to be avoided by the proposed modification, the proponent should prepare an application for their removal under the *Surveying and Spatial Information Act 2002 (***Section 7.6.2**).

Management measures for the five locally listed items at Bellata within N2MS3 outlined in Section 8.2 of Jacobs (2018) must be followed to ensure they are not impacted by vibration during the proposed modification.

No further recommendations than those described in Section 9.2 of OzArk 2018 for the proposed modification are required in relation to historic heritage.

REFERENCES

British Standard 2009 — British Standard BS 5228-1:2009 *Code of practice for noise and vibration control on construction and open sites* (BS 5228-1: 2009)

Burke & Smith 2004 — Burke, H. and Smith, C. 2004. *The Archaeologist's Field Handbook*, Blackwell, Oxford.

DECC 2006 — Department of Environment, Climate Change (now EPA). *Assessing vibration: a technical guideline.*

DECCW 2010 — Department of Environment, Climate Change and Water, Sydney (now OEH). *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales*.

Heritage Council 2006 — Heritage Office of the Department of Planning (now DPC). 2006. *Historical Archaeology Code of Practice.*

Jacobs 2018 — Jacobs. 2018. *Newell Highway Heavy Duty Pavements, Narrabri to Moree: Operational traffic and construction noise and vibration assessment report*. Report to Roads and Maritime Services.

OEH 2011 — Office of Environment and Heritage. 2011. *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW.*

OzArk 2018 — OzArk Environment & Heritage Management. 2018. *Aboriginal and Historic Archaeological Survey Report: Newell Highway HD Pavements – Narrabri to Moree, Narrabri and Moree LGA, NSW.* Report to Roads and Maritime Service.

RMS 2011 — Roads and Maritime Services 2011. *Procedure for Aboriginal Cultural Heritage Consultation and Investigation*. Roads and Maritime Services, Sydney.

RMS 2015 — Roads and Maritime Services 2015. *Cultural Heritage Guidelines*. Roads and Maritime Services, Sydney.

Umwelt 2017 — Umwelt (Australia) Pty Ltd (Umwelt) prepared the *Aboriginal Cultural Heritage and Archaeological Assessment: Inland Rail Programme, Narrabri to North Star Project.* Report to ARTC.

APPENDIX 1: AHIMS EXTENSIVE SEARCH RESULT

Office of Environment & Heritage NSW GOVERNMENT

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 2499
Client Service ID : 468896

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
10-6-0001	Bellata:	AGD	55	769133	6685809	Open site	Valid	Modified Tree (Carved or Scarred) : -, Burial : -	Burial/s,Carved Tree	65
	Contact	Recorders	David Bell,Isabel McBryde,Max Grace					Permits		
10-3-0036	HC-IF-1	AGD	55	776650	6731010	Open site	Valid	Artefact : -	Isolated Find	97835
	Contact	Recorders	Central West Archaeological and Heritage Services Pty Ltd					Permits		
10-3-0032	Steelbridge Camp	GDA	55	776593	6736883	Open site	Not a Site	Artefact : -, Potential Archaeological Deposit (PAD) : -	Open Camp Site	97714,99149
	Contact	Recorders	Central West Archaeological and Heritage Services Pty Ltd,OzArk Environmental a					Permits	1974,2052	
10-3-0034	BG-WS-1	AGD	55	776500	6736190	Open site	Valid	Ceremonial Ring (Stone or Earth) : -	Bora/Ceremonial	97714
	Contact	Recorders	Central West Archaeological and Heritage Services Pty Ltd					Permits		
10-3-0040	SC-IF1	GDA	55	776684	6738212	Open site	Destroyed	Artefact : 1		98851,99149
	Contact	Recorders	Doctor.Jodie Benton,OzArk Environmental and Heritage Management,Miss.Stephar					Permits	1974	
10-3-0041	SC PAD	GDA	55	776693	6738283	Open site	Partially Destroyed	Potential Archaeological Deposit (PAD) : -		98854,99149
	Contact	Recorders	Christine Tester,OzArk Environmental and Heritage Management,Miss.Stephanie R					Permits	1974	
10-6-0040	HC-OS1	AGD	55	776646	6730892	Open site	Valid	Stone Quarry : 5		
	Contact	Recorders	Mr.Phillip Cameron					Permits		
10-3-0070	SC-OS1	AGD	55	776666	6737934	Open site	Valid	Artefact : 2		
	Contact	Recorders	Mr.Phillip Cameron					Permits		
10-6-0048	N2NS ST1	GDA	55	772469	6717260	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	Miss.Nicola Roche					Permits		
10-3-0071	Boolooroo-HW17-ST1 (BR-HW17-ST1)	GDA	55	786677	6751939	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	OzArk Environmental and Heritage Management,Doctor.Chris Lovell					Permits		
10-3-0072	Boolooroo-HW17-ST2 (BR-HW17-ST2)	GDA	55	787091	6752395	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	OzArk Environmental and Heritage Management,Doctor.Chris Lovell					Permits		
10-6-0049	Bellata-HW17-ST1 (BL-HW17-ST1)	GDA	55	769464	6688542	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	OzArk Environmental and Heritage Management,Doctor.Chris Lovell					Permits		

Report generated by AHIMS Web Service on 02/12/2019 for Stephanie Rusden for the following area at Search using shape-file Newell Hwy buffer.SHP with a buffer of 0 meters. Additional Info : survey. Number of Aboriginal sites and Aboriginal objects found is 22

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Office of Environment & Heritage NSW GOVERNMENT

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 2499
Client Service ID : 468896

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
19-3-0159	Bobbiwaa Creek-HW17-ST1 (BC-HW17-ST1)	GDA	55	771240	6659225	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	OzArk Environmental and Heritage Management,Miss.Stephanie Rusden					Permits		
10-6-0050	Tookey Creek-HW17-ST1 (TC-HW17-ST1)	GDA	55	769334	6692168	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	OzArk Environmental and Heritage Management,Miss.Stephanie Rusden					Permits		
10-6-0059	NNS IA4	GDA	55	769391	6688985	Open site	Valid	Artefact : -		
	Contact	Recorders	Umwelt (Australia) Pty Limited,Miss.Nicola Roche					Permits		
10-6-0060	NNS AS1	GDA	55	769391	6688985	Open site	Valid	Artefact : -		
	Contact	Recorders	Umwelt (Australia) Pty Limited,Miss.Nicola Roche					Permits		
10-6-0051	NNS IA3	GDA	55	769391	6688985	Open site	Valid	Artefact : -		
	Contact	Recorders	Umwelt (Australia) Pty Limited,Miss.Nicola Roche					Permits		
10-6-0052	NNS IA2	GDA	55	769391	6688985	Open site	Valid	Artefact : -		
	Contact	Recorders	Umwelt (Australia) Pty Limited,Miss.Nicola Roche					Permits		
10-6-0053	NNS IA5	GDA	55	769391	6688985	Open site	Valid	Artefact : -		
	Contact	Recorders	Umwelt (Australia) Pty Limited,Miss.Nicola Roche					Permits		
10-6-0054	NNS IA6	GDA	55	769391	6688985	Open site	Valid	Artefact : -		
	Contact	Recorders	Umwelt (Australia) Pty Limited,Miss.Nicola Roche					Permits		
10-6-0055	NNS IA11	GDA	55	769391	6688985	Open site	Valid	Artefact : -		
	Contact	Recorders	Umwelt (Australia) Pty Limited,Miss.Nicola Roche					Permits		
10-6-0056	NNS AS2	GDA	55	769391	6688985	Open site	Valid	Artefact : -		
	Contact	Recorders	Umwelt (Australia) Pty Limited,Miss.Nicola Roche					Permits		

Report generated by AHIMS Web Service on 02/12/2019 for Stephanie Rusden for the following area at Search using shape-file Newell Hwy buffer.SHP with a buffer of 0 meters. Additional Info : survey. Number of Aboriginal sites and Aboriginal objects found is 22

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View south along Transect 1 at BC-HW17-PAD1.

ABORIGINAL ARCHAEOLOGICAL TEST EXCAVATION REPORT

NEWELL HIGHWAY HEAVY DUTY PAVEMENTS – NARRABRI TO MOREE

BC-HW17-PAD1 INVESTIGATION

NARRABRI NSW

AUGUST 2020

Report prepared by

OzArk Environment & Heritage

for Jacobs on behalf of

Transport for NSW

OzArk
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DOCUMENT CONTROLS

Proponent	Transport for NSW
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Acknowledgement

OzArk acknowledge Traditional Owners of the area on which this assessment took place and pay respect to their beliefs, cultural heritage and continuing connection with the land. We also acknowledge and pay respect to the post-contact experiences of Aboriginal people with attachment to the area and to the elders, past and present, as the next generation of role models and vessels for memories, traditions, culture and hopes of local Aboriginal people.

EXECUTIVE SUMMARY

OzArk Environment & Heritage (OzArk) has been engaged by Jacobs (the client) on behalf of Transport for NSW (TfNSW; the proponent) to conduct an archaeological test excavation as per Stage 3 of the *Roads and Maritime Services Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (PACHCI; RMS 2011) and in accordance with the *Code of Practice for the Investigation of Aboriginal Objects in NSW* (the Code of Practice; DECCW 2010).

The test excavation program was required to investigate BC-HW17-PAD1, a potential archaeological deposit (PAD), which will be partially impacted by work associated with the Newell Highway Heavy Duty Pavements – Narrabri to Moree project (N2M; the proposal). BC-HW17-PAD1 is located north of Narrabri in the Narrabri Local Government Area.

The test excavation at BC-HW17-PAD1 follows the recommendations contained with an Aboriginal and historic assessment (OzArk 2018) and addendum Aboriginal and historic assessment (OzArk 2020) completed as part of Stage 2 of the PACHI.

The fieldwork component of this assessment was undertaken on Tuesday 14 July 2020. A total of ten 0.5 metre (m) x 0.5 m squares were excavated within the portion of BC-HW17-PAD1 which overlaps with the construction boundary. No Aboriginal objects or features were identified during the test excavation and it was concluded that the portion of BC-HW17-PAD1 within the construction boundary has a very low likelihood for containing any undetected intact subsurface archaeological deposits.

As no artefacts were identified during the test excavation, either in surface or subsurface contexts, the proponent may proceed with the proposal without any further constraints on the grounds of Aboriginal cultural heritage, and no Aboriginal Heritage Impact Permit is required.

Recommendations concerning Aboriginal cultural values within the construction boundary at BC-HW17-PAD1 are as follows:

1. The proposed work may proceed without further archaeological investigation under the condition that all land-disturbing activities are confined to within the construction boundary. Should the parameters of the proposed work extend beyond the assessed area, then further archaeological assessment may be required.
2. A ‘no-go’ zone should be erected along the construction boundary adjacent to BC-HW17-PAD1 to ensure the reminder of the PAD is not impacted by the proposal (**Figure 6-1**).
3. The *Standard Management Procedure - Unexpected Heritage Items* (Roads and Maritime, 2015; **Appendix 3**) should be followed if an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction.
4. All construction personnel should undergo a cultural heritage induction to ensure they recognise Aboriginal artefacts and are aware of the legislative protection of Aboriginal

objects under the *National Parks and Wildlife Act 1974* and the contents of the *Standard Management Procedure - Unexpected Heritage Items.*

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FIGURES

TABLES

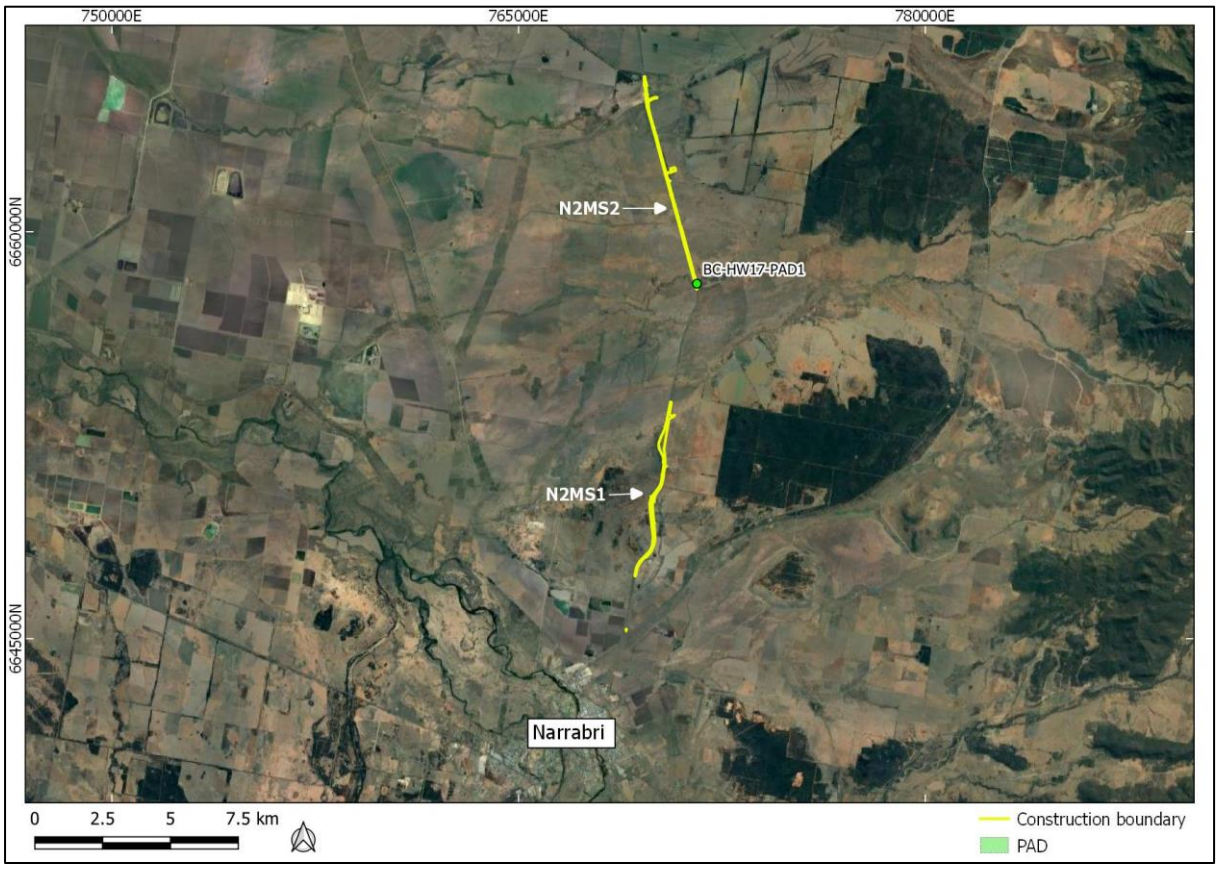
1 INTRODUCTION

1.1 DESCRIPTION OF THE PROPOSAL

OzArk Environment & Heritage (OzArk) has been engaged by by Jacobs (the client) on behalf of Transport for NSW (TfNSW; the proponent) to conduct an archaeological test excavation as per Stage 3 of the *Roads and Maritime Services Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (PACHCI; RMS 2011).

The test excavation program was required to investigate BC-HW17-PAD1, a potential archaeological deposit (PAD), which will be partially impacted by work associated with the Newell Highway Heavy Duty Pavements – Narrabri to Moree project (N2M; the proposal). BC-HW17-PAD1 is located north of Narrabri in the Narrabri Local Government Area (LGA) (**Figure 1-1**).

Figure 1-1: Location of N2MS2 and BC-HW17-PAD1 in relation to Narrabri.



1.2 BACKGROUND

OzArk (2018) completed an Aboriginal and historic assessment of the proposal in accordance with Stage 2 of the PACHCI. Three Aboriginal scarred trees and one PAD were recorded during the survey:

- 10-6-0049 (BL-HW17-ST1)
- 19-3-0159 (BC-HW17-ST1)

- 10-6-0050 (TC-HW17-ST1)
- BC-HW17-PAD1.

The three scarred trees have been registered with the Aboriginal Heritage Information Management System (AHIMS) register. The PAD was not registered as an Aboriginal site as this is dependent on the results of subsurface investigations.

The assessment initially found that harm to the recorded Aboriginal sites and the PAD could be avoided in the 100% detail design via the implementation of management strategies. As such, OzArk (2018) recommended the Aboriginal scarred trees and the PAD be demarcated using high visibility ground markers to delineate the site perimeter (i.e. staking and flagging) and be avoided by the works.

Since the completion of the assessment, the construction boundary has been amended for the 100% detail design and part of the area designated as BC-HW17-PAD1 is no longer able to be avoided (OzArk 2020). Therefore, test excavation was required within the construction boundary to determine if subsurface archaeological deposits are present and to develop management recommendations in relation to the activities of the proposal based on the results of the test excavation.

This report details the results of the archaeological test excavation carried out at BC-HW17-PAD1.

1.3 PROPOSED WORK

TfNSW proposes to carry out major road upgrades to five segments of the Newell Highway between Narrabri and Moree in northwest NSW; largely within the existing road corridor (the proposal).

The proposal has been separated into five sections. BC-HW17-PAD1 is located at the southern extent of N2MS2, on the northern bank of Bobbiwaa Creek (**Figure 1-2**).

Proposed work at the location of BC-HW17-PAD1 will include:

- Clearing and grubbing
- Removal of the existing fence
- Installation of a new fence
- Utility works (relocation of Telstra cables)
- Installation of a new safety barrier on Bobbiwaa Creek bridge and its approaches
- Earthworks and paving
- Construction of a new table drain.

1.4 DESCRIPTION OF BC-HW17-PAD1

BC-HW17-PAD1, is located within Lot 1 DP387144 about 17 kilometres (km) north of the town of Narrabri, a few metres east of the Newell Highway, and 120 metres (m) north of the intersection of Junefield Road and the Newell Highway.

BC-HW17-PAD1 is located on the northern bank of Bobbiwaa Creek within an alluvial plain supporting a highly modified open woodland and riparian habitat (**Figure 1-2** and **Figure 1-3**). The PAD extends for approximately 100 m (east–west) by 110 m (north–south) encompassing a flat, slightly raised landform above the creek bank. The PAD includes a point bar deposit on the inner bank of Bobbiwaa Creek and the landform encompassed by the PAD has a slightly elevated topography relative to the surrounding alluvial plain.

Vegetation clearance, animal grazing and trampling, fencing, the construction and maintenance of the Newell Highway and the bridge over Bobbiwaa Creek, as well as, ploughing are likely to have affected the integrity of any archaeological deposits. Nevertheless, OzArk (2018) concluded that intact archaeological deposits are considered likely to exist in the PAD area.

The identification of BC-HW17-PAD1 was based upon the prediction that artefact scatters (also termed open camp sites) in the Northern Outwash subregion are likely to occur within a few hundred metres of major watercourses, particularly on raised landforms adjacent to those watercourses (see **Section 4.2**). These landforms are relatively infrequently inundated compared to the more frequently flooded plains.

Figure 1-2 shows the extent of BC-HW17-PAD1 in relation to the construction boundary of N2MS2.

Figure 1-2: BC-HW17-PAD1 in relation to the construction boundary of the proposal.

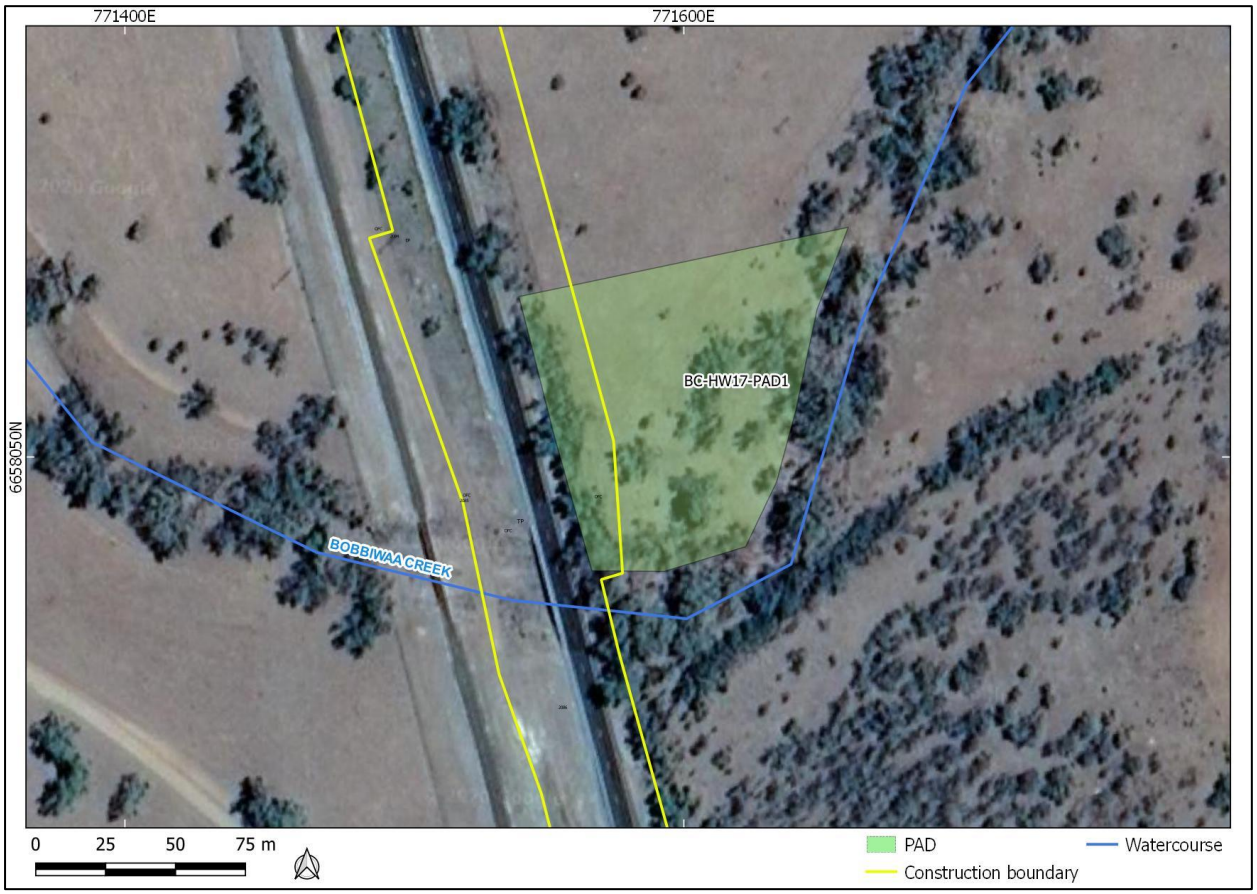


Figure 1-3: Photographs showing an overview of BC-HW17-PAD and the existing bridge over Bobbiwaa Creek.

1. Overview of BC-HW17-PAD1 showing the flat, slightly elevated landform above the northern and western creek bank, facing southeast.

2. View showing the Newell Highway and the existing bridge over Bobbiwaa Creek from the northern bank, facing south. The BC-HW17-PAD1 boundary is on the left.

2 THE ARCHAEOLOGICAL TEST EXCAVATION

2.1 PURPOSE AND OBJECTIVES

The purpose of the test excavation program is to determine the nature and extent of any subsurface archaeological deposits at BC-HW17-PAD1 within the construction boundary. Data obtained from the test excavation program will be used to inform mitigation and management options.

The aims of the test excavation are to:

1. Establish whether there are any subsurface deposits at the PAD within the construction boundary. If there are subsurface deposits, then the extent and nature of the subsurface archaeological deposits will also be established
2. Use the data gained from the test excavation program to better evaluate the archaeological significance and potential of the site area
3. Develop, in consultation with the Registered Aboriginal Parties (RAPs) and the proponent, an informed strategy for the management of impacts to any Aboriginal cultural heritage likely to be impacted by the proposal.

2.2 ASSESSMENT APPROACH

As required under the *National Parks and Wildlife Act 1974* (NPW Act), this test excavation program was designed to conform with specifications of the *Code of Practice for the Investigation of Aboriginal Objects in NSW* (the Code of Practice; DECCW 2010). This Code of Practice was adopted in the NPW Regulations 2009, Clause 3A.

Test excavations undertaken as per the *Code of Practice* do not require an Aboriginal Heritage Impact Permit (AHIP) under the NPW Act.

2.3 DATE OF THE ARCHAEOLOGICAL INVESTIGATION

The fieldwork component of this investigation was undertaken on Tuesday 14 July 2020.

2.4 THE EXCAVATION TEAM

The excavation team consisted of:

- Director: Dr Jodie Benton, OzArk Principal Archaeologist
- Heritage Officer: Harrison Rochford: OzArk Heritage Officer
- Narrabri Local Aboriginal Land Council (LALC) representative Kristie Toomey
- Narrabri LALC representative Dave Tindall
- Pilliga LALC representative Melissa Barnes

- Gomeroi Dreaming Pty Ltd representative Alfred Priestley
- Gomeroi Dreaming Pty Ltd representative William Priestley
- Gomeroi People Native Title Group (applicants) representative Maria Cutmore
- Gomeroi People Native Title Group (applicants) representative Malu French
- TfNSW representative Jeff Charlton
- TfNSW representative Edward Paas
- TfNSW representative Georgia Rogan.

2.5 REPORT COMPLIANCE WITH THE CODE OF PRACTICE

The Code of Practice establishes requirements that should be followed by all archaeological test excavation investigations. **Table 2-1** tabulates the compliance of this report with the requirements established by the Code of Practice.

Table 2-1: Test excavation compliance with the Code of Practice.

Code of Practice Requirement	Context of the Requirement	Concordance in this report
Requirement 14	Test excavation which is not excluded from the definition of harm	The test excavation did not take place in any of the landforms identified in Requirement 14.
Requirement 15	Pre-conditions to carrying out test excavation	*See subsection below*
Requirement 15a	Consultation	Consultation has included the ACHCRs which were undertaken by TfNSW (see **Section 3**).
Requirement 15b	Test excavation sampling strategy	A test excavation methodology was produced (**Appendix 2**) and issued to RAPs for their information.
Requirement 15c	Notification	The Biodiversity and Conservation Division ([BCD] now Heritage NSW) Dubbo office was provided with a copy of the test excavation methodology on 26 June 2020.
Requirement 16	Test excavation that can be carried out in accordance with this Code	*See subsection below*
Requirement 16a	Test excavations	The test excavation program complied with this requirement; see **Section 5.**
Requirement 16b	Objects recovered during test excavations	The test excavation methodology established that any artefacts recovered from the excavations would be temporarily stored at the OzArk office (145 Wingewarra Street Dubbo NSW 2830).
Requirement 17	When to stop test excavations	The methodology of the test excavation adhered to this requirement (**Appendix 2**).

3 ABORIGINAL COMMUNITY CONSULTATION

3.1 ABORIGINAL COMMUNITY CONSULTATION

The Aboriginal cultural heritage consultation for the proposal has been completed by TfNSW and followed the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (ACHCRs) (DECCW 2010b).

Copies of correspondence with Aboriginal community stakeholders are presented in **Appendix 1**.

The ACHCRs include four main stages and these will be detailed in the following sections.

3.1.1 ACHCRs Stage 1

The aim of Stage 1 is to identify the RAPs who wish to be consulted about the proposal.

An advertisement requesting registrations of interest in the proposal was placed in the *Narrabri Courier* on 9 April 2020 (**Appendix 1 Figure 1**). A list of Aboriginal groups with possible interest in the proposal was compiled by writing to the following agencies on 6 March 2020: NTSCORP Pty Ltd; Office of the Registrar, Aboriginal Land Rights Act; BCD (now Heritage NSW); Narrabri Shire Council; Narrabri LALC; National Native Title Tribunal; and Local Lands Service (**Appendix 1 Figure 2**). Aboriginal community members and organisations whose names were obtained from the agencies were notified of the proposed project in writing and provided with at least 14 days to register interest (**Appendix 1 Figure 3**). Registrations were received from the following groups or individuals (hereafter referred to as the RAPs):

- Narrabri LALC
- Pilliga LALC
- Wee Waa LALC
- Gomeroi People Native Title Group (applicants)
- Gomeroi Dreaming Pty Ltd.

3.1.2 ACHCRs Stages 2 & 3

The aim of Stages 2 and 3 is to provide information about the proposal to the RAPs and to acquire information regarding Aboriginal cultural values associated with the proposal either through consultation and/or field work. Often these two stages are run together, and the detailed project information is provided in the assessment methodology that is issued to all RAPs for their consideration.

OzArk drafted the Stage 2/3 – *Archaeological Test Excavation Methodology: Newell Highway Heavy Duty Pavements – Narrabri to Moree. BC-HW17-PAD1 Investigation* (**Appendix 1 Figure**

4 and **Appendix 2**). This document as was sent to the RAPs for review and comment on 9 June 2020.

3.1.2.1 Aboriginal Focus Group Meeting

An Aboriginal Focus Group Meeting (AFGM) was held on 18 June 2020 in Narrabri to outline the proposal and allow for comment on the test excavation methodology (**Appendix 1 Figure 5** and **Appendix 1 Figure 6**).

The AFGM was attended by the following:

- OzArk: Dr Jodie Benton
- TfNSW: Jeff Charlton
- TfNSW: Edward Paas
- TfNSW: Georgia Rogan.
- Narrabri: Edward Trindall
- Pilliga LALC: Sheryl/Noeline Nicholls
- Wee Waa LALC: Robyn Keeffe
- Gomeroi Dreaming Pty Ltd: Alfred Priestley
- Gomeroi People Native Title Group (applicants): Maria Cutmore.

3.1.3 ACHCRs Stage 4

Stage 4 involves the production of a draft (ACHAR) that is issued to all RAPs for their consideration.

As the test excavation determined that no Aboriginal objects will be harmed by the proposal, there is no requirement to apply for an AHIP and consequently, no requirement to produce an ACHAR. However, a copy of this test excavation report will be sent to all RAPs for their information; although there is no requirement for RAPs to comment on this document.

4 PREVIOUS ARCHAEOLOGICAL RESEARCH

4.1 PREVIOUS SUBSURFACE INVESTIGATIONS WITHIN THE REGION OF THE PROPOSAL

No previous subsurface archaeological investigation has occurred within the study area for the proposal. Nor have subsurface investigations been undertaken in closely adjacent landforms.

Archaeological assessments and associated test excavations that have occurred in the nearby region are summarised below to gain an understanding on the nature of subsurface deposits that may be encountered at BC-HW17-PAD1.

4.1.1 Haglund 1987

Archaeological investigation of locations along proposed Haul Road Route west of Gunnedah.

Haglund (1985) conducted a survey of all previous studies relating to the area immediately north of Gunnedah and the Namoi River. This survey concluded that the archaeology of the area is concentrated along rivers and other permanent waterways. This concentration is a result of both prehistoric land use patterns, in which such locations arguably constituted more permanent camps, and historical land use patterns, such as agriculture, which may have disturbed and/or destroyed the archaeology present in areas away from these waterways (Haglund 1985).

Haglund returned to Gunnedah in 1986 to conduct two test excavations of sites requiring ground truthing (Haglund 1987). These sites were located on opposite sides of the Namoi River and one was a portion of the extensive Namoi River/C.W.R. site. Artefacts were recovered at these sites, however, Haglund noted that the artefacts were largely too dispersed to be considered archaeologically significant and were situated in secondary contexts created by vehicle movement and water flows (Haglund 1987).

4.1.2 OzArk 2004

Archaeological test excavation at Mehi River & Skinners Creek PADs

OzArk (2004) conducted subsurface test excavations within the PADs identified on the banks of the Mehi River (10-3-0032) and Skinners Creek (10-3-0040 and 10-3-0041) along the then proposed Moree bypass alignment. The PADs identified for testing were located on the east bank of the Mehi River and on either side of Skinners Creek near the location of an isolated find of a ‘silcrete’ artefact.

Three 2 m x 4 m excavation squares were excavated on the northern side of the elevated terrace adjoining the Mehi River. The top two spits (an arbitrary division of vertical space) were 25 centimetres (cm), the third 30 cm, fourth 35 cm and last 25 cm. Lithic materials were recovered from the upper 80 cm of deposit, which had been disturbed through historic land use, the plastic nature of the soils and heavy bioturbation. Glass and other materials from historic times were

located to a depth of 80 cm. The alluvial nature of the deposits suggested that the material recovered was not *in situ*. This is also supported by the small size of the lithics and other materials (none more than 2 cm in size), with the vast majority mostly less than 1 cm in size. The naturally occurring gravels were of a similar size range and did not occur in layers throughout the test pits. The PAD is also part of the Steel Bridge Aboriginal Fringe Camp. No artefacts were found in the excavated squares of the Mehi PAD, and combined with the results of the geomorphological assessment, this suggested that material has been moved within the soil profile by natural processes.

Two 1 m x 1 m squares were excavated on the southern side of Skinners Creek within the then proposed road corridor in three spits of 20 cm. One chalcedony artefact recovered in spit 2 of south pit 1 exhibited a clear and definite bulb, errailure scar, a platform with a waterworn cortex showing numerous fine impact fractures caused by transport in a high energy reach of a stream. The landform had been clearly disturbed through agricultural activities, the plastic nature of the soils and heavy bioturbation. The alluvial nature of deposits and the water wearing on the artefact suggests that the artefact was not *in situ*. Naturally occurring gravels were of a similar size range and did not occur in layers throughout the test excavation squares.

The northern side of the Skinners Creek PAD occurs on a slight bend where flood waters inundate at more frequent intervals. Two 1 m x 1 m squares were excavated in 20 cm spits with no artefacts or lithic materials recovered. It was concluded that the lack of lithic material, and even naturally occurring gravels, were indicative of the alluvial nature of the soil profile.

4.1.3 ARAS 2007

Boggabri Coal Project

ARAS (2007) completed a salvage program at Boggabri Coal Mine for the then proposed open pit and haul road. Excavations were completed at two sites: BC 35 and BC 41. BC 35 comprised two stone artefacts on a forestry track within the Leard State Forest. One metre square test probes were excavated along the track. A total of 18.6 square metres (m^2) were excavated and 179 artefacts recovered. Excavation of Site BC 35 revealed evidence of stone tool manufacturing and knapping events and a small number of backed artefacts were recorded.

BC 41, located on the edge of Nagero Creek, comprised three artefacts on a creek terrace. The site was considered part of the complex of five loci in this area. A total of 8 m^2 was excavated and 30 artefacts were recorded. In both areas, artefacts were recorded in the A-Horizon of the duplex soils.

The following conclusions were made following text excavation:

- Over 90% of artefacts recovered from test excavations consist of unmodified broken flakes and flaked piece material

- Retouch or modified tools account for less than 2% of the entire stone artefact record
- A majority of stone tool raw material used in stone tool production is derived from local volcanic siliceous origins located within colluvial gravels near ridgelines
- Exotic stone raw materials (i.e. cherts, quartz, silcretes) account for less than 10% of the entire stone artefact assemblage recorded.

4.2 PREDICTIVE MODEL

Heritage Concepts (2009: 69–72) developed a predictive model for the Northern Outwash subregion of the Brigalow Belt South bioregion. Flood mapping indicates that the alluvial plains of the Northern Outwash subregion are not frequently inundated, with flooding generally confined to the immediate overbank areas. As such, occupational sites are more likely to be located within 100 m of major watercourses, since they are infrequently covered by alluvial deposits, than on the frequently flooded plains. Erosion acting on high points on the alluvial plains is likely to create lag deposits due to the flat topography.

Based on the conclusions provided by Heritage Concepts (2009), alluvial landforms such as those at BC-HW17-PAD1 are more likely to preserve archaeological evidence due to aggradation. However, a general under-representation of archaeological deposits may be expected within the alluvial landform due to potential past intensive agricultural practices. If objects are found to be preserved *in situ* they are likely to represent episodic small-scale events that have subsequently been covered. Alternatively, objects may have been transported and deposited in secondary contexts via fluvial processes.

Knowledge of the environmental contexts of the study area and a desktop review of additional known local and regional archaeological record, the following further predictions are made concerning the potential for subsurface deposits to occur:

- Should subsurface material be identified, the most common raw material will be volcanic materials, chert, quartz and silcrete. These items would likely have been sourced outside of the immediate surrounds of BC-HW17-PAD1
- Artefactual material will most likely comprise unmodified flakes (including flaked pieces and broken flakes), cores, a small collection of blades and worked tools, and debitage pieces. It is expected that unmodified flakes will dominate the overall artefact assemblage
- Due to the predicted alluvial nature of the soil deposits, the depth of squares will likely be relatively deep before B-Horizon soils are encountered
- Should evidence of agricultural disturbance be observed, they will have likely impacted the top 20 cm of the A-Horizon
- Artefacts will likely be associated with the A-Horizon soils layers indicating a date in the Holocene period (i.e. in the past 12,000 years).

4.3 RESEARCH QUESTIONS

While any test excavation program is limited in the level of research objectives it can achieve due to the restricted nature of the excavations, the test excavations attempted to answer the following research questions:

- Are there subsurface archaeological deposits that confirm the recorded area as a site?
- How does the artefactual material and stratigraphy identified at the site compare to other archaeological excavations undertaken in the local area and the region?
- Do the elevated landforms associated with Bobbiwaa Creek preserve intact subsurface archaeological deposits?
- Are additional archaeological features, such as hearths, present in the site area?
- Can chronological dates be obtained (i.e. from *in situ* charcoal samples) that will aid our understanding of Aboriginal occupation in the region?

5 TEST EXCAVATION RESULTS

5.1 SAMPLING STRATEGY

Transect layout followed the parameters of the test excavation methodology (**Appendix 2**). Two transects, each consisting of five 0.5 m x 0.5 m squares (spaced approximately 10 m apart) were excavated within the portion of BC-HW17-PAD1 which overlaps with the construction boundary.

Transect 1 and 2 were located within Lot 1 DP387144, approximately 8 m east of the boundary fence of the Newell Highway road corridor. The transects are on the undifferentiated terrace of Bobbiwaa Creek.

Figure 5-1 shows photographs of each transect location. **Figure 5-2** shows the location of the excavation squares.

Figure 5-1: General landscape shots of the excavation area.

	
1. View south towards Bobbiwaa Creek along Transect 1 within a recently ploughed paddock.	2. View south towards Bobbiwaa Creek along Transect 2.

Figure 5-2: View of the location of the excavation squares.

5.2 TEST EXCAVATION RESULTS

5.2.1 Stratigraphy

No archaeological stratigraphy was noted during the test excavation program.

The excavation squares displayed similar soil profiles. These squares consisted of a soft light brown loam to variable depths but no deeper than 15 cm. Below this, the A2 Horizon was noted as being light brown to grey self-mulching/cracking clay. This was encountered to a maximum depth of 36 cm before a hard-packed clay was reached. Compaction and clay content generally increased with depth. This transition to heavier clays was gradual, and at least partially due to ploughing which has impacted the top 20 cm of the deposit.

Very few stone inclusions were noted in any of the excavation squares, and where present these were small broken waterworn stones.

Table 5-1 presents the information gained from the excavation regarding the soil profile and shows the excavated sections from each of the excavation squares.

Table 5-1: Soil profiles noted during the test excavation program.

Transect	Square	Soil profile	Photo
1	1	Manual Excavation. 10 cm spits Light brown loam to 10–20 cm Light brown to grey self-mulching/cracking clay to 20 cm Hard-pack clay base at 20 cm Few plant roots	
1	2	Manual Excavation. 10 cm spits Light brown loam to 10 cm Light brown to grey self-mulching/cracking clay to 30 cm Hard-pack clay base at 30 cm Few plant roots	

Transect	Square	Soil profile	Photo
1	3	Manual Excavation. 10 cm spits Light brown loam to 12 cm Light brown to grey self-mulching/cracking clay to 23 cm Hard-pack clay base at 23 cm Few plant roots	
1	4	Manual Excavation. 10 cm spits Light brown loam to 5–10 cm Light brown to grey self-mulching/cracking clay to 35 cm Hard-pack clay base at 35 cm Few plant roots	

Transect	Square	Soil profile	Photo
1	5	Manual Excavation. 10cm spits Light brown loam to 10 cm Light brown to grey self-mulching/cracking clay to 30 cm Hard-pack clay base at 30 cm Few plant roots	
2	1	Manual Excavation. 10 cm spits Light brown loam to 5–10 cm Light brown to grey self-mulching/cracking clay to 35 cm Hard-pack clay base at 35 cm Few plant roots	

Transect	Square	Soil profile	Photo
2	2	Manual Excavation. 10 cm spits Light brown loam to 5–8 cm Light brown to grey self-mulching/cracking clay to 36 cm Hard-pack clay base at 36 cm Few plant roots	
2	3	Manual Excavation. 10 cm spits Light brown loam to 5–10 cm Light brown to grey self-mulching/cracking clay to 30 cm Hard-pack clay base at 30 cm Few plant roots	

Transect	Square	Soil profile	Photo
2	4	Manual Excavation. 10 cm spits Light brown loam to 10–15 cm Light brown to grey self-mulching/cracking clay to 35 cm Hard-pack clay base at 35 cm Few plant roots	
2	5	Manual Excavation. 10 cm spits Light brown loam to 5–8 cm Light brown to grey self-mulching/cracking clay to 36 cm Hard-pack clay base at 36 cm Few plant roots	

5.2.2 Artefact assemblage

No Aboriginal objects or features were recovered during the test excavation program. Further, very little stone material such as gravels was identified within any of the excavation squares.

5.3 DISCUSSION

As highlighted above no Aboriginal objects or features were identified during the test excavation. The absence of artefacts within the area of PAD investigated is likely to be attributed to a combination of the factors discussed below:

- The relatively small portion of the overall PAD landform which was subject to test excavation
- British occupation disturbance and European farming practices that have impacted the topmost 20 cm across the landform from ploughing
- The presence of self-mulching/cracking clays. This type of geomorphological horizon tends to 'swallow' archaeological evidence, particularly stone artefacts
- While the alluvial terrace is likely to be have less frequently subject to flooding, any flooding events have potential to remove and displace artefactual material.
- It may be that this portion of the PAD was never the subject of Aboriginal occupation capable of leaving a physical signature.

5.3.1 Research questions

In **Section 4.3**, several research questions were posed for the test excavation program. These will be answered below.

- Are there subsurface archaeological deposits that confirm the recorded area as a site?
    - No: the results of the test excavation program clearly showed that cultural deposits/artefacts are not present within portion of BC-HW17-PAD1 which overlaps with the construction boundary. The areas not tested outside of the proposal are predicted to have a low likelihood for subsurface archaeological deposits to be present.
- How does the artefactual material and stratigraphy identified at the site compare to other archaeological excavations undertaken in the local area and the region?
    - As no artefacts were recovered during the test excavation, this question cannot be answered.
- Do the elevated landforms associated with Bobbiwaa Creek preserve intact subsurface archaeological deposits?
    - The landform subject to test excavation did not reveal any subsurface archaeological deposits. However, only a small portion of this landform was investigated. Therefore, this research question remains unanswered.

- Are additional archaeological features, such as hearths, present in the site area?
    - No archaeological features, including intact atone artefact deposits or hearths, were identified.
- Can chronological dates be obtained (i.e. from *in situ* charcoal samples) that will aid our understanding of Aboriginal occupation in the region?
    - As no features were identified, no chronological dates can be obtained.

6 CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

The archaeological test excavation program undertaken at the PAD landform identified as BC-HW17-PAD1, determined that there remains a very low likelihood for there being any undetected intact subsurface archaeological deposits within the construction boundary of the proposal. Further, it is likely that the remainder of BC-HW17-PAD1 is associated with only a low-density of artefacts based on the excavation results.

As no Aboriginal objects or features have been identified during the test excavation, an AHIP is not required and the proponent may proceed with undertaking the proposal without any further constraints on the grounds of Aboriginal cultural heritage at the location of BC-HW17-PAD1.

In order to ensure the remaining portion of BC-HW17-PAD1 is not impacted by the proposal a temporary 'no-go' zone should be erected along the construction boundary adjacent to the PAD (**Figure 6-1**).

Figure 6-1: Revised extent of BC-HW17-PAD1 and the proposed 'no-go' zone fencing.

6.2 RECOMMENDATIONS

Recommendations concerning Aboriginal cultural values within the construction boundary at BC-HW17-PAD1 are as follows:

1. The proposed work may proceed without further archaeological investigation under the condition that all land-disturbing activities are confined to within the construction boundary. Should the parameters of the proposed work extend beyond the assessed area, then further archaeological assessment may be required.
2. A 'no-go' zone should be erected along the construction boundary adjacent to BC-HW17-PAD1 to ensure the reminder of the PAD is not impacted by the proposal (**Figure 6-1**).
3. The *Standard Management Procedure - Unexpected Heritage Items* (Roads and Maritime, 2015; **Appendix 3**) should be followed if an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction.
4. All construction personnel should undergo a cultural heritage induction to ensure they recognise Aboriginal artefacts and are aware of the legislative protection of Aboriginal objects under the NPW Act and the contents of the *Standard Management Procedure - Unexpected Heritage Items.*

REFERENCES

ARAS 2007 — ARAS. 2007. *Boggabri Coal Project Final Report: Section 87 and 90 Consent Conditions*. Report to Idemitsu Boggabri Coal Pty Ltd.

DECCW 2010 — Department of Environment, Climate Change and Water. 2010. *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales*. Department of Environment, Climate Change and Water, Sydney.

DECCW 2010b — Department of Environment, Climate Change and Water, Sydney (now BCD). 2010. *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010.*

Haglund 1985 — Haglund and Associates 1985. *Archaeological Investigations of areas that may be affected by proposed mining for coal in the Gunnedah area, NSW*. Report to Vickery Joint Venture.

Haglund 1987 — Haglund and Associates 1987. *Archaeological investigation of locations along proposed haul road route west of Gunnedah, NSW*. Report to Vickery Joint Venture.

Heritage Concepts 2009 — Heritage Concepts Pty Ltd 2009. *Aboriginal Heritage Study: Moree Plains Shire Council Local Environmental Plan*. Report to Moree Plains Shire Council.

OzArk 2004 — OzArk Environment & Heritage. 2004. *Archaeological Test Excavation of Mehi River (#10-3-0032) & Skinners Creek PADs (#10-3-0040 & 41): Proposed Moree Bypass, Moree, NSW*. Report to Roads and Traffic Authority.

OzArk 2018 — OzArk Environment & Heritage. 2018. *Aboriginal and Historic Archaeological Survey Report: Newell Highway HD Pavements – Narrabri to Moree*. Report to Roads and Maritime Services.

OzArk 2020 — OzArk Environment & Heritage. 2018. *Aboriginal and Historic Archaeological Survey Report: Newell Highway HD Pavements – Narrabri to Moree Addendum*. Report to Transport for NSW.

RMS 2011 — Roads and Maritime Services (now TfNSW). 2011. *Procedure for Aboriginal Cultural Heritage Consultation and Investigation*. Roads and Maritime Services, Sydney.

APPENDIX 1: ABORIGINAL COMMUNITY CONSULTATION DOCUMENTATION

TfNSW Consultation log

Contact List – Bobbiwaa Creek Project AHIP

Project Manager: Ed Paas (PM)	M: 0459081400 E: ed.paas@transport.nsw.gov.au
Aboriginal Cultural Heritage Officer: Jeff Charlton (ACHO)	P: 6861 1658 M: 0428 463 258 E: jeffery.charlton@transport.nsw.gov.au
Environment Officer: Jonathan Blizzard (EO)	P: 6841 4022 M: 0476 836 490 E: jonathan.blizzard@transport.nsw.gov.au

Bobbiwaa Creek Call Log

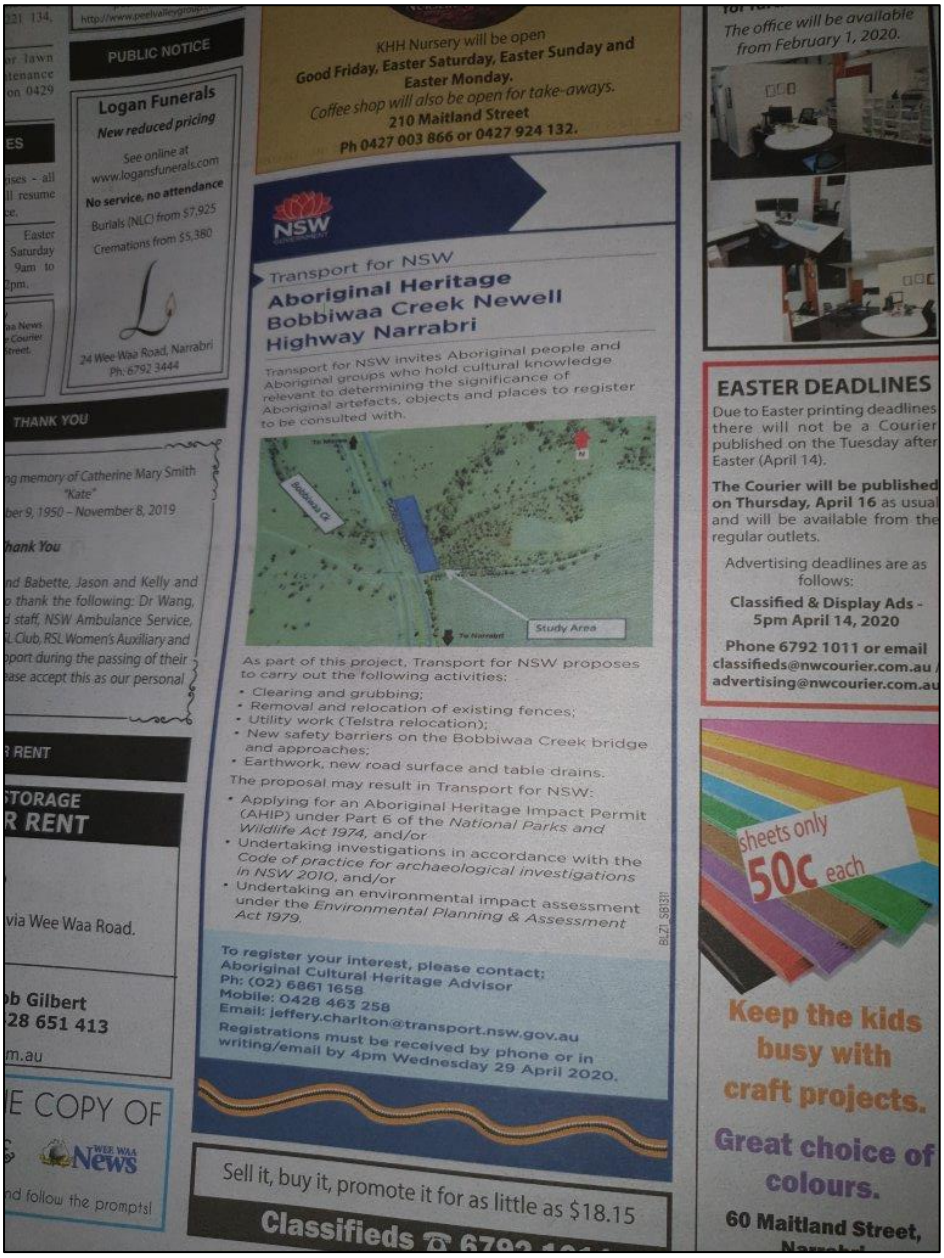
Date	P/E/Meetings	To	From	Comments
11/03/2020	Phone	Gomeroi Dreaming P/L	ACHO	Check on Email No answer left messages
11/03/2020	Phone	Narrabri LALC	ACHO	Check on Email
11/03/2020	Phone	Pilliga LALC	ACHO	Check on Email No answer left messages
13/03/2020	Phone	Wee Waa LALC	ACHO	Check on Email
13/03/2020	Phone	Gomeroi People NT Claimants – c/- Dylan Orsborn	ACHO	Check on Email No answer left messages
15/03/2020	Phone	Gomeroi Dreaming P/L		Received
15/03/2020	Phone	Narrabri LALC		Received
15/03/2020	Phone	Pilliga LALC		No Answer
15/03/2020	Phone	Wee Waa LALC		No answer
15/03/2020	Phone	Gomeroi People NT Claimants – c/- Dylan Orsborn		May have send to Sheryl Nicolls?
16/06/2020	Phone	Gomeroi People NT Claimants –	ACHO	Will bring the paperwork on the day to sign

Bobbiwaa Creek Correspondence Log

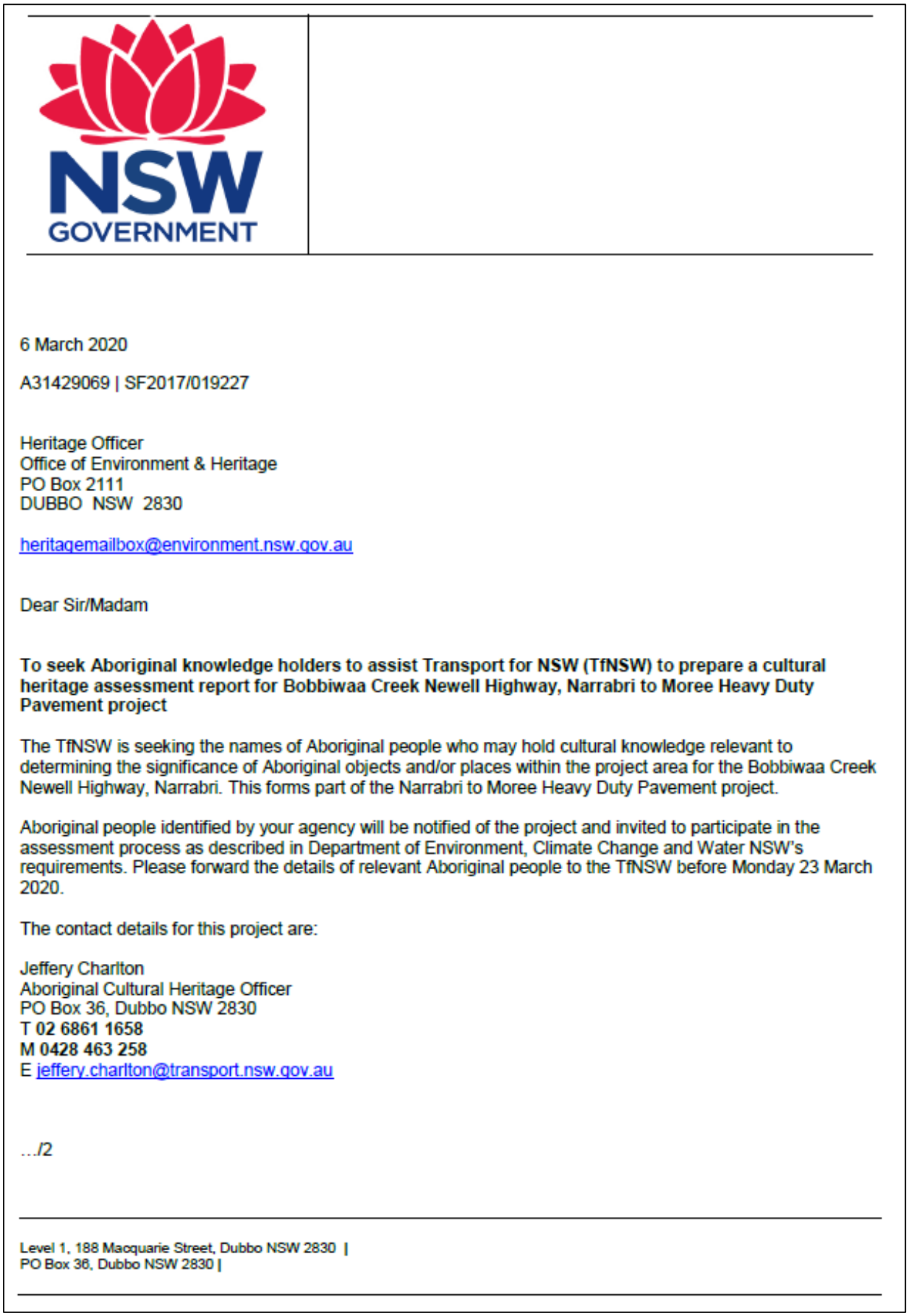
Date	Email | Post | Meetings	To	From	Comments
06/03/2020	Email	NSW ALC	ACHO	Seek names Aboriginal knowledge holders – Resource 10
06/03/2020	Email	OEH	ACHO	Seek names Aboriginal knowledge holders – Resource 10
06/03/2020	Email	NNTT	ACHO	Seek names Aboriginal knowledge holders – Resource 10
06/03/2020	Email	ORALRA	ACHO	Seek names Aboriginal knowledge holders – Resource 10
06/03/2020	Email	Narrabri Shire Ccl	ACHO	Seek names Aboriginal knowledge holders – Resource 10
06/03/2020	Email	LLS	ACHO	Seek names Aboriginal knowledge holders – Resource 10
06/03/2020	Email	Narrabri LALC	ACHO	Seek names Aboriginal knowledge holders – Resource 10
11/03/2020	Email	ACHO	NNTT	Response – Resource 10
19/03/2020	Email	ACHO	Narrabri Shire Ccl	Response – Resource 10
19/03/2020	Email	ACHO	Narrabri LALC	Response – Resource 10
19/03/2020	Email	ACHO	Gomeroi Dreaming P/L	Response – Resource 10
25/03/2020	Email	Gomeroi Dreaming P/L	ACHO	Invitation to participate in community consultation - Resource 12
25/03/2020	Email	Narrabri LALC	ACHO	Invitation to participate in community consultation - Resource 12
25/03/2020	Email	Pilliga LALC	ACHO	Invitation to participate in community consultation - Resource 12
25/03/2020	Email	Wee Waa LALC	ACHO	Invitation to participate in community consultation - Resource 12
30/04/2020	Email	TfNSW	LLS	Response – Resource 10
04/05/2020	Email	Moree LALC	ACHO	Invitation to participate in community consultation – Resource 12
11/05/2020	Email	Narrabri LALC	ACHO	Resource 16 – Registration for participation and methodology
11/05/2020	Email	Gomeroi Dreaming	ACHO	Resource 16 – Registration for participation and methodology
11/05/2020	Email	Gomeroi People NT Claimants – c/- Maeve Parker	ACHO	Resource 16 – Registration for participation and methodology
13/05/2020	Email	Gomeroi People NT Claimants – c/- Dylan Orsborn	ACHO	Resource 16 – Registration for participation and methodology
13/05/2020	Email	Wee Waa LALC	ACHO	Resource 16 – Registration for participation and methodology

13/05/2020	Email	Pilliga LALC	ACHO	Resource 16 – Registration for participation and methodology
09/06/2020	Email	Gomeroi Dreaming P/L	ACHO	Resource 18- Invitation to participate in the heritage assessment process and to attend an Aboriginal focus group meeting
09/06/2020	Email	Narrabri LALC	ACHO	Resource 18- Invitation to participate in the heritage assessment process and to attend an Aboriginal focus group meeting
09/06/2020	Email	Pilliga LALC	ACHO	Resource 18- Invitation to participate in the heritage assessment process and to attend an Aboriginal focus group meeting
09/06/2020	Email	Wee Waa LALC	ACHO	Resource 18- Invitation to participate in the heritage assessment process and to attend an Aboriginal focus group meeting
09/06/2020	Email	Gomeroi People NT Claimants – c/- Dylan Orsborn	ACHO	Resource 18- Invitation to participate in the heritage assessment process and to attend an Aboriginal focus group meeting

Appendix 1 Figure 1: Stage 1 Advertisement placed in the Narrabri Courier, 9 April 2020.



Appendix 1 Figure 2: Stage 1 Letter to agencies (sample).



NSW GOVERNMENT

6 March 2020

A31429069 | SF2017/019227

Heritage Officer
Office of Environment & Heritage
PO Box 2111
DUBBO NSW 2830

heritagemailbox@environment.nsw.gov.au

Dear Sir/Madam

To seek Aboriginal knowledge holders to assist Transport for NSW (TfNSW) to prepare a cultural heritage assessment report for Bobbiwaa Creek Newell Highway, Narrabri to Moree Heavy Duty Pavement project

The TfNSW is seeking the names of Aboriginal people who may hold cultural knowledge relevant to determining the significance of Aboriginal objects and/or places within the project area for the Bobbiwaa Creek Newell Highway, Narrabri. This forms part of the Narrabri to Moree Heavy Duty Pavement project.

Aboriginal people identified by your agency will be notified of the project and invited to participate in the assessment process as described in Department of Environment, Climate Change and Water NSW's requirements. Please forward the details of relevant Aboriginal people to the TfNSW before Monday 23 March 2020.

The contact details for this project are:

Jeffery Charlton
Aboriginal Cultural Heritage Officer
PO Box 36, Dubbo NSW 2830
T **02 6861 1658**
M 0428 463 258
E jeffery.charlton@transport.nsw.gov.au

.../2

Level 1, 188 Macquarie Street, Dubbo NSW 2830 |
PO Box 36, Dubbo NSW 2830 |

Map: Scope of works Bobbiwaa Creek

The TfNSW proposes the following activities: clearing and grubbing; removal and relocate existing fences; utility works (Telstra relocation); new safety barrier on Bobbiwaa Creek Bridge approaches and earthworks, new pavement and table drains.

This letter forms part of the TfNSW' s commitment to actively identify relevant Aboriginal people in accordance with section 4.1.2 of the Department of Environment, Climate Change and Water NSW *Aboriginal cultural heritage consultation requirements for proponents 2010.*

Yours faithfully

Jeff Charlton
Aboriginal Cultural Heritage Officer

Appendix 1 Figure 3: Stage 1 Sample to Aboriginal stakeholders (sample).

NSW GOVERNMENT

6 March 2020

A31429069 | SF2017/019227

Chief Executive Officer
Narrabri Local Aboriginal Land Council
96 Barwan Street
NARRABRI NSW 2390

ceo@narrabrilalc.com.au

Dear Sir/Madam

To seek Aboriginal knowledge holders to assist Transport for NSW (TfNSW) to prepare a cultural heritage assessment report for Bobbiwaa Creek Newell Highway, Narrabri to Moree Heavy Duty Pavement project

The TfNSW is seeking the names of Aboriginal people who may hold cultural knowledge relevant to determining the significance of Aboriginal objects and/or places within the project area for the Bobbiwaa Creek Newell Highway, Narrabri. This forms part of the Narrabri to Moree Heavy Duty Pavement project.

Aboriginal people identified by your agency will be notified of the project and invited to participate in the assessment process as described in Department of Environment, Climate Change and Water NSW's requirements. Please forward the details of relevant Aboriginal people to the TfNSW before Monday 23 March 2020.

The contact details for this project are:

Jeffery Charlton
Aboriginal Cultural Heritage Officer
PO Box 36, Dubbo NSW 2830
T 02 6861 1658
M 0428 463 258
E jeffery.charlton@transport.nsw.gov.au

.../2

Level 1, 188 Macquarie Street, Dubbo NSW 2830 |
PO Box 36, Dubbo NSW 2830 |

Page 2 of 2 Resource 10 – seeking Aboriginal knowledge holders – Bobbiwaa Creek Newell Highway, Narrabri

Map: Scope of works Bobbiwaa Creek

The TfNSW proposes the following activities: clearing and grubbing; removal and relocate existing fences; utility works (Telstra relocation); new safety barrier on Bobbiwaa Creek Bridge approaches and earthworks, new pavement and table drains.

This letter forms part of the TfNSW' s commitment to actively identify relevant Aboriginal people in accordance with section 4.1.2 of the Department of Environment, Climate Change and Water NSW *Aboriginal cultural heritage consultation requirements for proponents 2010.*

Yours faithfully

Jeff Charlton
Aboriginal Cultural Heritage Officer

Appendix 1 Figure 4: Stage 2/3 consultation letter (sent to all RAPs) accompanied by the test excavation methodology and invitation to the AFGM.

Transport Roads & Maritime Services

Resource 18

9 June 2020

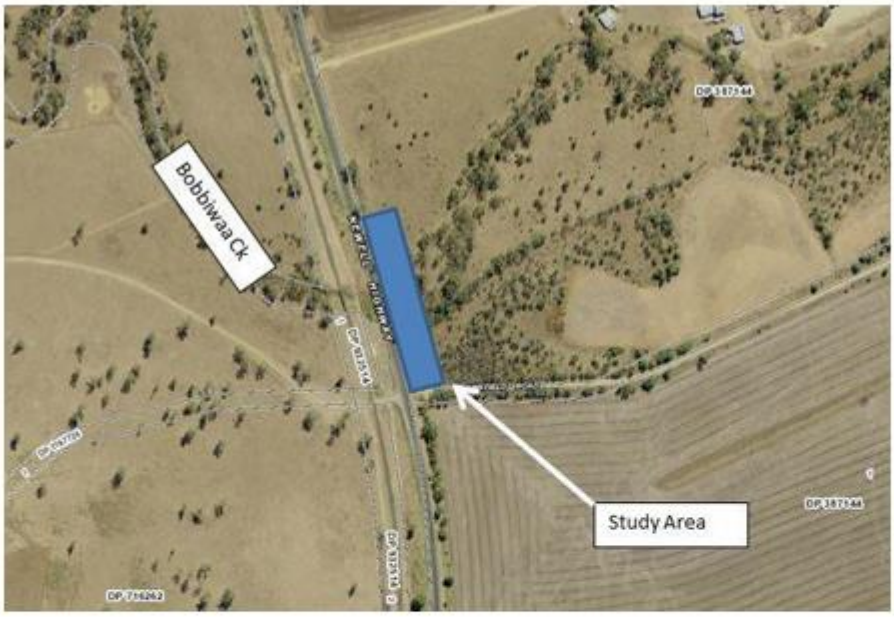
A32622906
SF2015/109172

Chief Executive Officer
Pilliga Local Aboriginal Land Council
4 Dangar Street
PILLIGA NSW 2388
pilligalalc@bigpond.com

Dear Sir/Madam

Invitation to participate in the heritage assessment process and to attend an Aboriginal focus group meeting for the Newell Highway Heavy Duty Pavements Project (Narrabri to Moree)

Transport for NSW (TfNSW) proposes to carry out PACHCI stage 3 test pitting of a Potential Archaeological deposits located near to Bobbiwaa Ck bridge on the Newell Highway approximately 17km North of Narrabri.



TFNSW believes that the project may have an impact on Aboriginal cultural heritage. As a consequence, TFNSW may require approvals under *National Parks & Wildlife Act 1974* and/or the *Environmental Planning & Assessment Act 1979* for this project.

As part of the consultation process, TFNSW seeks cultural information to identify:

Roads & Maritime Services

Level 1, 51-55 Currajong St Parkes NSW 2870
T 02 6861 1658 | **M** 0428 463 258 | **E**
www.transport.nsw.gov.au

- Whether there are any Aboriginal objects of cultural value to Aboriginal people in the area of the proposed project.
- Whether there are any places of cultural value to Aboriginal people in the area of the proposed project. This includes places of social, spiritual and cultural value, historic places with cultural significance, and potential places/areas of historic, social, spiritual and/or cultural significance.

TFNSW will be holding an Aboriginal focus group meeting to discuss the management of Aboriginal cultural heritage for this project, 18 June 2020 at the Crossing Theatre, 117 Newell Highway Narrabri NSW 2390 commencing at 10.45am. An agenda for the meeting has been enclosed.

Also find enclosed a copy of the draft archaeological methodology and archaeological report for your review and comment.

All comments on the cultural values of the study area, the archaeological methodology and/or archaeological report must be received by 5 July 2020. Comments can be provided in writing, by phone or at the Aboriginal focus group meeting.

Aboriginal site officers may be required to undertake archaeological field work for this project. If you would like to nominate an Aboriginal person (including you) to be considered for a site officer role, please fill in and return the attached Aboriginal Site Officer Application Form.

Please advise TFNSW whether any specific disability assistance may be required to assist in your attendance at the meeting, such as wheelchair access, hearing loops etc and any dietary requirements as lunch is to be provided.

Please note that travel expenses will not be reimbursed for attendance at focus group meetings and site visits for this project.

To register your interest in attending the Aboriginal focus group meeting, you should write, email or phone:

Aboriginal cultural heritage advisor,
Ph. (02) 6861 1658
Mobile: 0428 463 258
jeffery.charlton@transport.nsw.gov.au

For further information regarding the TFNSW Aboriginal Cultural Heritage Consultation and Investigation procedure (PACHCI), please refer to the link below.

http://www.rta.nsw.gov.au/environment/downloads/rtaprocedure_aboriginal_cultural.html

We look forward to your participation in the assessment of this project.

Yours faithfully

Jeffery Charlton
Aboriginal cultural heritage advisor,

Appendix 1 Figure 5: AFGM agenda and attendance sheet

AGENDA

Transport Roads & Maritime Services

RESOURCE 20

Name of meeting:	Aboriginal Focus Group Meeting – Newell Highway Heavy Duty Pavement Project-Narrabri to Moree – PACHI stage 3 test pitting for Potential Archaeological Deposits near Bobbiwaa Ck bridge
Location of meeting:	The Crossing Theatre, 117 Newell Highway, Narrabri NSW 2390
Meeting facilitator:	Jodie Benton
Date: 18 June 2020	**Time:** 10.45am for 11.00am start
Attendees:	Jeff Charlton, Aboriginal Cultural Heritage Office, TfNSW Edward Paas, Project Manager TfNSW Jon Blizzard, Environmental Manager TfNSW Jodie Benton, Senior Consultant Ozarks Various Aboriginal Group stakeholders
Please read:	Draft Archaeological report and methodology
Please bring:	n/a

1. Welcome to country/acknowledgement (Allow 1 min)

2. Introductions and apologies (Allow 4 min)

Jeff Charlton

3. Define roles and scope of meeting (Allow 10 min)

Jeff Charlton

5. The proposal (Allow 20 mins)

Edward Paas

6. Archaeological assessment and methodology

Archaeologist – Jodie Benton

7. Cultural assessment

Archaeologist – Jodie Benton

8. Site officer applications (Allow 5 mins)

Archaeologist – Jodie Benton & All - Discuss the need for Aboriginal site officers, and provide site officer applications.

9. Review of outcomes/actions

Meeting End

Memo

Page 1 of 1

Appendix 1 Figure 6: AFGM minutes

Objective Ref enter Objective reference number.

Transport for NSW

MINUTES

Bobbiwaa Creek AFG

Date	18/06/2020		
Time	11am		
Venue	Crossing Theatre Narrabri		
Chairperson	Ed Pass TfNSW Project Manager		
Invitees	Edward Trindall Sheryl Nicholls Noeline Nicholls Robyn Keeffe Alfred Priestley	ED SN NN RK AP	Narrabri LALC Gomeroi Native Title Pilliga LALC Wee Waa LALC Gomeroi Dreaming PTY LTD
Apologies:	Nil		

		Responsible/ Due Date
1.	**Welcome to Country**	Completed
1.1	Sheryl Nicholls was ask from the floor to do the Welcome to Country.	Completed
2.	**Ed Pass Project Manager PowerPoint presentation**	EP
2.1	Questions held over to General Business, but was discussed as delivered See Below	
2.2	APIC was discussed and the Value of the Program $10 million	EP/JC
2.3	**Questions raised :** How would small business be used on this project, stakeholders need to be informed of how the contractor will meet this target and if they will be a sit down meeting with local Aboriginal Business's and community	AP
2.4	**Action;** Project Manager talked about the contractors obligation to provide an Aboriginal action plan and how it will be delivered once the contract is awarded	EP/JC
3.	**Ozark Presentation Methodology**	JB
3.1	**Questions raised**: Number of Site officers and when will the test pitting be done, **Action:** 6 site officers Men and Women equal numbers	JC
3.2	**Questions raised :** How many pits to be dug and how was it going to be done	ET
3.3	**Action:** Ozark spoke on the amount, around 10 pits over two days 500mil x 500mil each, maybe more pending the findings	JB

MINUTES – Bobbiwaa Creek AFG Held on 18/06/20

Objective Ref enter Objective reference number.

		Responsible/ Due Date
3.4	Alf spoke about the high amount of damage to the area because of farming, road construction between the road and fence lines along highways	AP
3.5	Edward spoke about the amount of artefacts that have been lost and the one's still around that area, and how its necessary to preserve them	ET
3.6	**Questions raised**: Are we going to dig on both sides of the roads and why not.	ET/AP
3.7	**Action**: No Ozark explained that its more factual to dig on high ground to have a better chance of artefacts found and where not going on that side because it's not an assessed pad area	JB
4.	**Other Business**	
4.1	All Paperwork will be sent out to the addresses provided	JC
4.2	Will call the week before to confirm attendance	JC
5.	**Next Meeting will be on site** SWMS and inductions plus Covid 19 restrictions on 14/07/2020 at 8am at Bobbiwaa Creek southern side of the bridge	JB/ EP/JC
5.1		Note

STATUS OF ACTIONS FROM LAST MEETING

		Status	Responsible/ Revised Due Date
1.	All Letters of Engagement have been sent out the stakeholders	Completed	JC

MINUTES – Bobbiwaa Creek AFG Held on 18/06/20

APPENDIX 2: TEST EXCAVATION METHODOLOGY

Overview of BC-HW17-PAD1 facing southeast.

ARCHAEOLOGICAL TEST EXCAVATION METHODOLOGY

NEWELL HIGHWAY HEAVY DUTY PAVEMENTS – NARRABRI TO MOREE

BC-HW17-PAD1 INVESTIGATION

NARRABRI NSW

MARCH 2020

Report prepared by

OzArk Environment & Heritage

for Transport for NSW

OzArk
Environment & Heritage
145 Wingewarra St
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Dubbo NSW 2830
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enquiry@ozarkehm.com.au
www.ozarkehm.com.au

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OzArk Environment & Heritage

DOCUMENT CONTROLS

Proponent	Transport for NSW
Client	Jacobs
Document Description	*Archaeological Test Excavation Methodology: Newell Highway Heavy Duty Pavements – Narrabri to Moree. BC-HW17-PAD1 Investigation.*
File Location	OzArk Job No.
S:\OzArk EHM Data\Clients\Jacobs	2499

Document Status **V2.1 FINAL DRAFT**	Date 24 March 2020
Draft V1.0 Author to editor OzArk 1st internal (Series V1 = OzArk internal edits)	V1.0 SR author 17/03/2020 V1.1 BC edit 19/3/20
Draft V2.0 Report Draft for release to client (Series V2 = OzArk and client edits)	V2.0 OzArk to client 19/2/20 V2.1 OzArk amends 24/3/20
FINAL V3.0 = Final report	
Prepared For	Prepared By
Tina Donovan Senior Environmental Scientist Jacobs Tina-Maria.Donovan@jacobs.com	Stephanie Rusden Senior Archaeologist OzArk Environment & Heritage 145 Wingewarra Street (PO Box 2069) Dubbo NSW 2830 P: 02 6882 0118 F: 02 6882 6030 stephanie@ozarkehm.com.au

OzArk Environment & Heritage

Acknowledgement

OzArk acknowledge Traditional Owners of the area on which this assessment took place and pay respect to their beliefs, cultural heritage and continuing connection with the land. We also acknowledge and pay respect to the post-contact experiences of Aboriginal people with attachment to the area and to the elders, past and present, as the next generation of role models and vessels for memories, traditions, culture and hopes of local Aboriginal people.

OzArk Environment & Heritage

CONTENTS

FIGURES

OzArk Environment & Heritage

1 INTRODUCTION

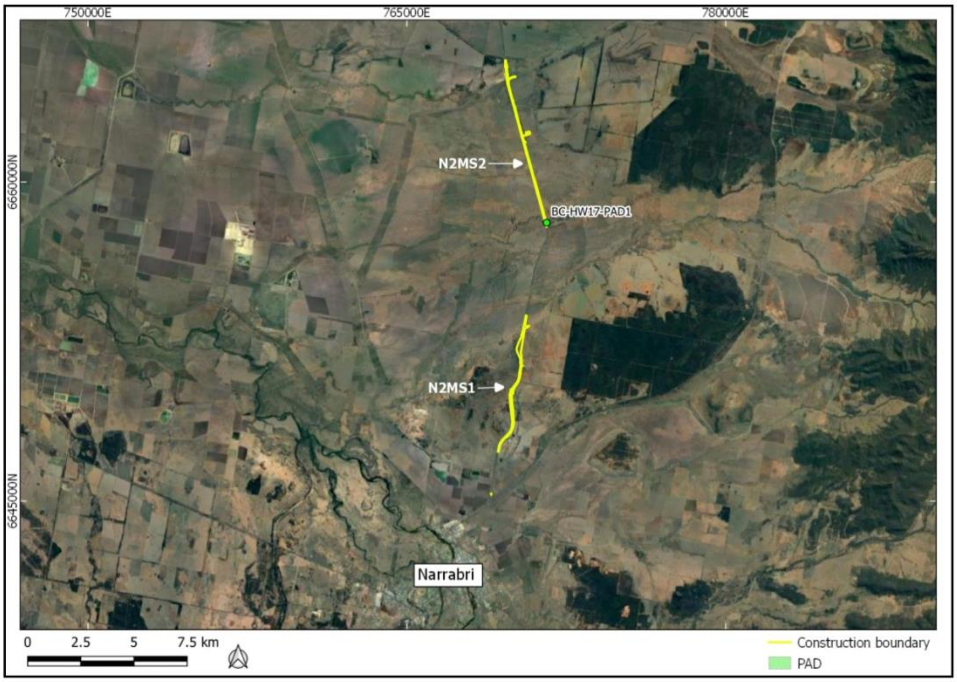
1.1 PREAMBLE

Transport for NSW (TfNSW) have engaged OzArk Environment & Heritage (OzArk) to prepare a test excavation methodology as per Stage 3 of the Roads and Maritime Services *Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (PACHCI; RMS 2011). The proposed text excavation will investigate BC-HW17-PAD1, a potential archaeological deposit (PAD), which will be partially impacted by work associated with the Newell Highway Heavy Duty Pavements – Narrabri to Moree project (N2M; the proposal). BC-HW17-PAD1 is located north of Narrabri along Bobbiwaa Creek in the Narrabri Local Government Area (LGA) (**Figure 1-1**).

Test excavations will be undertaken in accordance with the *Code of Practice for the Investigation of Aboriginal Objects in New South Wales* (Code of Practice; DECCW 2010) (**Section 3**). In addition, this methodology has been prepared in accordance with Stages 2 and 3 of the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (ACHCRs) (DECCW 2010b).

Archaeological test excavation is required to determine if subsurface archaeological material is present and to provide management recommendations in relation to the findings. If the test excavation indicates that Aboriginal objects/features are likely to be impacted by the proposal, then potential impacts will be assessed in an Aboriginal Cultural Heritage Assessment Report (ACHAR).

Figure 1-1: Location of N2MS2 and BC-HW17-PAD1 in relation to Narrabri.



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1.2 BACKGROUND

OzArk (2018) completed an Aboriginal and historic assessment of the project in accordance with Stage 2 of the PACHCI. Three Aboriginal scarred trees and one PAD were recorded during the survey:

- 10-6-0049 (BL-HW17-ST1)
- 19-3-0159 (BC-HW17-ST1)
- 10-6-0050 (TC-HW17-ST1)
- BC-HW17-PAD1.

The three scarred trees have been registered with the Aboriginal Heritage Information Management System (AHIMS) register. The PAD has not yet been registered as an Aboriginal site but will be should the results of the test excavation indicate that the landform contains Aboriginal objects.

The assessment initially found that harm to the recorded Aboriginal sites and the PAD could be avoided in the 100% detail design via the implementation of management strategies. As such, OzArk (2018) recommended the Aboriginal scarred trees and the PAD be demarcated using high visibility ground markers to delineate the site perimeter (i.e. staking and flagging) and be avoided by the works.

Since the completion of the assessment, the construction boundary has been amended for the 100% detail design and the area designated as BC-HW17-PAD1 is no longer able to be avoided. As such, test excavation is required to determine if BC-HW17-PAD1 is an Aboriginal site, and if it is, to enable management measures to be put in place appropriate to the significance of the site.

1.3 THE PROPOSAL

TfNSW proposes to carry out major road upgrades to five segments of the Newell Highway between Narrabri and Moree in north west NSW, within the existing road corridor (the proposal).

The proposal has been separated into five sections. BC-HW17-PAD1 is located at the southern extent of N2MS2, on the northern bank of Bobbiwaa Creek.

Proposed work at the location of BC-HW17-PAD1 will include:

- Clearing and grubbing
- Removal of the existing fence
- Installation of a new fence
- Utility works (relocation of Telstra cables)
- Installation of a new safety barrier on Bobbiwaa Creek bridge and its approaches

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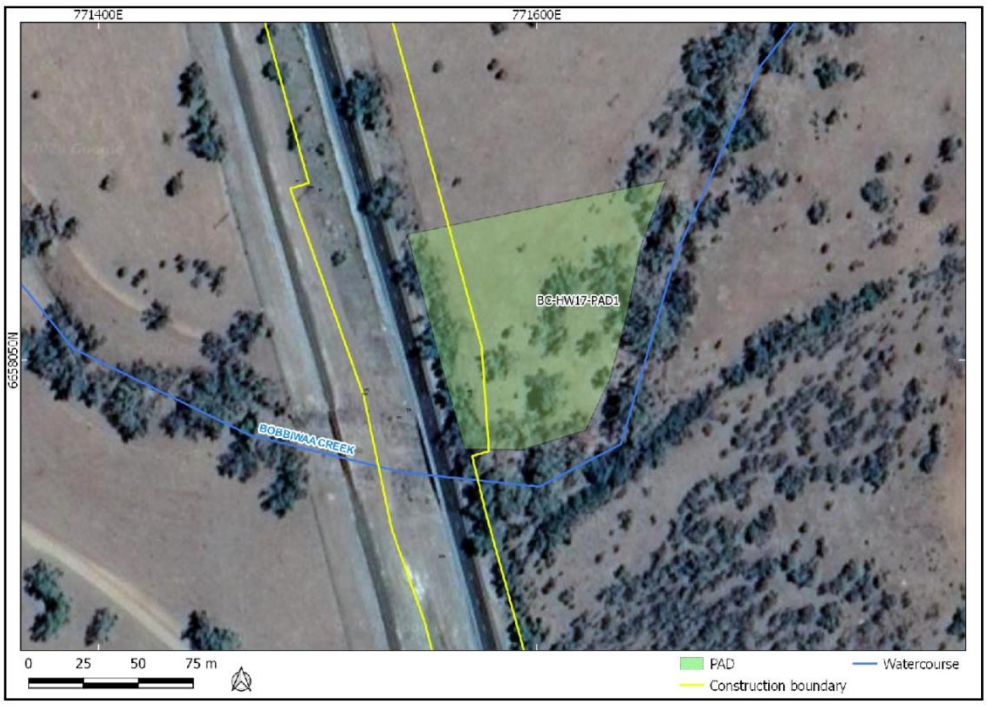
- Earthworks and paving
- Construction of a new table drain.

1.4 STUDY AREA

The study area, BC-HW17-PAD1, is located within Lot 1 DP387144 about 17 kilometres (km) north of the town of Narrabri, a few metres (m) east of the Newell Highway, and 120 m north of the intersection of Junefield Road and the Newell Highway.

Figure 1-2 shows the extent of BC-HW17-PAD1 in relation to the construction boundary of N2MS2.

Figure 1-2: BC-HW17-PAD1 in relation to the construction boundary of the proposal.



1.5 CODE REQUIREMENTS OF THE TEST EXCAVATION PROGRAM

The Code of Practice lists a number of requirements pertaining to test excavation. These requirements are enumerated below and further information pertaining to these requirements follow in subsequent sections of this document.

- **Requirement 14** (Test excavation which is not excluded from the definition of harm):

  Sub-surface investigation will not be excluded from harm where they are carried out in the following areas:

  - in or within 50 m of an area where burial sites are known or are likely to exist

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- in or within 50 m of a declared Aboriginal place
- in or within 50 m of a rock shelter, shell midden or earth mound
- in areas known or suspected to be Aboriginal missions or previous Aboriginal reserves or institutes
- in areas known or suspected to be conflict or contact sites.
  - The test excavation locations are not located within the vicinity of the items listed under Requirement 14 of the Code.

- **Requirement 15a** (Consultation): The ACHCRs have been initiated for the proposal and have been completed to the stage described in subclause 80C (6) of the *National Parks and Wildlife Regulation 2009* (NPW Regulation).
- **Requirement 15b** (Test excavation sampling strategy): This document sets out the proposed sampling strategy for the test excavation program.
- **Requirement 15c** (Notification):
  - the location of the proposed test excavation and the subject area
    - This document sets out the proposed location of the test excavation program
  - the name and contact details of the legal entity with overall responsibility for the project
    - TfNSW, 26 Hampton Street, Dubbo, NSW, 2830
  - the name and contact details of the person who will be carrying out the test excavations where this is different to the legal entity with overall responsibility for the project
    - OzArk, 145 Wingewarra St, Dubbo NSW 2830
  - the proposed date of commencement, and estimated date of completion, of the test excavations
    - Anticipated Commencement: TBC
    - Anticipated Completion: TBC

    Weather permitting, the projected period for the excavation is up to 1.5 days.
  - the location of the temporary storage location for any Aboriginal objects uncovered during the test excavations
    - Aboriginal objects recovered during the excavations will be temporarily stored in a locked cupboard at 145 Wingewarra Street, Dubbo, NSW (OzArk office) for analysis. Other objects, such as faunal or charcoal samples, may be sent to third party specialists for analysis.
- **Requirement 16a** (Test Excavation): The test excavation program will adhere to Requirement 16a of the Code as set out in this document (see **Section 3**).

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- **Requirement 16b** (Objects recovered during test excavations): Aboriginal objects recovered during the excavations will be analysed at 145 Wingewarra Street, Dubbo, NSW (OzArk office). When not being analysed, the objects will be temporarily stored in a locked cupboard at 145 Wingewarra Street, Dubbo, NSW.
- **Requirement 17** (When to stop test excavations): the test excavation program will adhere to the requirements set out in the Code: *Any test excavation carried out under this requirement will cease when suspected human remains area encountered; or when enough information has been recovered to adequately characterise the objects present with regard to their nature and significance*.
    - OzArk shall ensure that this requirement is adhered to during the test excavation program. This will include ceasing work as soon as human skeletal material is noted and immediately notifying the police. If the skeletal material is determined to be Aboriginal, the Biodiversity and Conservation Division (BCD) within the Department of Planning, Industry and Environment (DPIE) will be immediately notified.

2 ARCHAEOLOGICAL BACKGROUND TO THE TEST EXCAVATION PROGRAM

The test excavation program follows a program of pedestrian survey across areas that will be potentially impacted by the proposal. The Aboriginal heritage pedestrian assessment of potentially impacted areas identified one area of PAD (BC-HW17-PAD1) (**Section 1.2**).

2.1 ARCHAEOLOGICAL CONTEXT

2.1.1 Introduction

According to O'Connell and Allen (2004), Aboriginal people have inhabited the Australian continent for at least the last 50,000 years. Hamm et al (2016) report dates of between 46,000 and 49,000 years for the occupation of the arid interior. Aboriginal occupation of the NSW Darling Basin has been dated to over 42,000 years at Willandra Lakes (Bowler et al 2003). At Cuddie Springs, southwest of the proposal near the Macquarie River, flaked and ground stone tools have been found potentially associated with the remains of several megafauna species in horizons dating to between 30,000 and 40,000 years (Field and Dodson 1999; Dodson et al 1993). These dates are subject to continued revision as further evidence of Aboriginal cultural heritage is discovered and as more research is conducted.

2.2 REGIONAL ARCHAEOLOGICAL CONTEXT

Prior to 1980 little or no systematic archaeological studies had been undertaken in the Moree-Narrabri region. In the interim, a number of archaeological studies have since been conducted, providing baseline data for placing past Aboriginal sites within a regional landscape context (e.g. Balme 1985; Purcell 2000 and 2002; Heritage Concepts 2009).

Balme (1985) undertook a study focused on the Moree plains area, including surveys of the four major landforms identified in the area: major river channels, minor channels, floodplain areas not frequently inundated and frequently inundated floodplains. Aboriginal scarred trees and open camp sites were the most commonly recoded site types. Most were located close to water or on elevated areas more distant from water. Erosion had exposed many of the sites. Balme noted that open camp sites were poorly represented, probably due to sediment deposition during flood events, rather than reflecting a true absence of sites.

In an assessment of the Pilliga and Goonoo State Forests, Purcell (2000) recorded 47 and 106 Aboriginal sites respectively. Purcell (2000: 31) found that sites were more frequently located within alluvium landforms including creeks, swamps and chains of ponds surrounded by floodplains and terraces, and that 91.5% of sites were recorded within 200 to 300 m of water. Purcell (2002) found that sites located in the Moree area were often on floodplain and alluvial landforms within a few hundred metres of water. In the Northern Outwash subregion (encompassing BC-HW17-PAD1), sites were found up to 750 m from water sources, with an average distance of about 100 m.

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Heritage Concepts (2009: 70) note that river channels in the Northern Outwash subregion often display evidence of stream channel migration and shifting with numerous palaeochannels present. As such, today's permanent water sources were likely in different locations during earlier periods. Predictive models must therefore take account of both modern and ancient water sources. Purcell (2002) surveyed palaeochannels in the Northern Outwash subregion but did not locate any surface manifestations within these landforms. Balme (1986) notes that palaeochannel landforms have been subjected to extensive sand mining in the region, perhaps destroying Pleistocene period sites within these landforms (Heritage Concepts 2009: 70).

2.3 PREVIOUS SUBSURFACE INVESTIGATIONS WITHIN THE REGION OF THE PROPOSAL

No previous subsurface archaeological investigation has occurred within the study area for the proposal. Nor have subsurface investigations been undertaken in closely adjacent landforms.

Archaeological assessments and associated test excavations that have occurred in the nearby region are summarised below to gain an understanding on the nature of subsurface deposits that may be encountered at BC-HW17-PAD1.

2.3.1 Haglund 1987

Archaeological investigation of locations along proposed Haul Road Route west of Gunnedah.

Haglund (1985) conducted a survey of all previous studies relating to the area immediately north of Gunnedah and the Namoi River. This survey concluded that the archaeology of the area is concentrated along rivers and other permanent waterways. This concentration is a result of both prehistoric land use patterns, in which such locations arguably constituted more permanent camps, and historical land use patterns, such as agriculture, which may have disturbed and/or destroyed the archaeology present in areas away from these waterways (Haglund 1985).

Haglund returned to Gunnedah in 1986 to conduct two test excavations of sites requiring ground truthing (Haglund 1987). These sites were located on opposite sides of the Namoi River and one was a portion of the extensive Namoi River/C.W.R. site. Artefacts were recovered at these sites, however, Haglund noted that the artefacts were largely too dispersed to be considered archaeologically significant and were situated in secondary contexts created by vehicle movement and water flows (Haglund 1987).

2.3.2 OzArk 2004

Archaeological test excavation at Mehi River & Skinners Creek PADs

Ozark (2004) conducted subsurface test excavations within the PADs identified on the banks of the Mehi River (10-3-0032) and Skinners Creek (10-3-0040 & 41) along the then proposed Moree bypass alignment. The PADs identified for testing were located on the east bank of the Mehi River and on either side of Skinners Creek near the location of an isolated find of a 'silcrete' artefact.

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Three 2 m x 4 m excavation squares were excavated on the north side of the elevated terrace adjoining the Mehi River. The top two spits (an arbitrary division of vertical space) were 25 centimetres (cm), the third 30 cm, fourth 35 cm and last 25 cm. Lithic materials were recovered from the upper 80 cm of deposit, which had been disturbed through historic land use, the plastic nature of the soils and heavy bioturbation. Glass and other materials from historic times were located to a depth of 80 cm. The alluvial nature of the deposits suggested that the material recovered was not *in situ*. This is also supported by the small size of the lithics and other materials (none more than 2 cm in size), with the vast majority mostly less than 1 cm in size. The naturally occurring gravels were of a similar size range and did not occur in layers throughout the test pits. The PAD is also part of the Steel Bridge Aboriginal Fringe Camp. No artefacts were found in the excavated pits of the Mehi PAD, and combined with the results of the geomorphological assessment, this suggested that material has been moved within the soil profile by natural processes.

Two 1 m x 1 m pits were excavated on the southern side of Skinners Creek within the then proposed road corridor in three spits of 20 cm. Two diagnostic materials were found within the deposits. A chalcedony artefact was recovered in spit 2 of south pit 1, exhibiting a clear and definite bulb, errailure scar, a platform with a waterworn cortex showing numerous fine impact fractures caused by transport in a high energy reach of a stream. The landform had been clearly disturbed through agricultural activities, the plastic nature of the soils and heavy bioturbation. The alluvial nature of deposits and the water wearing on the artefact suggests that the artefact was not *in situ*. This is also supported by the small size of the lithics (none more than 2 cm in size), with the vast majority mostly less than 1 cm in size. Naturally occurring gravels were of a similar size range and did not occur in layers throughout the test pits.

The northern side of the Skinners Creek PAD occurs on a slight bend where flood waters inundate at more frequent intervals. Two 1 m x 1 m pits were excavated in 20 cm spits with no artefacts or lithic materials recovered. It was concluded that the lack of lithic material, and even naturally occurring gravels, were indicative of the heavy alluvial movement of the deposits.

2.3.3 ARAS 2007

Boggabri Coal Project

ARAS (2007) completed a salvage program at Boggabri Coal Mine for the then proposed open pit and haul road. Excavations were completed at two sites: BC 35 and BC 41. BC 35 comprised two stone artefacts on a forestry track within the Leard State Forest. One metre square test probes were excavated along the track. A total of 18.6 square metres ($m^{2)}$ were excavated and 179 artefacts recovered. Excavation of Site BC 35 revealed evidence of stone tool manufacturing and knapping events and a small number of backed artefacts were recorded.

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BC 41, located on the edge of Nagero Creek, comprised three artefacts on a creek terrace. The site was considered part of the complex of five loci in this area. A total of 8 m^2 was excavated and 30 artefacts were recorded. In both areas, artefacts were recorded in the A-Horizon of the duplex soils.

The following conclusions were made following text excavation:

- Over 90% of artefacts recovered from test excavations consist of unmodified broken flakes and flaked piece material
- Retouch or modified tools account for less than 2% of the entire stone artefact record
- A majority of stone tool raw material used in stone tool production is derived from local volcanic siliceous origins located within colluvial gravels near ridgelines
- Exotic stone raw materials (i.e. cherts, quartz, silcretes) account for less than 10% of the entire stone artefact assemblage recorded.

2.4 DESCRIPTION OF BC-HW17-PAD1

BC-HW17-PAD1 is located on the northern bank of Bobbiwaa Creek within an alluvial plain supporting a highly modified open woodland and riparian habitat (**Figure 1-2** and **Figure 2-1**). The PAD extends for approximately 100 m (east–west) by 110 m (north–south) encompassing a flat, slightly raised landform above the creek bank. The PAD includes a point bar deposit on the inner bank of Bobbiwaa Creek and the landform encompassed by the PAD has a slightly elevated topography relative to the surrounding alluvial plain.

Vegetation clearance, animal grazing and trampling, fencing, the construction and maintenance of the Newell Highway and possibly ploughing are likely to have affected the integrity of any archaeological deposits. Nevertheless, intact archaeological deposits are considered likely to exist in the PAD area.

The identification of BC-HW17-PAD1 was based upon the prediction that artefact scatters (i.e. open camp sites) in the Northern Outwash subregion are likely to occur within a few hundred metres of major watercourses, particularly on raised landforms adjacent to those watercourses. These landforms are relatively infrequently inundated comparted to the more frequently flooded plains further west. Very few Aboriginal PADs have been identified in the region and even fewer have been subjected to subsurface archaeological investigation (Heritage Concepts 2009: 45–46). As such, the careful identification of PADs, including those identified entirely on the basis of landform potential, is vital to the ongoing characterisation of the region's apparently sparse Aboriginal archaeological record.

Figure 2-1: Photographs showing an overview of BC-HW17-PAD and the existing bridge over Bobbiwaa Creek.

1. Overview of BC-HW17-PAD1 showing the flat slightly elevated landform above the northern and western creek bank, facing southeast.

2. View showing the Newell Highway and the existing bridge over Bobbiwaa Creek from the northern bank, facing south. The BC-HW17-PAD1 boundary is on the left.

2.5 PREDICTIVE MODEL

Heritage Concepts (2009: 69–72) developed a predictive model for the Northern Outwash subregion of the Brigalow Belt South bioregion. Flood mapping indicates that the alluvial plains of the Northern Outwash subregion are not frequently inundated, with flooding generally confined to the immediate overbank areas. As such, occupational sites are more likely to be located within 100 m of major watercourses, since they are infrequently covered by alluvial deposits, than on the frequently flooded plains located to the west. Erosion acting on high points on the alluvial plains is likely to create lag deposits due to the flat topography.

Based on the conclusions provided by Heritage Concepts (2009), alluvial landforms such as those at BC-HW17-PAD1 are more likely to preserve archaeological evidence due to aggradation. However, a general under-representation of archaeological deposits may be expected within the alluvial landform due to potential past intensive agricultural practices. If objects are found to be preserved *in situ* they are likely to represent episodic small-scale events that have subsequently been covered. Alternatively, objects may have been transported and deposited in secondary contexts via fluvial processes.

Knowledge of the environmental contexts of the study area and a desktop review of additional known local and regional archaeological record, the following further predictions are made concerning the potential for subsurface deposits to occur:

- Should subsurface material be identified, the most common raw material will be volcanic materials, cherts, quartz and silcrete. These items would likely have been sourced outside of the immediate surrounds of the BC-HW17-PAD1

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- Artefactual material will most likely comprise unmodified flakes (including flaked pieces and broken flakes), cores, a small collection of blades and worked tools, and debitage pieces. It is expected that unmodified flakes will dominate the overall artefact assemblage
- Due to the predicted alluvial nature of the soil deposits, the depth of pits will likely be relatively deep before B-Horizon soils are encountered
- Should evidence of agricultural disturbance be observed, they will have likely impacted the top 20 cm of the A-Horizon
- Artefacts will likely be associated with the A-Horizon soils layers indicating a date in the Holocene period (i.e. in the past 12,000 years).

2.6 RESEARCH QUESTIONS

Several research questions can meaningfully be applied to the test excavation program which can guide the required information and outcomes that are proposed to be achieved. These research questions include:

- Are there subsurface archaeological deposits that confirm the recorded area as a site?
- How does the artefactual material and stratigraphy identified at the site compare to other archaeological excavations undertaken in the local area and the region?
- Do the elevated landforms associated with Bobbiwaa Creek preserve intact subsurface archaeological deposits?
- Are additional archaeological features, such as hearths, present in the site area?
- Can chronological dates be obtained (i.e. from *in situ* charcoal samples) that will aid our understanding of Aboriginal occupation in the region?

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3 PROPOSED METHODS

3.1 PURPOSE OF THE TEST EXCAVATION METHODOLOGY

The purpose of the test excavation program is to determine whether sub-surface material is present at BC-HW17-PAD1 and examine the extent of sub-surface material. Data obtained from the test excavation program will inform the mitigation and management options.

The aims of the test excavation are to:

1. Establish whether there are any subsurface deposits at the PAD within the construction boundary. If there are subsurface deposits, then the extent and nature of the subsurface archaeological deposits will also be established
2. Use the data gained from the test excavation program to better evaluate the archaeological significance and potential of the site area
3. Develop, in consultation with the Registered Aboriginal Parties (RAPs) and the proponent, an informed strategy for the management of impacts to any Aboriginal cultural heritage likely to be impacted by the proposal.

Excavations undertaken as per the Code do not require an Aboriginal Heritage Impact Permit (AHIP) under the *National Parks and Wildlife Act 1974* (NPW Act).

3.2 SAMPLING STRATEGY

OzArk (2018) identified an area of PAD (BC-HW17-PAD) which partially overlaps with the construction boundary of the project (**Figure 1-2**). Two transects, each consisting of five 0.5 m x 0.5 m test pits (spaced about 10 m apart) will be excavated within the portion of the PAD which overlaps with the construction boundary (**Figure 3-1**).

Ultimately, the location of the excavation pits will be confirmed in the field so that they are placed at the most advantageous locations (i.e. areas likely to contain subsurface deposits and away from areas of localised disturbance and/or areas frequently inundated. Once excavation commences, should pits encounter shallow A-Horizon soils or show evidence of high past disturbance, modification of pit locations will likely occur so that pits are placed in areas that have the potential to provide information on the subsurface deposits.

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Figure 3-1: Preliminary layout of test excavation pits[1].

[1] Please note: these are preliminary locations and may be subject to slight variation in the field. However, pits will remain in the construction boundary as this reflects the area for the proposed ground impact work.

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3.3 PERSONNEL AND METHODS

The excavation program will be undertaken by archaeologists and RAPs and will include the following aspects:

1. Two transects will be excavated within the PAD and the construction boundary. Preliminary location of pits has been proposed, however, exact locations of pits will be discussed and determined on the day in consultation with OzArk and the RAPs.
2. Prior to any excavation, the site will be recorded via digital photography.
3. A minimum of ten 0.5 m x 0.5 m excavation units will be excavated in the proposed transects. Excavation pits will be spaced about 10 m apart.
4. Initial excavation squares will be excavated in 5 cm spits to determine whether archaeological stratigraphy is present. If not, spit size will be increased to 10 cm. If archaeological stratigraphy is present, this can be used rather than spits, otherwise spit size will return to 5 cm units.
5. If the soils within the PAD are deep, the decision on when to stop excavation will rest with the supervising archaeologist although Requirement 16a, point 9 will be followed. This states: *Test excavation units must be excavated to at least the base of the identified Aboriginal object-bearing units, and must continue to confirm the soils below are culturally sterile*.
6. The excavated material from all pits will be sieved on-site using dry sieving methods through nested sieves of a five millimetre (mm) mesh.
7. Each excavator (by hand) will be responsible for sieving the deposit from their pit, retrieving the artefacts and, in conjunction with the supervising archaeologist, correctly recording their provenance. There could be some room for assistance with the sieving, but a self-contained approach is preferable. Deposits will be sieved on to tarpaulins and the spoil used to backfill the pit once the pit has been photographed and recorded.
8. A standard excavation recording form will be used for each excavated pit. Details will include; date, site recorder, spit number and depth, description of finds, description of soil, sketch plan of excavation (if relevant to show structure), end of spit levels, and soil pH (when necessary or appropriate).
9. It is envisioned that the excavation crew will consist of two archaeologists and up to four RAP representatives over one and a half (1.5) days. The excavator of each pit, in conjunction with the supervising archaeologist, will be responsible for ensuring any forms are correctly completed. It will be the site archaeologist's responsibility to perform all photographic tasks, undertake any planning and section drawing if required and to ensure that a correct location of each pit is maintained.

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10. Given that the work will be physical, all persons participating on the test excavation program should be aware of this and be 'fit for work'.
11. If a feature of conservation value is encountered, then additional archaeological pits may be excavated to ensure documentation of the feature. The decision of whether any expansion is warranted rests with the supervising archaeologist.
12. Photographic and scale-drawn recordings of the stratigraphic/soil profile features and informative Aboriginal objects must be made for each single excavation point if warranted (i.e. archaeological stratigraphy is encountered). At a minimum, an indicative section of each pit will be photographed.
13. Analysis of all excavated lithics will be made to determine the site's characteristics and to enable the site to be compared with other sites in the region. Analysis will also assist in determining what type of activities the Aboriginal people carried out at the site and their relationship with local resources (fauna, flora, water and stone). All artefacts will be analysed and selectively photographed, and the more diagnostic artefacts may be drawn by a lithic specialist.
14. If charcoal from a secure context is obtained, it may be sent to a laboratory for C14 dating (subject to proponent's agreement). If deposits dictate it, further dating attempts may be warranted (e.g. thermoluminescence: subject to proponent's agreement).
15. All faunal remains, if recovered, will be analysed by a fauna specialist. Remnant shell and bone fragments may assist in determining what foods Aboriginal people may have eaten at the specific site and may elucidate possible foraging strategies. In conjunction with *in situ* stone tools, bone/shell fragments may also provide evidence of specific usage of stone tools for food processing.
16. Artefacts will remain at the OzArk office (145 Wingewarra Street, Dubbo NSW) until the analysis is complete. Once complete, the artefacts will remain at the OzArk office where whey will be kept at a locked location until point 18 below is enacted.
17. Excavation results will be used to advise further courses of action in relation to the management and mitigation options for the project.
18. Once all excavation activities for this project are complete, artefacts, if present, will be amalgamated and their future care and control will be a negotiated agreement between the RAPs and DPIE.

3.4 SAMPLING STRATEGY COMPLIANCE WITH THE CODE: REQUIREMENT 16

1. Test excavation units must be placed on a systematic grid appropriate to the scale of the area—either PAD or site—being investigated e.g. 10 m intervals, or other justifiable and regular spacing

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- The sampling strategy outlined above complies with this requirement. All pits will be confined to within the PAD and placed along linear alignments in the area proposed for the ground disturbance work.

2. Any test excavation point must be separated by at least 5 m

   - The sampling strategy outlined above complies with this requirement. There are ten test pits proposed to be excavated in the PAD across two transects all separated by 10 m. The Code allows for expansion around pits displaying an archaeological feature. These 'expansions' are limited to a maximum area of 3 m^2.

3. Test excavations units must be excavated using hand tools only

   - The sampling strategy outlined above complies with this requirement.

4. Test excavations must be excavated in 0.5 m x 0.5 m units

   - The sampling strategy outlined above complies with this requirement. However, depending on the depth to the B-Horizon identified in the pits, additional pit/s may be placed adjacent (making the pits 0.5m x 1m) to determine the depth of the horizon and identified stratigraphic information should the pits become too deep to excavate at 0.5 m x 0.5 m
   - Once the B-Horizon has been reached, a hand auger will be used to identify if there is a change in soil composition or the presence of Aboriginal objects.

5. Test excavations units may be combined and excavated as necessary to understand the site characteristics, however:

   - i) the maximum continuous surface area of a combination of test excavation units at any single excavation point conducted in accordance with point 1 (above) must be no greater than 3 m^2
     - The sampling strategy outlined above complies with this requirement.
   - ii) The maximum surface area of all test excavation units must be no greater than 0.5% of the area—either PAD or site—being investigated
     - The area of BC-HW17-PAD1 is approximately 9,322 m^2. The area of PAD shown in **Figure 3-1** displays the extent of the PAD which is 105 m north–south and 120 m east–west. Based on the size of the PAD, no more than 46.6 m^2 of the PAD can be excavated. However, for the proposed testing program, less than 0.5% of the PAD area will be investigated and testing will be undertaken only within the areas of proposed ground impact. This methodology proposes that ten 0.5 m x 0.5 m squares being excavated, totalling 2.5 m^2 of the PAD.

6. Where the 0.5 m x 0.5 m excavation unit is greater than 0.5% of the area then point 5 (ii) (above) does not apply

   - Not applicable, see point 5 ii).

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7. The first excavation unit must be excavated and documented in 5 cm spits at each area—either PAD or site—being investigated. Based on the evidence of the first excavation unit, 10 cm spits or sediment profile/stratigraphic excavation (whichever is smaller) may then be implemented

   - Complies. See **Section 3.3** point 4.

8. All material excavated from the test excavation units must be sieved using a 5 mm aperture wire-mesh sieve

   - Complies. See **Section 3.3** point 6.

9. Test excavation units must be excavated to at least the base of the identified Aboriginal object-bearing units and must continue to confirm the soils below are culturally sterile

   - This requirement will be fulfilled in the field and all excavation squares will be excavated to the basal clays or where it is considered that culturally sterile units are present. The decision on when this point is reached will rest with the supervising archaeologist.

10. Photographic and scale-drawn records of the stratigraphy/soil profile features and informative Aboriginal objects must be made for each single excavation point

    - Complies. See **Section 3.3** points 8, 9, 13, 14, 15 and 16.

11. Test excavations units must be backfilled as soon as practicable

    - Complies. See **Section 3.3** point 7.

12. Following test excavation, if Aboriginal objects have been identified the site card will be updated with the additional site information and submitted to the AHIMS Registrar as soon as practicable. Following the submission of the site card to the AHIMS Registrar an Aboriginal Site Impact Recording form will be completed as in accordance with the requirements of the Code

    - It will be the responsibility of OzArk to ensure that this requirement is met.

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REFERENCES

ARAS 2007 — ARAS. 2007. *Boggabri Coal Project Final Report: Section 87 and 90 Consent Conditions*. Report to Idemitsu Boggabri Coal Pty Ltd.

Balme 1985 — Balme, J. 1985. *A preliminary Archaeological Assessment of the Moree Plains Shire Council Region*. Report to Moree Plains Shire Council.

Bowler et al 2003 — Bowler, James M., Harvey Johnston, Jon M. Olley, John R. Prescott, Richard G. Roberts, Wilfred Shawcross and Nigel A. Spooner 2003. New Ages for Human Occupation and Climatic Change at Lake Mungo, Australia. *Nature* 421(6925): 837.

DECCW 2010 — Department of Environment, Climate Change and Water. 2010. *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales*. Department of Environment, Climate Change and Water, Sydney.

DECCW 2010b — Department of Environment, Climate Change and Water, Sydney (now BCD). 2010. *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010*.

Dodson at al. 1993 — Dodson, John, Richard Fullagar, Judith Furby, Robert Jones and Ian Prosser 1993. Humans and Megafauna in a Late Pleistocene Environment from Cuddie Springs, North Western New South Wales. *Archaeology in Oceania* 28(2): 94–99.

Field and Dodson 1999 — Field, Judith and John Dodson 1999. Late Pleistocene Megafauna and Archaeology from Cuddie Springs, South-Eastern Australia. *Proceedings of the Prehistoric Society* 65: 275–301.

Haglund 1985 — Haglund and Associates 1985. *Archaeological Investigations of areas that may be affected by proposed mining for coal in the Gunnedah area, NSW*. Report to Vickery Joint Venture.

Haglund 1987 — Haglund and Associates 1987. *Archaeological investigation of locations along proposed haul road route west of Gunnedah, NSW*. Report to Vickery Joint Venture.

Hamm et al 2016 — Hamm, Giles, Peter Mitchell, Lee J. Arnold, Gavin J. Prideaux, Daniele Questiaux, Nigel A. Spooner, Vladimir A. Levchenko, Elizabeth C. Foley, Trevor H. Worthy, Birgitta Stephenson, Vincent Coulthard, Clifford Coulthard, Sophia Wilton and Duncan Johnston 2016. Cultural Innovation and Megafauna Interaction in the Early Settlement of Arid Australia. *Nature* 539(7628): 280–283.

OzArk Environment & Heritage

Heritage Concepts 2009 — Heritage Concepts Pty Ltd 2009. *Aboriginal Heritage Study: Moree Plains Shire Council Local Environmental Plan*. Report to Moree Plains Shire Council.

O'Connell and Allen 2004 — O'Connell, James F. and J. Allen 2004. Dating the Colonization of Sahul (Pleistocene Australia-New Guinea): A Review of Recent Research. *Journal of Archaeological Science* 31: 835–853.

OzArk 2004 — OzArk Environment & Heritage. 2004. *Archaeological Test Excavation of Mehi River (#10-3-0032) & Skinners Creek PADs (#10-3-0040 & 41): Proposed Moree Bypass, Moree, NSW.* Report to Roads and Traffic Authority.

OzArk 2018 — OzArk Environment & Heritage. 2018. *Aboriginal and Historic Archaeological Survey Report: Newell Highway HD Pavements – Narrabri to Moree*. Report to Roads and Maritime Services.

Purcell 2000 — Purcell, P. 2000. *Aboriginal Cultural Heritage Assessment: Brigalow Belt South, Stage 1*. Report to: Resource and Conservation Assessment Council.

Purcell 2002 — Purcell, P. 2002. *Aboriginal Cultural Heritage Assessment: Brigalow Belt South Bioregion, Stage 2*. Report to: Resource and Conservation Assessment Council.

RMS 2011 — Roads and Maritime Services (now TfNSW). 2011. *Procedure for Aboriginal Cultural Heritage Consultation and Investigation*. Roads and Maritime Services, Sydney.

APPENDIX 3: ABORIGINAL HERITAGE: UNANTICIPATED FINDS PROTOCOL

7. Unexpected heritage items procedure

Table 1: Specific tasks to be implemented following the discovery of an unexpected heritage item.

Aboriginal Cultural Heritage Advisor (ACHA); Aboriginal Sites Officer (ASO); Archaeologist (A); Project Manager (PM); Regional Environment Staff (RES); Registered Aboriginal Parties (RAPs); Senior Environmental Specialist (Heritage) (SES(H)); Team leader – Roads and Maintenance Division (TL - RMD); Works supervisor – Roads and Maintenance Division (WS - RMD).

Step	Task	Responsibility	Guidance & Tools
1	**Stop work, protect item and inform Roads and Maritime environment staff**		
1.1	Stop all work in the immediate area of the item and notify the Project Manager or Team Leader-RMD. (For maintenance activities, the Team Leader is to also notify the Works Supervisor-RMD)	All	**Appendix A** (Identifying Unexpected Heritage items)
1.2	Establish a 'no-go zone' around the item. Use high visibility fencing, where practical.	PM or TL-RMD	
1.3	Inform all site personnel about the no-go zone. No further interference, including works, ground disturbance, touching or moving the item must occur within the no-go zone.	PM or TL-RMD	
1.4	Inspect, document and photograph the item using 'Unexpected Heritage Item Recording Form 418'.	PM or TL-RMD	**Appendix B** (Unexpected Heritage Item Recording Form 418) **Appendix C** (Photographing Unexpected Heritage Items)

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	If **yes**, follow the steps in Appendix E – 'Uncovering bones'. Where it is obvious that the bones are human remains, you must notify the local police by telephone immediately. They may take command of all or part of the site. If **no**, proceed to next step.	PM or WS-RMD	**Appendix E** (Uncovering Bones)
	Is the item likely to be: a) A relic? (A relic is evidence of past human activity which has local or state heritage significance. It may include items such as bottles, utensils, remnants of clothing, crockery, personal effects, tools, machinery and domestic or industrial refuse) and/or b) An Aboriginal object? (An Aboriginal object may include a shell midden, stone tools, bones, rock art or a scarred tree). If **yes**, proceed directly to Step 1.8 If **no**, proceed to next step.	PM or WS-RMD	**Appendix A** (Identifying heritage items)
	Is the item likely to be a "work", building or standing structure? (This may include tram tracks, kerbing, historic road pavement, fences, sheds or building foundations). If **yes**, can works avoid further disturbance to the item? (E.g. if historic road base/tram tracks have been exposed, can they be left in place?) If **yes**, works may proceed without further disturbance to the item. Complete Step 1.8 within 24 hours. If works cannot avoid further disturbance to the item, works must not recommence at this time. Complete the remaining steps in this procedure.	PM or WS-RMD	**Appendix A** (Identifying heritage items)

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Step	Task	Responsibility	Guidance & Tools
1.8	Inform relevant Roads and Maritime Regional Environmental Staff of item by providing them with the completed 'Form 418'.	PM or WS-RMD (RES)	**Appendix D** (Key Environmental Contacts)
1.9	Regional Environmental Staff to advise Project Manager or Works Supervisor whether RMS has an approval or safeguard in place (apart from this procedure) to impact on the 'item'. (An approval may include an approval under the *Heritage Act*, the *National Parks and Wildlife Act* or the *Planning and Assessment Act*). Does RMS have an approval, permit or appropriate safeguard in place to impact on the item? If **yes**, work may recommence in accordance with the approval, permit or safeguard. There is no further requirement to follow this procedure. If **no**, continue to next step.		
1.10	Liaise with Traffic Management Centre where the delay is likely to affect traffic flow.	PM or WS-RMD	
1.11	Report the item as a 'Reportable Event' in accordance with the Roads and Maritime *Environmental Incident Classification and Reporting Procedure*. Implement any additional reporting requirements related to the project's approval and CEMP, where relevant.	PM or WS-RMD	RMS Environmental Incident Classification and Reporting Procedure
2	**Contact and engage an archaeologist and, where required, an Aboriginal site officer**		
2.1	Contact the Project (on-call) Archaeologist to discuss the location and extent of the item and to arrange a site inspection, if required. The project CEMP may contain contact details of the Project Archaeologist. OR	PM or WS-RMD (A; RES; SES(H))	Also see **Appendix D** (Key Environmental Contacts)

Step	Task	Responsibility	Guidance & Tools
	Where there is no project archaeologist engaged for the works, engage a suitably qualified and experienced archaeological consultant to assess the find. A list of heritage consultants is available on the RMS contractor panels on the Buyways homepage. Regional environment staff and Roads and Maritime heritage staff can also advise on appropriate consultants.		Buyways
2.2	Where the item is likely to be an Aboriginal object, speak with your Aboriginal Cultural Heritage Advisor to arrange for an Aboriginal Sites Officer to assess the find. Generally, an Aboriginal Sites Officer would be from the relevant local Aboriginal land council. If an alternative contact person (ie a RAP) has been nominated as a result of previous consultation, then that person is to be contacted.	PM or WS-RMD (ACHA; ASO)	
2.3	If requested, provide photographs of the item taken at Step 1.4 to the archaeologist, and Aboriginal Sites Officer if relevant.	PM or WS-RMD (RES)	**Appendix C** (Photographing Unexpected Heritage items)
3	**Preliminary assessment and recording of the find**		
3.1	In a minority of cases, the archaeologist (and Aboriginal Sites Officer, if relevant) may determine from the photographs that no site inspection is required because no archaeological constraint exists for the project (*eg the item is not a 'relic', a 'heritage item' or an 'Aboriginal object'*). Any such advice should be provided in writing (eg via email) and confirmed by the Project Manager or Works Supervisor - RMD.	A/PM/ASO/ WS-RMD	Proceed to Step 8
3.2	Arrange site access for the archaeologist (and Aboriginal Sites Officer, if relevant) to inspect the item as soon as practicable. In the majority of cases a site inspection is required to conduct a preliminary assessment.	PM or WS-RMD	
3.3	Subject to the archaeologist's assessment (and the Aboriginal Sites Officer's assessment, if relevant), work may recommence at a set distance from the item. This is to protect any other archaeological material that may exist in the vicinity, which has not yet been uncovered. Existing protective fencing established in Step 1.2 may need to be adjusted to	A/PM/ASO/ WS-RMD	

Step	Task	Responsibility	Guidance & Tools
	reflect the extent of the newly assessed protective area. No works are to take place within this area once established.		
3.4	The archaeologist (and Aboriginal Sites Officer, if relevant) may provide advice after the site inspection and preliminary assessment that no archaeological constraint exists for the project (*eg the item is not a 'relic', a 'heritage item' or an 'Aboriginal object'*). Any such advice should be provided in writing (eg via email) and confirmed by the Project Manager or Works Supervisor - RMD.	A/PM/ASO/ WS-RMD	Proceed to Step 8
3.5	Where required, seek additional specialist technical advice (such as a forensic or physical anthropologist to identify skeletal remains). Regional environment staff and/or Roads and Maritime heritage staff can provide contacts for such specialist consultants.	RES/SES(H)	**Appendix D** (Key Environmental Contacts)
3.6	Where the item has been identified as a 'relic', 'heritage item' or an 'Aboriginal object' the archaeologist should formally record the item.	A	
3.7	The regulator can be notified informally by telephone at this stage by the archaeologist, Project Manager (or delegate) or Works Supervisor - RMD. Any verbal conversations with regulators must be noted on the project file for future reference.	PM/A/WS-RMD	
4	**Prepare an archaeological or heritage management plan**		
4.1	The archaeologist must prepare an archaeological or heritage management plan (with input from the Aboriginal Sites Officer, where relevant) shortly after the site inspection. This plan is a brief overview of the following: (a) description of the feature, (b) historic context, if data is easily accessible, (c) likely significance, (d) heritage approval and regulatory notification requirements, (e) heritage reporting requirements, (f) stakeholder consultation requirements, (g) relevance to other project approvals and management plans etc.	A/ASO	**Appendix F** (Archaeological/ Heritage Advice Checklist)
4.2	In preparing the plan, the archaeologist with the assistance of regional environment staff must review the CEMP, any heritage sub-plans, any conditions of heritage approvals, conditions of project approval (and or Minister's Conditions of Approval) and heritage assessment documentation (eg Aboriginal Cultural Heritage Assessment Report). This will outline if the unexpected item is consistent with previous heritage/project approval(s)	A/RES/PM	**Appendix F** (Archaeological/ Heritage Advice Checklist)

Step	Task	Responsibility	Guidance & Tools
	and/or previously agreed management strategies. The Project Manager and regional environment staff must provide all relevant documents to the archaeologist to assist with this. Discussions should occur with design engineers to consider if re-design options exist and are appropriate.		
4.3	The archaeologist must submit this plan as a letter, brief report or email to the Project Manager outlining all relevant archaeological or heritage issues. This plan should be submitted to the Project Manager as soon as practicable. Given that the archaeological management plan is an overview of all the necessary requirements (and the urgency of the situation), it should take no longer than two working days to submit to the Project Manager.	A	
4.4	The Project Manager or Works Supervisor must review the archaeological or heritage management plan to ensure all requirements can reasonably be implemented. Seek additional advice from regional environment staff and Roads and Maritime heritage staff, if required.	PM/RES/SES(H)/ WS-RMD	
5	**Notify the regulator, if required.**		
5.1	Review the archaeological or heritage management plan to confirm if regulator notification is required. Is notification required? If **no**, proceed directly to Step 6 If **yes**, proceed to next step.	PM/RES/SES(H)/ WS-RMD	
5.2	If notification is required, complete the template notification letter.	PM or WS-RMD	**Appendix G** (Template Notification Letter)
5.3	Forward the draft notification letter, archaeological or heritage management plan and the site recording form to regional environment staff and Senior Environmental Specialist (Heritage) for review, and consider any suggested amendments.	PM/RES/SES(H)/ WS-RMD	

Step	Task	Responsibility	Guidance & Tools
5.4	Forward the signed notification letter to the relevant regulator (ie notification of relics must be given to the Heritage Division, Office of Environment and Heritage (OEH), while notification for Aboriginal objects must be given to the relevant Aboriginal section of OEH). Informal notification (via a phone call or email) to the regulator prior to sending the letter is appropriate. The archaeological management plan and the completed site recording form must be submitted with the notification letter. For Part 3A and Part 5.1 projects, the Department of Planning and Environment must also be notified.	PM or WS-RMD	**Appendix D** (Key Environmental Contacts)
5.5	A copy of the final signed notification letter, archaeological or heritage management plan and the site recording form should be kept on file by the Project Manager or Works Supervisor- RMD and a copy sent to the Senior Environmental Specialist (Heritage).	PM or WS-RMD	
6	**Implement archaeological or heritage management plan**		
6.1	Modify the archaeological or heritage management plan to take into account any additional advice resulting from notification and discussions with the regulator.	A/PM or WS-RMD (RES)	
6.2	Implement the archaeological or heritage management plan. Where impact is expected, this would include such things as a formal assessment of significance and heritage impact assessment, preparation of excavation or recording methodologies, consultation with registered Aboriginal parties, obtaining heritage approvals etc, if required.	PM or WS-RMD (RAPs and RES)	PACHCI Stage 3
6.3	Where heritage approval is required contact regional environment staff for further advice and support material. Please note time constraints associated with heritage approval preparation and processing. Project scheduling may need to be revised where extensive delays are expected.	PM/RES/WS-RMD	
6.4	For Part 3A/Part 5.1 projects, assess whether heritage impact is consistent with the project approval or if project approval modification is required from the Department of Planning and Environment. Seek advice from regional environment staff and Environment Branch specialist staff if unsure.	PM/RES	

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Step	Task	Responsibility	Guidance & Tools
6.5	Where statutory approvals (or project approval modification) are required, impact upon relics and/or Aboriginal objects must not occur until heritage approvals are issued by the appropriate regulator.	PM or WS-RMD	
6.6	Where statutory approval (or Part 3A/Part 5.1 project modification) is not required and where recording is recommended by the archaeologist, sufficient time must be allowed for this to occur.	PM or WS-RMD	
6.7	Ensure short term and permanent storage locations are identified for archaeological material or other heritage material is removed from site, where required. Interested third parties (eg museums or local councils) should be consulted on this issue. Contact regional environment staff and Senior Environmental Specialist (Heritage) for advice on this matter, if required.	PM or WS-RMD	
7	**Review CEMPs and approval conditions**		
7.1	Check whether written notification is required to be sent to the regulator before re-commencing work. Where this is not explicit in heritage approval conditions, expectations should be clarified directly with the regulator.	PM	
7.2	Update the CEMP, site mapping and project delivery program as appropriate with any project changes resulting from final heritage management (eg retention of heritage item, salvage of item). Updated CEMPs must incorporate additional conditions arising from any heritage approvals, and Aboriginal community consultation if relevant. Include any changes to CEMP in site induction material and update site workers during toolbox talks.	PM	
8	**Resume work**		
8.1	Seek written clearance to resume project work from regional environment staff and the archaeologist (and regulator, if required). Clearance would only be given once all archaeological excavation and/or heritage recommendations (where required) are complete. Resumption of project work must be in accordance with the all relevant project/heritage approvals/determinations.	RES/A/PM/WS-RMD	
8.2	If required, ensure archaeological excavation/heritage reporting and other heritage	PM/A/WS-RMD	

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Step	Task	Responsibility	Guidance & Tools
	approval conditions are completed in the required timeframes. This includes artefact retention repositories, conservation and/or disposal strategies.		
8.3	Forward all heritage/archaeological assessments, heritage location data and its ownership status to the Senior Environmental Specialist (Heritage). They will ensure all heritage items in Roads and Maritime ownership and/or control are considered for the Roads and Maritime S170 Heritage and Conservation Register.	PM/SES(H)/ WS-RMD	
8.4	If additional unexpected items are discovered this procedure must begin again from Step 1.	PM/TL-RMD	

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Appendix D Statutory consultation checklists

ISEPP

Council related infrastructure or services

Issue	Potential impact	Yes / No	If 'yes' consult with the relevant local council(s).	ISEPP clause
Stormwater	Are the works likely to have a *substantial* impact on the stormwater management services which are provided by council?	No	Moree Shire Council / Narrabri Shire	ISEPP cl.13(1)(a)
Traffic	Are the works likely to generate traffic to an extent that will *strain* the capacity of the existing road system in a local government area?	Yes	Consultation was carrying out as part of the project REF	ISEPP cl.13(1)(b)
Sewerage system	Will the works involve connection to a council owned sewerage system? If so, will this connection have a *substantial* impact on the capacity of any part of the system?	No		ISEPP cl.13(1)(c)
Water usage	Will the works involve connection to a council owned water supply system? If so, will this require the use of a *substantial* volume of water?	No		ISEPP cl.13(1)(d)
Temporary structures	Will the works involve the installation of a temporary structure on, or the enclosing of, a public place which is under local council management or control? If so, will this cause more than a *minor* or *inconsequential* disruption to pedestrian or vehicular flow?	No		ISEPP cl.13(1)(e)
Road & footpath excavation	Will the works involve more than *minor* or *inconsequential* excavation of a road or adjacent footpath for which council is the roads authority and responsible for maintenance?	No		ISEPP cl.13(1)(f)

Local heritage items

Issue	Potential impact	Yes / No	If 'yes' consult with the relevant local council(s)	ISEPP clause
Local heritage	Is there is a local heritage item (that is not also a State heritage item) or a heritage conservation area in the study area for the works? If yes, does a	No	Moree Shire Council / Narrabri Shire	ISEPP cl.14

Issue	Potential impact	Yes / No	If 'yes' consult with the relevant local council(s)	ISEPP clause
	heritage assessment indicate that the potential impacts to the heritage significance of the item/area are more than *minor* or *inconsequential*?			

Flood liable land

Issue	Potential impact	Yes / No	If 'yes' consult with local Council(s)	ISEPP clause
Flood liable land	Are the works located on flood liable land? If so, will the works change flood patterns to more than a *minor* extent?	Yes	Moree Shire Council / Narrabri Shire	ISEPP cl.15

Public authorities other than councils

	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
National parks and reserves	Are the works adjacent to a national park or nature reserve, or other area reserved under the *National Parks and Wildlife Act 1974*, or on land acquired under that Act?	No	DPIE	ISEPP cl.16(2)(a)
National parks and reserves	Are the works on land in Zone E1 National Parks and Nature Reserves or in a land use zone equivalent to that zone?	No	DPIE	ISEPP cl. 16(2)(b)
Aquatic reserves and marine parks	Are the works adjacent to an aquatic reserve or a marine park declared under the *Marine Estate Management Act 2014*?	No	DPIE	ISEPP cl.16(2)(c)
Sydney Harbour foreshore	Are the works in the Sydney Harbour Foreshore Area as defined by the *Sydney Harbour Foreshore Authority Act 1998*?	No	Sydney Harbour Foreshore Authority	ISEPP cl.16(2)(d)
Bush fire prone land	Are the works for the purpose of residential development, an educational establishment, a health services facility, a correctional centre or group home in bush fire prone land?	No	Rural Fire Service	ISEPP cl.16(2)(f)

	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
Artificial light	Would the works increase the amount of artificial light in the night sky and that is on land within the dark sky region as identified on the dark sky region map? (Note: the dark sky region is within 200 kilometres of the Siding Spring Observatory)	No	Director of the Siding Spring Observatory	ISEPP cl. 16(2)(g)
Defence communications buffer land	Are the works on buffer land around the defence communications facility near Morundah? (Note: refer to Defence Communications Facility Buffer Map referred to in clause 5.15 of Lockhardt LEP 2012, Narrandera LEP 2013 and Urana LEP 2011).	No	Secretary of the Commonwealth Department of Defence	ISEPP cl. 16(2)(h)
Mine subsidence land	Are the works on land in a mine subsidence district within the meaning of the *Mine Subsidence Compensation Act 1961*?	No	Mine Subsidence Board	ISEPP cl. 16(2)(i)

Appendix E Biodiversity assessment

Newell Highway Heavy Duty Pavements, Narrabri to Moree

Supplementary Biodiversity Assessment

April 2020

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Transport for New South Wales

Newell Highway Heavy Duty Pavements, Narrabri to Moree

Addendum BAR

April 2020

Prepared by AREA Environmental Consultants and Jacobs

In preparing this report, AREA Environmental Consultants has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, AREA Environmental Consultants has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then our observations and conclusions as expressed in this report may change.

AREA Environmental Consultants derived the data in this report from information sourced from the Client (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the Proposed modification and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. AREA Environmental Consultants has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

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Executive summary

Project Background

Transport for New South Wales (TfNSW) proposes to modify the Newell Highway Heavy Duty Pavements, Narrabri to Moree project (proposed modification) as the detail design refinements and construction staging are anticipated to exceed the REF boundary. The project is located in the Narrabri Shire and Moree Plains Local Government Areas (LGAs) (see Figure 1.1).

A review of environmental factors (REF) was prepared for the Newell Highway Heavy Duty Pavements, Narrabri to Moree (the project) in June 2018 (the project REF). The project and the activities described in the Project REF were determined by TfNSW in September 2018

An addendum REF is currently being prepared for the proposed modification on the behalf of TfNSW Western region to fulfil TfNSW's obligations under section 5.5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

This addendum BAR considers additional impact from the proposed modification to meet the requirements of the EP&A Act. Section 5.5 of the EP&A Act requires that the significance of the impact on threatened species, populations and endangered ecological communities listed under the NSW *Biodiversity Conservation Act* 2016 (BC Act) is assessed using the test of significance outlined in s.7.3 of the BC Act.

As part of this addendum Biodiversity assessment report (BAR), additional field survey were carried out over three days from 16 to 18 December 2019 for the additional land requiring assessment as well as targeted threatened species searches. It includes the part of the construction boundary that have not been assessed or a BAR completed by Jacobs in May 2018 as part of the project REF. AREA Environmental Consultants (AREA) sought to confirm the presence and extent of critically endangered ecological communities and species habitat within the study area addendum BAR.

Potential impact

Based on the 100 per cent concept design (proposed modification area), the estimated clearing of native vegetation for the project (project REF and proposed modification combined) as a whole is about 75.92 hectares. This includes about 7.45 hectares of state listed TECs (9.81 per cent of the vegetation loss) and 28.97 hectares of nationally listed TECs (38.15 per cent of the vegetation loss). About 16.22 hectares in total of the critically endangered *Natural grasslands on basalt and fine-textured alluvial plains* ecological community would be directly impacted, 15.53 hectares of the CEEC in N2MS5and 0.69 hectares in Segment 3 (N2MS3). The assessment identifies the loss of vegetation and TECs relevant to each segment.

The biodiversity assessment identifies the loss of individuals and habitat for listed threatened species relevant to each proposed modification segment.

Assessments of impact significance were undertaken according to EPBC Act and BC Act requirements, based on the proposed modification with a four metre buffer for construction for each of the identified threatened species and ecological communities. Subject matter experts were engaged to provide expert opinion of the likelihood of significant impact as required.

Assessments of significance prepared in accordance with the BC Act concluded the proposed modification would not have a significant impact on the affected species and communities. With regard to recorded threatened species, the assessments concluded:

- *Homopholis belsonii* (Endangered BC Act) occurs as three populations within the study area. The population within N2MS2 was identified in 2018 as at risk of being significantly affected by the proposed modification however this population by late 2018 and in 2019 was cleared by an adjoining landholder when replacing an agricultural fence line. This action combined with planned design refinement of the proposed modification and other

mitigation measures have reduced the impact of this proposed modification to *Homopholis belsonii* so this proposed modification would not significantly affect it. Impact on the other two populations in the study area are considered unlikely to be significant, as surveys have demonstrated these local populations are large and extend well beyond the proposed modification area.

- Impact to two other recorded threatened plant species, *Digitaria porrecta* (Endangered BC Act) and *Desmodium campylocaulon* (Endangered BC Act), are considered unlikely to be significant, as surveys have demonstrated the local viable population of these species is large and extends well beyond the proposed modification area.
- Potential impact to threatened bird species recorded are not likely to be significant as the edge habitat removed is unlikely to be important for breeding and is only likely to be moderately important for foraging, movement and shelter.

An assessment of significance was prepared for each of the identified threatened aquatic species and the aquatic ecological community listed under the FM Act. The assessment was based on the final proposed modification design and has concluded it is unlikely to have a significant impact on these two aquatic species and the aquatic ecological community.

Assessments of relevant species and communities under the EPBC Act significance criteria identified a likely significant impact for the following ecological community:

- *Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland* (Critically Endangered Act– EPBC): Almost entirely restricted to N2MS5. The proposed modification would remove 16.22 hectares of the 55.84 hectare viable local population leaving a residual population of 39.62 hectares (29 per cent reduction).

The *TfNSW Strategic Assessment: Environment Protection and Biodiversity Conservation Act 1999* negates the requirement to refer significant impacts on nationally listed species, ecological communities and migratory species to the Federal Department of the Environment and Energy. In accordance with the strategic assessment, this proposed modification has applied the “avoid, minimise, mitigate and offset” hierarchy.

Avoidance and mitigation

An opportunity to avoid and minimise impacts to biodiversity was considered in the detailed design of the proposed modification. As residual impact to biodiversity will occur, mitigation measures are required during construction and operational phases to manage potential impact to biodiversity. The TfNSW *Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects* (NSW Roads and Traffic Authority, 2011a) will be implemented during construction.

Biodiversity Offsets

It is TfNSW policy that biodiversity offsets (or where offsets are not reasonable or feasible, supplementary measures) would be provided for impact exceeding predetermined thresholds. The work involves clearing of threatened ecological communities and habitat for threatened species. As such, offsets (or supplementary measures) are required. In addition, this biodiversity assessment identifies the proposed modification is likely to have a significant impact on threatened biodiversity listed under the EPBC Act. Offsets for significantly impacted Commonwealth matters will be provided on a ‘like-for-like’ basis in accordance with the strategic assessment. Offset requirements will be determined in a biodiversity offset package prepared for the proposed modification.

Contents

Glossary of terms

Definitions

Cumulative impact	The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Refer to Clause 228(2) of the EP&A Regulation 2000 for cumulative impact assessment requirements.
Direct impact	Where a primary action is a substantial cause of a secondary event or circumstance which has an impact on a protected matter (ref http://www.environment.gov.au/system/files/resources/0b0cfb1e-6e28-4b23-9a97-fdadda0f111c/files/environment-assessment-manual.pdf).
Habitat	An area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community, including any biotic or abiotic component (OEH 2014).
Indirect impact	Where an event or circumstance is a direct consequence of the action (ref http://www.environment.gov.au/system/files/resources/0b0cfb1e-6e28-4b23-9a97-fdadda0f111c/files/environment-assessment-manual.pdf).
Local viable population	The ecological community that occurs within the study area. However, the local viable population may include adjacent areas if the ecological community on the study area forms part of a larger contiguous area of that ecological community and the movement of individuals and exchange of genetic material across the boundary of the study area can be clearly demonstrated.
Local population	The population that occurs in the study area. The assessment of the local population may be extended to include individuals beyond the study area if it can be clearly demonstrated that contiguous or interconnecting parts of the population continue beyond the study area, according to the following definitions: • The local population of a threatened plant species comprises those individuals occurring in the study area or the cluster of individuals that extend into habitat adjoining and contiguous with the study area that could reasonably be expected to be cross-pollinating with those in the study area • The local population of resident fauna species comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the study area • The local population of migratory or nomadic fauna species comprises those individuals that are likely to occur in the study area from time to time. In cases where multiple populations occur in the study area, each population should be assessed separately.
Matters of NES	A matter of national environmental significance (NES) protected by a provision of Part 3 of the EPBC Act
Mitchell landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000 (OEH 2014).
Mitigation	Action to reduce the severity of an impact. (OEH 2014).
Mitigation measure	Any measure that facilitates the safe movement of wildlife and/or prevents wildlife mortality.
Population	All the individuals that interbreed within a given area.
Proposed modification area / Proposed modification area	The area of land that is directly impacted on by a proposed Major Proposed modification that is under the EP&A Act, including access roads, and areas used to store construction materials (OEH 2014).
Study area	The area directly affected by the development and any additional areas likely to be affected by the development, either directly or indirectly (OEH 2014).
Target species	A species that is the focus of a study or intended beneficiary of a conservation action or connectivity measure.

Abbreviations

BBCC	BioBanking Credit Calculator
BC Act	Biodiversity Conservation Act 2016
BVT	Biometric Vegetation Type
CEMP	Construction Environmental Management Plan
DP&E	Department of Planning and Environment
DPI	Department of Primary Industries
EEC	Endangered ecological community
EIS	Environmental Impact Statement
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999 (Federal).
FM Act	Fisheries Management Act 1994 (NSW)
GDE	Groundwater dependent ecosystems
IBRA	Interim Biogeographically Regionalisation of Australia
MNES	Matters of National Environmental Significance
OEH	Office of Environment and Heritage
PCT	Plant Community Type
REF	Review of Environmental Factors
TECs	Threatened Ecological Communities
TSPD	Threatened Species Profile Database
VIS	Vegetation information system

1 Introduction

1.1 Project background

Transport for NSW (TfNSW, formerly Roads and Maritime Services NSW) proposes to carry out major road upgrades to five segments of the Newell Highway between Narrabri and Moree (the highway) in north west NSW, within the existing road corridor (the project).

The project would be delivered in five segments (N2MS1, M2NS2, N2MS3, N2MS4 and N2MS5) with a combined length of about 30 kilometres of upgrades along the Newell Highway.

The project forms part of the *Newell Highway Corridor Strategy* (Transport for NSW, 2015) to provide an efficient and sustainable corridor that caters for increasing growth and improves safety along the Newell Highway.

A review of environmental factors (REF) was prepared for the Newell Highway Heavy Duty Pavements, Narrabri to Moree (the project) in June 2019 (the project REF). The project and the activities described in the Project REF were determined by TfNSW in September 2019

This addendum BAR follows on from Jacobs (2018) Biodiversity Development Assessment Report. It supports the addendum REF which is currently been prepared for the proposed modification on the behalf of TfNSW Western region.

1.2 The proposed modification

TfNSW proposes to modify the approved Newell Highway Heavy Duty Pavements, North Moree project (the proposed modification) as the detail design refinements and construction staging are anticipated to exceed the Newell Highway Heavy Duty Pavements, Narrabri to North Moree Project review of environmental factors (REF) boundary.

The proposed modification is required for the change in proposed modification area to accommodate the detail design modifications and construction staging requirements. The proposed modification is shown in Figure 1-1.

1.3 Study area

The biodiversity assessment study area and survey area for this assessment was the 100 per cent design proposed modification area.

The following areas are discussed throughout the report and are defined as:

- Project: The Newell Highway Heavy Duty Pavements, Narrabri to North Moree which will be delivered in five segments (N2MS1, M2NS2, N2MS3, N2MS4 and N2MS5) with a combined length of about 30 kilometres of upgrades along the Newell Highway.
- Project REF boundary. This is the project REF project area which refers to the area that would be directly impacted by the project as assessed in the project REF. This was based on the 50 per cent concept design plus a variable construction buffer
- Proposed modification area: The increased project boundary based on the 100 per cent detailed design and includes all the proposed design modifications. This defines the impact area for the project as a whole, refer Figure 1-2.
- The study area refers to the area investigated during the preparation of the project REF and Addendum REF; it includes the wider area that may be indirectly impacted by the project (see Figure 1.2)
- Survey area: refers to the area surveyed by AREA Environmental, i.e. additional areas affected by the proposed modification area. No private property was accessed during the field surveys

- Locality: This is defined as the area within a 30 kilometre radius surrounding the proposed modification area and used in the analysis of the known local distribution of threatened species; refer to S.2.2 of this report for further discussion of database searches and search area selected
- Bioregion: The study area is located in the Brigalow Belt South bioregion (Thackway and Cresswell, 1995) and crosses the Northern Basalts and Northern Outwash sub-regions
- Local viable population: This is defined as residual native vegetation within a 1500 metre buffer surrounding the proposed modification area and used in the analysis of the known / ground truthed local distribution of plant community types.

1.4 Legislative context

The proposed modification is assessed under the same legislative context as provided in Jacobs (2018).

Update significant assessments were carried out to satisfy requirements of the EPBC and BC Acts.

Figure 1.1 Proposed modification location (Source: Jacobs)

Figure 1.2 The proposed modification and study area (Source: Jacobs)
Page 1

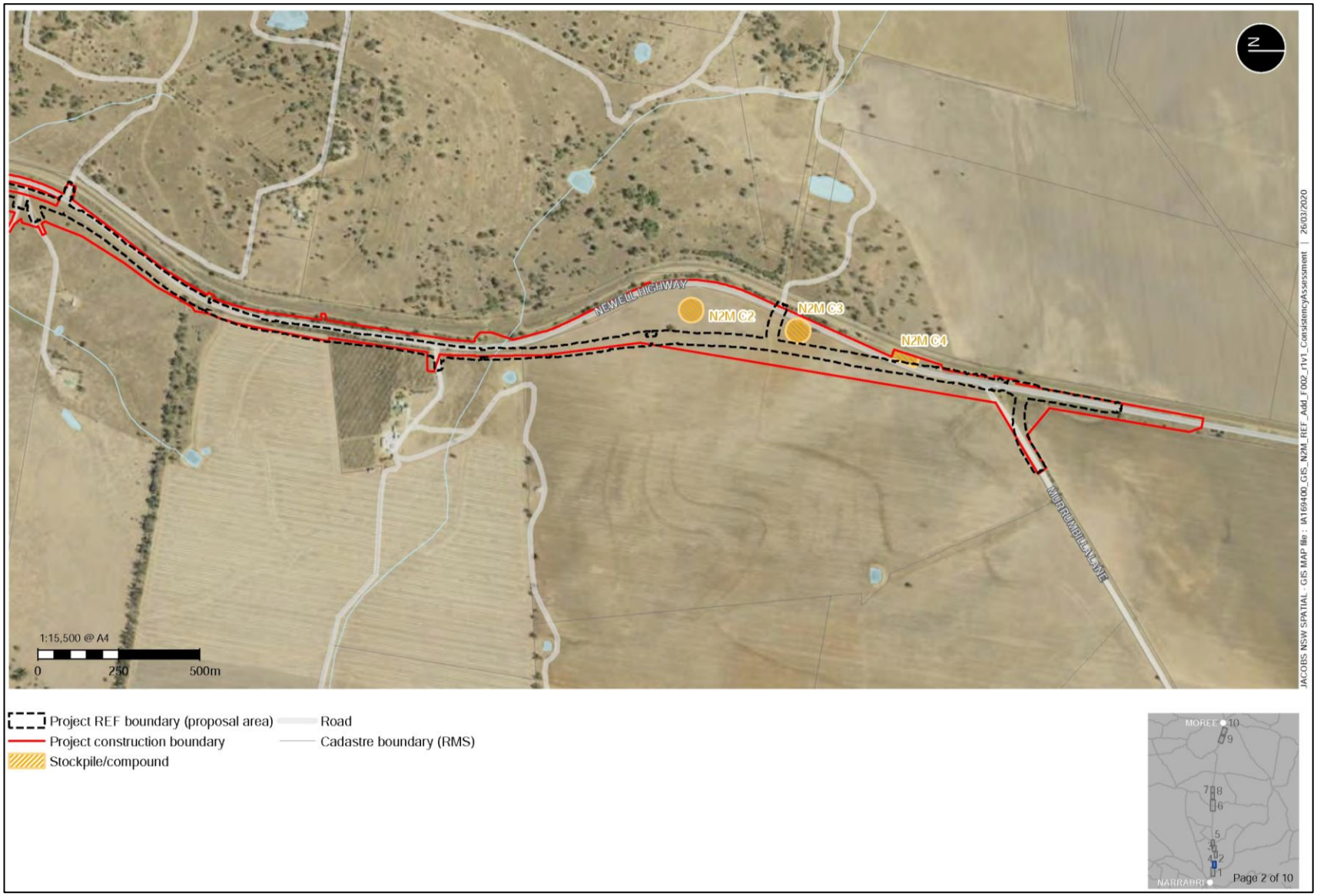

Figure 1.2 The proposed modification and study area (Source: Jacobs)
Page 2

Figure 1.2 The proposed modification and study area (Source: Jacobs)
Page 3

Figure 1.2 The proposed modification and study area (Source: Jacobs)
Page 4

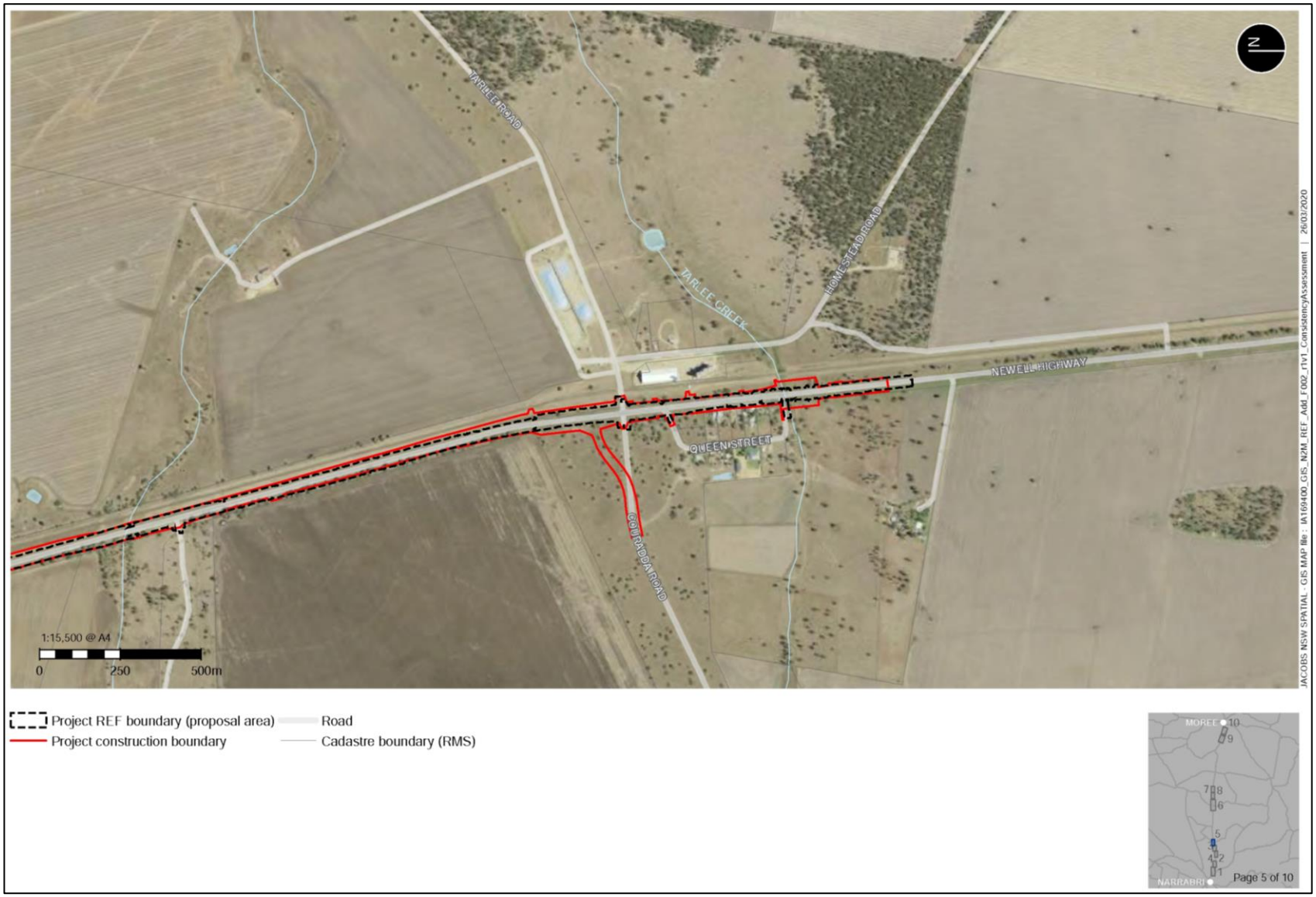

Figure 1.2 The proposed modification and study area (Source: Jacobs)
Page 5

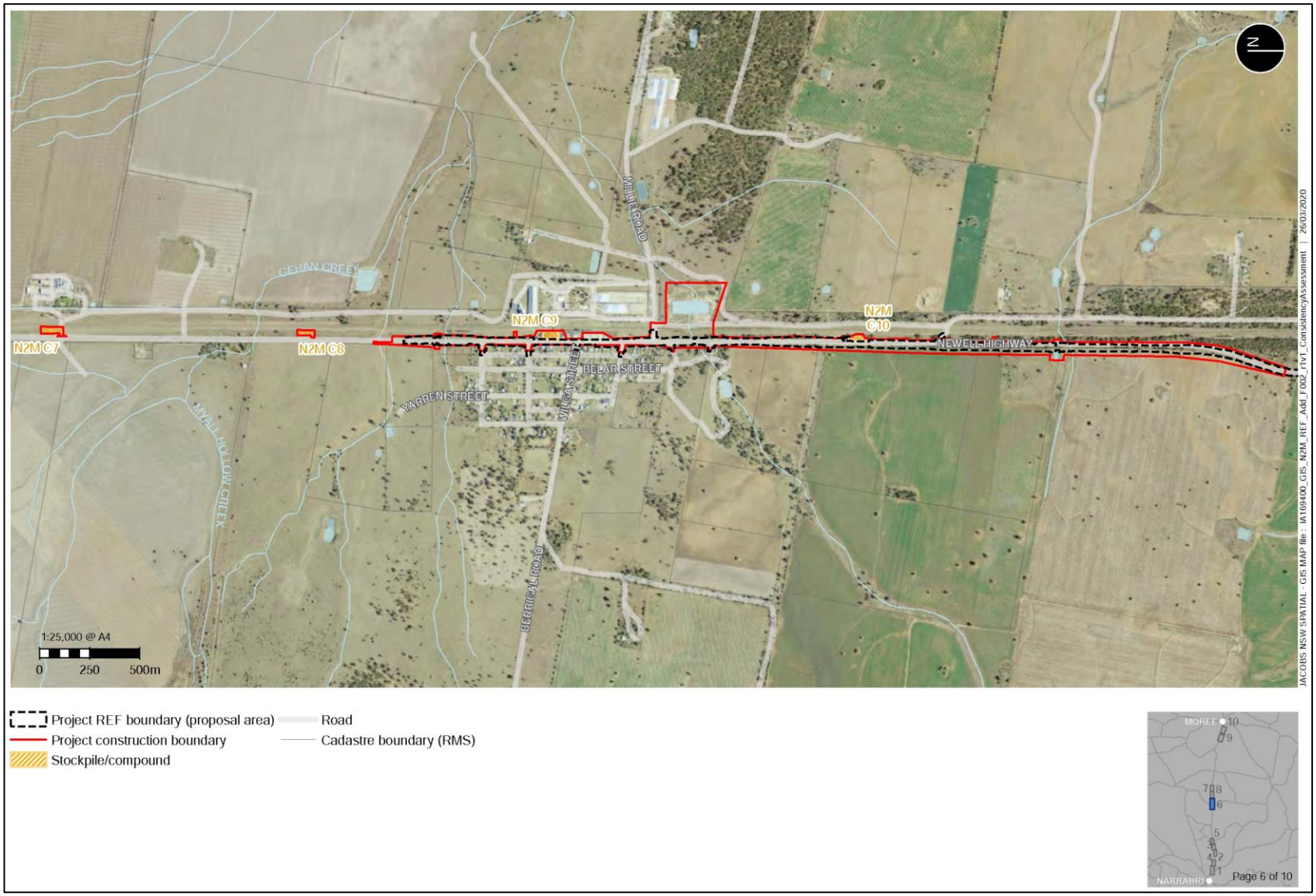

Figure 1.2 The proposed modification and study area (Source: Jacobs)
Page 6

Figure 1.2 The proposed modification and study area (Source: Jacobs)
Page 7

Figure 1.2 The proposed modification and study area (Source: Jacobs)
Page 8

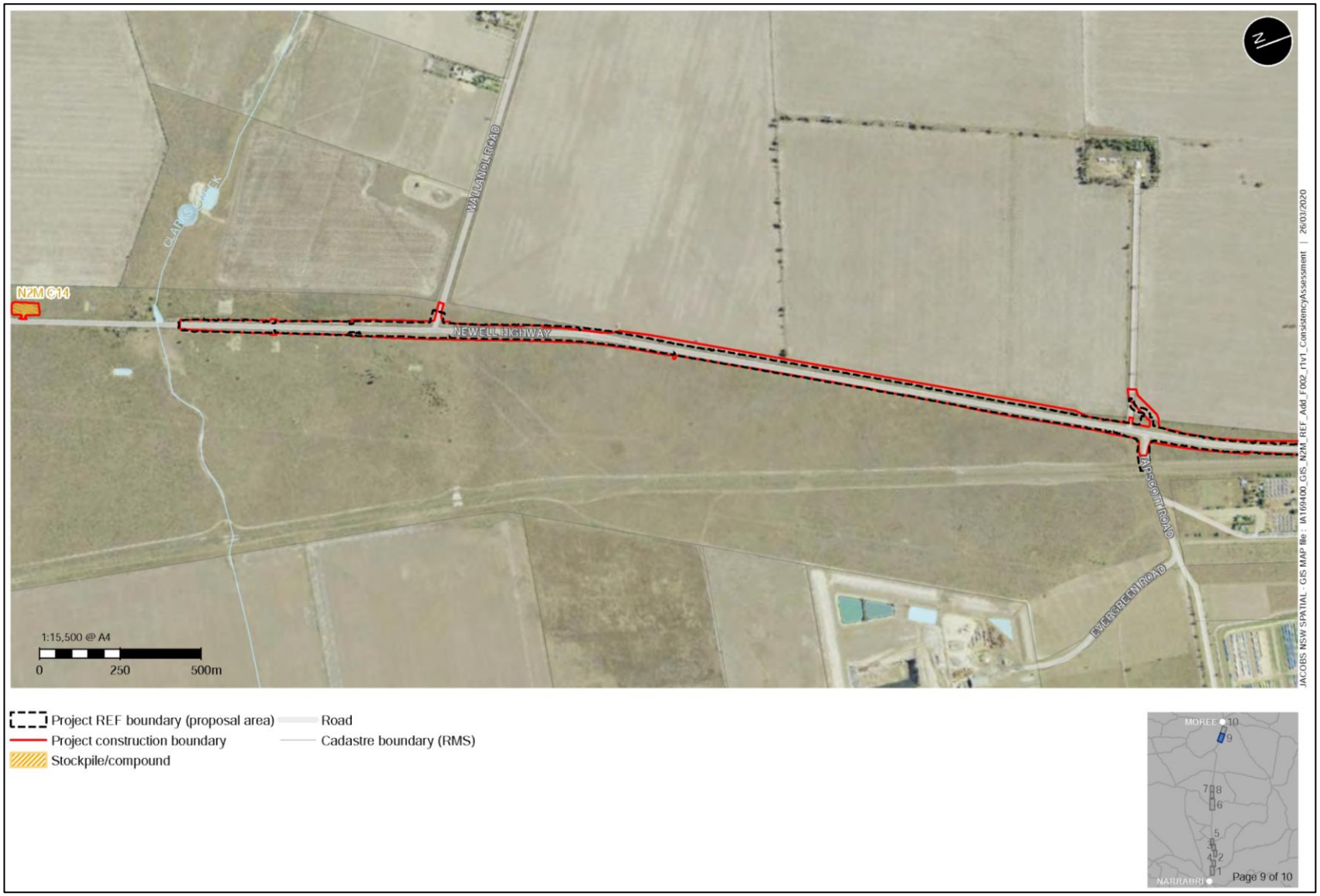

Figure 1.2 The proposed modification and study area (Source: Jacobs)
Page 9

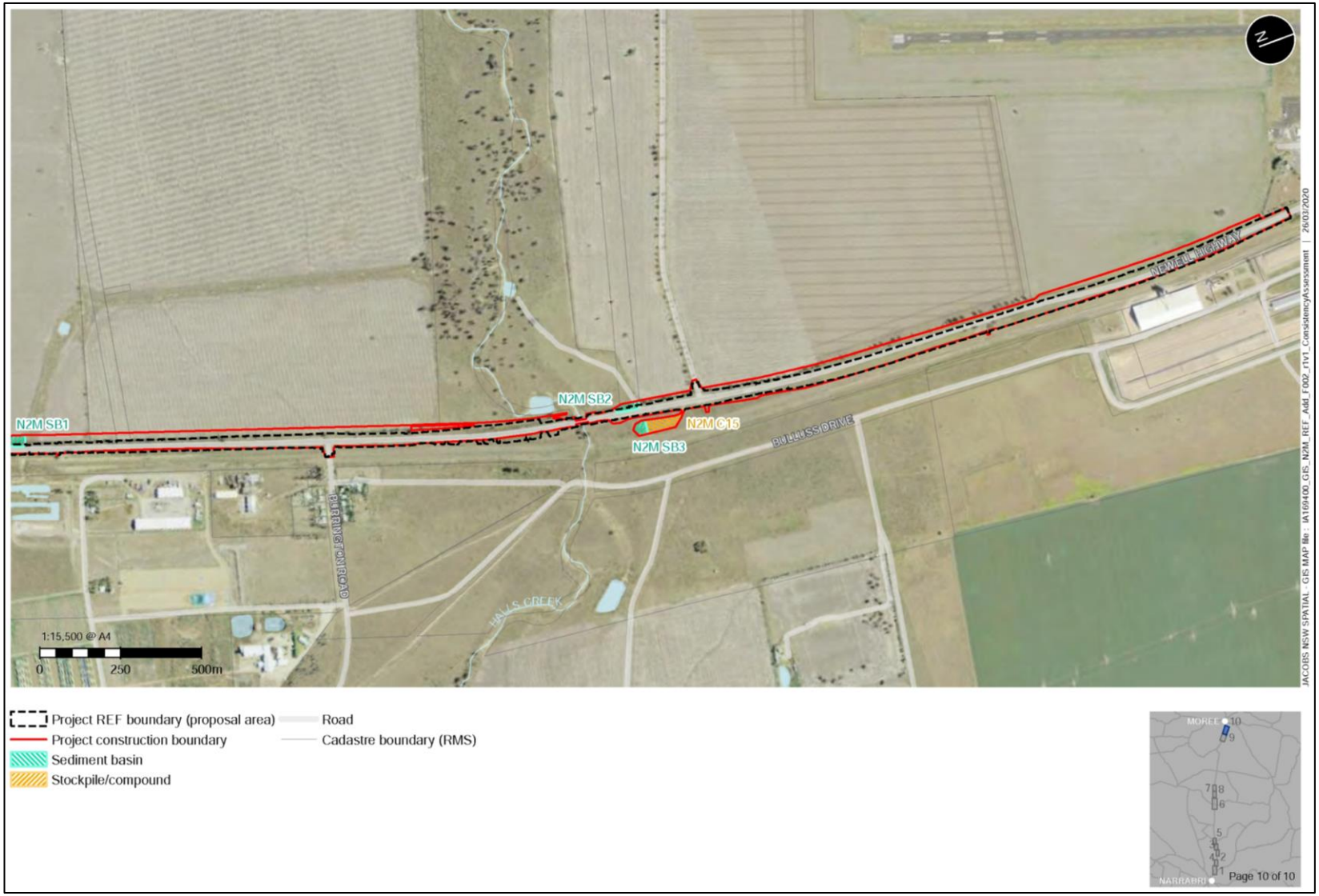

Figure 1.2 The proposed modification and study area (Source: Jacobs)
Page 10

2 Methods

2.1 Personnel

The addendum BAR was undertaken and prepared by a team of appropriately qualified and experienced ecologists (refer to Table 2-1).

Table 2-1 Personnel, role and qualifications

Name	Role	Qualifications
Phillip Cameron (AREA Environmental)	Principal Consultant (ecology): Technical review, field survey, reporting	Bachelor of Science (Biology) Associate Diploma of Applied Science Cert III (Captive Vertebrate Management) Biodiversity Assessment Method accredited EIANZ Certified Environmental Practitioner AHCPCM201- Recognising grasses
Dave Sturman (AREA Environmental)	Ecologist – Field survey	Bachelor of Environmental Science Cert III (Horticulture) AHCPCM201- Recognising grasses
Dr Sarah McDonald (AREA Environmental)	Subcontractor subject matter specialist – Field survey (Targeted Belson's Panic assessments)	Bachelor of Natural Resources (Honours) Doctor of Philosophy (PhD)
Gerry Swan (AREA Environmental)	Subcontractor subject matter specialist - Field survey (Targeted Five-clawed worm-skink)	Research associate – Australian Museum. Author and co-author of numerous books, papers, notes and articles on reptiles

2.2 Background

2.2.1 Previous assessment findings

The Biodiversity assessment report (BAR) was completed by Jacobs in May 2018 as part of the project REF identified the potential for significant impact to the following entities listed under the EPBC Act:

- Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland which is a critically endangered ecological community (CEEC)
- Belson's Panic (*Homopholis belsonii*)
- Five-clawed Worm-skink (*Anomalopus mackayi*).

The supplementary BAR was carried out by Jacobs (2018) including additional information from AREA Environmental Consultants (AREA) (AREA, 2018a). The additional assessments sought to confirm the presence and extent of CEEC's and species habitat within the study area.

The BAR concluded the determined project would have a significant impact on the Natural grasslands CEEC through the removal of about 11.31 hectares within N2MS5. AREA concluded the evidence provided in the BAR was technically sound. Therefore, in the project REF, the project was considered likely to have a significant impact on the Natural Grasslands CEEC within N2MS5.

The addendum BAR (AREA,2018a) also confirmed the presence of the EPBC Act listed *Homopholis belsonii* (Belson's Panic) in the study area. The additional assessment for the project REF concluded that a significant impact to *Homopholis belsonii* (Belson's Panic) populations would only occur in one of the five determined project segments (N2MS2) as opposed to the three determined project segments (N2MS2, N2MS4 and N2MS5) originally assessed in the project REF. The determined project was still considered likely to have a significant impact on *Homopholis belsonii* (Belson's Panic) within N2MS2.

The determined project would require the removal of habitat listed as being associated with the Five-clawed Worm-skink (*Anomalopus mackayi*). This is consistent with the finding of the BAR. However, Gerry Swan (a subject matter expert commissioned by AREA) determined that much of the land in the road corridor is unsuitable habitat. In addition, any remaining areas of suitable habitat with the study area would likely to be modified by edge effects that may change the soil surface and microhabitat conditions, altering its suitability for this species. Based on the information available, AREA (AREA, 2018b) concluded that the determined project was not at risk of causing a significant impact (as defined under the EPBC Act) on a viable local population of the Five-clawed Worm-skink (*Anomalopus mackayi*).

2.2.2 Background review

A background review of existing information and databases was carried out for the BAR (Jacobs, 2018) to identify the existing environment of the proposed modification within a search area of 30 kilometres.

AREA Environmental updated these searches in July 2018 and again in December 2019 and did not find any new items requiring additional consideration. All conclusions, species predictions documents by Jacobs (2018) were considered robust and representative which did not need to be updated or changed. Table 2-4 provides a list of species Jacobs concluded had potential to use habitat in the proposed modification area.

2.3 Habitat assessment

Supplementary habitat assessments were undertaken within the project modification area with consideration of the identified list of threatened flora and fauna species known or predicted to

occur in the Brigalow Belt South IBRA bioregion which have been recorded within a 30 kilometre radius of the proposed modification (see Appendix B for the habitat assessment results). This list was identified from databases and literature as well as past surveys unrelated to this proposed modification as well as several stages of surveys over different seasons related to the proposed modification. The habitat assessment compared the preferred habitat features for these species with the type and quality of the habitats identified in the project modification area. This habitat assessment was completed to make an assessment of the likelihood of the species being present in the study area (i.e. subject species). The habitat assessment was a continuously refined process and informed the nature and extent of targeted surveys within the study area.

The criteria used in the habitat assessment are detailed in Table 2.2. The results of the habitat assessment are provided in Appendix B.

Table 2-2 Likelihood of occurrence classification and criteria

Likelihood	Criteria
Recorded	The species was observed in the study area during the current survey
High	It is highly likely the species inhabits the study area and is dependent on identified suitable habitat (ie. for breeding or important life cycle periods such as winter flowering resources), has been recorded recently in the locality (30km) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Moderate	Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however, may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent (ie. for breeding or important life cycle periods such as winter flowering resources) on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.
Low	It is unlikely the species inhabits the study area and has not been recorded recently or frequently in the locality (30km). It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent (ie. for breeding or important life cycle periods such as winter flowering resources) on available habitat. Specific habitat is not present in the study area or the species are non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
None	Suitable habitat is absent from the study area.

2.4 Field survey

As part of this assessment, a further three days of field survey were carried out by two AREA Environmental ecologists for additional land requiring assessment within the proposed modification area from 16 to 18 December 2019. Additional targeted threatened species search were also carried out. The field survey dates were 2 to 5 July 2018 for Belson's Panic and Five-clawed Worm-skink habitat assessments.

Jacobs (2018) details the methods to record and document native vegetation.

In summary broad scale vegetation mapping and aerial photography was used to initially identify the extent of native vegetation. The initial vegetation mapping was then ground-truthed in the field and assigned to Plant Community Types (PCTs) according to the OEH BioNet Vegetation Classification System (Office of Environment and Heritage, 2017b). The identified PCTs and their extent were mapped across the study area. The vegetation survey was completed using field survey methods in line with Chapter 5 of the Biodiversity Assessment Method (BAM). The survey was stratified and targeted to assess environmental variation.

Representative sites were surveyed in detail to enable the floristic and condition classification of vegetation types and extrapolation for areas not subject to detailed survey.

Areas of landscape plantings and grassland dominated by exotic species (mapped as 'not native') were mapped. These areas were not assigned vegetation zones as they are not naturally occurring and cannot be matched to a PCT.

A summary of vegetation survey effort, outlining the number of vegetation zones and respective number of floristic plots / transects sampled in the field using an updated dataset incorporating the proposed modification is presented in Table 2.3.

Please note:

- The number of BAM plots assessed by Jacobs (2018) in all but once case (PCT52) exceeded the requirement of the 100 per cent design requirement. The excess plots completed by Jacobs (2018) were associated with the quantum of the impact for previous alignment designs
- Rounding to two decimal places has been used.

Table 2-3 Summary of survey effort

Plant community type (PCT)	Condition class	Area (ha) in proposed modification area	Plot requirement based on the BAM	No. plots sampled in proposed modification area and broader study area
Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions (55)	Moderate to Good (Relatively Intact)	1.93	1 plot	3 plots (N2M03) (N2M10, N2M19)
	Moderate to Poor (Derived Grassland)	0.32	-	-
Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt South Bioregion (445)	Moderate to Good (Relatively Intact)	1.47	1 plot	3 plots (N2M12, N2M13, N2M17)
	Moderate to Poor (Derived Grassland)	0.87	-	-
Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion (628)	Moderate to Good (Relatively Intact)	3.04	2 plots	2 plots (N2M08, N2M09)
	Moderate to Poor (Derived Grassland)	1.24	-	-
Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion (147)	Moderate to Good (Relatively Intact)	0.11	1 plot	1 plot (N2M16)
Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW (56)	Moderate to Good (Relatively Intact)	8.34	3 plots	3 plots (N2M11, N2M14, N2M15)
	Moderate to Poor (Derived Grassland)	0.42	-	-
Poplar Box - White Cypress Pine shrub grass tall woodland of the Pilliga - Warialda region, Brigalow Belt South Bioregion (397)	Moderate to Good (Relatively Intact)	9.38	3 plots	4 plots (N2M02, N2M04, (N2M05), N2M18)
	Moderate to Poor (Derived Grassland)	17.26		-

Plant community type (PCT)	Condition class	Area (ha) in proposed modification area	Plot requirement based on the BAM	No. plots sampled in proposed modification area and broader study area
Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (52)	Moderate to Good (Relatively Intact)	16.22	3 plots	2 plots (N2M20, N2M21)
Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (27)	Moderate to Good (Relatively Intact)	0.9	1 plot	1 plot (N2M06)
	Moderate to Poor (Derived Grassland)	14.42	-	1 plot (N2M07)
Not native (excluding water bodies)	-	127.9	-	1 plot (N2M01)

2.4.1 Targeted flora surveys

The surveys undertaken for all identified candidate flora species initially considered moderately likely to occur within the study area were undertaken by Jacobs (2018) following the methods described in the *NSW Guide to Surveying Threatened Plants* (Office of Environment and Heritage, 2016) with additional random meander surveys.

The following species of flora were recorded in the study area or in the case of *Swainsona murrayana* were considered high likelihood to occur based on closely occurring BioNet records. The threatened plant species as likely to occur in the proposed modification area and therefore to require targeted survey included:

- *Desmodium campylocaulon*
- *Dichanthium setosum*
- *Digitaria porrecta*
- *Swainsona murrayana.*

Species predictions for this supplementary BAR are largely based on the Jacobs (2018) conclusions which were considered fair and accurate, however by mid-2018 and late 2019 the vegetation possessed significantly less biodiversity due to:

- Severe drought
- Broadscale heavy continuous grazing within the proposed modification area
- Clearing of all Belson's Panic habitat in Segment 2 south Edgeroi associated with replacing a farm fence (an activity not related to this proposed modification) effectively removing the entire residual population.

Species predictions for Belson's Panic have been updated based additional ecology assessments informed by subject matter expert advice and additional suitable season targeted surveys in 2018 and 2019. Dr McDonald's 2018 and AREA 2019 additional assessments were used as part of this assessment to provide revised assessment of significance for this species.

Re-evaluation of the likelihood of occurrence of threatened species based on site conditions and a thorough desktop study indicated a number of additional species may be present in the proposed modification area. These species were assumed as present in areas of suitable habitat.

Table 2-4 Targeted species survey techniques for threatened flora species and survey effort

Threatened flora species	Status		Recommended survey timing	Additional targeted Belson's Panic surveys completed 2 to 5 July 2018 (4 days)	Additional assessment of proposed modification land and Belson's Panic surveys completed 16 to 18 December 2019 (3 days)
	BC Act	EP BC Act			
Cyperus conicus	E	-	Year-round but likely to be dependent on rainfall	N/A	Threatened species transects applied as required across all additional land requiring assessment (timing varied dependant on size of land)
Desmodium campylocaulon	E	-	December to May	N/A	Threatened species transects applied as required across all additional land requiring assessment (timing varied dependant on size of land)
Dichanthium setosum	V	V	December to May	N/A	Threatened species transects applied as required across all additional land requiring assessment (timing varied dependant on size of land)
Digitaria porrecta	E	-	December to May	N/A	Threatened species transects applied as required across all additional land requiring assessment (timing varied dependant on size of land)
Homopholis belsonii	E	V	December to May	32 hours of transects across potential habitat in proposed modification area. Out of season survey conducted by a subject matter specialist.	8 person hours across potential habitat in proposed modification area. Ground truth check of N2MS2 removed population near Edgeroi.
Lepidium aschersonii	V	V	September to May but likely to be responsive to seasonal conditions	N/A	Threatened species transects applied as required across all additional land requiring assessment (timing varied dependant on size of land)
Swainsona murrayana	V	V	September to January	N/A	Threatened species transects applied as required across all additional land requiring assessment (timing varied dependant on size of land)
Diuris tricolor	V	-	September to late October	N/A	Threatened species transects applied as required across all additional land requiring assessment (timing varied dependant on size of land)
Lepidium monoplocoides	E	E	January to December but highly dependent on seasonal conditions.	N/A	Threatened species transects applied as required across all additional land requiring assessment (timing varied dependant on size of land)
Polygala linariifolia	E	-	Year-round but highly responsive to seasonal conditions.	N/A	Threatened species transects applied as required across all additional land requiring assessment (timing varied dependant on size of land)

Threatened flora species	Status		Recommended survey timing	Additional targeted Belson's Panic surveys completed 2 to 5 July 2018 (4 days)	Additional assessment of proposed modification land and Belson's Panic surveys completed 16 to 18 December 2019 (3 days)
	BC Act	EP BC Act			
Sida rohlenae	E	-	September to December	N/A	Threatened species transects applied as required across all additional land requiring assessment (timing varied dependant on size of land)
Tylophora linearis	V	E	September to May		Threatened species transects applied as required across all additional land requiring assessment (timing varied dependant on size of land)
Pterostylis cobarensis	V	-	September to November		Threatened species transects applied as required across all additional land requiring assessment (timing varied dependant on size of land)

2.4.2 Targeted fauna surveys

Site assessment for fauna during December 2017 and May 2018 (See Jacobs 2018) identified the threatened animal species as likely to occur in the study area:

- Koala
- Yellow-bellied Sheathtail-bat and Little Pied Bat
- Five-clawed Worm-skink
- Threatened bird species including Dusky Woodswallow, Glossy Black-Cockatoo, Spotted Harrier, Brown Treecreeper, Varied Sittella, Black Falcon, Brolga, Little Eagle, Square-tailed Kite, Turquoise Parrot, Superb Parrot, Barking Owl, Masked Owl, Grey-crowned Babbler, Diamond Firetail.

For further information on target species searches please refer Jacobs (2018).

2.4.3 Aquatic habitat assessment

An aquatic habitat assessment was conducted to assess the waterways in the study area against the NSW DPI (Fisheries) document *Policy and Guidelines for fish habitat conservation and management (2013 update)* (NSW Department of Primary Industries, 2013) and *Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003) by Jacobs (2018). These assessments did not need to be updated or modified in light of the proposed modification area.

2.5 Limitations

A PCT map showing the viable local population within 1500 metres from each Segment was produced in December 2019 during a severe drought. While initially thought as a limitation the severe drought did result in a higher level of confidence to map PCTs are virtually no exotic plants remained diluting the effectiveness of the broad brush stroke approach to mapping in these areas. The one exception to finer scale mapping was the number of BAM plots required in PCT52 *Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion.* An extra plot was required after the final design detail was issued, during 2019 time the region was in severe drought and effectively no or very few alive plants were present or detectable and those present did not have flowering or seed heads for identification due to severe grazing. Absence of this one plot is not considered a limitation as the AREAs principal ecologist has substantive

experience with this PCT as an expert witness in the same area as the proposed modification region. Overall, the detailed floristic survey was undertaken in Jacobs (2018) to provide a list of flora species was adequate and representative for all PCTs assessed.

Targeted surveys for threatened species were undertaken at each proposed modification area.

Additional flora and fauna species may appear in other times of the year, particularly cryptic orchids and wetland birds. A period of several seasons or years is often needed to identify all the species present in an area, and specific weather conditions are required for optimum detection (e.g. heavy rainfall events and flowering periods). The conclusions of this report are therefore based upon available data and limited field survey and are indicative of the environmental condition of the study area at the time of the survey. It should be recognised that site conditions, including the presence of threatened species, can change with time. To address this limitation, the assessment has aimed to identify the presence and suitability of the habitat for threatened species based on substantive local experience in the region.

The mapping included in this report shows the inferred distribution of plant community types and habitat within the broader,1500 metre viable local population study area. In many cases, the boundaries between plant community types and habitats are not well-defined and the mapping provides an approximation of on-ground conditions.

3 Existing environment

3.1 Environmental context of the study area

For the full description of the existing environment refer to the BAR (Jacobs, 2018) completed for the determined project REF.

3.2 Plant community types

For the full description of the existing plant community types (PCTs) in this report refer to the BAR (Jacobs, 2018) completed for the determined project REF.

In summary the eight PCTs identified within the proposed modification area are consistent with those recorded by Jacobs (2018). These are listed below and shown in Figure 3-2.

1. Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions (**PCT55**), present in small areas of N2MS1 but mostly in N2MS4
2. Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt South Bioregion (**PCT445**) in the vicinity of Brigalow Lane in N2MS4
3. Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion (**PCT628**); this vegetation was classified in the PEI as River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (PCT78) but the floristic composition of the vegetation on the site does not match that PCT. While the vegetation on site contains *Eucalyptus camaldulensis* (River Red Gum), it does not contain any of the other tree species associated with PCT 78. The vegetation on site contains three of the tree species associated with PCT 628 (including *Eucalyptus camaldulensis, E. coolabah and E. populnea*) and has middle and ground strata more consistent with that PCT. Although *Corymbia tessellaris* (Carbeen) was not recorded in the study area, it was seen in adjacent lands. The vegetation containing *Eucalyptus camaldulensis* recorded along small waterways has therefore been interpreted as representative of small scale variation within an area of PCT 628 due to slightly different environmental conditions along these waterways
4. Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion **(PCT147**) in N2MS4
5. Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW (**PCT56**). Recorded in N2MS2 to N2MS4, with N2MS4 possessing the highest populations
6. Poplar Box - White Cypress Pine shrub grass tall woodland of the Pilliga - Warialda region, Brigalow Belt South Bioregion (**PCT397**) characterised by abundant White Cypress Pine (*Callitris glaucophylla)* and different understorey composition, found on the sandier soils and more elevated landscape in N2MS1
7. Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (**PCT27**). Recorded in N2MS1, N2MS2, N2MS3 and N2MS5. Often degraded / derived due to agricultural impacts. The majority of this PCT possessing Belson's Panic near Edgeroi has been cleared by the adjoining landholder when replacing an agricultural fence.
8. Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (**PCT52**) located on the clay plains at the north end of N2MS1 a small area in N2MS3 and throughout N2MS5.

Table 3-1 Plant community types

Plant community type (PCT)	Condition class	Threatened ecological community?	Area (ha) in proposed modification area	Size (ha) of residual local viable population in 1500m after proposed modification
Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions (PCT55)	Moderate to Good (Relatively Intact)	Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions (Endangered – BC Act) Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (Endangered – EPBC Act).	0	51.47
	Moderate to Poor (Derived Grassland)		0.32	
Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt South Bioregion (PCT445)	Moderate to Good (Relatively Intact)	Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (Endangered – BC Act) Brigalow (Acacia harpophylla dominant and co-dominant) (Endangered – EPBC Act).	1.47	52.39
	Moderate to Poor (Derived Grassland)	No (See note 1)	0.87	
Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion (PCT628)	Moderate to Good (Relatively Intact)	Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions (Endangered – BC Act)	3.04	4.67
	Moderate to Poor (Derived Grassland)		1.24	
Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion (PCT147)	Moderate to Good (Relatively Intact)	Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions (Endangered – BC Act) Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (Endangered – EPBC Act)	0.11	0 (VIS mapping accuracy as opposed to absence of PCT)
Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW (PCT56)	Moderate to Good (Relatively Intact)		8.34	380.28

Plant community type (PCT)	Condition class	Threatened ecological community?	Area (ha) in proposed modification area	Size (ha) of residual local viable population in 1500m after proposed modification
	Moderate to Poor (Derived Grassland)	No (But There is a preliminary listing of Endangered for this community under the EPBC Act).	0.42	
Poplar Box - White Cypress Pine shrub grass tall woodland of the Pilliga - Warialda region, Brigalow Belt South Bioregion (PCT397)	Moderate to Good (Relatively Intact)	No (But There is a preliminary listing of Endangered which may include this community under the EPBC Act).	9.38	388.44
	Moderate to Poor (Derived Grassland)		17.26	
Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (PCT52)	Moderate to Good (Relatively Intact)	Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (Critically Endangered – EPBC Act)	16.22	39.26
Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (PCT27)	Moderate to Good (Relatively Intact)	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (Endangered – BC Act) Weeping Myall Woodlands (Endangered – EPBC Act)	0.9	386.06
	Moderate to Poor (Derived Grassland)	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (Endangered – BC Act) Derive grasslands do not meet EPBC Act condition thresholds.	14.42	
Total			**75.92 ha**	**1306.2 ha**

Note 1: Derived grasslands are not included in the definition of the community under the BC Act or EPBC Act.

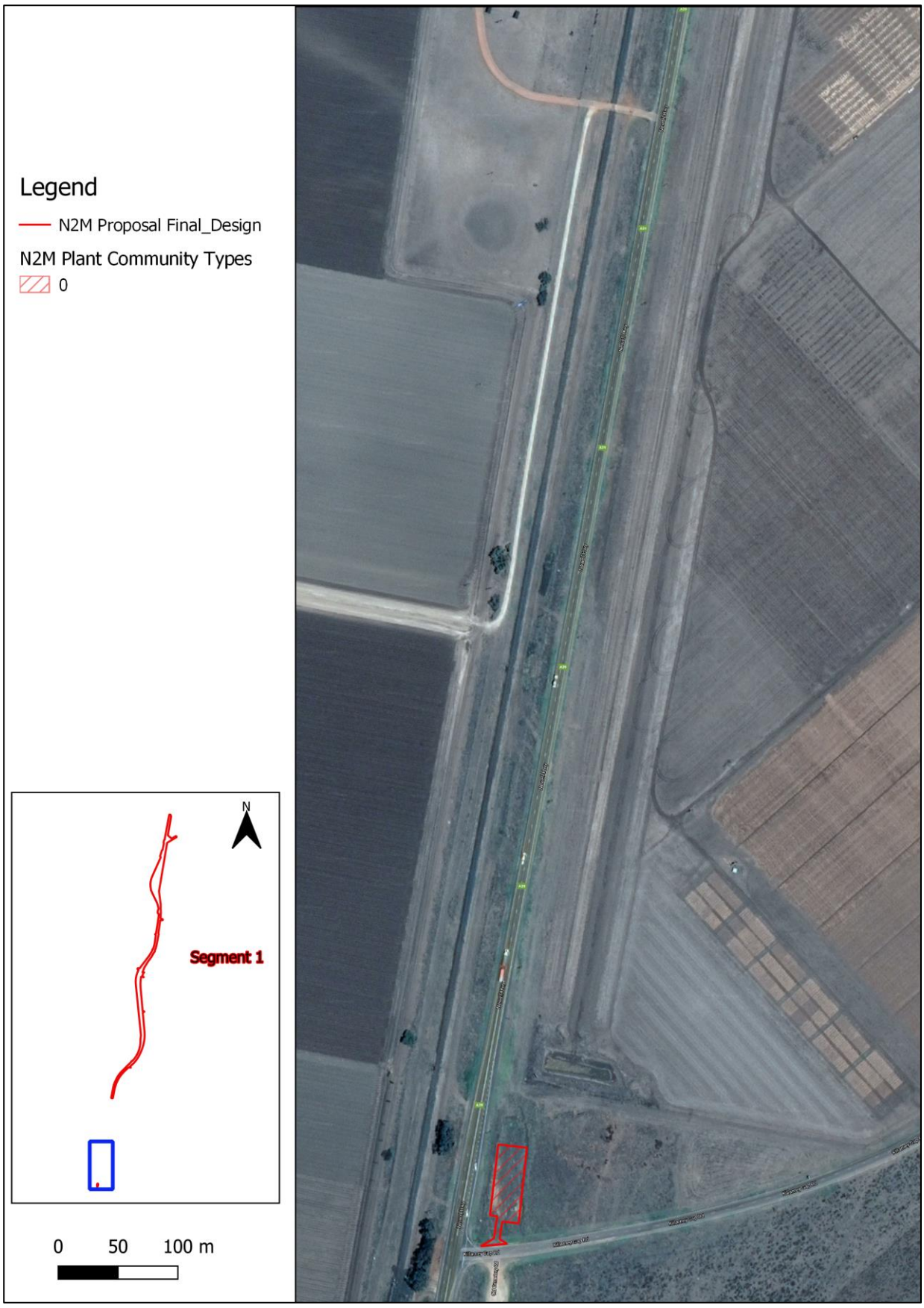

Figure 3.2 Plant Community types Segment 1
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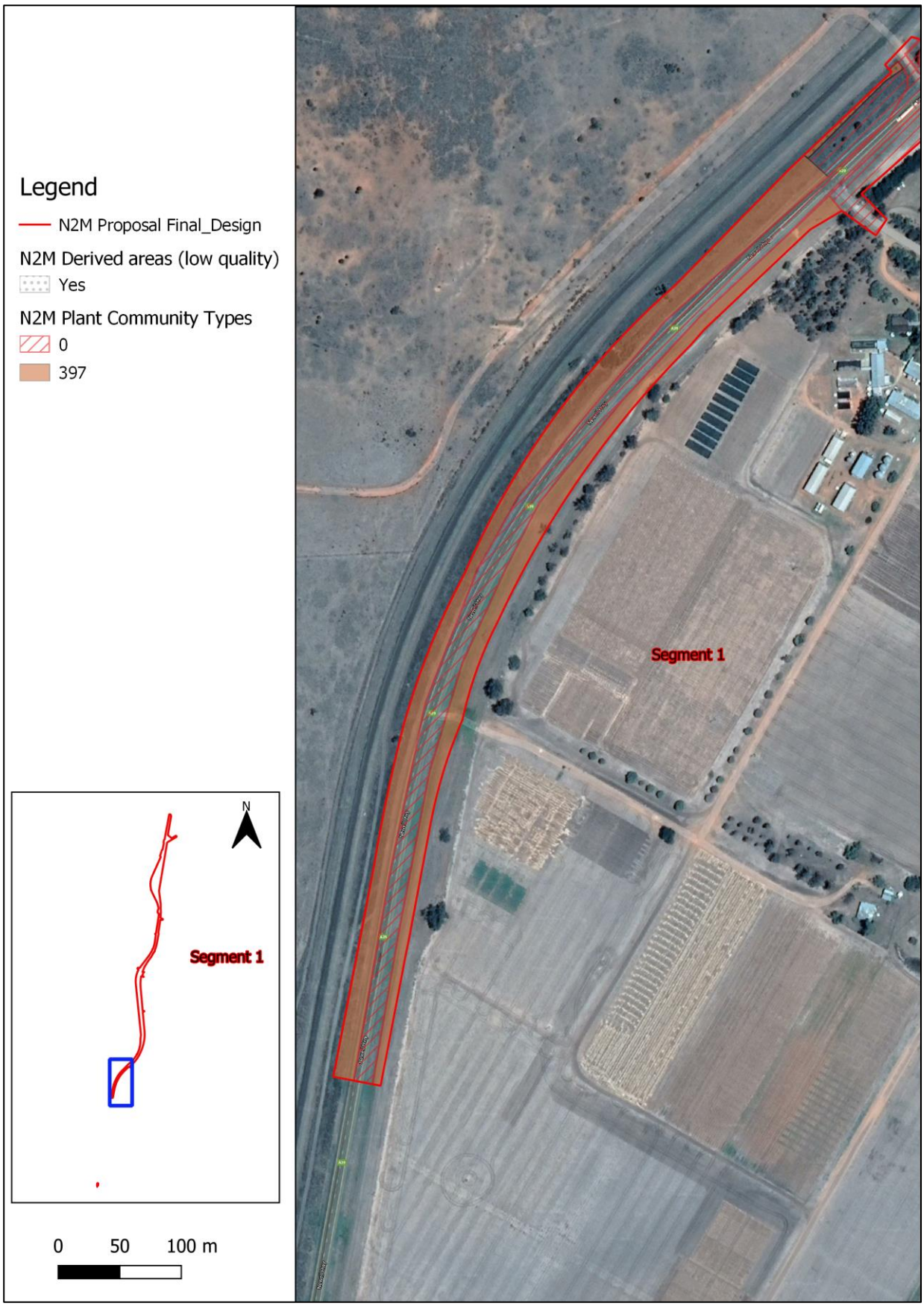

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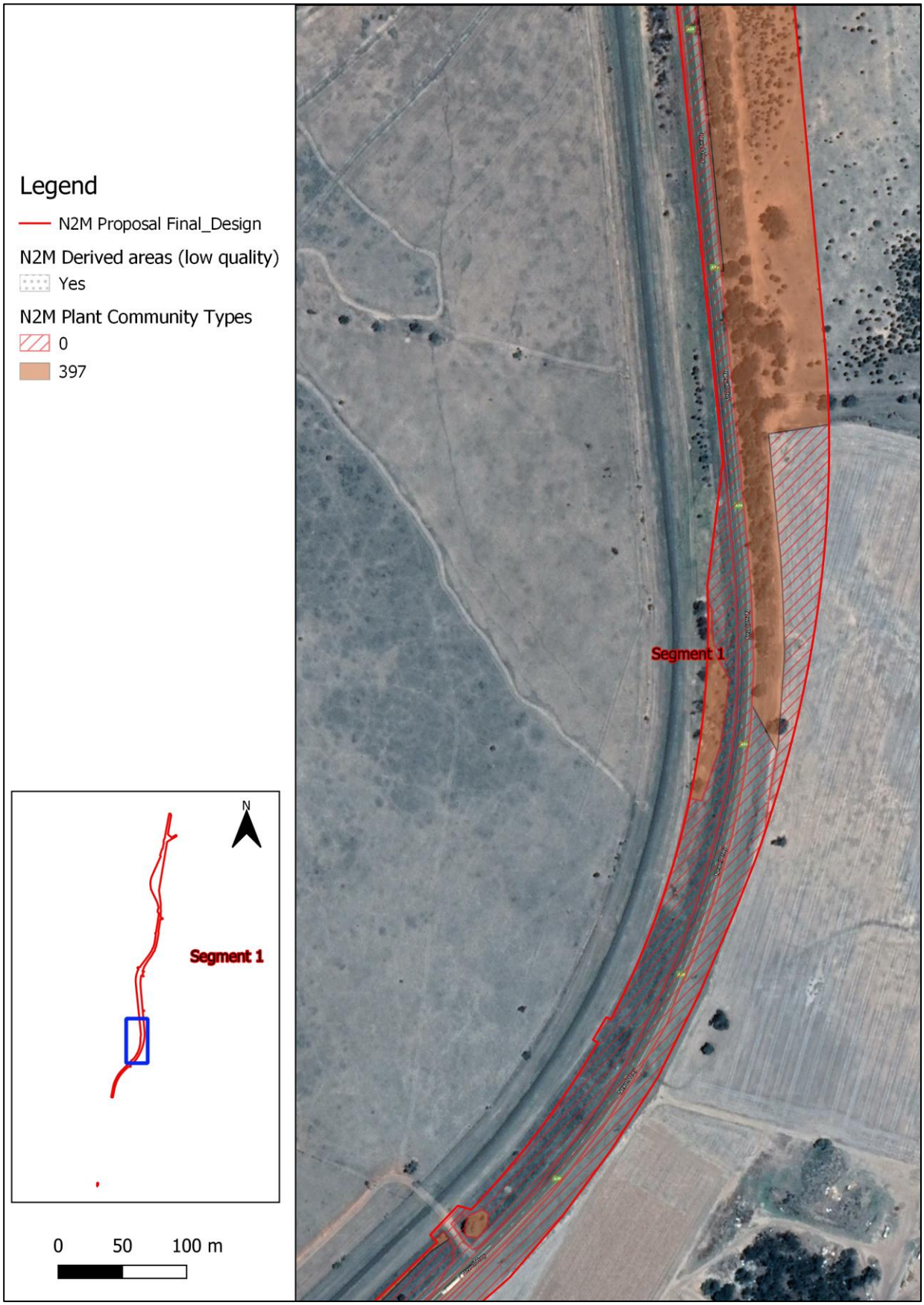

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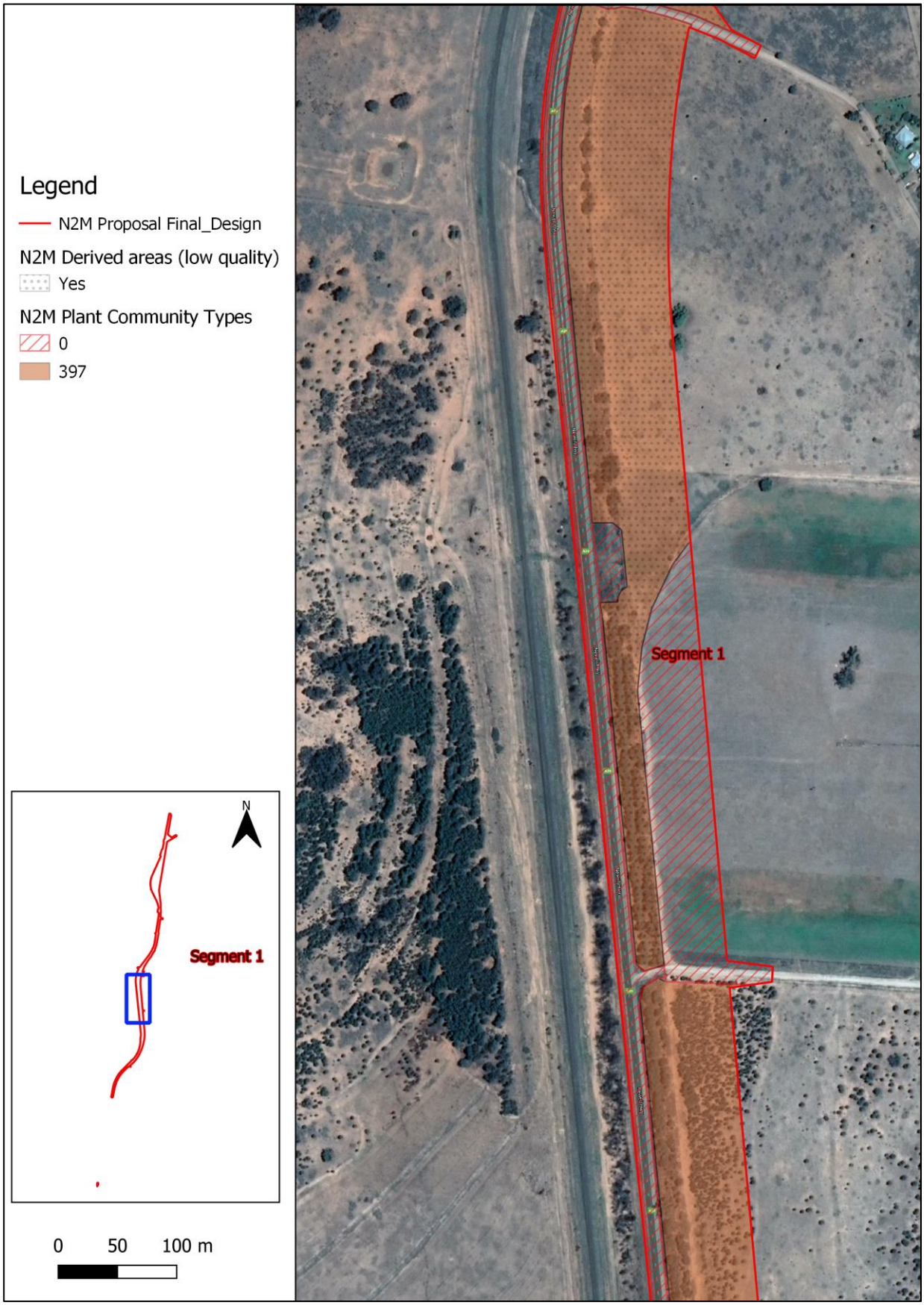

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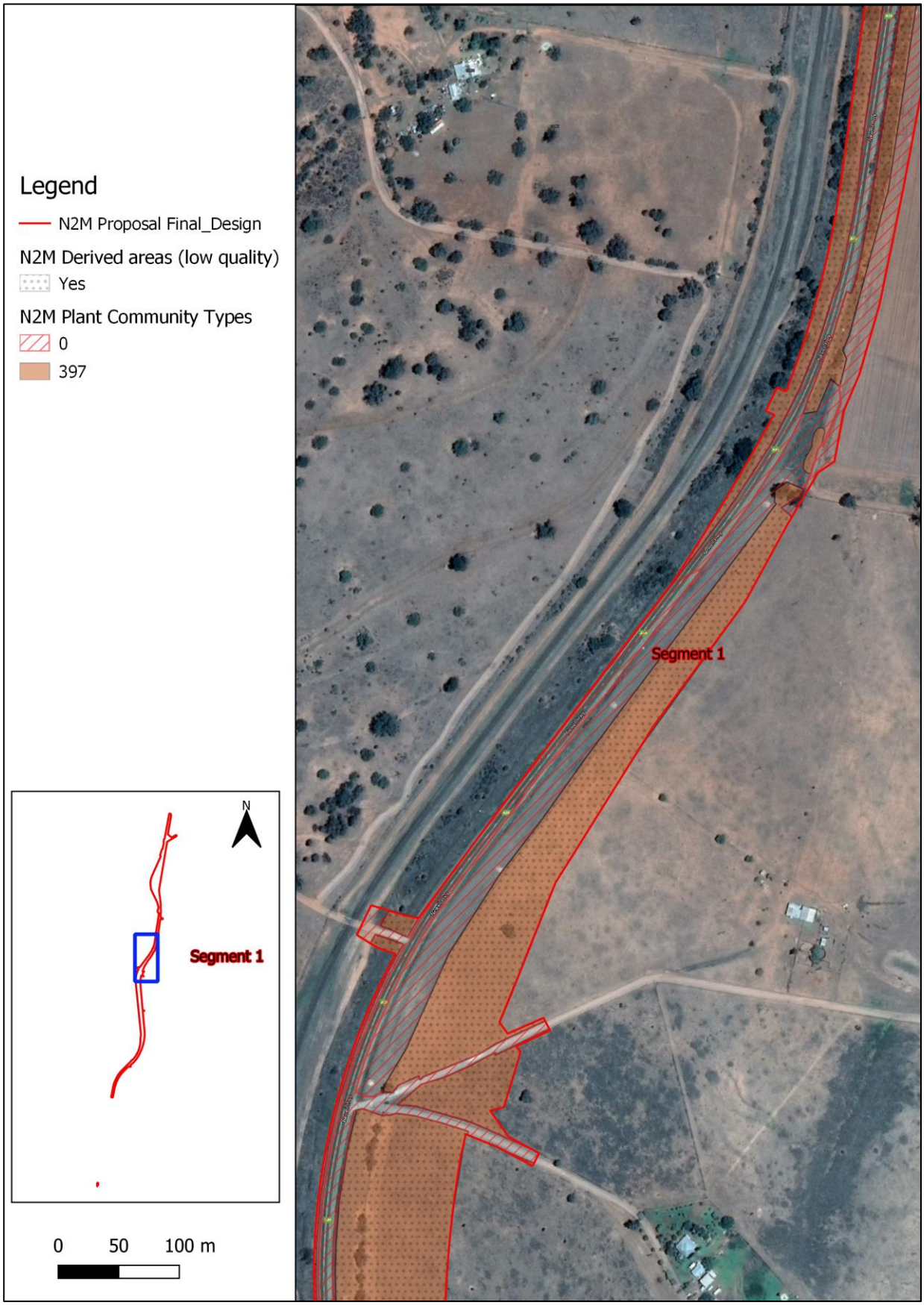

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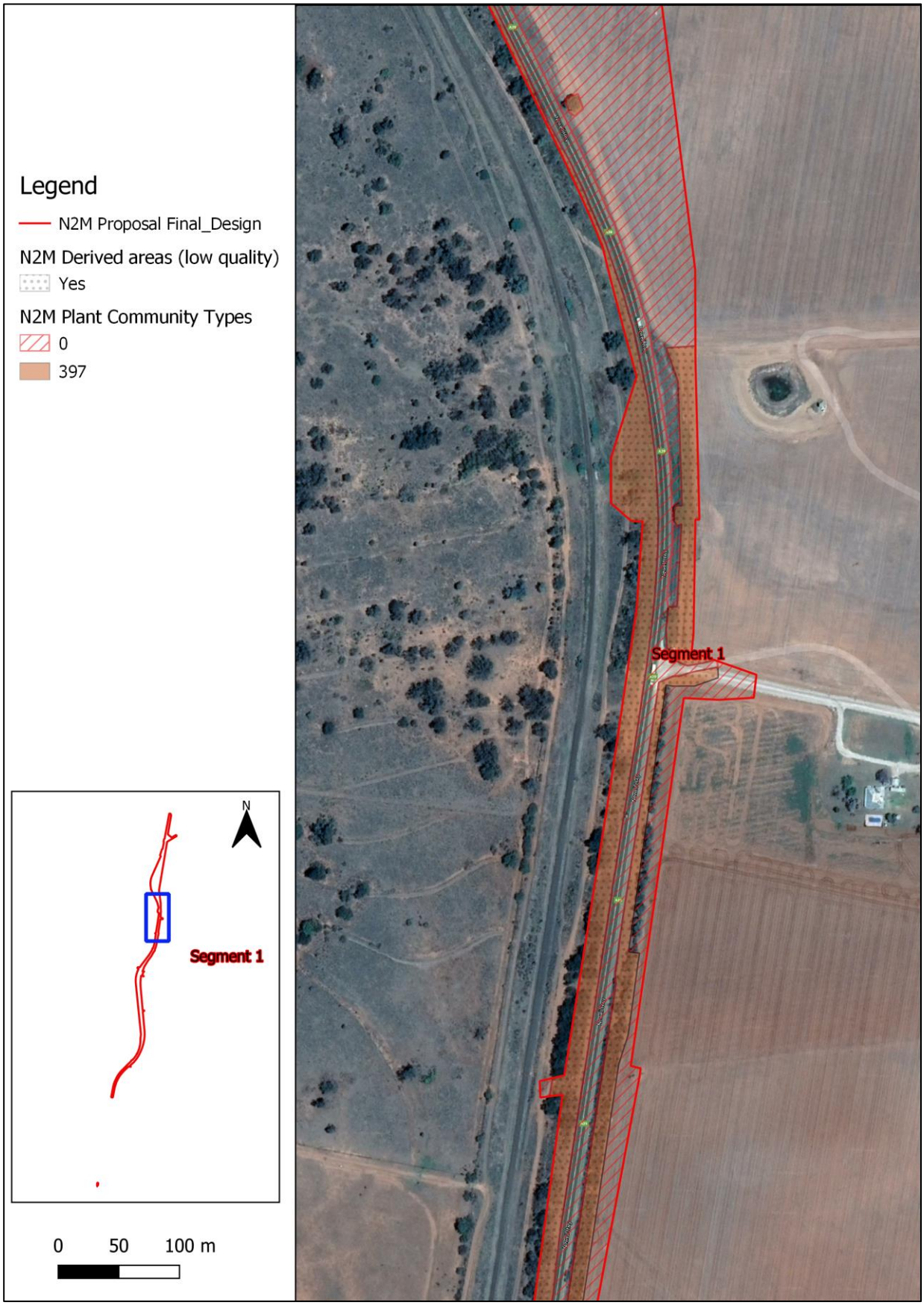

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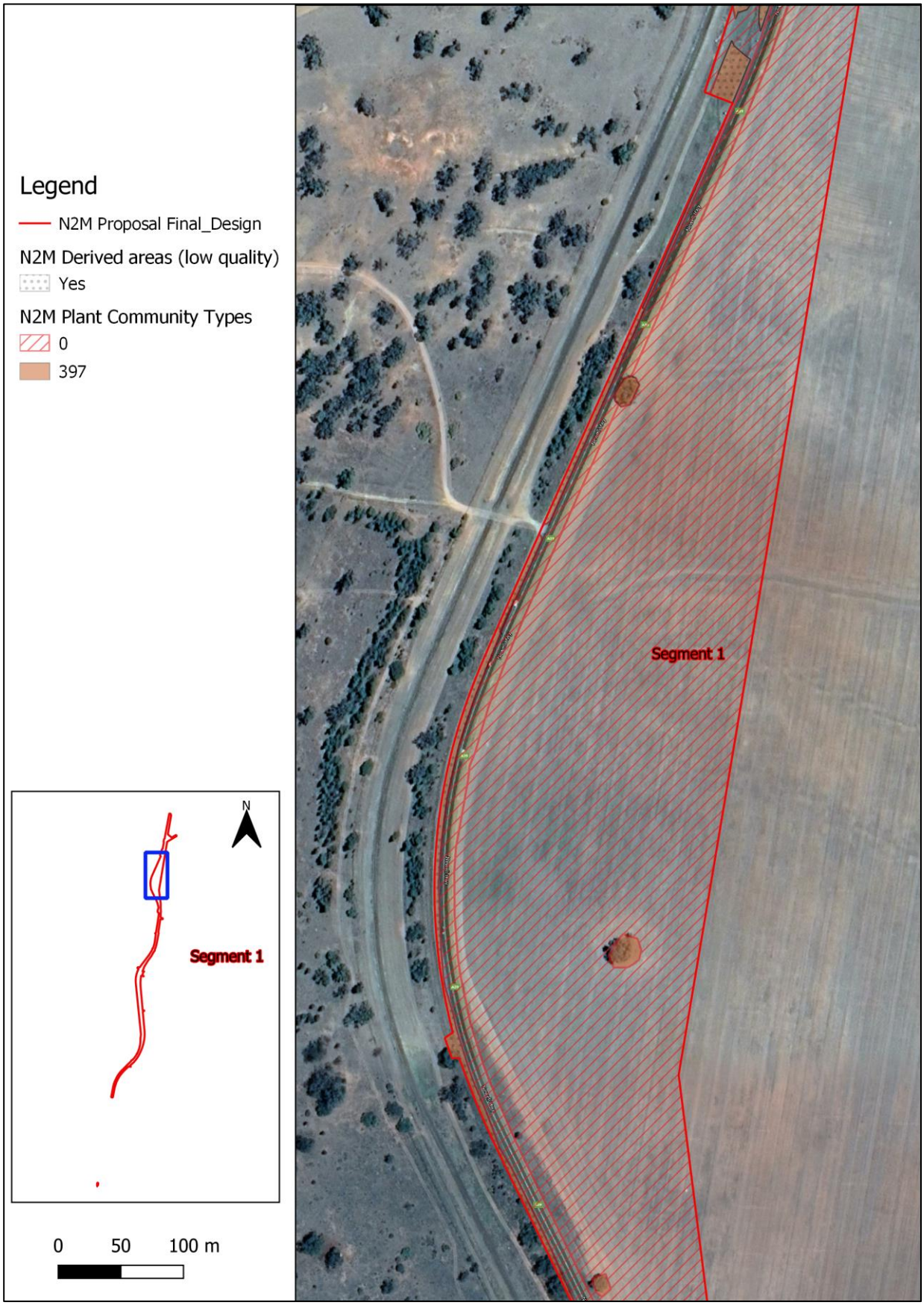

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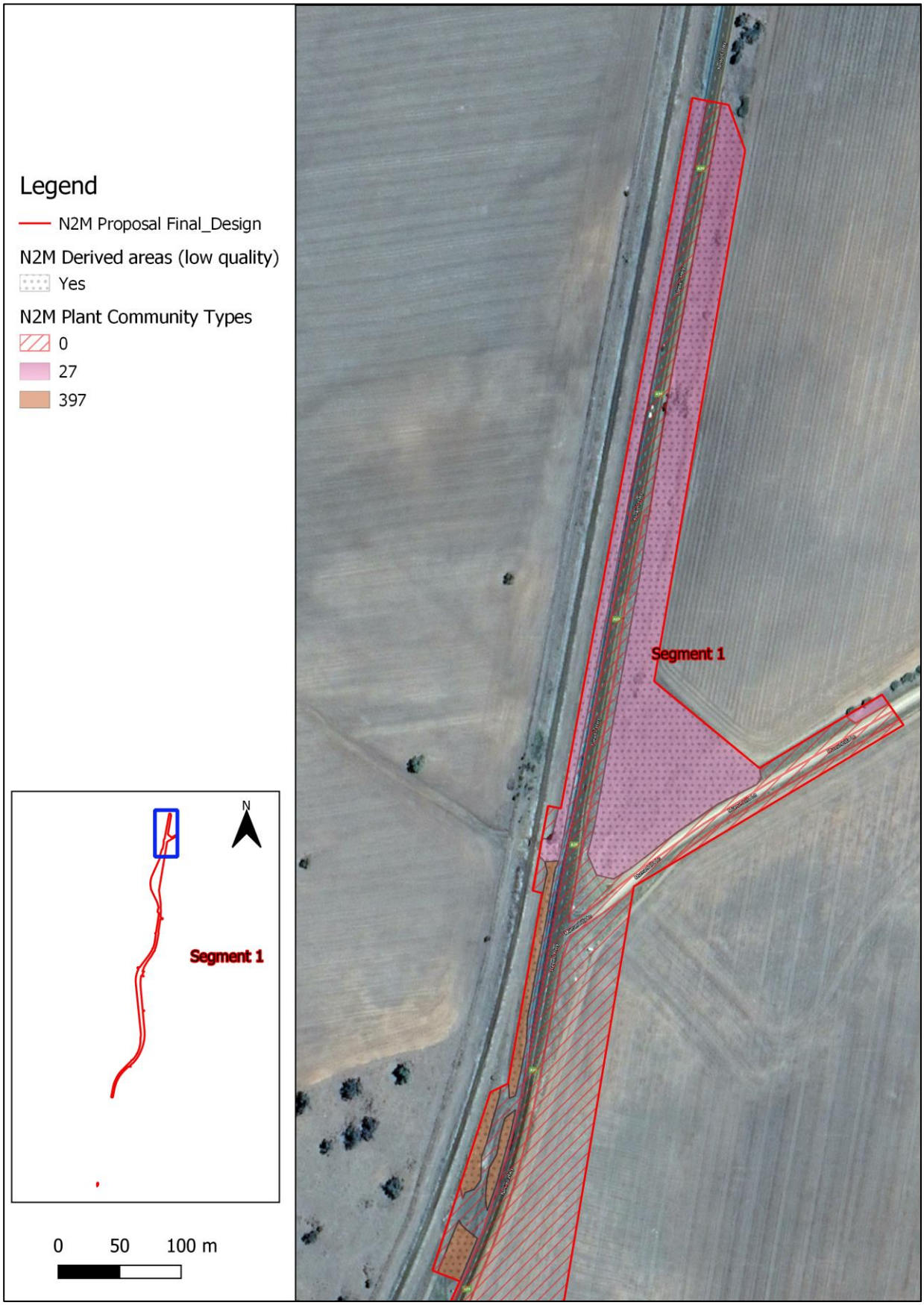

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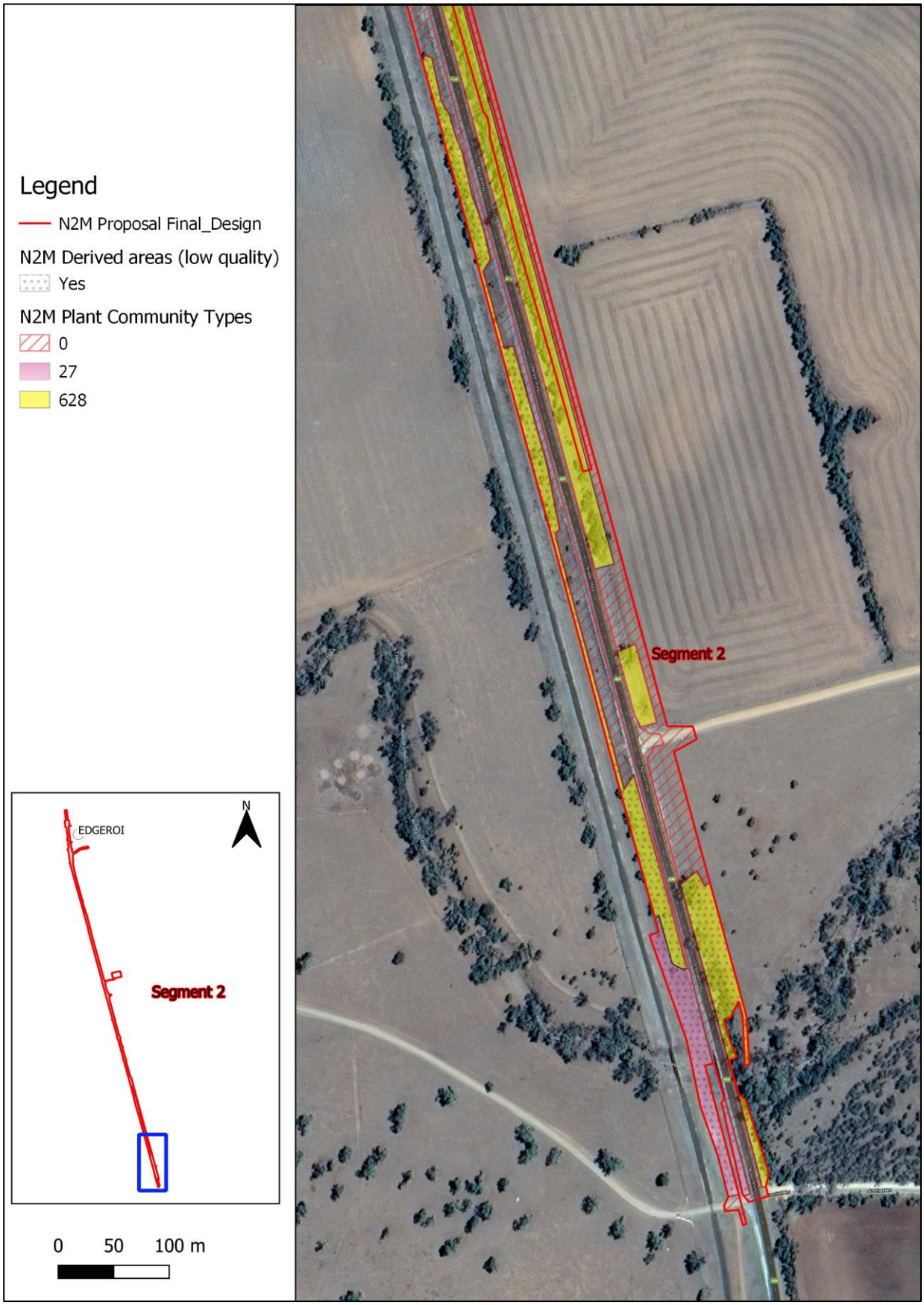

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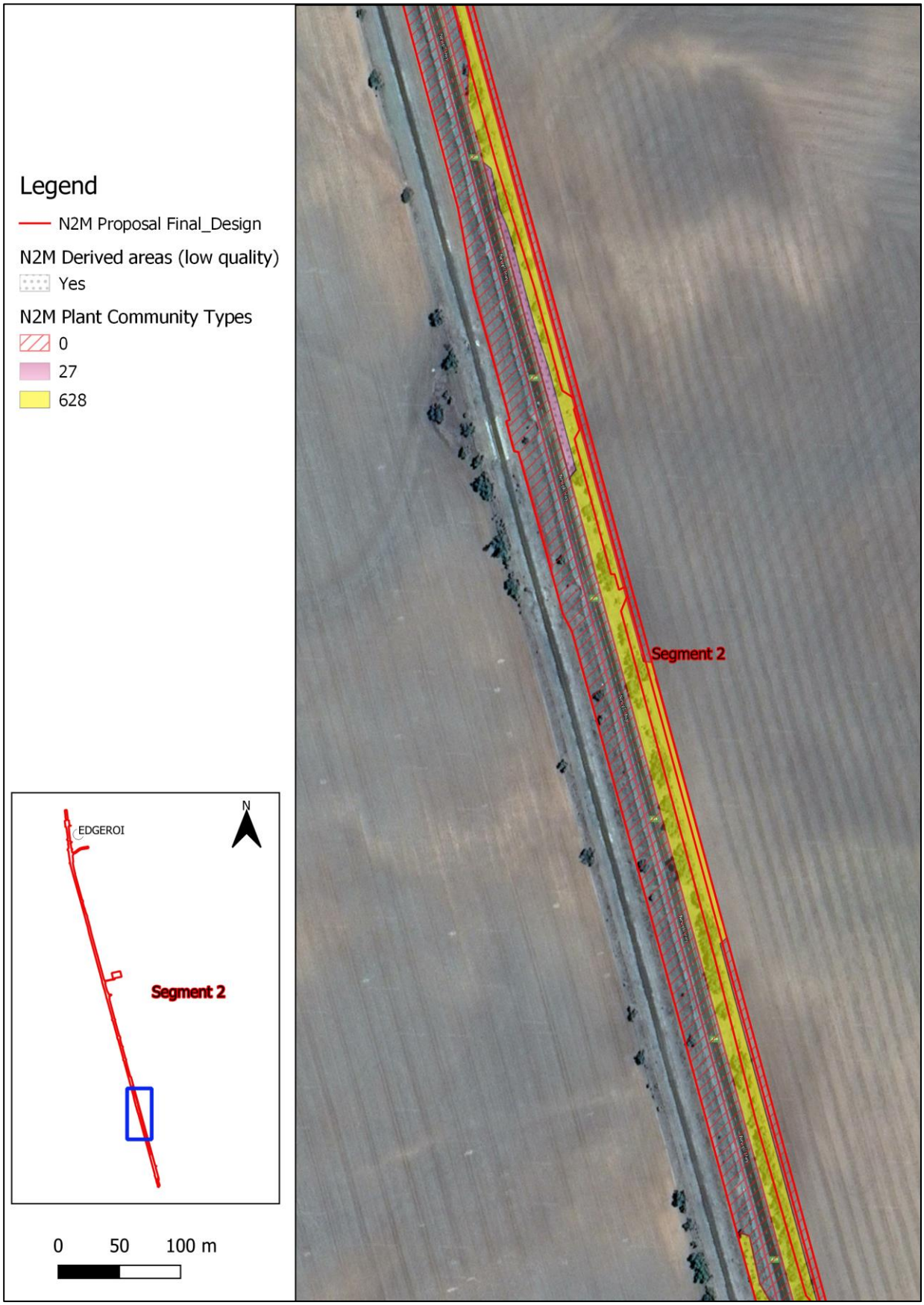

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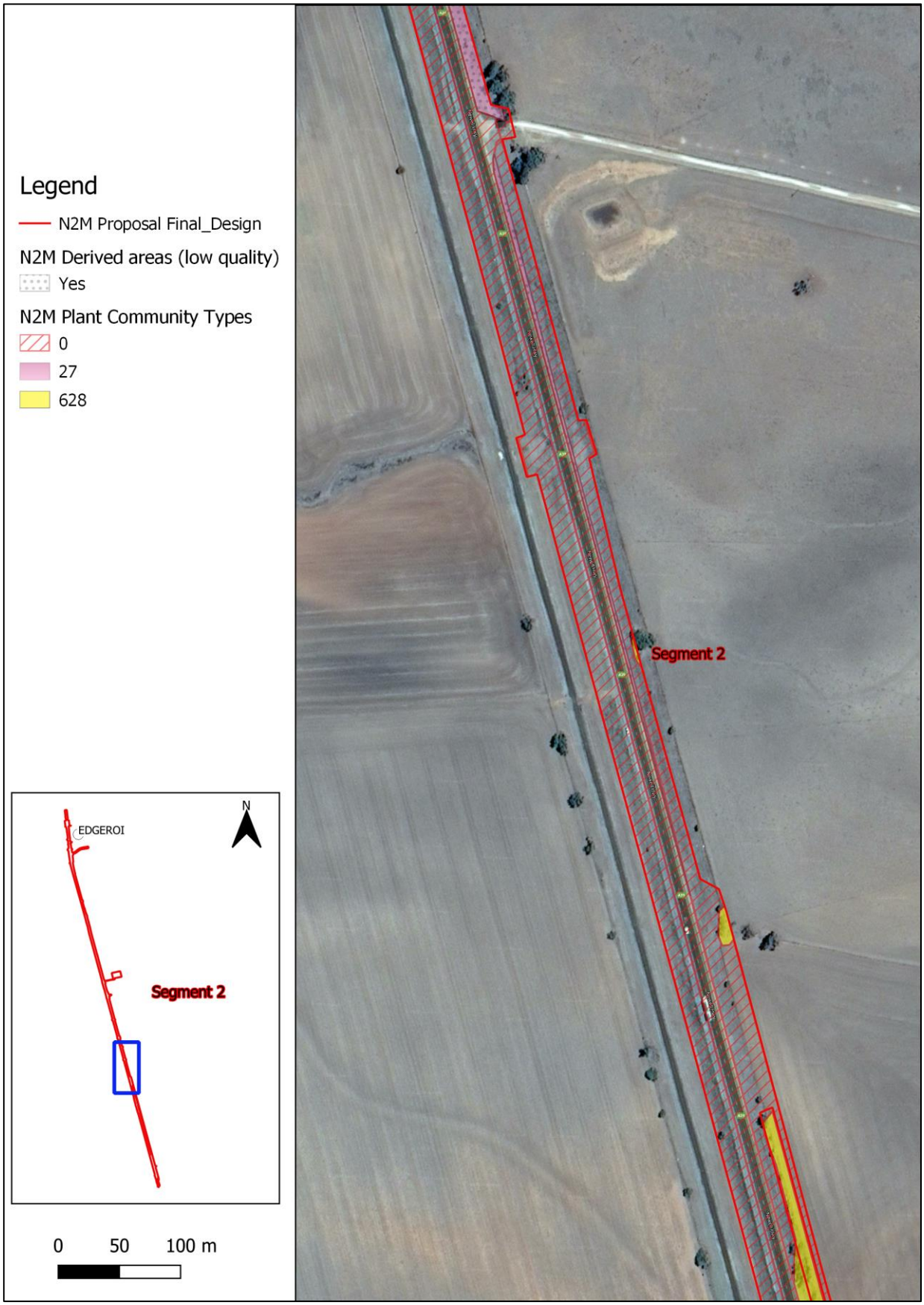

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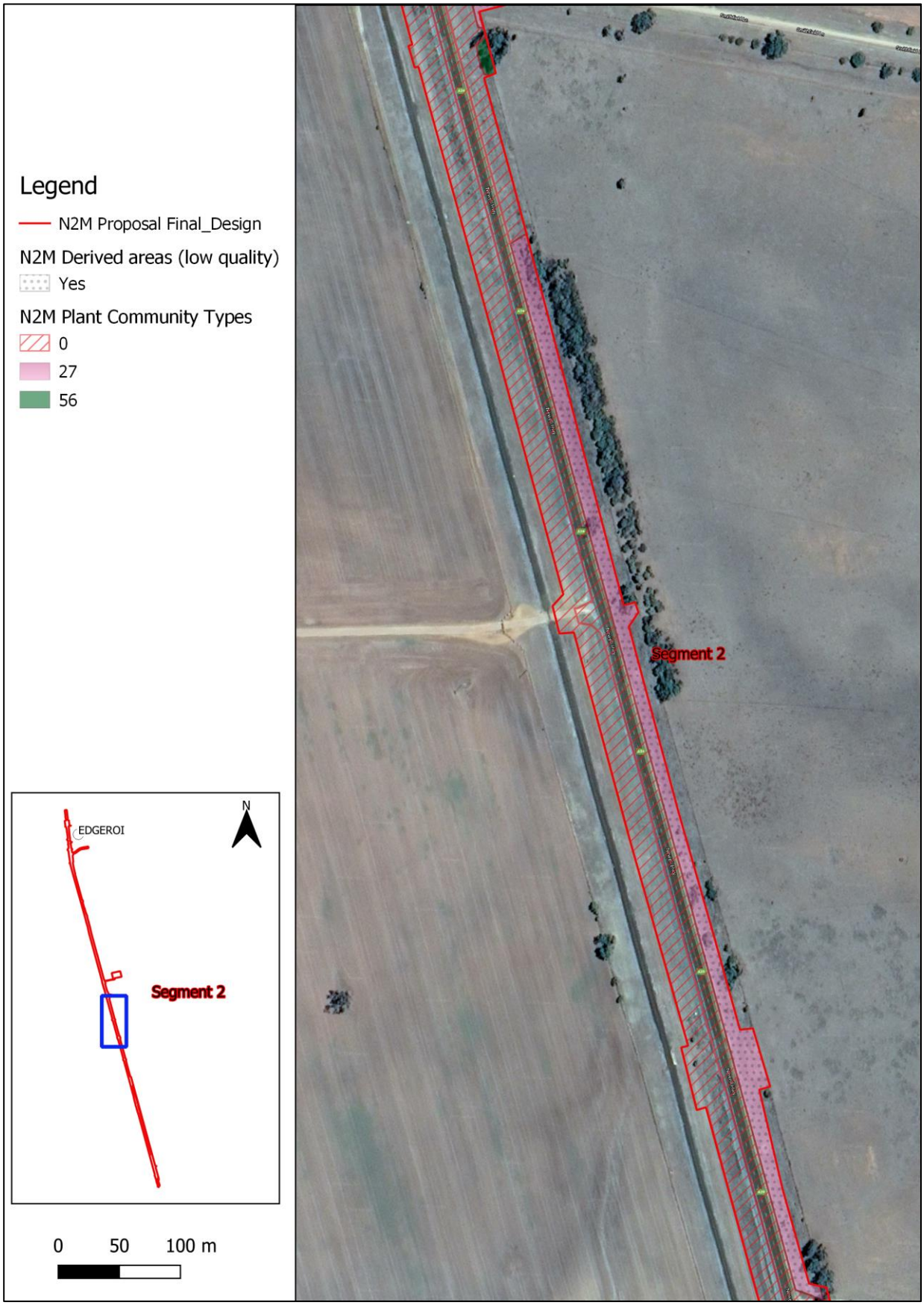

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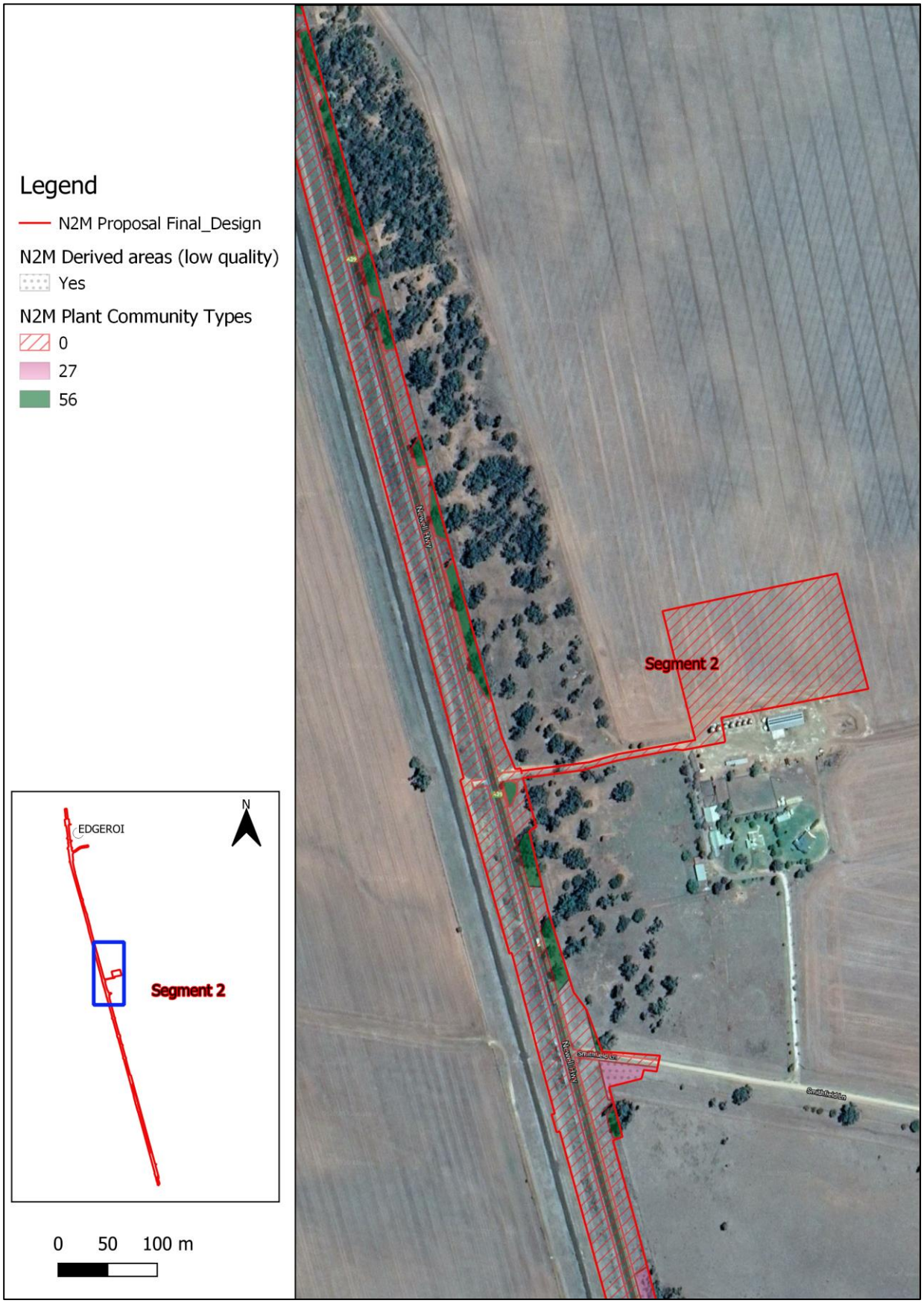

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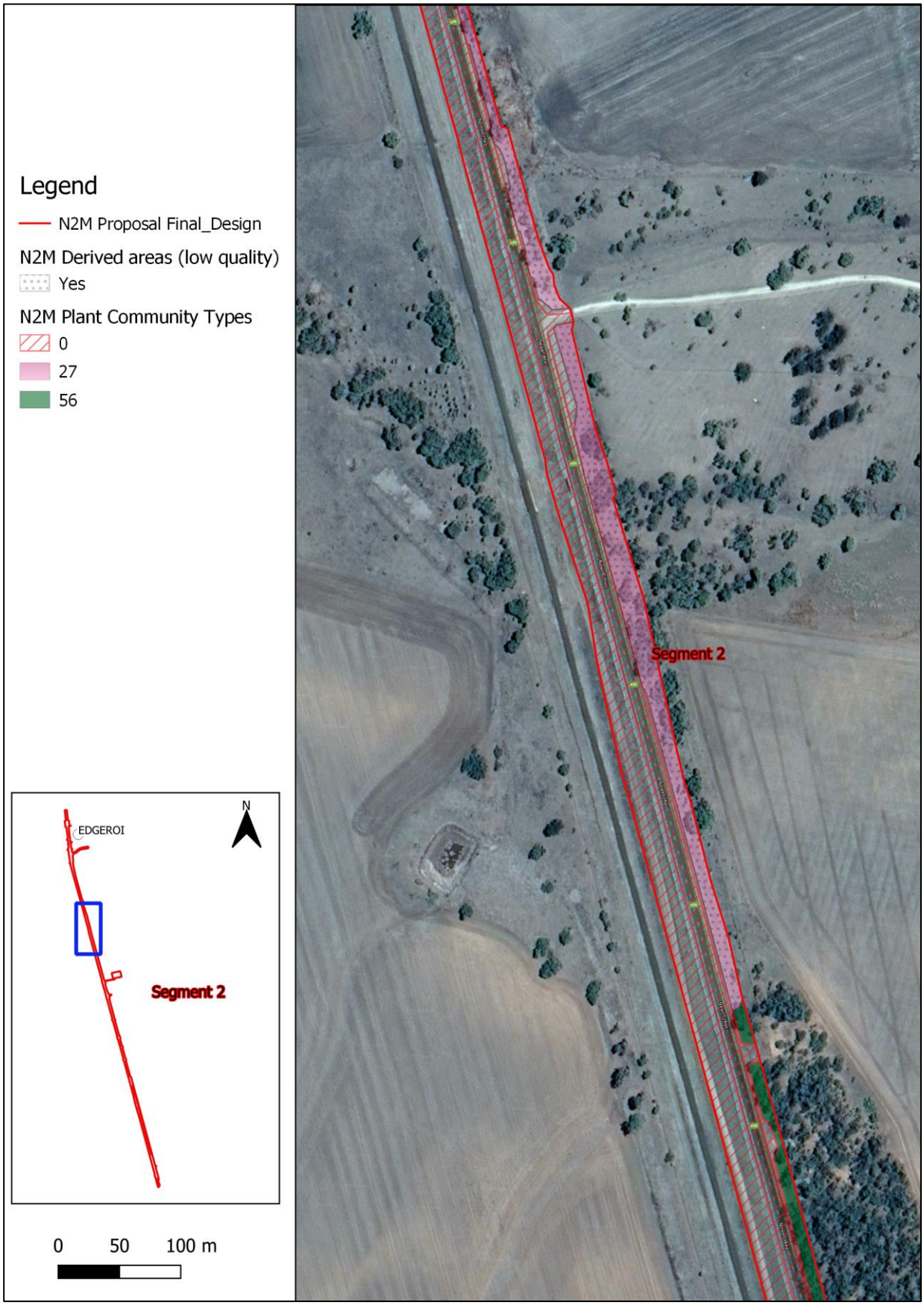

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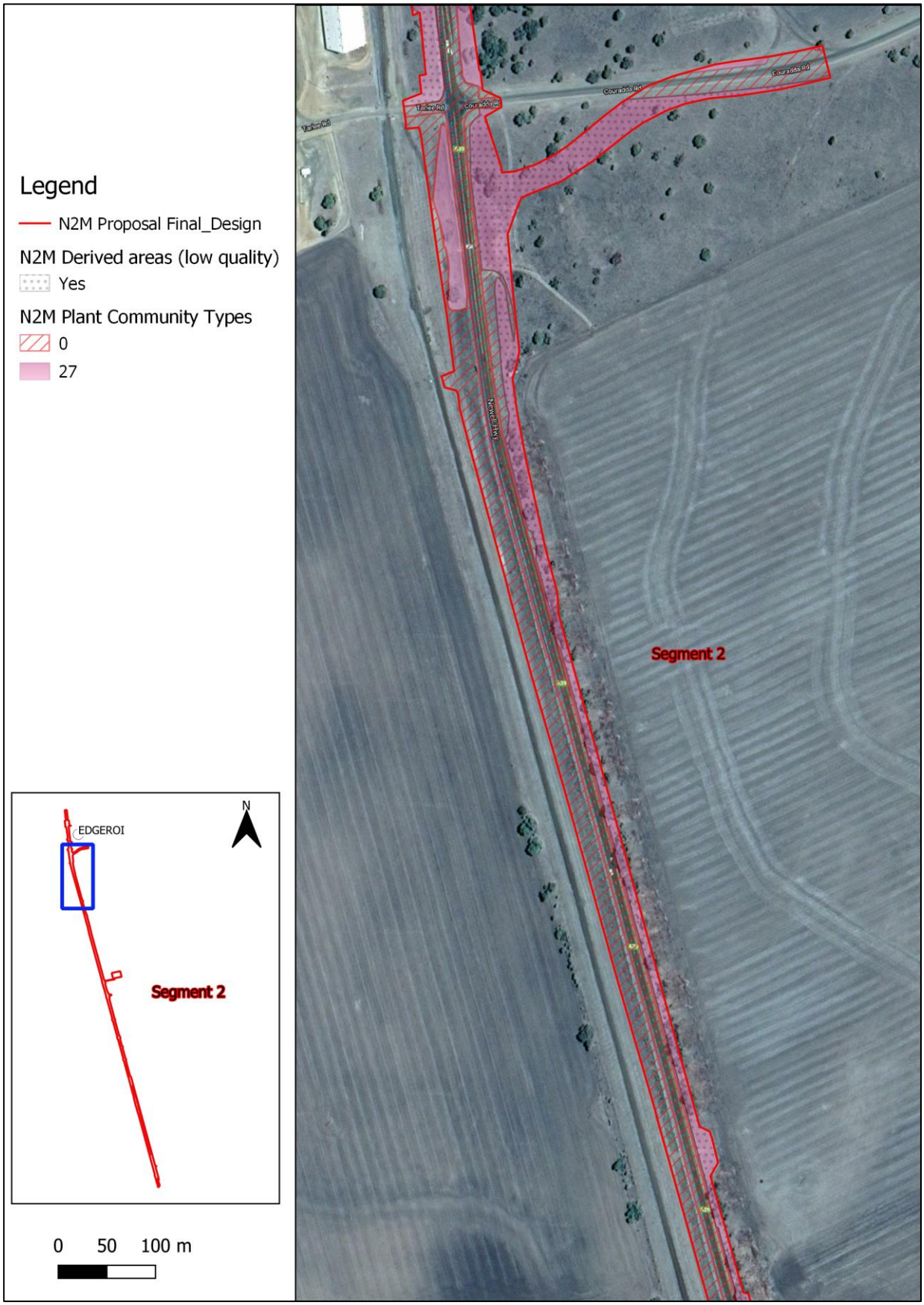

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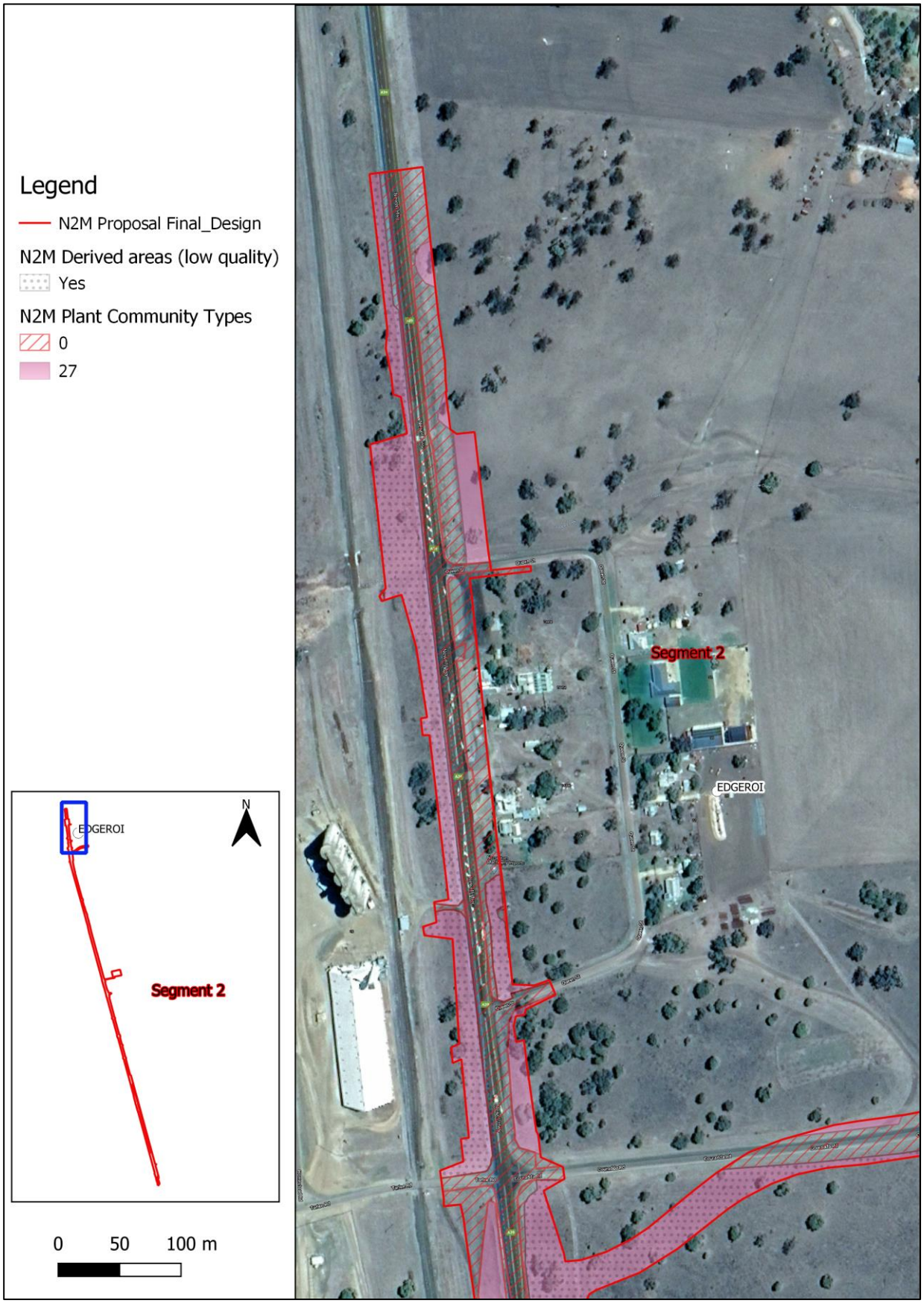

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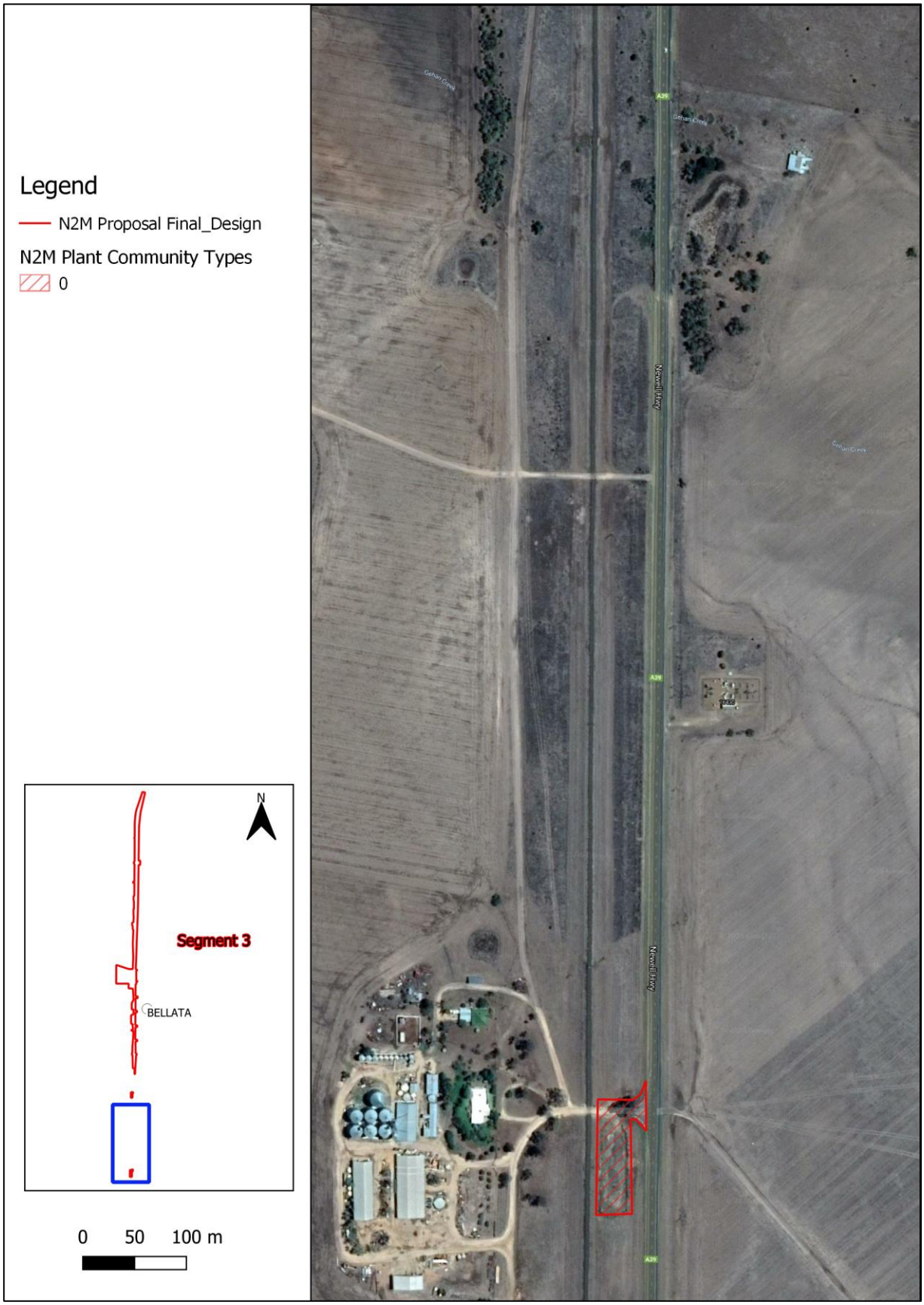

Figure 3.2 Plant Community types Segment 3
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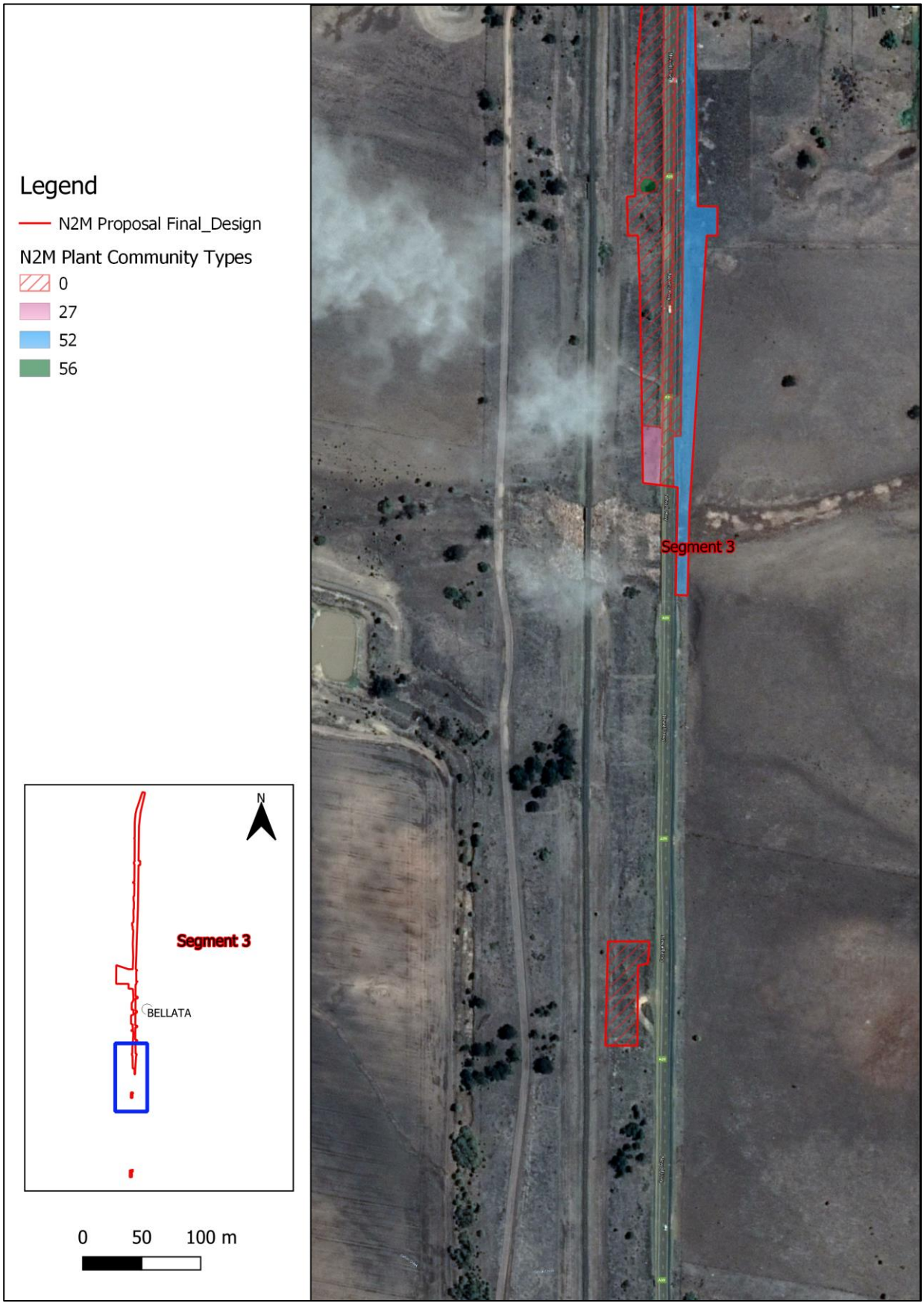

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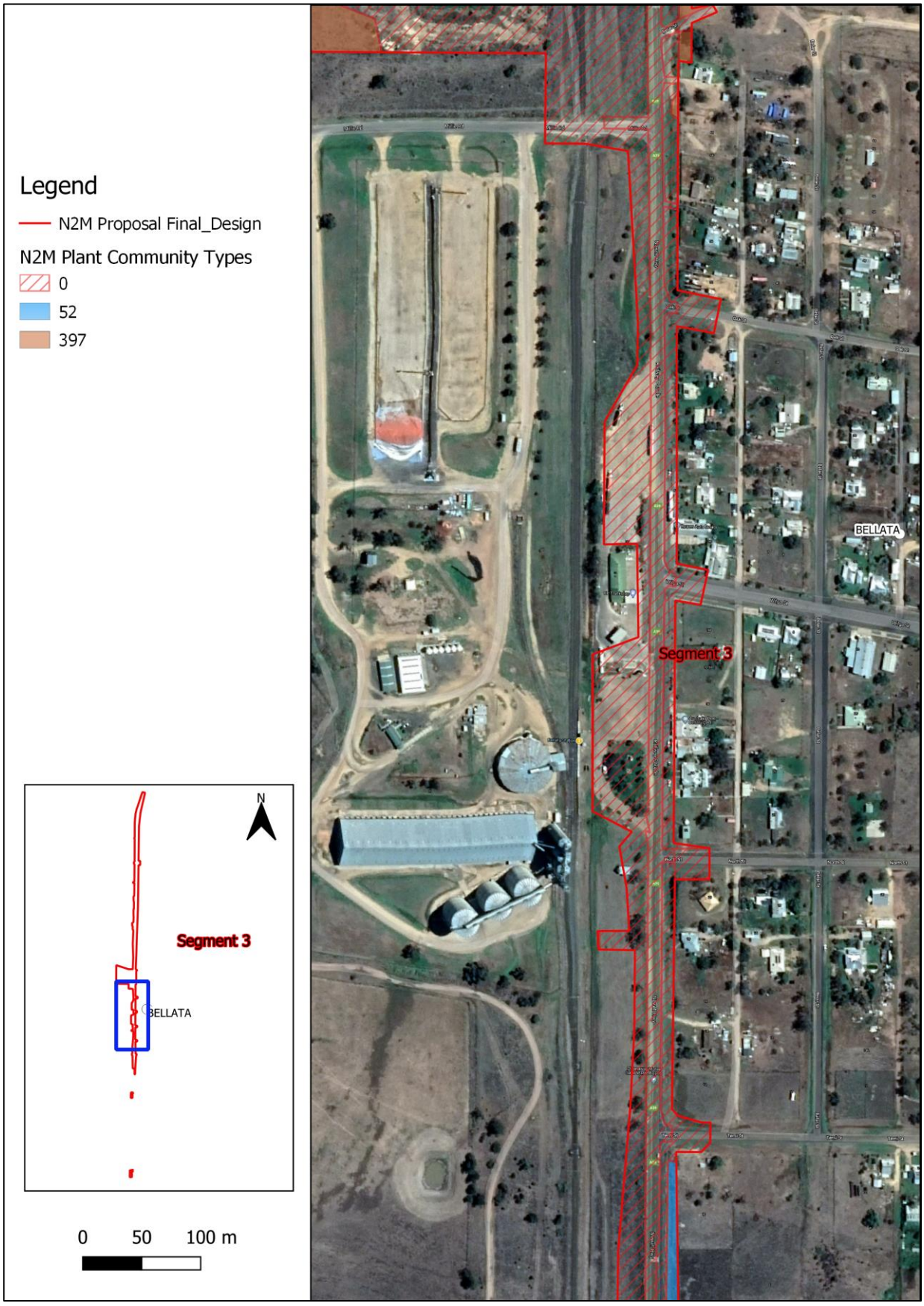

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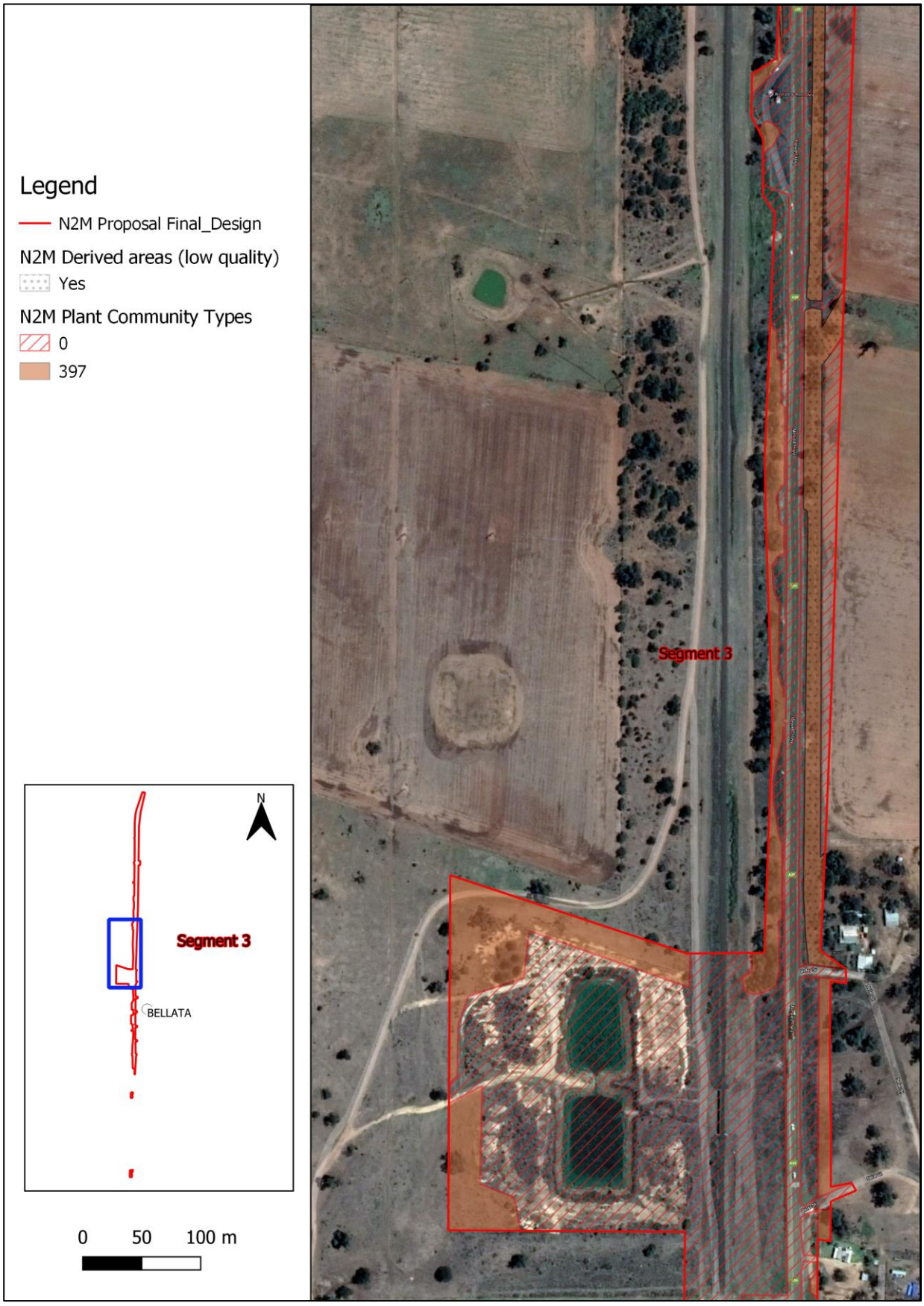

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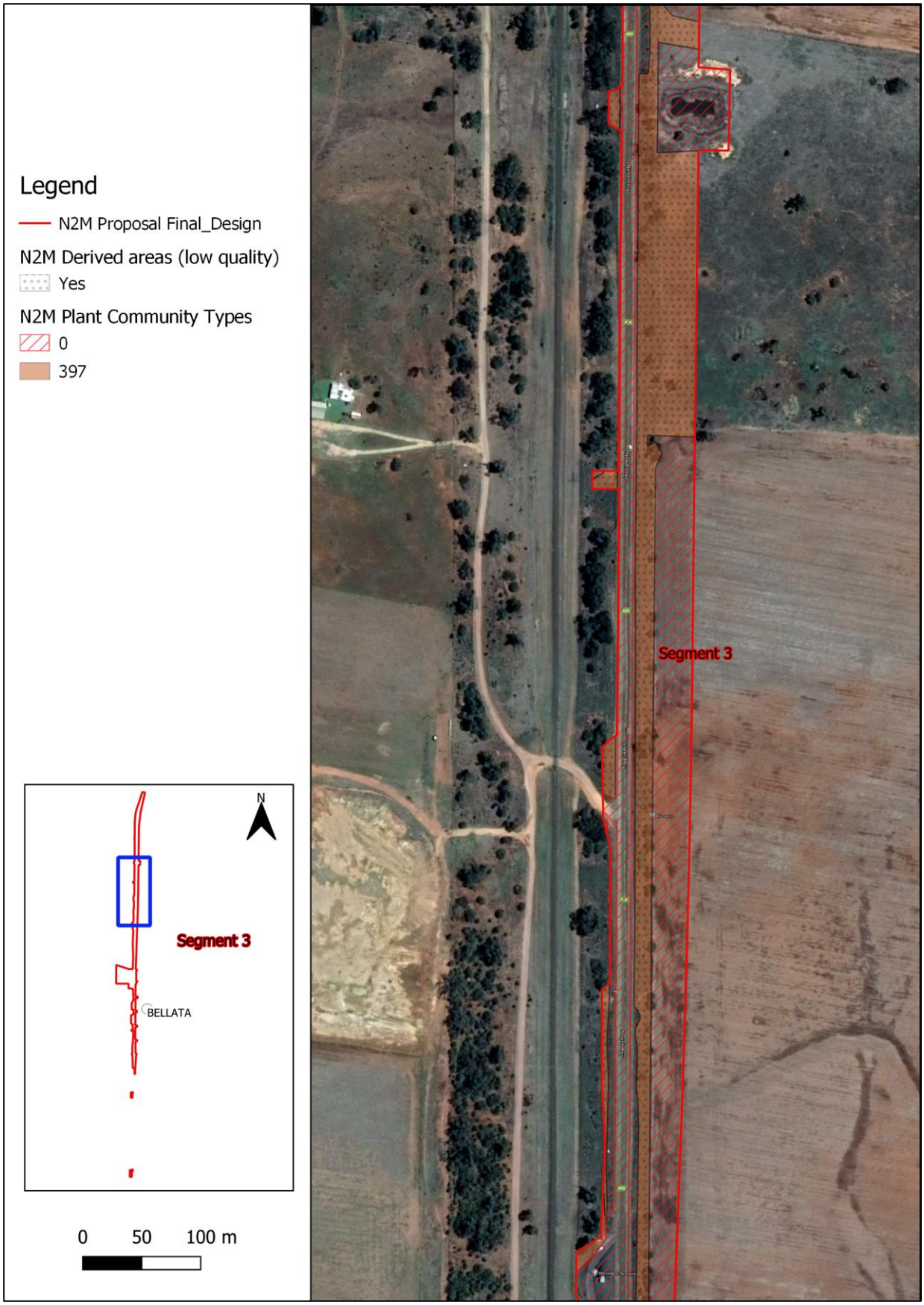

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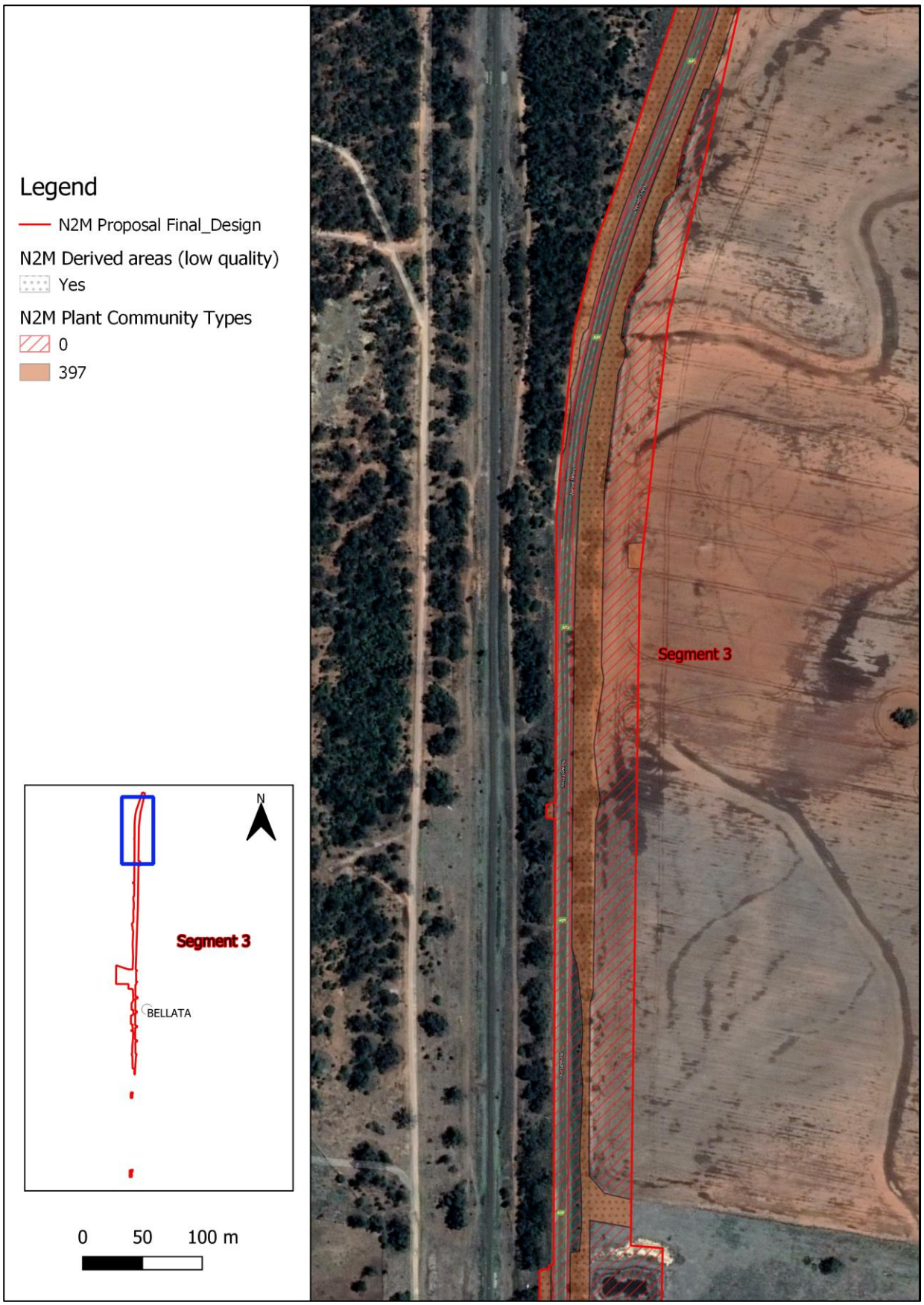

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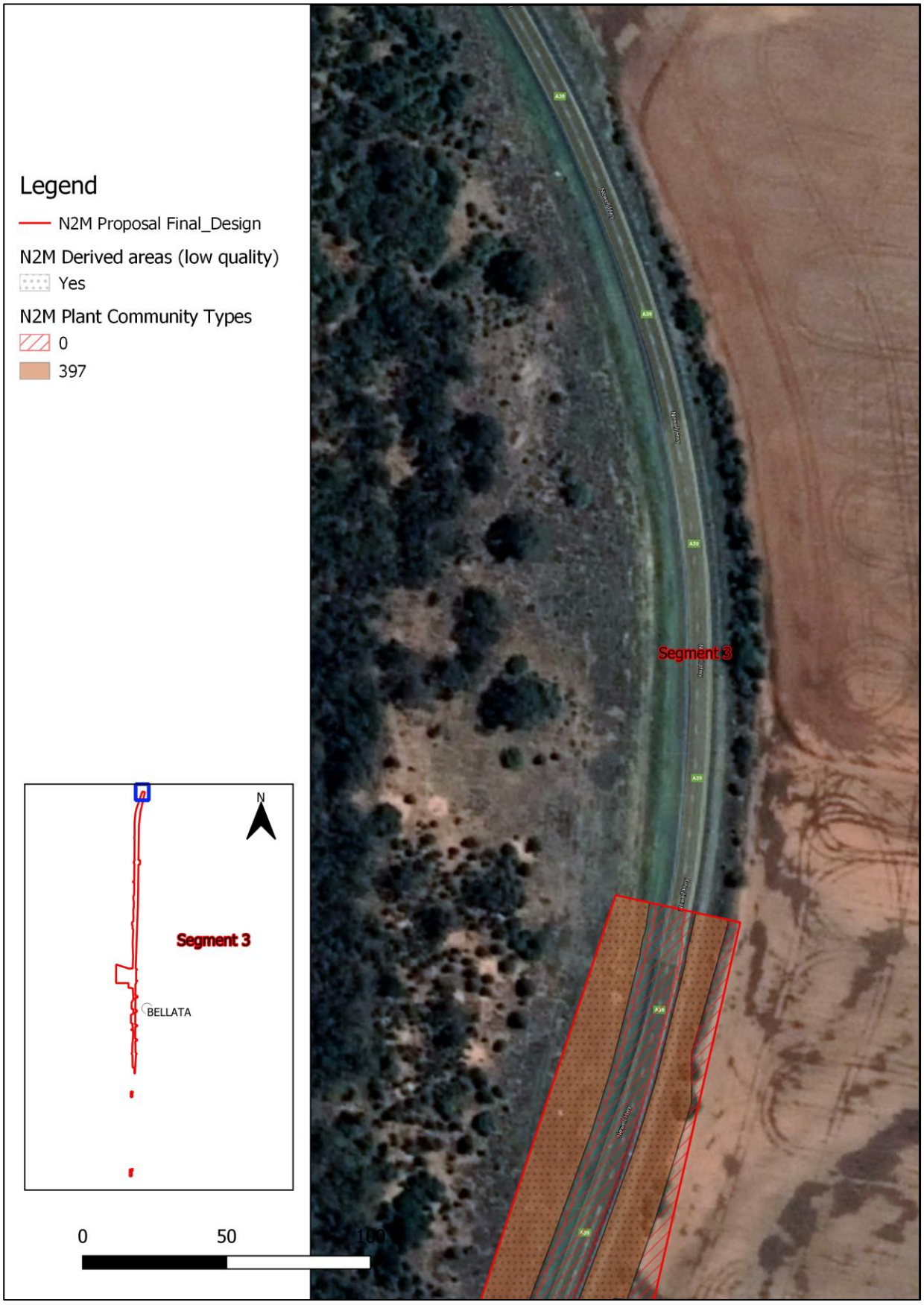

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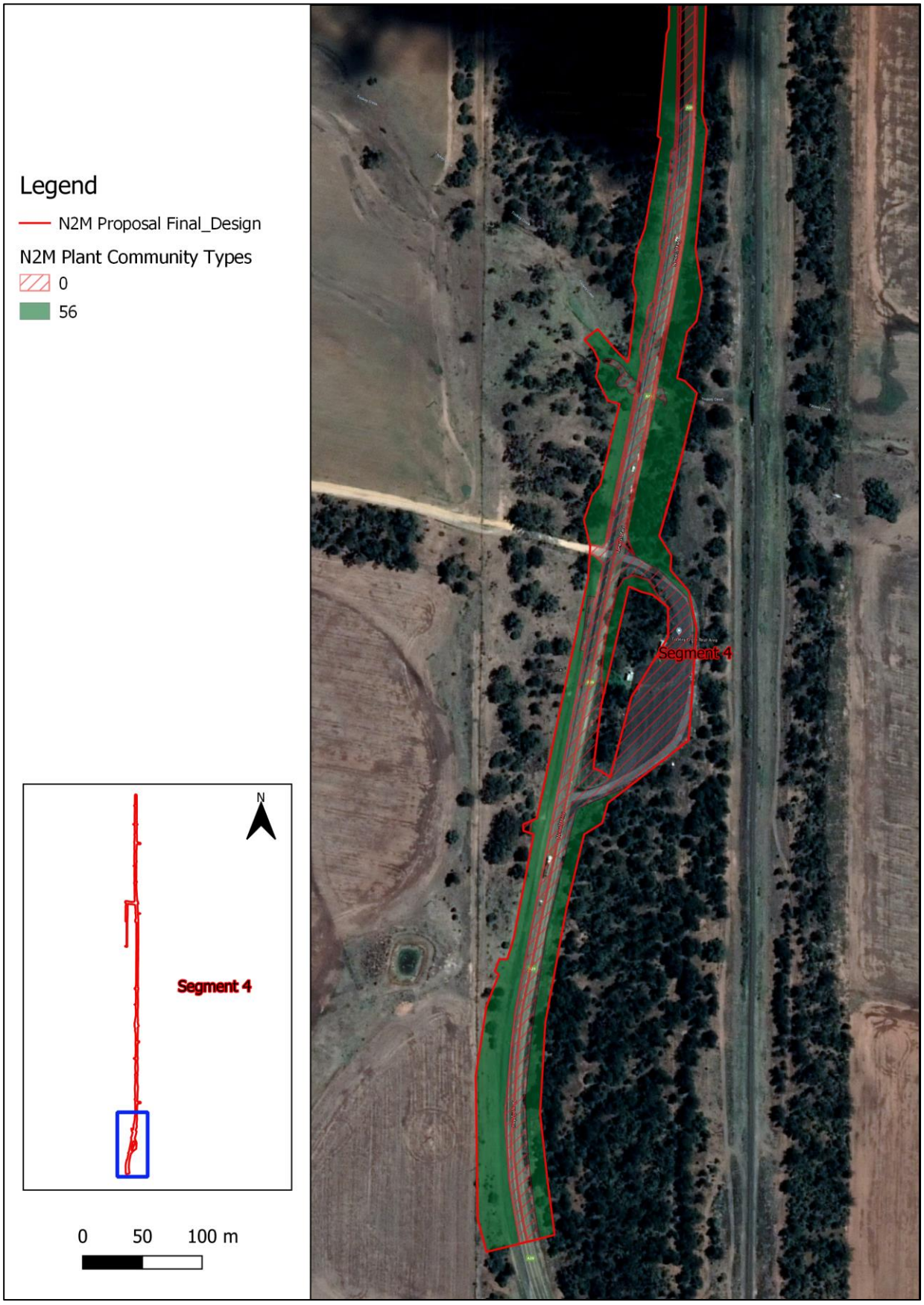

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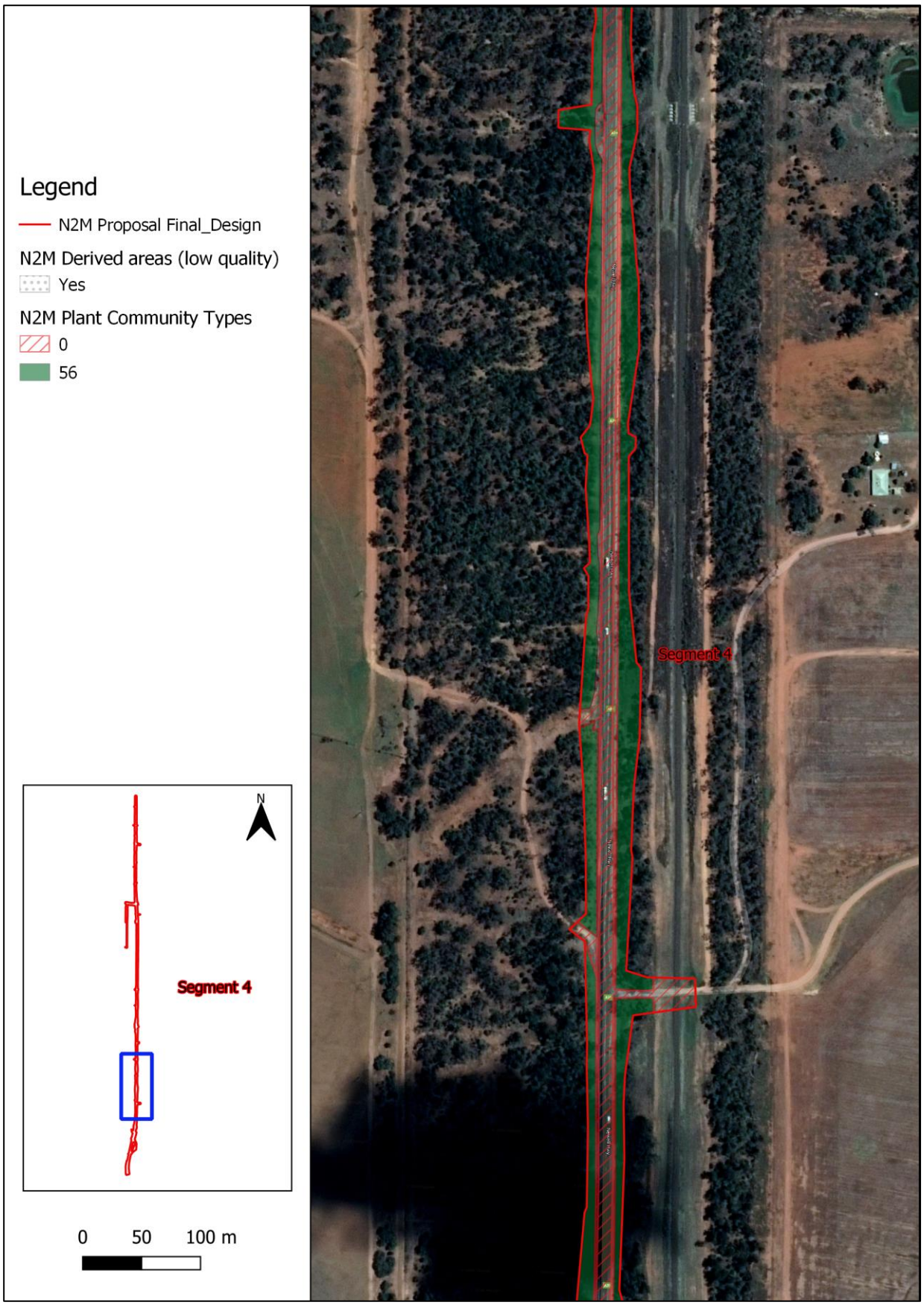

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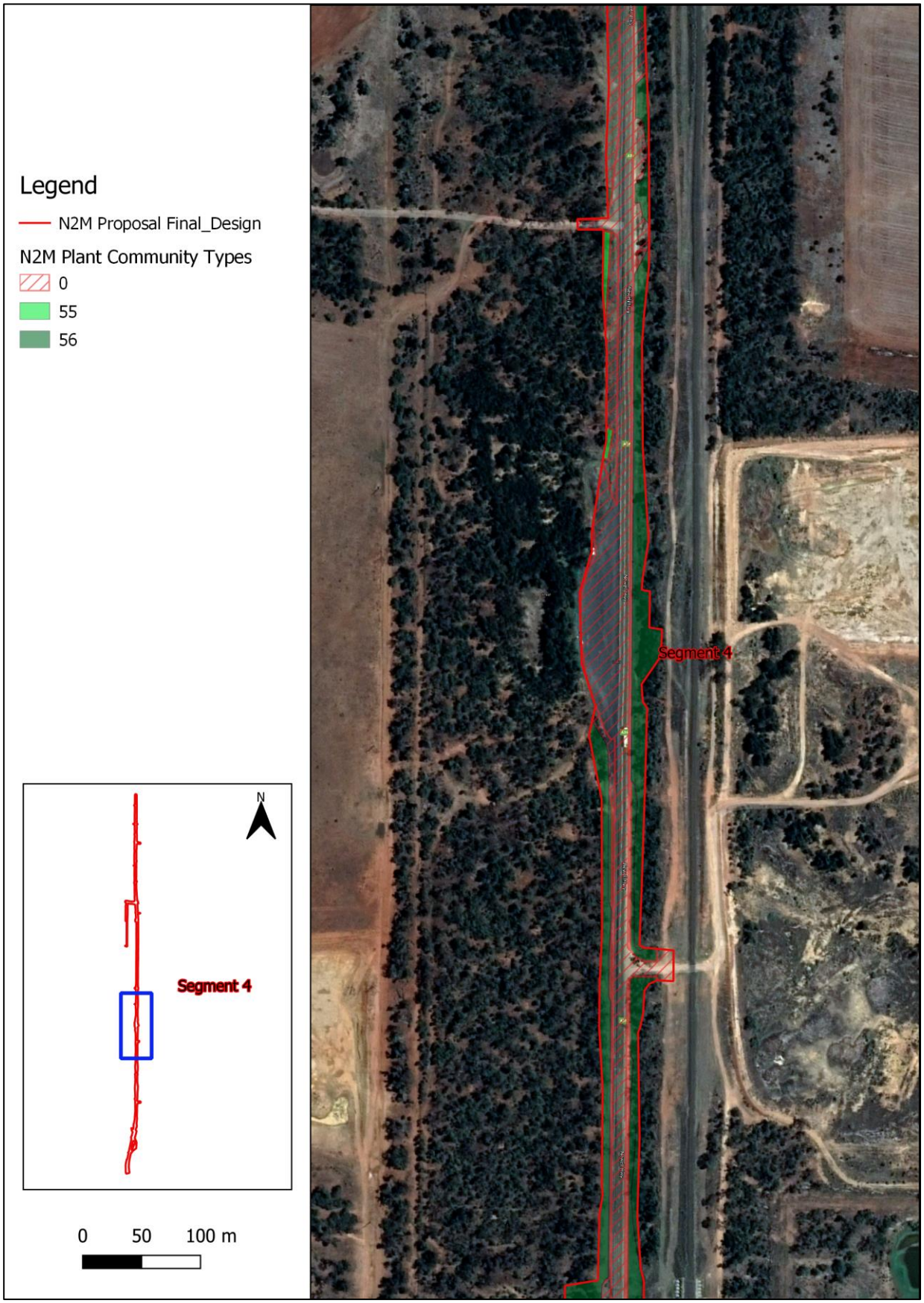

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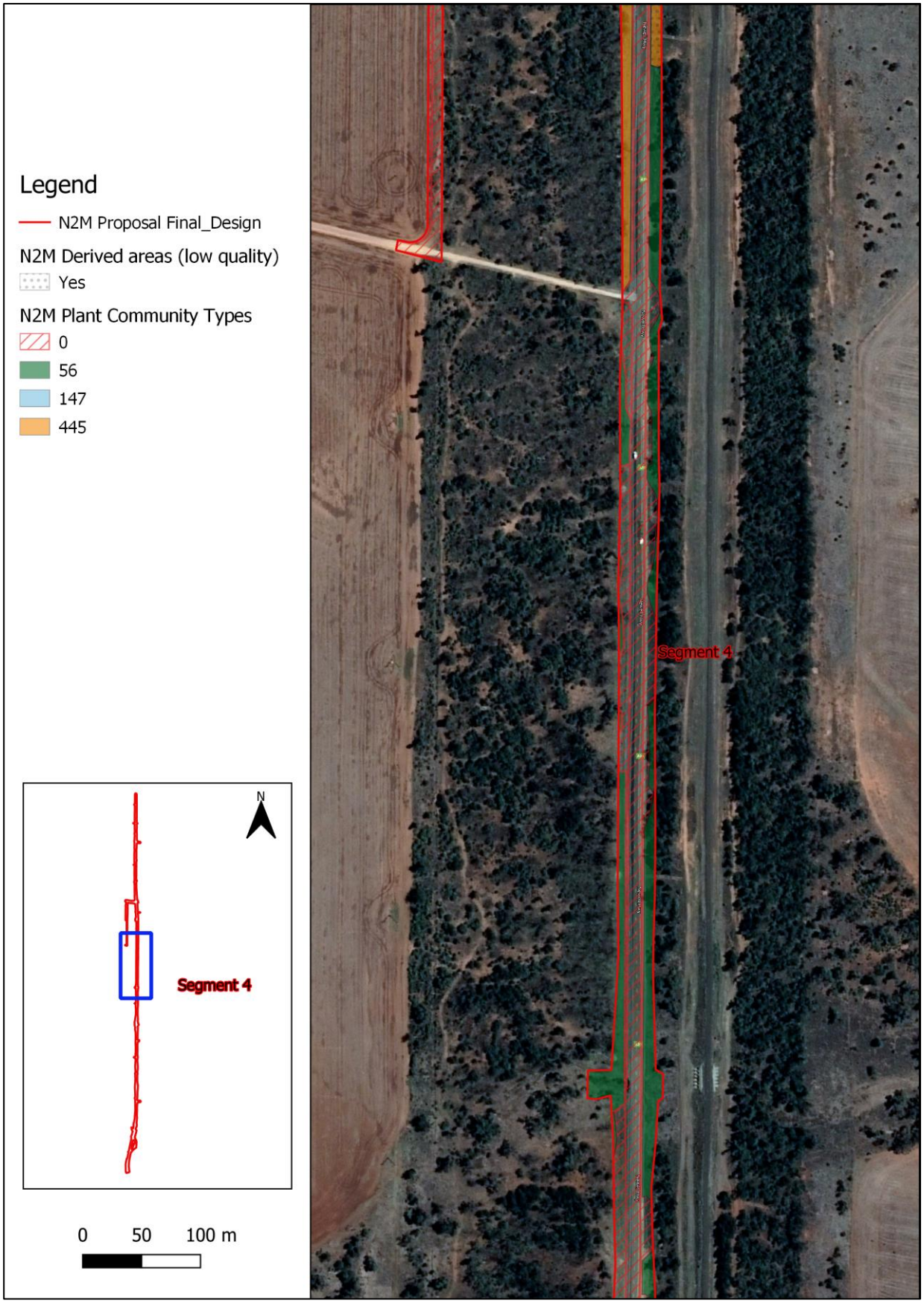

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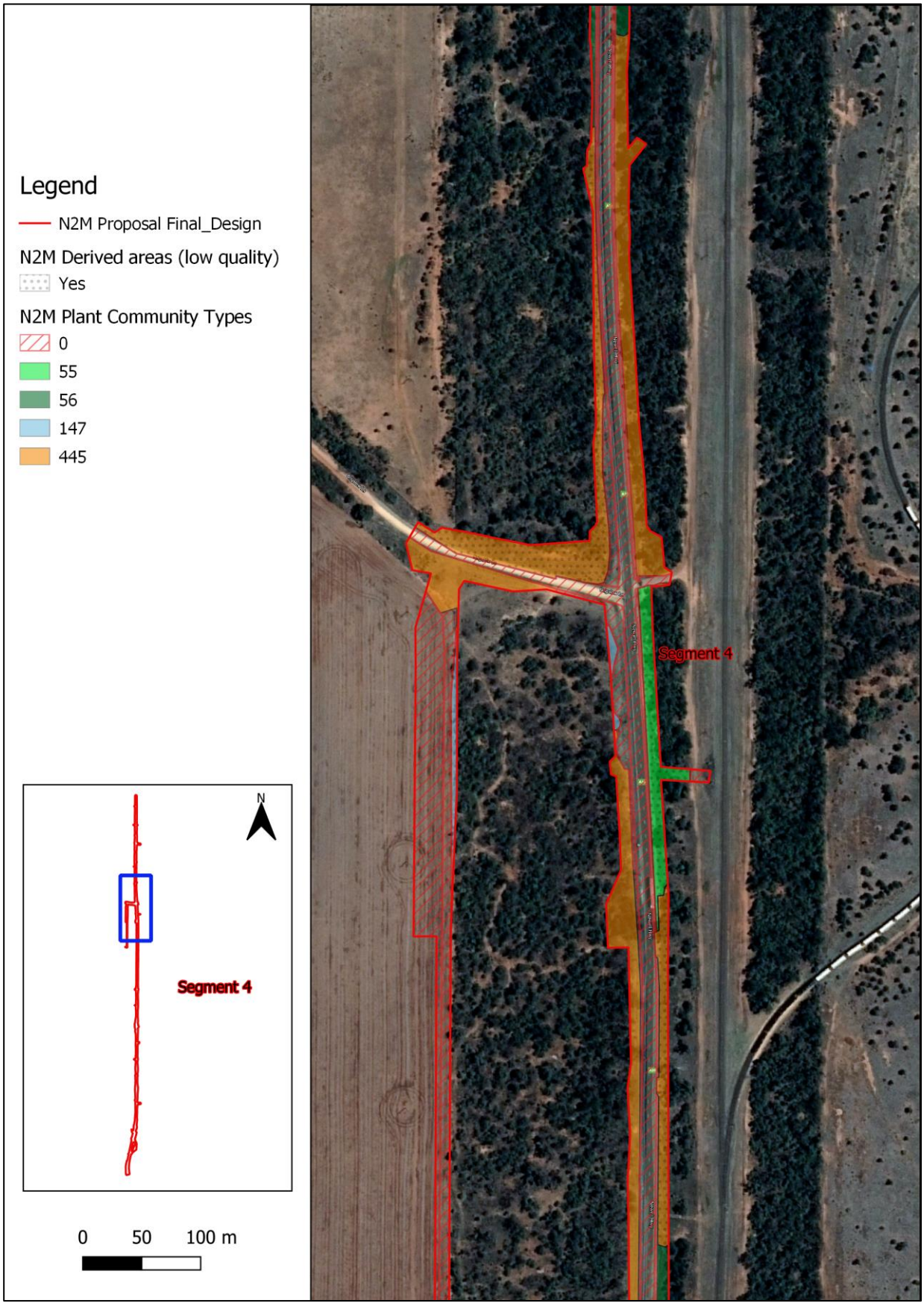

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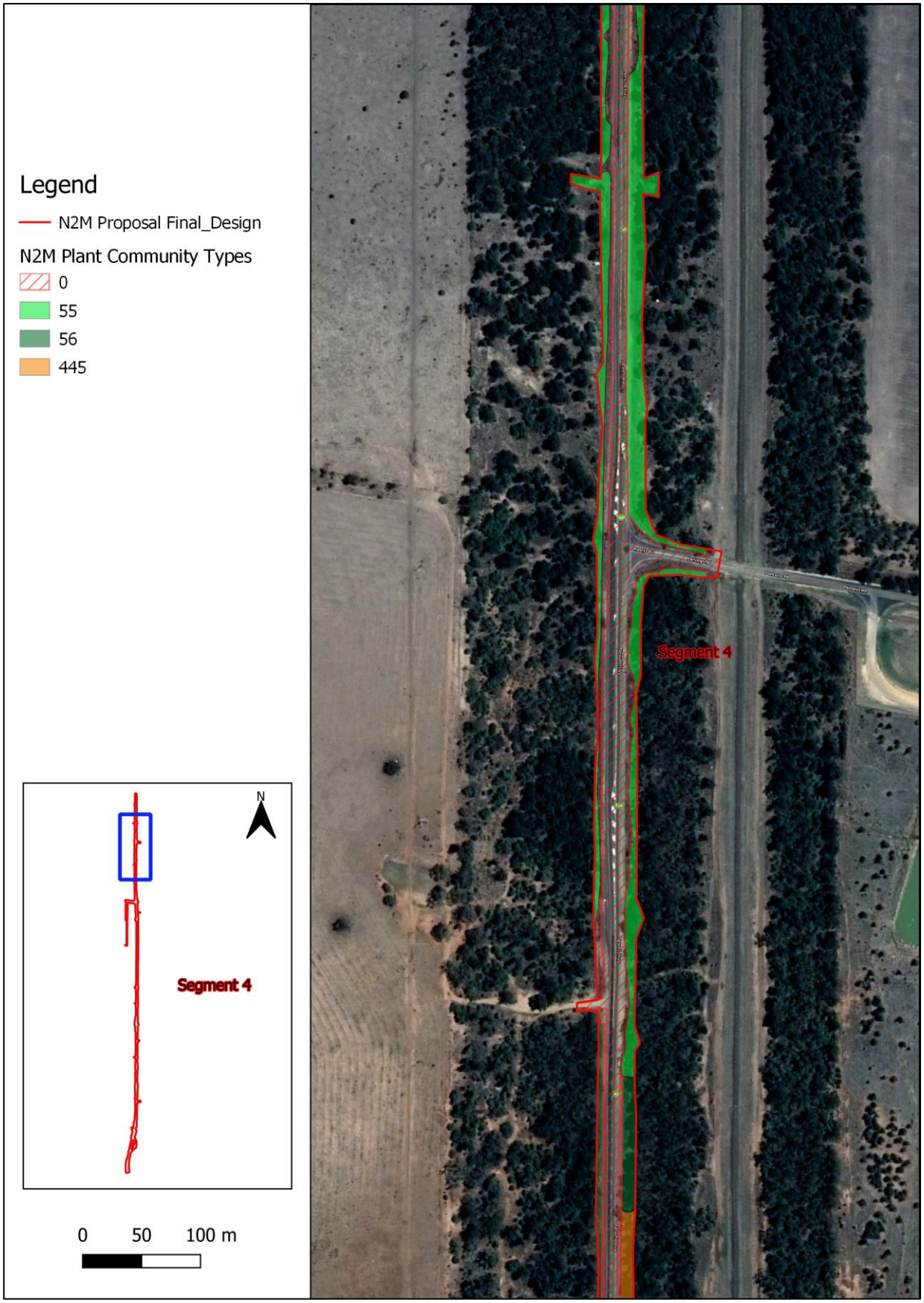

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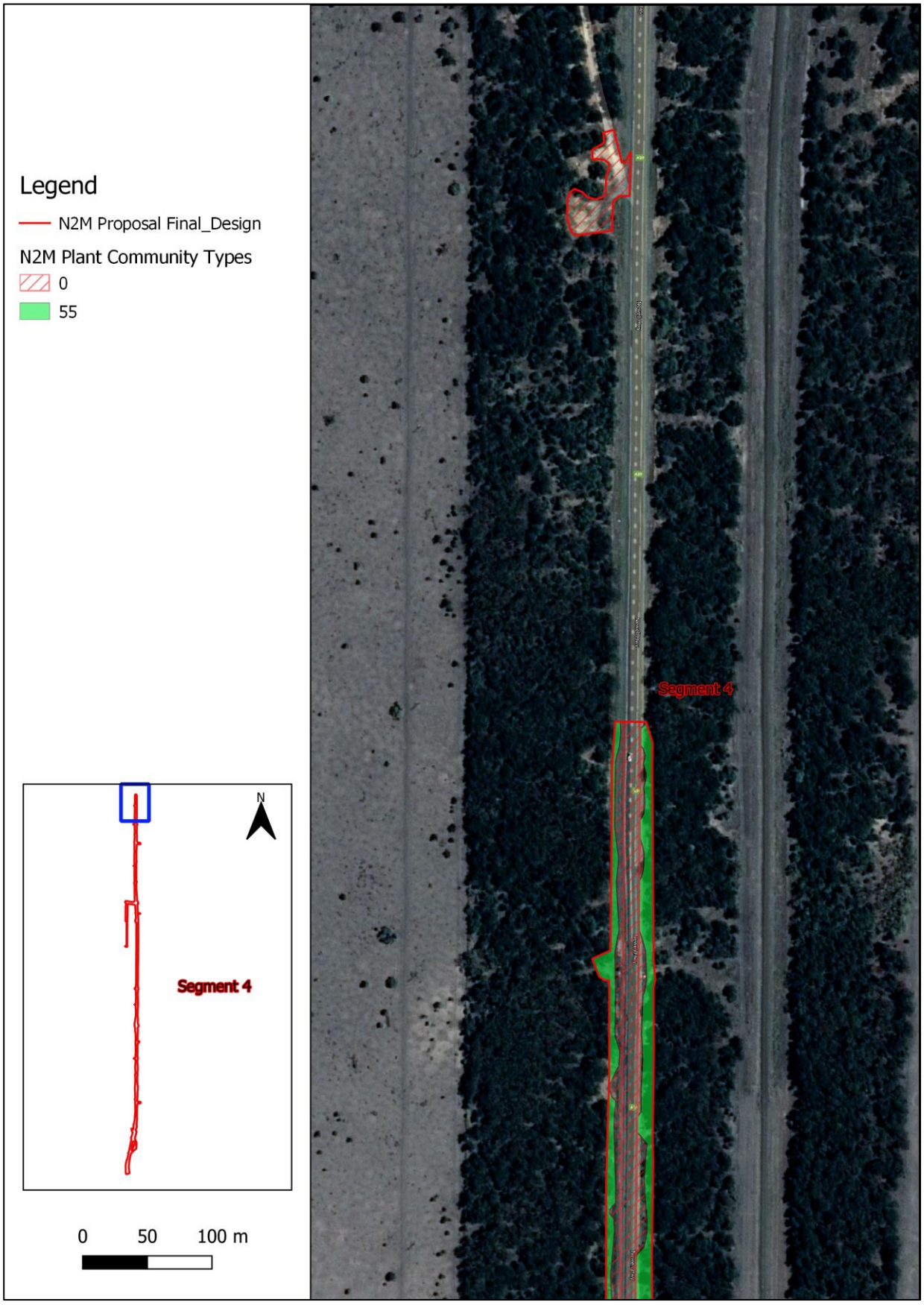

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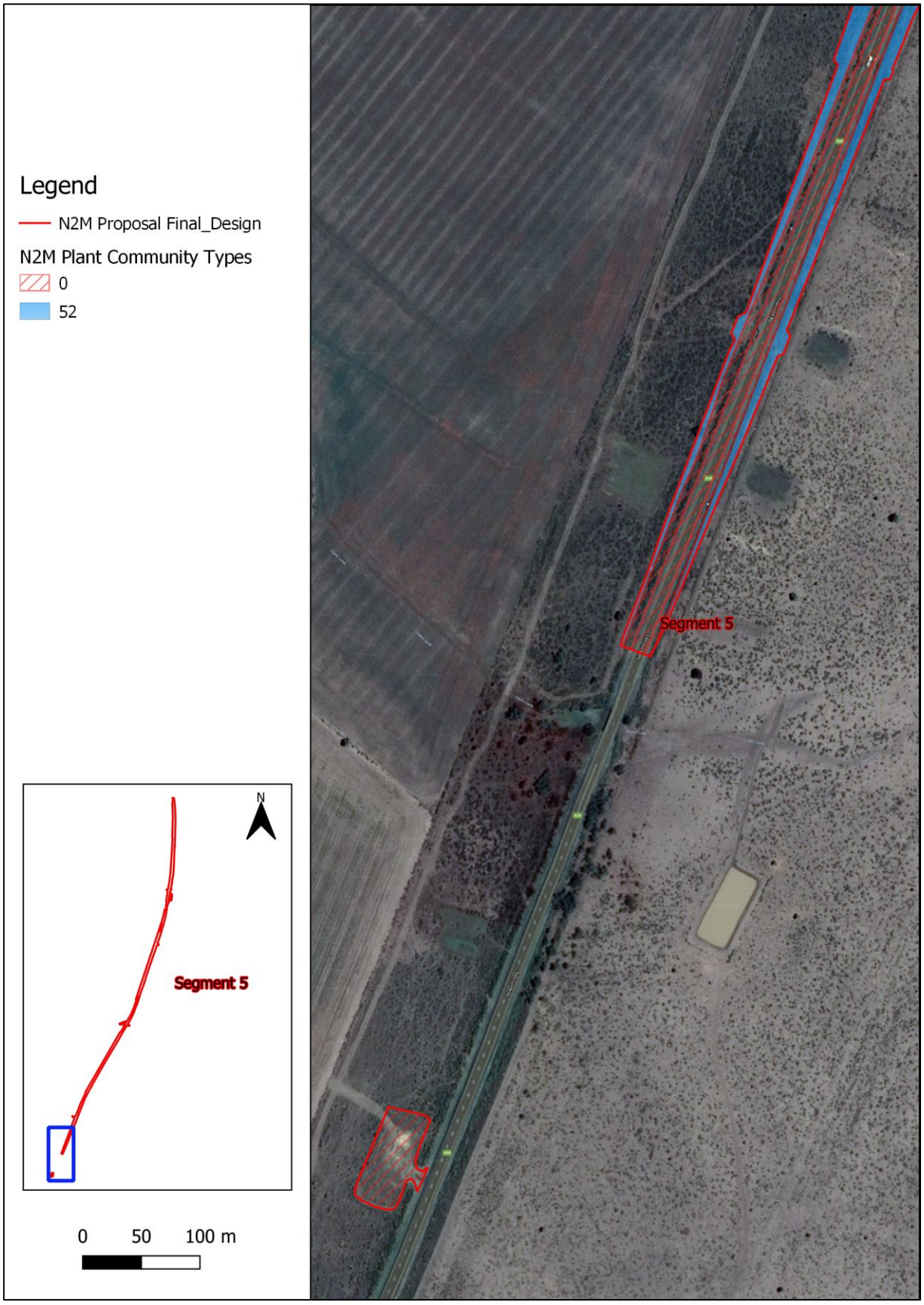

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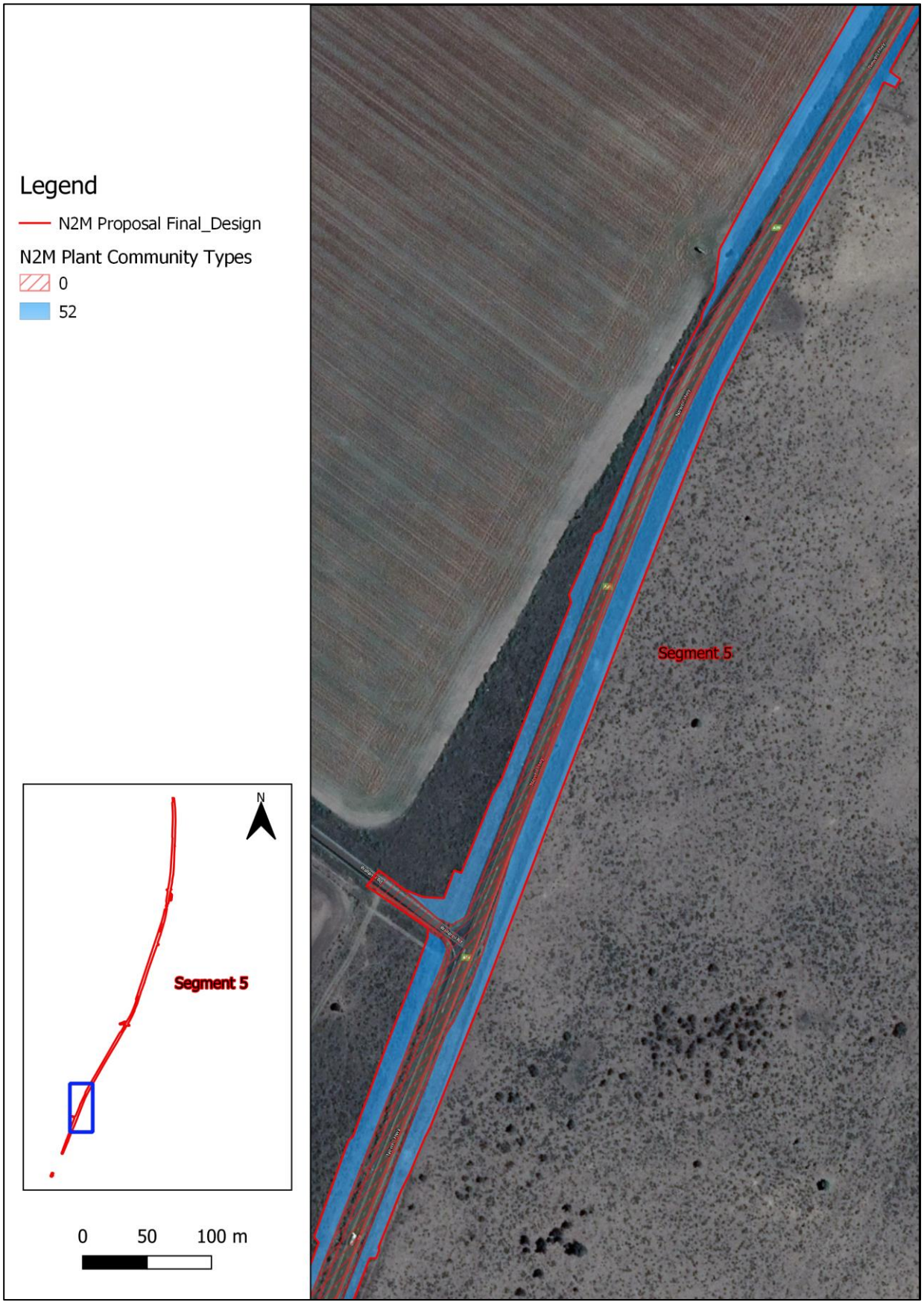

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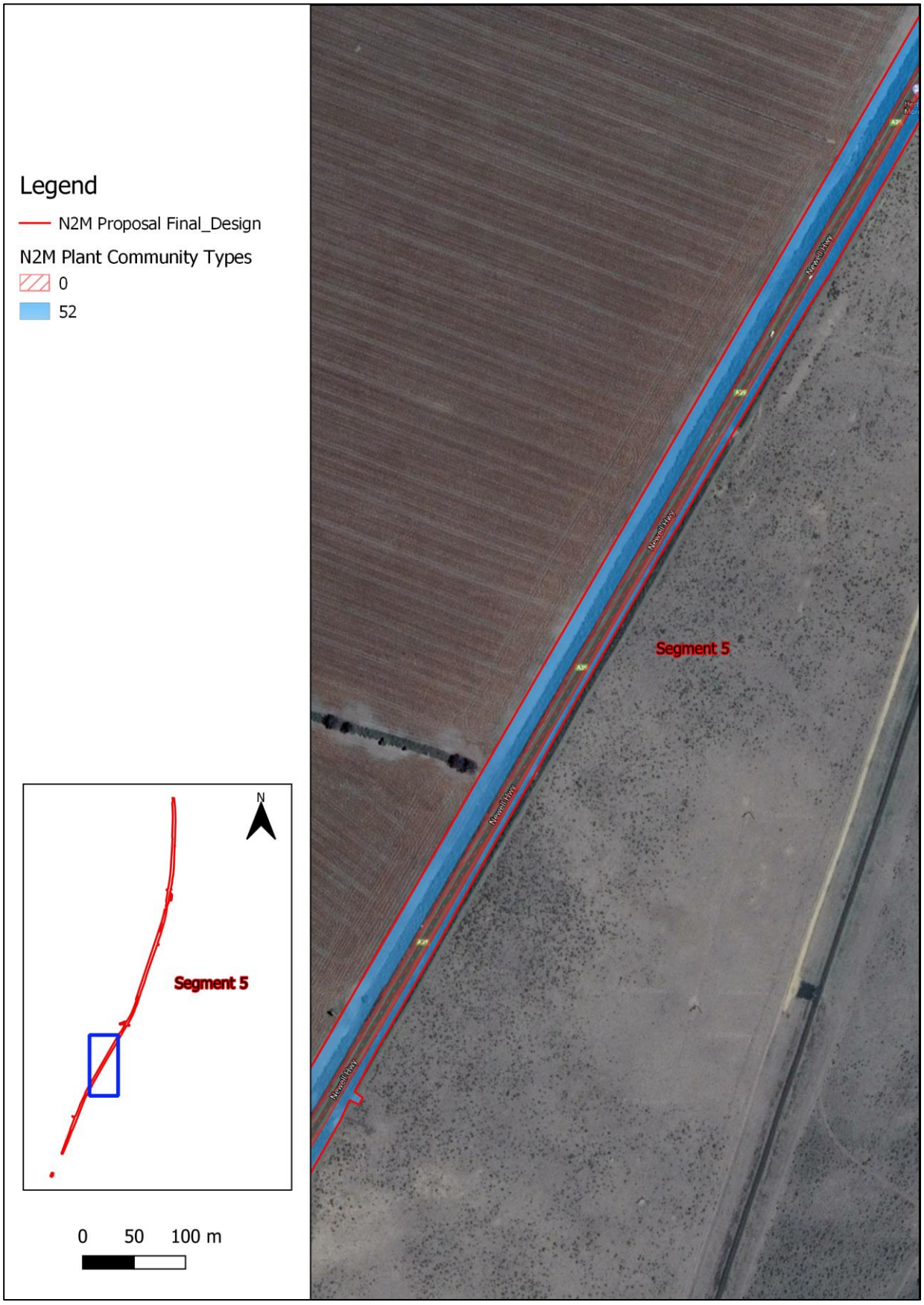

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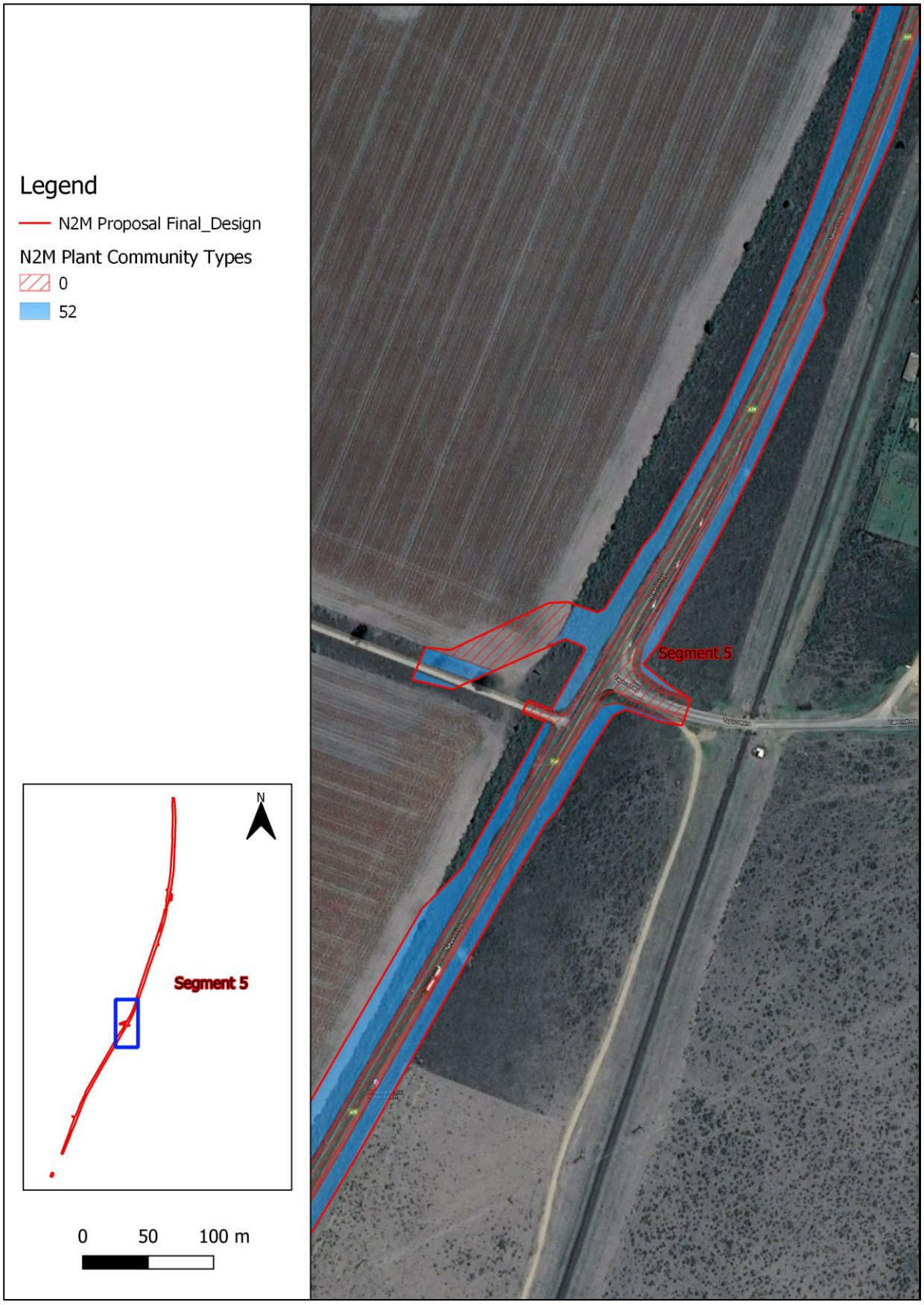

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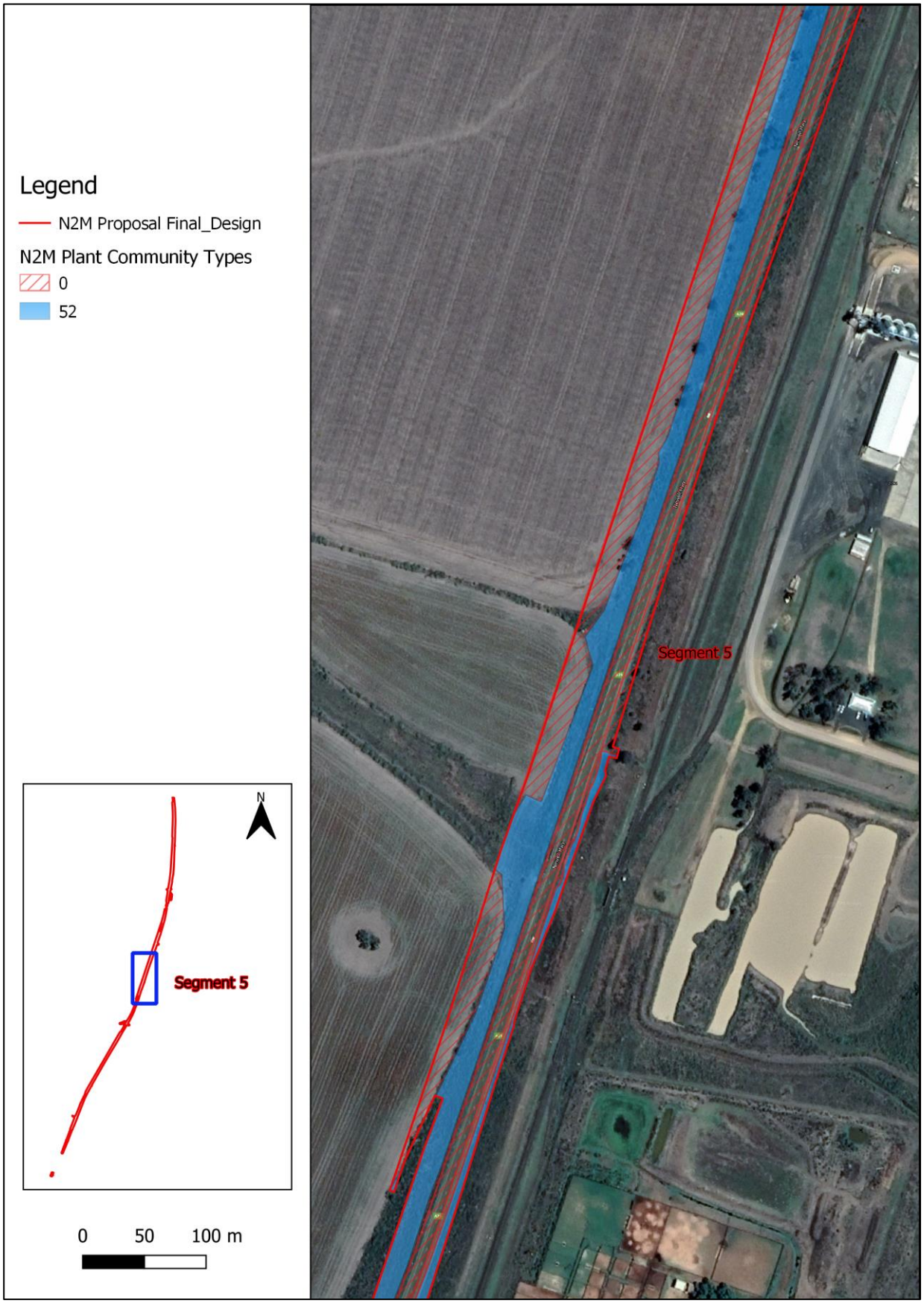

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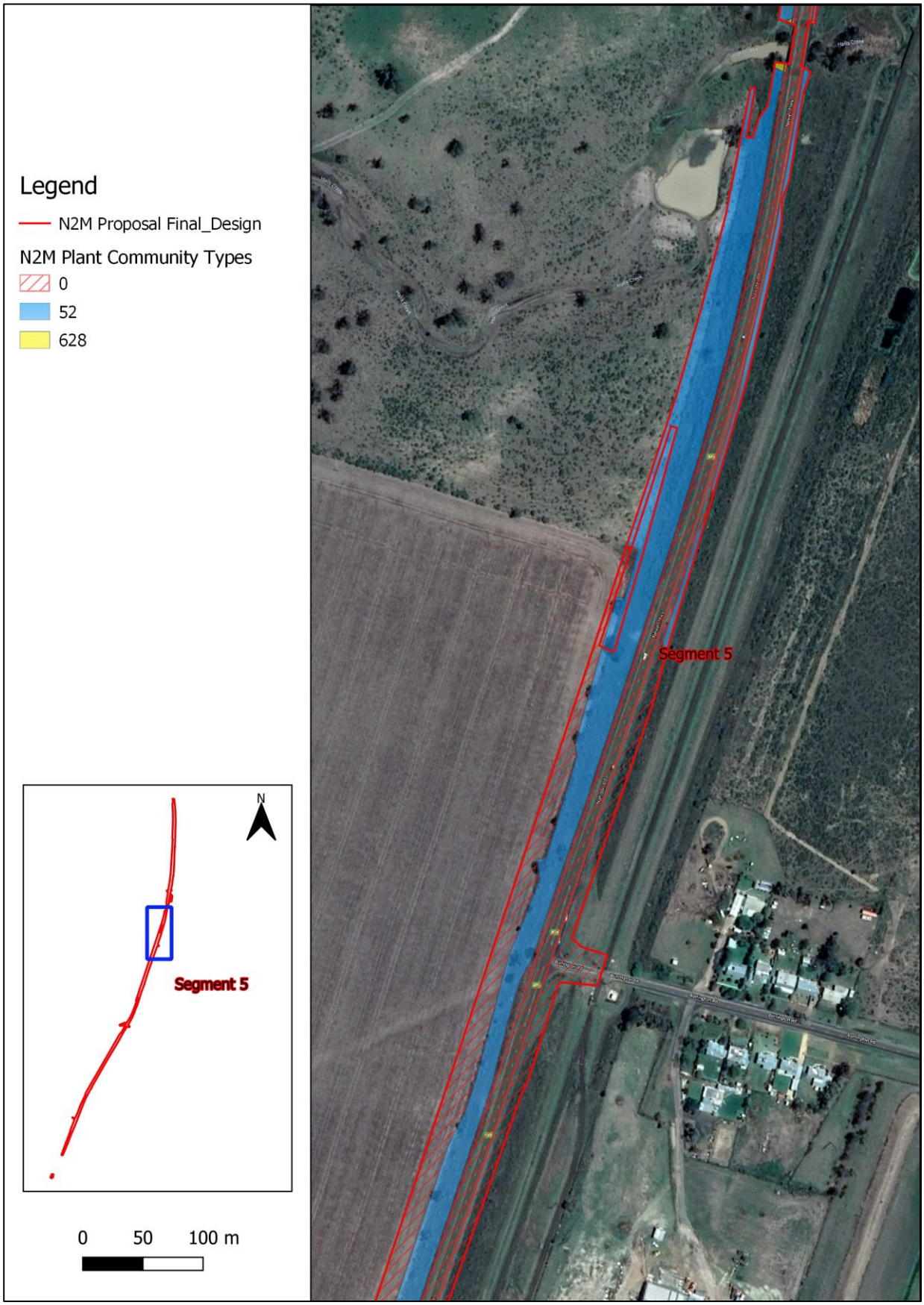

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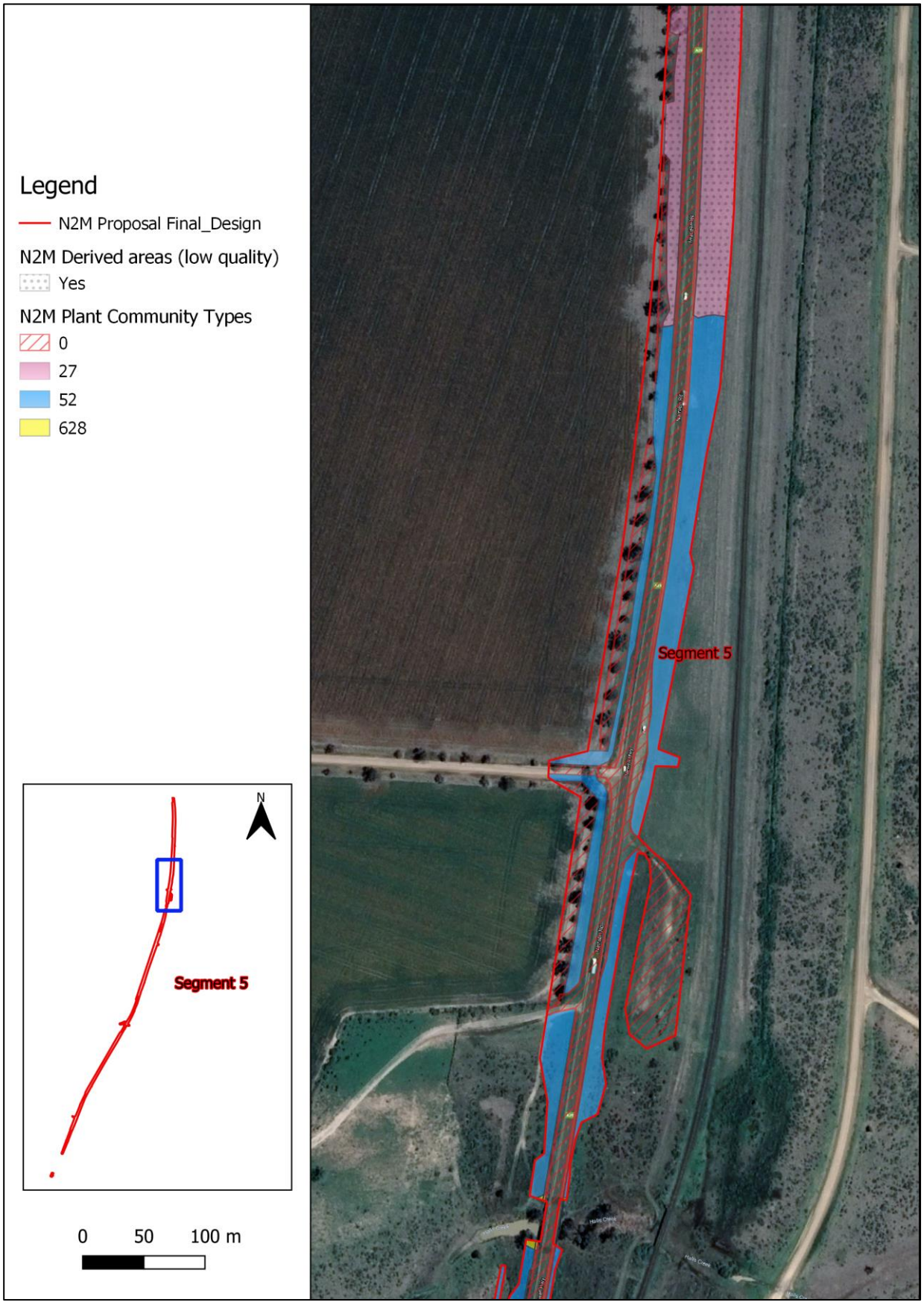

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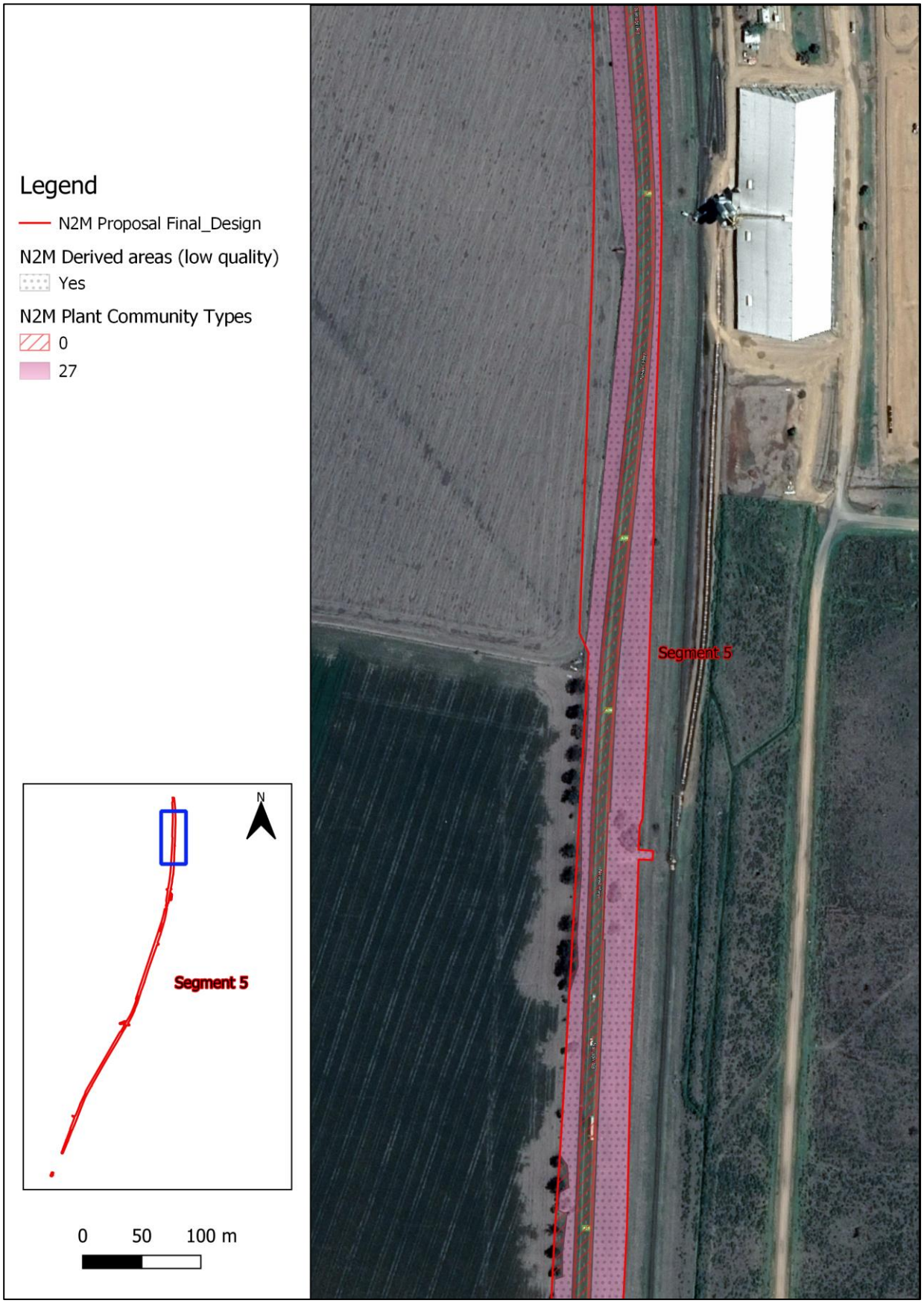

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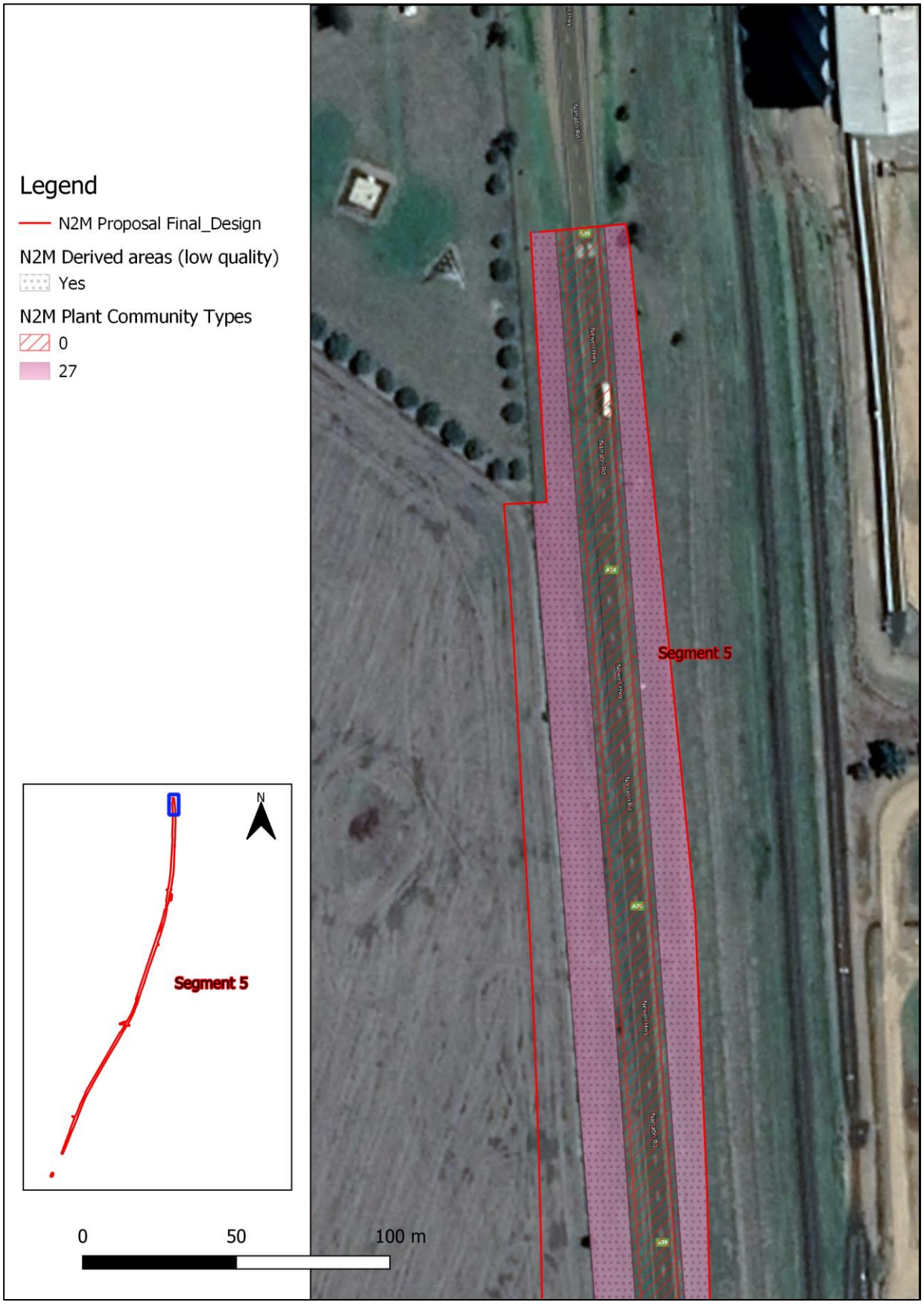

Figure 3.2 Plant Community types Segment 5
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3.3 Threatened terrestrial ecological communities

A number of state and Commonwealth listed terrestrial threatened ecological communities were recorded across the proposed modification area. Table 3-8 lists the terrestrial threatened ecological communities and condition thresholds. Communities listed under the BC Act are discussed in detail in this section with communities listed under the EPBC Act discussed in Section 3.9.1 and aquatic threatened ecological communities listed under the FM Act discussed in Section 3.6. Communities listed under the BC Act are described in detail below. The distribution and extent of threatened ecological communities in the study area is mapped in Figure 3.2

BC Act (NSW):

- Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions (Endangered). This EEC is represented by:
  - PCT147 Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion
  - PCT55 Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions
- Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (Endangered) represented by PCT445 Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt South Bioregion
- Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions (Endangered). This EEC is represented by PCT628 Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion
- Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (Endangered). This EEC is represented by PCT27 Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion.

EPBC Act (Commonwealth):

- Brigalow (*Acacia harpophylla* dominant and co-dominant) (Endangered). This EEC is represented by PCT445 Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt South Bioregion
- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (Endangered) This EEC is represented by:
  - PCT147 Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion
  - PCT55 Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions
- Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (Critically Endangered). This EEC is represented by Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion
- Weeping Myall Woodlands (Endangered). This EEC is represented by PCT27 Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion.

Since the 2018 BAR was submitted an additional Commonwealth preliminary listed EEC was announced and has been addressed in this supplementary assessment:

- Poplar Box Grassy Woodland on Alluvial Plains endangered ecological community. This EEC is represented by PCT56 Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW.

Table 3-2 Terrestrial threatened ecological communities and condition thresholds

BC Act listed threatened ecological community	EPBC Act listed threatened ecological community?	Associated plant community type (PCT/s)	Relevant condition class	Discussion regarding inclusion in the community as described in the BC Act scientific committee determination
Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (Endangered)	Yes. Refer to Section 3.8.1 for discussion of EPBC Act listed TECs.	Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt South Bioregion (445)	Moderate to Good (Relatively Intact)	The relevant patches of vegetation are located in the Brigalow Belt South bioregion and are dominated in parts and co-dominated in other by Brigalow (*Acacia harpophylla*). The floristic composition of the vegetation observed and the associated PCT matches the BC Act determination for the TEC and the PCT is listed as being part of the TEC in the BioNet Vegetation classification database. The occurrence of the PCT in Moderate to Good (Relatively Intact) condition is dominated by native species in all vegetation layers. Part of the occurrence has recently been burnt and is regenerating and therefore does not currently meet structural benchmarks for the PCT. Other, unburnt areas meet all condition benchmarks for the PCT. There are no condition criteria in the determination for inclusion and exclusion of patches of characteristic vegetation on the basis of condition. Both the burnt and unburnt areas are consistent with the determination for the community.
			Moderate to Poor (Derived Grassland); only in close association with the relatively Intact condition class.	Unlike some other determinations, the determination for the community does not explicitly include derived native grassland. Derived native grassland is therefore excluded from consideration as part of the TEC in this assessment except where it is clearly dominated by native species and located adjacent to or within patches of the community containing elements of the upper and/or middle vegetation strata; such areas of derived grassland are considered to have potential to naturally regenerate into the community under appropriate management.
Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions (Endangered)	No	Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion (628)	Moderate/ Good (Moderately disturbed)	The relevant patches of vegetation are located in the Brigalow Belt South bioregion and have upper strata dominated by *Eucalyptus camaldulensis, Eucalyptus populnea, Casuarina cristata, Geijera parviflora* and *Acacia salicina*, all of which are consistent with the TEC determination. In some locations, the patches also contain occasional specimens of *Eucalyptus coolabah* and the surrounding landscape contains scattered individuals of *Corymbia tessellaris* (Carbeen). The ground stratum in the Moderate/ Good (Moderately disturbed) patches of this community in the study area is moderately to highly disturbed but still retains some species characteristic of the TEC such as *Einadia nutans, Paspalidium jubiflorum* and *Eriochloa crebra*. The Moderate to Poor (Derived Grassland) patches of the associated PCT are generally at least co-dominated by exotic species. There are no condition criteria in the determination for inclusion and exclusion of patches of characteristic vegetation on the basis of condition. Unlike some other determinations, the determination for the community does not explicitly include derived native grassland. Derived native grassland is therefore excluded from consideration as part of the TEC in this assessment except where it is clearly dominated by native species and located adjacent to or within patches of the community containing elements of the upper and/or middle vegetation strata; such areas of

BC Act listed threatened ecological community	EPBC Act listed threatened ecological community?	Associated plant community type (PCT/s)	Relevant condition class	Discussion regarding inclusion in the community as described in the BC Act scientific committee determination
				derived grassland are considered to have potential to naturally regenerate into the community under appropriate management.
			Moderate to Poor (Derived Grassland); only in close association with the relatively Intact condition class.	Unlike some other determinations, the determination for the community does not explicitly include derived native grassland. Derived native grassland is therefore excluded from consideration as part of the TEC in this assessment except where it is clearly dominated by native species and located adjacent to or within patches of the community containing elements of the upper and/or middle vegetation strata; such areas of derived grassland are considered to have potential to naturally regenerate into the community under appropriate management.
Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions (Endangered)	Yes. Refer to Section 3.8.1 for discussion.	Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion (147) Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions (55)	Moderate to Good (Relatively Intact)	The relevant patches of vegetation are located in the Brigalow Belt South bioregion. The areas of PCT 147 have an upper stratum dominated by *Ehretia membranifolia, Ventilago viminalis* and *Geijera parviflora* with occasional *Eucalyptus populnea* and *Casuarina cristata*. *Notelaea microcarpa* and *Carissa ovata* were found in the middle stratum and a variety of characteristic ground stratum species were recorded, such as *Austrostipa verticillata, Brunoniella australis, Dichondra s. A,* and *Dichanthium sericeum*. The floristic composition of the vegetation observed and the associated PCT clearly match the description of the *Southern semi-evergreen vine thickets* unit of the TEC as described in the national recovery plan for the TEC and the associated PCT is listed as being part of the TEC in the BioNet Vegetation classification database. The areas of PCT 55 in the study area consist of small-scale mixture of areas dominated by *Casuarina cristata* and areas dominated by *Geijera parviflora* with *Notelaea microcarpa*, *Alectryon oleifolius* and *Capparis lasiantha*. The floristic composition of the vegetation observed and the associated PCTs match the BC Act determination for the TEC and the associated PCTs are listed as being part of the TEC in the BioNet Vegetation classification database. The occurrences of the PCTs are dominated by native species in all vegetation layers. There are no condition criteria in the determination for inclusion and exclusion of patches of characteristic vegetation on the basis of condition.
			Moderate to Poor (Derived Grassland); only in close association with the relatively Intact condition class.	Unlike some other determinations, the determination for the community does not explicitly include derived native grassland. Derived native grassland is therefore excluded from consideration as part of the TEC in this assessment except where it is clearly dominated by native species and located adjacent to or within patches of the community containing elements of the upper and/or middle vegetation strata; such areas of derived grassland are considered to have potential to naturally regenerate into the community under appropriate management.
-	Preliminary listed TSSC.	Poplar Box - Belah woodland on clay-	N/A	N/A

BC Act listed threatened ecological community	EPBC Act listed threatened ecological community?	Associated plant community type (PCT/s)	Relevant condition class	Discussion regarding inclusion in the community as described in the BC Act scientific committee determination
	Refer to Section 3.8.1 for discussion.	loam soils on alluvial plains of north-central NSW (56)		
-	Yes. Refer to Section 3.8.1 for discussion.	Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (52).	N/A	N/A
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (Endangered)	Yes. Refer to Section 3.8.1 for discussion.	Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (27)	Moderate to Good (Relatively Intact)	The relevant patches of vegetation are located in the Brigalow Belt South and/or Darling Riverine Plains bioregions, have upper strata dominated by Weeping Myall (*Acacia pendula*) or co-dominated by Weeping Myall and Belah (*Casuarina cristata*). *Myoporum montanum* was abundant in the middle stratum with other species such as *Pittosporum angustifolium* and *Geijera parviflora*. A variety of characteristic ground stratum species were recorded, such as *Panicum decompositum, Solanum esuriale, Eriochloa sp.,* and *Dichanthium sericeum*. The floristic composition of the vegetation observed and the associated PCT clearly match the BC Act determination for the TEC and the associated PCT is listed as being part of the TEC in the BioNet Vegetation classification database. The Moderate to Good (Relatively Intact) occurrences of the PCT are dominated by native species in all vegetation layers. There are no condition criteria in the determination for inclusion and exclusion of patches of characteristic vegetation on the basis of condition.
			Moderate to Poor (Derived Grassland); only in close association with the relatively Intact condition class.	Unlike some other determinations, the determination for the community does not explicitly include derived native grassland. Derived native grassland is therefore excluded from consideration as part of the TEC in this assessment except where it is clearly dominated by native species and located adjacent to or within patches of the community containing elements of the upper and/or middle vegetation strata; such areas of derived grassland are considered to have potential to naturally regenerate into the community under appropriate management.

3.4 Threatened species and populations

Flora

Three threatened flora species were recorded in the proposed modification area and broader study area, refer to the BAR (Jacobs, 2018) completed for the determined project REF.

These were:

- *Homopholis belsonii* (Belson's Panic) (Vulnerable EPBC Act, Endangered BC Act)
- *Desmodium campylocaulon* (Creeping Tick-trefoil) (Endangered BC Act)
- *Digitaria porrecta* (Finger Panic Grass) (Endangered BC Act).

A further nine threatened flora species are considered at least moderately likely to occur based on the presence of suitable habitat. These include:

- *Dichanthium setosum* (Bluegrass)
- *Bertya opponens* (Coolabah Bertya)
- *Diuris tricolor* (Pine Donkey Orchid)
- *Swainsona sericea* (Silky Swainson-pea)
- *Tylophora linearis* - no common name
- *Lepidium aschersonii* (Spiny Peppercress)
- *Polygala linariifolia* (Native Milkwort)
- *Pterostylis cobarensis* (Greenhood Orchid)
- *Swainsona murrayana* (Slender Darling Pea)
- *Lepidium monoplocoides* (Winged Peppercress)
- *Sida rohlenae* (Shrub Sida)
- *Cyperus conicus* - no common name.

Fauna

Three threatened fauna species were recorded in the study area:

- Little Eagle (Vulnerable BC Act)
- Grey-crowned Babbler eastern sub species (Vulnerable BC Act)
- Glossy Black-cockatoo (Vulnerable BC Act).

A further 32 threatened fauna species are considered at least moderately likely to occur based on the presence of suitable habitat:

- *Circus assimilis* (Spotted Harrier)
- *Macropus dorsalis* (Black-striped Wallaby)
- *Artamus cyanopterus cyanopterus* (Dusky Woodswallow)
- *Chthonicola sagittata / Pyrrholaemus sagittatus* (Speckled Warbler)
- *Ninox connivens* (Barking Owl)
- *Grantiella picta* (Painted Honeyeater)
- *Chalinolobus picatus* (Little Pied Bat)
- *Saccolaimus flaviventris* (Yellow-bellied Sheathtail-bat)
- *Phascolarctos cinereus* (Koala)
- *Daphoenositta chrysoptera* (Varied Sittella)
- *Melanodryas cucullata cucullata* (Hooded Robin south-eastern form)
- *Melithreptus gularis gularis* (Black-chinned Honeyeater eastern subsp.)
- *Hoplocephalus bitorquatus* (Pale-headed Snake)
- *Burhinus grallarius* (Bush Stone-curlew)

- *Sminthopsis macroura* (Stripe-faced Dunnart)
- *Falco hypoleucos* (Grey Falcon)
- *Hamirostra melanosternon* (Black-breasted Buzzard)
- *Tyto novaehollandiae* (Masked Owl)
- *Neophema pulchella* (Turquoise Parrot)
- *Aepyprymnus rufescens* (Rufous Bettong)
- *Lophoictinia isura* (Square-tailed Kite)
- *Jalmenus eubulus* (Pale Imperial Hairstreak)
- Stagonopleura guttata (Diamond Firetail)
- *Ardeotis australis* (Australian Bustard)
- *Anomalopus mackayi* (Five-clawed Worm-skink)
- *Falco subniger* (Black Falcon)
- *Petaurus norfolcensis* (Squirrel Glider)
- *Glossopsitta pusilla* (Little Lorikeet)
- *Mormopterus eleryi* (Bristle-faced free-tailed bat, Hairy-nosed Freetail Bat)
- *Nyctophilus corbeni* (Corben's Long-eared Bat)
- *Vespadelus troughtoni* (Eastern Cave Bat)
- *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat)
- *Polytelis swainsonii* (Superb Parrot).

Refer to the BAR (Jacobs, 2018) for a further discussion on the threatened species and Appendix A and B for likely impact to these species.

3.5 Aquatic threatened ecological communities

This supplementary assessment has concluded there are no additional considerations needed for the proposed modification area. Refer to the BAR (Jacobs, 2018) for a further discussion on for likely impact to aquatic threatened ecological communities.

3.5.1 Habitat assessment and survey results for threatened fauna

This supplementary assessment has concluded there are no additional considerations needed for the proposed modification area. Refer to the BAR (Jacobs, 2018) for a further discussion on for likely impact to threatened fauna habitats.

3.5.2 Aquatic species and populations

This supplementary assessment has concluded there are no additional considerations needed for the proposed modification area. Refer to the BAR (Jacobs, 2018) for a further discussion on for likely impact to aquatic species and populations.

3.6 Wildlife connectivity corridors and habitat fragmentation

There are no officially mapped wildlife corridors in the IBRA subregions in which the study area is located. The wildlife connectivity in and around the project is discussed in the BAR (Jacobs, 2018) prepared for the project REF.

3.7 Matters of National Environmental Significance

3.7.1 Threatened ecological communities

There are no world heritage properties or ands of international importance in the locality.

The plant community types within the project modification area are associated with nationally listed threatened ecological communities include:

- Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (Critically Endangered). This is represented in the project modification area as PCT52
- Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (Endangered). This is represented in the project modification area as PCT27
- Brigalow (*Acacia harpophylla* dominant and co-dominant) (Endangered). This is represented in the project modification area as PCT445
- Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions (Endangered). This is represented in the project modification area as PCTs55 and 145
- Poplar Box Grassy Woodland on Alluvial Plains (Preliminary listed – Endangered). This is represented in the project modification area as PCT56.

3.7.2 Threatened species and populations

This supplementary assessment has concluded only information updates for Belson's Panic (*Homopholis belsonii*) are required for the proposed modification area. Refer to the BAR (Jacobs, 2018) for a further discussion on nationally listed threatened flora and fauna species either recorded in the study area or considered as having a moderate to high likelihood of occurring based on the presence of suitable habitat.

Belson's Panic (*Homopholis belsonii*) was found in study area during field surveys in a variety of PCTs (27, 35, 52, 55, 56). The number of individuals recorded in the development area were n=11 in Segment 2, n=19 in Segment 4 and n=17 in Segment 5.

Associated habitat on site includes:

- Belah woodland (PCT 55)
- Brigalow viney scrub open forest (PCT 445)
- Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (PCT 147)
- Poplar Box - Belah woodland (PCT 56)
- Queensland Bluegrass +/- Mitchell Grass (PCT 52)
- Weeping Myall open woodland (PCT 27).

The population in N2MS2 near Edgeroi was removed when an agricultural fence line was replaced by a landholder late 2018 and then again in 2019. No extant individuals were observed in late 2018 or 2019 by AREAs ecologists.

3.7.3 Migratory species

This supplementary assessment has concluded the nationally listed migratory fauna species considered as having a moderate to high likelihood of occurring based on the presence of suitable habitat do not require updating. Refer to the BAR (Jacobs, 2018) for a further discussion on migratory species.

4 Impact assessment

4.1 Construction impacts

4.1.1 Removal of native vegetation

The determined project REF estimated that about 47 hectares of native vegetation clearing would be required for the project. The proposed modification about 75.92 hectares. A summary of the vegetation loss for each segment is shown in Table 4-1.

Table 4-1 Native vegetation loss across each segment and the proposed modification

Segment	Native vegetation loss (ha)	Loss of state listed EECs (mod good quality) (BC Act)	Loss of national listed TECs (mod good quality) (EPBC Act)	Confirmed threatened plant species impacted
N2MS1	21.44	0.3	0.3	
N2MS2	12.67	3.82	1.41	Yes
N2MS3	9.1	0.08	0.79	
N2MS4	12.61	3.51	11.21	Yes
N2MS5	20.1	0.01	15.53	Yes
TOTAL	**75.92**	**7.45**	**28.97**	

A breakdown of native vegetation removal in each PCT and vegetation zone for the whole proposed modification is shown in Table 4.2. A summary of vegetation removal per proposed modification segment is provided in Table 4.3.

The proposed modification would also result in the removal of approximately:

- 0.47 ha of planted eucalypts, consisting of a mix of locally native species and species which are unlikely to occur naturally in the study area
- 31.85 ha of non-native vegetation which consists mainly of grassland/herbfield dominated (>50% of vegetation cover) by exotic species.

Table 4-2 Impact to vegetation across whole proposed modification including TECs

Plant community type (PCT)	Condition class	BC Act	EPBC Act	Proposed modification area [1] (hectares)	Percent[2] cleared
Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions (55)	Moderate to Good (Relatively Intact)	EEC	EEC	1.93	75
	Moderate to Poor (Derived Grassland)	No	No	0.32	
Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt South Bioregion (445)	Moderate to Good (Relatively Intact)	EEC	EEC	1.47	90
	Moderate to Poor (Derived Grassland)	No	No	0.87	
Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion (628)	Moderate to Good (Relatively Intact)	EEC	No	3.04	90
	Moderate to Poor (Derived Grassland)	No	No	1.24	

Plant community type (PCT)	Condition class	BC Act	EPBC Act	Proposed modification area [1] (hectares)	Percent[2] cleared
Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion (147)	Moderate to Good (Relatively Intact)	EEC	EEC	0.11	83
Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW (56)	Moderate to Good (Relatively Intact)	No	EEC (refer note 3)	8.34	78
	Moderate to Poor (Derived Grassland)	No	No	0.42	
Poplar Box - White Cypress Pine shrub grass tall woodland of the Pilliga - Warialda region, Brigalow Belt South Bioregion (397)	Moderate to Good (Relatively Intact)	No	No	9.38	45
	Moderate to Poor (Derived Grassland)	No	No	17.26	
Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (52)	Moderate to Good (Relatively Intact)	No	CEEC	16.22	70
	Moderate to Poor (Derived Grassland - simplified)	No	No		
Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (27)	Moderate to Good (Relatively Intact)	EEC	EEC	0.9	86
	Moderate to Poor (Derived Grassland)	No	No	14.41	
Planted eucalypts	-	No	No	<1ha	-
Non-native vegetation	-	No	No	~30ha	-
Total clearing of BC Act listed threatened ecological communities					7.45
Total clearing of EPBC Act listed threatened ecological communities					28.97
Total clearing of native vegetation in moderate to good (relatively intact) condition					41.39
Total clearing of native vegetation in moderate to poor (derived grassland) condition					34.53
Total clearing of native vegetation					**75.92**

1- Area to be cleared based on ground-truthed vegetation mapping within the study area.
2- Based on the VIS classification database for the entire PCT
3- There is a preliminary determination to list this community as Endangered under the EPBC Act.

Table 4-3 Impact to vegetation per proposed modification segment

Plant community type (PCT)	Condition class	BC Act	EPBC Act	Proposed modification area [1] (hectares)	Percent cleared[2]
N2MS1					
Poplar Box - White Cypress Pine shrub grass tall woodland of the Pilliga - Warialda region, Brigalow Belt South Bioregion (397)	Moderate to Good (Relatively Intact)	No	No	7.0	45
	Moderate to Poor (Derived Grassland)	No	No	11.33	
Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (27)	Moderate to Good (Relatively Intact)	EEC	EEC	0.03	86
	Moderate to Poor (Derived Grassland)	No	No	3.08	
Planted eucalypts	-	No	No	0.17	-
Non-native vegetation	-	No	No	5.09	-
Total clearing of BC Act listed TECs for N2MS1				0.03 ha	
Total clearing of EPBC Act listed TECs for N2MS1				0 ha	
Total clearing of native vegetation for N2MS1				21.44 ha	
N2MS2					

Plant community type (PCT)	Condition class	BC Act	EPBC Act	Proposed modification area [1] (hectares)	Percent cleared[2]
Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion (628)	Moderate to Good (Relatively Intact)	EEC	No	3.03	90
	Moderate to Poor (Derived Grassland)	No	No	1.24	
Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW (56)	Moderate to Good (Relatively Intact)	No	No	0.62	78
	Moderate to Poor (Derived Grassland)	No	No	0.21	
Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (27)	Moderate to Good (Relatively Intact)	EEC	EEC	0.79	86
	Moderate to Poor (Derived Grassland)	No	No	6.78	
Planted eucalypts	-	No	No		-
Non-native vegetation	-	No	No		-
Total clearing of BC Act listed TECs for N2MS2				12.67 ha	
Total clearing of EPBC Act listed TECs for N2MS2				3.82 ha	
Total clearing native vegetation for N2MS2				12.67 ha	
N2MS3					
Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW (56)	Moderate to Good (Relatively Intact)	No	No	0.02	78
Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (52)	Moderate to Good (Relatively Intact)	No	CEEC	0.69	70
Poplar Box - White Cypress Pine shrub grass tall woodland of the Pilliga - Warialda region, Brigalow Belt South Bioregion (397)	Moderate to Good (Relatively Intact)	No	No	2.38	50
	Moderate to Poor (Derived Grassland)	No	No	5.93	
Non-indigenous Trees	-	No	No		-
Planted eucalypts	-	No	No		-
Non-native vegetation	-	No	No		-
Total clearing of BC Act listed TECs for N2MS3				0.08 ha	
Total clearing of EPBC Act listed TECs for N2MS3				0.71 ha	
Total clearing native vegetation for N2MS3				9.1 ha	
N2MS4					
Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions (55)	Moderate to Good (Relatively Intact)	No	No	1.93	83
	Moderate to Poor (Derived Grassland)	No	No	0.32	
Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt South Bioregion (445)	Moderate to Good (Relatively Intact)	EEC	EEC	1.47	90
	Moderate to Poor (Derived Grassland)	No	No	0.87	

Plant community type (PCT)	Condition class	BC Act	EPBC Act	Proposed modification area [1] (hectares)	Percent cleared[2]
Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW (56)	Moderate to Good (Relatively Intact)	No	EEC recommended (refer note 3)	7.7	78
	Moderate to Poor (Derived Grassland)	No	No	0.21	
Non-native vegetation	-	No	No	3.77	-
Total clearing of BC Act listed TECs for N2MS4				12.61 ha	
Total clearing of EPBC Act listed TECs for N2MS4				11.21 ha	
Total clearing native vegetation for N2MS4				12.61 ha	
N2MS5					
Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion (628)	Moderate to Good (Relatively Intact)	EEC	No	0.01	90
Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (52)	Moderate to Good (Relatively Intact)	No	CEEC	15.53	70
	Moderate to Poor (Derived Grassland - simplified)				
Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (27)	Moderate to Good (Relatively Intact)	EEC	EEC	0	86
	Moderate to Poor (Derived Grassland)	No	No	4.56	
Planted eucalypts	-	No	No	0.12	-
Non-native vegetation	-	No	No	5.57	-
Total clearing of BC Act listed TECs for N2MS5				0.01 ha	
Total clearing of EPBC Act listed TECs for N2MS5				15.53 ha	
Total clearing native vegetation for N2MS5				20.1 ha	

1- Area to be cleared based on ground-truthed vegetation mapping within the study area.
2- Based on the VIS classification database
There is a preliminary determination to list this community as Endangered under the EPBC Act.

4.1.2 Threatened Ecological Communities

The estimated clearing of Threatened Ecological Communities for the proposed modification is shown in Table 4-4 and Table 4-5.

Table 4-4 Description of TECs impacted by the proposed modification (BC Act)

Threatened Ecological Community (BC Act)	N2MS1 (ha)	N2MS2 (ha)	N2MS3 (ha)	N2MS4 (ha)	N2MS5 (ha)	Total (ha)	Impact on local viable population (1500m)	Residual local viable population (1500m) hectares
Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions (Endangered) PCT147 and PCT55	-	-	-	2.04	-	2.04	<0.01%	51.47
Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (Endangered) PCT445	-	-	-	1.47	-	1.47	2.78%	52.93
Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions (Endangered) PCT628	-	3.03	-	-	0.01	3.04	64.88%[1]	4.67
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (Endangered) PCT27	0.03	0.79	0.08	-	-	0.9	<0.01%	386.06
TOTAL	**0.03 ha**	**3.82 ha**	**0.08 ha**	**3.51 ha**	**0.01 ha**	**7.45 ha**		

[1] Ground truthing the VIS map to a level of being able to separate out river red gum community derivatives from a Carbeen community in the broader area would see the impact to the viable local population (circa two areas of at least 80 hectares) be in order of less than 5% (P Cameron pers com).

Table 4-5 Description of TECs impacted by the proposed modification (EPBC Act)

Threatened Ecological Community (EPBC Act)	N2MS1 (ha)	N2MS2 (ha)	N2MS3 (ha)	N2MS4 (ha)	N2MS5 (ha)	Total (ha)	Impact on local viable population (1500m)	Residual local viable population (1500m) hectares
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregion (Endangered) PCT147 and PCT55	-	-	-	2.04	-	2.04	<0.01%	51.47
Brigalow (*Acacia harpophylla* dominant and co-dominant) (Endangered)	-	-	-	1.47	-	1.47	2.7%	52.93
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (Critically Endangered) PCT52	-	-	0.13	-	15.53	16.22	29.2%	39.26
Weeping Myall Woodlands (Endangered) PCT27	0.03	0.79	0.08	-	-	0.9	<0.01%	386.06
Poplar Box Grassy Woodland on Alluvial Plains (Preliminary listed – Endangered) PCT56	-	0.62	0.02	7.7	-	8.34	2.14%	380.28
TOTAL	0.03 ha	1.41 ha	0.23 ha	11.21 ha	15.53 ha	28.97 ha		

4.1.3 Removal of threatened species and habitat

The extent of vegetation clearing estimated to result from the proposed modification is outlined above in Section 4.1.1. This vegetation provides suitable habitat for a range of threatened animal and plant species listed under the BC Act and EPBC Act. As such, direct impacts to habitat for threatened species would occur during construction.

The direct impact of the proposed modification to threatened species and their habitats have been estimated based on the current design. A breakdown of the direct impact to habitat for threatened flora is provided in Table 4-6 and for threatened fauna species is provided in Table 4.7.

Table 4-6 Impacts on threatened plant species

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act	
Digitaria porrecta	Finger Panic Grass	-	E	**Recorded** in the study areas of N2MS2, N2MS4 and N2MS5 during field surveys in a variety of PCTs (55, 27, 52). **A number of individuals** were recorded within the proposed modification area though only a proportion of the proposed modification area was subject to targeted searches and more individuals are likely to occur. Habitat, associated with the recorded locations, to be impacted includes: • Belah woodland (1.93 ha – intact, 0.32 ha - derived) • Brigalow viney scrub open forest (1.47 ha - intact, 0.87 -derived) • Carbeen +/- Coolabah grassy woodland (3.04 ha intact, 1.24 ha derived) • Poplar Box - Belah woodland (8.34 ha - intact, 0.42 ha - derived) • Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact) • Weeping Myall open woodland (0.9 ha - intact, 14.42 ha - derived). Habitat for the species includes intact woodland/forest, natural grassland and derived grasslands. The intact woodland/forest and natural grassland are considered to be the more valuable habitats for the species. Considering this species was found distributed relatively evenly across the whole proposed modification, it is likely that it occurs in suitable in all segment's habitat. The impact has been calculated across the whole proposed modification. **Total known and potential habitat affected 49.17 hectares**
Homopholis belsonii	Belson's Panic	V	E	**Recorded;** found in the study areas of N2MS2 and N2MS4 during field surveys in a variety of PCTs (27, 35, 52, 55, 56). Habitat, associated with the recorded locations, to be impacted includes: • Belah woodland (1.93 ha – intact) • Brigalow viney scrub open forest (1.47 ha - intact) • Poplar Box - Belah woodland (8.34 ha - intact) • Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact) • Weeping Myall open woodland (0.9 ha - intact). Habitat for the species generally excludes derived grasslands however scattered individuals are present under Mimosa (*Vachellia farnesiana*) bushes. **Total known and potential habitat affected 28.86 hectares**
Desmodium campylocaulon	Creeping Tick-trefoil	-	E	**Recorded**; in the study area of N2MS5 during field surveys. Habitat, associated with the recorded locations, to be impacted includes: • Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact) • Weeping Myall open woodland (0.9 ha - intact, 14.42 ha - derived).

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act	
				Habitat for this species includes derived grasslands. **Total known and potential habitat affected in N2MS5 = 31.54 hectares**
Diuris tricolor	Pine Donkey Orchid	-	V	Moderate – species not known from locality but is known from a relevant IBRA subregion and study area contains potential habitat. Survey timing was not suitable for detection of this species. Associated habitat to be impacted includes: • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) • Poplar Box - Belah woodland (8.34 ha - intact). **Total potential habitat affected = 17.72 hectares**
Swainsona sericea	Silky Swainson-pea	-	V	Moderate– Not recorded in the locality but associated with a relevant IBRA subregion and the study area contains some possibly suitable habitat. Survey timing was not suitable for detection of this species. Associated habitat to be impacted includes: • Weeping Myall open woodland (0.9 ha - intact, 14.42 ha - derived) • Poplar Box - Belah woodland (8.34 ha - intact, 0.42 ha - derived) • Carbeen +/- Coolabah grassy woodland (3.04 ha intact, 1.24 ha derived). Habitat for the species includes derived grasslands. **Total potential habitat affected = 28.36 hectares**
Tylophora linearis	-	E	V	Moderate– Not recorded in the locality but associated with a relevant IBRA subregion and the study area contains some possibly suitable habitat. Associated habitat to be impacted includes: • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact). **Total potential habitat affected = 9.38 hectares**
Lepidium aschersonii	Spiny Peppercress	V	V	Moderate– recorded in the locality and suitable habitat are found in study area. Associated habitat to be impacted includes: • Belah woodland (1.93 ha – intact, 0.32 ha - derived) • Brigalow viney scrub open forest (0.66 ha - intact, 0.53 -derived) • Poplar Box - Belah woodland (8.76 ha - intact, 0.42 ha - derived). Habitat for the species includes derived grasslands. **Total potential habitat affected = 12.62 hectares**
Polygala linariifolia	Native Milkwort	-	E	Moderate– Recorded in the locality and the study area contains some possibly suitable habitat: Associated habitat to be impacted includes: • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact). **Total potential habitat affected = 9.38 hectares**
Pterostylis cobarensis	Greenhood Orchid	-	V	Moderate– Recorded in the locality and the study area contains some possibly suitable habitat. Survey timing was not suitable for detection of this species.

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act	
				Associated habitat to be impacted includes: • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact). **Total potential habitat affected = 9.38 hectares**
Swainsona murrayana	Slender Darling Pea	V	V	Moderate– Recorded in the locality and the study area contains a large amount of likely suitable habitat. Survey timing was marginal for detection of this species. Associated habitat to be impacted includes: • Belah woodland (1.93 ha – intact, 0.32 ha - derived) • Brigalow viney scrub open forest (1.47 ha - intact, 0.87 -derived) • Carbeen +/- Coolabah grassy woodland (3.04 ha intact, 1.24 ha derived) • Poplar Box - Belah woodland (8.34 ha - intact, 0.42 ha - derived) • Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact) • Weeping Myall open woodland (0.9 ha - intact, 14.42 ha - derived). Habitat for the species includes derived grasslands. **Total potential habitat affected = 49.17 hectares**
Lepidium monoplocoides	Winged Peppercress	E	E	Moderate. Recently recorded near Narrabri and in the Pilliga area. Associated habitat to be impacted includes: • Carbeen +/- Coolabah grassy woodland (3.04 ha intact, 1.24 ha derived) • Poplar Box - Belah woodland (8.34 ha - intact, 0.42 ha - derived) • Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact) Habitat for the species includes derived grasslands. **Total potential habitat affected = 29.26 hectares**
Sida rohlenae	Shrub Sida		E	Moderate. Known from the Brigalow Belt south but not the relevant subregions. Associated habitat to be impacted includes: • Carbeen +/- Coolabah grassy woodland (3.04 ha intact, 1.24 ha derived) • Poplar Box - Belah woodland (8.34 ha - intact, 0.42 ha - derived) Habitat for the species includes derived grasslands. **Total potential habitat affected = 13.04 hectares**
Cyperus conicus	-	-	E	Moderate. Recorded in the locality and associated habitat is present. Associated habitat to be impacted includes: • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) • Belah woodland (1.93 ha – intact, 0.32 ha - derived) • Poplar Box - Belah woodland (8.34 ha - intact, 0.42 ha - derived) • Carbeen +/- Coolabah grassy woodland (3.04 ha intact, 1.24 ha - derived)

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act	
				Total potential habitat affected = 24.67 hectares

Table 4-7 Summary of habitat impacts on threatened fauna

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act (or FM Act)	
Pomatostomus temporalis temporalis	Grey-crowned Babbler	-	V	**Recorded**; confirmed in the study areas of Sections 1 and 2 during field surveys. Also, highly likely to be present in N2MS3 and N2MS4. Habitat widespread. Associated habitat to be impacted includes: • Belah woodland (1.93 ha – intact) • Carbeen +/- Coolabah grassy woodland (3.04 ha intact) • Poplar Box - Belah woodland (8.34 ha - intact) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) • Weeping Myall open woodland (0.9 ha - intact). **Total known and potential habitat affected = 25.59 hectares**
Calyptorhynchus lathami	Glossy-black Cockatoo	-	V	**Recorded**; likely presence confirmed by chewed cones in roadside Belah in N2MS4 during field surveys. Belah habitat widespread. Associated habitat to be impacted includes: • Belah woodland (1.93 ha – intact) • Carbeen +/- Coolabah grassy woodland (3.04 ha intact) • Poplar Box - Belah woodland (8.34 ha - intact) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) **Total known and potential habitat affected = 24.69 hectares**
Circus assimilis	Spotted Harrier	-	V	High – known from locality. Suitable habitat widespread; the most suitable habitat includes the edges of ephemeral wetlands and creeks. Associated habitat to be impacted includes: • Belah woodland (1.93 ha – intact, 0.32 ha - derived) • Brigalow viney scrub open forest (1.47 ha - intact, 0.87 -derived) • Carbeen +/- Coolabah grassy woodland (3.04 ha intact, 1.24 ha derived) • Poplar Box - Belah woodland (8.34 ha - intact, 0.42 ha - derived) • Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact) • Weeping Myall open woodland (0.9 ha - intact, 14.42 ha - derived). **Total potential habitat affected = 49.17 hectares**

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act (or FM Act)	
Macropus dorsalis	Black-striped Wallaby	-	E	High – many of records of this species from the Pilliga National Park. Some records also along the road alignment. Suitable habitat present in the study area includes: • Brigalow viney scrub open forest (1.47 ha - intact) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) • Mock Olive - Wilga - Peach Bush - Carissa (0.11 ha - intact) • patches are considered marginal as they exist as narrow and fragmented patches with little connectivity. **Total potential habitat affected (excluding marginal habitat) = 10.96 hectares.**
Artamus cyanopterus cyanopterus	Dusky Woodswallow	-	V	High – recorded in the locality at moderate frequency and suitable habitat widespread in study area. • Belah woodland (1.93 ha – intact, 0.32 ha - derived) • Brigalow viney scrub open forest (1.47 ha - intact, 0.87 -derived) • Carbeen +/- Coolabah grassy woodland (3.04 ha intact, 1.24 ha derived) • Poplar Box - Belah woodland (8.34 ha - intact, 0.42 ha - derived) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) • Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact) • Weeping Myall open woodland (0.9 ha - intact, 14.42 ha - derived) • Mock Olive - Wilga - Peach Bush - Carissa (0.11 ha - intact) **Total potential habitat affected = 58.66 hectares**
Chthonicola sagittata (Pyrrholaemus sagittatus)	Speckled Warbler	-	V	Moderate – marginal habitat present (relatively small patch size, linear shape and fragmentation). Associated habitat to be impacted includes: • Belah woodland (1.93 ha – intact, 0.32 ha - derived) • Brigalow viney scrub open forest (1.47 ha - intact, 0.87 -derived) • Carbeen +/- Coolabah grassy woodland (3.04 ha intact, 1.24 ha derived) • Poplar Box - Belah woodland (8.34 ha - intact, 0.42 ha - derived) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) • Mock Olive - Wilga - Peach Bush - Carissa (0.11 ha - intact) **Total potential habitat affected = 27.12 hectares**
Hieraaetus morphnoides	Little Eagle	-	V	High – suitable habitat widespread and recorded at moderate frequency, including a record immediately adjacent to the study area. Associated habitat to be impacted includes: • Belah woodland (1.93 ha – intact, 0.32 ha - derived) • Brigalow viney scrub open forest (1.47 ha - intact, 0.87 -derived) • Carbeen +/- Coolabah grassy woodland (3.04 ha intact, 1.24 ha derived) • Poplar Box - Belah woodland (8.34 ha - intact, 0.42 ha - derived) • Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact)

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act (or FM Act)	
				• Weeping Myall open woodland (0.9 ha - intact, 14.42 ha - derived) • Mock Olive - Wilga - Peach Bush - Carissa (0.11 ha - intact) **Total potential habitat affected = 49.28hectares**
Ninox connivens	Barking Owl	-	V	High – suitable habitat widespread through study area. Recorded in larger woodland areas NE of Narrabri and in close proximity to Moree. Associated habitat to be impacted includes: • Belah woodland (1.93 ha – intact) • Brigalow viney scrub open forest (1.47 ha - intact) • Carbeen +/- Coolabah grassy woodland (3.04 ha intact) • Poplar Box - Belah woodland (8.34 ha - intact) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) • Weeping Myall open woodland (0.9 ha - intact) **Total potential habitat affected = 25.06 hectares**
Grantiella picta	Painted Honeyeater	V	V	High – suitable habitat widespread, particularly in areas with mistletoes; has been recorded in the Little Bumble TSR (road reserve) between Narrabri and Moree. Associated habitats in the study area include: • Belah woodland (1.93 ha – intact) • Brigalow viney scrub open forest (1.47 ha - intact) • Carbeen +/- Coolabah grassy woodland (3.04 ha intact) • Poplar Box - Belah woodland (8.34 ha - intact) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) • Weeping Myall open woodland (0.9 ha - intact) • Mock Olive - Wilga - Peach Bush - Carissa (0.11 ha - intact) **Total potential habitat affected = 25.17 hectares**
Chalinolobus picatus	Little Pied Bat	-	V	High; likely to forage in the study area and may roost in hollow-bearing trees and bridges/culverts. Associated habitats in the study area include: • Belah woodland (1.93 ha – intact, 0.32 ha - derived) • Brigalow viney scrub open forest (1.47 ha - intact, 0.87 -derived) • Carbeen +/- Coolabah grassy woodland (3.04 ha intact, 1.24 ha derived) • Poplar Box - Belah woodland (8.34 ha - intact, 0.42 ha - derived) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) • Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact) • Weeping Myall open woodland (0.9 ha - intact, 14.42 ha - derived) • Mock Olive - Wilga - Peach Bush - Carissa (0.11 ha - intact) **Total potential habitat affected = 58.66 hectares**

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act (or FM Act)	
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	-	V	High – this species may forage in woodland/forest and roost in hollow-bearing trees in the study area. Associated habitat to be impacted includes: • Belah woodland (1.93 ha – intact, 0.32 ha - derived) • Brigalow viney scrub open forest (1.47 ha - intact, 0.87 -derived) • Carbeen +/- Coolabah grassy woodland (3.04 ha intact, 1.24 ha derived) • Poplar Box - Belah woodland (8.34 ha - intact, 0.42 ha - derived) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) • Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact) • Weeping Myall open woodland (0.9 ha - intact, 14.42 ha - derived) • Mock Olive - Wilga - Peach Bush - Carissa (0.11 ha - intact) **Total potential habitat affected = 58.66 hectares**
Phascolarctos cinereus	Koala	V	V	High – identified north of the Mehi River in Moree during field surveys but no conclusive evidence was found within the study area. A single previous record is known from the study area (Bellata) and there are multiple other records in the locality, in larger woodland remnants further to the east. Habitat in the study area likely to be part of the home range of a low-density population. Associated (marginal) habitat present in the study area includes: • Belah woodland (1.93 ha – intact) • Brigalow viney scrub open forest (1.47 ha - intact) • Carbeen +/- Coolabah grassy woodland (3.04 ha intact) • Poplar Box - Belah woodland (8.34 ha - intact) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) **Total potential habitat affected = 24.16 hectares**
Daphoenositta chrysoptera	Varied Sittella	-	V	High. Frequently recorded in the locality and habitat is widespread in the study area. • Belah woodland (1.93 ha – intact) • Brigalow viney scrub open forest (1.47 ha - intact) • Carbeen +/- Coolabah grassy woodland (3.04 ha intact) • Poplar Box - Belah woodland (8.34 ha - intact) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) • Weeping Myall open woodland (0.9 ha - intact). **Total potential habitat affected = 25.06 hectares**
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	-	V	Moderate – infrequently recorded in the locality but suitable habitat is present. Associated habitat to be impacted includes: • Belah woodland (1.93 ha – intact) • Brigalow viney scrub open forest (1.47 ha - intact)

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act (or FM Act)	
				• Carbeen +/- Coolabah grassy woodland (3.04 ha intact) • Poplar Box - Belah woodland (8.34 ha - intact) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) • Weeping Myall open woodland (0.9 ha - intact) • Mock Olive - Wilga - Peach Bush - Carissa (0.11 ha - intact) **Total potential habitat affected = 25.17 hectares**
Hoplocephalus bitorquatus	Pale-headed Snake	-	V	Moderate – may occur in the study area, particularly around vegetated creek lines. Associated habitat to be impacted includes: • Poplar Box - Belah woodland (8.34 ha - intact, 0.42 ha - derived) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) • Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact) • Weeping Myall open woodland (0.9 ha - intact) **Total potential habitat affected = 35.26 hectares**
Burhinus grallarius	Bush Stone-curlew	-	E	Moderate – may utilise woodland habitats; recorded infrequently in the locality. Associated habitat to be impacted includes: • Brigalow viney scrub open forest (1.47 ha - intact, 0.87 -derived) • Carbeen +/- Coolabah grassy woodland (3.04 ha intact, 1.24 ha derived) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) • Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact) • Weeping Myall open woodland (0.9 ha - intact, 14.42 ha - derived) **Total potential habitat affected = 47.54 hectares**
Sminthopsis macroura	Stripe-faced Dunnart	-	V	Moderate – no records in locality, however this species occupies the same habitat as the common fat-tailed dunnart, of which there are records in Narrabri, Bellata and Moree. Unlikely there has been comprehensive surveys for this species in the study area. Associated habitat to be impacted includes: • Belah woodland (1.93 ha – intact, 0.32 ha - derived) • Brigalow viney scrub open forest (1.47 ha - intact, 0.87 -derived) • Carbeen +/- Coolabah grassy woodland (3.04 ha intact, 1.24 ha derived) • Poplar Box - Belah woodland (8.34 ha - intact, 0.42 ha - derived) • Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact) • Weeping Myall open woodland (0.9 ha - intact, 14.42 ha - derived) **Total potential habitat affected = 48.27 hectares**
Falco hypoleucos	Grey Falcon	-	E	Moderate – not common in the locality however this species may pass through the study area on occasion. Associated habitat to be impacted includes:

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act (or FM Act)	
				• Belah woodland (1.93 ha – intact, 0.32 ha - derived) • Brigalow viney scrub open forest (1.47 ha - intact, 0.87 -derived) • Carbeen +/- Coolabah grassy woodland (3.04 ha intact, 1.24 ha derived) • Poplar Box - Belah woodland (8.34 ha - intact, 0.42 ha - derived) • Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact) • Weeping Myall open woodland (0.9 ha - intact, 14.42 ha - derived) **Total potential habitat affected = 48.27 hectares**
Hamirostra melanosternon	Black-breasted Buzzard	-	V	Moderate – occasionally recorded in the locality, this species may hunt around creeks, woodlands and grasslands in the study area. Associated habitat to be impacted includes: • Belah woodland (1.93 ha – intact) • Poplar Box - Belah woodland (8.34 ha - intact) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) **Total potential habitat affected = 19.65 hectares**
Tyto novaehollandiae	Masked Owl	-	V	Moderate – several records of this species in Pilliga NP, Bobbiwaa Conservation Area and Moema NP. This species is likely to use the study area for hunting, though may also nest in the larger hollows. Associated habitat to be impacted includes: • Belah woodland (1.93 ha – intact, 0.32 ha - derived) • Brigalow viney scrub open forest (1.47 ha - intact, 0.87 -derived) • Poplar Box - Belah woodland (8.34 ha - intact, 0.42 ha - derived) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) • Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact) • Weeping Myall open woodland (0.9 ha - intact, 14.42 ha - derived) • Mock Olive - Wilga - Peach Bush - Carissa (0.11 ha - intact) **Total potential habitat affected = 54.38 hectares**
Neophema pulchella	Turquoise Parrot	-	V	Moderate – some suitable habitat found in the study area. Associated habitat to be impacted includes: • Carbeen +/- Coolabah grassy woodland (3.04 ha intact) • Poplar Box - Belah woodland (8.34 ha - intact) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) **Total potential habitat affected = 20.76 hectares**
Aepyprymnus rufescens	Rufous Bettong	-	V	Moderate – species not recorded in locality (nearest records are in the Pilliga region), but the study area contains potential habitat. Associated habitats in the study area include: • Brigalow viney scrub open forest (1.47 ha - intact) • Mock Olive - Wilga - Peach Bush - Carissa (0.11 ha - intact)

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act (or FM Act)	
				Total potential habitat affected = 1.58 hectares
Lophoictinia isura	Square-tailed Kite	-	V	Moderate – species seen 20km south-eat of Moree and in Moree. Likely to pass through the study area on occasion. May nest in large trees in the study area. Associated habitat to be impacted includes: • Belah woodland (1.93 ha – intact) • Brigalow viney scrub open forest (1.47 ha - intact) • Carbeen +/- Coolabah grassy woodland (3.04 ha intact) • Poplar Box - Belah woodland (8.34 ha - intact) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) • Weeping Myall open woodland (0.9 ha - intact) • Mock Olive - Wilga - Peach Bush - Carissa (0.11 ha - intact) **Total potential habitat affected = 25.17 hectares**
Jalmenus eubulus	Pale Imperial Hairstreak	-	CE	Moderate – suitable habitat presents in study area. No records in the locality, however this does not discount the potential for this species to occur as it is only known from a single population. Associated habitat to be impacted includes: • Brigalow viney scrub open forest (1.47 ha - intact). **Total potential habitat affected = 1.47 hectares**
Stagonopleura guttata	Diamond Firetail	-	V	Moderate – suitable habitat widespread but few local records. Associated habitat to be impacted includes: • Belah woodland (1.93 ha – intact) • Brigalow viney scrub open forest (1.47 ha - intact) • Carbeen +/- Coolabah grassy woodland (3.04 ha intact) • Poplar Box - Belah woodland (8.34 ha - intact) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) • Weeping Myall open woodland (0.9 ha - intact) • Mock Olive - Wilga - Peach Bush - Carissa (0.11 ha - intact) **Total potential habitat affected = 25.17 hectares**
Ardeotis australis	Australian Bustard	-	E	Moderate – suitable habitat widespread in study area but the species has been infrequently recorded. Associated habitat to be impacted includes: • Belah woodland (1.93 ha – intact, 0.32 ha - derived) • Brigalow viney scrub open forest (1.47 ha - intact, 0.87 -derived) • Carbeen +/- Coolabah grassy woodland (3.04 ha intact, 1.24 ha derived) • Poplar Box - Belah woodland (8.34 ha - intact, 0.42 ha - derived) • Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact)

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act (or FM Act)	
				• Weeping Myall open woodland (0.9 ha - intact, 14.42 ha - derived) **Total potential habitat affected = 79.13 hectares**
Falco subniger	Black Falcon	-	V	Moderate – suitable habitat widespread. Recorded locations include Narrabri rubbish dump. This species may hunt and perch in the study area; nesting habitat in the study area is likely to be marginal due to its proximity to the highway. Potential habitat in the study area includes all woodland/forest and grasslands with scattered trees. The habitat likely to be most suitable for the species includes: • Carbeen +/- Coolabah grassy woodland (3.04 ha intact, 1.24 ha derived) • Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact) • Weeping Myall open woodland (0.9 ha - intact, 14.42 ha - derived) **Total potential habitat affected = 35.82 hectares**
Petaurus norfolcensis	Squirrel Glider	-	V	Moderate – this species has been recorded in Kaputar National Park and Bobbiwaa State Conservation Area. Although vegetation in the study area is fragmented, it offers an abundance of hollow-bearing trees suitable for this species, particularly in River Red Gum Woodlands (e.g. Bobbiwaa Creek is connected to the conservation area). The species is moderately likely to be found in segments 1 and 2. • Carbeen +/- Coolabah grassy woodland (3.04 ha intact) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) **Total potential habitat affected = 12.42 hectares**
Glossopsitta pusilla	Little Lorikeet	-	V	Moderate – this species has been seen near Moree. Not common in the area though is likely to pass through. Associated habitat to be impacted includes: • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) **Total potential habitat affected = 9.38 hectares**
Mormopterus eleryi	Bristle-faced free-tailed bat, Hairy-nosed Freetail Bat	-	E	Moderate – this species may forage and roost in hollow-bearing trees in the study area. Associated habitat to be impacted includes: • Carbeen +/- Coolabah grassy woodland (3.04 ha intact) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) • Brigalow viney scrub open forest (1.47 ha - intact). **Total potential habitat affected = 13.89 hectares**
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	Moderate – this species may forage and roost in hollow-bearing trees in the study area. Associated habitat to be impacted includes: • Belah woodland (1.93 ha – intact) • Brigalow viney scrub open forest (1.47 ha - intact) • Poplar Box - Belah woodland (8.34 ha - intact) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact)

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act (or FM Act)	
				• Weeping Myall open woodland (0.9 ha - intact) • Mock Olive - Wilga - Peach Bush - Carissa (0.11 ha - intact) **Total potential habitat affected = 22.13 hectares**
Vespadelus troughtoni	Eastern Cave Bat	-	V	Moderate – this species may forage in and around forest/woodland and roost in Fairy Martin mud nests in bridges and culverts in the study area. Associated habitat to be impacted includes: • Carbeen +/- Coolabah grassy woodland (3.04 ha intact) • Belah woodland (1.93 ha – intact) • Poplar Box - Belah woodland (8.34 ha - intact) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) • Mock Olive - Wilga - Peach Bush - Carissa (0.11 ha - intact) **Total potential habitat affected = 28.97 hectares**
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	-	V	Moderate – this species may forage in and around woodland/forest and roost in bridges/culverts in the study area. Associated habitat to be impacted includes: • Carbeen +/- Coolabah grassy woodland (3.04 ha intact) • Belah woodland (1.93 ha – intact) • Poplar Box - Belah woodland (8.34 ha - intact) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) • Mock Olive - Wilga - Peach Bush - Carissa (0.11 ha - intact) **Total potential habitat affected = 28.97 hectares**
Polytelis swainsonii	Superb Parrot	V	V	Moderate – this species previously recorded occasionally in and around Moree. Suitable habitat widespread in study area which is near the limit of species' range. Associated habitat to be impacted includes: • Belah woodland (1.93 ha – intact, 0.32 ha - derived) • Carbeen +/- Coolabah grassy woodland (3.04 ha intact, 1.24 ha derived) • Poplar Box - Belah woodland (8.34 ha - intact, 0.42 ha - derived) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) • Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact) • Weeping Myall open woodland (0.9 ha - intact, 14.42 ha - derived) **Total potential habitat affected = 56.12 hectares**

4.1.4 Aquatic impacts

This supplementary assessment has concluded impact to aquatic habitats is consistent with the BAR. Refer to the BAR (Jacobs, 2018) for a further discussion on these matters.

4.1.5 Injury and mortality

The injury and mortality impacts associated with the proposed modification are consisted consistent with the BAR (Jacobs, 2018) prepared for the project REF.

4.2 Indirect/operational impacts

The indirect/ operation impacts associated with the proposed modification are consistent with the BAR (Jacobs, 2018) prepared for the project REF.

4.2.1 Wildlife connectivity corridors and habitat fragmentation

This supplementary assessment has concluded wildlife connectivity corridors and habitat fragmentation is consistent with the BAR. Refer to the BAR (Jacobs, 2018) for a further discussion on these matters.

4.2.2 Edge effects on adjacent native vegetation and habitat

This supplementary assessment has concluded edge effects on adjacent native vegetation and habitat is consistent with the BAR. Refer to the BAR (Jacobs, 2018) for a further discussion on these matters.

4.2.3 Injury and mortality

This supplementary assessment has concluded risk of injury and mortality considerations are consistent with the BAR. Refer to the BAR (Jacobs, 2018) for a further discussion on these matters.

4.2.4 Invasion and spread of weeds

This supplementary assessment has concluded invasion and spread of weeds considerations are consistent with the BAR. Refer to the BAR (Jacobs, 2018) for a further discussion on these matters.

4.2.5 Invasion and spread of pests

This supplementary assessment has concluded invasion and spread of pest considerations are consistent with the BAR. Refer to the BAR (Jacobs, 2018) for a further discussion on these matters.

4.2.6 Invasion and spread of pathogens and disease

This supplementary assessment has concluded invasion and spread of pathogens and disease considerations are consistent with the BAR. Refer to the BAR (Jacobs, 2018) for a further discussion on these matters.

4.2.7 Changes to hydrology

This supplementary assessment has concluded changes to hydrology considerations are consistent with the BAR. Refer to the BAR (Jacobs, 2018) for a further discussion on these matters.

4.2.8 Noise, light and vibration

This supplementary assessment has concluded changes to noise, light and vibration are consistent with the BAR. Refer to the BAR (Jacobs, 2018) for a further discussion on these matters.

4.2.9 Groundwater dependent ecosystems

This supplementary assessment has concluded impact to groundwater dependent ecosystems are consistent with the BAR. Refer to the BAR (Jacobs, 2018) for a further discussion on these matters.

4.3 Cumulative impact

The potential biodiversity impacts of the proposed modification must be considered as a consequence of the construction and operation of the proposed modification within the existing environment. The proposed modification would not act alone in causing impacts to biodiversity. The incremental effects of multiple sources of impact (past, present and future) are referred to as cumulative impacts and provide an opportunity to consider the proposed modification within a strategic context.

The accumulating impacts of historic vegetation clearing for agriculture, urban development, and development and maintenance of infrastructure have contributed to the loss of biodiversity in the Brigalow Belt South Bioregion (Table 4-10).

While data from all recent projects in the locality is not freely available, some information on the likely biodiversity impacts from recent projects is available as follows:

- North Moree heavy duty pavement upgrade
- Newell Highway Mungle Back Creek to Boggabilla heavy duty pavement upgrade
- Previous Newell Highway upgrade projects.

Table 4-8 Summary of potential cumulative impacts for endangered ecological communities and species recorded in the proposed modification area

Value impacted (area of community or species habitat)	Newell Highway Heavy Duty Pavement proposed modifications/projects – clearing in hectares			Other recent and future proposed modifications in the region	Cumulative impact
	Narrabri to Moree (this (proposed modification)	North Moree (planned proposed modification)	Mungle Back Creek to Boggabilla (proposed modification approved)		
Brigalow-Belah Woodland (Brigalow TEC; BC Act and EPBC Act)	1.45 ha	0 ha	17.5 ha	Unknown	18.95 ha
Weeping Myall open woodland (Weeping Myall TEC; BC Act and EPBC Act) (PCT 27)	0.9 ha	2.81	0	Unknown	3.71
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	16.22 ha	9.62 ha	-.	Unknown	25.84

Value impacted (area of community or species habitat)	Newell Highway Heavy Duty Pavement proposed modifications/projects – clearing in hectares			Other recent and future proposed modifications in the region	Cumulative impact
	Narrabri to Moree (this (proposed modification)	North Moree (planned proposed modification)	Mungle Back Creek to Boggabilla (proposed modification approved)		
(EPBC Act CEEC) (PCT 52)					
Homopholis belsonii (Belson's Panic)	28.86 ha	12.05	34 ha	Unknown	~50-100 ha
Desmodium campylocaulon (Creeping Tick-trefoil)	31.54 ha	14.37	41 ha	Unknown	~50-90 ha
Grey-crowned Babbler (*Pomatostomus temporalis*)	25.59 ha	6.44	34 ha	Unknown	~50-60 ha

4.4 EPBC Act Strategic Assessment

In September 2015, a “strategic assessment” approval was granted by the Federal Minister in accordance with the EPBC Act. The approval applies to TfNSW activities being assessed under Part 5 of the EP&A Act with respect to potential impacts on nationally listed threatened species, ecological communities and migratory species.

As a result, TfNSW proposed modifications assessed via a REF:

- must address and consider potential impacts on nationally listed threatened species, populations, ecological communities and migratory species, including application of the “avoid, minimise, mitigate and offset” hierarchy
- do not require referral to the Federal Department of the Environment for these matters, even if the activity is likely to have a significant impact.

TfNSW must consider impacts to nationally listed threatened species, ecological communities and migratory species as part of the approval process under the strategic assessment. To assist with this, assessments are required in accordance with the *Matters of National Environmental Significance: Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999* (DoE 2013).

The *Transport for New South Wales Environment Protection and Biodiversity Conservation Act 1999 – Strategic Assessment policy* states biodiversity offsets are required when a significant impact is likely for threatened biodiversity listed under the EPBC Act (Transport for New South Wales 2005).

The proposed modification may result in a significant impact upon one threatened ecological community listed under the EPBC Act; therefore, biodiversity offsets are required. The strategic assessment recommends that biodiversity offsets are calculated using the BC Act methodology. A Biodiversity Offset Strategy (BOS) will be prepared for the proposed modification which will identify:

- The credits required under the BC Act to compensate for nationally listed threatened species, ecological communities and migratory species where a significant impact is likely; and
- Options available to meet the offset requirements for nationally listed matters on a 'like-for-like' basis.

4.5 Assessments of significance

Update Assessment of Significance has been conducted for threatened species that have been positively identified within the study area or that are considered to have a moderate or high likelihood of occurring in the study area due to the presence of suitable habitat.

The proposed works would be assessed under Part 5.1 of the EP&A Act. Section 7.3 of the BC Act outlines the 'test of significance' that is to be undertaken to assess the likelihood of significant impact upon threatened species or ecological communities listed under the BC Act. As a new guideline has not been produced by the DPIE, these tests of significance have been undertaken in accordance with the guidelines provided in the *Threatened Species Assessment Guidelines: The Assessment of Significance* (Department of Environment and Climate Change, 2007) which outlines a set of guidelines to help applicants/proponents of a development or activity with interpreting and applying the factors of assessment in the former 'seven-part test'. The guidance provided by the Department of Environment and Climate Change (2007) has been used here in preparing these tests of significance and in determining whether there is likely to be a significant effect to a threatened species, population or ecological community listed under the BC Act.

Full details of assessment of significance under the BC Act are presented in Appendix B. The conclusions of the BC Act assessment are provided in Table 4.11.

For threatened biodiversity listed under the EPBC Act, significance assessments have been completed in accordance with the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (Department of Environment, 2013). Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment that is affected, and upon the intensity, duration, magnitude and geographic extent of the impacts (Department of Environment, 2013). Importantly, for a 'significant impact' to be 'likely', it is not necessary for a significant impact to have a greater than 50 per cent chance of happening; it is sufficient if a significant impact on the environment is a real or not remote chance or possibility (Department of Environment, 2013). This advice has been considered while undertaking the assessments.

Full details of assessment of significance under the EPBC Act are presented in Appendix C. The conclusions of the assessment are provided in Table 4-11.

Table 4-9 Summary findings of the BC Act test of significance

Biodiversity Conservation Act 2016 test of significance						
Threatened species, or communities	**Significance assessment question[1]**					**Likely significant effect?**
	a	**b**	**c**	**d**	**e**	
Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions	X	N	Y	N	Y	No
Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions	X	N	?	N	Y	No
Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions	X	N	Y	N	Y	No
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	X	N	Y	N	Y	No
Desmodium campylocaulon (Creeping Tick-trefoil)	N	X	N	N	Y	No
Digitaria porrecta (Finger Panic Grass)	N	X	N	N	Y	No
Homopholis belsonii (Belson's Panic)	Y	X	Y	N	Y	No
Plants chiefly associated with PCTs on sandy soils containing White Cypress Pine: • *Polygala linariifolia* (Native Milkwort) • *Pterostylis cobarensis* (Greenhood Orchid) • *Tylophora linearis.*	N	X	Y	N	Y	No
Plants not recorded during surveys and chiefly associated with PCTs on sandy and sandy-loam soils containing White Cypress Pine and Belah: • *Cyperus conicus* • *Diuris tricolor* (Pine Donkey Orchid) • *Lepidium aschersonii* (Spiny Peppercress) • *Sida rohlenae* (Shrub Sida)	N	X	Y	N	Y	No
Plants not recorded during surveys and chiefly associated with a wide range of PCTs on cracking-clay and clay-loam soils: • *Lepidium monoplocoides (*Winged Peppercress*)* • *Swainsona murrayana* (Slender Darling Pea) • *Swainsona sericea* (Silky Swainson-pea)	N	X	Y	N	Y	No
Grey-crowned Babbler (*Pomatostomus temporalis temporalis*)	N	X	Y	N	Y	No
Painted Honeyeater (*Grantiella picta*)	N	X	Y	N	Y	No
Little Lorikeet (*Glossopsitta pusilla*)	N	X	Y	N	Y	No
Superb Parrot (*Polytelis swainsonii*)	N	X	Y	N	Y	No
Black-cockatoos: • Glossy-black Cockatoo (*Calyptorhynchus lathami*)	N	X	Y	N	Y	No
Woodland/forest birds • Diamond Firetail (*Stagonopleura guttata*) • Dusky Woodswallow (*Artamus cyanopterus cyanopterus*) • Hooded Robin (south-eastern form) (*Melithreptus gularis gularis*) • Speckled Warbler (*Chthonicola sagittata*) • Varied Sittella (*Daphoenositta chrysoptera*) • Turquoise Parrot (*Neophema pulchella*).	N	X	Y	N	Y	No
Forest/Woodland Owls: • Barking Owl (Ninox connivens) • Masked Owl (Tyto novaehollandiae)	N	X	Y	N	Y	No
Birds of open woodland and grassland habitats: • Australian Bustard (*Ardeotis australis*) • Bush Stone-curlew (*Burhinus grallarius*)	N	X	Y	N	Y	No
Birds of prey: • Square-tailed Kite (*Lophoictinia isura*) • Spotted Harrier (*Circus assimilis*) • Little Eagle (*Hieraaetus morphnoides*) • Grey Falcon (*Falco hypoleucos*) • Black Falcon (*Falco subniger*)	N	X	Y	N	Y	No

Biodiversity Conservation Act 2016 test of significance						
• Black-breasted Buzzard (*Hamirostra melanosternon*)						
Insectivorous Bats: • Little Pied Bat (*Chalinolobus picatus*) • Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) • Bristle-faced free-tailed bat, Hairy-nosed Freetail Bat (*Mormopterus eleryi*) • Eastern Cave Bat (*Vespadelus troughtoni*) • Corben's Long-eared Bat (*Nyctophilus corbeni*) • Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*)	N	X	Y	N	Y	No
Koala (*Phascolarctos cinereus*)	N	X	Y	N	Y	No
Squirrel Glider (*Petaurus norfolcensis*)	N	X	Y	N	Y	No
Black-striped Wallaby (*Macropus dorsalis*)	N	X	Y	N	Y	No
Rufous Bettong (*Aepyprymnus rufescens*)	N	X	Y	N	Y	No
Stripe-faced Dunnart (*Sminthopsis macroura*)	N	X	Y	N	Y	No
Pale-headed Snake (*Hoplocephalus bitorquatus*)	N	X	Y	N	Y	No
Five-clawed Worm Skink (*Anomalopus mackayi*)	N	X	Y	N	Y	No
Pale Imperial Hairstreak (*Jalmenus eubulus*)	N	X	Y	N	Y	No

Notes: Y= Yes (negative impact), N= No (no or positive impact), X= not applicable, ? = unknown impact.

1. Significance Assessment Questions as set out in the *Biodiversity Conservation Act 2016:*
   - a in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
   - b in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:
     - (i) is likely to have an adverse effect on the extent of the ecological community such that its local viable population is likely to be placed at risk of extinction, or
     - (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local viable population is likely to be placed at risk of extinction,
   - c in relation to the habitat of a threatened species or ecological community:
     - (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and
     - (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
     - (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.
   - d whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),
   - e whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

FM Act test of significance								
Threatened species, or communities	**Significance assessment question[1]**							**Likely significant effect?**
	a	**b**	**c**	**d**	**e**	**f**	**g**	
Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River	X	X	N	N	N	N	Y	No
Purple-spotted Gudgeon (*Morgurnda adspersa)*	N	X	N	X	N	N	Y	No
Eel-tailed Catfish in the Murray / Darling Basin Endangered Population (*Tandanus tandanus*)	X	N	N	X	N	N	Y	No

1. Significance Assessment Questions as set out in the FM Act:
   - a in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
   - b in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.
   - c in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:
     - (iii) is likely to have an adverse effect on the extent of the ecological community such that its local viable population is likely to be placed at risk of extinction, or
     - (iv) is likely to substantially and adversely modify the composition of the ecological community such that its local viable population is likely to be placed at risk of extinction,
   - d in relation to the habitat of a threatened species or ecological community:

(iv) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

(v) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

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

e whether the proposed development is likely to have an adverse effect on critical habitat (either directly or indirectly)

f whether the action proposed is consistent with the objectives or action of a recovery plan or threat abatement plan

g whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

Table 4-10 Summary findings of the EPBC Act significance assessments

Species/Ecological Community	*Assessment of significance questions (EPBC Act)									Important Population +	Likely Significant Impact
	1	2	3	4	5	6	7	8	9		
Ecological communities											
Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Qld	Y	N	Y	N	N	Y	Y	NA	NA	NA	Yes
Weeping Myall Woodlands	Y	N	N	N	N	N	Y	NA	NA	NA	No
Brigalow (*Acacia harpophylla* dominant and co-dominant)	Y	N	Y	N	Y	Y	Y	NA	NA	NA	No
Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions	Y	N	N	N	N	N	Y	NA	NA	NA	No
Species											
Homopholis belsonii	Y	Y	N	Y	Y	N	N	N	N	Yes	No
Lepidium aschersonii	N	N	N	N	N	N	N	N	N	No	No
Lepidium monoplocoides	N	N	N	N	N	N	N	N	N	NA	No
Swainsona murrayana	N	N	N	N	N	N	N	N	N	No	No
Tylophora linearis	N	N	N	N	N	N	N	N	N	NA	No
Five-clawed Worm-skink (*Anomalopus mackayi*)	N	N	N	N	N	N	N	N	N	No	No
Painted Honeyeater (*Grantiella picta*)	N	N	N	N	N	N	N	N	N	No	No
Superb Parrot (*Polytelis swainsonii*)	N	N	N	N	N	N	N	N	N	No	No
Koala (*Phascolarctos cinereus*)	N	N	N	N	N	N	N	N	N	No	No
Corben's Long-eared Bat (*Nyctophilus corbeni*)	N	N	N	N	N	N	N	N	N	No	No

Notes: Y= Yes (negative impact), N= No (no or positive impact), X= not applicable, ?= unknown impact.

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

1) reduce the extent of an ecological community
2) fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines
3) adversely affect habitat critical to the survival of an ecological community
4) modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns
5) cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting
6) cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:
   -- assisting invasive species, that are harmful to the listed ecological community, to become established, or
   -- causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or
7) interfere with the recovery of an ecological community.

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

1) Lead to a long-term decrease in the size of a population
2) Reduce the area of occupancy of the species
3) Fragment an existing population into two or more populations
4) Adversely affect habitat critical to the survival of a species
5) Disrupt the breeding cycle of a population
6) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
7) Result in invasive species that are harmful to a species becoming established in the species' habitat
8) Introduce disease that may cause the species to decline
9) Interfere with the recovery of the species.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1) lead to a long-term decrease in the size of an important population of a species
2) reduce the area of occupancy of an important population
3) fragment an existing important population into two or more populations
4) adversely affect habitat critical to the survival of a species
5) disrupt the breeding cycle of an important population
6) modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
7) result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
8) introduce disease that may cause the species to decline, or
9) interfere substantially with the recovery of the species.

An important population as determined by the EPBC Act is a population of a vulnerable species that is likely to be key source populations either for breeding or dispersal, is likely to be necessary for maintaining genetic diversity, or is at or near the limit of the species range. The Grey-headed Flying-fox exists as one interconnected population along the east coast of Australia. Therefore, it is considered an important population for the purposes of this assessment.

4.6 Impact summary

The proposed modification will impact biodiversity (see chapter 4), which includes listed ecological communities, populations of threatened species and known habitat.

Separate impacts significance assessments were undertaken under the differing impact significance criteria of the NSW BC Act and FM Act and Commonwealth EPBC Act.

The assessments under the BC Act and FM Act concluded that, according to the relevant criteria, the proposed modification would not have a significant impact on the affected species and communities.

Assessment of relevant species and communities under the EPBC Act significance criteria identified a likely significant impact for one ecological community. This impact is summarised below:

- *Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland* (Critically Endangered Act– EPBC): Almost entirely restricted to N2MS5. The proposed modification would remove 16.22 hectares of this community leaving a residual viable local population of 39.26 hectares

A summary of the overall predicted ecological impacts from the proposed modification is provided in Table 4.13.

Table 4-11 Summary of potential impacts

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposed modification constitute or exacerbate a key threatening process?
Removal of native vegetation	All terrestrial threated ecological communities (BC Act)	Reduction in extent of communities	Segments: • N2MS1 = 0.03 ha • N2MS2 = 3.82 ha • N2MS3 = 0.08 ha • N2MS4 = 3.51 ha • N2MS5 = 0.01 ha	Permanent	Clearing of native vegetation
	All terrestrial threated ecological communities (EPBC Act)	Reduction in extent of communities	Segments: • N2MS1 = 0.03 ha • N2MS2 = 1.41ha • N2MS3 = 0.79 ha • N2MS4 = 11.21 ha • N2MS5 = 15.53 ha	Permanent	
	All threatened plants	A reduction in population size and extent	Species identified during surveys: • *Desmodium campylocaulon* = 31.54 ha, with the core habitat consisting of the 15.53 ha of natural grassland habitat in Segment 5 • *Digitaria porrecta* = 49.17 ha across whole proposed modification • *Homopholis belsonii* known and potential habitat: ○ N2MS2 = ~2.00 ha ○ N2MS3 = 0 ha ○ N2MS4 = 4.59ha ○ N2MS5 = 15.53 (habitat considered less valuable to the species due to the lack of trees). Species moderately to highly likely to occur but not detected during surveys. Impacts to associated habitat across whole proposed modification include: • *Polygala linariifolia*, *Pterostylis cobarensis*, *Tylophora linearis* = 8.21 ha • *Cyperus conicus* = 24.67 ha • *Diuris tricolor* = 17.72 ha • *Lepidium aschersonii* = 12.62 ha • *Sida rohlenae* = 13.04 ha • *Lepidium monoplocoides* = 29.26 ha • *Swainsona murrayana* = 49.17 ha • *Swainsona sericea* = 28.36 ha	Permanent	

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposed modification constitute or exacerbate a key threatening process?
Removal of threatened fauna habitat	Threatened ground-foraging fauna	Loss of habitat and a reduction in population size	Macropods highly likely to occur across whole proposed modification. Impacts to associated habitat include: • Black-striped Wallaby = 8.95 ha Macropods moderately likely to occur across whole proposed modification. Impacts to associated habitat include: • Rufous Bettong = 0.66 ha Small terrestrial mammals moderately likely to occur across whole proposed modification. Impacts to associated habitat include: • Stripe-faced Dunnart = 35.64 ha Arboreal reptiles moderately likely to occur across whole proposed modification. Impacts to associated habitat include: • Pale-headed Snake = 42.74 ha	Permanent	Clearing of native vegetation
	Threatened hollow-dependant fauna	Loss of habitat and a reduction in population size	Hollow dependent species identified during surveys: • Glossy Black-cockatoo (chewed cones recorded in N2MS4). Total impact to habitat = 24.69 ha. Owls moderately likely to occur across whole proposed modification. Impacts to associated habitat include moderately likely to occur across whole proposed modification: • Barking Owl = 25.05 ha • Masked Owl = 54.38 ha. Other hollow dependent birds moderately likely to occur across whole proposed modification. Impacts to associated habitat include: • Little Lorikeet = 9.38 ha • Superb Parrot = 56.12 ha • Turquoise Parrot = 20.67 ha. Hollow-roosting insectivorous bats moderately likely to occur across whole proposed modification. Impacts to associated habitat include moderately likely to occur across whole proposed modification: • Yellow-bellied Sheathtail-bat = 58.66 ha • Bristle-faced free-tailed bat = 13.89 ha • Corben's Long-eared Bat = 22.13 ha.	Permanent	• Clearing of native vegetation • Removal of dead wood and dead trees

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposed modification constitute or exacerbate a key threatening process?
			Arboreal mammals moderately likely to occur. Impacts to associated habitat across whole proposed modification include: • Squirrel Glider = 12.24 ha		
	All other threatened fauna	Loss of habitat and a reduction in population size	Species identified during surveys: • Grey-crowned Babbler (recorded in Segments 1 and 2. Likely also in N2MS3 and N2MS4). Total impact to habitat = 25.59 ha Species highly likely to occur; impacts to associated habitat across whole proposed modification include: • Koala = 24.16 ha • Pale Imperial Hairstreak = 1.47 ha • Five-clawed Worm-skink = 0 ha Birds highly likely to occur across whole proposed modification. Impacts to associated habitat include: • Painted Honeyeater = 25.17 ha • Dusky Woodswallow = 58.66 ha • Varied Sittella = 25.06 ha • Spotted Harrier = 49.17 ha • Little Eagle = 49.28 ha Birds moderately likely to occur across whole proposed modification. Impacts to associated habitat include: • Diamond Firetail = 25.17 ha • Hooded Robin (south-eastern form) = 25.17 ha • Speckled Warbler = 27.12 ha • Australian Bustard = 79.13 ha • Bush Stone-curlew = 47.54 ha • Square-tailed Kite = 25.17 ha • Grey Falcon = 35.82 ha • Black Falcon = 48.27 ha • Black-breasted Buzzard = 19.65 ha Cave-roosting insectivorous bats moderately likely to occur across whole proposed modification. Impacts to associated habitat include moderately likely to occur across whole proposed modification: • Little Pied Bat = 58.66 ha • Eastern Cave Bat = 22.8 ha • Eastern Bentwing-bat = 22.8 ha	Permanent	• Clearing of native vegetation • Loss of hollow-bearing trees

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposed modification constitute or exacerbate a key threatening process?
Removal of threatened flora	All threatened flora	A reduction in population size and extent	Species identified during surveys: • *Desmodium campylocaulon* = 31.54 ha, with the core habitat consisting of the 15.53 ha of natural grassland habitat in Segment 5 • *Digitaria porrecta* = 49.17 ha across whole proposed modification • *Homopholis belsonii* known and potential habitat: ○ N2MS2 = ~2.00 ha ○ N2MS3 = 0 ha ○ N2MS4 = 4.59 ha ○ N2MS5 = 15.53 (habitat considered less valuable to the species due to the lack of trees). Species moderately to highly likely to occur but not detected during surveys. Impacts to associated habitat across whole proposed modification include: • *Polygala linariifolia*, *Pterostylis cobarensis*, *Tylophora linearis* = 8.21 ha • *Cyperus conicus* = 24.67 ha • *Diuris tricolor* = 17.72 ha • *Lepidium aschersonii* = 12.62 ha • *Sida rohlenae* = 13.04 ha • *Lepidium monoplocoides* = 29.26 ha • *Swainsona murrayana* = 49.17 ha • *Swainsona sericea* = 28.36 ha	Permanent	• Clearing of native vegetation
Aquatic impacts	Purple Spotted Gudgeon	A reduction in population size and extent Decreased movement ability	Difficult to quantify	Long term	• Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands
Injury and mortality of fauna	Threatened microbats Threatened reptiles Threatened small terrestrial mammals Threatened woodland birds (nestlings)	A reduction in population size	Difficult to quantify	Long term	-

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposed modification constitute or exacerbate a key threatening process?
	Threatened arboreal mammals Purple Spotted Gudgeon (if draining of water required)				
Fragmentation of identified biodiversity links and habitat corridors	Threatened reptiles Threatened terrestrial mammals Threatened plants	Reduced genetic interaction of sub-populations Reduced ability for species to re-establish after local extinction.	Difficult to quantify	Long term	-
	Threatened ecological communities	Reduced ecosystem functionality due to reduced ability for component species to re-establish after local extinction.	Difficult to quantify		
Edge effects on adjacent native vegetation and habitat	All threatened species and communities	A reduction in habitat condition due increased light and wind penetration and other changes to microclimatic conditions	Difficult to quantify	Long term	-
Invasion and spread of weeds	Threatened terrestrial animals	A reduction in habitat condition changes to floristics and vegetation structure	Difficult to quantify	Long term	• Invasion and establishment of exotic vines and scramblers • Invasion of native plant communities by African Olive (*Olea europaea* L. subsp. *cuspidata)* • Invasion of native plant communities by exotic perennial grasses
	Threatened plants	A reduction in habitat condition due competitive exclusion of native species			

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposed modification constitute or exacerbate a key threatening process?
Invasion and spread of pests	Unlikely to occur with adequate mitigation	N/A	N/A	Long term	N/A
Invasion and spread of pathogens and disease	Unlikely to occur with adequate mitigation	N/A	N/A	Long term	• Infection of native plants by *Phytophthora cinnamomi* • Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae • Infection of frogs by amphibian chytrid causing the disease chytridiomycosis
Noise, light and vibration	Minimal impact with adequate mitigation	N/A	N/A	Short term	-
Groundwater dependent ecosystems	All threatened species habitat and communities	N/A	Difficult to quantify	Permanent	N/A

5 Avoid, minimise and mitigate impacts

This supplementary assessment has concluded no additional management measures are required and those provided BAR are relevant to the proposed modification. Refer to the BAR (Jacobs, 2018) for a further discussion on these matters.

6 Biodiversity offsets

6.1 Offset requirements

Although efforts have been made to avoid, minimise and mitigate potential ecological impacts from the proposed modification, some residual impacts would occur.

The Roads and Maritime *Guideline for Biodiversity Offsets* (November 2016) indicates offsets are required where clearing of threatened communities and/or habitat for threatened species exceeds set thresholds.

In addition, this biodiversity assessment identifies that the proposed modification is likely to have a significant impact on threatened biodiversity listed under EPBC Act (see Section 4.5 and Appendix B and C). TfNSW would provide biodiversity offsets or where offsets are not reasonable or feasible, supplementary measures for impacts that exceed the thresholds in Table 6.1.

Refer to Jacobs (2018) for a summary offsetting context.

The amounts of each vegetation type proposed for offsetting are shown in Table 6.1.

Table 6-1 TfNSW offset thresholds

Description of activity or impact	Offsets required	Vegetation proposed to be offset
Activities in accordance with Transport for New South Wales Environmental assessment procedure: Routine and Minor Works (RTA 2011)	No	N/A
Works on cleared land, plantations, exotic vegetation where there are no threatened species or habitat present	No	None Applies to areas mapped as 'not native'.
Works involving clearing of vegetation planted as part of a road corridor landscaping program (this includes where threatened species or species comprising listed ecological communities have been used for landscaping purposes)	No	None Applies to the planted eucalypts vegetation only
Works involving clearing of national or NSW listed critically endangered ecological communities (CEEC)	Where there is any clearing of a CEEC in moderate to good condition	Applies to the 16.22 hectares of *Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland* community (PCT 52) listed as Critically endangered under the EPBC Act.
Works involving clearing of nationally listed threatened ecological community (TEC) or nationally listed threatened species habitat	Where clearing >1 ha of a TEC or habitat in moderate to good condition	Applies to the following TECs: • Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (Critically Endangered – EPBC Act) (PCT 52 - 16.22 ha). • Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions (Endangered – EPBC & BC Act) (2.04 ha including PCT 147 – 0.11 ha and PCT 55 – 1.93 ha) • Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW (Preliminary Endangered – EPBC Act) 8.34 ha of PCT 64

Description of activity or impact	Offsets required	Vegetation proposed to be offset
		Also applies to the following PCTs in moderate to good condition that are not TECs but are threatened species habitat: • Poplar Box - White Cypress Pine woodland (9.38 ha).
Works involving clearing of NSW endangered or vulnerable ecological community	Where clearing > 5 ha or where the ecological community is subject to an SIS	Does not apply.
Works involving clearing of NSW listed threatened species habitat where the species is a species credit species as defined in the OEH Threatened Species Profile Database (TSPD)	Where clearing >1 ha or where the species is the subject of an SIS	Applies to the habitat of multiple species and includes the TECs and some better condition areas of non-threatened vegetation types. • Belah woodland (1.93 ha - intact, 0.32 ha - derived) • Brigalow viney scrub open forest (1.47 ha - intact, 0.87 -derived) • Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact) • Weeping Myall open woodland (0.9 ha - intact, 14.42 ha - derived)
Works involving clearing of NSW listed threatened species habitat where the species is an ecosystem credit species as defined in the OEH Threatened Species Profile Database (TSPD)	Where clearing >5 ha or where the species is the subject of an SIS	Applies to the habitat of multiple species and includes the TECs and some better condition areas of non-threatened vegetation types: • Belah woodland (1.93 ha - intact) • Brigalow viney scrub open forest (1.47 ha - intact) • Mock Olive - Wilga - Peach Bush - Carissa (0.11 ha) • Poplar Box - Belah woodland (8.34 ha - intact) • Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact) • Queensland Bluegrass +/- Mitchell Grass (16.22 ha) • Weeping Myall open woodland (3.17 ha - intact).
Type 1 or Type 2 key fish habitats (as defined by NSW Fisheries)	Where there is any net loss of habitat	Applies to predicted habitat of the Purple Spotted Gudgeon and Eel-tailed Catfish. To be calculated based on the detailed design. Estimated at around 0.03 ha in total based on around 50 square metres of net loss of habitat at each of six culvert extension locations affecting predicted habitat for the Purple Spotted Gudgeon.

For aquatic biodiversity listed under the FM Act, offsets are to be provided in accordance with DPI's Policy and Guidelines for Fish Habitat Conservation and Management (Update 2013).

The precise extent and nature of offsets required will be determined as the detailed design progresses and based on the final design and impacts of the proposed modification.

6.2 Biodiversity offsets

The offset requirement for the REF projects would be:

- Loss of threated ecological community 4:1 (for offset areas in moderate to good condition) or 8:1 for offset areas in poor condition). See Table 6-1 for TEC / EECs triggering consideration for offsetting.
- Loss of threatened fauna species 3:1. See Table 6-1 for triggering consideration of fauna habitat for offsetting.
- Loss of threatened flora species 3:1. Forty-eight Belson's Panic (*Homopholis belsonii*) and seven Finger Panic Grass (*Digitaria porrecta*) are affected by the proposed modification.

A Biodiversity Offset Strategy is required to document how the offsetting will be delivered.

6.2.1 Availability of offsets

The biodiversity offsets for the proposed modification will be dependent on whether or not there are areas containing the relevant species and communities available in the relevant bioregions for dedication as offsets. Such land may include:

- Lands under the control of Transport for New South Wales
- Travelling Stock Reserves
- Pastoral leasehold lands.

6.2.2 Opportunities for undertaking supplementary actions

There may be opportunities to undertake supplementary actions to benefit some of the affected species. Such activities may include:

- Seed collection, germination
- Strategic restoration of native vegetation to enhance local and regional scale habitat connectivity, e.g. on crown lands (e.g. travelling stock reserves and roadsides) and on private land (e.g. along waterways).
- Undertaking research on the distribution and ecology of poorly-known species.

7 Conclusion

This addendum biodiversity assessment has investigated potential impact to terrestrial and aquatic flora and fauna associated with the proposed modification. The investigation has involved desktop investigation and field surveys to build on the BAR. Refer to the BAR (Jacobs, 2018).

Based on the preferred design, the estimated clearing of native vegetation for the proposed modification as a whole is about 75.92 hectares. This includes about 7.45 hectares of state listed TECs (10 per cent of the vegetation loss) and 28.97 hectares of nationally listed TECs (38 per cent of the vegetation loss). Around 16.22 hectares of the critically endangered Natural Grasslands ecological community would be directly impacted in N2MS5. The assessment identifies the loss of vegetation and TECs relevant to each proposed modification segment proposed, in order to provide data that may be used to further avoid and minimise impacts to vegetation.

Three threatened species of plant were recorded in the proposed modification area and broader study area:

- *Homopholis belsonii* (Belson's Panic) (Vulnerable EPBC Act, Endangered BC Act)
- *Desmodium campylocaulon* (Creeping Tick-trefoil) (Endangered BC Act)
- *Digitaria porrecta* (Finger Panic Grass) (Endangered BC Act).

A further nine threatened flora species are considered at least moderately likely to occur based on the presence of suitable habitat.

Three threatened fauna species were recorded in the study area:

- Little Eagle (Vulnerable BC Act)
- Grey-crowned Babbler eastern sub species (Vulnerable BC Act)
- Glossy Black-cockatoo (Vulnerable BC Act).

A further 32 threatened fauna species are considered at least moderately likely to occur based on the presence of suitable habitat.

The biodiversity assessment identifies the loss of individuals and habitat for these listed species relevant to each proposed modification segment proposed, in order to provide data that may be used to further avoid and minimise impacts to threatened species.

An assessment of significance was prepared in accordance with the BC Act (Section 7.3) and EPBC Act (Significant Impact Guidelines 1.1) for each of the identified threatened species and ecological communities.

Assessments of significance prepared in accordance with the BC Act (Section 7.3) concluded, according to the relevant criteria, the proposed modification would not have a significant impact on the affected species and communities. With regard to recorded threatened plants, the assessments concluded:

- *Homopholis belsonii* (Endangered BC Act) occurs as three populations within the study area. The assessment of significance was managed by engaging a subject matter specialist. The population within N2MS2 were substantially impacted by an unrelated activity where an adjoining landholder replaced an agricultural fence line in which the population occurred. As a result of this the proposed modification will no longer affect that population. Planned design refinement of the proposed modification and other mitigation measures are likely to reduce impact to residual habitat for the species (also taking into account its ability to naturally recover from the soil seedbank) such an extent that they would not be significant. Impact on the other two populations in the study area are considered unlikely to be significant as surveys have demonstrated these populations are large and extend well beyond the proposed modification

- Impact to the other two recorded threatened plant species, *Digitaria porrecta* (Endangered BC Act) and *Desmodium campylocaulon* (Endangered BC Act), are considered unlikely to be significant, as surveys have demonstrated the local viable population of these species is large and extends well beyond the proposed modification
- Potential impact to threatened bird species recorded are not likely to be significant as the edge habitat which would be removed is unlikely to be important for breeding and is only likely to be moderately important for foraging, movement and shelter.
- Potential impact to five-clawed worm-skink (Endangered BC Act) was managed by engaging a subject matter specialist. This process confirmed five-clawed worm-skink or suitable habitat is unlikely to be affected by the proposed modification.

No additional waterways within the study area will be affected by the proposed modification. An assessment of significance was prepared in accordance with the FM Act for each of the identified threatened species and the aquatic ecological community in the BAR and concluded it is unlikely to have a significant impact on the two aquatic species and the aquatic ecological community considered. This supplementary assessment agrees with those conclusions.

Assessment of relevant species and communities under the EPBC Act significance criteria identified a likely significant impact for one ecological community:

- *Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland* (Critically Endangered Act– EPBC): Almost entirely restricted to N2MS5. The proposed modification would remove 16.22 hectares of this community and 39.26 hectares within 1500 metres (the local viable population) would remain unaffected.

The TfNSW Strategic Assessment: *Environment Protection and Biodiversity Conservation Act 1999* negate the requirement to refer significant impacts to nationally listed species, ecological communities and migratory species to the Federal Department of the Environment and Energy. In accordance with the strategic assessment, this proposed modification has applied the “avoid, minimise, mitigate and offset” hierarchy.

Opportunities to avoid and minimise impact to biodiversity have been realised as the detailed design was developed. However residual impact to biodiversity would occur, mitigation measures are needed during construction and operational phases to lessen potential impact to biodiversity. The TfNSW *Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects* (NSW Roads and Traffic Authority, 2011a) identify a range of mitigation techniques to be applied and these techniques must be implemented during construction.

It is TfNSW policy for biodiversity offsets (or where offsets are not reasonable or feasible, supplementary measures) to be provided for any impact exceeding predetermined thresholds. The work involves clearing of habitat for threatened species and areas of threatened ecological communities in moderate to good condition. As such, offsets (or supplementary measures) are warranted. In addition, this biodiversity assessment identifies that the proposed modification is likely to have a significant impact on a critically endangered ecological community listed under the EPBC Act. Offsets for this matter will be provided on a ‘like-for-like’ basis in accordance with the strategic assessment.

A biodiversity offset package is recommended to be prepared for the proposed modification.

8 References

BAREA, L. P. 2008. Nest-site selection by the Painted Honeyeater (Grantiella picta), a mistletoe specialist. Emu, 108(3), 213-220.

BAREA, L. P. AND WATSON, D. M. 2007. Temporal variation in food resources determines onset of breeding in an Australian mistletoe specialist. Emu 107: 203–209.

BRIGALOW BELT REPTILES WORKSHOP 2010. Proceedings from the workshop for the nine listed reptiles of the Brigalow Belt bioregions. 18-19 August. Brisbane: Queensland Herbarium.

COGGER, H.G., E.E. CAMERON, R.A. SADLIER & P. EGGLER 1993. The Action Plan for Australian Reptiles. Canberra, ACT: Australian Nature Conservation Agency. Available from: http://www.environment.gov.au/biodiversity/threatened/action/reptiles/index.html.

COMMONWEALTH OF AUSTRALIA 2011. Draft Referral guidelines for the nationally listed Brigalow Belt reptiles. Available from: http://www.environment.gov.au/resource/epbc-act-draft-referral-guidelines-nationally-listed-brigalow-belt-reptiles

COMMONWEALTH OF AUSTRALIA 2014. EPBC Act Referral Guidelines for the vulnerable koala (combined populations of Queensland, New South Wales and the Australian Capital Territory).

COURTNEY, J. & DEBUS, S. 2006. Breeding habits and conservation status of the Musk Lorikeet *Glossopsitta concinna* and Little Lorikeet *G. pusilla* in Northern New South Wales. *Australian Field Ornithology,* 23**,** 109-124.

DEPARTMENT OF ENVIRONMENT 2013. Matters of National Environmental Significance, Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999. Canberra, ACT: Commonwealth of Australia.

DEPARTMENT OF THE ENVIRONMENT AND ENERGY (2018) Species Profile and Threats Database. Anomalopus mackayi — Five-clawed Worm-skink, Long-legged Worm-skink. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?showprofile=Y&taxon_id=25934

DEPARTMENT OF ENVIRONMENT AND CLIMATE CHANGE 2007. Threatened species assessment guidelines. The assessment of significance. Hurstville: Department of Environment and Climate Change.

DEPARTMENT OF ENVIRONMENT AND CLIMATE CHANGE 2008. Recovery Plan for the Koala (Phascolarctos cinereus) (Approved). Sydney: Department of Environment and Climate Change.

DEPARTMENT OF ENVIRONMENT CLIMATE CHANGE AND WATER 2009. Draft National Recovery Plan for the Grey-headed Flying-fox *Pteropus poliocephalus*. Sydney: Department of Environment, Climate Change and Water.

DEPARTMENT OF ENVIRONMENT CLIMATE CHANGE AND WATER 2010. Cumberland Plain Recovery Plan. *In:* DEPARTMENT OF ENVIRONMENT, C. C. A. W. (ed.). Sydney: Department of Environment, Climate Change and Water.

DEPARTMENT OF THE ENVIRONMENT AND ENERGY. 2017. *Finalised priority assessment lists* [Online]. Canberra: Australian Government. Available:

http://www.environment.gov.au/biodiversity/threatened/assessments/fpal [Accessed 14/11/2017.

FAHRIG, L. 2002. Effects of habitat fragmentation on the extinction threshold: a review. *Ecological Applications,* 12**,** 346-352.

FAIRFULL, S. & WITHERIDGE, G. 2003. Why do fish need to cross the road? Fish passage requirements for waterway crossings. Cronulla: NSW Fisheries.

GALL, B.C. 1980. Aspects of the ecology of the koala Phascolarctos cinereus (Goldfuss) in Tucki Tucki Nature Reserve, New South Wales. Australian Wildlife Research. 7:167-176.

GARNETT, S. T., SZABO, J. K. AND DUTSON, G. 2011. The Action Plan for Australian Birds 2010. Birds Australia, CSIRO Publishing, Melbourne.HIGGINS, P. J. (ed.) 1999. *Handbook of Australian, New Zealand and Antarctic Birds Volume 4: Parrots to Dollarbirds,* Melbourne: Oxford University Press.

JACOBS 2018. Supplementary Biodiversity Assessment Report - Narrabri to Moree: NSW Roads and Maritime Services.

JURSKIS, V. & M. POTTER 1997. Koala surveys, ecology and conservation at Eden. Sydney, NSW: Forest Research and Development Division, State Forests of New South Wales.

KUGINIS, L., BYRNE, G., SEROV, P. & WILLIAMS, J. P. 2012. Risk assessment guidelines for groundwater dependent ecosystems Volume 3 – Identification of high probability groundwater dependent ecosystems on the coastal plains of NSW and their ecological value. Sydney: Department of Primary Industries, Office of Water.

NSW DEPARTMENT OF PRIMARY INDUSTRIES 2013. Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 upate).

NSW DEPARTMENT OF PRIMARY INDUSTRIES 2017. Southern Purple Spotted Gudgeon - Mogurnda adspersa July 2017, Primefact 1275, Second edition. Threatened Species Unit.

NSW ROADS AND TRAFFIC AUTHORITY 2011a. Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects. Sydney: NSW Roads and Traffic Authority.

NSW ROADS AND TRAFFIC AUTHORITY 2011b. Protecting and managing biodiversity on RTA projects. Sydney: RTA Environment Branch.

OFFICE OF ENVIRONMENT AND HERITAGE 2015. BRG-Namoi Regional Native Vegetation Mapping. Sydney: NSW Office of Environment and Heritage.

OFFICE OF ENVIRONMENT AND HERITAGE 2016. NSW Guide to Surveying Threatened Plants Sydney: NSW Office of Environment and Heritage.

OFFICE OF ENVIRONMENT AND HERITAGE 2017a. Biodiversity Assessment Method. Sydney: State of New South Wales.

OFFICE OF ENVIRONMENT AND HERITAGE. 2017b. *BioNet Vegetation Classification* [Online]. NSW Office of Environment and Heritage. Available: http://www.environment.nsw.gov.au/NSWVCA20PRapp/default.aspx [Accessed 08/08/2015.

OFFICE OF ENVIRONMENT AND HERITAGE. 2017c. *Preliminary determinations by date* [Online]. NSW Government. Available:

http://www.environment.nsw.gov.au/committee/preliminarydeterminationsbydate.htm [Accessed Page last updated: 28 August 2017.

ROYAL AUSTRALIAN ORNITHOLOGISTS UNION 2003. *The New Atlas of Australian Birds*, Royal Australian Ornithologists Union, Hawthorn East, Victoria.

SAUNDERS, D. L. & TZAROS, C. L. 2011. National Recovery Plan for the Swift Parrot Lathamus discolor. Melbourne: Birds Australia.

SPARK, P. (2010). Survey of the Habitat Requirements and Review of the Conservation Status of the Five-clawed Worm-skink (Anomalopus mackayi) within the Namoi River Catchment. Report to the Namoi Catchment Management Authority: Threatened Grassland Reptile Species Project, Tamworth. Tamworth, NSW: North West Ecological Services.

STRAHAN, R. (ed.) 1995. The Mammals of Australia. Australian Museum and Reed Books, Sydney.

TAYLOR, R., 2014. A Survey of the Pale Imperial Hairstreak Butterfly Jalmenus eubulus in New South Wales. Australian zoologist, 37(2), pp.248-255.

THACKWAY, R. & CRESSWELL, I. D. 1995. *An Interim Biogeographic Regionalisation of Australia,* Canberra, Australian Nature Conservation Agency.

THREATENED SPECIES SCIENTIFIC COMMITTEE 2008. Commonwealth Conservation Advice on *Eucalyptus nicholii*. Canberra: Department of the Environment, Water, Heritage and the Arts.

THREATENED SPECIES SCIENTIFIC COMMITTEE 2017. Guidelines for assessing the conservation status of native species according to the *Environment Protection and Biodiversity Conservation Act 1999* and *Environment Protection and Biodiversity Conservation Regulations 2000*. https://www.environment.gov.au/system/files/pages/d72dfd1a-f0d8-4699-8d43-5d95bbb02428/files/tssc-guidelines-assessing-species-2017.pdf

WSP 2017. Newell Highway Upgrade: Narrabri to Moree Preliminary Ecological Investigation. Sydney.

Appendix A – Habitat assessment table

Likelihood of occurrence criteria

Likelihood	Criteria
Recorded	The species was observed in the study area during the current survey
High	It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods such as winter flowering resources), has been recorded recently in the locality (30km) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Moderate	Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however, may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent (i.e. for breeding or important life cycle periods such as winter flowering resources) on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.
Low	It is unlikely that the species inhabits the study area and has not been recorded recently in the locality (30km). It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent (i.e. for breeding or important life cycle periods such as winter flowering resources) on available habitat. Specific habitat is not present in the study area or the species are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
None	Suitable habitat is absent from the study area.

Habitat assessment table – Threatened Flora

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Records or modelled in the locality (number of records)	Associated with relevant IBRA subregions	Likelihood of occurrence
Acacia jucunda	Yetman Wattle	-	E	Yetman Wattle is found in the Yetman district near the Queensland border on the North West Slopes of NSW. It also occurs in Queensland where it is reasonably common. Acacia jucunda abundance in populations has been recorded as locally occasional, locally common and frequent, with one population noted as being about 0.5 hectares in extent. Mainly restricted to dry eucalypt woodland communities on sandy to sandy-loam soils. In Queensland, the species is found in dry ranges on loams or clay-loams in eucalypt communities. Associated species at the NSW sites include Acacia polybotrya and Callitris endlicheri.	-	Northern Basalts	Low – species not known from locality but is predicted for IBRA subregion. There is only a small amount of suitable habitat in the study area and the species has a very restricted known distribution in NSW. Associated habitat on site includes: Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35).
Acacia pycnostachya	Bolivia Wattle	V	V	Two extensive populations exist in the vicinity of Bolivia Hills and Bluff River Nature Reserves south of Tenterfield, and on nearby private land. Smaller populations have been found west of Tenterfield on private land and the species may be more widespread than is currently documented. The plant tends to occur in patches although sparsely distributed individuals are common at Bolivia Hills. Acacia pycnostachya grows in dry sclerophyll forest amongst granite outcrops, on hillsides at altitudes of 700 to 900 m. Soil types range from acid volcanic to sandy and skeletal on exposed outcrops, to shallow sandy loams in less exposed sites. It often grows in stands in areas sheltered from fire.	-	Northern Basalts	None – species is known from a relevant IBRA subregion but is not known from the locality and associated habitat is absent from the study area unsuitable.
Androcalva procumbens (*Commersonia procumbens*)	-	V	V	Endemic to NSW, mainly confined to the Dubbo-Mendooran-Gilgandra region, but also in the Pilliga and Nymagee areas. Recent collections made from the Upper Hunter region, and additional populations found in Goonoo SCA in response to the 2007 fires. Grows in sandy sites, often along roadsides. Recorded in *Eucalyptus dealbata* and *Eucalyptus sideroxylon* communities, *Melaleuca uncinata* scrub, under mallee eucalypts with a *Calytrix tetragona* understorey, and in a recently burnt Ironbark and Callitris area. Also, in *Eucalyptus fibrosa* subsp. *nubila*, *Eucalyptus dealbata*, *Eucalyptus albens* and *Callitris glaucophylla* woodlands north of Dubbo.	PMST	-	Low – species recorded from Mount Kaputar National Park approximately 30km to the east and further south in the Pilliga. A small amount of potential though likely marginal habitat is present. Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397).

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Records or modelled in the locality (number of records)	Associated with relevant IBRA subregions	Likelihood of occurrence
				Other associated species include *Acacia triptera*, *Callitris endlicheri*, *Eucalyptus melliodora*, *Allocasuarina diminuta*, *Philotheca salsolifolia*, *Xanthorrhoea species*, *Exocarpos cupressiformis*, *Leptospermum parvifolium* and *Kunzea parvifolia*.			
Austrostipa metatoris	A spear-grass	V	V	Recorded in the Murray Valley with sites including Cunninyeuk Station, Stony Crossing, Kyalite State Forest (now part of Murrumbidgee Valley Regional Park) and Lake Benanee; scattered records also in central NSW including Lake Cargelligo, east of Goolgowi, Condobolin and south west of Nymagee. Otherwise only known from near Bordertown in south east South Australia. Grows in sandy areas of the Murray Valley; habitats include sandhills, sand ridges, undulating plains and flat open mallee country, with red to red-brown clay-loam to sandy-loam soils. Associated species include Eucalyptus populnea, E. intertexta, Callitris glaucophylla, Casuarina cristata, Santalum acuminatum and Dodonaea viscosa.	Associated PCT/s only	-	Low– associated PCTs present but the species is not known or predicted to occur in the bioregion. Associated habitat on site includes: Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56)
Austrostipa wakoolica	A spear-grass	E	E	Confined to the floodplains of the Murray River tributaries of central-western and south-western NSW, with localities including Manna SF, Matong, Lake Tooim, Merran Creek, Tulla, Cunninyeuk and Mairjimmy State Forest (now part of South West Woodland Nature Reserve). Grows on floodplains, in open woodland on grey, silty clay or sandy loam soils; habitats include the edges of a lignum swamp with box and mallee; creek banks in grey, silty clay; mallee and lignum sandy-loam flat; open Cypress Pine forest on low sandy range; and a low, rocky rise. Associated species include Callitris glaucophylla, Eucalyptus microcarpa, E. populnea, Austrostipa eremophila, A. drummondii, Austrodanthonia eriantha and Einadia nutans.	Associated PCT/s only	-	Low – associated PCTs present but the species is not known or predicted to occur in the bioregion. Associated habitat on site includes: Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56) Weeping Myall open woodland (PCT 27)
Bertya opponens	Coolabah Bertya	V	V	This plant is currently known from only four scattered sites in NSW: one from private property near Coolabah in western NSW and two to the south of Narrabri on the North West Slopes, including the largest population in Jacks Creek State Forest. Coolabah Bertya occurs in a range of habitats including stony mallee ridges and cypress pine forest on red	135 – OEH PMST	-	Low – all records of this species are from Jacks Creek to the south of Narrabri. The study area contains only a small amount of possibly suitable habitat and the species was not recorded

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Records or modelled in the locality (number of records)	Associated with relevant IBRA subregions	Likelihood of occurrence
				soils. The wide variation in habitat type between the populations makes the identification of critical habitat very difficult. Consideration of disturbance regimes and grazing management are probably more important to the survival of populations in the long term. Associated species at Jacks Creek State Forest include Eucalyptus chloroclada, Callitris glaucophylla and Eucalyptus fibrosa.			during surveys despite being quite conspicuous. Associated habitat on site includes: Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397).
Capparis canescens	Wild Orange	-	E	Occurs in eastern Queensland and has recently been confirmed as occurring in north-western NSW. The species was known in NSW from a single population about 20 km NNW of Bonshaw and 50 km north of Ashford, however this population is reported to have recently been cleared by roadworks. Seven plants are said to still survive at the site. Grows in open eucalypt forest. Associated species include Eucalyptus sideroxylon and E. microcarpa woodland on siliceous sediments. Associated species at Queensland sites include E. dealbata, E. microtheca, E. crebra, E. fibrosa subsp. nubila, E. melanophloia, Callitris glaucophylla, Allocasuarina luehmannii, Lysiphyllum cunninghamii and Acacia and Alphitonia species.	-	Northern Basalts	None – species not known from locality. Habitat in study area unsuitable.
Cyperus conicus		-	E	Occurs rarely in the Pilliga area of NSW and is also found in Victoria, Qld, the NT and WA. Grows in open woodland on sandy soil. In central Australia, the species grows near waterholes and on the banks of streams in sandy soils. In Qld the species usually found on heavy soils. Recorded from Callitris forest in the Pilliga area, growing in sandy soil with Cyperus gracilis, C. squarrosus and C. fulvus. Interstate habitats include floodplains, creek beds and banks, swamps, run-on areas and various watercourses, near or in dams and bores, and in vegetation communities such as Melaleuca swamps, open Box woodland and sedgelands. Soils are usually sandy or silty and damp to wet.	2 – OEH	Northern Outwash Northern Basalts	**Moderate**. Recorded in the locality and associated habitat is present. Associated habitat on site includes: • Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) • Belah woodland on alluvial plains and low rises (PCT 55) • Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56) • Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628)
Desmodium campylocaulon	Creeping Tick-trefoil	-	E	Occurs chiefly in the Collarenebri and Moree districts in the north-western plains of NSW. Also occurs in the NT and Darling Downs district of south-eastern Queensland.	53 – OEH	Northern Outwash	**Recorded**; in the study area of N2MS5 during field surveys.

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Records or modelled in the locality (number of records)	Associated with relevant IBRA subregions	Likelihood of occurrence
				Creeping Tick-Trefoil is confined to clay soils, usually with Astrebla and Iseilema species. In NSW Desmodium campylocaulon grows on cracking black soils in the Narrabri, Moree and Walgett local government areas. Associated species include Acacia harpophylla, Astrebla pectinata and Sorghum, Dichanthium and Panicum species.		Northern Basalts	Probable elsewhere in associated habitat. Associated habitat on site includes: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Weeping Myall open woodland (PCT 27) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35)
Dichanthium setosum	Bluegrass	V	V	Dichanthium setosum has been reported from mid-coastal to inland NSW and Queensland. Dichanthium setosum occurs on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW, extending west to Narrabri. Dichanthium setosum is associated with heavy basaltic black soils and red-brown loams with clay subsoil.	4 – OEH PMST	Northern Outwash Northern Basalts	Low – The most recent record was dated from the 1800s. While suitable habitat is widespread it has not been recorded in modern history. Associated potential habitat in the study area includes: Weeping Myall open woodland (PCT 27) Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56) Belah woodland on alluvial plains and low rises (PCT 55) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628)

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Records or modelled in the locality (number of records)	Associated with relevant IBRA subregions	Likelihood of occurrence
Digitaria porrecta	Finger Panic Grass	-	E	Finger Panic Grass occurs in NSW and Queensland. In NSW it is found on the North West Slopes and Plains, from near Moree south to Tambar Springs and from Tamworth to Coonabarabran. It largely occurs on private land. In NSW, the most frequently recorded associated tree species are Eucalyptus albens and Acacia pendula. Common associated grasses and forbs in NSW sites include Austrostipa aristiglumis, Enteropogon acicularis, Cyperus bifax, Hibiscus trionum and Neptunia gracilis. Flowering season is summer or late summer from mid-January to late February, with seeds maturing and falling from the plant soon after. Native grassland, woodlands or open forest with a grassy understorey, on richer soils. Often found along roadsides and travelling stock routes where there is light grazing and occasional fire.	31 – OEH	Northern Outwash Northern Basalts	**Recorded** in the study areas of N2MS2, N2MS4 and N2MS5 during field surveys. Associated habitat on site includes: Weeping Myall open woodland (PCT 27) Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628)
Diuris tricolor	Pine Donkey Orchid	-	V	Sporadically distributed on the western slopes of NSW, extending from south of Narrandera all the way to the north of NSW. Localities in the south include Red Hill north of Narrandera, Coolamon, and several sites west of Wagga Wagga. Condobolin-Nymagee road, Wattamondara towards Cowra, Eugowra, Girilambone, Dubbo and Cooyal, in the Central West. Pilliga SCA, Pilliga National Park and Bibblewindi State Forest in the north and Muswellbrook in the east. Disturbance regimes are not known, although the species is usually recorded from disturbed habitats. Associated species include Callitris glaucophylla, Eucalyptus populnea, Eucalyptus intertexta, Ironbark and Acacia shrubland. The understorey is often grassy with herbaceous plants such as Bulbine species. Usually flowers between early September to late October. The species is a tuberous, deciduous terrestrial orchid and the flowers have a pleasant, light sweet scent. The Pine Donkey Orchid grows in	-	Northern Basalts	**Moderate** – species not known from locality but is known from a relevant IBRA subregion and study area contains potential habitat. Survey timing was not suitable for detection of this species. Associated habitat on site includes: Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56).

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Records or modelled in the locality (number of records)	Associated with relevant IBRA subregions	Likelihood of occurrence
				sclerophyll forest among grass, often with native Cypress Pine (Callitris spp.). It is found in sandy soils, either on flats or small rises. Also recorded from a red earth soil in a Bimble Box community in western NSW.			
Eleocharis obicis	A Spike-Rush	V	V	Found relatively recently near Condobolin and Hay, with an old collection from the Barrier Range near Broken Hill. The more recent collection was made on the Lachlan River floodplain at Micabil, near Condobolin. Grows in ephemerally wet situations such as roadside mitre drains and depressions, usually in low-lying grasslands. Sites include depressions with heavy clay soils on the Lachlan River floodplain, with Eragrostis australasica, Atriplex vesicaria and A. nummularia shrublands, low-lying claypans near an irrigation channel, and a shallow open ditch on a low ridge with Eucalyptus populnea in red sandy soil over clay. Recorded as flowering in November. Found to be locally frequent to abundant in western NSW populations.	Associated PCT/s only	-	None– associated PCTs present but the species is not known or predicted to occur in the bioregion. Associated habitat on site includes: Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56)
Hakea pulvinifera	Lake Keepit Hakea	E	E	Lake Keepit Hakea is confined to the North West Slopes of NSW, where it is known from a single population near Lake Keepit, north-east of Gunnedah. Associated species at the site include Alstonia constricta and Acacia decora also prevalent as shrubs. A sparse cover of grasses and forbs forms a ground layer but at least fifty percent of the site is bare earth or rock. The most common ground cover species is the introduced plant Petrorhagia nanteuilii. Other common species are the grasses Themeda australis, Cymbopogon obtectus and Aristida species.	-	Northern Basalts	None – species only known to occur in Lake Keepit locality. The study area does not contain suitable habitat.
Homopholis belsonii	Belson s Panic	V	E	It occurs on the northwest slopes and plains of NSW, mostly between Wee Waa, Goondiwindi and Glen Innes. It also occurs in Queensland, mainly in the Brigalow Belt South bioregion. Grows in dry woodland (e.g. Belah) often on poor soils, although sometimes found in basalt-enriched sites north of Warialda and in alluvial clay soils. Habitat and ecology appear to be poorly known.	14 – OEH PMST	Northern Outwash Northern Basalts	**Recorded**; found in the study areas of N2MS2 and N2MS4 during field surveys in a variety of PCTs. Associated habitat on site includes: Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35)

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Records or modelled in the locality (number of records)	Associated with relevant IBRA subregions	Likelihood of occurrence
							Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (PCT 147) Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Weeping Myall open woodland (PCT 27)
Lepidium aschersonii	Spiny Peppercress	V	V	Not widespread, occurring in the marginal central-western slopes and north-western plains regions of NSW (and potentially the south western plains). Found on ridges of gilgai clays dominated by Brigalow (Acacia harpophylla), Belah (Casuarina cristata), Buloke (Allocasuarina luehmanii) and Grey Box (Eucalyptus microcarpa). In the south has been recorded growing in Bull Mallee (Eucalyptus behriana). Often the understorey is dominated by introduced plants. The species grows as a component of the ground flora, in grey loamy clays. Vegetation structure varies from open to dense, with sparse grassy understorey and occasional heavy litter.	84 – OEH PMST	Northern Outwash Northern Basalts	**Moderate** – recorded in the locality and suitable habitat are found in study area. Associated habitat on site includes: Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56)
Lepidium monoplocoides	Winged Peppercress	E	E	Widespread in the semi-arid western plain's regions of NSW. Collected from widely scattered localities. Occurs on seasonally moist to waterlogged sites, on heavy fertile soils. Predominant vegetation is usually an open woodland dominated by Allocasuarina luehmannii (Bulloak) and/or eucalypts, particularly Eucalyptus largiflorens (Black Box) or Eucalyptus populnea (Poplar Box). The field layer of the surrounding woodland is dominated by tussock grasses. Recorded in a wetland-grassland community comprising Eragrostis australasicus, Agrostis avenacea, Austrodanthonia duttoniana, Homopholis proluta, Myriophyllum crispatum, Utricularia dichotoma and Pycnosorus globosus, on waterlogged grey-brown clay. Also recorded from a Maireana pyramidata shrubland.	Associated PCT/s only	-	**Moderate.** Recently recorded near Narrabri and in the Pilliga area. Associated habitat on site includes: Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628)

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Records or modelled in the locality (number of records)	Associated with relevant IBRA subregions	Likelihood of occurrence
Monotaxis macrophylla	Large-leafed Monotaxis	-	E	Recorded from several highly disjunct populations in NSW: eastern edge of Deua NP, Bemboka portion of South East Forests NP, Cobar area (Hermitage Plains), Tenterfield area, Woodenbong, and recently in the eastern spur of the Nandewar Range in the Namoi catchment; also known in Queensland. Its distribution and supposed rarity in NSW are related to the occurrence of fire; in NSW it has not been found in the absence of fire. There is a great diversity in the associated vegetation within NSW, encompassing coastal heath, arid shrubland, forests and montane heath from almost sea level to 1300 m altitude. Plants have a short life span and do not seem to persist longer than six months. It typically grows on rocky ridges and hillsides.	Associated PCT/s only.	-	Low. A small amount of marginal habitat is present but lacks typical microhabitat features (rock outcrops) associated with the species. It has not been recorded in the relevant IBRA subregions. Associated habitat on site includes: Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)
Philotheca ericifolia	-	V	-	Known only from the upper Hunter Valley and Pilliga to Peak Hill districts of NSW. The records are scattered over a range of over 400 km between West Wyalong and the Pilliga Scrub. Site localities include Pilliga East State Forest, Goonoo State Forest, Hervey Range, Wingen Maid Nature Reserve, Toongi, Denman, Rylestone district and Kandos Weir. Grows chiefly in dry sclerophyll forest and heath on damp sandy flats and gullies. It has been collected from a variety of habitats including heath, open woodland, dry sandy creek beds, and rocky ridge and cliff tops. Associated species include *Melaleuca uncinata*, *Eucalyptus crebra*, *E. rossii*, *E. punctata*, *Corymbia trachyphloia*, *Acacia triptera*, *A. burrowii*, *Beyeria viscosa*, *Philotheca australis*, *Leucopogon muticus* and *Calytrix tetragona*. Flowering time is in the spring. Fruits are produced from November to December.	PMST	-	Low – species not known from locality or relevant IBRA subregions. Some areas in study area may offer marginal habitat features. Associated habitat on site includes: Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)
Picris evae	Hawkweed	V	V	Hawkweed is a soft-stemmed annual plant. Known from Inverell area, in the NW slopes and plains regions; collected in and around Inverell, Tamworth and also from Dangar Falls in the Oxley Wild Rivers NP in the northern tablelands. It also occurs in the Darling Downs and Moreton regions of SE Queensland. Its main habitat is open Eucalypt forest including a canopy of Eucalyptus melliodora, E. crebra, E. populnea, E. albens, Angophora subvelutina, Allocasuarina torulosa, and/or Casuarina cunninghamiana with a Dichanthium grassy	Associated PCT/s only	-	Low A substantial area of potential habitat is present, but the species has not been recorded in the relevant IBRA subregions. Associated habitat on site includes: Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Records or modelled in the locality (number of records)	Associated with relevant IBRA subregions	Likelihood of occurrence
				understory. Soils are black, dark grey or red-brown (specified as shallow, stony soil over basalt for one collection) and reddish clay-loam or medium clay soils.			Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628)
Platyzoma microphyllum	Braid Fern	-	E	Recorded in NSW only in the Yetman district. The species is widespread across northern Australia, from WA to the NT, eastern Qld and just into central-northern NSW. Grows in sandy or swampy soils, or in clay soils adjacent to streams and lagoons and subject to periodic flooding. Other associated species include Hakea dactyloides, Brachyloma daphnoides, Jacksonia scoparia, Xylomelum cunninghamii and Calytrix tetragona.	-	Northern Basalts	None – species not known from locality but is known from a relevant IBRA subregion. Habitat in study area is unsuitable.
Polygala linariifolia	Native Milkwort	-	E	North from Copeton Dam and the Warialda area to southern Queensland; also found on the NSW north coast near Casino and Kyogle, and there is an isolated population in far western NSW near Weebah Gate, west of Hungerford. This species also occurs in Western Australia. Sandy soils in dry eucalypt forest and woodland with a sparse understorey. The species has been recorded from the Inverell and Torrington districts growing in dark sandy loam on granite in shrubby forest of *Eucalyptus caleyi*, *Eucalyptus dealbata* and Callitris, and in yellow podsolic soil on granite in layered open forest. In the Pilliga area, this species has been recorded in Fuzzy Box woodland, White Cypress Pine-Bulloak - Ironbark woodland, Rough-barked Apple riparian forb-grass open forest, and Ironbark - Brown Bloodwood shrubby woodland. Other associated species include *Eucalyptus trachyphloia*, *Eucalyptus sphaerocarpa*, *Angophora floribunda*, *Angophora leiocarpa*, *Tristania suaveolens*, *Allocasuarina torulosa* and Wahlenbergia species in the understorey.	2 – OEH	Northern Basalts	**Moderate** – Recorded in the locality and the study area contains some possibly suitable habitat: Associated habitat on site includes: Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397).
Pomaderris queenslandica	*Scant Pomaderris*	-	E	Widely scattered but not common in north-east NSW and in Queensland. It is known from several locations on the NSW north coast and a few locations on the New England Tablelands and North West Slopes, including near Torrington and Coolata. Found in moist eucalypt forest or sheltered	18 – OEH	Northern Basalts	Low – Recorded in the locality but the study area contains only a small amount of possibly suitable habitat and the species was not recorded during surveys despite being quite conspicuous.

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Records or modelled in the locality (number of records)	Associated with relevant IBRA subregions	Likelihood of occurrence
				woodlands with a shrubby understorey, and occasionally along creeks.			Associated habitat on site includes: Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397).
Prasophyllum sp. Wybong (C.Phelps ORG 5269)		CE	-	Endemic to NSW, it is known from near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell, Tenterfield, Currabubula and the Pilliga area. A perennial orchid, appearing as a single leaf over winter and spring. Flowers in spring and dies back to a dormant tuber over summer and autumn. Known to occur in open eucalypt woodland and grassland.	PMST	-	Low – Some areas in study area may offer marginal habitat features but it has not been recorded in the locality or relevant IBRA subregions. Associated habitat on site includes: Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628)
Pterostylis cobarensis	Greenhood Orchid	-	V	Recorded from Bourke, Nyngan, Cobar, Nymagee, Warren, Gilgandra, Narrabri, Coonabarabran districts. Habitats are eucalypt woodlands, open mallee or Callitris shrublands on low stony ridges and slopes in skeletal sandy-loam soils. Associated species include Eucalyptus morrisii, E. viridis, E. intertexta, E. vicina, Callitris glaucophylla, Geijera parviflora, Casuarina cristata, Acacia doratoxylon, Senna spp. and Eremophila spp.	3 – OEH	-	**Moderate** – Recorded in the locality and the study area contains some possibly suitable habitat: Associated habitat on site includes: Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397).
Sida rohlenae	Shrub Sida	-	E	It has a limited distribution in Qld, NT, SA and WA. In NSW, recorded south of Enngonia, south of Bourke and north-west of Coonamble with one collection north of Bourke. It grows on flood-out areas, creek banks and at the base of rocky hills. NSW specimens have been found along roadsides in hard red loam to sandy-loam soils. The species can become locally abundant and is often more common in disturbed sites. Flowers appear in spring and summer.	Associated PCT/s only	-	**Moderate.** Known from the Brigalow Belt south but not the relevant subregions. Associated habitat on site includes: Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628)
Swainsona murrayana	Slender Darling Pea	V	V	Found throughout NSW, it has been recorded in the Jerilderie and Deniliquin areas of the southern riverine plain, the Hay plain as far north as Willandra National Park, near Broken Hill and in various localities between Dubbo and Moree. The species has been collected from clay-based soils, ranging	10 – OEH PMST	Northern Basalts	**Moderate** – Recorded in the locality and the study area contains some possibly suitable habitat. Associated habitat on site includes:

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Records or modelled in the locality (number of records)	Associated with relevant IBRA subregions	Likelihood of occurrence
				from grey, red and brown cracking clays to red-brown earths and loams. Grows in a variety of vegetation types including bladder saltbush, black box and grassland communities on level plains, floodplains and depressions and is often found with Maireana species. Plants have been found in remnant native grasslands or grassy woodlands that have been intermittently grazed or cultivated.			Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Weeping Myall open woodland (PCT 27) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628)
Swainsona plagiotropis	Red Darling Pea	V	V	Occurs in the upper Murray River valley in the south-western plains of NSW and into Victoria. Most NSW records are from the Jerilderie area, with possible collections from the Louth-Bourke area and a disjunct record in the north-western plains from Buttabone Stud Park 35 km NW of Warren. Grows on flat grassland and in heavy red soil, often on roadsides and especially in table drains. Soils are derived from quaternary sediments and are usually red-brown clay-loams. The species is absent from black low-lying soils. Recorded from roadsides, rail reserves, stock routes and areas of lightly grazed unimproved pasture comprising Austrodanthonia, Enteropogon acicularis and Austrostipa grassland communities.	Associated PCT/s only	-	Low – associated PCTs present but the species is not known or predicted to occur in the bioregion. Associated habitat on site includes: Weeping Myall open woodland (PCT 27).
Swainsona sericea	Silky Swainson-pea	-	V	Silky Swainson-pea has been recorded from the Northern Tablelands to the Southern Tablelands and further inland on the slopes and plains. There is one isolated record from the far north-west of NSW. Its stronghold is on the Monaro. Also found in South Australia, Victoria and Queensland. Found in Natural Temperate Grassland and Snow Gum Eucalyptus pauciflora Woodland on the Monaro. Found in Box-Gum Woodland in the Southern Tablelands and South West	-	Northern Basalts	**Moderate** – Not recorded in the locality but associated with a relevant IBRA subregion and the study area contains some possibly suitable habitat. Associated habitat on site includes: Weeping Myall open woodland (PCT 27)

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Records or modelled in the locality (number of records)	Associated with relevant IBRA subregions	Likelihood of occurrence
				Slopes. Sometimes found in association with cypress-pines Callitris spp. Habitat on plains unknown.			Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628)
Thesium australe	Austral Toadflax	V	V	Found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (*Themeda australis*).	PMST	Northern Basalts	Low – species not known from locality but is associated with a relevant IBRA subregion. Some areas in study area may offer marginal habitat.
Tylophora linearis	-	E	V	Majority of records occur in the central western region. Records from Goonoo, Pilliga West, Pilliga East, Bibblewindi, Cumbil and Eura State Forests, Coolbaggie NR, Goobang NP and Beni SCA. Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of Eucalyptus fibrosa, Eucalyptus sideroxylon, Eucalyptus albens, Callitris endlicheri, Callitris glaucophylla and Allocasuarina luehmannii. Also grows in association with Acacia hakeoides, Acacia lineata, Melaleuca uncinata, Myoporum species and Casuarina species.	PMST	Northern Basalts	**Moderate** – Not recorded in the locality but associated with a relevant IBRA subregion and the study area contains some possibly suitable habitat. Associated habitat on site includes: Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)

Habitat assessment table – Threatened Fauna

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Actitis hypoleucos*	Common Sandpiper	M	-	Found along all coastlines of Australia and in many areas inland, the Common Sandpiper is widespread in small numbers. The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats.	PMST	-	Low – species not recorded in locality. Some areas in study area may offer marginal habitat features.
Bird	*Alectura lathami (endangered population)*	Australian Brush-turkey population in the Nandewar and Brigalow Belt South Bioregions	-	EP	The Australian Brush-turkey has a largely coastal distribution from Cape York south as far as the Illawarra in NSW. A population of the Australian Brush-turkey is known from the Nandewar and Brigalow Belt South Bioregions. Recent records for the species show the population to range from north east of Warialda, to Narrabri, approximately 115 km to the south-west, and occur within the local government areas of Yallaroi, Bingara, Narrabri, Barraba and Moree Plains. Usually prefers dry rainforest that is found within the Semi-evergreen Vine Thicket. Birds build nesting mounds in areas of dense vegetation. This provides ample litter for the mound building and decomposition process, as well as shade to reduce moisture loss from the mound. Tall trees such as eucalypts are used for nocturnal and diurnal roosting (15 - 20m above the ground).	2 – OEH	Northern Outwash Northern Basalts	Low – the few records in the locality are from some well vegetated areas east of Narrabri. Some areas in study area may offer marginal habitat. Associated habitat in the study area includes: Mock Olive - Wilga - Peach Bush - Carissa (PCT 147).
Bird	*Anseranas semipalmata*	Magpie Goose	-	V	Mainly found in shallow wetlands (less than 1 m deep) with dense growth of rushes or sedges. Equally at home in aquatic or terrestrial habitats; often seen walking and grazing on land; feeds on grasses, bulbs and rhizomes. Activities are centred on wetlands, mainly those on floodplains of rivers and large shallow wetlands formed by run-off; breeding can occur in both summer and winter dominated rainfall areas and is strongly influenced by water level; most breeding now occurs in monsoonal areas; nests are formed in trees over deep water; breeding is unlikely in south-eastern NSW.	7 – OEH Birdline	Northern Outwash	Low – may occur in ephemeral wetland habitats after periods of high rainfall. Birds reported in Narrabri Lake (in town) and on the Mehi River at Moree. At best, marginal potential nesting habitat in study area. Associated habitat in the study area includes pools in waterways, fam dams. Ephemeral wetlands within grassland areas are also likely to provide habitat, particularly with tin the following habitats: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Anthochaera Phrygia*	Regent Honeyeater	CE	CE	The Regent Honeyeater that has a patchy distribution between south-east Queensland and central Victoria. It mostly inhabits inland slopes of the Great Dividing Range, in areas of low to moderate relief with moist, fertile soils. It is most commonly associated with box-ironbark eucalypt woodland and dry sclerophyll forest, but also inhabits riparian vegetation such as sheoak (*Casuarina* spp) where it feeds on needle-leaved mistletoe and sometimes breeds. It sometimes utilises lowland coastal forest, which may act as a refuge when its usual habitat is affected by drought. It also uses a range of disturbed habitats within these landscapes including remnant patches in farmland and urban areas and roadside vegetation. It feeds primarily on the nectar of eucalypts and mistletoes and, to a lesser extent, lerps and honeydew; it prefers taller and larger diameter trees for foraging. It is nomadic and partly migratory with its movement through the landscape being governed by the flowering of select eucalypt species. There are four known key breeding areas: three in NSW and one in Victoria. Breeding varies between regions and corresponds with flowering of key eucalypt and mistletoe species. It usually nests in horizontal branches or forks in tall mature eucalypts and Sheoaks.	1 – OEH PMST	Northern Basalts	Low – study area outside of species' known/predicted range. Single record 15 years old. Some areas of suitable habitat may be present.
Bird	*Apus pacificus*	Fork-tailed Swift	M	-	Recorded in all regions of NSW. The Fork-tailed Swift is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher.	PMST	-	**Moderate** – would likely fly over the study area during migration.
Bird	*Ardea alba*	Great Egret	M	-	Widespread in Australia. Reported in a wide range of wetland habitats (for example inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small, natural and artificial).	PMST	-	**High** - confirmed north of Moree during field surveys.

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Ardea ibis*	Cattle Egret	M	-	Widespread and common according to migration movements and breeding localities surveys. Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands.	PMST	-	**Moderate** – may occur in study area when cattle are present.
Bird	*Ardeotis australis*	Australian Bustard	-	E	The Australian Bustard mainly occurs in inland Australia and is now scarce or absent from southern and south-eastern Australia. In NSW, they are mainly found in the north-west corner and less often recorded in the lower western and central west plains regions. Occasional vagrants are still seen as far east as the western slopes and Riverine plain. Breeding now only occurs in the north-west region of NSW. Mainly inhabits tussock and hummock grasslands, though prefers tussock grasses to hummock grasses; also occurs in low shrublands and low open grassy woodlands; occasionally seen in pastoral and cropping country, golf courses and near dams. Breeds on bare ground on low sandy ridges or stony rises in ecotones between grassland and protective shrubland cover; roosts on ground among shrubs and long grasses or under trees.	3 – OEH	Northern Outwash Northern Basalts	**Moderate** – suitable habitat widespread in study area but the species has been infrequently recoded. Associated habitat in the study area includes: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Belah woodland on alluvial plains and low rises (PCT 55) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Weeping Myall open woodland (PCT 27) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Artamus cyanopterus*	Dusky Woodswallow	-	V	The Dusky Woodswallow has two separate populations. The eastern population is found from Atherton Tableland, Queensland south to Tasmania and west to Eyre Peninsula, South Australia. The other population is found in south-west Western Australia. The Dusky Woodswallow is found in open forests and woodlands and may be seen along roadsides and on golf courses.	11 – OEH	Northern Outwash Northern Basalts	**High** – recorded in the locality at moderate frequency and suitable habitat widespread in study area. Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52).
Bird	*Botaurus poiciloptilus*	Australasian Bittern	E	E	Occurs from south-east Queensland to south-east South Australia, Tasmania and the south-west of Western Australia. The Australasian Bittern's preferred habitat is comprised of wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. It favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds (e.g. Phragmites, Cyperus, Eleocharis, Juncus, Typha, Baumea, Bolboschoenus) or cutting grass (Gahnia) growing over a muddy or peaty substrate	PMST	Northern Basalts	Low – species is not known from the locality. Some small areas of suitable habitat may be present in the study area, although not of sufficient size or quality for a resident local population to persist.

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Burhinus grallarius*	Bush Stone-curlew	-	E	Open forests and woodlands with a sparse grassy ground layer and fallen timber. Largely nocturnal, being especially active on moonlit nights. Feed on insects and small vertebrates, such as frogs, lizards and snakes. Nest on the ground in a scrape or small bare patch.	2 – OEH	Northern Basalts	**Moderate** – may utilise woodland habitats; recorded infrequently in the locality. Associated habitat in the study area includes: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Calidris acuminata*	Sharp-tailed Sandpiper	M	-	The Sharp-tailed Sandpiper spends the non-breeding season in Australia with small numbers occurring regularly in New Zealand. Most of the population migrates to Australia, mostly to the south-east and are widespread in both inland and coastal locations and in both freshwater and saline habitats. Many inland records are of birds on passage. Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation; this includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline saltlakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves. They tend to occupy coastal mudflats mainly after ephemeral terrestrial wetlands have dried out, moving back during the wet season. Sometimes they occur on rocky shores and rarely on exposed reefs.	PMST Birdline	-	Low – Vagrant birds may infrequently use habitat in the study area after suitable rainfall on passage between more suitable habitats. Associated habitat in the study area includes ephemeral wetlands.

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Calidris ferruginea*	Curlew Sandpiper	CE	E	In Australia, Curlew Sandpipers occur around the coasts of all states and are also quite widespread inland, though in smaller numbers. They occur in Australia mainly during the non-breeding period but also during the breeding season when many non-breeding one year old birds remain. Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They generally roost on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands, occasionally roosting in dunes during very high tides and sometimes in saltmarsh and in mangroves.	PMST		Low – species not known from the locality. Some areas of suitable habitat may be present.
Bird	*Calidris melanotos*	Pectoral Sandpiper	M	-	In New South Wales (NSW), the Pectoral Sandpiper is widespread, but scattered. Records exist east of the Great Divide, from Casino and Ballina, south to Ulladulla. West of the Great Divide, the species is widespread in the Riverina and Lower Western regions. Prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.	PMST		Low – species not known from the locality. Some areas of suitable habitat may be present.

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Bird	*Calyptorhynchus banksii samueli*	Red-tailed Black-Cockatoo (inland subspecies)	-	V	The Red-tailed Black-Cockatoo (inland subspecies) is known to occur around watercourses and overflows of the Darling, Paroo, Bogan, Macquarie and Barwon Rivers extending in an arc along the Darling River from Wentworth (though rare south of Menindee) in the south to Bourke and thence through to Brewarrina in the north. It extends east to Walgett and perhaps Boggabilla on the Barwon and south through to the Macquarie Marshes. Red-tailed Black-Cockatoos are found in a wide variety of habitats. Prefer Eucalyptus forest and woodlands, particularly river red gum and coolabah lined water courses. In the arid zone usually occur mainly near eucalypts along larger watercourses and associated Acacia and Casuarina woodlands nearby. Also utilise grasslands, scrublands, wetlands and vegetation on floodplains.	1 – OEH	-	Low – suitable habitat widespread in study area but the species has been infrequently recorded in the region. Probable only as a vagrant. Associated habitat in the study area includes: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Belah woodland on alluvial plains and low rises (PCT 55) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Weeping Myall open woodland (PCT 27) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35)
Bird	*Calyptorhynchus lathami*	Glossy-black Cockatoo	-	V	The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. An isolated population exists on Kangaroo Island, South Australia. Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of Sheoak occur. Black Sheoak (*Allocasuarina littoralis*) and Forest Sheoak (*A. torulosa*) are important foods. Inland populations feed on a wide range of Sheoaks, including Drooping Sheoak, *Allocasuarina diminuta*, and *A. gymnanthera*. Belah is also utilised and may be a critical food source for some populations. In the Riverina, birds are associated with hills and rocky rises supporting Drooping Sheoak, but also recorded in open woodlands dominated by Belah (Casuarina cristata).	20 – OEH	Northern Outwash Northern Basalts	**Recorded**; likely presence confirmed by chewed cones in roadside Belah in N2MS4 during field surveys. Belah habitat widespread. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)

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Bird	*Chthonicola sagittata (Pyrrholaemus sagittatus)*	Speckled Warbler	-	V	The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt re-growth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area. Pairs are sedentary and occupy a breeding territory of about ten hectares, with a slightly larger home-range when not breeding. The rounded, domed, roughly built nest of dry grass and strips of bark is located in a slight hollow in the ground or the base of a low dense plant, often among fallen branches and other litter. A side entrance allows the bird to walk directly inside.	58 – OEH Birdline	Northern Outwash Northern Basalts	**Moderate** – marginal (fragmented, liner and relatively small patch-size) habitat present and the species has been recorded in the locality, chiefly in larger patches of woodland in the east. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)

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Bird	*Circus assimilis*	Spotted Harrier	-	V	The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	7 – OEH Birdline	Northern Outwash Northern Basalts	**High** – known from locality. Suitable habitat widespread; the most suitable habitat includes the edges of wetlands and creeks. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Weeping Myall open woodland (PCT 27) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52)

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Bird	*Climacteris picumnus victoriae*	Brown Treecreeper (eastern subspecies)	-	V	Endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. It is less commonly found on coastal plains and ranges. Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (Eucalyptus camaldulensis) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains. Hollows in standing dead or live trees and tree stumps are essential for nesting.	12 – OEH	Northern Outwash Northern Basalts	Low – recorded in the locality and suitable habitat present in woodland vegetation, particularly riparian areas. However, the study area is west of the western boundary of the range of *Climacteris picumnus victoriae* which runs approximately through Inverell at this latitude and along this line the subspecies intergrades with the arid zone subspecies of Brown Treecreeper *Climacteris picumnus picumnus* which then occupies the remaining parts of the state. Associated habitat in the study area includes: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)

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Bird	*Daphoenositta chrysoptera*	Varied Sittella	-	V	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy. Nests in an upright tree fork high in the living tree canopy.	20 – OEH	Northern Outwash Northern Basalts	**High**. Frequently recorded in the locality and habitat is widespread in the study area. Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27)

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Bird	*Ephippiorhynchus asiaticus*	Black-necked Stork	-	E	In Australia, Black-necked Storks are widespread in coastal and subcoastal northern and eastern Australia, as far south as central NSW (although vagrants may occur further south or inland, well away from breeding areas). In NSW, the species becomes increasingly uncommon south of the Clarence Valley, and rarely occurs south of Sydney. Since 1995, breeding has been recorded as far south as Bulahdelah. Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries. Storks usually forage in water 5-30cm deep for vertebrate and invertebrate prey. Eels regularly contribute the greatest biomass to their diet, but they feed on a wide variety of animals, including other fish, frogs and invertebrates (such as beetles, grasshoppers, crickets and crayfish). Black-necked Storks build large nests high in tall trees close to water. Trees usually provide clear observation of the surroundings and are at low elevation (reflecting the floodplain habitat).	7 – OEH Birdline	Northern Outwash Northern Basalts	Low – this species has been recorded numerous times around the Moree area, particularly in the Gwydir wetlands. This species would be sedentary in these habitats and may occasionally use creeks, dams, flooded grassland and wetlands in the study area, particularly after extended periods of heavy rain.

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Bird	*Epthianura albifrons*	White-fronted Chat	-	V	The White-fronted Chat is found across the southern half of Australia, from southernmost Queensland to southern Tasmania, and across to Western Australia as far north as Carnarvon. Found mostly in temperate to arid climates and very rarely sub-tropical areas, it occupies foothills and lowlands up to 1000 m above sea level. In NSW, it occurs mostly in the southern half of the state, in damp open habitats along the coast, and near waterways in the western part of the state. Along the coastline, it is found predominantly in saltmarsh vegetation but also in open grasslands and sometimes in low shrubs bordering wetland areas. Gregarious species usually found foraging on bare or grassy ground in wetland areas, singly or in pairs. They are insectivorous, feeding mainly on flies and beetles caught from or close to the ground. Have been observed breeding from late July through to early March, with 'open-cup' nests built in low vegetation. Nests in the Sydney region have also been seen in low isolated mangroves. Nests are usually built about 23 cm above the ground (but have been found up to 2.5 m above the ground).	Associated PCT/s only	-	Low – Not recorded in the locality since the 1930s. Associated (marginal) habitat present in the study area includes: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52).

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Bird	*Erythrotriorchis radiatus*	Red Goshawk	V	CE	This unique Australian endemic raptor is distributed sparsely through northern and eastern Australia, from the western Kimberley Division of northern Western Australia to north-eastern Queensland and south to far north-eastern NSW, and with scattered records in central Australia. The species is very rare in NSW, extending south to about 30°S, with most records north of this, in the Clarence River Catchment, and a few around the lower Richmond and Tweed Rivers. Formerly, it was at least occasionally reported as far south as Port Stephens. Red Goshawks inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, Melaleuca swamp forest and riparian Eucalyptus forest of coastal rivers.	PMST	-	Unlikely – species not known from locality. Habitat in study area unsuitable.
Bird	*Falco hypoleucos*	Grey Falcon	-	E	Sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range. Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast.	Birdline	Northern Outwash	**Moderate** – not common in the locality however this species may pass through the study area on occasion. Associated habitat in the study area includes: Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Belah woodland on alluvial plains and low rises (PCT 55) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Weeping Myall open woodland (PCT 27)

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Bird	*Falco subniger*	Black Falcon	-	V	Widely, but sparsely, distributed in MSW, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of New South Wales are likely to be referrable to the Brown Falcon. There is assumed to be a single continental population, given that falcons are highly mobile, commonly travelling hundreds of kilometres (Marchant & Higgins 1993). It inhabits woodland, shrubland and grassland in the arid and semi-arid zones, especially wooded watercourses and agricultural land with scattered remnant trees. It is usually associated with streams or wetlands; in search of prey and often using standing dead trees as lookout posts. Habitat selection is generally influenced more by prey densities than by specific aspects of habitat floristics or condition, although in agricultural landscapes it tends to nest in healthy, riparian woodland remnants with a diverse avifauna.	4 – OEH Birdline	Northern Outwash Northern Basalts	**Moderate** – suitable habitat widespread. Recorded locations include Narrabri rubbish dump. This species may hunt and perch in the study area; nesting habitat in the study area is likely to be marginal due to its proximity to the highway. Potential habitat in the study area includes all woodland/forest and grasslands with scattered trees. The habitat likely to be most suitable for the species includes: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Weeping Myall open woodland (PCT 27)
Bird	*Gallinago hardwickii*	Latham s Snipe	M	-	Recorded along the east coast of Australia from Cape York Peninsula through to south-eastern South Australia. Occurs in permanent and ephemeral wetlands up to 2000 m above sea-level.	PMST Birdline		**High**; Confirmed during surveys near the study area in ephemeral wetland (impeded drainage associated with the highway) just south of Moree. Habitat confined to creeks and wetlands and larger areas after suitable rainfall.

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Geophaps scripta scripta*	Squatter Pigeon (southern)	V	CE	Found from north Queensland to the North West Slopes of NSW and extending down to the Liverpool Plains and Dubbo. Today they are very rare in the southern parts of their range. Grassy woodlands and plains, preferring sandy areas and usually close to water. Grassy woodlands and plains, preferring sandy areas and usually close to water. Feed on the ground, on seeds of grasses, herbs and shrubs, as well as insects. Nest on the ground.	PMST	Northern Basalts	Low – species not known from the locality and hasn't been recorded in NSW in over a decade. Some areas of suitable habitat may be present. Associated habitat in the study area includes: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Weeping Myall open woodland (PCT 27)
Bird	*Glossopsitta pusilla*	Little Lorikeet	-	V	In NSW it is found from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. The species forages primarily in the canopy of dry open eucalypt forest and woodland but also utilises paperbark (*Melaleuca* sp.) dominated forests. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country (e.g. paddocks, roadside remnants) and urban trees also help sustain viable populations of the species. Nests in proximity to feeding areas if possible, most typically selecting hollows in the limb or trunk of smooth-barked eucalypts. Entrance is small (3 cm) and usually high above the ground (2–15 m). These nest sites are often used repeatedly for decades, suggesting that preferred sites are limited; riparian trees are often chosen, including non-eucalypt species such as she-oaks.	6 – OEH Birdline	Northern Basalts	**Moderate** – this species has been seen near Moree. Not common in the area though is likely to pass through. Associated habitat in the study area includes: Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397).

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Grantiella picta*	Painted Honeyeater	V	V	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of birds, and almost all breeding, occur on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus Amyema.	19 – OEH PMST Birdline	Northern Outwash Northern Basalts	**High** – suitable habitat widespread, particularly in areas with mistletoes. This species has been recorded in the Little Bumble TSR (road reserve) between Narrabri and Moree. Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27)
Bird	*Grus rubicunda*	Brolga	-	V	The Brolga was formerly found across Australia, except for the south-east corner, Tasmania and the south-western third of the country. It is still abundant in the northern tropics, but very sparse across the southern part of its range. Though Brolgas often feed in dry grassland or ploughed paddocks or even desert claypans, they are dependent on wetlands too, especially shallow swamps, where they will forage with their head entirely submerged.	2 – OEH Birdline	Northern Basalts	Low – this species has been observed on the Gwydir Wetlands. Some suitable habitat in study area around creeks and wetlands and larger areas after suitable rainfall. Associated habitat in the study area includes: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Weeping Myall open woodland (PCT 27).

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	M	V	Distributed along the coastline (including offshore islands) of mainland Australia and Tasmania. Found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. Habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, and the sea). It feeds opportunistically on a variety of fish, birds, reptiles, mammals and crustaceans, and on carrion. It generally forages over large expanses of open water; this is particularly true of birds that occur in coastal environments close to the sea-shore. However, the it will also forage over open terrestrial habitats (such as grasslands). Nests may be built in a variety of sites including tall trees (especially Eucalyptus species), bushes, mangroves, cliffs, rocky outcrops, caves, crevices, on the ground or even on artificial structures.	3 – OEH PMST Birdline	Northern Outwash	Low – this species has been seen occasionally in the locality. May hunt over the study area, particularly wetlands and creeks during wet years. There is a low likelihood that the habitat on the site would be used for breeding or be important foraging habitat. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Weeping Myall open woodland (PCT 27)
Bird	*Hamirostra melanosternon*	Black-breasted Buzzard	-	V	The Black-breasted Buzzard is found sparsely in areas of less than 500mm rainfall, from north-western NSW and north-eastern South Australia to the east coast at about Rockhampton, then across northern Australia south almost to Perth, avoiding only the Western Australian deserts. Lives in a range of inland habitats, especially along timbered watercourses which is the preferred breeding habitat. Also hunts over grasslands and sparsely timbered woodlands.	2 – OEH	Northern Basalts	**Moderate** – occasionally recorded in the locality, this species may hunt around creeks, woodlands and grasslands in the study area. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Hieraaetus morphnoides*	Little Eagle	-	V	The Little Eagle is found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW. Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used.	11 – OEH	Northern Outwash Northern Basalts	**High** – suitable habitat widespread and recorded at moderate frequency, including a record immediately adjacent to the study area. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - Belah woodland (PCT 56) Weeping Myall open woodland (PCT 27) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52)
Bird	*Hirundapus caudacutus*	White-throated Needletail	M, Priority assessment list for Vulnerable	-	Widespread in eastern and south-eastern Australia. Almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. They also commonly occur over heathland but less often over treeless areas, such as grassland or swamps.	PMST Birdline		**Moderate** – likely to fly over the study area during migration.

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Lathamus discolor*	Swift Parrot	CE	E	The swift parrot breeds in Tasmania during the summer and the entire population migrates north to mainland Australia for the winter. Whilst on the mainland the swift parrot disperses widely to forage on flowers and psyllid lerps in eucalypt species, with the majority being found in Victoria and NSW. In NSW they forage in forests and woodlands throughout the coastal and western slopes regions each year. Coastal regions tend to support larger numbers of birds when inland habitats are subjected to drought. Non-breeding birds preferentially feed in inland box-ironbark and grassy woodlands, and coastal swamp mahogany (*E. robusta*) and spotted gum (*Corymbia maculata*) woodland when in flower, otherwise often in coastal forests. On the mainland they occur in areas where eucalypts are flowering profusely or where there is abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as *Eucalyptus robusta, Corymbia maculata, C. gummifera, E. sideroxylon*, and *E. albens*. Commonly used lerp infested trees include *E. microcarpa, E. moluccana* and *E. pilularis*.	PMST	Northern Basalts	Low – no records of this species in the locality. The study area is on the very northern-western boundary of this species known migration extent and only sparsely scattered records. Only *E. pilligaensis* provides a suitable winter flowering resource. Associated habitat in the study area includes: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)
Bird	*Leipoa ocellata*	Malleefowl	E	V	The stronghold for this species in NSW is the mallee in the south west centred on Mallee Cliffs NP and extending east to near Balranald and scattered records as far north as Mungo NP. Predominantly inhabit mallee communities, preferring the tall, dense and floristically-rich mallee found in higher rainfall (300 - 450 mm mean annual rainfall) areas. Utilises mallee with a spinifex understorey, but usually at lower densities than in areas with a shrub understorey. Less frequently found in other eucalypt woodlands, such as Inland Grey Box, Ironbark or Bimble Box Woodlands with thick understorey, or in other woodlands such dominated by Mulga or native Cypress Pine species. Prefers areas of light sandy to sandy loam soils and habitats with a dense but discontinuous canopy and dense and diverse shrub and herb layers.	PMST	-	Low – this species is not known from the locality. Closest records are from the Pilliga National Park. Only small amounts of likely marginal potential habitat for this species in the study area.

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Limosa limosa*	Black-tailed Godwit	M	V	A migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently found at Kooragang Island (Hunter River estuary). Occurs in sheltered bays, estuaries and lagoons with large intertidal mudflats and sand flats. Also found at inland mudflats, swamps.	Associated PCTs only	Northern Basalts	Low – species not known from the locality. Some areas of suitable habitat may be present in ephemeral wetlands after rainfall.
Bird	*Lophochroa leadbeateri*	Major Mitchell's Cockatoo	-	V	Found across the arid and semi-arid inland, from south-western Queensland south to north-west Victoria, through most of South Australia, north into the south-west Northern Territory and across to the west coast between Shark Bay and about Jurien. In NSW it is found regularly as far east as about Bourke and Griffith, and sporadically further east than that. Inhabits a wide range of treed and treeless inland habitats, always within easy reach of water. Nesting, in tree hollows, occurs throughout the second half of the year; nests are at least 1 km apart, with no more than one pair every 30 square kilometres.	Associated PCT/s only	-	Low – species not known from the locality; some areas of marginal habitat may be present. Low – species not known from the locality. Some areas of suitable habitat may be present in ephemeral wetlands after rainfall. Associated habitat in the study area includes: Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Lophoictinia isura*	Square-tailed Kite	-	V	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by Eucalyptus longifolia, Corymbia maculata, E. elata, or E. smithii. Individuals appear to occupy large hunting ranges of more than 100 km2. They require large living trees for breeding, particularly near water with surrounding woodland /forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.	3 – OEH Birdline	Northern Outwash Northern Basalts	**Moderate** – species seen 20km south-eat of Moree and in Moree. Likely to pass through the study area on occasion. May nest in large trees in the study area. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Melanodryas cucullata cucullata*	Hooded Robin (south-eastern form)	-	V	The Hooded Robin is widespread, found across Australia, except for the driest deserts and the wetter coastal areas - northern and eastern coastal Queensland and Tasmania. However, it is common in few places, and rarely found on the coast. Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. The nest is a small, neat cup of bark and grasses bound with webs, in a tree fork or crevice, from less than 1 m to 5 m above the ground.	3 – OEH	Northern Outwash Northern Basalts	**Moderate** – infrequently recorded but suitable habitat is present in study area. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27)
Bird	*Melithreptus gularis gularis*	Black-chinned Honeyeater (eastern subsp.)	-	V	Extends south from central Queensland, through NSW, Victoria into south eastern South Australia, though it is very rare in the last state. In NSW it is widespread, with records from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (*Eucalyptus sideroxylon*), White Box (*E. albens*), Inland Grey Box (*E. microcarpa*), Yellow Box (*E. melliodora*), Blakely's Red Gum (*E. blakelyi*) and Forest Red Gum (*E. tereticornis*). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees.	2 – OEH	Northern Outwash Northern Basalts	Low – infrequently recorded and only a small amount of potential habitat is present in study area. Associated habitat in the study area includes: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Merops ornatus*	Rainbow Bee-eater	M	-	Distributed across much of mainland Australia and occurs on several near-shore islands. Occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation.	PMST Birdline	-	**Moderate** – species has been recorded in the locality. Suitable habitat in study area.
Bird	*Motacilla flava*	Yellow Wagtail	M	-	Rare but regular visitor around Australian coast, especially in the NW coast Broome to Darwin. Found in open country near swamps, salt marshes, sewage ponds, grassed surrounds to airfields, bare ground, occasionally on drier inland plains.	PMST	-	Low – marginal habitat in the study area.
Bird	*Myiagra cyanoleuca*	Satin Flycatcher	M	-	Widespread in eastern Australia and vagrant to New Zealand. Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests.	PMST	-	Low – marginal habitat in the study area.
Bird	*Neophema pulchella*	Turquoise Parrot	-	V	Range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	14 – OEH	Northern Outwash Northern Basalts	**Moderate** – some suitable habitat found in the study area. Associated habitat in the study area includes: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)
Bird	*Nettapus coromandelianus*	Cotton Pygmy-goose	-	E	Although once found from north Queensland to the Hunter River in NSW, the Cotton Pygmy-Goose is now only a rare visitor to NSW. Uncommon in Queensland. Occupies freshwater lakes, lagoons, swamps and dams, particularly those vegetated with waterlilies and other floating and submerged aquatic vegetation. The Cotton Pygmy-goose uses standing dead trees with hollows close to water for roosting and breeding.	-	Northern Basalts	Low– this species is not known from the locality but the related Green Pygmy Goose which has similar habitat prefers has been recorded in Narrabri Lake. Only scattered records in broader region. Marginal habitat in the study area; possible as a vagrant only.

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Ninox connivens*	Barking Owl	-	V	Found throughout continental Australia except for the central arid regions. Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas.	14 – OEH	Northern Outwash Northern Basalts	**High** – suitable habitat widespread through study area. Recorded in larger woodland areas NE of Narrabri and in close proximity to Moree. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Oxyura australis*	Blue-billed Duck	-	V	Endemic to south-eastern and south-western Australia. It is widespread in NSW, but most common in the southern Murray-Darling Basin area. Birds disperse during the breeding season to deep swamps up to 300 km away. It is generally only during summer or in drier years that they are seen in coastal areas. Prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed but prefers to dive if approached. Partly migratory, with short-distance movements between breeding swamps and overwintering lakes with some long-distance dispersal to breed during spring and early summer. Usually nest solitarily in Cumbungi over deep water between September and February. They will also nest in trampled vegetation in Lignum, sedges or Spike-rushes, where a bowl-shaped nest is constructed. The most common clutch size is five or six. Males take no part in nest-building or incubation.	ALA	Northern Basalts	Low – several records of this species are shown on the Atlas of Living Australia located on Narrabri Lake. However, habitat in the study area is not likely to be suitable for this species.
Bird	*Pandion cristatus*	Eastern Osprey	M	V	The Osprey has a global distribution with four subspecies previously recognised throughout its range. Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water.	PMST Birdline	-	Low – species seen on Mehi and Gwydir Rivers. Few areas of suitable hunting habitat in study area. Vagrant birds may fly over and occasionally perch in trees in study area in areas closer to major waterways.
Bird	*Petroica boodang*	Scarlet Robin	-	V	The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and re-growth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. This species' nest is built in the fork of tree usually more than 2 metres above the ground; nests are often found in a dead branch in a live tree, or in a dead tree or shrub.	Associated PCT/s only	-	Low – Not recorded in the locality and there is only at best marginal habitat for this species in the study area. Likely only as a vagrant. Associated (marginal) habitat present in the study area includes: Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35).

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Polytelis swainsonii*	Superb Parrot	V	V	Found throughout eastern inland NSW. On the South-western Slopes their core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. Inhabit Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest. In the Riverina the bird's nest in the hollows of large trees (dead or alive) mainly in tall riparian River Red Gum Forest or Woodland. On the South West Slopes nest trees can be in open Box-Gum Woodland or isolated paddock trees. Species known to be used are Blakely's Red Gum, Yellow Box, Apple Box and Red Box. Nest in small colonies, often with more than one nest in a single tree.	5 – OEH PMST Birdline	-	**Moderate** – this species previously recorded occasionally in and around Moree. Suitable habitat widespread in study area which is near the limit of species' range. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52)
Bird	*Pomatostomus temporalis temporalis*	Grey-crowned Babbler	-	V	In NSW, the eastern sub-species occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Balranald. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. It may be extinct in the southern, central and New England tablelands. Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Build and maintain several conspicuous, dome-shaped stick nests about the size of a football. A nest is used as a dormitory for roosting each night. Nests are usually located in shrubs or sapling eucalypts, although they may be built in the outermost leaves of low branches of large eucalypts. Nests are maintained year round, and old nests are often dismantled to build new ones.	60 – OEH	Northern Outwash Northern Basalts	**Recorded**; confirmed in the study areas of Sections 1 and 2 during field surveys. Habitat widespread. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Rhipidura rufifrons*	Rufous Fantail	M	-	Occurs in coastal and near coastal districts of northern and eastern Australia. In east and south-east Australia, the Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood (Eucalyptus microcorys), Mountain Grey Gum (E. cypellocarpa), Narrow-leaved Peppermint (E. radiata), Mountain Ash (E. regnans), Alpine Ash (E. delegatensis), Blackbutt (E. pilularis) or Red Mahogany (E. resinifera); usually with a dense shrubby understorey often including ferns.	PMST ALA	-	**Moderate** – few records occur in the locality. Species has been recorded in Narrabri. May pass through the study area on occasion.
Bird	*Rostratula australis*	Australian Painted Snipe	E, M	E	Most records are from south east Australia, particularly the Murray Darling Basin, with scattered records across northern Australia. They generally inhabit shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum Muehlenbeckia or canegrass. Breeding habitat requirements may be quite specific; shallow wetlands with areas of bare wet mud and both low cover and canopy cover nearby; nest records nearly all from or near small islands in freshwater wetlands. Has also been recorded nesting in and near swamps, canegrass swamps, flooded areas including samphire, grazing land, among cumbungi, sedges and grasses; one nest has been found in the centre of a cow-pat in a clump of long grass.	2 – OEH PMST	Northern Basalts	Low – Suitable habitat represented in study area by some creeks and wetlands. Infrequently recorded in the locality. Suitable habitat likely to be widespread after suitable rainfall; persisting longer in ephemeral wetland areas. Latham's Snipe, a species with similar habitat preferences, observed in an ephemeral wetland just south of Moree. Associated habitat in the study area includes: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Pools in waterways, farm dams and areas of impeded drainage (ephemeral wetlands)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Stagonopleura guttata*	Diamond Firetail	-	V	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland. Nests are globular structures built either in the shrubby understorey, or higher up, especially under hawk's or raven's nests. Birds roost in dense shrubs or in smaller nests built especially for roosting.	3 – OEH Birdline	Northern Outwash Northern Basalts	**Moderate** – suitable habitat widespread but few local records. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27)
Bird	*Stictonetta naevosa*	Freckled Duck	-	V	Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds.	1 – OEH Birdline	Northern Basalts	Low – little suitable habitat in study area as this species requires open water. This species has been seen around Moree on farms dams.
Bird	*Tringa nebularia*	Common Greenshank	M	-	The Common Greenshank does not breed in Australia; however, the species occurs in all types of wetlands and has the widest distribution of any shorebird in Australia.	PMST Birdline		Low – Habitat confined to creeks and wetlands and larger areas after suitable rainfall.

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Turnix maculosus*	Red-backed Button-quail	-	V	The Red-backed Button-quail is recorded only infrequently in NSW, with most records from the North Coast Bioregion; there are historical records south as far as Sydney and three outlying records from western NSW. Over their Australian range, Red-backed Button-quail inhabit grasslands, open and savannah woodlands with grassy ground layer, pastures and crops of warm temperate areas, typically only in regions subject to annual summer rainfall greater than 400 mm. In NSW, said to occur in grasslands, heath and crops. Said to prefer sites close to water, especially when breeding. The species has been observed associated with the following grasses (in various vegetation formations): speargrass Heteropogon, Blady Grass Imperata cylindrica, Triodia, Sorghum, and Buffel Grass Cenchrus ciliaris. Observations of populations in other parts of its range suggest the species prefers sites near water, including grasslands and sedgelands near creeks, swamps and springs, and wetlands. Red-backed Button-quail usually breed in dense grass near water, and nests are made in a shallow depression sparsely lined with grass and ground litter.	Associated PCT/s only	-	Low – Not recorded in the locality and there is only at best marginal habitat for this species in the study area. .
Bird	*Tyto longimembris*	Eastern Grass Owl	-	V	Eastern Grass Owls have been recorded occasionally in all mainland states of Australia but are most common in northern and north-eastern Australia. In NSW they are more likely to be resident in the north-east. Eastern Grass Owl numbers can fluctuate greatly, increasing especially during rodent plagues. Eastern Grass Owls are found in areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains. They are also found in agricultural land (mainly sugar cane and sorghum, and rice fields in fallow) (Birdlife Australia).	2 – OEH Birdline	Northern Outwash	Low – several birds have been seen near Bellata. May use habitat in study area for hunting, though not considered ideal due to an absence of tall grassed areas. Associated habitat includes: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Pools in waterways, farm dams and areas of impeded drainage (ephemeral wetlands)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Tyto novaehollandiae*	Masked Owl	-	V	Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. There is no seasonal variation in its distribution. Dry eucalypt forests and woodland typically prefers open forest with low shrub density. Requires old trees for roosting and nesting.	3 – OEH	Northern Basalts	**Moderate** – several records of this species in Pilliga NP, Bobbiwaa Conservation Area and Moema NP. This species is likely to use the study area for hunting, though may also nest in the larger hollows. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52)
Birds	*Certhionyx variegatus*	Pied Honeyeater	-	V	Widespread in arid and semi-arid Australia. Occasionally occurs further east, on the slopes and plains and the Hunter Valley, typically during periods of drought. Inhabits wattle shrub, primarily Mulga (Acacia aneura), mallee, spinifex and eucalypt woodlands, usually when shrubs are flowering; feeds on nectar, predominantly from various species of emu-bushes (Eremophila spp.); also from mistletoes and various other shrubs (e.g. Grevillea spp.); also eats saltbush fruit, berries, seed, flowers and insects. Highly nomadic, following the erratic flowering of shrubs; can be locally common at times. Nests in a shrub or tree up to 5 m above the ground.	Associated PCT/s only	-	Low – Not recorded in the locality and there is only at best marginal habitat for this species in the study area. Associated (marginal) habitat present in the study area includes: Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Belah woodland on alluvial plains and low rises (PCT 55) Poplar Box - Belah woodland (PCT 56).

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Fish	*Ambassis agassizii*	Olive Perchlet	-	EP	In NSW Ambassis agassizii was once widespread in the Lachlan, lower Murrumbidgee, and lower Murray Rivers and throughout the Darling drainage system and in coastal streams in northern NSW. Its distribution throughout the Murray-Darling system (western population) has significantly declined in recent years and now appears to be limited to a few localities in the Darling drainage upstream from Bourke. It has not been recorded in any NSW survey of the lower Murray or lower Darling below Bourke since the 1960s. Olive Perchlet inhabit rivers, creeks, ponds and swamps. They are usually found in slow-flowing or still waters in sheltered areas such as overhanging vegetation, aquatic macrophyte beds, logs, dead branches and boulders during the day, and disperse to feed during the night.	-	-	Low - No records in the locality. No mapped habitat in the study area. The DPI indicative distribution for the species (high probability of occurrence) includes the following streams outside of, but in close proximity to the study area: • Mehi River, Gwydir River and Duffys Creek near Moree • Namoi River near Narrabri Unmapped but possibly marginal habitat in the study area includes: • Halls Creek south of Moree (north of Halls Creek-Burrington Road).
Fish	*Bidyanus bidyanus*	Silver Perch	-	V	Once widespread and abundant throughout most of the Murray-Darling river system. They have now declined to low numbers or disappeared from most of their former range. Only one remaining secure and self-sustaining population occurs in NSW in the central Murray River downstream of Yarrawonga weir, as well as several anabranches and tributaries. Silver perch show a preference for faster-flowing water, including rapids and races, and more open sections of river. Stocked silver perch appear to make little improvement to the conservation situation of wild silver perch.	1 - ALA	-	Low - There is an old record of the species in the vicinity of Moree. No mapped habitat in the study area. Mapped habitat in the locality includes: • Mehi River, Gwydir River and Duffys Creek near Moree • Namoi River and Narrabri Creek near Narrabri.

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Fish	*Maccullochella peelii*	Murray Cod	V	-	The Murray Cod occurs naturally in the waterways of the Murray-Darling Basin (ACT, SA, NSW and Vic) and is known to live in a wide range of warm water habitats that range from clear, rocky streams to slow flowing turbid rivers and larger billabongs of inland plains. Within these broad habitat types, it is usually found associated with complex structural cover such as large rocks, large snags and smaller structural woody habitat, undercut banks and over-hanging vegetation. It will use floodplain channels when these are inundated. While nursery habitats for post-larval fish have not been identified, juveniles less than one year-old have been found in main river channels.	PMST ALA	-	**Moderate** – the species has been recorded from Narrabri Creek (Narrabri township) as recently as 2009 and from the Mehi River near Moree (east) as recently as 2014. The ephemerally flowing waterways (pools in waterways) in the study area may contain individuals dispersed from main rivers by floodwaters. Potential habitat includes: • Halls Creek south of Moree (north of Halls Creek-Burrington Road) (standing water and riparian vegetation present).

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Fish	*Mogurnda adspersa*	Purple Spotted Gudgeon			It occurs in inland drainages of the Murray-Darling basin as well as coastal drainages of northern NSW and Queensland. The western population was previously widespread in the Murray, Murrumbidgee and Lachlan River systems and tributaries of the Darling. The western population is now confined to small remnant populations in the Macquarie, Gwydir and Border Rivers catchments and a self-sustaining population created from captive-bred fish in the Castlereagh Catchment. It is a benthic species that can be found in a variety of habitat types such as rivers, creeks and billabongs with slow-moving or still waters or in streams with low turbidity. Cover in the form of aquatic vegetation, overhanging vegetation from riverbanks, leaf litter, rocks or snags are important for the species. Most remnant populations in NSW occur in small to medium sized streams.	-	-	**Moderate** No records in the locality. The DPI indicative distribution for the species (high probability of occurrence) includes: • Bobbiwaa Creek (2nd or 3rd order stream; braided) (no standing water) • Tarlee Creek north of Edgeroi (1st order) and some small areas of shallow standing water) • Unnamed stream south of Edgeroi (1st order) (ephemeral wetland and some small areas of standing water) • Unnamed stream north of Bellata 1 (1st order) (no standing water – dammed upstream and downstream) • Unnamed stream north of Bellata 2 (1st order) (standing water in Typha-fringed dam approximately 20m from road; dammed upstream and downstream) • Tookey Creek (1st or 2nd order with moderate sized ephemeral ponds; no standing water) Unmapped but possible habitat in the study area includes: • Halls Creek south of Moree (north of Halls Creek-Burrington Road) (standing water and riparian vegetation present).

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Fish	*Tandanus tandanus*	Eel Tailed Catfish	-	EP	The western population was widely distributed in the Murray-Darling River System in NSW, Qld, Vic., and SA except in cooler parts. It is non migratory and lives in a wide range of habitats including rivers, creeks, lakes, billabongs and lagoons, and although it inhabits flowing streams, prefers sluggish or still waters. It can be found in clear to turbid waters, and over substrates ranging from mud to gravel and rock. It is rare in natural riverine habitats but can be found in farm dams through-out inland NSW and southern Qld. Moderate remnant populations occur in the Macquarie catchment, the Castlereagh catchment, the Namoi catchment upstream of Wee Waa, the Gwydir catchment upstream of Moree and the Border Rivers Goondiwindi (Fisheries Scientific Committee final determination).	1 -ALA		**Moderate** Apparently recorded via electrofishing in 2013 in Halls Creek south of Moree and in 2007 in Tycannah Creek. The DPI indicative distribution for the species (high probability of occurrence) includes: • Bobbiwaa Creek (2nd or 3rd order stream; braided) (no standing water). Unmapped but possible habitat in the study area includes: • Halls Creek south of Moree (north of Halls Creek-Burrington Road) (standing water and riparian vegetation present).
Frogs	*Crinia sloanei*	Sloane s Froglet	Priority assessment list for Endangered status			Associated PCT/s only	-	Low; Records exist from the adjacent Pilliga Outwash IBRA subregion; nearest record is in the Pilliga area. The authenticity of records north of Dubbo has been questioned (refer EPBC Act Consultation Document on Listing Eligibility and Conservation Actions Crinia sloanei (Sloane's froglet)). Possible habitat present in the study area includes ephemeral wetlands, areas of impeded drainage (e.g. table drains) on floodplains and farm dams in all communities but most likely within the following habitats: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56).

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Frogs	*Litoria booroolongensis*	Booroolong Frog	E	-	Restricted to tablelands and slopes in NSW and north-east Victoria at 200–1300 m above sea level. Occurs along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses.	PMST	-	None – closest known occurrence of this species is in Mount Kaputar National Park. Habitat in the study area is unlikely to be suitable for this species.
Invertebrate	*Jalmenus eubulus*	Pale Imperial Hairstreak	-	CE	*Jalmenus eubulus* is found in Queensland and NSW. In Queensland it is restricted to the seasonally sub-humid central and southern areas of the state. In NSW it is found only in Brigalow-dominated open forests and woodlands in northern areas of the state. Only known to breed in old-growth forest or woodland and does not appear to colonise regrowth habitats following clearing or other major disturbance. Suitable habitat is dominated by Brigalow, *Acacia harpophylla* and Buloke, *Casuarina cristata* on clay soils on flat to gently undulating plains, usually with scattered emergent eucalypts such as Poplar Box, *Eucalyptus populnea* and low trees of Wilga, *Geijera parviflora*. In NSW, the species is currently known only from one location (one site).	Associated PCT/s only	Northern Outwash Northern Basalts	**Moderate** – suitable habitat presents in study area. No records in the locality, however this does not discount the potential for this species to occur as it is only known from a single population. Associated habitat in the study area includes: Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35).
Mammals	*Aepyprymnus rufescens*	Rufous Bettong	-	V	In NSW it has largely vanished from inland areas but there are sporadic, unconfirmed records from the Pilliga and Torrington districts. Rufous Bettongs inhabit a variety of forests from tall, moist eucalypt forest to open woodland, with a tussock grass understorey. A dense cover of tall native grasses is the preferred shelter.	Associated PCT/s only	Northern Basalts	**Moderate** – species not recorded in locality (nearest records are in the Pilliga region), but the study area contains potential habitat. Associated habitats in the study area include: Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Mammals	*Antechinomys laniger*	Kultarr	-	E	Widespread across arid and semi-arid NSW but present in very low numbers. Records typically derive from captures by domestic cats or are collected after falling into steep-sided holes. Recent records have come primarily from the Cobar and Brewarrina region. A terrestrial insectivore that inhabits open country, especially claypans among Acacia woodlands. Nocturnal, sheltering by day in hollow logs or tree-stumps, beneath saltbush and spinifex tussocks, in deep cracks in the soil and in the burrows of other animals.	Associated PCT/s only	-	Low – potential habitat present but the study area is outside the species' known or predicted range. Associated habitats in the study area include: Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52)
Mammals	*Cercartetus nanus*	Eastern Pygmy-possum	-	V	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; soft fruits are eaten when flowers are unavailable. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum dreys or thickets of vegetation, (e.g. grass-tree skirts); nest-building appears to be restricted to breeding females; tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks. Important habitat requirements include trees with hollows >2cm, loose bark of eucalypts or accumulations of shredded bark in tree forks for nesting; and associated vegetation types and with an understorey containing heath, banksias or myrtaceous shrubs and soft-fruited plants in rainforests.	2 – OEH	Northern Basalts	Low – records of this species in the locality are from Jacky Creek. Only a small area of generally disturbed and fragmented potential habitat exists in the study area is Associated habitats in the study area include: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Mammals	*Chalinolobus dwyeri*	Large-eared Pied Bat	V	V	Forages over a broad range of open forest and woodland habitats, this species is a cave roosting bat which favours sandstone escarpment habitats for roosting, in the form of shallow overhangs, crevices and caves.	1 – OEH PMST	Northern Basalts	Low – no favoured roosting habitat in the study area. May forage in vegetation in the study area on occasion. Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)
Mammals	*Chalinolobus picatus*	Little Pied Bat	-	V	The Little-Pied Bat is found in inland Queensland and NSW (including Western Plains and slopes) extending slightly into South Australia and Victoria. Occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress pine forest and mallee and Bimbil box woodlands. Roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings.	9 – OEH	Northern Outwash Northern Basalts	**High** – this species is likely to forage in the study area and may roost in hollow-bearing trees and culverts there. Associated habitats in the study area include: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Mammals	*Dasyurus maculatus*	Spotted-tailed Quoll	E	V	Wet and dry sclerophyll forests and rainforests, and adjacent open agricultural areas. Generally associated with large expansive areas of habitat to sustain territory size. Requires hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.	1 – OEH PMST	Northern Outwash Northern Basalts	Low – Some individuals may pass through the area on occasion, but the generally fragmented landscape of the locality is unlikely to support a resident population. Associated habitats in the study area include: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147)
Mammals	*Leggadina forresti*	Forrest's Mouse	-	V	Sparsely distributed across arid and semi-arid inland Australia including north-west NSW where it has been found in Sturt National Park, Tibooburra, Fowler's Gap, Mutawintji National Park (as subfossil remains), between Wanaaring and Louth and, most recently, 15km north of Wilcannia. Arid and semi-arid plains habitats, especially tussock grassland and chenopod shrubland. Also, mulga or savannah woodlands, claypans and sandy ridges.	Associated PCT/s only	-	None; Some potential habitat present but the study area is well outside the species' known range. Associated habitat presents in the study area includes Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52).
Mammals	*Macropus dorsalis*	Black-striped Wallaby	-	E	From the Townsville area in Queensland to northern NSW where it occurs on both sides of the Great Divide. On the north west slopes of NSW, it occurs in Brigalow remnants to south of Narrabri. On the north coast it is confined to the upper catchments of the Clarence and Richmond Rivers. Preferred habitat is characterised by dense woody or shrubby vegetation within three metres of the ground. This dense vegetation must occur near a more open, grassy area to provide suitable feeding habitat. On the north west slopes, associated with dense vegetation, including Brigalow, Ooline and semi-evergreen vine thicket. On the north coast, closely associated with dry rainforest but also occur in moist eucalypt forest with a rainforest understorey or a dense shrub layer.	617 – OEH	Northern Outwash Northern Basalts	**High** – many of records of this species from the Pilliga National Park. Some records also along the road alignment. Suitable habitat present in the study area includes: Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Mammals	*Miniopterus schreibersii oceanensis*	Eastern Bentwing-bat	-	V	Occurs on east and north west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other manmade structures.	1 – OEH	Northern Basalts	**Moderate** – this species may forage in and around woodland/forest and roost in culverts in the study area. Associated habitat present in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)
Mammals	*Mormopterus eleryi*	Bristle-faced free-tailed bat	-	E	Distributed from the southern half of the Northern Territory to central Queensland and north-western NSW. In NSW, the species has been recently recorded from only three disjunct locations: thirteen individuals from Gundabooka National Park, south of Bourke; one individual from Dhinnia Dthinawan Nature Reserve (formerly Bebo State Forest), north of Warialda two individuals near Bonshaw. Knowledge of the ecology of the Hairy-nosed Freetail Bat is limited, however evidence suggests that the species depends on hollows and tree fissures for roosting sites. All other Australian species from the same family generally roost in tree hollows and fissures. Appears to be extremely rare throughout its range. Nationally, it has been recorded from only 15 locations.	Associated PCT/s only	Northern Outwash Northern Basalts	**Moderate** – this species may forage and roost in hollow-bearing trees in the study area. Associated habitat present in the study area includes: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Mammals	*Nyctophilus corbeni*	Corben's Long-eared Bat	V	V	Overall, the distribution of the south eastern form coincides approximately with the Murray Darling Basin with the Pilliga Scrub region being the distinct stronghold for this species. Inhabits a variety of vegetation types, including mallee, bulloke *Allocasuarina luehmannii* and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. Roosts in tree hollows, crevices, and under loose bark.	4 – OEH PMST	Northern Outwash Northern Basalts	**Moderate** – this species may forage and roost in hollow-bearing trees in the study area. Associated habitat present in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35)
Mammals	*Petauroides volans*	Greater Glider	V	-	The Greater Glider occurs in eucalypt forests and woodlands along the east coast of Australia from north east Queensland to the Central Highlands of Victoria from sea level to 1200 m altitude. It feeds exclusively on eucalypt leaves, buds, flowers and mistletoe and favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species. It roosts in tree hollows, with a particular selection for large hollows in large, old trees. Individuals use multiple hollows and a relatively high abundance of tree hollows (at least 4-8 suitable hollows per hectare) seems to be needed for the species to persist. Individuals occupy relatively small home ranges with an average size of 1 to 3 ha, but the species has relatively low persistence in small forest fragments and disperses poorly across vegetation that is not native forest. Forest patches of at least 160 km^2 may be required to maintain viable populations.	PMST	-	Low – this species is not known from the locality and the closest records are from Kaputar National Park. Some areas of marginal habitat (riparian areas with mature River Redgum) may be found in the in study area.

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Mammals	*Petaurus norfolcensis*	Squirrel Glider	-	V	The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey.	5 – OEH	Northern Basalts	**Moderate** – this species has been recorded in Kaputar National Park and Bobbiwaa State Conservation Area. Although vegetation in the study area is very fragmented, it offers an abundance of hollow-bearing trees suitable for this species, particularly in River Red Gum Woodlands (e.g. Bobbiwaa Creek is connected to the conservation area). Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)
Mammals	*Petrogale penicillata*	Brush-tailed Rock-wallaby	V	E	Range extends from south-east Queensland to the Grampians in western Victoria, roughly following the line of the Great Dividing Range. Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.	PMST	-	None– species not known from the locality. Only marginal habitat in the study area. Associated (marginal) habitat present in the study area includes: Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - Belah woodland (PCT 56)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Mammals	*Phascolarctos cinereus*	Koala	V	V	In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	39 – OEH PMST	Northern Outwash Northern Basalts	**High** – this species was identified north of the Mehi River in Moree during field surveys, but no conclusive evidence was found within the study area. A single previous record is known from the study area (Bellata) and there are multiple other records in the locality, in larger woodland remnants further to the east. Habitat in the study area likely to be part of the home range of a low-density population. Associated (marginal) habitat present in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) .

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Mammals	*Pseudomys delicatulus*	Delicate Mouse	-	E	The Delicate Mouse is distributed from the north-west of Western Australia, across northern Australia to the south east of Queensland. Until recently, no records of the species were known from NSW. In 2002, as part of intensive surveys at 160 sites in the Brigalow Belt South Bioregion, three individuals were trapped at two sites in Bebo State Forest, north of Warialda near the NSW-Queensland border (now Dthinna Dthinnawan National Park). One mouse was in Smooth-barked Apple *Angophora leiocarpa* woodland on deep sandy soil; and two were found in Broad-leaved Ironbark - Silver-leaved Ironbark *Eucalyptus fibrosa - E. melanophloia* woodland. These records represent a significant southern range extension for the species. Given the close relationship between this species and the Pilliga Mouse, habitat selection in NSW may be broad. The Delicate Mouse has been found to occupy grassy habitats and excavates simple burrows to 40cm in depth.	Associated PCT/s only	Northern Basalts	Low – most southern extent of this species is near the QLD border at Dthinna Dthinnawan National Park.

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Mammals	*Pseudomys pilligaensis*	Pilliga Mouse	V	V	Distribution restricted to the Pilliga region of New South Wales. However, a Pilliga Mouse was reportedly trapped in the Warrumbungle's after a major wildfire in January 2013, suggesting a local population may have previously existed that could now respond to early stages of the post-fire succession. The Pilliga Mouse is very sparsely distributed and appears to prefer areas with a sparse ground cover. Some evidence exists of marked population fluctuations by this species. The Pilliga Mouse is restricted to an isolated area of low-nutrient deep sand which has long been recognised as supporting a distinctive vegetation type (Pilliga Scrub). Recent studies indicate that the Pilliga Mouse were found in greatest abundance in recently burnt moist gullies, areas dominated by broombush and areas containing an understorey of kurricabah (*Acacia burrowii*) with a bloodwood (*Corymbia trachyphloia*) overstorey. Consistent features of the latter two habitats were: a relatively high plant species richness; a moderate to high low shrub cover; and a moist groundcover of plants, litter and fungi. The gully where high rates of capture were encountered had an extensive cover by low grasses and sedges, with little shrub cover and large areas of ash-covered ground.	1 – OEH PMST	-	Low – infrequently recorded in the locality. There are numerous records in the Pilliga National Park. Some suitable areas of habitat may be present in the study area however these are small and fragmented. Associated (marginal) habitat present in the study area includes: Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397).
Mammals	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	V	Generally, found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. In times of natural resource shortages, they may be found in unusual locations. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating, and for giving birth and rearing young.	PMST	Northern Outwash Northern Basalts	Low – no camps within 150 km of the study area. Associated (marginal) habitat present in the study area includes: Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35).

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Mammals	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	-	V	Wide-ranging species found across northern and eastern Australia. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows.	17 – OEH	Northern Outwash Northern Basalts	**High** – this species may forage in woodland/forest and roost in hollow-bearing trees in the study area. Associated habitat present in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Mammals	*Sminthopsis macroura*	Stripe-faced Dunnart	-	V	Throughout much of inland central and northern Australia, extending into central and northern NSW, western Queensland, Northern Territory, South Australia and Western Australia. They are rare on the NSW Central West Slopes and North West Slopes with the most easterly records of recent times located around Dubbo, Coonabarabran, Warialda and Ashford. Native dry grasslands and low dry shrublands, often along drainage lines where food and shelter resources tend to be better. They shelter in cracks in the soil, in grass tussocks or under rocks and logs. Co-occupies areas with the more common Fat-tailed Dunnart but prefers relatively ungrazed habitats with greater diversity and healthier understorey vegetation.	2- ALA	Northern Outwash Northern Basalts	**High** – there are two records in the locality, between Tycannah and Moree, one of which is in contiguous habitat <1 km from the study area. Associated habitat present in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Poplar Box - Belah woodland (PCT 56) Weeping Myall open woodland (PCT 27) Poplar Box - Belah woodland (PCT 56) Weeping Myall open woodland (PCT 27) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Mammals	*Vespadelus troughtoni*	Eastern Cave Bat	-	V	Found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals.	1 – OEH	Northern Basalts	Moderate – this species may forage in and around forest/woodland and roost in Fairy Martin mud nests in bridges and culverts in the study area. Associated habitat present in the study area includes: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)
Reptiles	*Amalosia rhombifer*	Zigzag Velvet Gecko	-	E	The Zigzag Velvet Gecko was first recorded in NSW in 2001, and only a small number of records are known from locations on the north western slopes near the NSW-Queensland border. Two of these locations are from reserves: Dthinna Dthinnawan National Park and Arakoola Nature Reserve. Largely confined to woodland habitats, with such canopy species as *Eucalyptus sideroxylon, E. moluccana, E. blakelyi* and *Callitris* species. It has also been recorded from urban environments in Queensland. This species is largely arboreal, living and foraging in trees. NSW specimens have been found beneath the decorticating bark of standing trees.	Associated PCT/s only	Northern Basalts	Low – species not recorded in locality. Some areas in study area may offer marginal habitat features. Associated (marginal) habitat present in the study area includes: 35

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Reptiles	*Anomalopus mackayi*	Five-clawed Worm-skink	V	E	Patchy distribution on the North West Slopes and Plains of north-east NSW and south-east Queensland, from the Ashford area west to Mungindi and Walgett in NSW and north to Dalby in Queensland. Close to or on the lower slopes of slight rises in grassy White Box woodland on moist black soils, and River Red Gum-Coolabah-Bimble Box woodland on deep cracking loose clay soils. May also occur in grassland areas and open paddocks with scattered trees. Live in permanent deep tunnel-like burrows and deep soil cracks, coming close to the surface under fallen timber and litter, especially partially buried logs.	5 – OEH PMST	Northern Outwash Northern Basalts	Low – suitable habitat widespread but expert advice confirms it is not on any land affected by the proposed modification. The proposed modification is in the middle of the 'likely-to-occur' distribution (DSEWPaC 2011), with the floodplain area around Bellata also being in the 'known' distribution of the species which why expert advice was engaged. The expert advised considered species presence in: Belah woodland on alluvial plains and low rises (PCT 55) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Poplar Box - Belah woodland (56) Weeping Myall open woodland (PCT 27) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Reptiles	*Antaresia stimsoni*	Stimson s Python	-	V	Occurs in north-west NSW, from Bourke and Gundabooka National Park in the east to Broken Hill and Wilcannia in the south. A terrestrial and semi-arboreal species that inhabits a wide range of arid and semi-arid environments including rock outcrops, sandy plains and dune fields where it is associated with larger trees and termite mounds. The species occupies a broad spectrum of habitats includes woodlands, shrublands (including *Acacia* and chenopods) and hummock grasslands, where rocky outcrops provide caves and deep crevices and where tree-lined watercourses provide numerous low hollows and fallen trees.	Associated PCT/s only	-	Low; study area outside of the species' known range and habitat is marginal. Associated (marginal) habitat present in the study area includes: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52).
Reptiles	*Aprasia parapulchella*	Pink-tailed Legless Lizard	V	V	The Pink-tailed Legless Lizard is only known from the Central and Southern Tablelands, and the South Western Slopes. There is a concentration of populations in the Canberra / Queanbeyan Region. Other populations have been recorded near Cooma, Yass, Bathurst, Albury and West Wyalong. This species is also found in the Australian Capital Territory. Inhabits sloping, open woodland areas with a predominantly native grassy groundlayer, particularly those dominated by Kangaroo Grass (*Themeda australis*). Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks. Commonly found beneath small, partially-embedded rocks and appear to spend considerable time in burrows below these rocks; the burrows have been constructed by and are often still inhabited by small black ants and termites.	PMST	-	Low – this species is not known from the area. Associated (marginal) habitat present in the study area includes:
Reptiles	*Demansia rimicola*	a whip snake	-	V	Collected in Tibooburra and the vicinity of Sturt National Park. A terrestrial, predominantly diurnal species that shelters under fallen timber, flat rocks, debris, in deep soil cracks, rock crevices, grass clumps, and animal burrows. Preferred habitats include open forests, woodlands or shrublands with an understorey of grass, shrubs or hummock grasslands on the slopes and plains.	Associated PCT/s only	-	Low; study area outside of the species' known range and habitat is marginal. Associated (marginal) habitat present in the study area includes: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52).

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Reptiles	*Furina dunmalli*	Dunmall s Snake	V	-	Occurs in south-east interior of Queensland, including the Darling Downs, and is thought to potentially extend into inland north-eastern NSW. Most locality records are between 200 and 500 m elevation. Preferred habitat is Brigalow forest and woodland with fallen timber and ground litter, growing on cracking clay soils and clay loam soils. Also occurs in eucalypt and Callitris woodland with fallen timber and ground litter.	Associate d PCT/s only	Northern Basalts	Low – Not recorded in the locality and there is only at best marginal habitat for this species in the study area. Associated (marginal) habitat present in the study area includes: Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35)
Reptiles	*Hoplocephalus bitorquatus*	Pale-headed Snake	-	V	A patchy distribution from north-east Queensland to the north-eastern quarter of NSW. In NSW it has historically been recorded from as far west as Mungindi and Quambone on the Darling Riverine Plains, across the north west slopes, and from the north coast from Queensland to Sydney. The Pale-headed Snake is a highly cryptic species that can spend weeks at a time hidden in tree hollows. Found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest.	9 – OEH	Northern Outwash Northern Basalts	**Moderate** – may occur in the study area, particularly around vegetated creek lines. Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27)
Reptiles	*Uvidicolus sphyrurus (Underwoodisaur us sphyrurus)*	Border Thick-tailed Gecko	V	V	Found only on the tablelands and slopes of northern NSW and southern Queensland, reaching south to Tamworth and west to Moree. Most common in the granite country of the New England Tablelands. Occurs at sites ranging from 500 to 1100 m elevation. Populations are mostly fragmented, with over 50 discrete sites currently known that are separated by at least 2 km. As implied by another of its common names (Granite Thick-tailed Gecko), this species often occurs on steep rocky or scree slopes, especially granite. Recent records from basalt and metasediment slopes and flats indicate its habitat selection is broader than formerly thought and may have extended into areas that were cleared for agriculture. Favours forest and woodland areas with boulders, rock slabs, fallen timber and deep leaf litter. Occupied sites often have a dense tree canopy that helps create a sparse understorey.	PMST	Northern Basalts	Low – Not recorded in the locality and there is only at best marginal habitat for this species in the study area. Associated (marginal) habitat present in the study area includes:

Appendix B – Assessments of significance – BC Act

Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

a. **in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.**

Not applicable

b. **in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:**
   i. **is likely to have an adverse effect on the extent of the ecological community such that its local viable population is likely to be placed at risk of extinction, or**
   ii. **is likely to substantially and adversely modify the composition of the ecological community such that its local viable population is likely to be placed at risk of extinction,**

In addressing this question, the local viable population of the threatened ecological community is taken to be the community that occurs within the study area and all contiguous areas of the community (as defined in the *Threatened Species Assessment Guidelines: The Assessment of Significance* (Department of Environment and Climate Change 2007). The local occupancy has been contextualised and is consistent with a 'viable local population' identified within 1500 metres of the proposed modification. Risk of extinction is used here as the likelihood that the local viable population of the ecological community would become extinct either in the short-term or in the long-term as a result of direct or indirect impacts on the threatened ecological community from the proposed modification. Composition refers to the assemblage of species and the physical structure of the community.

Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (the TEC) is listed as an endangered ecological community and is considered likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

The mapped local viable population of the TEC extends outside the study area and is about 387.96 hectares of which 387.06 will remain after 0.9 hectares is removed as a result of the proposed modification. It should be noted however that the broad scale mapping in the locality has proven to be somewhat inaccurate in relation to the study area but to manage this limitation ground truthing was undertaken in December 2019 to increase the accuracy of the mapping. Therefore, the local viable population can only be estimated but it is based on well informed mapping. Area agrees and has been consistent with Jacobs (2018) in managing derived / low quality parts of PCT27 as not part of the EEC.

The proposed modification would remove about 0.9 hectares of the TEC from a local viable population of about 387.96 hectares. The area that would be removed by the proposed modification represents less than 0.01 per cent of the local viable population. The proposed modification is also likely to reduce the quality of some of the adjacent retained area of the TEC due to edge effects such as increased light, increased wind, altered hydrology and weed invasion leading to indirect impacts.

A breakdown of the potential impacts to this TEC according to proposed modification segment is provided below in Table B.1.

Table B.1 Breakdown of impacts to the Weeping Myall Woodland TEC by proposed modification segment

Threatened Ecological Community (BC Act)	N2MS1 (ha)	N2MS2 (ha)	N2MS3 (ha)	N2MS4 (ha)	N2MS5 (ha)	Total (ha)
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (Endangered)	0.03	0.79	0.08	0	0	0.9

The absolute impact in terms of hectares removed (approximately 0.9) is considered minor as it is less than 0.01% of the local viable population. The proposed modification will contribute to reducing the extent of the local viable population, but it is considered unlikely to have an adverse effect on the extent of the TEC such that its local viable population is likely to be placed at risk of extinction.

in relation to the habitat of a threatened species or ecological community:

iii. the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and
iv. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
v. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality[1]

The proposed modification is predicted to remove around 0.9 hectares of the TEC from a local viable population of about 387.96 hectares (Less than 0.01 per cent affected). After the proposed modification 386.06 hectares will remain.

The patches of the TEC that make up the local viable population are already somewhat fragmented and isolated by the existing Newell Highway. The proposed modification is unlikely to break the local viable population into more fragments, so fragmentation is not an issue. However, the proposed modification is likely to increase the distance between the remaining fragments due to the road widening, as the distance between patches on either side of road would be increased, resulting in a level of increased isolation. This increased isolation may result in a reduction in the function of ecological processes such as pollination and seed dispersal (e.g. seed dispersal by ants) between fragments.

The patches of the TEC affected are of small to large size and vary in structure from old growth woodland (i.e. possibly never previously cleared) through regrowth shrubland to derived grassland. The TEC exists in two condition states; Moderate-to-Poor (small patches and derived grassland including some areas with substantial weed cover), and Moderate-to-Good (regrowth shrubland and old growth patches clearly dominated by native species). Due to their size, generally moderate to good condition and continuity with other native vegetation, the TEC patches in the study area are considered to retain moderate to high levels of ecological integrity and function. Due to the conservation significance of this TEC, all remaining moderate to large sized remnants in moderate to good condition are likely to be important for its long-term survival. As such, the moderate to good condition TEC patches within the study area (0.9 hectares) are considered to be important to the long-term survival of the community in the locality. As the impact removes its edge the significance is lowered.

c. whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The proposed modification will not impact on any declared area of outstanding biodiversity value.

d. whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

A Key Threatening Process (KTP) is a process which threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs. Of the 38 listed KTPs under the BC Act, 23 are applicable to the TECs subject to this assessment (see Table B.2).

The proposed modification would undoubtedly result in an increase in the following three KTPs:

- Clearing of native vegetation
- Removal of dead wood and dead trees
- Invasion of native plant communities by exotic perennial grasses.

The main effect on KTPs would be the substantial *Clearing of native vegetation* and *Removal of dead wood and dead trees*. Due to the scale of native vegetation loss, the impact on this KTP in the local context is considered to be not significant.

While there is potential for other KTPs of relevance to this TEC to be affected by the proposed modification, these KTPs are likely to be able to be adequately managed by TfNSW' standard environmental management measures. A significant impact is unlikely.

Table B.2 Key threatening processes that may result from the proposed modification that may affect threatened ecological communities

Key threatening process	Relevance to the TEC and proposed modification
Removal of dead wood and dead trees	**Increased.** Some dead wood and dead trees would be removed as part of the proposed modification; dead wood and dead trees would be lost from the 0.9 hectares of the TEC.
Clearing of native vegetation	**Increased.** The proposed modification would result in clearing of approximately 0.9 hectares of the TEC.
Invasion of native plant communities by exotic perennial grasses	**Likely.** The proposed modification is likely to result in the invasion and establishment of exotic perennial grasses. However, weed control measures would be followed to minimise invasion and establishment of exotic perennial grasses.
Anthropogenic Climate Change	Possibly increased. The proposed modification would result in the loss of a carbon sink consisting of native vegetation. The proposed modification will generate CO_2 emissions; these emissions may be somewhat countered by increased efficiency of vehicles on the upgraded road. The loss of a carbon sink may also be offset by increased woody vegetation associated with biodiversity offsets.
High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition	Possibly increased. The construction phase of the proposed modification could result in accidental fire and associated disruption to native vegetation. Part of this community has recently been affected by fire and is recovering. Another fire in the short-term may be very detrimental.
Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners Manorina melanocephala	Possible but low risk. The proposed modification would result in additional habitat isolation that may encourage proliferation of Noisy Miners.
Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners	Possibly increased. The proposed modification would result in additional fragmentation that may encourage proliferation of Bell Miners.
Introduction of the Large Earth Bumblebee Bombus terrestris (L.)	Possible but low risk. The proposed modification could result in the importation of Large Earth Bumblebee if plant/vehicles or materials are imported from areas containing the species. However, control measures would be followed to prevent introduction.
Invasion of the Yellow Crazy Ant, Anoplolepis gracilipes (Fr. Smith) into NSW	Possible but low risk. The proposed modification could result in the importation of Yellow Crazy Ant if plant/vehicles or materials are imported from areas containing the species. However, control measures would be followed to prevent importation.
Importation of Red Imported Fire Ants Solenopsis invicta Buren 1972	Possible. The proposed modification could result in the importation of Fire Ants if plant/vehicles or materials are imported from areas containing the species. However, control measures would be followed to prevent importation.
Infection of native plants by Phytophthora cinnamomi	Possible. The proposed modification could result in the introduction or spread of *Phytophthora cinnamomi*. However, hygiene measures would be followed to prevent spread of *Phytophthora cinnamomi*.
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	Possible. The proposed modification could result in the introduction or spread of Exotic Rust Fungi. However, hygiene measures would be followed to prevent spread of Exotic Rust Fungi.

Key threatening process	Relevance to the TEC and proposed modification
Invasion and establishment of exotic vines and scramblers	Possible. The proposed modification could result in the invasion and establishment of exotic vines and scramblers. However, weed control measures would be followed to prevent invasion and establishment of exotic vines and scramblers.
Invasion and establishment of Scotch Broom (Cytisus scoparius)	Possible. The proposed modification could result in the invasion and establishment of Scotch Broom. However, weed control measures would be followed to prevent invasion and establishment of Scotch Broom.
Invasion of native plant communities by African Olive Olea europaea L. subsp. cuspidata	Possible. The proposed modification could result in the invasion and establishment of African Olive. However, weed control measures would be followed to prevent invasion and establishment of African Olive.
Invasion of native plant communities by *Chrysanthemoides monilifera*	Possible. The proposed modification could result in the invasion and establishment of *Chrysanthemoides monilifera*. However, weed control measures would be followed to prevent invasion and establishment of *Chrysanthemoides monilifera.*
Invasion, establishment and spread of Lantana camara	Possible. The proposed modification could result in the invasion and establishment of *Lantana camara*. However, weed control measures would be followed to prevent invasion and establishment of *Lantana camara.*
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	Possible. The proposed modification could result in the invasion and establishment of escaped garden plants. However, weed control measures would be followed to prevent invasion and establishment of escaped garden plants.
Competition from feral honeybees, Apis mellifera L.	Neutral. The proposed modification is unlikely to influence feral bee numbers.
Herbivory and environmental degradation caused by feral deer	Neutral. The proposed modification is unlikely to influence feral deer numbers.
Competition and habitat degradation by Feral Goats, Capra hircus Linnaeus 1758	Neutral. The proposed modification is unlikely to influence feral goat numbers.
Predation, habitat degradation, competition and disease transmission by Feral Pigs, Sus scrofa Linnaeus 1758	Neutral. The proposed modification is unlikely to influence Feral Pig numbers.
Competition and grazing by the feral European Rabbit, Oryctolagus cuniculus (L.)	Neutral. The proposed modification is unlikely to influence feral rabbit numbers.

Conclusion

The TEC within the study area is likely to be important to the long-term survival of the TEC in the locality as the patches are of moderate size and in moderate to good condition. The proportion of the local viable population affected impact is low (0.9 ha of 387.96 ha; <0.01%) when considered in the context of the known extent of the TEC within the broader locality. The proposed modification is considered likely to adversely modify the composition of adjacent areas of the TEC that would not be cleared, due to increased edge effects but not to the point of resulting in local extinction. There is likely to be an increase in isolation of patches within the local viable population due to the increase in the width of cleared land associated with the road. The proposed modification would contribute to some KTPs that cannot be mitigated against including clearing of native vegetation and removal of dead wood and dead trees.

The direct impact within the proposed modification area is small and the remaining patches will be subject to degradation from edge effects, the overall low proportional impact on the local viable population suggests it is unlikely to have an adverse effect on the extent of the TEC such that its local viable population is likely to

be placed at risk of extinction. Modification of the adjacent retained TEC is likely to adversely modify the composition of the TEC through edge effects. However, this in itself is not likely to place the local viable population at risk of extinction.

Considering the context of the TEC and intensity of the potential impacts to the TEC from the proposed modification, an overall conclusion has been made that the proposed modification is unlikely to result in a significant effect to this TEC.

Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats*:*

a. in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable

b. in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:
- **i. is likely to have an adverse effect on the extent of the ecological community such that its local viable population is likely to be placed at risk of extinction, or**
- **ii. is likely to substantially and adversely modify the composition of the ecological community such that its local viable population is likely to be placed at risk of extinction,**

In addressing this question, the local viable population of this threatened ecological communities is taken to be the community that occurs within the study area and all contiguous vegetation (as defined in the *Threatened Species Assessment Guidelines: The Assessment of Significance* (Department of Environment and Climate Change, 2007). Risk of extinction is used here as the likelihood the local viable population of the ecological community would become extinct either in the short-term or in the long-term as a result of direct or indirect impacts on the threatened ecological community from the proposed modification. The local viable population within 1500 metres from the proposed modification is 53.36 hectares. Composition refers to the assemblage of species and the physical structure of the community.

Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions is listed as an endangered ecological community (TEC) and is considered likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

The study area contains patches of the TEC in close proximity to one another totalling approximately 1.47 hectares. The local viable population of the TEC was ground truthed as about 53.36 hectares. The area removed by the proposed modification represents about 2.75 per cent of the local viable population. The proposed modification is also likely to reduce the quality of some of the adjacent retained area of the TEC due to edge effects such as increased light, increased wind, altered hydrology and weed invasion. The impact would mostly occur on one side of the road, the side where a smaller patch of the community occurs and would mostly be restricted to highly to moderately disturbed edges. Due to its relatively small extent the clearing proposed is unlikely to significantly reduce the viability of the remaining area.

The absolute impact to the EEC in terms of hectares removed are not very high, and when the impact is considered in the local context, and in proportion to the size of the local viable population of the TEC, they are not considered significant. A breakdown of the potential impacts to this TEC according to proposed modification segment is provided below in Table B.3. Redesign of the proposed modification for avoidance and minimisation of impacts on this TEC in N2MS4 has greatly reduced impacts to this TEC.

Table B.3 Breakdown of impacts to the Brigalow TEC by proposed modification segment

Threatened Ecological Community (BC Act)	N2MS1 (ha)	N2MS2 (ha)	N2MS3 (ha)	N2MS4 (ha)	N2MS5 (ha)	Total (ha)
Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (Endangered)	-	-	-	1.47	-	1.47

The proposed modification is considered unlikely to increase the likelihood of the extinction of the local viable population of the TEC.

c. in relation to the habitat of a threatened species or ecological community:
   i. the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and
   ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
   iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.

The proposed modification is predicted to remove around 1.47 hectares of the TEC from a local viable population of about 53.36 hectares. This represents about 2.75 per cent of the local viable population.

The patches of the TEC that make up the local viable population are already somewhat fragmented and isolated by the Newell Highway. The proposed modification is unlikely to break the local viable population into more fragments. However, it is likely to slightly increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in slightly increased isolation. This increased isolation may result in a slight reduction in the function of ecological processes such as pollination and seed dispersal (e.g. seed dispersal by ants) between fragments. This disruption of ecological processes would contribute to a small extent to an increased risk of extinction of the local viable population of the TEC.

The patches of the TEC affected are of small to moderate size (totalling 1.47 ha) and is regrowth. It ranges in condition from in moderate condition (recovering from recent fire and/or edge-effected) to high condition (core areas in apparently natural condition). Due to their size, moderate to good condition, and continuity with other native vegetation, the TEC patches in the study area are considered to retain high levels of ecological integrity and function.

Due to the conservation significance of this TECs all remaining moderate to large sized remnants in moderate to good condition are likely to be important for its long-term survival. As such, the TEC patches within the study area are considered to be important for the long-term survival of the community in the locality.

While the proposed modification would remove some important habitat, the area to be removed is relatively small and much of the vegetation to be removed is already moderately disturbed resulting in a significant impact on habitat for the community being unlikely.

d. whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The proposed modification will not impact on any declared area of outstanding biodiversity value.

e. whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

A Key Threatening Process (KTP) is a process which threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs. Of the 38 listed KTPs under the BC Act, 23 are applicable to the TECs subject to this assessment (see Table B.4).

The proposed modification would result in an increase in the following KTPs:

- Invasion of native plant communities by exotic perennial grasses
- Clearing of native vegetation
- Removal of dead wood and dead trees

The main effect on KTPs would be the *Clearing of native vegetation*. Brigalow is currently threatened by clearing, fire and weed invasion. Due to the scale of clearing proposed (i.e. 2.75 % of the local viable population), the impact of the proposed modification on this KTP in the local context is not considered to be significant and it is unlikely contribute significantly to the long-term decline of remaining areas. Removal of dead wood will occur, and the proposed modification may increase invasion by exotic perennial grasses.

While there is potential for other KTPs of relevance to this TEC to be affected by the proposed modification, these KTPs are likely to be able to be adequately managed by TfNSW' standard environmental management measures.

Considering the context of the TEC and intensity of the potential impacts to the TEC from the proposed modification, an overall conclusion has been made that the proposed modification is unlikely to result in a significant effect to this TEC.

Table B.4 Key threatening processes that may result from the proposed modification that may affect threatened ecological communities

Key threatening process	Relevance to the TEC and proposed modification
Removal of dead wood and dead trees	**Increased.** Some dead wood and dead trees would be removed as part of the proposed modification; dead wood and dead trees would be lost from the 0.66 hectares of the TEC).
Clearing of native vegetation	**Increased.** The proposed modification would result in clearing of approximately 0.66 hectares of the TEC.).
Invasion of native plant communities by exotic perennial grasses	**Likely.** The proposed modification is likely to result in the invasion and establishment of exotic perennial grasses. However, weed control measures would be followed to minimise invasion and establishment of exotic perennial grasses.
Anthropogenic Climate Change	Possibly increased. The proposed modification would result in the loss of a carbon sink consisting of 1.47 hectares of Brigalow. The proposed modification will generate CO_2 emissions; these emissions may be somewhat countered by increased efficiency of vehicles on the upgraded road. The loss of a carbon sink may be offset by increases in woody native vegetation elsewhere, associated with biodiversity offsets.
High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition	Unlikely. The construction phase of the proposed modification could result in accidental fire and associated disruption to native vegetation. Part of this community has recently been affected by fire and is recovering. Another fire in the short-term may be very detrimental.
Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners Manorina melanocephala	Possibly increased. The proposed modification would result in additional fragmentation that may encourage proliferation of Noisy Miners.
Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners	Low risk. Bell miners not associated with this habitat.
Introduction of the Large Earth Bumblebee Bombus terrestris (L.)	Possible but low risk. The proposed modification could result in the importation of Large Earth Bumblebee if plant/vehicles or materials are imported from areas containing the species. However, control measures would be followed to prevent introduction.
Invasion of the Yellow Crazy Ant, Anoplolepis gracilipes (Fr. Smith) into NSW	Low risk
Importation of Red Imported Fire Ants Solenopsis invicta Buren 1972	Low risk.
Infection of native plants by Phytophthora cinnamomi	Possible. The proposed modification could result in the introduction or spread of *Phytophthora cinnamomi*. However, hygiene measures would be followed to prevent spread of *Phytophthora cinnamomi*.
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	Possible. The proposed modification could result in the introduction or spread of Exotic Rust Fungi. However, hygiene measures would be followed to prevent spread of Exotic Rust Fungi.

Key threatening process	Relevance to the TEC and proposed modification
Invasion and establishment of exotic vines and scramblers	Low risk. The proposed modification could result in the invasion and establishment of exotic vines and scramblers. However, weed control measures would be followed to prevent invasion and establishment of exotic vines and scramblers.
Invasion and establishment of Scotch Broom (Cytisus scoparius)	Low risk. The proposed modification could result in the invasion and establishment of Scotch Broom. However, weed control measures would be followed to prevent invasion and establishment of Scotch Broom.
Invasion of native plant communities by African Olive Olea europaea L. subsp. cuspidata	Low risk. The proposed modification could result in the invasion and establishment of African Olive. However, weed control measures would be followed to prevent invasion and establishment of African Olive.
Invasion of native plant communities by *Chrysanthemoides monilifera*	Low risk. The proposed modification could result in the invasion and establishment of *Chrysanthemoides monilifera*. However, weed control measures would be followed to prevent invasion and establishment of *Chrysanthemoides monilifera.*
Invasion, establishment and spread of Lantana camara	Low risk. The proposed modification could result in the invasion and establishment of *Lantana camara*. However, weed control measures would be followed to prevent invasion and establishment of *Lantana camara.*
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	Low risk. The proposed modification could result in the invasion and establishment of escaped garden plants. However, weed control measures would be followed to prevent invasion and establishment of escaped garden plants.
Competition from feral honeybees, Apis mellifera L.	Neutral. The proposed modification is unlikely to influence feral bee numbers.
Herbivory and environmental degradation caused by feral deer	Neutral. The proposed modification is unlikely to influence feral deer numbers.
Competition and habitat degradation by Feral Goats, Capra hircus Linnaeus 1758	Neutral. The proposed modification is unlikely to influence feral goat numbers.
Predation, habitat degradation, competition and disease transmission by Feral Pigs, Sus scrofa Linnaeus 1758	Neutral. The proposed modification is unlikely to influence Feral Pig numbers.
Competition and grazing by the feral European Rabbit, Oryctolagus cuniculus (L.)	Neutral. The proposed modification is unlikely to influence feral rabbit numbers.

Conclusion

Any part of a TEC is likely to be important to its long-term survival. Outside of the study area, the nearest known occurrence of the TEC is in excess of 30 kilometres away to the north-east separated by a mixture of non-native vegetation (croplands) and other native vegetation types. Consequently, the TEC within the study area is the only known occurrence in the locality. 0.66 ha of 10.5 ha; or about 5% of the local viable population will be affected, this is not considered significant. The proposed modification is also considered to have potential to adversely modify the composition of some adjacent areas of the TEC. There is likely to be a small increase in isolation of patches within the local viable population due to the increase in the width of cleared land associated with the road. The proposed modification would result in a relatively small increase to some KTPs, some of which may be mitigated against. In summary, with the inclusion in the proposed modification of intensive weed control and vegetation restoration, the proposed modification is considered unlikely to have a significant effect on the local viable population of the *Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions* TEC.

Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats*:*

a. in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable

b. in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:
- **i. is likely to have an adverse effect on the extent of the ecological community such that its local viable population is likely to be placed at risk of extinction, or**
- **ii. is likely to substantially and adversely modify the composition of the ecological community such that its local viable population is likely to be placed at risk of extinction,**

In addressing this question, the local viable population of these threatened ecological communities is taken to be the PCTs associated with it occurring in 1500 metres of the proposed modification and all contiguous vegetation (as defined in the Threatened Species Assessment Guidelines: The Assessment of Significance Department of Environment and Climate Change, 2007). Risk of extinction is used here as the likelihood the local viable population of the ecological community would become extinct either in the short-term or in the long-term as a result of direct or indirect impacts on the threatened ecological community from the proposed modification. Composition refers to the assemblage of species and the physical structure of the community.

For the purposes of this assessment the viable local population is 52.49 hectares.

Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions is listed as an endangered ecological community (TEC) and is considered likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

The study area contains patches of the TEC in close proximity to one another totalling about 2.04 hectares. The TEC is composed of the following PCTs:

- Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion (147) – 0.11 ha
- Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions (55) – 1.93 ha. This TEC is a partial subset of the PCT.

Within the study area the TEC is restricted to N2MS4. The extent and distribution of vegetation containing the TEC, comprising the local viable population is 52.49 hectares. The area removed would about 3.85 per cent of the local viable population, a small proportional impact.

The proposed modification is also likely to reduce the quality of some of the adjacent retained area of the TEC due to edge effects such as increased light, increased wind, altered hydrology and weed invasion. The absolute impact in terms of hectares removed is not high, and when the impacts are considered in the local context, and in proportion to the size of the presumed local viable population of the TEC, they are unlikely significant and likely to have an adverse effect on the extent of the TEC and its local viable population is unlikely to be placed at significantly elevated risk of extinction.

c. in relation to the habitat of a threatened species or ecological community:
- **i. the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
- **ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**
- **iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.**

The proposed modification would remove about 2.04 hectares of vegetation containing small patches of the TEC from a local viable population of similar vegetation of about 52.49 hectares. The area removed would about 3.85 per cent of the local viable population, a small proportional impact.

The patches of the TEC that make up the local viable population are already somewhat fragmented and isolated by the existing Newell Highway. The proposed modification is unlikely to break the local viable

population into more fragments. However, it is likely to slightly increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in slightly increased isolation. This increased isolation may result in a small reduction in the function of ecological processes such as pollination and seed dispersal (e.g. seed dispersal by ants) between fragments. This disruption of ecological processes would contribute to a slightly increased risk of extinction of the local viable population of the TEC.

Due to the conservation significance of this TEC all remaining moderate to large sized remnants in moderate to good condition and are likely to be important for its long-term survival, particularly those (like the occurrence of PCT 147) with a high diversity and abundance of typical Semi evergreen vine thicket (SEVT) species. The most important area of the TEC in the study area is that comprising PCT 147. A very small area, only about 0.11 ha, of this PCT, would be directly impacted. The patches of the TEC which are part of PCT 55 are considered to be of lower importance as they contain a lower diversity and abundance of typical Semi-evergreen Vine Thicket species and are considered to be transitional in nature between pure Semi-evergreen Vine Thicket (like PCT 147) and the broader PCT 55.

d. whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The proposed modification will not impact on any declared area of outstanding biodiversity value.

e. whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs. Of the 38 listed KTPs under the BC Act, 23 are applicable to the TECs subject to this assessment (see Table B.6).

The proposed modification would result in an increase in the following KTPs:

- Invasion of native plant communities by exotic perennial grasses
- Clearing of native vegetation
- Removal of dead wood and dead trees.

The main effect on KTPs would be the *Clearing of native vegetation*. The TEC is currently threatened by clearing, fire and weed invasion. Due to the scale of clearing proposed (i.e. about 3.85 per cent of the associated PCT in the locality), the impact of this KTP in the local context is considered to be a minor reduction in extent and would not significantly contribute to a long-term decline of remaining areas. Removal of dead wood will likely occur, and the proposed modification has potential to increase invasion by exotic perennial grasses, but it would not be significant.

While there is potential for other KTPs of relevance to this TEC to be affected by the proposed modification, these KTPs are likely to be able to be adequately managed by TfNSW' standard environmental management measures.

Table B.6 Key threatening processes that may result from the proposed modification that may affect threatened ecological communities

Key threatening process	Relevance to the TEC and proposed modification
Removal of dead wood and dead trees	**Increased.** Some dead wood and dead trees would be removed as part of the proposed modification; dead wood and dead trees would be lost from the 0.48 hectares of the TEC.
Clearing of native vegetation	**Increased.** The proposed modification would result in clearing of approximately 0.48 hectares of the TEC.).
Invasion of native plant communities by exotic perennial grasses	**Likely.** The proposed modification is likely to result in the invasion and establishment of exotic perennial grasses. However, weed control measures would be followed to minimise invasion and establishment of exotic perennial grasses.

Key threatening process	Relevance to the TEC and proposed modification
Anthropogenic Climate Change	Possibly increased. The proposed modification would result in the loss of a carbon sink. The proposed modification will generate CO2 emissions; these emissions may be somewhat countered by increased efficiency of vehicles on the upgraded road. The loss of a carbon sink may be offset by increases in woody native vegetation elsewhere, associated with biodiversity offsets.
High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition	Unlikely. The construction phase of the proposed modification could result in accidental fire and associated disruption to native vegetation. Part of this community has recently been affected by fire and is recovering. Another fire in the short-term may be very detrimental.
Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners Manorina melanocephala	Possibly increased. The proposed modification would result in additional fragmentation that may encourage proliferation of Noisy Miners.
Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners	Low risk. Bell miners not associated with this habitat.
Introduction of the Large Earth Bumblebee Bombus terrestris (L.)	Possible but low risk. The proposed modification could result in the importation of Large Earth Bumblebee if plant/vehicles or materials are imported from areas containing the species. However, control measures would be followed to prevent introduction.
Invasion of the Yellow Crazy Ant, Anoplolepis gracilipes (Fr. Smith) into NSW	Low risk.
Importation of Red Imported Fire Ants Solenopsis invicta Buren 1972	Low risk.
Infection of native plants by Phytophthora cinnamomi	Possible. The proposed modification could result in the introduction or spread of *Phytophthora cinnamomi*. However, hygiene measures would be followed to prevent spread of *Phytophthora cinnamomi*.
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	Possible. The proposed modification could result in the introduction or spread of Exotic Rust Fungi. However, hygiene measures would be followed to prevent spread of Exotic Rust Fungi.
Invasion and establishment of exotic vines and scramblers	Low risk. The proposed modification could result in the invasion and establishment of exotic vines and scramblers. However, weed control measures would be followed to prevent invasion and establishment of exotic vines and scramblers.
Invasion and establishment of Scotch Broom (Cytisus scoparius)	Low risk. The proposed modification could result in the invasion and establishment of Scotch Broom. However, weed control measures would be followed to prevent invasion and establishment of Scotch Broom.
Invasion of native plant communities by African Olive Olea europaea L. subsp. cuspidata	Low risk. The proposed modification could result in the invasion and establishment of African Olive. However, weed control measures would be followed to prevent invasion and establishment of African Olive.
Invasion of native plant communities by *Chrysanthemoides monilifera*	Low risk. The proposed modification could result in the invasion and establishment of *Chrysanthemoides monilifera*. However, weed control measures would be followed to prevent invasion and establishment of *Chrysanthemoides monilifera.*

Key threatening process	Relevance to the TEC and proposed modification
Invasion, establishment and spread of Lantana camara	Low risk. The proposed modification could result in the invasion and establishment of *Lantana camara*. However, weed control measures would be followed to prevent invasion and establishment of *Lantana camara.*
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	Low risk. The proposed modification could result in the invasion and establishment of escaped garden plants. However, weed control measures would be followed to prevent invasion and establishment of escaped garden plants.
Competition from feral honeybees, Apis mellifera L.	Neutral. The proposed modification is unlikely to influence feral bee numbers.
Herbivory and environmental degradation caused by feral deer	Neutral. The proposed modification is unlikely to influence feral deer numbers.
Competition and habitat degradation by Feral Goats, Capra hircus Linnaeus 1758	Neutral. The proposed modification is unlikely to influence feral goat numbers.
Predation, habitat degradation, competition and disease transmission by Feral Pigs, Sus scrofa Linnaeus 1758	Neutral. The proposed modification is unlikely to influence Feral Pig numbers.
Competition and grazing by the feral European Rabbit, Oryctolagus cuniculus (L.)	Neutral. The proposed modification is unlikely to influence feral rabbit numbers.

Conclusion

Part of the TEC within the study area (PCT 147) is likely to be important to the long-term survival of the TEC in the locality as the patches are of moderate size and in moderate to good condition. The areas of the TEC associated with PCT 55 are not likely to be of high importance to the long-term survival of the TEC in the locality. The presumed proportion of the local viable population affected is low at about 3.85% when considered in the context of the presumed extent of the vegetation associated with the TEC within the broader locality and the known threats to this community.

The proposed modification is also considered likely to adversely modify the composition of adjacent areas of the TEC that would not be cleared, due to increased edge effects. There is also likely to be an increase in isolation of patches within the local viable population due to the increase in the width of cleared land associated with the road. The proposed modification would contribute to some KTPs that cannot be mitigated against including clearing of native vegetation and removal of dead wood and dead trees, but the impact is likely not significant. In summary, the proposed modification is considered unlikely to have a significant impact on the extent and condition of the *Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions* TEC and unlikely to place its local viable population at a significantly greater risk of extinction.

Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats*:*

a. in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable

b. in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:
   i. is likely to have an adverse effect on the extent of the ecological community such that its local viable population is likely to be placed at risk of extinction, or
   ii. is likely to substantially and adversely modify the composition of the ecological community such that its local viable population is likely to be placed at risk of extinction,

In addressing this question, the local viable population of these threatened ecological communities is taken to be the community that occurs within the study area and all contiguous vegetation (as defined in the *Threatened Species Assessment Guidelines: The Assessment of Significance* Department of Environment and Climate Change, 2007). Risk of extinction is used here as the likelihood that the local viable population of the ecological community would become extinct either in the short-term or in the long-term as a result of direct or indirect impacts on the threatened ecological community from the proposed modification. Composition refers to the assemblage of species and the physical structure of the community.

Determining a viable local population for the purposes of this report has been problematic as the field assessment team identified the PCT in absence of Carbeen therefore ground truthing the 1500m buffer in absence of this tree where other canopy tree species associated with the EEC were present, without an ability to use formal BAM plots to align the species assemblage with the EEC has been challenging. Instead an estimation of the PCT mapped that was later identified as the EEC has been used to determine the local viable population. In this case about 80 hectares of vegetation likely associated with the EEC has been identified.

Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions (TEC) is listed as an endangered ecological community and is considered likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

The study area contains small areas of the TEC, associated with minor waterways and in disturbed narrow roadside strips. The patches of the community affected extend beyond the study areas into adjacent grazing paddocks. The patches of the TEC in the study area total about 4.76 hectares. Outside of the study area, the nearest known mapped occurrence of the TEC is in excess of seven kilometres away to the east of N2MS2 separated by a mixture of non-native vegetation (croplands) and other native vegetation types. The extent and distribution of vegetation consistent with the TEC, comprising the local viable population, is unknown but estimated as 80 hectares (conservatively) at each area. The estimate is based on existing vegetation mapping and aerial photography, the area of contiguous native vegetation possibly consistent with the TEC is estimated at around 140 hectares in N2MS2, and in N2MS5 at around 100 hectares, representing two separate local viable populations but 80 hectares has been used as this number has the highest level of confidence without further field assessment. Assuming that these estimates are reasonably accurate, the absolute and proportional impacts of the proposed modification on these populations would be low at about:

- 3.03 ha in N2MS2 equating to about 3.7 % of the presumed local viable population
- 0.01 ha in N2MS5 equating to < 0.01 % of the presumed local viable population.

The proposed modification would remove about 3.04 hectares of the TEC from two local viable populations. The proposed modification is also likely to slightly reduce the quality of some of the adjacent retained area of the TEC due to increased edge effects such as increased light, increased wind, altered hydrology and weed invasion. The absolute impact in terms of hectares removed is low, and when the impacts are considered in the local context, and in proportion to the size of the local viable population of the TEC, they may be considered to be insignificant.

A breakdown of the potential impact to this TEC according to proposed modification segment is provided below in Table B.7.

Table B.7 Breakdown of impacts to the Carbeen TEC by proposed modification segment

Threatened Ecological Community (BC Act)	N2MS1 (ha)	N2MS2 (ha)	N2MS3 (ha)	N2MS4 (ha)	N2MS5 (ha)	Total (ha)
Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions (Endangered)	-	3.03	-	-	0.01	3.04

c. in relation to the habitat of a threatened species or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

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

Based on existing vegetation mapping and aerial photography, the area of contiguous native vegetation possibly consistent with the TEC is estimated at around 80 hectares in N2MS2, and in N2MS5 at around 80 hectares, representing two separate local viable population s. Assuming that these estimates are reasonably accurate, the absolute and proportional impacts of the proposed modification on these populations would be low at about:

- 3.03 ha in N2MS2 equating to about 3.7 % of the presumed local viable population
- 0.01 ha in N2MS5 equating to < 0.01 % of the presumed local viable population.

The proposed modification would remove about 3.04 hectares of the TEC from two local viable populations.

The patches of the TEC that make up the local viable populations are already somewhat fragmented and isolated by the Newell Highway. The proposed modification is unlikely to break the local viable population into more fragments. However, it is likely to slightly increase the distance between the remaining fragments on either side of road, resulting in increased isolation. This increased isolation may result in a slight reduction in the function of ecological processes such as pollination and seed dispersal (e.g. seed dispersal by ants) between fragments. This disruption of ecological processes would contribute to a slightly increased risk of extinction of the local viable population of the TEC.

The areas of the TEC affected are of a very small size and most of the affected vegetation is in moderate condition (relatively native canopy with Carbeen absent in the project modification area and mixed native and exotic understorey) to poor condition (substantially reduced canopy with exotic species dominant in the understorey). Due to their size, moderate to poor condition and moderate continuity with other native vegetation, the TEC patches in the study area are considered to have moderate levels of ecological integrity and function.

Due to the conservation significance of this TEC all remaining moderate to large sized remnants in moderate to good condition are likely to be important for its long-term survival. As the TEC patches within the study area are relatively small, linear and in moderate to poor condition, they are not considered to be important for the long-term survival of the community in the locality.

d. whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The proposed modification will not impact on any declared area of outstanding biodiversity value.

e. whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs. Of the 38 listed KTPs under the BC Act, 23 are applicable to the TECs subject to this assessment (see Table B.8).

The proposed modification would result in an increase in the following KTPs:

- Invasion of native plant communities by exotic perennial grasses
- Clearing of native vegetation

- Removal of dead wood and dead trees.

The main effect on KTPs would be the *Clearing of native vegetation*. Carbeen TEC is currently threatened by clearing, fire and weed invasion. Due to the scale of clearing proposed, the impact of this KTP in the local context is considered to be a significant reduction in extent and may contribute to the long-term decline of remaining areas. Removal of dead wood will likely occur, and the proposed modification may increase invasion by exotic perennial grasses.

While there is potential for other KTPs of relevance to this TEC to be affected by the proposed modification, these KTPs are likely to be able to be adequately managed by TfNSW' standard environmental management measures.

Table B.8 Key threatening processes that may result from the proposed modification that may affect threatened ecological communities

Key threatening process	Relevance to the TEC and proposed modification
Removal of dead wood and dead trees	**Increased.** Some dead wood and dead trees would be removed as part of the proposed modification; dead wood and dead trees would be lost.
Clearing of native vegetation	**Increased.** The proposed modification would result in clearing of approximately 2.98 hectares of the TEC.
Invasion of native plant communities by exotic perennial grasses	**Likely.** The proposed modification is likely to result in the invasion and establishment of exotic perennial grasses. However, weed control measures would be followed to minimise invasion and establishment of exotic perennial grasses.
Anthropogenic Climate Change	Possibly increased. The proposed modification would result in the loss of a carbon sink consisting of 3.04 hectares of Carbeen EEC. The proposed modification will generate CO_2 emissions; these emissions may be somewhat countered by increased efficiency of vehicles on the upgraded road. The loss of a carbon sink may be offset by increases in woody native vegetation elsewhere, associated with biodiversity offsets.
High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition	Unlikely. The construction phase of the proposed modification could result in accidental fire and associated disruption to native vegetation. Part of this community has recently been affected by fire and is recovering. Another fire in the short-term may be very detrimental.
Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners Manorina melanocephala	Possibly increased. The proposed modification would result in additional fragmentation that may encourage proliferation of Noisy Miners.
Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners	Low risk. Bell miners not associated with this habitat.
Introduction of the Large Earth Bumblebee Bombus terrestris (L.)	Possible but low risk. The proposed modification could result in the importation of Large Earth Bumblebee if plant/vehicles or materials are imported from areas containing the species. However, control measures would be followed to prevent introduction.
Invasion of the Yellow Crazy Ant, Anoplolepis gracilipes (Fr. Smith) into NSW	Low risk.
Importation of Red Imported Fire Ants Solenopsis invicta Buren 1972	Low risk.

Key threatening process	Relevance to the TEC and proposed modification
Infection of native plants by Phytophthora cinnamomi	Possible. The proposed modification could result in the introduction or spread of *Phytophthora cinnamomi*. However, hygiene measures would be followed to prevent spread of *Phytophthora cinnamomi*.
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	Possible. The proposed modification could result in the introduction or spread of Exotic Rust Fungi. However, hygiene measures would be followed to prevent spread of Exotic Rust Fungi.
Invasion and establishment of exotic vines and scramblers	Low risk. The proposed modification could result in the invasion and establishment of exotic vines and scramblers. However, weed control measures would be followed to prevent invasion and establishment of exotic vines and scramblers.
Invasion and establishment of Scotch Broom (Cytisus scoparius)	Low risk. The proposed modification could result in the invasion and establishment of Scotch Broom. However, weed control measures would be followed to prevent invasion and establishment of Scotch Broom.
Invasion of native plant communities by African Olive Olea europaea L. subsp. cuspidata	Low risk. The proposed modification could result in the invasion and establishment of African Olive. However, weed control measures would be followed to prevent invasion and establishment of African Olive.
Invasion of native plant communities by *Chrysanthemoides monilifera*	Low risk. The proposed modification could result in the invasion and establishment of *Chrysanthemoides monilifera*. However, weed control measures would be followed to prevent invasion and establishment of *Chrysanthemoides monilifera*.
Invasion, establishment and spread of Lantana camara	Low risk. The proposed modification could result in the invasion and establishment of *Lantana camara*. However, weed control measures would be followed to prevent invasion and establishment of *Lantana camara.*
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	Low risk. The proposed modification could result in the invasion and establishment of escaped garden plants. However, weed control measures would be followed to prevent invasion and establishment of escaped garden plants.
Competition from feral honeybees, Apis mellifera L.	Neutral. The proposed modification is unlikely to influence feral bee numbers.
Herbivory and environmental degradation caused by feral deer	Neutral. The proposed modification is unlikely to influence feral deer numbers.
Competition and habitat degradation by Feral Goats, Capra hircus Linnaeus 1758	Neutral. The proposed modification is unlikely to influence feral goat numbers.
Predation, habitat degradation, competition and disease transmission by Feral Pigs, Sus scrofa Linnaeus 1758	Neutral. The proposed modification is unlikely to influence Feral Pig numbers.
Competition and grazing by the feral European Rabbit, Oryctolagus cuniculus (L.)	Neutral. The proposed modification is unlikely to influence feral rabbit numbers.

Conclusion

The TEC within the study area is likely to be moderate to low importance to the long-term survival of the TEC in the locality as the area within the study area is small and in moderate to poor condition. The presumed proportion of the local viable population affected is low at less than 3.7 per cent in one location and less than 0.01 per cent in the other. A definitive conclusion can be made that a significant impact to the local viable

population is unlikely to occur. The proposed modification is also considered likely to have a minor adverse effect on the composition of adjacent areas of the TEC that would not be cleared, due to increased edge effects. There is also likely to be a slight increase in isolation of patches within the local viable population due to the increase in the width of cleared land associated with the road. The proposed modification would contribute to a small extent to some KTPs that cannot be mitigated against including clearing of native vegetation and removal of dead wood and dead trees, but the impact will not be significant.

Based on current information the proposed modification will not have a significant adverse effect on the extent and condition of the known local viable population *Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions* TEC.

Homopholis belsonii (Belson's Panic)

Belson's Panic (*Homopholis belsonii*) occurs on the northwest slopes and plains of NSW, mostly between Wee Waa, Goondiwindi and Glen Innes. It also occurs in Queensland, mainly in the Brigalow Belt South bioregion. It generally grows in dry woodland (e.g. Belah) often on poor soils, although it is sometimes found in basalt-enriched sites and on alluvial clay soils. The species' habitat and ecology appear to be poorly known.

The impact of the proposed modification include loss of about 19.04 ha of known and probable habitat constituting the following Plant Community types (PCTs):

- Belah woodland on alluvial plains and low rises (PCT 55); loss = 1.93 ha.
- Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (PCT 147); 0.11 ha.
- Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56); loss = 8.34 ha.
- Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52); loss = 16.22 ha.
- Weeping Myall open woodland (PCT 27); loss = 0.9 ha (S2).

Belson's Panic was recorded in the study areas of N2MS2, N2MS4 and N2MS5 during the field surveys, associated with all of the above mentioned PCTs except for PCT 147. The species appeared to be most abundant within PCTs 27, 35, 52 and 55. The density of the species at recorded locations varied from scattered individuals to extensive areas in which the species was the dominant ground layer species. The species is strongly associated with partially shaded areas created by an over storey of trees and/or shrubs in the study area, and rarely extends into areas which lack a tree or shrub layer.

Spot surveys undertaken in contiguous habitat outside of but in close proximity to the study area indicate that the species local range extends well beyond the study area in remnant vegetation associated with the Newell Highway, local roads and the adjacent railway line. These data suggest that the species is more widespread and abundant in the locality than suggested by the very small number of pre-existing local records on wildlife databases.

Individual Belson's Panic impacted by the proposed modification are:

- 11 in Segment 2
- 19 in Segment 4
- 17 in Segment 5.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

a. in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

At least three separate areas are occupied by the species in the study area however, a subject matter specialist was engaged to sample the study area on foot to confirm it is likely the species also occurs in adjacent areas of suitable habitat which were not surveyed in detail. The occurrences of this species in the study area are separated from one-another by areas of vegetation outside of the study area, between segments of the proposed modification, that are likely to be only marginal as potential habitat. As there is likely to be little interaction between plants in these separate areas, each is considered to represent a separate local population. Accurately estimating the number of individuals of this species is problematic as

the species is rhizomatous; with individuals intertwined. Due to the species' habit and the representative rather than comprehensive nature of surveys on-foot, population numbers are only an estimate.

These populations and the impacts of the proposed modification are summarised in the Table B.9 below.

Table B.9 Summary of the *Homopholis belsonii* populations and potential habitat in the study area

Segment	Local Population	Associated habitat	Estimated area occupied by the population in the study area and contiguous habitat	Area removed by proposed modification	Percentage loss of population as a result of this proposed modification
N2MS2	Edgeroi South (moderate to high density - estimated at 200-500 individuals)	Weeping Myall Woodland (PCT 27)	4.4 ha	0 ha as this population was removed by a landholder replacing an agricultural fence	~0%
N2MS4	Brigalow Lane (moderate to high density - estimated at 1000+ individuals)	Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (PCT 147) Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56)	~280 ha	~4.59 ha	~2%
N2MS5	Tycannah North (scattered - estimated at roughly 500-1000 individuals)	Queensland Bluegrass +/- Mitchell Grass grassland (PCT 52)	~635 ha	~16.22 ha	~2%

While the Brigalow Lane population is likely to be reduced in size, it is also likely to be larger and less susceptible to associated impacts on the lifecycle of the species. The Tycannah North local population is of low density and likely to be spread over a large area of habitat. While a substantial area of habitat for the species in the Tycannah North local population would be affected, the habitat affected makes up a relatively small proportion of similar habitat in the likely distribution of the local population. The impacts of the proposed modification on the lifecycle of the species in the Brigalow Lane and Tycannah North populations are unlikely to be significant.

The removal of a substantial proportion of the habitat for the Edgeroi South population, and degradation of the remaining habitat due to edge effects from an adjoining landholder replacing an agricultural fence line has substantially reduced or possibly removed this local population. The species is likely to naturally recover over time but not before the tree canopy removed is replaced. This will not occur before this proposed modification is constructed. The Edgeroi South local population is effectively removed and therefore is not likely to be placed at significantly increased risk of extinction as a result of this proposed modification.

The proposed modification overall is therefore unlikely to cause a viable local population of the species to be placed at significantly elevated risk of extinction.

b. in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:
   i. is likely to have an adverse effect on the extent of the ecological community such that its local viable population is likely to be placed at risk of extinction, or

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

Not applicable

c. in relation to the habitat of a threatened species or ecological community:
- **i. the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
- **ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**
- **iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.**

Found in the study areas of N2MS2 and N2MS4 during field surveys in a variety of PCTs (27, 35, 52, 55, 56). Habitat, associated with the recorded locations, to be impacted includes:
- Belah woodland (1.93 ha – intact)
- Brigalow viney scrub open forest (1.47 ha - intact)
- Poplar Box - Belah woodland (8.34 ha - intact)
- Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact)
- Weeping Myall open woodland (0.9 ha - intact).

Habitat for the species generally excludes derived grasslands however scattered individuals are present under Mimosa (*Vachellia farnesiana*) bushes. Total known and potential habitat affected is 28.86 hectares

There may be additional indirect impacts to remaining areas of habitat (i.e. drying/modification of the soil surface) due to edge effects.

Clearing of habitat for the Tycannah population will increase the distance between areas of habitat by a small amount in some locations but it is unlikely to fragment habitat. The habitat of the Edgeroi South population is all on the eastern side of the road and the proposed modification is unlikely to affect isolation or fragmentation of this population. Clearing of habitat of the Brigalow Lane population would not be significant.

The Tycannah population occurs at low density in marginal habitat (natural grassland TEC) but may nonetheless be moderately important as it is part of a large contiguous area of habitat that may support a moderately large number of individuals. The road reserve is likely to be under a less intense disturbance regime than some of the adjacent habitat on private lands, is likely to contain a disproportionately high percentage of the population of the species and to be of moderate importance to the long-term survival of the species in the locality.

The Edgeroi South population was found in an area of moderate to good condition habitat (Weeping Myall Woodland TEC). The species was quite abundant in the vegetation to be removed by the proposed modification and the habitat removed was considered to be moderately important to the long-term survival of the species in the locality. This area was cleared with replacement of an agricultural fence by an adjoining landholder in 2018 then again in 2019 and the population was not detectable in December 2019. This population will no longer be affected by this proposed modification.

The habitat of the Brigalow Lane population that would be affected is of high quality (good condition Brigalow TEC and Belah woodland), is part of a large contiguous area of habitat in the road reserve and adjacent riparian lands in the north. As part of one of the largest contiguous areas of habitat in the locality, it is considered moderately important to the long-term survival of the species in the locality.

d. whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The proposed modification will not impact on any declared area of outstanding biodiversity value.

e. whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs.

The proposed modification would undoubtedly result in an increase to the *Clearing of native vegetation* with the removal of 28.86 hectares of suitable habitat for Belson's Panic. Other KTPs that may influence the quality of habitat and may be increased by the proposed modification include:

- Invasion of native plant communities by exotic perennial grasses – Likely
- High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition – Possibly increased due to the drying of vegetation associated with edge effects.

While there is potential for other KTPs of relevance to this species to be affected by the proposed modification, these KTPs are likely to be able to be adequately managed by TfNSW' standard environmental management measures.

Conclusion

The proposed modification will result in the removal of 28.86 hectares of moderately important habitat for three local populations of Belson's Panic. Earthwork within areas of suitable habitat would result in direct mortality of some individuals. Due to the stoloniferous, mat-forming habit of the species the number of individuals affected is difficult to quantity as a single individual may cover a substantial area. A reduction of available habitat and increases in habitat isolation may indirectly affect the ability of this species to survive due to lower breeding success and reduced dispersal and recolonization after disturbance events.

The proposed modification is considered unlikely to place the local populations of Belson's Panic in the study area at significantly elevated risk of extinction. The degree to which the risk of extinction of the Brigalow Lane and Tycannah population would be elevated is considered to be low as only a relatively small proportion of their area would be impacted. The Edgeroi South population was removed by an adjoining landholder when replacing an agricultural fence line.

The assessment of significance is a qualitative analysis of the likely impacts and it is not a 'pass or fail' test. In this case, although there will be impacts on populations of the species, due to the populations extending beyond the impact area and the planned refinement of the proposed modification, a significant impact on the species is unlikely.

Digitaria porrecta (Finger Panic Grass)

Finger Panic Grass (*Digitaria porrecta*) occurs in four disjunct areas extending over 1000 km. In Queensland, it occurs in the Nebo district, south-west of Mackay; the Central Highlands between Springsure and Rolleston; and from Jandowae south to Warwick (41 sites). In NSW, it occurs from Graman and Croppa Creek (near Inverell), south to the Liverpool Plains near Coonabarabran and Werris Creek (33 sites). It grows in grasslands on extensive basaltic plains, and in undulating woodlands and open forests with an underlying basaltic geology. It grows on dark and fine textured soils with some degree of seasonal cracking. It also persists in disturbed habitats, such as fallow paddocks, but its capability to maintain a viable population in such situations is unknown.

Flowering season is summer or late summer from mid-January to late February, with seeds maturing and falling from the plant soon after. Fire, livestock grazing and trampling, and physical disturbance of habitat by road and farm machinery are types of disturbances known to occur in Finger Panic Grass sites. Field observations indicate that the grass does continue to persist in such habitats but the effect of the disturbances on the long term capability of the species to maintain a viable population is unknown. Its population is estimated to be 200 000 individuals with 75% occurring near Premer (approximately 41 500 individuals) and Tambar Springs (114 000 individuals) in NSW. Plants have been recorded as occurring occasionally and frequently in populations.

Considering this species was found in multiple locations across segments 2 to 5, it is likely that it could occur anywhere in these segments in appropriate habitat.

The impact on the species would include the loss of about 49.17 ha of known and potential habitat constituting the following Plant Community types (PCTs):

Habitat, associated with the recorded locations, to be impacted includes:
- Belah woodland (1.93 ha – intact, 0.32 ha - derived)
- Brigalow viney scrub open forest (1.47 ha - intact, 0.87 -derived)
- Carbeen +/- Coolabah grassy woodland (3.04 ha intact, 1.24 ha derived)
- Poplar Box - Belah woodland (8.34 ha - intact, 0.42 ha - derived)
- Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact)
- Weeping Myall open woodland (0.9 ha - intact, 14.42 ha - derived).

Habitat for the species includes intact woodland/forest, natural grassland and derived grasslands. The intact woodland/forest and natural grassland are considered to be the more valuable habitats for the species.

Considering this species was found distributed relatively evenly across the whole proposed modification, it is likely that it occurs in suitable in all segment's habitat. The impact has been calculated across the whole proposed modification. Total known and potential habitat affected 49.17 hectares

Finger Panic Grass was recorded at 22 locations across the study area (many within the proposed modification area) during field surveys, however only a representative sample of the study area was traversed on foot and it is likely that the species also occurs in other areas of suitable habitat, both within and outside of the study area, which were not surveyed in detail. This species was found in N2MS2, N2MS4 and N2MS5 during the survey. It was more commonly found in PCT 52, PCT 27 and the edges of PCT 55 in intact and derived grassland areas and occasionally in non-native (exotic-species dominant) roadside grassland. The occurrences of the species at recorded locations generally consisted of scattered individuals and small groups.

For the purposes of this report it is known seven *Digitaria porrecta* will be affected:

- four *Digitaria porrecta* will be affected in Segment 2
- three were *Digitaria porrecta* will be affected in Segment 5.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

a. in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Finger Panic Grass was recorded in multiple locations across the study area and in contiguous areas of vegetation outside of the study area, both within and outside of the proposed modification area during. However only a representative sample of the study area was traversed on foot and it is likely that the species also occurs in other areas of suitable habitat, both within and outside of the study area, which were not surveyed in detail. The density of the species at recorded locations generally consisted of a few scattered individuals.

The proposed modification will result in direct removal of individual plants and also a reduction in the extent of available habitat for this species. The impact to available habitat will total 49.17 hectares. The removal of habitat, and degradation of some of the remaining habitat due to edge effects such as increased sunlight and wind are likely to result in a reduction in the size of local populations. The reduction in population size and degradation of habitat that would be caused by the proposed modification is likely to have a negative effect on the life cycle of the species.

The recording of the species in multiple locations in contiguous habitat outside of the proposed modification area suggests that the local populations/s of the species extend well beyond the study area and that the locality is likely to contain one or more large populations of *Digitaria porrecta*. The proposed modification would therefore have a small proportional impact on the local viable population, and it is unlikely that the impacts of the proposed modification would significantly increase the risk of the local extinction of the species.

b. in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:
  i. is likely to have an adverse effect on the extent of the ecological community such that its local viable population is likely to be placed at risk of extinction, or
  ii. is likely to substantially and adversely modify the composition of the ecological community such that its local viable population is likely to be placed at risk of extinction,

Not applicable

c. in relation to the habitat of a threatened species or ecological community:
  i. the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and
  ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
  iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.

The proposed modification is predicted to remove at least 49.17 hectares of known and potential habitat within the proposed modification area for the species, consisting of:

- Belah woodland (1.93 ha – intact, 0.32 ha - derived)
- Brigalow viney scrub open forest (1.47 ha - intact, 0.87 -derived)
- Carbeen +/- Coolabah grassy woodland (3.04 ha intact, 1.24 ha derived)
- Poplar Box - Belah woodland (8.34 ha - intact, 0.42 ha - derived)
- Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact)
- Weeping Myall open woodland (0.9 ha - intact, 14.42 ha - derived).

There may be additional indirect impacts to remaining areas of habitat (i.e. drying/modification of the soil surface) the due to edge effects.

Based on the distribution of records in NSW, the individuals found within the study area appear to be part of a thin north-south portion (approximately 40km wide) of the NSW population, connecting two wider areas (one north of the Gwydir Highway and the other south of Boggabri). Although these records cannot be assumed to be perfectly representative of the true distribution and extent of the species, it appears the individuals found in the study area may form part of an important connection link for the NSW population. Removal of plants and reduction of available habitat could increase the distance between local populations and therefore increase threat of fragmenting the NSW population into two separate populations. However, given that the clearing associated with the proposed modification is relatively small in proportion to the likelihood of population fragmentation.

The road reserve in the study area may be important habitat for this species. As part of one of the largest contiguous areas of habitat in the locality, it may be important to the long-term survival of the species in the locality. The most important habitats for this species in the locality are unknown and the road reserves in the study area and other travelling stock routes may be some of the last surviving habitats in the locality. However, it appears that the local populations/s of the species extend well beyond the study area within contiguous habitat, and it is unlikely that the impacts of the proposed modification would affect a significant proportion of this habitat.

d. whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The proposed modification will not impact on any declared area of outstanding biodiversity value.

e. whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs.

The proposed modification would undoubtedly result in an increase to the *Clearing of native vegetation* with the removal of 68.28 hectares of suitable habitat for Finger Panic Grass. Other KTPs that may influence the quality of habitat and may be increased by the proposed modification include:

- Invasion of native plant communities by exotic perennial grasses – Likely
- High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition – Possibly increased due to the drying of vegetation and increase in fuel load of grasslands due to weed invasion associated with edge effects.

While there is potential for other KTPs of relevance to this species to be affected by the proposed modification, the extent of the impact of these KTPs is likely to be small in relation to the area occupied by the species are likely to be able to be adequately mitigated by TfNSW' standard environmental management measures.

Conclusion

The proposed modification will result in the removal of 49.17 hectares of habitat for the local viable population of Finger Panic Grass which is part of a broader area that may be important to the long-term survival of this species. Earthwork within areas of suitable habitat would result in direct mortality of individuals. A reduction of available habitat and increase in the distance between north and south occurrences may increase the potential of fragmenting the population to a small degree. However, this species appears to be widespread in similar roadside habitats in the locality and the impacts associated with the proposed modification are likely to affect only a relatively small proportion of the population. As the local

populations/s of the species appear to extend well beyond the study area, it is unlikely that the impacts of the proposed modification would be significant.

Desmodium campylocaulon (Creeping Tick-trefoil)

Creeping Tick-trefoil (*Desmodium campylocaulon*) occurs chiefly in the Collarenebri and Moree districts in the north-western plains of NSW. Also occurs in the NT and Darling Downs district of south-eastern Queensland. In NSW Creeping Tick-trefoil grows on cracking black soils in the Narrabri, Moree and Walgett local government areas. Creeping Tick-trefoil is said to be hardy but grazed where sheep and cattle have regular access. Plants are strongly stoloniferous.

The proposed modification is predicted to remove at least 31.54 hectares of known and potential habitat for the species within the proposed modification area , consisting of:

- Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact)
- Weeping Myall open woodland (0.9 ha - intact, 14.42 ha - derived).

Creeping Tick-trefoil was recorded in a single area just south of Moree in Segment 5 during field surveys, however only a representative sample of the study area was traversed on foot and it is likely that the species also occurs in other areas of suitable habitat in Segment 5, both within and outside of the study area, which were not surveyed in detail but has been in unrelated assessments by Cameron in 2006 to 2014. Jacobs recorded six locations parallel to the highway just noting presence of absence (no individual numbers) and Cameron in 2004 recorded 100s of individuals and modelled 170,000 individuals on the adjoining property and 100s were observed a within the Travelling Stock Route and Newell Highway corridor along a single liner transect where a portion of this transect is within Section 5. This species in all occasions are mostly found in PCT 52, however there was one occurrence in PCT 27 derived grassland. The density of the species at recorded locations varied from a few scattered individuals to around one stem per square metre (based on finding 215 stems within a 300m^2 transect/plot in the study area). Considering this species is stoloniferous and grows stems from an underground rootstock, it was difficult to estimate the number of individuals likely to be affected.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

a. in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The individuals identified during surveys appear to be part of a regional population that is bounded approximately by Bellata, Boggabilla, St George and Collarenebri (an area of approximately 30,000 square kilometres). While the species may persist during unfavourable conditions as underground rootstocks, producing above ground plant tissue when conditions are favourable, the degree to which it can persist under continual grazing, is unknown. This species may be widespread this area or may be largely restricted to areas, such as travelling stock reserves, which are not cropped and only infrequently grazed. It is therefore unknown whether the plants in the study area are part of an extensive local/regional population, or form part of a relatively discrete local population centred on the infrequently grazed TSR/s surrounding the Newell Highway and the adjacent railway line. Based on the data collected, and other local studies, the population within and contiguous with the study area appears to be large.

The proposed modification will result in direct removal of individuals and also a reduction in the extent of available habitat for this species. The impact to suitable habitat will total 31.54 hectares. These impacts may negatively impact the lifecycle of individuals constituting the local population through reduced population size, reduced habitat and increased isolation. However, as the local populations of the species appears to be large and to extend well beyond the proposed modification area and beyond the study area, it is unlikely that the impacts of the proposed modification would be significant.

b. in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:
   i. is likely to have an adverse effect on the extent of the ecological community such that its local viable population is likely to be placed at risk of extinction, or
   ii. is likely to substantially and adversely modify the composition of the ecological community such that its local viable population is likely to be placed at risk of extinction,

Not applicable

c. in relation to the habitat of a threatened species or ecological community:

i. **the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
ii. **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**
iii. **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.**

The proposed modification is predicted to remove at least 31.54 hectares of known and potential habitat for the species within the proposed modification area , consisting of:

- Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact)
- Weeping Myall open woodland (0.9 ha - intact, 14.42 ha - derived).

There may be additional indirect impacts to remaining areas of habitat (i.e. drying/modification of the soil surface) the due to edge effects.

Considering the current fragmentation caused by the existing road corridor, the small increase in road width is unlikely to result in additional fragmentation of habitat for Creeping Tick-trefoil.

Creeping Tick-trefoil was found primarily in a large area of Queensland Bluegrass +/- Mitchell Grass in Section 5. This area contains a relatively high abundance of individuals and may be important to the long-term survival of the local viable population of this species. The most important habitats for this species in the locality are unknown and the study area may form part of one of the last surviving habitats in the locality. However, the local population of the species appears to be large and to extend well beyond the proposed modification area and beyond the study area. It is therefore unlikely that the impacts of the proposed modification on this important habitat would be significant.

d. whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The proposed modification will not impact on any declared area of outstanding biodiversity value.

e. whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs.

The proposed modification would undoubtedly result in an increase to the *Clearing of native vegetation* with the removal of 31.54 hectares of suitable habitat for Creeping Tick-trefoil. Other KTPs that may influence the quality of habitat and may be increased by the proposed modification include:

- Invasion of native plant communities by exotic perennial grasses – Likely

While there is potential for other KTPs of relevance to this species to be affected by the proposed modification, these KTPs are likely to be able to be adequately managed by TfNSW' standard environmental management measures.

Conclusion

The proposed modification will result in the removal of individuals and about 31.54 hectares of habitat for the local viable population of Creeping Tick-trefoil. This includes 16.22 hectares of Queensland Bluegrass +/- Mitchell Grass that may be important to the long-term survival of this species. Earthworks within areas of suitable habitat (in Section 5 where this species was identified) would result in direct mortality of individuals. This species appears to be more widespread and abundant than is represented by current recorded sightings and a large population appears to exist in the study area, the large majority of which would be unaffected by the proposed modification. As it appears that the local population of the species is large and extends well beyond the study area, it is unlikely that the impacts of the proposed modification would be significant.

Five-clawed Worm-skink (*Anomalopus mackayi*)

On the floodplains within its range in north-eastern New South Wales, the Five-clawed Worm-skink occurs in grasslands and grassy, open woodlands on heavy black and grey, alluvial cracking clay soils from 135–200 m above sea level (Spark 2010). During dry periods, the species is likely to shelter where moisture is available. For example, they may take refuge in deep cracks within alluvial clay soils or ephemeral drainage

lines and soaks where moisture is retained. Sufficient rainfall following extended dry conditions is likely to bring the skink to the surface (Brigalow Belt Reptiles Workshop 2010).

Thirty-minute targeted reptile searches were undertaken at each of 20 locations in the study area. Additionally, logs, rocks and other debris were turned opportunistically when encountered during other field activities. The Five-clawed Worm-skink was not identified, however much of the vegetation in the study area contains suitable habitat for this species and this species is difficult to detect, sheltering under decaying leaf litter, coarse woody debris or artificial debris, in deep cracks within alluvial clay soils, rotting tree bases, logs and in tussock bases, and is also known to dig permanent tunnel-like burrows.

Gerry Swan a subject matter specialist who recorded all *Anomalopus mackayi* in the region was engaged to provide expert advice. Nineteen transects were undertaken in N2M, more specifically

- N2M1 6.6km 5 transects
- N2M2 12.0km 6 transects
- N2M3 5.0km 3 transects
- N2M4 7.0km 4 transects
- N2M5 9.2km 4 transects

Several areas examined in the road corridor had a gravelly soil or conglomerate pebbles in the 30m area (presumably imported fill) although the soil outside this zone was cracking clay. The gravels / fill areas are not suitable habitat for the species. Mr Swans experience with the species indicates the impact of Mimosa bush on Five-clawed Worm-skink is likely determinantal. Notwithstanding, suitable habitat was considered as unlikely *Anomalopus mackayi* habitat because they are not continuous.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

a. in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The proposed modification will not remove any suitable habitat for this and will not affect the ability of this species to survive (i.e. impact foraging and breeding life-cycle activities) within a viable local population present in the locality.

The impact of the proposed modification on the life cycle of the population is unlikely to be significant. If present, any other local populations/s of the species are likely to extend well beyond the proposed modification area and it is unlikely that the impacts of the proposed modification on such populations would be significant.

b. in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:
   i. is likely to have an adverse effect on the extent of the ecological community such that its local viable population is likely to be placed at risk of extinction, or
   ii. is likely to substantially and adversely modify the composition of the ecological community such that its local viable population is likely to be placed at risk of extinction,

Not applicable

c. in relation to the habitat of a threatened species or ecological community:
   i. the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and
   ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
   iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.

The proposed modification would not impact on suitable habitat for the species, its habitat will not be fragmented and as such there is no important to the species for land removed by the proposed modification.

d. whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The proposed modification will not impact on any declared area of outstanding biodiversity value.

e. whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs.

The proposed modification would result in the *Clearing of native vegetation* (a key threatening process), however habitat for Five-clawed Worm-skink will not he removed. It may also increase the impact of *Removal of dead wood and dead trees*. Other KTPs that may influence the soil surface of suitable habitat and may be increased by the proposed modification include:

- Invasion of native plant communities by exotic perennial grasses – Likely

While there is potential for other KTPs of relevance to this species to be affected by the proposed modification, these KTPs are likely to be able to be adequately managed by TfNSW' standard environmental management measures.

Conclusion

Expert advice was needed to be able to confidently consider the likelihood of potential impact of the proposed modification to this species. The advice received determined suitable habitat would not be affected and a significant impact is not likely to occur.

Pale Imperial Hairstreak (*Jalmenus eubulus*)

There are only four records of the Pail Imperial Hairstreak (*Jalmenus eubulus*) in NSW, which are located north of the proposed modification area near North Star. One of the records is directly adjacent to the Newell Highway. These four records were the result of a survey of 37 locations around Croppa Creek, Yallaroi and North Star (Taylor 2014) which included the following observations:

- *Jalmenus eubulus* was only found in areas where Brigalow (*Acacia harpophylla*) is a highly dominant canopy species.
- The species was not found in areas where Belah (*Casuarina cristata*) and/or Bimble Box (*Eucalyptus populnea*) were the dominant species and Brigalow was sub-dominant.
- The species was not found in areas where patches of Brigalow were imbedded in a grassland mosaic.
- Many areas of apparently suitable habitat were not occupied by the species at the time of survey
- The species has been reported by other authors to be very localised or patchy in distribution with the location of colonies also being ephemeral. Personal experience with the species south of Mungleback Creek along the Newell Highway highlights only 'fresh' Brigalow regrowth is where the species is likely to be detected, when the assessment occurs at the right time of the year.

Given the small number of recorded sites, available information is inconclusive regarding whether or not strong dominance by Brigalow is an essential feature of the species' habitat however, it is strongly suspected. Given the possibly ephemeral nature of colonies, the failure of a single survey to record the species at a site would not necessarily mean that the site does not contain habitat for the species. No surveys for this species were undertaken for this study.

Although there are no records of this species in the proposed modification area , several patches of vegetation are present that meet the description of suitable habitat by Taylor (2014). Without having conducted targeted surveys as part of this proposed modification, the Pale Imperial Hairstreak is deemed to have a moderate likelihood of occurring in the study area based on the presence of suitable habitat. This may also be the case for areas surrounding the study area, however the extent of Brigalow in the locality is unknown. A review of regional mapping has shown that the nearest mapped area of Brigalow habitat is in excess of 30 kilometres away. While it is possible that other areas of Brigalow that could support a more widely distributed population may occur in the locality, the presence or absence and condition of such habitat are unknown.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats*:*

a. in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

There is currently only one known population of the Pale Imperial Hairstreak consisting of at least four sub-populations. There is no evidence of a viable local population at the site, however judging by the low prevalence of records of butterflies and moths recorded for the region in the Atlas of Living Australia (see excerpt below), the locality does not appear to have been surveyed in detail for butterfly species. Given that potential habitat was identified in the proposed modification area , and that surveys for the species are not likely to have occurred in the study area, the presence of a viable local breeding population of the species cannot be discounted.

The proposed modification will result in the removal of 1.47 hectares of Brigalow-dominated woodland that may be habitat for a viable local population of Pale Imperial Hairstreak. Considering this species has only been found in scattered locations, and the extent of Brigalow-dominated woodland in the region is restricted to small isolated patches, any substantial impact to habitat currently occupied by the Pale Imperial Hairstreak would directly impact the life cycle of this species. However, given that the proposed modification would result in the loss of only about 1.47 ha of possible habitat, from an area of potential habitat of about 52.39 ha (2.8 per cent), it is considered unlikely to result in the loss and modification of enough habitat to significantly affect the lifecycle of the local population of the species or significantly increase the likelihood of local extinction.

b. in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:
- **i. is likely to have an adverse effect on the extent of the ecological community such that its local viable population is likely to be placed at risk of extinction, or**
- **ii. is likely to substantially and adversely modify the composition of the ecological community such that its local viable population is likely to be placed at risk of extinction,**

Not applicable

c. in relation to the habitat of a threatened species or ecological community:
- **i. the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
- **ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**
- **iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.**

The proposed modification is predicted to remove around 1.47 hectares of habitat for the Pale Imperial Hairstreak. There may be additional indirect impacts to remaining areas of habitat due to edge effects.

The patches of habitat are already somewhat fragmented and isolated by the existing Newell Highway. The proposed modification is unlikely to break the local viable population into more fragments. However, it is likely to increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. This increased isolation may result in slightly increased mortality by vehicle strike and a slight reduction in breeding success between individuals travelling between fragments. This disruption of ecological processes would contribute to a slightly increased risk of extinction of the local viable population of the species.

If a population were to be present in the study area, it would represent the most southerly known population of the species and a significant range extension. Populations of the species are ephemeral, and breeding seems to be reliant on the presence of mixed age-structure Brigalow. If any more than a single individual were to be found, the presence of a breeding population would need to be assumed.

The area of habitat affected is small and is highly edge-affected, it is unlikely to be important for the long-term survival of the species in the locality.

d. whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The proposed modification will not impact on any declared area of outstanding biodiversity value.

e. whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs. The proposed modification would result in the ‘Clearing of native vegetation’ with the removal of 1.47 hectares of suitable

habitat for the Pale Imperial Hairstreak. While there is potential for other KTPs of relevance to this species to be affected by the proposed modification, these KTPs are likely to be able to be adequately managed by TfNSW' standard environmental management measures.

Conclusion

If the Pale Imperial Hairstreak is currently utilising Brigalow-dominated vegetation in the study area, then all this vegetation is likely to be important to the long-term survival of this species. Considering the lack of ecological data concerning this species and the limited known distribution of the single population, any substantial impacts to habitat occupied by the species would be considered significant. Additionally, the proposed modification is also considered likely to adversely modify the composition of some immediately adjacent areas of habitat that would not be cleared, due to increased edge effects. In summary, if the species is present, the proposed modification is considered to have a small adverse, but not significant, effect on the extent and condition of habitat important to the Pale Imperial Hairstreak. As the amount of habitat loss is small 1.47 ha) the risk of a significant impact of the proposed modification is low. However, due to a lack of survey data and general ecological understanding of the species, and in keeping with the precautionary principle, a survey for the species prior to the commencement of construction should be undertaken. If the species is detected a species-specific management plan should be developed to facilitate management of potential impacts and restoration of habitat.

Koala (*Phascolarctos cinereus*)

The Koala was identified north of the Mehi River in Moree during field surveys, but no conclusive evidence was found within the study area. A single previous record is known from the study area (Bellata) and there are multiple other records in the locality, in larger woodland remnants further to the east. Habitat in the study area is likely to be part of the home range of a low-density population. Associated (marginal) habitat present in the study area includes:

- Belah woodland (1.93 ha - intact)
- Brigalow viney scrub open forest (1.47 ha - intact)
- Carbeen +/- Coolabah grassy woodland (3.04 ha intact)
- Poplar Box - Belah woodland (8.34 ha - intact)
- Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact).

Koala are generally solitary except during the mating season and have a home range of about three hectares (although the size of this area is influenced by the distribution, abundance and quality of feeding resources). In the Pilliga State Forest of central-western New South Wales, the average home range is 10–15 ha (Department of Environment and Climate Change 2008). The Office of Environment and Heritage has published regional lists of koala food trees in separate primary and secondary food tree categories. Surveys identified low to high abundances of Koala secondary (*Eucalyptus populnea*) food trees within the study area Considering the reported home range sizes of this species and the widespread occurrence of feed tree species, a low density population is considered likely to utilise the study area.

There are numerous published criteria for determining the importance of koala habitat, however the most recent, relevant and measurable is the habitat assessment tool described in the *EPBC Act referral guidelines for the vulnerable koala* (Commonwealth of Australia 2014). Using this tool, impact areas that score five or more contain habitat critical to the survival of the koala. Table B.4 lists the five primary koala habitat attributes, the score given for each criterion and results of the habitat assessment tool for the two vegetation communities within the study area which contain a relatively high proportion of food trees. Several other communities also contain scattered food trees and also contribute to the viability of the landscape as Koala habitat, particularly in relation to their contribution to movement corridors between the main food tree areas. The result indicates that the habitats in the study area are not considered to be habitat critical to the survival of the Koala.

Table B.4 Results of the koala habitat assessment tool for the main habitat types

Attribute	Score and criteria (inland)	Score for habitat in the study area
Koala occurrence	**+2 (high)** = Evidence of one or more koalas within the last 5 years. **+1 (medium)** = Evidence of one or more koalas within 2 km of the edge of the impact area within the last 10 years **0 (low)** = None of the above.	**0 (low)** = None of the above. The habitats in the northern section are near the Mehi River where the Koala is known but the majority of habitats are more than 2 km away.

Attribute	Score and criteria (inland)	Score for habitat in the study area
Vegetation composition	**+2 (high)** = Has forest, woodland or shrubland with emerging trees with 2 or more known koala food tree species, OR 1 food tree species that alone accounts for >50% of the vegetation in the relevant strata. **+1 (medium)** = Has forest, woodland or shrubland with emerging trees with only 1 species of known koala food tree present. **0 (low)** = None of the above.	The habitats in the study area are considered secondary foraging habitats. The secondary feed tree species *Eucalyptus populnea* is most common with some *Eucalyptus pilligaensis* also present. The habitat would score **+1 (medium)** = Has forest, woodland or shrubland with emerging trees with only 1 species of known koala food tree present.
Habitat connectivity	**+2 (high)** = Area is part of a contiguous landscape ≥ 1000 ha. **+1 (medium)** = Area is part of a contiguous landscape < 1000 ha, but ≥ 500 ha. **0 (low)** = None of the above.	Habitat connectivity would score **0 (low)** = None of the above.
Key existing threats	**+2 (high)** = Little or no evidence of koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence, OR Areas which score 0 for koala occurrence and have no dog or vehicle threat present. **+1 (medium)** = Evidence of infrequent or irregular koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence, OR Areas which score 0 for koala occurrence and are likely to have some degree dog or vehicle threat present. **0 (low)** = Evidence of frequent or regular koala mortality from vehicle strike or dog attack in the study area at present, OR Areas which score 0 for koala occurrence and have a significant dog or vehicle threat present.	The habitats in the study area would score **0 (low)** as it is an area that scores 0 for koala occurrence and has a significant vehicle threat present.
Recovery value	**+2 (high)** = Habitat is likely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1. **+1 (medium)** = Uncertain whether the habitat is important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1. **0 (low)** = Habitat is unlikely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.	The study area would score **+1 (medium)** = Uncertain whether the habitat is important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.
TOTAL		2

The factors to be considered when determining whether proposed modification is likely to significantly affect the Koala, or its habitats are outlined below:

a) in the case of a Threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Koala habitat can be broadly defined as any forest or woodland containing species that are known koala food trees, or shrubland with emergent food trees, from which they feed on the leaves (Department of Environment and Climate Change 2008). The breeding season for the koala peaks between September and February and animals are most active during this period. Following birth, the young remains in the pouch for approximately six months and on leaving the pouch remains dependent on its mother and is carried on her back. Young reach independence at about 12 months, although they can remain in the mother's home range for a further 2–3 years (Mitchell and Martin, 1990). Koalas reach sexual maturity at two years (Martin and Handasyde, 1990).

At least one low density breeding population is expected to be present in the locality and potentially to occupy all at least moderately connected areas of habitat associated with the presence of feed trees. Potential habitat is likely to be widespread beyond the study area, however available habitat within the region is highly fragmented due to a history of clearing for agricultural purposes and it is likely that only a relatively small proportion of such habitat is occupied by Koalas. Within the study area Koala habitat is present where the secondary (*Eucalyptus populnea* and *Eucalyptus pilligaensis*) feed trees are located and all other adjoining habitats that may be used for movement and other non-foraging activities. Long movements in search of a mate or new food source are sometimes undertaken by Koalas, signifying the importance of dispersal corridors in secure koala habitat (Phillips 1990). Considering the highly fragmented nature of the landscape, individuals from the local population likely travel along vegetated corridors associated with waterways and road reserves. Clearing of vegetation associated with the proposed modification would remove approximately 13.71 hectares of marginal habitat for this species. The habitat removal includes:

- Belah woodland (1.93 ha - intact)
- Brigalow viney scrub open forest (1.47 ha - intact)
- Carbeen +/- Coolabah grassy woodland (3.04 ha intact)
- Poplar Box - Belah woodland (8.34 ha - intact)
- Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact).

This habitat is not critical to the Koala but is still likely to be valuable for Koala movement, shelter and dispersal in the landscape. The proposed clearing will reduce the availability of habitat for this population. It may also contribute to habitat isolation by widening the road corridor and increasing barriers between habitat patches. The proposed modification may also lead to an increased mortality by vehicular collision due to increased average vehicle speeds.

As no critical breeding habitat will be affected and a large proportion of a population is not likely to be present in the study area, the proposed modification is considered unlikely to have an adverse effect on the life cycle of the species such that a viable local population of the species.

The proposed modification would not result in the removal of a substantial amount of habitat categorised as critical to the survival of this species and is unlikely to significantly affect Koala movement or road-related mortality. The risk of a significant impact on the life cycle of the local population/s of the Koala is considered to be low.

b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

i. is likely to have an adverse effect on the extent of the ecological community such that its local viable population is likely to be placed at risk of extinction, or

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

Not applicable.

c) in relation to the habitat of a threatened species or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

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

Clearing of vegetation associated with the proposed modification would remove approximately 24.16 hectares of marginal habitat for this species. The habitat removal includes:

- Belah woodland (1.93 ha - intact)
- Brigalow viney scrub open forest (1.47 ha - intact)
- Carbeen +/- Coolabah grassy woodland (3.04 ha intact)
- Poplar Box - Belah woodland (8.34 ha - intact)

- Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact).

Vegetation and potential habitat within the landscape is already highly fragmented due to a history of clearing for agricultural purposes. Generally, the only option for Koalas to access vegetation containing *E. populnea* on both sides of the road is by crossing the road. As the proposed modification will involve widening of the current road corridor, it will slightly reduce east-west habitat connectivity through increased habitat isolation.

The habitat in the study are is not critical to the Koala but is still likely to be valuable for Koala movement, shelter and dispersal in the landscape.

d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The proposed modification will not impact on any declared area of outstanding biodiversity value.

e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

Of the 38 listed KTPs under the BC Act, the proposed modification will contribute to, or may indirectly contribute to the clearing of native vegetation which is a key impact affecting the Koala. Introduction and spread of weeds and pathogens will be managed with the mitigation measures and the CEMP so these KTPs are not expected to be a major impact of the proposed modification. Any introduction and spread of exotic pests and predators would not be increased significantly.

Conclusion

The proposed modification will result in the clearing of some potential foraging habitat and habitat that is likely to be valuable for Koala movement, shelter and dispersal in the landscape. However, the population is low density and is unlikely to be reliant on the habitats in the study area for survival. The proposed modification is likely to cause a small reduction in east-west connectivity and a small increase in the risk to Koalas of road-related mortality due to the widening of the current highway.

The habitat affected is not likely to be critical to the low density local population of the species, and the proposed modification is considered unlikely to have a significant effect on the Koala.

Black-striped Wallaby (*Macropus dorsalis*)

Field surveys did not identify the Black-striped Wallaby within the study area, however no targeted surveys were undertaken for the species. Individuals and small groups of wallabies were observed in several locations in the study area, particularly just north of Bellata where strips of vegetation run along both sides of the highway, however as many observations were only fleeting, an identification of species was not always possible. P Cameron (pers com) has recorded a population south of Mungle Back Creek along the Newell Highway (and into the adjoining land) but has not observed any other self-sustaining populations south of the Mungle Scrub in the Moree LGA. There are 617 records of the species in the locality; most records area from the Pilliga National Park but there is a record of the species from 2001, approximately 3 km south-east of the study area at Tycannah. The species was also recorded in 2017 in a Travelling Stock Reserve on the Newell Highway in a camera-trap survey conducted on behalf of North West Local Land Services however, the precise location of this record is yet to be published. Given that the species has been recorded nearby and suitable habitat is represented by five PCTs in the study area, there is high potential for this species to occur.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

a. in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Preferred habitat for the Black-striped Wallaby is characterised by dense woody or shrubby vegetation within three metres of the ground. This dense vegetation must occur near a more open, grassy area to provide suitable feeding habitat. On the north west slopes, the species is associated with dense vegetation including Brigalow, Ooline and semi-evergreen vine thicket. Most of the daylight hours are spent resting undercover; feeding normally takes place from dusk to dawn. Although Black-striped Wallabies are a social species during the day, often congregating in groups of 20 or more of both sexes and all ages, aged males live as solitary individuals. Breeding occurs year round (Strahan 1995).

Considering the number of records in the Pilliga National Park, it is likely a local viable population of the Black-striped Wallaby, extending broadly across the region is present. Highly vegetated areas such as the Pilliga National Park, Mount Kaputar National Park and nearby conservation reserves are likely to hold the greatest number of individuals, however some may disperse throughout the landscape in vegetation remnants along waterways and roads. The Newell Highway currently supports long stretches of vegetation that may be used by a range of fauna species to travel through the landscape. A reduction in 10.96 hectares of suitable habitat for the Black-striped Wallaby along the current alignment is unlikely to reduce the ability of this species to disperse, forage and successfully breed. Additionally, widening the road and increasing the speed limit will increase the potential for vehicle strike. Considering there may be a stronghold for this population within highly vegetated areas in the region, these impacts are likely going to only affect dispersing individuals. It is unlikely that the proposed modification will have adverse effect on the life cycle of the species such that the viable local population is likely to be placed at risk of extinction.

b. in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:
   i. is likely to have an adverse effect on the extent of the ecological community such that its local viable population is likely to be placed at risk of extinction, or
   ii. is likely to substantially and adversely modify the composition of the ecological community such that its local viable population is likely to be placed at risk of extinction,

Not applicable

c. in relation to the habitat of a threatened species or ecological community:
   i. the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and
   ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
   iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.

The proposed modification is predicted to remove around 10.96 hectares of potential habitat for the Black-striped Wallaby. There may be additional indirect impacts to remaining areas of habitat due to edge effects.

The patches of habitat are already somewhat fragmented and isolated by the existing Newell Highway. The proposed modification is unlikely to break the local viable population into more fragments. However, it is likely to increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. This increased isolation may result in increased mortality by vehicle strike, a reduction in breeding success between individuals travelling between fragments.

As mentioned, individuals of the local population that will be impacted by the proposed modification are those dispersing throughout the landscape. A reduction in 10.96 hectares of suitable habitat for the Black-striped Wallaby along the current alignment will reduce the ability of this species to disperse, forage and successfully breed. However, highly vegetated areas such as the Pilliga National Park, Mount Kaputar National Park and nearby conservation areas likely contain a vast majority of the local population. Therefore, it is unlikely that the impacts to Black-striped Wallaby habitat associated with the proposed modification will significantly affect the long-term survival of the species.

d. whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The proposed modification will not impact on any declared area of outstanding biodiversity value.

e. whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs.

The proposed modification would undoubtedly result in an increase to the ‘Clearing of native vegetation’ with the removal of 10.96 hectares of suitable habitat for the Black-striped Wallaby.

While there is potential for other KTPs of relevance to this species to be affected by the proposed modification, these KTPs are likely to be able to be adequately managed by TfNSW’ standard environmental management measures.

Conclusion

The region likely supports a viable local population of the Black-striped Wallaby, with most individuals located in highly vegetated areas such as the Pilliga National Park, Mount Kaputar National Park and nearby conservation areas. Individuals that disperse from these areas are likely do so throughout the landscape in vegetation remnants along waterways and roads. The proposed modification would cause a reduction in 10.96 hectares of suitable habitat for the Black-striped Wallaby. However, these impacts to Black-striped Wallaby habitat are not considered to significantly impact this species as the proposed modification is unlikely to reduce the ability of this species to disperse, forage and successfully breed and the affected habitat makes up a relatively small proportion of habitat available in the region.

There is likely to be an increase in distance between patches within the local viable population due to the increase in the width of cleared land associated with the road, slightly increasing the fragmentation of the species habitat. The greatest threat to this species associated with the proposed modification is increased posed risk by vehicle strike. This potential impact may, however, be adequately mitigated through road design and is unlikely to significantly affect the local population of the species.

In summary, the proposed modification is considered unlikely to have a significant adverse effect on the Black-striped Wallaby due to the relatively low number of individuals using habitat in the study area compared to more vegetated areas in the region. The proposed modification is unlikely to place the Black-striped Wallaby at a significantly elevated risk of extinction.

Painted Honeyeater (*Grantiella picta*)

Twenty-minute bird census surveys were undertaken throughout patches of suitable habitat in the study area. The Painted Honeyeater was not identified, however there were no areas of vegetation containing profusely fruiting or flowering resources which limited the detectability of this species. There are nine recorded sightings on the BioNet Atlas database from the search area, mostly from Killarney State Conservation Area and one on Millie Rd (east of Bellata). Birdline also contains multiple sightings in the area.

Many of the vegetation types in the study area along the Newell Highway present suitable habitat for the Painted Honeyeater, including areas with a high abundance of mistletoe species. Based on the presence of suitable habitat and location of nearby records, the Painted Honeyeater is considered moderately likely to occur in vegetation within the study area.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

a. in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The species exhibits seasonal north-south movements governed principally by the fruiting of mistletoe, with which its breeding season is closely matched (Barea and Watson, 2007). Many birds move after breeding to semi-arid regions such as north-eastern South Australia, central and western Queensland, and central Northern Territory. Considering its dispersive habits, the species is considered to have a single population. The painted honeyeater is the most specialised of Australia's honeyeaters. Its diet mainly consists of mistletoe fruits, but also includes nectar (from flowering mistletoe, eucalypts and possibly banksias) and arthropods, especially in the non-breeding season (Garnett et al., 2011).

The Painted Honeyeater is likely an occasional visitor in the study area, coming in to feed on flowering and fruiting resources when available. This species may also nest in the study area, though nesting is generally reported from areas that contain a high abundance of mistletoes, e.g. 10 per tree (Barea 2008), which was not a common feature of vegetation in the study area. A reduction in 25.17 hectares of suitable foraging habitat with some nesting opportunities for the Painted Honeyeater along the current alignment will impact the feeding and possibly the breeding of this species. There are likely areas in the locality containing a higher prevalence of mistletoes more suitable for nesting. Any individuals that use vegetation in the study area are likely passing through the landscape while foraging. It is unlikely that the proposed modification will have adverse effect on the life cycle of the species such that the viable local population is likely to be placed at risk of extinction.

b. in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

i. **is likely to have an adverse effect on the extent of the ecological community such that its local viable population is likely to be placed at risk of extinction, or**
ii. **is likely to substantially and adversely modify the composition of the ecological community such that its local viable population is likely to be placed at risk of extinction,**

Not applicable

c. **in relation to the habitat of a threatened species or ecological community:**
   i. **the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
   ii. **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**
   iii. **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.**

The proposed modification is predicted to remove around 25.17 hectares of foraging habitat for the Painted Honeyeater. Some areas of this may also present nesting opportunities. There may be additional indirect impacts to remaining areas of habitat due to edge effects.

The patches of habitat are already somewhat fragmented and isolated by the existing Newell Highway. The proposed modification is unlikely to break the local viable population into more fragments. However, it is likely to increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. For highly mobile species like birds, this is not a large problem, however the reduction of suitable habitats into small isolated patches inhibits movement throughout the landscape.

The Painted Honeyeater is a widely nomadic species that travels throughout its range in search of fruiting and flowering resources. Vegetation that will be impacted by the proposed modification includes mostly foraging habitat for the Painted Honeyeater. No areas considered to contain a high prevalence of mistletoes were observed (i.e. mean of 10 per tree), so the impact to potential nesting habitat is likely to be minor. Vegetation in the study area is likely to be important for individuals travelling through the landscape. Considering the amount of higher value vegetation in the region (i.e. Pilliga National Park, Mount Kaputar National Park and nearby conservation areas), the habitat that will be impacted by the proposed modification is unlikely to be highly important to the long-term survival of the Painted Honeyeater.

d. **whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),**

The proposed modification will not impact on any declared area of outstanding biodiversity value.

e. **whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.**

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs.

The proposed modification would result in the ‘Clearing of native vegetation’ with the removal of 25.17 hectares of suitable habitat for the Painted Honeyeater.

While there is potential for other KTPs of relevance to this species to be affected by the proposed modification, these KTPs are likely to be able to be adequately managed by TfNSW’ standard environmental management measures.

Conclusion

Any Painted Honeyeaters that occur in vegetation within the study area are part of a single population that occurs right across the range of this species. The Painted Honeyeater is highly nomadic and is likely to utilise vegetation in the study area as a foraging resource when mistletoes and trees are flowering and fruiting. There were no areas of vegetation observed during field surveys that contained a high prevalence of mistletoes considered preferential for nesting, therefore the impact to nesting habitat is likely to be minor.

The impact of widening the current road corridor is not considered likely to significantly impact the Painted Honeyeater as it is highly mobile. Further isolation of patches of suitable habitat will affect this species ability to move throughout the landscape.

In summary, the proposed modification is considered unlikely to have a significant adverse effect on the Painted Honeyeater due to the relatively low impact on habitat resources when the amount of higher value habitat in the region is considered (i.e. Pilliga National Park, Mount Kaputar National Park and nearby conservation areas). The proposed modification is unlikely to place the Painted Honeyeater at a significantly elevated risk of extinction.

Grey-crowned Babbler (*Pomatostomus temporalis temporalis*)

Twenty-minute bird census surveys were undertaken throughout patches of suitable habitat in the study area. The Grey-crowned Babbler was identified within the study area in Sections 1 and 2 during field surveys. This species was observed in large family groups, moving through the roadside vegetation. Both occurrences were near large patches of vegetation away from the road that may provide some suitable nesting opportunities, however the habitat affected is more likely used occasionally for foraging by species passing through. Many of the vegetation types in the study area along the Newell Highway present suitable habitat for the Grey-crowned Babbler.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

a. in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Grey-crowned Babbler was confirmed in the study areas of Sections 1 and 2 during field surveys. Likely to also be present in N2MS3 and N2MS4. Habitat is widespread and includes:

- Belah woodland (1.93 ha - intact)
- Carbeen +/- Coolabah grassy woodland (3.04 ha intact)
- Poplar Box - Belah woodland (8.34 ha - intact)
- Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact)
- Weeping Myall open woodland (0.9 ha - intact).

Total known and potential habitat affected is 25.59 hectares. The habitat affected is likely to be used for foraging and dispersal but due to its edge location, it is unlikely to be important for breeding. It is unlikely to be important foraging habitat for this species due to its location and level of disturbance. Some of the narrow strips of roadside vegetation habitat affected are likely to be important as cover during dispersal. While these patches will be reduced, their functionality as cover is unlikely to be lost. The works are unlikely to have a significant adverse effect on the life cycle of the species and are unlikely to place a viable local population at significantly elevated risk of extinction.

b. in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:
  i. is likely to have an adverse effect on the extent of the ecological community such that its local viable population is likely to be placed at risk of extinction, or
  ii. is likely to substantially and adversely modify the composition of the ecological community such that its local viable population is likely to be placed at risk of extinction,

Not applicable

c. in relation to the habitat of a threatened species or ecological community:
  i. the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and
  ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
  iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.

The proposed modification is predicted to remove around 25.59 hectares of foraging habitat for the Grey-crowned Babbler. Some areas of this may also present nesting opportunities but no nests were observed during the survey. There may be additional indirect impacts to remaining areas of habitat due to edge effects. The habitat to be impacted includes:

- Belah woodland (1.93 ha - intact)
- Carbeen +/- Coolabah grassy woodland (3.04 ha intact)
- Poplar Box - Belah woodland (8.34 ha - intact)
- Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact)

- Weeping Myall open woodland (0.9 ha - intact).

The patches of habitat are already somewhat fragmented and isolated by the existing Newell Highway. The proposed modification is unlikely to break the local viable population into more fragments. However, it is likely to increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. For highly mobile species like birds, this is not a large problem, however the reduction of suitable habitats into small isolated patches inhibits movement throughout the landscape.

Vegetation in the study area is likely to be important for individuals travelling through the landscape. Considering the amount of higher value vegetation in the region (i.e. Pilliga National Park, Mount Kaputar National Park and nearby conservation areas), the habitat that will be impacted by the proposed modification is unlikely to be highly important to the long-term survival of the Grey-crowned Babbler.

d. whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The proposed modification will not impact on any declared area of outstanding biodiversity value.

e. whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs.

The proposed modification would result in the 'Clearing of native vegetation' with the removal of 25.59 hectares of suitable habitat for the Grey-crowned Babbler.

While there is potential for other KTPs of relevance to this species to be affected by the proposed modification, these KTPs are likely to be able to be adequately managed by TfNSW' standard environmental management measures.

Conclusion

Any Grey-crowned Babblers that occur in vegetation within the study area are part of a single population that occurs right across the range of this species. The Grey-crowned Babbler is likely to utilise vegetation in the study area as a foraging resource. There were no nests observed so therefore the impact to nesting habitat is likely to be minor. The impact of widening the current road corridor is not considered likely to significantly impact the Grey-crowned Babbler as it is highly mobile. Further isolation of patches of suitable habitat will affect this species ability to move throughout the landscape.

In summary, the proposed modification is considered unlikely to have a significant adverse effect on the Grey-crowned Babbler due to the relatively low impact on habitat resources when the amount of higher value habitat in the region is considered (i.e. Pilliga National Park, Mount Kaputar National Park and nearby conservation areas). The proposed modification is unlikely to place the Grey-crowned Babbler at a significantly elevated risk of extinction.

Squirrel Glider (*Petaurus norfolcensis*)

Field surveys did not identify the Squirrel Glider within the study area, however no targeted surveys were undertaken for the species. This species has been recorded in Kaputar National Park and Bobbiwaa State Conservation Area. Although vegetation in the study area is very fragmented, it offers an abundance of hollow-bearing trees suitable for this species, particularly in River Red Gum Woodlands (e.g. Bobbiwaa Creek connects the study area to the conservation area). As such, this species is considered to have a moderate likelihood of occurring within suitable habitat in the study area.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

a. in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Squirrel Gliders nest in a bowl shaped, leaf-lined nest in a tree hollow. Typically, family group comprises one mature male (more than two years old), one or more adult females and their associated offspring of the season. Breeding usually begins in June or July, each female producing two young which remain in the

pouch for about 70 days and are then deposited in the group nest for a further 40-50 days. Young leave the nest after 110-120 days to forage. Young leave their family group at the age of 7-10 months. The reproductive biology of the Squirrel Glider is strikingly similar to the Sugar Glider (*Petaurus breviceps*) and the two have interbred in captivity, producing fertile offspring (Strahan, 1995).

Habitat for the Squirrel Gilder is widespread in the study area, however not all of it is likely to be used by this species. This species has been recorded in Kaputar National Park and Bobbiwaa State Conservation Area where they likely breed. Squirrel Gliders may come down from these large areas of vegetation along vegetated creek lines line (such as Bobbiwaa Creek) and pass through the study area. There is an abundance of hollow-bearing trees that represent suitable rooting habitat for this species, however breeding is unlikely due to the level of disturbance.

The Newell Highway currently supports long stretches of vegetation that may be used by a range of fauna species to travel through the landscape. A reduction in 12.42 hectares of potential habitat for the Squirrel Glider along the current alignment is unlikely to reduce the ability of this species to disperse, forage and successfully breed. Additionally, widening the road and increasing the speed limit will increase the potential for vehicle strike. Considering there may be a stronghold for this population within highly vegetated areas in the region, these impacts are likely going to only affect dispersing individuals. It is unlikely that the proposed modification will have adverse effect on the life cycle of the species such that the viable local population is likely to be placed at risk of extinction.

b. in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:
   i. is likely to have an adverse effect on the extent of the ecological community such that its local viable population is likely to be placed at risk of extinction, or
   ii. is likely to substantially and adversely modify the composition of the ecological community such that its local viable population is likely to be placed at risk of extinction,

Not applicable

c. in relation to the habitat of a threatened species or ecological community:
   i. the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and
   ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
   iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.

The proposed modification is predicted to remove around 12.42 hectares of potential habitat for the Squirrel Glider. There may be additional indirect impacts to remaining areas of habitat due to edge effects.

The patches of habitat are already somewhat fragmented and isolated by the existing Newell Highway. The proposed modification is unlikely to break the local viable population into more fragments. However, it is likely to increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. This increased isolation may result in increased mortality by vehicle strike, a reduction in breeding success between individuals travelling between fragments. Connectivity for the Squirrel Glider can be retained in certain areas (i.e. riparian corridors) by fauna crossing design.

As mentioned, individuals of the local population that will be impacted by the proposed modification are those dispersing throughout the landscape. A reduction in 12.42 hectares of potential habitat for the Squirrel Glider along the current alignment is unlikely to reduce the ability of this species to disperse, forage and find breeding partners. Breeding habitat will not be impacted. Highly vegetated areas such as Kaputar National Park and Bobbiwaa State Conservation Area likely contain a vast majority of the local population. Therefore, it is unlikely that the impacts to Squirrel Glider habitat associated with the proposed modification will significantly affect the long-term survival of the species.

d. whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The proposed modification will not impact on any declared area of outstanding biodiversity value.

e. whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs.

The proposed modification would undoubtedly result in an increase to the 'Clearing of native vegetation' with the removal of 12.42 hectares of suitable habitat for the Squirrel Glider.

While there is potential for other KTPs of relevance to this species to be affected by the proposed modification, these KTPs are likely to be able to be adequately managed by TfNSW' standard environmental management measures.

Conclusion

The region likely supports a viable local population of the Squirrel Glider, with most individuals located in highly vegetated areas such as the Kaputar National Park and Bobbiwaa State Conservation Area. Individuals that disperse from these areas likely do so throughout the landscape in vegetation remnants along waterways and roads. A reduction in 12.42 hectares of suitable habitat for the Squirrel Glider along the current alignment will unlikely reduce the ability of this species to disperse, forage and successfully breed. These impacts to Squirrel Glider habitat are not considered to significantly impact this species due to the proportion of higher quality habitat available throughout the region.

There is also likely to be an increase in distance between patches within the local viable population due to the increase in the width of cleared land associated with the road. A large threat to this species associated with the proposed modification is increased risk by vehicle strike. The design of the road should consider fauna crossing structures to retain connectivity for this species, particularly around riparian corridors.

In summary, the proposed modification is considered unlikely to have a significant adverse effect on the Squirrel Glider due to the relatively low number of individuals using habitat in the study area compared to more vegetated areas in the region. The proposed modification is unlikely to place the Squirrel Glider at a significantly elevated risk of extinction.

Rufous Bettong (*Aepyprymnus rufescens*)

Field surveys did not identify the Rufous Bettong within the study area, however no targeted surveys were undertaken for the species. However, suitable habitat is present.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

a. in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Habitat for the Rufous Bettong is widespread in the study area, however not all of it is likely to be used by this species. There are reports that the Rufous Bettong has largely vanished from inland areas but there are sporadic, unconfirmed records from the Pilliga and Torrington districts. The nearest records to the study area are in the Pilliga region and the study area contains potential habitat including habitat that could be used for breeding. Associated habitats in the study area include:

- Brigalow viney scrub open forest (1.47 ha - intact)
- Mock Olive - Wilga - Peach Bush - Carissa (0.11 ha - intact).

The Newell Highway currently supports long stretches of vegetation that may be used by a range of fauna species to travel through the landscape. A reduction in 1.58 hectares of potential habitat for the Rufous Bettong along the current alignment is unlikely to reduce the ability of this species to disperse, forage and successfully breed. Widening the road and increasing the speed limit will increase the potential for vehicle strike. These impacts are likely going to only affect dispersing individuals and it is unlikely that the proposed modification will have adverse effect on the life cycle of the species such that the viable local population is likely to be placed at risk of extinction.

b. in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:
   i. is likely to have an adverse effect on the extent of the ecological community such that its local viable population is likely to be placed at risk of extinction, or
   ii. is likely to substantially and adversely modify the composition of the ecological community such that its local viable population is likely to be placed at risk of extinction,

Not applicable

c. in relation to the habitat of a threatened species or ecological community:
   i. the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and
   ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
   iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.

The proposed modification is predicted to remove around 0.74 hectares of potential habitat for the Rufous Bettong consisting of:

- Brigalow viney scrub open forest (1.47 ha - intact)
- Mock Olive - Wilga - Peach Bush - Carissa (0.11 ha - intact).

The patches of habitat are already somewhat fragmented and isolated by the existing Newell Highway. The proposed modification is unlikely to break the local viable population into more fragments. However, it is likely to increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. This increased isolation may result in increased mortality by vehicle strike, a reduction in breeding success between individuals travelling between fragments. Connectivity for the Rufous Bettong can be retained in certain areas (i.e. riparian corridors) by fauna crossing design.

The individuals of the local population that may be impacted by the proposed modification are those dispersing throughout the landscape. A reduction in 1.58 hectares of potential habitat for the Rufous Bettong along the current alignment is unlikely to reduce the ability of this species to disperse, forage and find breeding partners. Breeding habitat may be impacted but a high density population is not expected to occur in the study area. Therefore, it is unlikely that the impacts to Rufous Bettong habitat associated with the proposed modification will significantly affect the long-term survival of the species.

d. whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The proposed modification will not impact on any declared area of outstanding biodiversity value.

e. whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs.

The proposed modification would undoubtedly result in an increase to the 'Clearing of native vegetation' with the removal of 1.58 hectares of suitable habitat for the Rufous Bettong.

While there is potential for other KTPs of relevance to this species to be affected by the proposed modification, these KTPs are likely to be able to be adequately managed by TfNSW' standard environmental management measures.

Conclusion

The region may support a viable local population of the Rufous Bettong with most individuals located in highly vegetated areas such as the Pilliga National Park, Mount Kaputar National Park and nearby conservation areas. Individuals that disperse from these areas likely do so throughout the landscape in vegetation remnants along waterways and roads. A reduction in 0.74 hectares of suitable habitat for the Rufous Bettong along the current alignment will unlikely reduce the ability of this species to disperse, forage and successfully breed. However, these impacts to Rufous Bettong habitat are not considered to significantly impact this species due to the proportion of higher quality habitat available throughout the region.

Stripe-faced Dunnart (*Sminthopsis macroura*)

Field surveys did not identify the Stripe-faced Dunnart within the study area, however no targeted surveys were undertaken for the species. Suitable habitat is present, and this species is considered to have a moderate likelihood of occurring within the study area.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

a. in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

There are no records of the Stripe-faced Dunnart in locality, however this species occupies the same habitat as the common fat-tailed dunnart, of which there are records in Narrabri, Bellata and Moree. It is unlikely there has been comprehensive surveys for this species in the study area. Associated habitat present in the study area includes:

- Belah woodland (1.93 ha – intact, 0.32 ha - derived)
- Brigalow viney scrub open forest (1.47 ha - intact, 0.87 -derived)
- Carbeen +/- Coolabah grassy woodland (3.04 ha intact, 1.24 ha derived)
- Poplar Box - Belah woodland (8.34 ha - intact, 0.42 ha - derived)
- Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact)
- Weeping Myall open woodland (0.9 ha - intact, 14.42 ha - derived).

The Newell Highway currently supports long stretches of vegetation that may be used by a range of fauna species to travel through the landscape. A reduction in 48.27 hectares of potential habitat for the Stripe-faced Dunnart along the current alignment is unlikely to reduce the ability of this species to disperse, forage and successfully breed. Additionally, widening the road and increasing the speed limit will increase the potential for vehicle strike. Considering there may be a stronghold for this population within highly vegetated areas in the region, these impacts are likely going to only affect dispersing individuals. It is unlikely that the proposed modification will have adverse effect on the life cycle of the species such that the viable local population is likely to be placed at risk of extinction.

b. in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:
  i. is likely to have an adverse effect on the extent of the ecological community such that its local viable population is likely to be placed at risk of extinction, or
  ii. is likely to substantially and adversely modify the composition of the ecological community such that its local viable population is likely to be placed at risk of extinction,

Not applicable

c. in relation to the habitat of a threatened species or ecological community:
  i. the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and
  ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
  iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.

The proposed modification is predicted to remove around 48.27 hectares of potential habitat for the Striped-face Dunnart including:

- Belah woodland (1.93 ha – intact, 0.32 ha - derived)
- Brigalow viney scrub open forest (1.47 ha - intact, 0.87 -derived)
- Carbeen +/- Coolabah grassy woodland (3.04 ha intact, 1.24 ha derived)
- Poplar Box - Belah woodland (8.34 ha - intact, 0.42 ha - derived)
- Queensland Bluegrass +/- Mitchell Grass (16.22 ha - intact)
- Weeping Myall open woodland (0.9 ha - intact, 14.42 ha - derived).

The patches of habitat are already somewhat fragmented and isolated by the existing Newell Highway. The proposed modification is unlikely to break the local viable population into more fragments. However, it is likely to increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. This increased isolation may result in increased mortality by vehicle strike, a reduction in breeding success between individuals travelling between fragments. Connectivity for the Stripe-faced Dunnart can be retained in certain areas (i.e. riparian corridors) by fauna crossing design.

As mentioned, individuals of the local population that will be impacted by the proposed modification are those dispersing throughout the landscape. A reduction in 35.64 hectares of potential habitat for the Stripe-

faced Dunnart along the current alignment is unlikely to reduce the ability of this species to disperse, forage and find breeding partners. Highly vegetated areas such as the Pilliga, Mount Kaputar National Park and Bobbiwaa State Conservation Area likely contain a vast majority of the local population. Therefore, it is unlikely that the impacts to Stripe-faced Dunnart habitat associated with the proposed modification will significantly affect the long-term survival of the species.

d. whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The proposed modification will not impact on any declared area of outstanding biodiversity value.

e. whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs.

The proposed modification would undoubtedly result in an increase to the 'Clearing of native vegetation' with the removal of 48.27 hectares of suitable habitat for the Stripe-faced Dunnart.

While there is potential for other KTPs of relevance to this species to be affected by the proposed modification, these KTPs are likely to be able to be adequately managed by TfNSW' standard environmental management measures.

Conclusion

The region may support a viable local population of the Stripe-faced Dunnart with most individuals located in highly vegetated areas such as the Pilliga, Mount Kaputar National Park and nearby conservation areas. Individuals that disperse from these areas likely do so throughout the landscape in vegetation remnants along waterways and roads. A reduction in 48.27 hectares of suitable habitat for the Stripe-faced Dunnart along the current alignment will unlikely reduce the ability of this species to disperse, forage and successfully breed. These impacts to Stripe-faced Dunnart habitat are not considered to significantly impact this species due to the proportion of higher quality habitat available throughout the region.

Remaining species – table format tests

Species assessed	Section 7.3 of the BC Act - Test for determining whether proposed development or activity likely to significantly affect threatened species or their habitats (see Footnote 1)						Conclusion
	(a) In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.	(c) in relation to the habitat of a threatened species or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity,	(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity,	iii) the importance of the habitat to be removed, modified fragmented or isolated to the long-term survival of the species or ecological community in the locality.	(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly), (see Note 2)	(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.	
Plants (sandy and sandy-loam soils containing White Cypress Pine and Belah): • *Cyperus conicus* • *Diuris tricolor* • *Lepidium aschersonii* • *Polygala linariifolia* • *Pterostylis cobarensis* • *Tylophora linearis* • *Sida rohlenae*	None of these species were identified during field surveys, however there are some suitable areas of habitat in the study area. Much of this habitat was surveyed and found to be modified due to edge effects such as weed invasion, so in the event that any of these species are present within the study area, the number of individual and the proportion of the local population affected is likely to be relatively small. Seed dispersal in these species is likely to be mainly via wind and floodwater and is unlikely to be substantially affected by the proposed modification. Pollination vectors (wind and insects) are also unlikely to be affected. The removal of vegetation may result in the direct mortality of a small number of individuals; however, the works are unlikely to have a significant adverse effect on the life cycle of the overall local populations of the species.	Based on associated PCTs/habitat, the proposed works will remove to following habitat: • *Cyperus conicus* – 24.67 ha • *Diuris tricolor* – 17.72 ha • *Lepidium aschersonii* – 12.62 ha • *Polygala linariifolia* – 9.38 ha • *Pterostylis cobarensis* – 8.21 ha • *Tylophora linearis* – 9.38 ha • *Sida rohlenae* – 13.04 ha	The habitat to be cleared is mostly an already isolated thin strip between the highway and rail corridor. The works will not result in fragmentation of habitat for the species. Seed dispersal in these species is likely to be mainly via wind and surface water and is unlikely to be substantially affected by the proposed modification. Pollination vectors (wind and insects) are also unlikely to be affected. The works will not substantially affect the level of isolation of populations of these species.	The habitat to be affected is unlikely to contain a substantial proportion of any local population of any of these species. The habitat is not considered to be important to the long-term survival of these species in the locality.	There are no declared areas of outstanding biodiversity value within or in close proximity to the site. The proposed activity is unlikely to have an adverse effect on any declared area of outstanding biodiversity value.	The works will contribute slightly to the impact of the *clearing of native vegetation* KTP. The impact is not significant in the context of the extent of habitat in the locality. The works may also contribute slightly to weed-related KTPs. Weed invasion will be limited through weed control activities and is unlikely to significantly affect the species.	Not significant
Plants (cracking-clay	None of these species were identified during field	Based on associated	The habitat to be cleared is mostly a thin	The habitat to be affected is unlikely to contain a	There are no declared areas of	The works will contribute slightly to the impact of the *clearing of*	Not significant

Species assessed	Section 7.3 of the BC Act - Test for determining whether proposed development or activity likely to significantly affect threatened species or their habitats (see Footnote 1)						Conclusion
	(a) In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.	(c) in relation to the habitat of a threatened species or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity,	(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity,	iii) the importance of the habitat to be removed, modified fragmented or isolated to the long-term survival of the species or ecological community in the locality.	(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly), (see Note 2)	(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.	
and clay-loam soils): • *Lepidium monoplocoides* • *Swainsona murrayana* • *Swainsona sericea*	surveys, however there are some suitable areas of habitat in the study area. Much of this habitat was surveyed, so in the event that any of these species are present within the study area, the number of individual and the proportion of the local population affected is likely to be relatively small. Seed dispersal in these species is likely to be mainly via wind and floodwater and is unlikely to be substantially affected by the proposed modification. Pollination vectors (wind and insects) are also unlikely to be affected. The removal of vegetation may result in the direct mortality of a small number of individuals; however, the works are unlikely to have a significant adverse effect on the life cycle of the overall local populations of the species.	PCTs/habitat, the proposed works will remove to following habitat: • *Lepidium monoplocoides* – 29.26 ha • *Swainsona murrayana* – 25.64 ha • *Swainsona sericea* – 49.17 ha	strip along the existing edge of the highway. The works will not result in substantial fragmentation of habitat for the species. Seed dispersal in these species is likely to be mainly via wind and floodwater and is unlikely to be substantially affected by the proposed modification. Pollination vectors (wind and insects) are also unlikely to be affected. The works will not substantially affect the level of isolation of populations of these species.	substantial proportion of any local population of any of these species. The habitat is not considered to be important to the long-term survival of these species in the locality.	outstanding biodiversity value within or in close proximity to the site. The proposed activity is unlikely to have an adverse effect on any declared area of outstanding biodiversity value.	*native vegetation* KTP. The impact is not significant in the context of the extent of habitat in the locality. The works may also contribute slightly to weed-related KTPs. Weed invasion will be limited through weed control activities and is unlikely to significantly affect the species.	
Little Lorikeet	Hollow-bearing trees are a common feature of the vegetation in the study area and are likely to present suitable roosting habitat for the species. The habitat affected may be used occasionally for foraging but	Based on associated PCTs/habitat, the proposed works will remove 9.38 ha of habitat	The works will not result in fragmentation of habitat for the species. The species is highly mobile and will freely fly long distances over open areas to move between roost sites and	The habitat to be affected is unlikely to be used as breeding habitat, however hollow-bearing trees are common and may offer suitable nesting features. Much of the study area is likely to be used as foraging	There are no declared areas of outstanding biodiversity value within or in close proximity to the site. The proposed activity is unlikely	The works will contribute slightly to the impact of the *clearing of native vegetation* KTP. The impact is not significant in the context of the extent of habitat in the locality. The works may also contribute slightly to weed-related KTPs. Weed invasion will be	Not significant

Species assessed	Section 7.3 of the BC Act - Test for determining whether proposed development or activity likely to significantly affect threatened species or their habitats (see Footnote 1)						Conclusion
	(a) In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.	(c) in relation to the habitat of a threatened species or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity,	(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity,	iii) the importance of the habitat to be removed, modified fragmented or isolated to the long-term survival of the species or ecological community in the locality.	(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly), (see Note 2)	(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.	
	is unlikely to be important foraging habitat for the species due to its location and level of disturbance. The works are unlikely to have a significant adverse effect on the life cycle of the species.		foraging sites. The works will not affect the movement of the species between habitat patches.	habitat by individuals passing through but is unlikely to be important for the species due to its location and level of disturbance. The habitat is not considered to be important to the long-term survival of these species in the locality.	to have an adverse effect on any declared area of outstanding biodiversity value.	limited through weed control activities and is unlikely to significantly affect the species.	
Superb Parrot	The study area is in the very north of the migration range for this species and is likely only used on occasion for foraging and roosting by birds during seasonal migration (i.e. non-breeding season). Hollow-bearing trees across the entire study area likely present suitable roosting habitat. This species will also forage in just about all areas of the study area depending on available resources, however the study area is unlikely to be important foraging habitat for the species due to its location and level of disturbance. The works are unlikely to have a significant adverse effect on the life cycle of the species.	Based on associated PCTs/habitat, the proposed works will remove 56.12 ha of foraging habitat.	The works will not result in fragmentation of habitat for the species. The species is highly mobile and will freely fly long distances, however Superb Parrots usually move along wooded corridors, seldom crossing extensive open areas. The proposed modification is unlikely to fragment a major movement corridor for this species.	The habitat to be affected is unlikely to be used as breeding habitat, however hollow-bearing trees are common and may offer suitable nesting features. Much of the study area is likely to be used as foraging habitat by individuals visiting during seasonal migration in winter. However, it is unlikely to be important for the species due to its location and level of disturbance. The habitat is not considered to be important to the long-term survival of these species in the locality.	There are no declared areas of outstanding biodiversity value within or in close proximity to the site. The proposed activity is unlikely to have an adverse effect on any declared area of outstanding biodiversity value.	The works will contribute slightly to the impact of the *clearing of native vegetation* KTP. The impact is not significant in the context of the extent of habitat in the locality. The works may also contribute slightly to weed-related KTPs. Weed invasion will be limited through weed control activities and is unlikely to significantly affect the species.	Not significant
Black-cockatoos:	No likely breeding habitat (woodland or forest with areas of tall dense shrubbery and/or mature trees in areas distant from regular human	Based on associated PCTs/habitat, the proposed	The works will not result in fragmentation of habitat for the species. The species is highly mobile and will freely fly	The habitat to be affected is unlikely to be used as breeding habitat. It may be used for foraging but is unlikely to be important	There are no declared areas of outstanding biodiversity value within or in close	The works will contribute slightly to the impact of the *clearing of native vegetation* KTP. The impact is not significant in the context of the extent of habitat in	Not significant

Species assessed	Section 7.3 of the BC Act - Test for determining whether proposed development or activity likely to significantly affect threatened species or their habitats (see Footnote 1)						Conclusion
	(a) In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.	(c) in relation to the habitat of a threatened species or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity,	(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity,	iii) the importance of the habitat to be removed, modified fragmented or isolated to the long-term survival of the species or ecological community in the locality.	(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly), (see Note 2)	(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.	
• Glossy-black Cockatoo	disturbance) occurs in the areas affected by the works. Some vegetation in the larger patches away from the road may provide some suitable nesting opportunities, however the habitat affected is more likely used occasionally for foraging by individuals passing through. Large stands of Belah offer foraging resources for the Glossy Black Cockatoo. Belah is common and widespread through the locality. It is unlikely to be important foraging habitat for these species due to its location and level of disturbance. The works are unlikely to have a significant adverse effect on the life cycle of the species.	works will remove: 24.69 ha of habitat for the Glossy-black Cockatoo	long distances over open areas to move between roost sites and foraging sites. The works will not affect the movement of these species between habitat patches.	foraging habitat for the species due to its location and level of disturbance. The habitat is not considered to be important to the long-term survival of these species in the locality.	proximity to the site. The proposed activity is unlikely to have an adverse effect on any declared area of outstanding biodiversity value.	the locality. The works may also contribute slightly to weed-related KTPs. Weed invasion will be limited through weed control activities and is unlikely to significantly affect the species.	
Woodland birds: • Diamond Firetail • Dusky Woodswallow • Hooded Robin (south-eastern form)	These species may occur in the study area based on the presence of records and suitable habitat. Breeding habitat likely occurs further away from the road edge (woodland or forest with areas of tall dense shrubbery and/or mature trees in areas distant from regular human disturbance) in areas that will not be affected by the works. The habitat affected	Based on associated PCTs/habitat, the proposed works will remove: 25.17 habitat for the Diamond Firetail 58.66 habitat for the Dusky Woodswallow	The works will not result in fragmentation of habitat for the species. The species is highly mobile and will freely fly long distances over open areas to move between roost sites and foraging sites. The works will not affect the movement of these species between habitat patches.	The habitat to be affected is unlikely to be used as breeding habitat. It may be used for foraging but is unlikely to be important foraging habitat for the species due to its location and level of disturbance. The habitat is not considered to be important to the long-term survival of these species in the locality.	There are no declared areas of outstanding biodiversity value within or in close proximity to the site. The proposed activity is unlikely to have an adverse effect on any declared area of outstanding biodiversity value.	The works will contribute slightly to the impact of the *clearing of native vegetation* KTP. The impact is not significant in the context of the extent of habitat in the locality. The works may also contribute slightly to weed-related KTPs. Weed invasion will be limited through weed control activities and is unlikely to significantly affect the species.	Not significant

Species assessed	Section 7.3 of the BC Act - Test for determining whether proposed development or activity likely to significantly affect threatened species or their habitats (see Footnote 1)						Conclusion
	(a) In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.	(c) in relation to the habitat of a threatened species or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity,	(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity,	iii) the importance of the habitat to be removed, modified fragmented or isolated to the long-term survival of the species or ecological community in the locality.	(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly), (see Note 2)	(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.	
• Speckled Warbler • Varied Sittella • Turquoise Parrot	may be used occasionally for foraging but is unlikely to be important foraging habitat for the species due to its location and level of disturbance. The works are unlikely to have a significant adverse effect on the life cycle of these species.	27.12 habitat for the Speckled Warbler 25.17 habitat for the Hooded Robin and 25.06 ha for Varied Sittella. 20.76 habitat for the Turquoise Parrot					
Forest/Woodland Owls: • Barking Owl • Masked Owl	Large hollow-bearing trees are scattered across the study area and may provide some nesting opportunities, however due to their close proximity to the road they are unlikely to present high quality breeding habitat. These species are also likely to use the study area for perching and hunting at night. However, the habitat is unlikely to be important for these species due to its location and level of disturbance. The works are unlikely to have a significant adverse effect on the life cycle of these species.	Based on associated PCTs/habitat, the proposed works will remove: 19.64 ha of habitat for the Barking Owl 46.26 ha of habitat for the Masked Owl	The works will not result in fragmentation of habitat for the species. The species are highly mobile and will freely fly long distances over open areas to move between roost sites and foraging sites. The works will not affect the movement of these species between habitat patches.	The habitat to be affected is unlikely to be used as breeding habitat, however some suitable nesting hollows may be present. Much of the study area is likely to be used as hunting habitat but is unlikely to be important for the species due to its location and level of disturbance. The habitat is not considered to be important to the long-term survival of these species in the locality.	There are no declared areas of outstanding biodiversity value within or in close proximity to the site. The proposed activity is unlikely to have an adverse effect on any declared area of outstanding biodiversity value.	The works will contribute slightly to the impact of the *clearing of native vegetation* KTP. The impact is not significant in the context of the extent of habitat in the locality. The works may also contribute slightly to weed-related KTPs. Weed invasion will be limited through weed control activities and is unlikely to significantly affect the species.	Not significant
Birds of open woodland and grassland habitats: • Australian Bustard	No potential breeding habitat occurs in the study area (i.e. too disturbed and close to the highway). The habitat affected may be used occasionally for foraging but is unlikely to be important	Based on associated PCTs/habitat, the proposed works will remove:	The works will not result in fragmentation of habitat for the species. The species are highly mobile and will freely fly long distances over open areas to move	The habitat to be affected is unlikely to be used as breeding habitat, as all species nest on the ground and the study area is likely to be too disturbed. Much of the study area is likely to be used	There are no declared areas of outstanding biodiversity value within or in close proximity to the site. The proposed	The works will contribute slightly to the impact of the *clearing of native vegetation* KTP. The impact is not significant in the context of the extent of habitat in the locality. The works may also contribute slightly to weed-related	Not significant

Species assessed	Section 7.3 of the BC Act - Test for determining whether proposed development or activity likely to significantly affect threatened species or their habitats (see Footnote 1)						Conclusion
	(a) In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.	(c) in relation to the habitat of a threatened species or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity,	(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity,	iii) the importance of the habitat to be removed, modified fragmented or isolated to the long-term survival of the species or ecological community in the locality.	(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly), (see Note 2)	(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.	
• Bush Stone-curlew	foraging habitat for the species due to its location and level of disturbance. The widening of the highway and associated increases in traffic/speeds may slightly increase the risk of vehicle strike. The works are unlikely to have a significant adverse effect on the life cycle of the species.	79.13 ha of habitat for the Australian Bustard 47.54 ha of habitat for the Bush Stone-curlew	between roost sites and foraging sites. The works will not affect the movement of these species between habitat patches.	as foraging habitat by individuals passing through but is unlikely to be important for the species due to its location and level of disturbance. The habitat is not considered to be important to the long-term survival of these species in the locality.	activity is unlikely to have an adverse effect on any declared area of outstanding biodiversity value.	KTPs. Weed invasion will be limited through weed control activities and is unlikely to significantly affect the species.	
Birds of prey: • Square-tailed Kite • Spotted Harrier • Little Eagle • Grey Falcon • Black Falcon • Black-breasted Buzzard	Many of the large trees in the study area may provide nesting opportunities, however due to their close proximity to the road they are unlikely to present high quality breeding habitat. These species are also likely to use the study area for perching and hunting. However, the habitat is unlikely to be important for these species due to its location and level of disturbance. The works are unlikely to have a significant adverse effect on the life cycle of these species.	Based on associated PCTs/habitat, the proposed works will remove: 25.17 ha of habitat for the Square-tailed Kite 49.17 ha of habitat for the Spotted Harrier 49.28 ha of habitat for the Little Eagle 48.27 ha of habitat for the Grey Falcon 35.82 ha of habitat for the Black Falcon 19.65 ha of habitat for the Black-breasted Buzzard	The works will not result in fragmentation of habitat for the species. The species are highly mobile and will freely fly long distances over open areas to move between roost sites and foraging sites. The works will not affect the movement of these species between habitat patches.	The habitat to be affected is unlikely to be used as breeding habitat, however some large trees may be suitable for nesting. Much of the study area is likely to be used as hunting habitat but is unlikely to be important for the species due to its location and level of disturbance. The habitat is not considered to be important to the long-term survival of these species in the locality.	There are no declared areas of outstanding biodiversity value within or in close proximity to the site. The proposed activity is unlikely to have an adverse effect on any declared area of outstanding biodiversity value.	The works will contribute slightly to the impact of the *clearing of native vegetation* KTP. The impact is not significant in the context of the extent of habitat in the locality. The works may also contribute slightly to weed-related KTPs. Weed invasion will be limited through weed control activities and is unlikely to significantly affect the species.	Not significant

Species assessed	Section 7.3 of the BC Act - Test for determining whether proposed development or activity likely to significantly affect threatened species or their habitats (see Footnote 1)						Conclusion
	(a) In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.	(c) in relation to the habitat of a threatened species or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity,	(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity,	iii) the importance of the habitat to be removed, modified fragmented or isolated to the long-term survival of the species or ecological community in the locality.	(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly), (see Note 2)	(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.	
Insectivorous bats: • Little Pied Bat • Yellow-bellied Sheathtail-bat • Bristle-faced free-tailed bat • Eastern Cave Bat • Corben's Long-eared Bat • Eastern Bentwing-bat	Hollow-bearing trees are a common feature of the vegetation in the study area and are likely to present suitable roosting habitat for the hollow-roosting species. Bridges and culverts may also provide roosting opportunities. There is unlikely to be a maternity roost in the study area for cave-dwelling species, except possibly in the bridges which would be unaffected by the proposed modification. Maternity roosts of hollow-dependent species may be found in the broader sections of the study area but are unlikely to be located at the disturbed road edge, where the clearing would take place, due to existing noise and light disturbance and edge effects disturbance. All these species are likely to forage around the vegetation in the study area. The habitat affected is unlikely to be important for these species due to its location and level of disturbance, and the amount of higher quality habitat in the locality. The works are unlikely to have a significant adverse effect on	Based on associated PCTs/habitat, the proposed works will remove: 58.66 habitat for the Little Pied Bat and Yellow-bellied Sheathtail-bat. 13.89 habitat for the Bristle-faced free-tailed bat. 22.13 habitat for the Corben's Long-eared bat. 28.97 habitat for the Eastern Cave bat. 28.97 habitat for the Eastern Bentwing-bat.	The works will not result in fragmentation of habitat for these species. These species are highly mobile and will freely fly long distances over open areas to move between roost sites and foraging sites. The works will not affect the movement of these species between habitat patches.	The habitat to be affected is unlikely to be used as breeding habitat (no maternity roosts identified during surveys), however hollow-bearing trees, bridges and culverts may offer suitable roosting habitat opportunities. These are likely to be used on occasion along with many other roosts throughout the landscape. It may be used for foraging but is unlikely to be important foraging habitat for the species due to its location and level of disturbance. The habitat is not considered to be important to the long-term survival of these species in the locality.	There are no declared areas of outstanding biodiversity value within or in close proximity to the site. The proposed activity is unlikely to have an adverse effect on any declared area of outstanding biodiversity value.	The works will contribute slightly to the impact of the *clearing of native vegetation* KTP. The impact is not significant in the context of the extent of habitat in the locality. The works may also contribute slightly to weed-related KTPs. Weed invasion will be limited through weed control activities and is unlikely to significantly affect the species.	Not significant

Species assessed	Section 7.3 of the BC Act - Test for determining whether proposed development or activity likely to significantly affect threatened species or their habitats (see Footnote 1)						Conclusion
	(a) In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.	(c) in relation to the habitat of a threatened species or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity,	(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity,	iii) the importance of the habitat to be removed, modified fragmented or isolated to the long-term survival of the species or ecological community in the locality.	(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly), (see Note 2)	(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.	
	the life cycle of these species.						
Fish Eel tail catfish	The western population was widely distributed in the Murray-Darling River System in NSW, Qld, Vic., and SA except in cooler parts. It is non migratory and lives in a wide range of habitats including rivers, creeks, lakes, billabongs and lagoons, and although it inhabits flowing streams, prefers sluggish or still waters. It can be found in clear to turbid waters, and over substrates ranging from mud to gravel and rock. It is rare in natural riverine habitats but can be found in farm dams through-out inland NSW and southern Qld. Moderate remnant populations occur in the Macquarie catchment, the Castlereagh catchment, the Namoi catchment upstream of Wee Waa, the Gwydir catchment upstream of Moree and the Border	Current area of occupancy will not be affected.	The pools of habitat in the study area are already somewhat fragmented and isolated by the drought however this is the norm for the species of which it is well adapted to overcome. The proposed modification is unlikely to break the local viable population into more fragments.	No habitat critical to this species will be affected.	No breeding habitat is present in the impact area.	Based on associated habitat, the proposed work will not remove potential foraging habitat. This impact is low in terms of the available habitat in the locality and not likely to result in the decline of this species.	Habitat loss is a key threat to this species. The associated indirect impact may increase potential for the proliferation of invasive species. Measures to minimise invasion of weeds during construction and operation would be included in the CEMP. With these measures in place, this proposed modification is not considered likely to result in a significant increase in the impact of

Species assessed	Section 7.3 of the BC Act - Test for determining whether proposed development or activity likely to significantly affect threatened species or their habitats (see Footnote 1)						Conclusion
	(a) In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.	(c) in relation to the habitat of a threatened species or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity,	(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity,	iii) the importance of the habitat to be removed, modified fragmented or isolated to the long-term survival of the species or ecological community in the locality.	(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly), (see Note 2)	(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.	
	Rivers Goondiwindi (Fisheries Scientific Committee final determination).						invasive species
Pale-headed Snake	A patchy distribution from north-east Queensland to the north-eastern quarter of NSW. In NSW it has historically been recorded from as far west as Mungindi and Quambone on the Darling Riverine Plains, across the north west slopes, and from the north coast from Queensland to Sydney. The Pale-headed Snake is a highly cryptic species that can spend weeks at a time hidden in tree hollows. Found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest. The proposed modification is unlikely to have a significant impact on the population such that it is placed at risk of extinction.	Current area of occupancy will not be affected.	Habitat in the study area are already somewhat fragmented. The proposed modification is unlikely to break the local viable population into more fragments.	No habitat critical to this species will be affected.	No breeding habitat is present in the impact area.	Based on associated habitat, the proposed work will not remove potential foraging habitat. This impact is low in terms of the available habitat in the locality and not likely to result in the decline of this species.	Habitat loss is a key threat to this species. The associated indirect impact may increase potential for the proliferation of invasive species. Measures to minimise invasion of weeds during construction and operation would be included in the CEMP. With these measures in place, this proposed modification is not considered likely to result in a significant

Species assessed	Section 7.3 of the BC Act - Test for determining whether proposed development or activity likely to significantly affect threatened species or their habitats (see Footnote 1)						Conclusion
	(a) In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.	(c) in relation to the habitat of a threatened species or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity,	(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity,	iii) the importance of the habitat to be removed, modified fragmented or isolated to the long-term survival of the species or ecological community in the locality.	(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly), (see Note 2)	(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.	
							increase in the impact of invasive species

Appendix C – Assessments of Significance – EPBC Act

Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland

Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland occurs on the Darling Downs, Liverpool Plains and Moree Plains, mostly in the Brigalow Belt South and Darling Riverine Plains bioregions of Queensland and New South Wales (NSW). The following descriptions and information used in the assessment is soured from the Commonwealth advice for listing this ecological community under the EPBC Act, and the results of the targeted survey.

The distribution of the ecological community is strongly reliant on soil type as it is associated with fine textured, often cracking clays derived from either basalt or quaternary alluvium. The development of deep cracks as the soils dry, and the tearing of tap roots during the soil contraction and expansion cycle are possible reasons why trees and large woody shrubs are typically lacking in these grasslands.

The ecological community generally occurs on flat to low slopes, of no more than 5 percent inclination. As slope increases, grassy woodlands dominated by trees such as *Acacia pendula* (Weeping Myall), *Eucalyptus coolabah* (Coolabah), *E. populnea* (Poplar Box) or *E. melliodora* (Yellow Box) occur. The ground layer component of these woodlands may be similar to the grassland, but the soils will not be the same cracking clays as on the plains.

It is important to note that native grasslands comprise not only the more obvious grass species, but also a great diversity of other herbaceous plants such as native daisies, orchids, lilies and other wildflowers. Many of these plants are only easily seen in the spring. The native grassland flora also includes herbaceous legumes such as Desmodium, Glycine, Lotus and Rhynchosia that have an important role in soil nitrogen fixation. The native legumes of grasslands on the Liverpool Plains are now mainly restricted to sites that have not been heavily degraded by past land management practices.

The shrub cover is typically a very minor component of the grassland however in some areas such as Kirramingly (south of Moree) the cover of shrubs, such as *Acacia farnesiana* (Mimosa), can be quite thick. At sites like this, the thick shrub cover does not affect the abundance of grass species. The total projective canopy cover of woody shrubs over 0.5 m tall can be up to 50% in this ecological community but is typically much less. A tree canopy is typically absent. Where trees are present, they are of variable species composition and comprise less than 10% of projective crown cover.

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will*:*

Reduce the extent of an ecological community

The listing advice for the community concluded that the ecological community has undergone a very severe decline in extent, likely to be at least 95%, from about 683 000 hectares to about 29 000 hectares.

The proposed modification would remove approximately 16.22 hectares of the TEC from two patches, one the east and one on the west of the highway. Each of these patches is estimated to have an extent of around 300 hectares and the impact of the proposed modification would affect each to a similar extent. The proposed modification is likely to result in a reduction in the extent of each of these populations by around two per cent. Within 1500 metres (the viable local population) this CEEC has a mapped extent of 55.48 hectares. The proposed modification would remove about 29 per cent of the local viable population.

The reduction in the extent of the community is considered to be substantial for the local viable population.

Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines

The proposed modification will result in a minor increase reduction in the connectivity of patches due to the increase in the width of cleared land associated with the road widening. The slight increase in isolation of patches as a result of road widening is unlikely to significantly impact their long-term viability.

Adversely affect habitat critical to the survival of an ecological community

According to the MNES SIG 1.1 EPBC Act (DoE 2013) Habitat critical to the survival of an ecological community refers to areas that are necessary:

- for the long-term maintenance of the ecological community (including the maintenance of species essential to the survival of the ecological community, such as pollinators)
- to maintain genetic diversity and long term evolutionary development, or
- for the reintroduction of populations or recovery of the ecological community.

Such habitat may be but is not limited to: habitat identified in a recovery plan for the ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act.

There are very few undisturbed patches of the community remaining in existence; most remaining patches have some degree of disturbance and degradation. While habitat critical to the survival of the community has not been formally identified, important habitat for the community is assumed to consist of large patches in 'best' and/or 'good' condition as defined in the condition thresholds for the community and shown in Table 1.

Table C.1 - Condition thresholds for the Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland ecological community.

Condition thresholds	Best quality	Good quality
Patch size	Minimum patch size at least 0.5 ha, **AND**	Minimum patch size at least 2 ha AND
Grasses	At least 4 native perennial grass species from the indicator species list **AND**	At least 3 native perennial grass species from the indicator species list AND
Tussock cover	At least 200 native perennial grass tussocks **AND**	At least 200 native perennial grass tussocks **AND**
Woody shrub cover	Total projected canopy cover of shrubs is less than 30% **AND**	Total projected canopy cover of shrubs is less than 50% **AND**
Introduced species	Perennial non-woody introduced weed species are less than 5% of the total projected crown cover	Perennial non-woody introduced weed species are less than 30% of the total projected crown cover
Notes: • Shrubs are typically absent. When present, they are defined as woody plants more than 0.5 m tall that occupy the mid vegetation layer. The upper, tree canopy layer also is typically absent but may comprise scattered trees to less than 10% projective crown cover • Sampling should be based upon a quadrat size of 0.1 ha (e.g. 50 m x 20 m) selected in an area with the most apparent native perennial grass species. Unless exceptional circumstances apply, to maximise the assessment of condition, a site must be assessed during a good season, two months after cessation of disturbance (fire, grazing, mowing or slashing) and within two months of effective rain.		

Most of the occurrence of the community in the impacted areas and broader study area meets the thresholds for inclusion in the best quality category while edge areas that have been subject to a moderate level of disturbance (typically within five metres of the edges of the community) would only meet the good quality thresholds. Both of the patches affected are large (~300 hectares) and are considered to be of high importance to the survival of the community.

The removal of approximately 16.22 hectares of habitat for the community, from patches considered to be critical to the survival of the ecological community, is considered to have a substantial adverse impact on habitat critical to the survival of the community.

Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns

The proposed modification is likely to reduce the quality of some of the adjacent retained area of the TEC due to edge effects such as increased light, increased wind, altered hydrology and weed invasion.

Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting

The proposed modification is likely to reduce the quality of a small proportion of the immediately adjacent retained area of the TEC due to edge effects such as increased wind, altered hydrology and weed invasion.

These changes in environmental conditions may result in a change in the species constitution and vegetation structure. This would likely involve a proliferation of tolerant species (typically grasses), a reduction in floristic diversity (particularly of small herbs) and reduced structural complexity due to the development of a continuous grass cover with little or no inter-tussock space. This impact would be restricted to areas immediately adjacent to the proposed modification and would not substantially affect the broader patch of the community.

Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

- **assisting invasive species, that are harmful to the listed ecological community, to become established, or**
- **causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or**

Unless the proposed modification includes very careful soil management, weed monitoring and management and intensive vegetation restoration, weed proliferation is likely to occur on the newly created fill batters. Weeds on the fill batters are likely to invade the adjacent edges of the community. This impact would be restricted to areas immediately adjacent to the proposed modification and would not substantially affect the broader patch of the community.

Interfere with the recovery of an ecological community.

There is no adopted or made Recovery Plan for this ecological community. The conservation advice for the community includes the following priority actions of relevance to the proposed modification:

- Ensure road widening and maintenance activities (or other infrastructure or development activities as appropriate) in areas where the ecological community occurs do not adversely impact on known sites.
- Manage disruptions to water flows and any changes to hydrology which may result in changes to the water table levels, increased salinity and increased run off or sediment.
- Develop and implement a management plan for the control of weeds such as Lippia (Phyla canescens), Coolatai Grass (Hyparrhenia hirta), African Love Grass (Eragrostis curvula) and Buffel Grass (Cenchrus ciliaris) in the region.
- Manage sites to prevent introduction of invasive weeds, which could become a threat to the ecological community, using appropriate methods.
- Implement good hygiene measures for mowing and grading equipment and observe appropriate state protocols for moving stock.

The proposed modification is not consistent with the first priority action through removal of 16.22 hectares of this critically endangered ecological community. Mitigation measures for the proposed modification would be designed to ensure it does not interfere with the remaining actions.

Conclusion

The extent of the critically endangered ecological community that would be lost is 16.22 ha. This represents a loss of ~2% when considered in the context of the contiguous extent of the TEC in the surrounding environment and about 29 per cent of the local viable population. The proposed modification is also considered likely to adversely modify the composition of some immediately adjacent 39.26 hectares of the TEC that would not be cleared, due to increased edge effects.

The TEC within the study area is likely to be important to the long-term survival of the TEC as the patches are of large size and are in moderate to good condition.

There is likely to be minor increase in fragmentation and isolation of patches due to the increase in the width of cleared land associated with the road.

In summary, the proposed modification is considered likely to have a significant impact on the extent of the *Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland*.

Weeping Myall Woodlands

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will*:*

Reduce the extent of an ecological community

The EPBC Act listing for Weeping Myall Woodlands only includes areas that have the following characteristics:

- Tree canopy dominated (at least 50% of trees present) by living and/or dead Weeping Myall; and
- At least 5% tree canopy cover; and
- An area of at least 0.5 ha; and
- Has more than two layers of regeneration of Weeping Myall present; or the tallest layer of living or dead Weeping Myall is at least 4 m tall and of the vegetative cover present, at least 50% is comprised of native species.

The proposed modification would result in the loss of approximately 0.9 hectares of vegetation which meets these criteria. The loss in the extent of the community includes the area to be cleared and the remaining small fragments of patches which would be reduced to a size at which they no longer meet the criteria for inclusion in the community. The local viable population is estimated at approximately 387.96 hectares. The local, contiguous extent of the community would be reduced by less than 0.01 per cent.

The reduction in the extent of the community is considered not to be substantial both in absolute terms and in proportion to the local viable population.

Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines

The proposed modification will result in a minor increase in fragmentation due to the loss of some small patches which contribute to landscape scale connectivity for the community and would reduce the connectivity of patches due to the increase in the width of cleared land associated with the road.

Adversely affect habitat critical to the survival of an ecological community

No recovery plan has been prepared for the community and no formal identification of critical habits has been undertaken to date. While habitat critical to the survival of the community has not been formally identified, important habitat for the community is assumed to consist of larger patches of the community in areas where land management practices are conducive to the regeneration of *Acacia pendula* after cyclical natural die-off events. Such conditions generally do not exist in continually grazed farmland where the highly palatable seedlings are often consumed by livestock. Larger remnants in travelling stock reserves and road reserves are therefore considered particularly important as livestock grazing in these areas is absent or of low frequency and the community is likely to be able to regenerate and persist indefinitely under such conditions. The largest and most contiguous patches affected include two patches (3.5 ha and 45.5 ha) in close proximity to one another on both sides of Couradda Road south of Edgeroi, a patch of approximately 2.0 ha immediately south of the Couradda Road patches which contains a substantial population of *Homopholis belsonii* (EPBC Act-Vulnerable), and a patch of 3.4 ha south of the entrance to the Bellbowrie property at 4274 Newell Hwy Edgeroi. Due to their moderate size and close proximity to one-anther, in aggregate these patches are considered to be important to the survival of the local viable population of the community.

The loss of approximately 0.1 hectares of habitat from the community, from patches considered to be moderately to highly important, is considered to have a small adverse impact on habitat critical to the survival of the community.

Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns

The proposed modification is likely to reduce the quality of some of the adjacent retained area of the TEC due to edge effects such as increased light, increased wind, altered hydrology and weed invasion. The area over which such impacts are likely to occur is estimated at 0.1 hectares assuming a width of substantial additional edge effects of five metres.

Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting

The proposed modification is likely to reduce the quality of some of the adjacent retained area of the TEC due to edge effects such as increased light, increased wind, altered hydrology and weed invasion. The area over which such impacts are likely to occur is estimated at 0.1 hectares assuming a width of substantial additional edge effects of five metres.

These changes in environmental conditions may result in a change in the species constitution and vegetation structure. This would likely involve a proliferation of tolerant species (typically grasses), a reduction in floristic diversity (particularly of small herbs) and reduced structural complexity due to the development of a continuous grass cover with little or no inter-tussock space.

Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

- **assisting invasive species, that are harmful to the listed ecological community, to become established, or**
- **causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or**

Unless the proposed modification includes very careful soil management, weed monitoring and management and intensive vegetation restoration, weed proliferation is likely to occur on the newly created fill batters. Weeds on the fill batters are likely to invade the adjacent edges of the community.

The area over which such impacts are likely to occur is estimated at 0.1 hectares assuming a width of substantial additional edge effects of five metres.

Interfere with the recovery of an ecological community.

There is no adopted or made Recovery Plan for this ecological community. The conservation advice for the community includes the following priority actions of relevance to the proposed modification:

- Protecting remnants of the listed ecological community through the development of conservation agreements and covenants.
- Replanting of understorey species where they have been depleted.
- Avoiding the application of fertilisers and herbicides in or near remnants.
- Protecting remnants from weeds including the speedy eradication of any new invasions.

The proposed modification would interfere substantially with the first of these actions as it would adversely impact remnants of the community that may otherwise be suitable for conservation through loss of 0.9 hectares of the community.

There may be opportunities to contribute to the replanting of understorey species during revegetation works associated with the proposed modification.

Mitigation measures for the proposed modification would be designed to ensure that the proposed modification does not interfere with the remaining actions relating to fertilisers and weeds.

Conclusion

The extent of the community that would be lost is not substantial (0.9 ha) and the proportion of the local viable population is considered low (< 0.01%) when considered in the context of the contiguous extent of the TEC in the surrounding environment. The proposed modification is considered likely to adversely modify the composition of adjacent areas of the TEC that would not be cleared, due to increased edge effects.

The TEC within the study area is likely to be important to the long-term survival of the TEC as the patches are of moderate to large size and in moderate to good condition.

There is likely to be minor increase in fragmentation and isolation of patches due to the increase in the width of cleared land associated with the road.

In summary, the proposed modification is considered unlikely to have a significant adverse effect on the extent and condition of the *Weeping Myall Woodlands* community.

Brigalow (*Acacia harpophylla* dominant and co-dominant)

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will*:*

Reduce the extent of an ecological community

The EPBC Act listing for Brigalow only includes areas that have the following characteristics:

- The presence of *Acacia harpophylla* as one of the most abundant tree species in the patch. *A. harpophylla* is either dominant in the tree layer, or co-dominant with other species (notably) *Casuarina cristata*, other species of Acacia, or species of Eucalyptus), and
- In New South Wales - the patch meets one of the following NSW Vegetation Classification and Assessment (VCA) community descriptions. The NSW VCA communities are: VCA IDs 29, 31 and 35; as described in Benson et al. (2006), and/or
- The vegetation in the patch is brigalow regrowth with species composition and structural elements broadly typical of one of the identified Qld REs or NSW vegetation communities (although species density may be reduced). This can be assumed to be the case where it has been at least 15 years since it was last comprehensively cleared (not just thinned); unless direct evidence proves otherwise, and
- The patch is 0.5 ha or more in size, and
- Exotic perennial plants comprise less than 50% of the total vegetation cover of the patch, as assessed over a minimum sample area of 0.5 ha (100 m by 50 m), that is representative of the patch.

The proposed modification would result in the loss of about 1.47 hectares of vegetation which meets these criteria in N2MS4. The local, contiguous extent of the community is estimated at approximately 53.49 hectares. The local viable population would be reduced by around 2.74 per cent. The proposed modification is also likely to reduce the quality of some of the adjacent retained area of the TEC due to edge effects such as increased light, increased wind, altered hydrology and weed invasion. The impact only occurs on one side of the road, the side where most of the community occurs, however, the reduction in the area of the community is likely to reduce the viability of the remaining area, even if it is not directly impacted, due to a reduction in the population size and reduced genetic diversity of the species (e.g. Brigalow) which make it unique.

The absolute impacts in terms of hectares removed are low, and when the impacts are considered in the local context, and in proportion to the size of the local viable population of the TEC, they are considered unlikely to be significant.

The local viable population of the TEC subject to this assessment is already at risk of extinction due to its relatively small size, high edge to area ratio and susceptibility to disturbance events such as the recent fire that has already affected, but not eliminated, the community.

Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines

The patches of the TEC that make up the local viable population are already somewhat fragmented and isolated by the existing Newell Highway. The proposed modification is unlikely to break the local viable population into more fragments. However, it is likely to increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. This increased isolation may result in a reduction in the function of ecological processes such as pollination and seed dispersal (e.g. seed dispersal by ants) between fragments. This disruption of ecological processes would contribute to a very small, insignificant, increased risk of extinction of the local viable population of the TEC.

Adversely affect habitat critical to the survival of an ecological community

The Brigalow (Acacia harpophylla dominant and co-dominant) ecological community states:

The areas considered critical to the survival of the Brigalow ecological community includes all patches that meet the key diagnostic characteristics and condition thresholds for the ecological community; plus, the buffer zones, particularly where these include native vegetation.

About 1.47 hectares of Brigalow vegetation that will be cleared as part of the proposed works are critical to the survival of the ecological community. As this habitat is already somewhat disturbed and edge-affected, this loss is unlikely to be significant.

Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns

The proposed modification is likely to reduce the quality of some of the adjacent retained area of the TEC due to edge effects such as increased light, increased wind and altered hydrology. The area over which such impacts are likely to occur is estimated at 0.59 hectares assuming a width of substantial additional edge effects of five metres. However, the level of impact will largely be dependent on the design of the road and potential impacts can likely be avoided.

Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting

The proposed modification is likely to reduce the quality of some of the adjacent retained area of the TEC due to edge effects such as increased light, increased wind, altered hydrology and weed invasion.

These changes in environmental conditions may result in a change in the species constitution and vegetation structure. This would likely involve a proliferation of tolerant species (typically grasses), a reduction in floristic diversity (particularly of small herbs) and reduced structural complexity due to the development of a continuous grass cover with little or no inter-tussock space.

Such impacts would, however, be mitigated by weed control and revegetation undertaken as part of the proposed modification.

Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

- **assisting invasive species, that are harmful to the listed ecological community, to become established, or**
- **causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or**

The patches of the TEC affected are of small to moderate size (totalling 1.47 ha) and most of the affected vegetation (except the last 2-3 metres between the core and clearing associated with the road) appears to be old growth, ie. not previously cleared. It ranges in condition from in moderate condition (recovering from recent fire) to high condition (core areas in apparently natural condition). Due to their size, moderate to good condition and continuity with other native vegetation, the TEC patches in the study area are considered to retain high levels of ecological integrity and function.

Unless the proposed modification includes very careful soil management, weed monitoring and management and intensive vegetation restoration, weed proliferation is likely to occur on the newly created fill batters. Weeds on the fill batters are likely to invade the adjacent edges of the community.

Interfere with the recovery of an ecological community.

There is no adopted or made Recovery Plan for this ecological community. The conservation advice for the community includes the following priority actions of relevance to the proposed modification:

- Protect and conserve remnant and regrowth areas of the ecological community. Prevent clearance of this endangered ecological community and of nearby native vegetation including buffer zones and connecting corridors.
- Where further clearance is unavoidable:
- *Mitigate the severity of impacts (e.g. avoid higher quality areas, avoid dissection of patches, act to minimise hydrological disruption and the spread of weeds); and,*
- *Offsetting should consider the location and emulate qualities of affected patches.*

- Manage areas of the Brigalow ecological community to reduce threats, including through:
- *Fire management that considers Brigalow conservation, protection, and ecological heterogeneity; and,*
- *Targeted weed and feral animal control with a particular focus on high biomass exotic grasses (Buffel grass, Rhodes grass, green panic grass) and feral pigs.*
- Manage all weeds appropriately within and close to the Brigalow ecological community, e.g.: spot application of herbicides, rather than aerial spraying; avoid fertiliser application; minimise tree thinning and soil disturbance.
- Manage foxes and cats (as well as feral pigs) using a coordinated approach, preferably among groups of neighbours and across regions.
- Help woodland birds to avoid aggression from noisy miners by encouraging and protecting shrubby understorey; managing grazing pressure so that it does not degrade native vegetation; and retaining dense stands of trees and regrowth.

The proposed modification would interfere to a small degree with the first of these actions as it would adversely impact remnants of the community, including buffer zones, that may otherwise be suitable for conservation through loss of 1.47 hectares of the community.

There may be opportunities to contribute to the replanting of understorey species during revegetation works associated with the proposed modification.

Mitigation measures for the proposed modification would be designed to ensure that the proposed modification does not interfere with the remaining actions relating to fertilisers and weeds.

Conclusion

The extent of the community that would be lost is small (1.47 ha) and the proportion of community lost is considered low when considered in the context of the contiguous extent of the TEC in the surrounding environment. The proposed modification is also considered likely to adversely modify the composition of adjacent areas of the TEC (about 0.59 ha) that would not be cleared, due to increased edge effects.

There is also likely to be an increase in isolation of patches within the local viable population due to the increase in the width of cleared land associated with the road.

In summary, although the proposed modification will have an adverse impact on the community, the impact is considered unlikely to have a significant adverse impact on the extent and condition of the Brigalow (*Acacia harpophylla* dominant and co-dominant) ecological community.

Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will*:*

Reduce the extent of an ecological community

The proposed modification is predicted to remove around 2.04 hectares of the TEC from a local viable population of approximately 53.49 hectares. The area that would be removed by the proposed modification represents about 3.8 per cent of the local viable population, a relatively small proportional impact.

Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines

The patches of the TEC which make up the local viable population are already somewhat fragmented and isolated by the existing Newell Highway. The proposed modification is unlikely to break the local viable population into more fragments. However, it is likely to increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. This increased isolation may result in a reduction in the function of ecological processes such as pollination and seed dispersal (e.g. seed dispersal by ants) between fragments. This disruption of ecological processes would contribute to a very slightly increased risk of extinction of the local viable population of the TEC.

Adversely affect habitat critical to the survival of an ecological community

There is no critical habitat identified for the Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions TEC.

The small roadside remnants in the study area are unlikely to be considered critical to the survival of this TEC as a whole.

Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns

The proposed modification is likely to reduce the quality of some of the adjacent retained area of the TEC due to edge effects such as increased light, increased wind and altered hydrology. The level of impact will largely be dependent on the design of the road and potential impacts can likely be avoided.

Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting

The proposed modification is likely to reduce the quality of some of the adjacent retained area of the TEC due to edge effects such as increased light, increased wind, altered hydrology and weed invasion. These changes in environmental conditions may result in a change in the species constitution and vegetation structure. This would likely involve a proliferation of tolerant species (typically grasses), a reduction in floristic diversity (particularly of small herbs) and reduced structural complexity due to the development of a continuous grass cover with little or no inter-tussock space.

Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

- **assisting invasive species, that are harmful to the listed ecological community, to become established, or**
- **causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or**

The patches of the TEC affected are of small to moderate size and most of the affected vegetation (except the last 2-3 metres between the core and clearing associated with the road) appears to be old growth, ie. not previously cleared. Due to their size, moderate to good condition and continuity with other native vegetation, the TEC patches in the study area are considered to retain high levels of ecological integrity and function.

Unless the proposed modification includes very careful soil management, weed monitoring and management and intensive vegetation restoration, weed proliferation is likely to occur on the newly created fill batters. Weeds on the fill batters are likely to invade the adjacent edges of the community.

Interfere with the recovery of an ecological community.

There is a National Recovery Plan for this ecological community that outlines the following priority actions:

- Complete and refine mapping of remnant SEVT EC.
- Determine the extent and condition of areas of the SEVT EC affected by invasive plant species, particularly weeds of national significance (WONS), e.g. rubber vine and lantana.
- Survey poorly known species, especially fungi, herpetofauna and invertebrates.
- Monitor selected populations of the EPBC Act-listed species across their distribution within the EC.
- Identify key areas of the SEVT EC for addition to the Queensland and NSW conservation reserve systems.
- Encourage landholders to enter into conservation agreements over semi-evergreen vine thickets.
- Liaise with landholders to develop appropriate burning practices and other procedures to minimize fire damage to remnant areas of SEVT on private and public lands.
- Determine the impact of grazing animals, both domestic and native, on remnant areas of SEVT. Develop guidelines and recommendations for fencing.

- Develop and implement a pest management program to control or manage feral animals and native animals in SEVT remnants.
- Encourage landholders through appropriate incentive programs to protect and foster regrowth SEVT and associated vegetation in buffer areas.
- Research and develop use of SEVT species for landscape rehabilitation and encourage mining companies, Main Roads and others to use native species in plantings.
- Undertake consultation with traditional owner groups to determine the level of indigenous knowledge of and association with the SEVT EC.
- Develop and implement education programs to increase the awareness of government and non-government organisations regarding SEVT conservation, and their responsibilities for SEVT protection and management

The proposed modification would interfere with some of these actions as it would adversely impact remnants of the community, including buffer zones, that may otherwise be suitable for conservation. There may be opportunities to contribute to the replanting of understorey species during revegetation works associated with the proposed modification. Mitigation measures for the proposed modification would be designed to ensure that the proposed modification does not interfere with the remaining actions relating to fertilisers and weeds.

Conclusion

The extent of the community that would be lost is small as the proposed modification is predicted to remove around 2.04 hectares of the TEC from a local viable population of approximately 53.49 hectares. The proposed modification is also considered likely to adversely modify the composition of a small amount of the adjacent area of the TEC that would not be cleared, due to increased edge effects. There is also likely to be a small increase in isolation of patches within the local viable population due to the increase in the width of cleared land associated with the road.

In summary, the proposed modification is considered unlikely to have a small impact on the EPBC Act listed TEC as a whole. The impacts are unlikely to be significant in terms of their context or intensity.

Homopholis belsonii (Belson's Panic)

The following information regarding 'important populations' is taken from the EPBC Act Significant Impact Guidelines 1.1.

A 'population of a species' is defined under the EPBC Act as an occurrence of the species in a particular area. In relation to critically endangered, endangered or vulnerable threatened species, occurrences include but are not limited to:

- A geographically distinct regional population, or collection of local populations, or
- A population, or collection of local populations, that occurs within a particular bioregion.

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- Key source populations either for breeding or dispersal
- Populations that are necessary for maintaining genetic diversity, and/or
- Populations that are near the limit of the species range.

There are no specific populations listed in the SPRAT profile or conservation advice for the species.

The local populations of the species in the study area are considered to form an important population as they are:

- Large and hence may constitute key source populations for dispersal
- Distributed across a variety of plant community types and hence are likely to have relatively high genetic diversity, reflecting environmental differences between habitats
- At or near the south-west limit of the species' known range.

Based on this assessment process, the population of the species in the study area can be considered and important population. Therefore, by this assessment process, the study area is likely to contain an important population of this species within suitable habitat.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or

possibility that it will:

Lead to a long-term decrease in the size of an important population

The proposed modification will result in the removal of 28.86 hectares of habitat for an important population of the species, consisting of a collection of three local populations of which one (South of Edgeroi) after initial identification was cleared by an adjoining landholder when replacing an agricultural fence line in 2018 and 2019 . The clearing will result in direct mortality to individuals and loss of habitat. Due to fact that this species is stoloniferous, forming small patches to extensive mats of intertwined stems, and that the accuracy of GPS data collection is typically limited to plus or minus approximately five metres, it is difficult to determine an accurate number of individuals affected but it is known that 11 will be affected in Segment 2, 19 in Segment 4 and 17 in Segment 5. The proposed modification will lead to a long-term decrease in the size of an important population by about 28.86 hectares due to the loss of this habitat.

Reduce the area of occupancy of an important population

Area of occupancy is defined as the area within a species' 'extent of occurrence' (shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a species) which is occupied by the species. To avoid inconsistencies and bias in assessments caused by estimating area of occupancy at different scales, IUCN (2016) recommends standardization of estimates by applying a 2 x 2 km grid to occurrence data and this is the approach adopted by the Threatened Species Scientific Committee in its assessment of the conservation status of native species (Threatened Species Scientific Committee, 2017). By this definition of area of occupancy, the proposed modification will not reduce the area of occupancy of an important population as it would not cause the species to be lost from an entire 2 x 2 km grid cell.

At a fine scale, however, the proposed modification will result in the removal of 28.86 hectares of habitat for an important population of the species, reducing the fine scale area of occupancy by that amount.

Fragment an existing important population into two or more populations

There is likely to be an increase in distance between patches within the population due to the increase in the width of cleared land associated with the road. Vegetation and potential habitat within the landscape is already highly fragmented due to a history of clearing for agricultural purposes and road construction. However, considering the wind pollination and wind seed dispersal mechanisms in this species, the increase in distance between patches of habitat is unlikely to affect the species to such an extent that an existing important population would be split into two or more populations.

Adversely affect habitat critical to the survival of the species

Habitat critical to the survival of a species refers to areas that are necessary for activities such as:

- Foraging, breeding, roosting, or dispersal
- For the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators
- To maintain genetic diversity and long-term evolutionary development
- For the reintroduction of populations or recovery of the species.

The habitat of the species in the study area is considered to be part of an area of critical habitat as it:

- Contains a large population and hence may be necessary for dispersal and may be of value for the reintroduction and recovery of the species
- Contains a variety of plant community types, is at or near the south-west limit of the species' known range and is hence likely to be of value in the maintenance of genetic diversity and facilitation of long-term evolutionary development of the species.

The proposed modification will result in the removal of 28.86 hectares of habitat critical to the survival of the species. Remaining areas of habitat are also likely to be modified by edge effects that may change the soil surface and microhabitat conditions, altering its suitability for this species.

Disrupt the breeding cycle of an important population

The reduction in population size and degradation of habitat that would be caused by the proposed modification is likely to have an adverse effect on the life cycle of the species but is unlikely to disrupt

the breeding cycle as it would not substantially affect the wind pollination or wind dispersal mechanisms used by this species.

Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Clearing of vegetation associated with the proposed modification would remove 28.86 hectares of important habitat for the species. Remaining areas of habitat are also likely to be modified by edge effects that may change the soil surface and microhabitat conditions, altering habitat suitability for this species. This clearing is likely to lead to a one-off reduction in the population of the species in the study area but not an ongoing decline in the population beyond the construction phase of the proposed modification.

The population recoded south of Edgeroi was removed in 2018 and 2019 by an adjoining landholder when replacing an agricultural fence line.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat

The clearing of habitat is recognised as a major factor contributing to the threatened status of the species. The associated indirect impacts of this key threatening process are well documented and include increased potential for the proliferation of invasive species. Measures to minimise invasion of weeds during construction and operation would be included in the CEMP. With these measures in place, this proposed modification is not considered likely to result in a significant increase in the impact of invasive species on the species or its habitat.

Introduce disease that may cause the species to decline

Infection of native plants by Phytophthora cinnamomi has been identified as being spread by construction machinery. This water-borne fungus infects the roots of plants and has the potential to cause dieback and associated habitat degradation. Machinery associated with vegetation clearance and subsequent construction for the proposed modification has the potential to transmit the fungus to remaining native vegetation remnants of the species. This is a potential indirect impact to the species as it may lead to a reduction in the quality of the soil surface microhabitat. This can be suitably mitigated through the development and implementation of suitable control measures for vehicle and plant hygiene such as the current best practice hygiene protocols as detailed in RTA (2011).

Interfere substantially with the recovery of the species

There is currently no specific recovery plan for Belson's Panic but the following regional priority recovery and threat abatement actions of relevance to the proposed modification are recommended in the conservation advice for the species:

- Ensure road widening and maintenance and mining activities (or other infrastructure or development activities) involving substrate or vegetation disturbance in areas where *H. belsonii* occurs do not adversely impact on known populations
- Protect populations of the listed species through the development of conservation agreements and/or covenants
- Identify populations of high conservation priority
- Undertake survey work in suitable habitat and potential habitat to locate any additional populations/occurrences/remnants
- Ensure fertilisers used in agriculture, and chemicals or other mechanisms used to eradicate weeds, do not have a significant adverse impact on *Homopholis belsonii*
- Develop and implement a management plan for the control of invasive weeds such as Green Panic Grass (*Panicum maximum var. trichoglume*), Coolatai Grass (*Hyparrhenia hirta*) and Tiger Pear (*Opuntia aurantiaca*) in the local region
- Manage sites to prevent introduction of invasive weeds, which could become a threat to the *H. belsonii*, using appropriate methods
- Investigate options for linking, enhancing or establishing additional populations.

The proposed modification may interfere with the first two of these actions as it would adversely impact remnants of the community, that may otherwise be suitable for conservation, through loss of 28.86 hectares of the habitat for the species.

The surveys conducted for the proposed modification will contribute to a better understanding of the abundance and distribution of the species in the locality and the conservation priority of populations.

- Environmental management during construction and landscaping associated with the proposed modification will include weed control and hygiene protocols to minimise weed dispersal, will be designed to minimise risks associated with herbicide use and will not include the use of fertilisers
- The offset package for the proposed modification may provide opportunities for linking, enhancing or establishing additional populations
- While the proposed modification will interfere with the recovery of the species through removal of individuals and habitat, it may also provide opportunities for increasing the information available about the distribution of the species and its restoration.

Conclusion

Based on the information available, a conservative approach finds this proposed modification is unlikely to have a significant impact, as defined under the EPBC Act, on *Homopholis belsonii* as the majority of the known and likely habitat for it is located beyond the limits of the proposed modification.

Five-clawed Worm-skink (*Anomalopus mackayi*)

The following information regarding 'important populations' is taken from the EPBC Act Significant Impact Guidelines 1.1.

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- Key source populations either for breeding or dispersal
- Populations that are necessary for maintaining genetic diversity, and/or
- Populations that are near the limit of the species range.

Given the difficulty in detecting this species, the Commonwealth environment department considers that an occurrence of important habitat for the Five-clawed Worm-skink is a surrogate for an 'important population' of the species (DoEE, 2018). Known important habitat for the Five-clawed Worm-skink is listed in the Dr*aft Referral guidelines for the nationally listed Brigalow Belt reptiles* (Commonwealth of Australia 2011) and includes:

- All suitable habitat within floodplains and riparian zones, uncultivated grassy headlands and strips between cropped areas, road reserves, travelling stock routes and remnant vegetation on vacant lands.
- Suitable habitat within the Known / Likely-to occur distribution of the species (see Map 3 in Appendix 1 of the report).

To provide confidence in this assessment a subject matter specialist (Gerry Swan) who was responsible for all records of the species in the region was engaged to assess the proposed modification and consider likely habitat for the species in the face of its removal. Based on this assessment no areas of vegetation in the proposed modification area were considered as important habitat for the Five-clawed Worm-skink.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

Lead to a long-term decrease in the size of an important population

Based on expert advice the proposed modification will not result in the removal of important habitat for a local population/s of the Five-clawed Worm-skink. The proposed modification will not lead to a long-term decrease in the size of an important population.

Reduce the area of occupancy of an important population

The proposed modification will not remove important habitat for the Five-clawed Worm-skink. The proposed modification would not reduce the area of occupancy of an important population.

Fragment an existing important population into two or more populations

The local viable population is unlikely to be affected to such an extent that an existing important population would be split into two or more populations.

Adversely affect habitat critical to the survival of the species

Habitat critical to the survival of a species refers to areas that are necessary for activities such as:

- Foraging, breeding, roosting, or dispersal
- For the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators
- To maintain genetic diversity and long-term evolutionary development
- For the reintroduction of populations or recovery of the species.

On the floodplains within its range in north-eastern New South Wales, the Five-clawed Worm-skink occurs in grasslands and grassy, open woodlands on heavy black and grey, alluvial cracking clay soils from 135–200 m above sea level. Known important habitat for the Five-clawed Worm-skink is listed in the Draft Referral guidelines for the nationally listed Brigalow Belt reptiles (Commonwealth of Australia 2011) and includes:

- All suitable habitat within floodplains and riparian zones, uncultivated grassy headlands and strips between cropped areas, road reserves, travelling stock routes and remnant vegetation on vacant lands.
- Suitable habitat within the Known / Likely-to occur distribution of the species (see Map 3 in Appendix 1 of the report).

This species is known to be associated with five of the PCTs in the study area, but after seeking expert advice none of the areas affected by the proposed modification were considered as suitable habitat.

A process was followed where uncertainty triggered a need for a subject matter specialist to be engaged to consider impact to this species from the proposed modification. This resulted in assessment of the project and the likely impact on the species form the proposed modification. Based on this process a referral is not recommended for impacts to the Five-clawed Worm-skink associated with the proposed modification.

Disrupt the breeding cycle of an important population

Very little is known about the biology of the Five-clawed Worm-skink. Average clutch size or mortality rates for newborns is unknown. One specimen was observed laying three eggs in spring (DoEE, 2018)

The process of habitat removal will reduce areas available for mating, breeding and foraging. Earthworks associated with the proposed modification will not remove its habitat or disrupt at least one breeding cycle of a local population of the species.

Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Clearing of vegetation associated with the proposed modification would not remove important habitat as defined by the *Draft Referral guidelines for the nationally listed Brigalow Belt reptiles*.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat

The clearing of habitat is recognised as a major factor contributing to the threatened status of the Five-clawed Worm-skink. The associated indirect impacts of this key threatening process are well documented and include increased potential for the proliferation of invasive species. Measures to minimise invasion of weeds during construction and operation would be included in the CEMP. With these measures in place, this proposed modification is not considered likely to result in a significant increase in the impact of invasive species on the Five-clawed Worm-skink or its habitat.

Introduce disease that may cause the species to decline

Infection of native plants by *Phytophthora cinnamomi* has been identified as being spread by construction machinery. This water-borne fungus infects the roots of plants and has the potential to cause dieback and associated degradation of habitat. Machinery associated with vegetation clearance and subsequent construction for the proposed modification has the potential to transmit the fungus to remaining native vegetation remnants of the species. This is a potential indirect impact to the species as it may lead to a reduction in the quality of the soil surface microhabitat. This can be suitably mitigated through the development and implementation of suitable control measures for vehicle and plant hygiene such as the current best practice hygiene protocols as detailed in RTA (2011).

Interferes substantially with the recovery of the species

There is currently no specific recovery plan for the Five-clawed Worm-skink. This species was included in The Action Plan for Australian Reptiles (Cogger *et. al.* 1993). The recovery plan objectives for this species include:

- 14.1: To obtain sufficient information on the species biology, ecology and distribution to determine its current conservation status and formulate appropriate management strategies,
- 14.2: To ensure that secure, viable populations of the species are maintained within a reserve system
- 14.3: To implement land management practices which promote the maintenance of secure viable populations of the species outside reserves.

The Action Plan for Australian Reptiles (Cogger *et. al.* 1993) is now becoming a relatively old document, although not much has changed regarding the level of understanding of this species' biology.

Conclusion

A process was followed where uncertainty triggered a need for a subject matter specialist to be engaged to consider impact to this species from the proposed modification. This resulted in assessment of all impact footprints and the likely impact on the species form the proposed modification. Based on this process the proposed modification is considered as not significant to Five-clawed Worm-skink.

Koala (*Phascolarctos cinereus*)

The Koala was identified north of the Mehi River in Moree during field surveys, but no conclusive evidence was found within the study area. A single previous record is known from the study area (Bellata) and there are multiple other records in the locality, in larger woodland remnants further to the east. Habitat in the study area is likely to be part of the home range of a low-density population. Associated (marginal) habitat present in the study area includes:

- Belah woodland (PCT 55)
- Brigalow viney scrub open forest (PCT 445)
- Carbeen +/- Coolabah grassy woodland (PCT 628)
- Poplar Box - Belah woodland (PCT 56)
- Poplar Box - White Cypress Pine woodland (PCT 397)

Koalas are generally solitary except during the mating season and have a home range of about 3 hectares (although the size of this area is influenced by the distribution, abundance and quality of feeding resources). In the Pilliga State Forest of central-western New South Wales, the average home range is 10–15 ha (Department of Environment and Climate Change 2008). The Office of Environment and Heritage has published regional lists of koala food trees in separate primary and secondary food tree categories. Surveys identified low to high abundances of Koala secondary (*Eucalyptus populnea*) food trees within the study area Considering the reported home range sizes of this species and the widespread occurrence of feed tree species, a low density population is considered likely to utilise the study area.

There are numerous published criteria for determining the importance of koala habitat, however the most recent, relevant and measurable is the habitat assessment tool described in the EPBC Act referral guidelines for the vulnerable koala (Commonwealth of Australia 2014). Using this tool, impact areas that score five or more contain habitat critical to the survival of the koala. Table C.3 lists the five primary koala habitat attributes, the score given for each criterion and results of the habitat assessment tool for the two vegetation communities within the study area which contain a relatively high proportion of food trees. Several other communities also contain scattered food trees and also contribute to the viability of the landscape as Koala habitat, particularly in relation to their contribution to movement corridors between the main food tree areas. The result indicates that the habitats in the study area are not considered to be habitat critical to the survival of the Koala.

Table C.3 Results of the koala habitat assessment tool for the main habitat types

Attribute	Score and criteria (inland)	Score for habitat in the study area
Koala occurrence	+2 (high) = Evidence of one or more koalas within the last 5 years. +1 (medium) = Evidence of one or more koalas within 2 km of the edge of the impact area within the last 10 years 0 (low) = None of the above.	0 (low) = None of the above. The habitats in the northern section are near the Mehi River where the Koala is known but the majority of habitats are more than 2 km away.

Attribute	Score and criteria (inland)	Score for habitat in the study area
Vegetation composition	+2 (high) = Has forest, woodland or shrubland with emerging trees with 2 or more known koala food tree species, OR 1 food tree species that alone accounts for >50% of the vegetation in the relevant strata. +1 (medium) = Has forest, woodland or shrubland with emerging trees with only 1 species of known koala food tree present. 0 (low) = None of the above.	The habitats in the study area are considered secondary foraging habitats. The secondary feed tree species *Eucalyptus populnea* is most common with some *Eucalyptus pilligaensis* also present. The habitat would score +1 (medium) = Has forest, woodland or shrubland with emerging trees with only 1 species of known koala food tree present.
Habitat connectivity	+2 (high) = Area is part of a contiguous landscape ≥ 1000 ha. +1 (medium) = Area is part of a contiguous landscape < 1000 ha, but ≥ 500 ha. 0 (low) = None of the above.	Habitat connectivity would score 0 (low) = None of the above.
Key existing threats	+2 (high) = Little or no evidence of koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence, OR Areas which score 0 for koala occurrence and have no dog or vehicle threat present. +1 (medium) = Evidence of infrequent or irregular koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence, OR Areas which score 0 for koala occurrence and are likely to have some degree dog or vehicle threat present. 0 (low) = Evidence of frequent or regular koala mortality from vehicle strike or dog attack in the study area at present, OR Areas which score 0 for koala occurrence and have a significant dog or vehicle threat present.	The habitats in the study area would score 0 (low) as it is an area that scores 0 for koala occurrence and has a significant vehicle threat present.
Recovery value	+2 (high) = Habitat is likely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1. +1 (medium) = Uncertain whether the habitat is important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1. 0 (low) = Habitat is unlikely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.	The study area would score +1 (medium) = Uncertain whether the habitat is important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.
TOTAL		2

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

Lead to a long-term decrease in the size of an important population

The study area only provides secondary habitat for the Koala and an important population has not been identified. Due to the lack of primary feed tree species the habitat is not considered likely to support a dense Koala population. If a koala population is present, the study area is considered likely to support only a low density Koala population and represents supplementary habitat for transient or dispersing individuals.

The removal of the habitat within the study area is not considered likely to have a large impact on the size of the Koala population as the proposed removal of a small amount of secondary habitat is not considered likely to detrimentally impact an important population. The habitat is not considered critical for the Koala.

Reduce the area of occupancy of an important population

An important population has not been identified in the study area. In NSW, Koalas occur along the coast, extending west to the Darling Riverine Plains and Mulga Lands bioregions in the north of the state; to the Cobar Peneplain bioregion in the centre of the state; and to the Riverina and eastern most parts of the Murray-Darling Depression bioregions in the south. The Proposed modification will not reduce this area of occupancy of an important population.

Fragment an existing important population into two or

The patches of habitat in the study area are already somewhat fragmented and isolated by the existing Newell Highway. The proposed modification is unlikely to break the local viable population into more fragments. However, it is likely to increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. However, the proposed modification will not fragment the Koala population into two or more populations.

Adversely affect habitat critical to the survival of the species

Habitat critical to the survival of a species refers to areas that are necessary for activities such as:

- Foraging, breeding, roosting, or dispersal
- For the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators
- To maintain genetic diversity and long-term evolutionary development
- For the reintroduction of populations or recovery of the species.

There are numerous published criteria for determining the importance of koala habitat, however the most recent, relevant and measurable is the habitat assessment tool described in the *EPBC Act referral guidelines for the vulnerable koala* (Commonwealth of Australia 2014). Using this tool, impact areas that score five or more contain habitat critical to the survival of the koala. The result for the study area indicates that the habitats in the study area are not considered to be habitat critical to the survival of the Koala (see Table C.3).

Disrupt the breeding cycle of an important population

The study area does not contain any breeding habitat for the Koala. There would be a minor impact on secondary foraging habitat but the habitat within the study area is not considered high enough quality to support a sedentary breeding population. No impacts to breeding Koalas are predicted.

Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The impacts from the proposed modification are limited to removal of secondary Koala habitat. Clearing of vegetation associated with the proposed modification would remove approximately 24.16 hectares of marginal habitat for this species. The habitat removal includes:

- Belah woodland (1.93 ha – intact)
- Brigalow viney scrub open forest (1.47 ha - intact)
- Carbeen +/- Coolabah grassy woodland (3.04 ha intact)
- Poplar Box - Belah woodland (8.34 ha - intact)
- Poplar Box - White Cypress Pine shrub grass tall woodland (9.38 ha - intact)

Vegetation and potential habitat within the landscape is already highly fragmented due to a history of clearing for agricultural purposes. Generally, the only option for Koalas to access vegetation containing *E. populnea* on both sides of the road is by crossing the road. As the proposed modification will involve widening of the current road corridor, it will reduce east-west habitat connectivity through increased habitat isolation. However, this habitat removal, modification and isolation is not likely to cause the species to decline in itself.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat

Habitat loss is a key threat to this species. The associated indirect impacts of this key threatening process are well documented and include increased potential for the proliferation of invasive species. Measures to minimise invasion of weeds during construction and operation would be included in the CEMP. With these measures in place, this proposed modification is not considered likely to result in a significant increase in the impact of invasive species on the Koala or its habitat.

Introduce disease that may cause the species to decline

There are no known disease issues affecting this species in relation to the proposed modification. The proposed modification would be unlikely to increase feral animal abundance or the potential for significant disease vectors to affect local populations. The proposed modification is considered unlikely to introduce or result in the spread of chlamydiosis or Koala Retrovirus.

Interferes substantially with the recovery of the species

The Threatened Species Scientific Committee identifies threat abatement actions that would support the recovery of the Koala in Queensland, NSW and the ACT, including:

- Develop and implement a development planning protocol to be used in areas of Koala sub-populations or sub-population fragments to prevent loss of Koala sub-populations, habitat critical to the survival of the species and vital habitat connectivity.
- Development plans should explicitly address ways to mitigate risk of vehicle strike when development occurs adjacent to, or within, Koala habitat.
- Develop and implement a management plan to control the adverse impacts of predation on Koalas by dogs in urban, peri-urban and rural environments.
- Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them, if necessary.
- Identify populations of high conservation priority.
- Develop and implement options of vegetation recovery and re-connection in regions containing fragmented Koala populations, including inland regions in which Koala populations were diminished by drought and coastal regions where development pressures have isolated Koala populations.
- Investigate formal conservation arrangements, management agreements and covenants on private land, and, for both Crown and private land, investigate and/or secure inclusion of habitat critical to the survival of the Koala in reserve tenure, if possible.
- Engage with private landholders and land managers responsible for the land on which populations occur and encourage these key stakeholders to contribute to the implementation of conservation management actions.
- Manage any other known, potential or emerging threats such a Bell Miner (*Manorina melanophrys*) Associated Dieback or Eucalyptus rust.

The proposed modification is not expected to interfere substantially with the recovery actions identified for the Koala as listed above.

Conclusion

The Koala will suffer a reduction in extent of suitable secondary habitat from the proposed modification. No primary foraging habitat will be affected. No known breeding habitat will be affected. The proposed modification is considered unlikely to reduce the population size of the Koala or decrease the reproductive success of this species. The proposed modification will not interfere with the recovery of the Koala. After consideration of the factors above, an overall conclusion has been made that the proposed modification is unlikely to result in a significant impact to the Koala.

Painted Honeyeater (*Grantiella picta*)

The following information regarding 'important populations' is taken from the EPBC Act Significant Impact Guidelines 1.1.

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

No important populations have been identified for the Painted Honeyeater. The species exhibits seasonal north-south movements governed principally by the fruiting of mistletoe, with which its breeding season is closely matched (Barea and Watson, 2007). Many birds move after breeding to semi-arid regions such as north-eastern South Australia, central and western Queensland, and central Northern Territory. Considering its dispersive habits, the species is considered to have a single population.

This species was not identified during field surveys, however there were no areas of vegetation containing profusely fruiting or flowering resources at the time, which limited the detectability of this species. There are

nine recorded sightings on the BioNet Atlas database from the search area, mostly from Killarney State Conservation Area and one on Millie Rd (east of Bellata). Birdline also contains multiple sightings in the area.

Many of the vegetation types in the study area along the Newell Highway present suitable habitat for the Painted Honeyeater, including areas with a high abundance of mistletoe species. Based on the presence of suitable habitat and location of nearby records, it is moderately likely that an important population of the Painted Honeyeater uses habitat in the study area.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

Lead to a long-term decrease in the size of an important population

The Painted Honeyeater is likely an occasional visitor in the study area, coming in to feed on flowering and fruiting resources when available. This species may also nest in the study area, though nesting is generally reported from areas that contain a high abundance of mistletoes, e.g. 10 per tree (Barea 2008), which was not a common feature of vegetation in the study area. A reduction in 25.17 hectares of suitable foraging habitat with some nesting opportunities for the Painted Honeyeater along the current alignment will impact the feeding and possibly the breeding of this species. There are likely areas in the locality containing a higher prevalence of mistletoes more suitable for nesting. Any individuals that use vegetation in the study area are likely passing through the landscape while foraging. It is unlikely that the proposed modification will have adverse effect on the life cycle of the species that will lead to a long-term decrease in an important population.

Reduce the area of occupancy of an important population

The area of occupancy of this species is estimated to be 1000 km^2. The proposed modification is predicted to remove around 25.17 hectares of foraging habitat for the Painted Honeyeater across the whole proposed modification. Some areas of this may also present nesting opportunities. The study area lies close to the centre of the likely distribution of this species. The potential for this species to occur in the area is not expected to be impacted by the proposed modification. The proposed modification is unlikely to reduce the area of occupancy of the population.

Fragment an existing important population into two or more populations

The patches of habitat in the study area are already somewhat fragmented and isolated by the existing Newell Highway. The proposed modification is unlikely to break the local viable population into more fragments. However, it is likely to increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. For highly mobile species like birds, this is not a large problem, however the reduction of suitable habitats into small isolated patches inhibits movement throughout the landscape. The proposed modification is unlikely to Fragment an existing important population into two or more populations.

Adversely affect habitat critical to the survival of the species

Habitat critical to the survival of a species refers to areas that are necessary for activities such as:

- Foraging, breeding, roosting, or dispersal
- For the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators
- To maintain genetic diversity and long-term evolutionary development
- For the reintroduction of populations or recovery of the species.

No critical habitat has been identified for the Painted Honeyeater. The Painted Honeyeater is a widely nomadic species that travels throughout its range in search of fruiting and flowering resources. Vegetation that will be impacted by the proposed modification includes mostly foraging habitat for the Painted Honeyeater. No areas considered to contain a high prevalence of mistletoes were observed, i.e. mean of 10 per tree (Barea 2008), so the impact to potential nesting habitat is likely to be minor. Vegetation in the study area is likely to be important for individuals travelling through the landscape. Considering the amount of higher value vegetation in the region (i.e. Pilliga National Park, Mount Kaputar National Park and nearby conservation areas), the habitat that will be impacted by the proposed modification is unlikely to be habitat critical to the survival of the Painted Honeyeater.

Disrupt the breeding cycle of an important population

The Painted Honeyeater is likely an occasional visitor in the study area, coming in to feed on flowering and fruiting resources when available. This species may also nest in the study area, though nesting is generally reported from areas that contain a high abundance of mistletoes, e.g. 10 per tree (Barea 2008), which was not a common feature of vegetation in the study area. A reduction in 25.17 hectares of suitable foraging habitat with some nesting opportunities for the Painted Honeyeater along the current alignment will impact the feeding and possibly the breeding of this species, however the study area is unlikely to be an important breeding location. There are likely areas in the locality containing a higher prevalence of mistletoes more suitable for nesting. Any individuals that use vegetation in the study area are likely passing through the landscape while foraging. It is unlikely that the proposed modification will disrupt the breeding cycle of an important population.

Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The proposed modification is predicted to remove around 16.08 hectares of foraging habitat for the Painted Honeyeater. Some areas of this may also present nesting opportunities. There may be additional indirect impacts to remaining areas of habitat due to edge effects.

The patches of habitat are already somewhat fragmented and isolated by the existing Newell Highway. The proposed modification is unlikely to break the local viable population into more fragments. However, it is likely to increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. For highly mobile species like birds, this is not a large problem, however the reduction of suitable habitats into small isolated patches inhibits movement throughout the landscape.

Considering the amount of higher value vegetation in the region (i.e. Pilliga National Park, Mount Kaputar National Park and nearby conservation areas), the habitat that will be impacted by the proposed modification is unlikely to cause the species to decline.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat

Habitat loss is a key threat to this species. The associated indirect impacts of this key threatening process are well documented and include increased potential for the proliferation of invasive species. Measures to minimise invasion of weeds during construction and operation would be included in the CEMP. With these measures in place, this proposed modification is not considered likely to result in a significant increase in the impact of invasive species on the Painted Honeyeater or its habitat.

Introduce disease that may cause the species to decline

Infection of native plants by *Phytophthora cinnamomi* has been identified as being spread by construction machinery. This water-borne fungus infects the roots of plants and has the potential to cause dieback. Machinery associated with vegetation clearance and subsequent construction for the proposed modification has the potential to transmit the fungus to remaining native vegetation remnants of the species. This is a potential indirect impact to the species as it may lead to a reduction in the quality of the soil surface microhabitat. This can be suitably mitigated through the development and implementation of suitable control measures for vehicle and plant hygiene such as the current best practice hygiene protocols as detailed in RTA (2011).

Interferes substantially with the recovery of the species

There is currently no specific recovery plan for the Painted Honeyeater. This species was included in The Action Plan for Australian Birds 2010 (Garnett *et al.* 2011). The recommended actions for this species that relate to the proposed modification include:

- 11.3: Protect all woodland in which Painted Honeyeaters have been recorded regularly from clearing and monitor compliance biennially.
- 11.4: Secure all Painted Honeyeater sub-populations found on public land through conservation management, particularly those in timber reserves, or transport corridors or on local government land.
- 11.5: Within the honeyeater's range manage at least 15% of the pre-European area of all woodland communities on public or private land for nature conservation, using incentives where necessary.
- 11.6: Using appropriate incentives, undertake extension with land-holders that have suitable woodland habitat to promote sound management of remnants and encourage greater connectivity between sub-populations.

- 11.7: Promote revegetation and land reclamation that recreates woodland habitat with a full complement of biodiversity, including the honeyeater.
- 11.8: Control and reduce firewood collection from areas occupied by Painted Honeyeaters, promoting wood-lot development close to markets, and reduce grazing densities where necessary.

The proposed modification would interfere with the first of these actions as it would impact 25.17 hectares of suitable foraging habitat for the Painted Honeyeater. However, the number of records of this species in the locality may not be classified as a regular occurrence.

These recommended actions primarily relate to actions for the government to complete. There may be opportunities to contribute to revegetation works associated with the proposed modification. Mitigation measures for the proposed modification would be designed to ensure that the proposed modification does not interfere with the remaining actions relating to fertilisers and weeds.

Conclusion

The proposed modification is considered unlikely to have a significant adverse effect on the Painted Honeyeater due to the relatively low impact on habitat resources when the amount of higher value habitat in the region is considered (i.e. Pilliga National Park, Mount Kaputar National Park and nearby conservation areas). The proposed modification is unlikely to place the Painted Honeyeater at a significantly elevated risk of extinction.

Remaining species – table format tests

Species assessed	Vulnerable species significant impact criteria An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:									Conclusion
	Lead to a long-term decrease in the size of an important population of a species	Reduce the area of occupancy of an important population	Fragment an existing important population into two or more populations	Adversely affect habitat critical to the survival of a species	Disrupt the breeding cycle of an important population	Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Introduce disease that may cause the species to decline, or	Interfere substantially with the recovery of the species.	
Corben's Long-eared Bat	Hollow-bearing trees are a common feature of the vegetation in the study area and are likely to present suitable roosting habitat for the Corben's Long-eared Bat. There is unlikely to be a maternity roost in the study area. The works are unlikely to lead to a long-term decrease in the size of an important population of this species as	Current area of occupancy will not be affected.	The patches of habitat in the study area are already somewhat fragmented and isolated by the existing Newell Highway. The proposed modification is unlikely to break the local viable population into more fragments.	No habitat critical to this species will be affected.	No breeding habitat is present in the impact area.	Based on associated PCTs/habitat, the proposed works will remove about 22.13 ha of potential roadside foraging habitat for the Corben's Long-eared bat. This impact is low in terms of the available habitat in the locality and not likely to result in the decline of this species.	Habitat loss is a key threat to this species. The associated indirect impacts of this key threatening process are well documented and include increased potential for the proliferation of invasive species. Measures to minimise invasion of weeds during construction and operation would be included in the CEMP. With these	There are no known disease issues affecting this species in relation to the proposed modification. The proposed modification would be unlikely to increase feral animal abundance or the potential for significant disease vectors to affect local populations.	Recovery of this species will not be affected by the proposed modification.	Not significant

	breeding won't be impacted.						measures in place, this proposed modification is not considered likely to result in a significant increase in the impact of invasive species			
Murray Cod	The Murray Cod occurs naturally in the waterways of the Murray-Darling Basin (ACT, SA, NSW and Vic) and is known to live in a wide range of warm water habitats that range from clear, rocky streams to slow flowing turbid rivers and larger billabongs of inland plains. Within these broad habitat types, it is usually found associated with complex structural cover such as large rocks, large snags and smaller structural	Current area of occupancy will not be affected.	The pools of habitat in the study area are already somewhat fragmented and isolated by the drought however this is the norm for the species of which it is well adapted to overcome. The proposed modification is unlikely to break the local viable population into more fragments.	No habitat critical to this species will be affected.	No breeding habitat is present in the impact area.	Based on associated habitat, the proposed work will not remove potential foraging habitat. This impact is low in terms of the available habitat in the locality and not likely to result in the decline of this species.	Habitat loss is a key threat to this species. The associated indirect impact may increased potential for the proliferation of invasive species. Measures to minimise invasion of weeds during construction and operation would be included in the CEMP. With these measures in place, this proposed modification is not considered likely to result in a significant increase in the impact of invasive species	There are no known disease issues affecting this species in relation to the proposed modification. The proposed modification would be unlikely to increase feral animal abundance or the potential for significant disease vectors to affect local populations.	Recovery of this species will not be affected by the proposed modification.	Not significant

	woody habitat, undercut banks and over-hanging vegetation. It will use floodplain channels when these are inundated. While nursery habitats for post-larval fish have not been identified, juveniles less than one year-old have been found in main river channels. The proposed modification is unlikely to have a significant impact on the population such that it is placed at risk of extinction.									
Superb Parrot	The study area is in the very north of the migration range for this species and is likely only used on occasion for foraging and roosting by birds during seasonal migration (i.e.	Current area of occupancy will not be affected.	The works will not result in fragmentation of habitat for the Superb Parrot. This species is highly mobile and will freely fly long distances over open areas to move between	No habitat critical to this species will be affected.	No breeding habitat is present in the impact area.	Based on associated PCTs/habitat, the proposed works will remove about 56.12 ha of foraging habitat. This impact is low in terms of the available habitat in the	Habitat loss is a key threat to this species. The associated indirect impacts of this key threatening process are well documented and include increased potential for	There are no known disease issues affecting this species in relation to the proposed modification. The proposed modification would be unlikely to	Recovery of this species will not be affected by the proposed modification.	Not significant

	non-breeding season). Hollow-bearing trees across the entire study area likely present suitable roosting habitat. This species will also forage in just about all areas of the study area depending on available resources, however the study area is unlikely to be important foraging habitat for the species due to its location and level of disturbance. The works are unlikely to lead to a long-term decrease in the size of an important population of this species as breeding won't be impacted.		roost sites and foraging sites.			locality and not likely to result in the decline of this species.	the proliferation of invasive species. Measures to minimise invasion of weeds during construction and operation would be included in the CEMP. With these measures in place, this proposed modification is not considered likely to result in a significant increase in the impact of invasive species	increase feral animal abundance or the potential for significant disease vectors to affect local populations.		
Lepidium aschersonii	Not known form the study area but suitable habitat present. The removal of	Current area of occupancy will not be affected.	The patches of habitat in the study area are already somewhat fragmented and	No habitat critical to this species will be affected.	Unknown if breeding cycle would be interrupted as this	Based on associated PCTs/habitat, the proposed works will remove about	Habitat loss is a key threat to this species. The associated indirect impacts of this	There are no known disease issues affecting this species in	Recovery of this species will not be affected by the proposed modification.	Not significant

	vegetation may result in the direct mortality of a small number of individuals; however, the works are unlikely to lead to a long-term decrease in the size of an important population of this species.		isolated by the existing Newell Highway. The proposed modification is unlikely to break the local viable population into more fragments.		species was not recorded in the study area.	12.62 ha of potential habitat. This impact is low in terms of the available habitat in the locality and not likely to result in the decline of this species.	key threatening process are well documented and include increased potential for the proliferation of invasive species. Measures to minimise invasion of weeds during construction and operation would be included in the CEMP. With these measures in place, this proposed modification is not considered likely to result in a significant increase in the impact of invasive species	relation to the proposed modification. The proposed modification would be unlikely to increase feral animal abundance or the potential for significant disease vectors to affect local populations.		
Swainsona murrayana	Not known form the study area but suitable habitat present. The removal of vegetation may result in the direct mortality of a small number of individuals;	Current area of occupancy will not be affected.	The patches of habitat in the study area are already somewhat fragmented and isolated by the existing Newell Highway. The proposed modification is unlikely to	No habitat critical to this species will be affected.	Unknown if breeding cycle would be interrupted as this species was not recorded in the study area.	Based on associated PCTs/habitat, the proposed works will remove about 49.17 ha of potential habitat. This impact is low in terms of the available	Measures to minimise invasion of weeds during construction and operation would be included in the CEMP. With these measures in place, this	There are no known disease issues affecting this species in relation to the proposed modification. The proposed modification would be	Recovery of this species will not be affected by the proposed modification.	Not significant

	however, the works are unlikely to lead to a long-term decrease in the size of an important population of this species.		break the local viable population into more fragments.			habitat in the locality and not likely to result in the decline of this species.	proposed modification is not considered likely to result in a significant increase in the impact of invasive species.	unlikely to increase feral animal abundance or the potential for significant disease vectors to affect local populations.		
Species assessed	**Endangered species significant impact criteria** An action is likely to have a significant impact on an endangered or critically endangered species if there is a real chance or possibility that it will:									**Conclusion**
	Lead to a long-term decrease in the size of a population	Reduce the area of occupancy of the species	Fragment an existing population into two or more populations	Adversely affect habitat critical to the survival of a species	Disrupt the breeding cycle of a population	Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	Introduce disease that may cause the species to decline, or	Interfere with the recovery of the species.	
Tylophora linearis	Not known form the study area but	Current area of occupancy	The patches of habitat in the study area are	No habitat critical to this	Unknown if breeding cycle	Based on associated PCTs/habitat,	Measures to minimise invasion of	There are no known disease	Recovery of this species will not be	Not significant

	suitable habitat present. The removal of vegetation may result in the direct mortality of a small number of individuals; however, the works are unlikely to lead to a long-term decrease in the size of a population of this species.	will not be affected.	already somewhat fragmented and isolated by the existing Newell Highway. The proposed modification is unlikely to break the local viable population into more fragments.	species will be affected	would be interrupted as this species was not recorded in the study area.	the proposed works will remove about 9.38 ha of potential habitat. This impact is low in terms of the available habitat in the locality and not likely to result in the decline of this species.	weeds during construction and operation would be included in the CEMP. With these measures in place, this proposed modification is not considered likely to result in a significant increase in the impact of invasive species.	issues affecting this species in relation to the proposed modification. The proposed modification would be unlikely to increase feral animal abundance or the potential for significant disease vectors to affect local populations.	affected by the proposed modification.	
Lepidium monoplocoides	Not known form the study area but suitable habitat present. The removal of vegetation may result in the direct mortality of a small number of individuals; however, the works are unlikely to lead to a long-term decrease in the size of a population of this species.	Current area of occupancy will not be affected.	The patches of habitat in the study area are already somewhat fragmented and isolated by the existing Newell Highway. The proposed modification is unlikely to break the local viable population into more fragments.	No habitat critical to this species will be affected	Unknown if breeding cycle would be interrupted as this species was not recorded in the study area.	Based on associated PCTs/habitat, the proposed works will remove about 29.26 ha of potential habitat. This impact is low in terms of the available habitat in the locality and not likely to result in the decline of this species.	Measures to minimise invasion of weeds during construction and operation would be included in the CEMP. With these measures in place, this proposed modification is not considered likely to result in a significant increase in the impact of invasive species.	There are no known disease issues affecting this species in relation to the proposed modification. The proposed modification would be unlikely to increase feral animal abundance or the potential for significant disease vectors to affect local populations.	Recovery of this species will not be affected by the proposed modification.	Not significant

Assessments of Significance - Migratory species.

Criteria	Migratory birds (all species provided as a precaution)
An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:	Great Egret (*Ardea alba*); Cattle Egret (*Ardea ibis*); Australian Painted Snipe (*Rostratula australis*); Latham's Snipe (*Gallinago hardwickii*); White-throated Needletail (*Hirundapus caudacutus*); Fork-tailed Swift (*Apus pacificus*); Rainbow Bee-eater (*Merops ornatus*); Satin Flycatcher, Rufous Fantail, Painted Snipe, Curlew Sandpiper, Marsh Sandpiper, Red-necked Avocet, Red necked-stint, Black-winged Stilt.
substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	There is little evidence to suggest that the Study Area supports 'important habitat' for migratory species, however it would most likely provide seasonal breeding and feeding grounds. Given their migratory habits, the permanent nature of food and habitat resources (riverine environment), and the extent of habitat across their range, it is likely that the existing resources within the Study Area would be utilised infrequently and on a transitory basis only. Migratory birds are extremely mobile in nature and have a large feeding area that would not be solely reliant on the habitat provided in the Study Area. The proximity of wetlands of international importance close by to the Study Area also reduces the likelihood that habitat in the Study Area is 'important habitat'. Those remaining wetland species for which specific potential impacts need to be considered are discussed separately below, along with those migratory species that do not inhabit wetland areas. Great Egret (*Ardea alba*) and Cattle Egret (*Bubulcus ibis*) These species are predicted to occur, within or nearby to the Study Area during periods of inundation. There is no record of either in the Study Area. Any such impacts involving habitat would be minor and may be mitigated by the habitat creation and enhancement activities noted above for other wetland species. The proposed action would have minimal effects on any local population of these species. White-bellied Sea-Eagle (*Haliaeetus leucogaster*) It is unlikely that the White-bellied Sea-Eagle would occur in the Study Area but not absolute. There is potential for a direct impact associated with the removal of large trees however in this case only ground cover impacts are proposed. Any such impacts involving habitat would be minor and may be mitigated by the retention of large trees (both live and dead), where practical. Australian Painted Snipe (*Rostratula australis*) and Latham's Snipe (*Gallinago hardwickii*) These species are predicted to occur, within or nearby to the Study Area, although neither have been recorded previously. Suitable wetland vegetation does not occur in the Study Area these species would only be expected to occur on the study site occasionally, at best. Potential habitat occurs outside the Study Area within the Namoi River which has suitable fringing vegetation. The proposed action is not expected to have any effect on these species. Fork-tailed Swift (*Apus pacificus*) and White-throated Needletail (*Hirundapus caudacutus*) These species have not been recorded within or nearby the Study Area however are predicted to have occasional habitat in the Study Area. Both are aerial species for which the Study Area will not represent 'important habitat' and no impacts are expected due to the ability of these species to forage over a wide variety of land use.

	Rainbow Bee-eater (*Merops ornatus)* The Namoi River is a known place for congregation of flocks and is core breeding habitat for the species. The Rainbow Bee-eater is most often found in open forests, woodlands and shrublands, and cleared areas, usually near water. It will use disturbed sites with sandy soils such as river banks, quarries, cuttings and mines or exposed sites on cleared flats to build its nesting tunnels. Providing that recommendations in this report are followed there will be no impact to individual birds or a long term decrease in the population. Rufous Fantail (*Rhipidura rufifrons*) This species are predicted to occur, within or nearby to the Study Area is swamp forest environments, although it has not been recorded previously. Suitable wetland vegetation does not occur in the Study Area and this species would only be expected to occur on the study site occasionally, at best. Potential habitat occurs outside the Study Area within the Namoi River which has suitable fringing vegetation. The proposed action is not expected to have any effect on this species.
result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or	The local area has a history of clearing and habitat modification, which has benefited a number of feral and invasive flora and fauna species. The proponent proposes to ensure the spread of weeds and feral fauna is not enhanced by the project that will contribute to the overall enhancement of habitat for migratory species.
seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	As noted above, the Study Area is not considered to be an area of 'important habitat' for migratory birds, whether they are wetland or terrestrial species. It is unlikely that an ecological significant proportion of these migratory birds would rely on habitat in the Study Area, given the multitude of more suitable habitat (less disturbed and more fringing aquatic vegetation nearby.

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Services

Appendix F Construction Noise Estimator

Noise Estimator (Scenario)

Steps:
1. Enter project name (cell C9).
2. Enter scenario name (cell C10).
3. Enter receiver address (cell C11).
4. Select area ground type (cell C12) - water, undeveloped green fields (e.g. rural areas with isolated dwellings) or developed settlements (e.g. urban and suburban areas)
5. Select type of background noise level input - Reprentative noise environment (to make assumptions) or user input (where noise monitoring data is available):
   (a) where representative noise environment is selected - select the appropriate noise area category (cell C16). The worksheet titled 'Representative Noise Environ.' provides a number of examples to help select the noise area category.
   (b) where user input is selected - enter the measured background noise level for each time period (cells D17 to D19).
6. Enter the representative distance in cell C24.
7. Select scenario from the drop-down list in cells A27.
   (a) is there line of sight to receiver? Select from drop down list in cells F27. Solid barrier can be in the form of road cutting, solid construction hoarding, acoustic curtain, timber lapped and capped fence, shipping container, site office, etc. Please note that vegetation and trees are not considered to be a form of solid barrier.
8. Identify the level above background and/or noise mangement level (see rows 36 to 41).
9. Identify and implement standard mitigation measures where feasible and reasonble. Include any shileiding implemented as part of the standard mitigation measures by changing the selection in the 'Is there line of sight to receiver' drop-down list.
10. Identify and implement feasible and reasonable additional mitigation measures (see rows 42 to 44).
11. Document a summary report detailing:
   (a) project description (including location, duration, hours of work, construction methodology, plant , potentially impacted receivers, etc.).
   (b) background noise levels.
   (c) noise management levels .
   (d) predicted noise levels for each time period.
   (e) sleep disturbance affected distance for night works.
   (f) mitigation measures.
   (g) team member responsible for implementing mitigation measures and managing noise and vibration.

(Note that suitable noise management levels for other noise-sensitive businesses not identified in the Construction Noise Estimator should be investigated on a project-by-project basis. Please contact a Roads and Maritime noise speciliast for more information)

Please input information into yellow cells
Please pick from drop-down list in orange cells

Project name	Newell Highway N2M Addenum REF
Scenario name	Foam bitumen batch plant
Receiver address	N2MS1
Select area ground type	Undeveloped green fields (rural areas with isolated dwellings)
Select type of background noise level input	Representative Noise Environment

		Representative Noise Environment	User Input
Noise area category		R0	
RBL or L_{A90} Background level (dB(A))	**Day**	30	30
	Evening	30	35
	Night	30	31
$L_{Aeq(15minute)}$ Noise mangement level (dB(A))	**Day**	40	40
	Day (OOHW)	35	40
	Evening	35	40
	Night	35	36

Representative distance (m)	1000

Scenario	SWL L_{Aeq} (dB(A))	Is there line of sight to receiver?	Shielding correction (dB(A))	Distance used in calculation (m)	Contribution SPL (dB(A))
Compound site establishment	119	Yes	0	1000	37

Total SPL $L_{Aeq(15minute)}$ (dBA)	***37***

		Residential receiver	*Non-residential receivers*						
			Classroom at schools and other educational institutions	*Hospital wards and operating theatres*	*Place of worship*	*Active recreation*	*Passive recreation*	*Industrial premise*	*Offices, retail outlets*
Noise Management Level (dB(A))	**Standard hours**	***40***	**55**	**65**	**55**	**65**	**60**	**75**	**70**
	Day (OOHW)	***35***	**55**	**65**	**55**	**65**	**60**	**75**	**70**
	OOHW Period 1	***35***		**65**	**55**	**65**	**60**	**75**	**70**
	OOHW Period 2	***35***		**65**	**55**			**75**	**70**
Level above background (dB(A))	**Standard hours**	***7***							
	Day (OOHW)	***7***							
	OOHW Period 1	***7***							
	OOHW Period 2	***7***							
Level above NML (dB(A))	**Standard hours**								
	Day (OOHW)	***2***							
	OOHW Period 1	***2***							
	OOHW Period 2	***2***							
Additional mitigation measures	**Standard Hours**	***-***	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Day (OOHW)	***-***	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	OOHW Period 1	***-***		**-**	**-**	**-**	**-**	**-**	**-**
	OOHW Period 2	***N***		**-**	**-**			**-**	**-**

Abbreviation	Measure
N	Notification
SN	Specific notifications
PC	Phone calls
IB	Individual briefings
RO	Respite offer
R1	Respite period 1
R2	Respite period 2
DR	Duration respite
AA	Alternative accommodation
V	Verification