PART C: Environmental Impact Assessment

9. Traffic, transport and access

This chapter provides a summary of the traffic, transport and access impact assessment of the proposal. It describes the existing traffic, transport and access environment, assesses the impacts of construction and operation, and provides recommended mitigation and management measures. The full assessment report is provided as Technical Report 1.

9.1 Assessment approach

9.1.1 Methodology

The assessment involved:

- reviewing the concept design for the proposal
- reviewing existing road features, traffic, transport services, pedestrian and cyclist facilities, and available traffic survey data
- estimating the traffic that would be generated during construction
- assessing the potential impacts of construction, including impacts to the operation of the local road network, pedestrians, cyclists, and public transport
- assessing the potential impacts to the road network during operation
- assessing the potential travel time impacts at level crossings based on the expected train lengths, travel speeds and closure times
- assessing potential operational impacts on the wider transport network, including impacts to cyclists, pedestrians, and public transport
- providing mitigation measures to manage the potential impacts on traffic, transport and access.

Traffic modelling was undertaken for level crossings to identify the potential for delays. The level crossing model was based on the operational train characteristics for Inland Rail (length and speed), and the volume of road traffic.

9.1.2 Legislative and policy context to the assessment

The traffic and transport assessment was undertaken with reference to the following guidelines:

- *Guide to Traffic Management – Part 3 Traffic Studies and Analysis* (Austroads, 2007)
- *Guide to Traffic Generating Developments Version 2.2* (RTA, 2002)
- *Cycling Aspects of Austroads Guides* (Austroads, 2014)
- *NSW Bicycle Guidelines v 1.2* (RTA, 2005)
- *Planning Guidelines for Walking and Cycling* (DIPNR, 2004)
- *Construction of New Level Crossing Policy* (TfNSW, undated)
- *Railway crossings policy* (ONRSR, 2016).

The traffic, transport and access impact assessment report (Technical Report 1) describes the legislative and policy context for the assessment in detail, including the policy and standards specifically related to level crossings.

9.2 Existing environment

9.2.1 Road network

The road network within the study area consists mainly of local/rural roads and private property access roads. The road network is described below and shown in Figure 9.1.

Main roads

Newell Highway

The Newell Highway, which runs generally in a north–south direction through the study area, stretches 1,060 kilometres through NSW between the Victorian border town of Tocumwal and the Queensland border town of Goondiwindi. The Newell Highway, which is managed by Roads and Maritime, is part of the national highway network. The importance of this highway is recognised by the *Newell Highway Corridor Strategy* (NSW Government, 2015). Further information on the highway is provided in Technical Report 1.

The Newell Highway runs to the east of the proposal site between Parkes and Tomingley, passing through Peak Hill. At its closest point, just south of Peak Hill, the highway is located about 500 metres to the east of the proposal site. The highway does not cross the proposal site.

Outside built-up areas, the highway has a posted speed limit of 110 kilometres per hour, and generally comprises a single lane of travel in each direction on a single carriageway. Overtaking lanes are provided in some locations.

Further information on the Newell Highway in relation to the proposal site is provided in chapter 2.

Henry Parkes Way

Henry Parkes Way (part of Main Road 61) is regional transport corridor that runs in an east to west alignment, between Orange and Condobolin. It is a state owned road managed by Roads and Maritime. The proposal site crosses Henry Parkes Way about six kilometres north-west of Parkes. At this location, Henry Parkes Way comprises a single lane of travel in each direction on a single carriageway, with a posted speed limit of 100 kilometres per hour.

Mitchell Highway

The Mitchell Highway is a state owned road which runs east-west through Narromine to the north of the proposal site. The highway is located about 20 metres to the north of the proposal site at its northern extent.

Local roads and intersections

Local roads

The study area includes a network of local roads and private access roads through properties. The local road network provides direct access to properties and to the main road network. Local roads that cross the proposal site are listed (from north to south) in Table 9.1 and are shown on Figure 9.1. The proposal site is also crossed by a number of private roads/driveways, which provide access to and/or within properties surrounding or close to the proposal site.

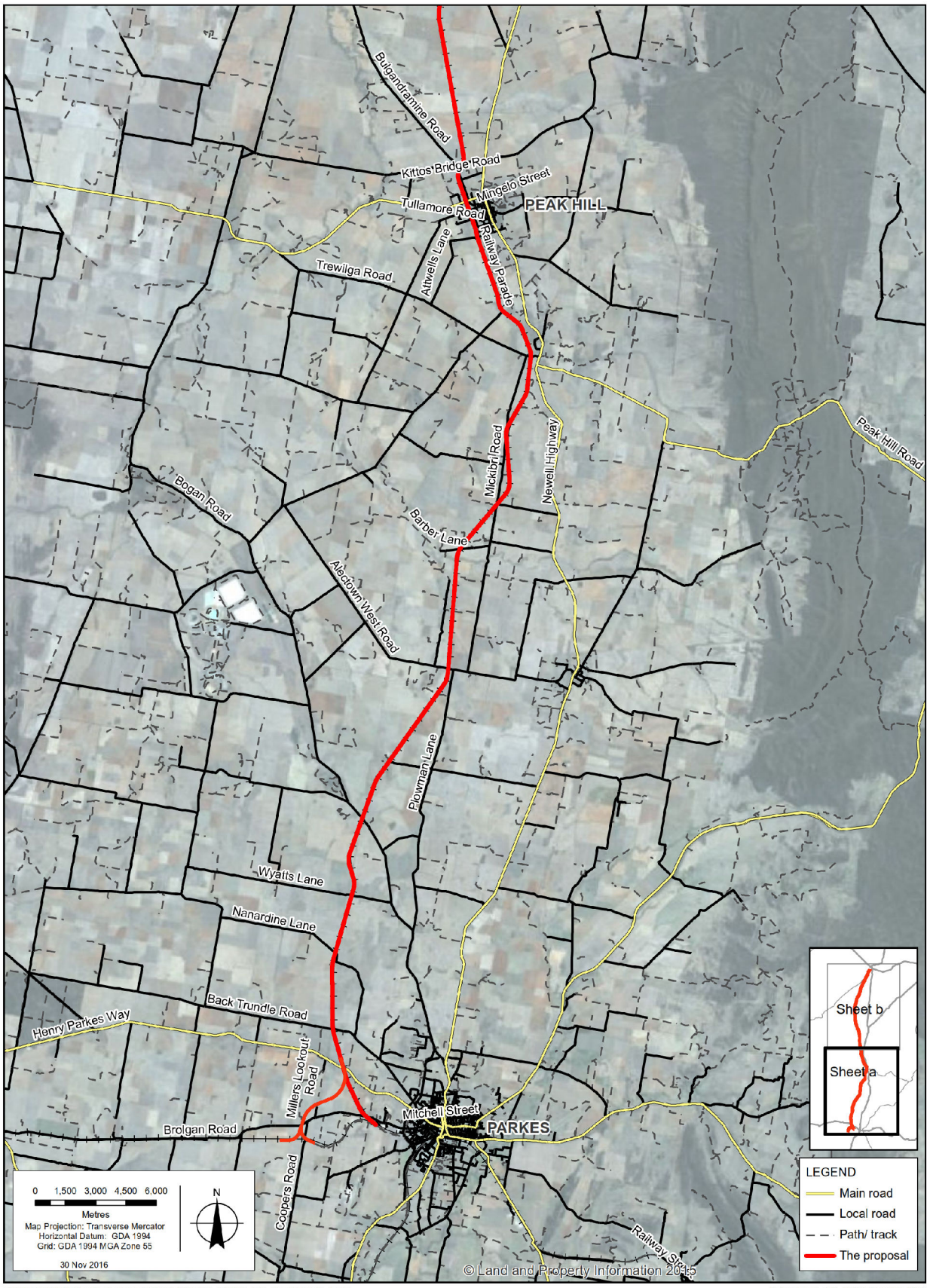


Figure 9.1a
Road network

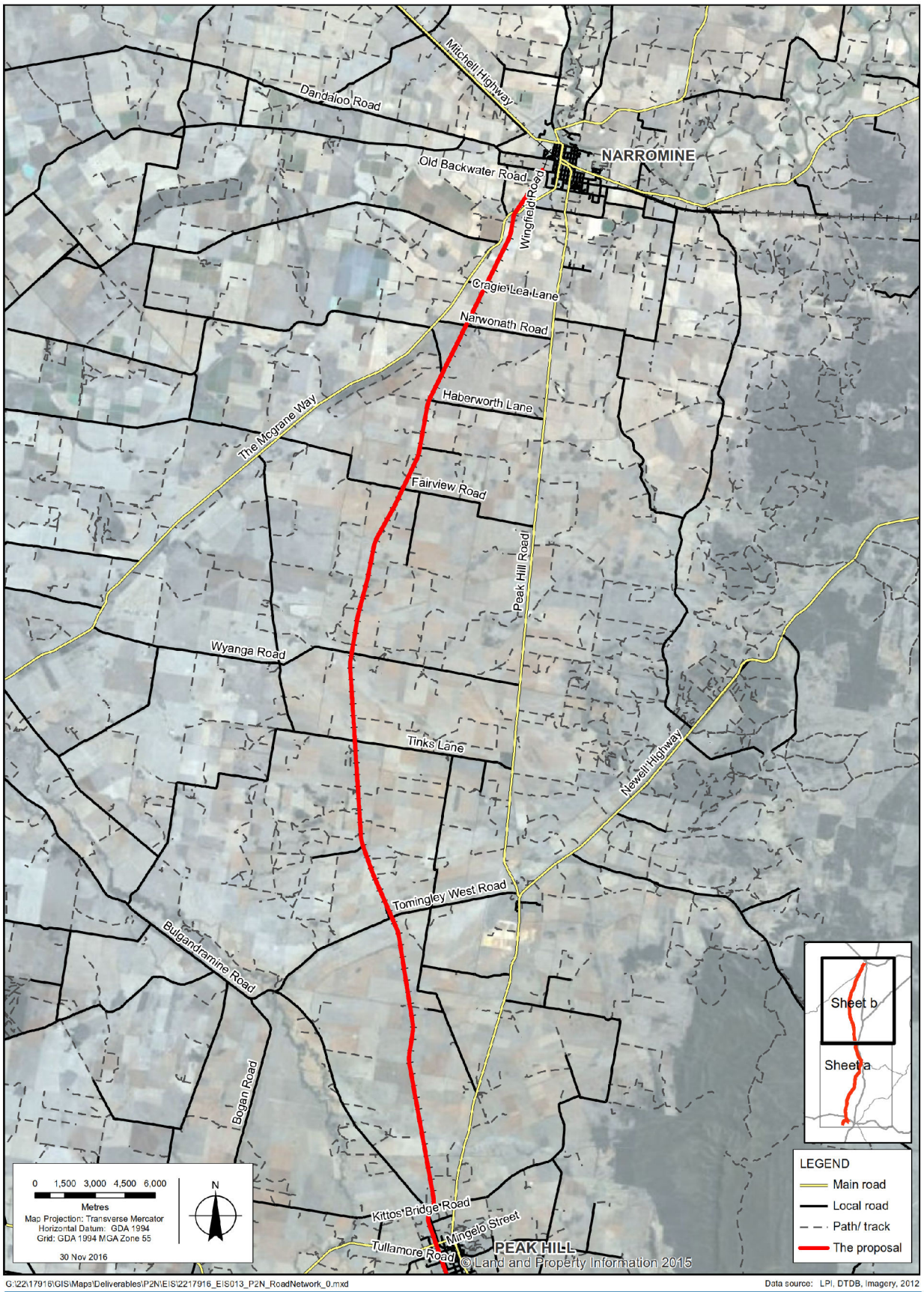


Figure 9.1b
Road network

Table 9.1 Local roads crossing the proposal site

Road name	Surface type	Shoulders	Line marking
Near Narromine			
Dandaloo Road	Sealed	No	Yes
Old Backwater Road	Sealed	No	No
Wingfield Road	Unsealed	No	No
Narromine to Peak Hill			
The McGrane Way (Tullamore to Narromine Road)	Sealed	No	Yes
Craigie Lea Lane	Unsealed	No	No
Narwonah Road	Sealed	No	No
Haberworth Lane	Unsealed	No	No
Fairview Road	Unsealed	No	No
Wyanga Road	Unsealed	No	No
Tinks Lane	Unsealed	No	No
Tomingley West Road	Sealed	No	No
Peak Hill to Parks			
Kittos Bridge Road	Unsealed	No	No
Bulgandramine Road	Sealed	No	No
Tullamore Road (Ingalba Street)	Sealed	No	Yes
Mingelo Street, Peak Hill	Sealed	No	No
Whitton Park Road (Attwells Lane)	Sealed	No	No
Trewilga Road	Unsealed	No	No
Mickibri Road	Unsealed	No	No
Barber Lane	Unsealed	No	No
Alectown West Road	Unsealed	No	No
Bogan Road	Sealed	No	Yes
Wyatts Lane	Unsealed	No	No
Nanardine Lane	Unsealed	No	No
Near Parkes			
Back Trundle Road	Sealed	No	Yes

Road name	Surface type	Shoulders	Line marking
Henry Parkes Way (Parkes to Condobolin Road)	Sealed	Yes	Yes
Millers Lookout Road	Unsealed	No	No
Brolgan Road	Sealed	Yes	Yes
Coopers Road	Unsealed	No	No

There are also a number of roads which run in close proximity to, but do not cross, the proposal site. These roads, which are listed in Table 9.2, may be used as part of construction site access arrangements.

Table 9.2 Roads located close to the proposal site

Road name	Surface type	Shoulders	Linemarking
Peak Hill Railway Road	Sealed	No	No
The McGrane Way	Sealed	No	Yes
Bulgandramine Road	Sealed	No	No
Newell Highway	Sealed	Yes	Yes
Railway Parade, Peak Hill	Unsealed	No	No
Mickibri Road	Unsealed	No	No
Plowman Lane	Unsealed	No	No

As described in section 7.3.1, the Parkes north west connection would cross Millers Lookout Road and Coopers Road. The northern section of Millers Lookout Road is an unsealed local road that intersects with Henry Parkes Way. The southern section is a narrow unsealed track that intersects with Brolgan Road via an access gate near Brolgan Road.

Coopers Road is an unsealed local road that intersects with Brolgan Road to the north, London Road about midway along, and Watts Lane to the south. Brolgan Road and London Road provide access to Parkes, and Watts Lane connects to the Newell Highway.

Intersections

A number of intersections are located on local roads near the proposal site. These are all priority controlled intersections (with give-way or stop signs), with very low traffic volumes on the side roads, and relatively low volumes on through movements. Intersections near the proposal site within the main towns and villages are listed in Table 9.3. The performance of these intersections was not quantified as part of the assessment. However, as a result of the low traffic volumes, it is expected that there would be little to no delay to existing road users.

Table 9.3 Key intersections located near the proposal site

Locality	Intersecting road	Intersecting road
Narromine	Peak Hill Railway Road	The McGrane Way
Narromine	Wingfield Road	The McGrane Way
Narromine	Wilsons Lane	The McGrane Way
Narromine	Dandalloo Road	Dandaloo Street
Tomingley	Tomingley West Road	Peak Hill Railway Road
Peak Hill	Tullamore Road	Bulgandramine Road
Peak Hill	Whitton Park Road	Railway Parade
Peak Hill	Whitton Park Road	Newell Highway
Peak Hill	Newell Highway	Trewilga Road
Peak Hill	Trewilga Road	Mickbiri Road
Alectown	Alectown west Road	Plowman Lane
Alectown	Alectown west Road	Mickbiri Road
Parkes	Henry Parkes Way	Brolgan Road
Parkes	Henry Parkes Way	Millers Lookout Road
Parkes	Brolgan Road	Harigan Avene/Westlime Road
Parkes	Brolgan Road	Coopers Road

Level crossings

There are 71 level crossings located along the proposal site – 33 on public roads and 38 on private roads or maintenance access tracks.

The duration of any delay at a level crossing is mainly related to train length and speed. At crossings with active control, a minimum pre-train warning time of 45 seconds, and a minimum five seconds once the train has passed, results in a total maximum delay under existing conditions of 122 seconds.

Further information on level crossings is provided in section 6.3.

Rail corridor access track

An internal access track used by maintenance vehicles runs along (within) the rail corridor for most of its length in the proposal site. Access to this track is provided off the local road network in a number of locations. Use of this track is restricted to authorised ARTC maintenance vehicles. The surface is unsealed.

Parking

There is no formal on-street or off-street parking provided along or near the proposal site. Rest areas are provided along the Newell Highway. Between Parkes and Tomingley, there are four rest areas designated for heavy and light vehicle access, and a further five suitable for light vehicles only.

9.2.2 Traffic volumes, level of service and safety

Traffic volumes

Limited traffic volume data is available for most roads in the study area, although based on road function, location and surrounding land use, existing traffic volumes are expected to range between 50 vehicles per day for lower order roads (which includes Peak Hill Railway Road), up to 2,000 vehicles per day on some of the more significant roads connection to Parkes.

The busiest road that would be used by construction traffic would be the Newell Highway, which would form the main access to the southern half of the proposal site (between Parkes and Peak Hill). Traffic counts (sourced from Roads and Maritime's traffic volume viewer) indicate that average annual daily traffic volumes are as follows:

- Tomingley – 2,800 in 2015:
  - 33 per cent are heavy vehicles
  - peak volumes of around 220 vehicles per hour (two-way) with traffic volumes relatively consistent between 9 am and 5 pm.
- Peak Hill (Caswell Street) – 6,100 in 2009:
  - peak volumes of 240 vehicles per hour in the peak direction, highest in the mid-morning.
- Parkes (south of Bogan Road) – 2,800 in 2009:
  - 31 per cent heavy vehicles
  - peak volumes of around 220 vehicles per hour (two-way) in the peak direction, relatively consistent across the middle of the day.

Traffic volumes on the road network are likely to increase during harvesting season. Harvesting of winter crops can begin in late October and continue through until January in higher rainfall areas (Australian Grain Magazine, July 2016). During this season, heavy vehicle usage on local and main roads increases as trucks transport grain, and tractors and harvesters move between properties. Farming machinery is generally much larger and slower than other vehicles using the roads.

Level of service

The performance of the road network is largely dependent on the operating performance of intersections which form critical capacity control points. Level of service is the standard measure used to assess the operational performance of the network and intersections. There are six levels of service, ranging from level of service A to level of service F. Level of service A represents the best performance, and level of service F the worst. A level of service of D or better is generally considered to be an acceptable level of service. Level of service E may also be acceptable during peak periods. Levels of service E or F generally refer to intersections operating at, or close to capacity.

A level of service assessment was undertaken for the Newell Highway, using the methodology outlined in the *Guide to Traffic Management – Part 3 Traffic Studies and Analysis* (Austroads, 2007) for two-lane, two-way roads. For the busiest of the above segments (at Peak Hill) the highway currently operates at level of service B (allowing for 1.2 per cent per annum growth in the peak hour volume since the 2009 count). This indicates that average delays are less than 15 seconds and the segment has good operation.

Approximate volume thresholds have been identified for each level of service band, for key road types, as an indication of the volume of traffic each road type is able to accommodate. These volume thresholds are listed in Table 9.4.

Table 9.4 Indicative maximum one way vehicle volumes for level of service bands

	Road description (vehicles per hour)		
Level of service band	**Newell Highway (2-lane, wide sealed shoulders)**	**Henry Parkes Way (2-lane, narrow sealed shoulders)**	**Local road (no centre line, no shoulders)**
A	250	150	150
B	500	500	900
C	900	900	1450
D	1500	1500	2000

Road safety

Five year crash history data (2009-2013) for key roads in the study area was obtained from the Transport for NSW Centre for Road Safety, and is listed in Table 9.5.

Table 9.5 Crash history 2009-2013

Road	Fatality	Serious	Moderate	Minor	Total
Newell Highway[1]					
Dubbo - Tomingley	3	10	6	0	19
Tomingley - Peak Hill	0	4	3	0	7
Peak Hill (town)	1	1			2
Peak Hill - Alectown	1	3	1	3	8
Alectown - Parkes	0	3	2	5	10
Newell Highway total	*5*	*21*	*12*	*8*	46
Old Backwater Road	0	1	0	0	1
Tomingley Road	0	2	1	1	4
Plowman Lane	0	1	0	0	1
Bogan Road	0	0	2	0	2
Henry Parkes Way	0	2	2	0	4
Brolgan Road	0	1	1	1	3

Note 1: Excludes urban areas in Dubbo and Parkes

The majority of crashes occurred on the Newell Highway, which is to be expected given the higher volumes of traffic along the highway compared to other roads. The high proportion of serious and moderate injury crashes is also noted, and is likely to be a factor of higher vehicle speeds on rural roads.

9.2.3 Other transport facilities

Public transport

In addition to passenger trains servicing Parkes via the Broken Hill line (described in chapter 2), there are a number of intercity coach (bus) services. Parkes is serviced by four to five coach services per day. This includes services to Dubbo and Orange. Narromine's coach network has a service between Dubbo and Bourke or Broken Hill, with four services most days. These regional services operate along the Newell Highway.

There are also local buses, including school services, operating around Parkes, Peak Hill, and Narromine. School buses cross the proposal site via level crossings on various routes including:

- Dandaloo Road
- Kitto's Bridge Road
- Tullamore Road
- Trewilga Road
- Bogan Road
- Henry Parkes Way.

Rail infrastructure and train movements

Existing rail infrastructure and train movements are described in chapter 2.

Pedestrians and cyclists

There are no formal pedestrian or cyclist paths crossing or located in the immediate vicinity of the proposal site. The remote nature of the proposal site means that pedestrian and cyclist activity is low.

9.3 Impact assessment

9.3.1 Risk assessment

Potential impacts

The environmental risk assessment undertaken for the proposal (summarised in Appendix B) included potential risks associated with traffic, transport and access. Potential risks were considered according to the impacts that may be generated by the construction and/or operation of the proposal. The likelihood, consequence and overall risk level of each potential risk were assessed, and avoidance and management measures were defined for each potential risk. Further information on the risk assessment, including the approach, methodology, and the full results, is provided in Appendix B.

The assessed risk level for the majority of potential risks to traffic and transport was between low and high. Risks with an assessed level of medium or above include:

- construction traffic impacts, including temporary delays to local and regional traffic
- impacts to emergency services through delays in access due to works
- impacts on access to private properties
- impacts to rural roads unsuitable for construction traffic
- increase in travel times due to increase in level crossing waiting times associated with increasing length and frequency of trains.

How potential impacts have been and would be avoided

Potential impacts on traffic, transport and access would continue to be avoided by:

- designing, constructing and operating the proposal to minimise the potential for impacts outside the rail corridor
- managing the potential impacts on traffic, transport and access in accordance with relevant design, legislative, and policy requirements, including those described in section 9.1.2
- implementing the traffic, transport and access mitigation measures provided in section 9.4.

Level crossings not impacted by the proposal would continue to operate as normal, with warning devices and other controls installed in accordance with ARTC's *Level Crossing Design* standard.

Interactions between vehicles on the road network would continue to be defined by road rules and the physical configuration of the road. In most cases all construction activities would be located clear of the existing road network. Any short-term impacts associated with construction vehicle access or works at particular sites would be managed by the traffic management arrangements put in place by the construction contractor, as described in section 9.4.

9.3.2 Construction impacts

Traffic and road network impacts

Traffic impacts

Construction would generate additional vehicle movements, including light and heavy vehicles. Light vehicles would generally be generated by construction workers moving to and from the construction work areas and/or compounds. Heavy vehicle movements would generally be trucks delivering materials. The estimated amount of construction traffic generation is described in chapter 8.

Construction of the proposal would result in a temporary increase in heavy and light vehicle movements on the local road network. The extent of impacts would depend on the location of the works, and the origin of material and/or workers.

Daily traffic generation associated with construction would be around 400 individual vehicle movements, including 230 heavy vehicle movements. The peak hour for traffic generation would occur at the beginning and end of each shift, with up to 114 vehicle movements (one way), including around 39 heavy vehicles.

The Newell Highway is the busiest road in the study area likely to be used for construction access. An additional 100 vehicles per hour would bring the total peak hour volume to around 360 vehicles per hour. This would be a 38 per cent increase, noting that trucks have a disproportionate impact compared to light vehicles. This is well within the threshold for a route with a level of service B. The anticipated maximum hourly volume on potential access roads is within the threshold for level of service B.

Proposed works on level crossings may result in disruptions to local traffic and short term access restrictions to private property. Where this occurs, alternative access arrangements would be provided and/or appropriate traffic controls implemented.

A large portion of the proposal's earthworks would be associated with construction of the Parkes north west connection. This means that there would be an increased amount of vehicle movement associated with spoil delivery in this area. The design of the Parkes north west connection has taken this into consideration, and the cutting and embankment are both located to the north of Brolgan Road within greenfield areas, which would be acquired as part of the proposal. Therefore, vehicle movements associated with spoil movement would be carried out off-road, and would not impact on the operation of Brolgan Road and the surrounding road network.

Measures to manage the potential for construction traffic impacts are provided in section 9.4.

Road network impacts

The surrounding road network is not expected to be significantly impacted by construction traffic. This is because the roads have sufficient capacity to absorb the increased traffic, and delays or closure at crossings and intersections would have a localised impact only due to the low volumes on affected roads. During the peak construction activity, a level of service B is expected to be achieved on all affected roads.

It is expected that construction vehicle movements would be spread out across the day, particularly delivery trucks. This would also assist in minimising delays for vehicles turning from side roads at intersections along the construction access routes.

Construction of the Brolgan Road overbridge would have localised minor impacts on Brolgan Road traffic, including access to Coopers Road. The new bridge would be mainly constructed on a separate alignment which would minimise disruption to the road network.

However, localised sections may need to be deviated for short periods to achieve safety clearances from the construction of the embankment. This may cause delays to road users. Construction works would be scheduled and controlled to minimise the potential for impacts.

Measures to manage the potential for impacts on the road network during construction are provided in section 9.4.

Parking impacts

Light vehicle parking for construction workers would be provided within construction compounds, and/within the rail corridor, and would not impact surrounding roads or properties. Parking would be adequate to accommodate the peak demands associated with construction. Parking locations would be detailed in the CEMP. Provision of buses for workers would reduce the number of light vehicles that would need to travel to individual construction sites, and corresponding parking requirements.

Access impacts

A description of the indicative construction methodology is provided in chapter 8. Construction would move progressively along the proposal site. Given the length of the proposal site, the access routes that would be used for construction traffic would vary depending on the origin of construction vehicles and the location of each construction work site.

As described in chapter 8, construction vehicle access to work areas would be by means of the existing road network and the access track within the rail corridor as far as possible. New temporary access tracks may be required in some locations.

Access points from the public road network would be selected such that an adequate sight distance and a safe access path are available. Further investigation of access locations would be undertaken during detailed design. All construction accesses would be designed in accordance with relevant standards and the requirements of the road owner, with adequate sight lines to ensure they operate in a safe and efficient manner. In addition, access would be provided wherever practicable from secondary roads to minimise the potential for impacts to the arterial road network.

Measures to manage the potential for impacts to access are provided in section 9.4.

Other transport impacts

Public transport impacts

Coaches between Parkes and Condobolin cross the Henry Parkes Way level crossing. While construction works are underway in this area, there may be some short term delays to some services.

As with other traffic, public and school buses may be impacted by the increase in traffic on the road network. However, given the relatively small number of services in the area, this would be a minor impact.

The proposal would not impact the stopping patterns of passenger trains using the Broken Hill line.

Impacts to train paths

Construction activities would result in temporary impacts on existing rail operations. During each construction stage, rail operations would be altered as outlined in section 8.3. This may result in additional train activity on some parts of the rail network which could result in delays at some level crossings. However, as the maximum length of trains would not change the length of delays are not likely to increase significantly.

The possession strategy would be developed in consultation with affected train operations, track stakeholders and relevant government departments so that the impacts on existing rail operations are minimised where possible.

Pedestrian and cyclist impacts

The main pedestrian and cyclist safety issues that may arise are:

- at construction site access and egress points where construction vehicles may interface with pedestrians using any surrounding footpaths, and any locations where footpath widths would reduce around construction sites
- the introduction of additional heavy vehicles to the road network has the potential to increase safety risks for pedestrians and cyclists.

Given the low volume of pedestrian and cyclist activity in and around the proposal site, and the remote nature of the majority of the works, there are not expected to be any significant impacts to pedestrian and cyclists.

9.3.3 Operation impacts

Traffic and road network impacts

During operation, some maintenance/operational traffic would be generated. However, this would be minimal, and is estimated to comprise about two to three trips to the proposal site per week. Occasionally there may be larger maintenance efforts required. The potential for significant traffic impacts is unlikely.

As described in chapter 5, the need for the proposal has been driven by continued growth in both road and rail freight volumes. Operation of the proposal would have a positive impact on the road network, particularly along major transport routes such as the Newell Highway, by decreasing the amount of heavy vehicles on the road. This has the potential to reduce travel times for road users and improve road safety.

Overall, the proposal is expected to have a positive impact on traffic, by relocating some of the road freight task to rail, thereby reducing the number of heavy vehicles on main roads.

Level crossings

The proposed works at level crossings involve a mix of retaining/refurbishing existing crossings, consolidation of some crossings, upgrading the level of control, or installing a gated crossing. At this stage of the planning process, 19 crossings have been identified as requiring further investigation and consultation in relation to consolidation options. These are mainly private crossings where alternative access is available, or access is no longer required. Further information on the level crossing strategy, including the next steps, is provided in section 6.3.3.

The main traffic impact of the proposal would be impacts on travel time as a result of increased train activity at level crossings. Table 9.6 lists the estimated duration of delays. The delays shown would increase only if the maximum length of trains increase, and may actually reduce if train speeds increase.

Table 9.6 Level crossing delays per train

Year and train length[1]	Maximum delay at crossing (seconds)[2]
Existing	122
Year 2040	109

Notes 1: Train speed 90 kilometres per hour existing and 110 kilometres per hour in 2040
2: 45 second pre-train and 5 second post-train down times (active controls) is a conservative duration in excess of the ARTC's Level Crossing Design standards

The frequency of trains, and therefore likelihood of delays, would also increase over time as the number of trains using Inland Rail increases. Given the local nature of most affected roads, this impact is expected to affect a small volume of cars and have a localised impact only. The potential for queued vehicles to impact on adjacent intersections is considered to be very low.

On the busier roads crossed by the proposal site, such as Henry Parkes Way, there is sufficient room for traffic to queue without obstructing any major junctions.

Longer trains could be used along the rail alignment as a result of the proposal. If this happens, there would be an increase in the duration of time for which road traffic could be delayed while a train crosses a level crossing.

Parking impacts

There is not expected to be any impacts on parking as a result of the proposal.

Impacts to access

Road crossings

As described in section 7.3.1, the Parkes north west connection would cross Millers Lookout Road and Coopers Road. The need for any road realignments would be determined during the detailed design phase following further investigations and consultation with relevant stakeholders (including Parkes Shire Council).

Alternative access to Coopers Road is available using Brolgan Road or London Road. The travel distance to Parkes is about the same using either road, from a location about 2.1 kilometres south of the Broken Hill line. That is, for any trips starting south of this point, the route via London Road, which is not affected by the crossing of Coopers Road, is shorter than the route via Brolgan Road. For a couple of properties, the travel distance to Parkes could increase, with a travel distance of up to 2.1 kilometres longer than the existing situation. This increase is not considered a significant impact, in the context of the number of people who would be affected, and the existing travel distance to Parkes.

The section of Millers Lookout Road that would be impacted has minimal traffic activity. Alternative access is available via Henry Parkes Way.

Brolgan Road overbridge

Construction of the Brolgan Road overbridge would leave a short 'bypassed' section of Brolgan Road about 1.1 kilometres long to the south of the overbridge. This section of road would be retained for local access purposes (to be confirmed in consultation with Parkes Shire Council). The configuration of the connection between the old Brolgan Road alignment and the new alignment would be finalised during detailed design.

Access to the rail corridor

During operation, minimal impacts to access are anticipated as access to the rail corridor would be via existing corridor access points.

Other transport impacts

Public transport impacts

Coaches between Parkes and Condobolin would cross the Henry Parkes Way level crossing. Due to the increased number of trains, there is a greater chance that coach services would need to stop at a level crossing and experience a delay of up to three minutes. This is a minor delay for coach services travelling long distances (100 kilometres between Parkes and Condobolin) and is therefore expected to have minimal impact on overall travel time.

No other public transport services are expected to be impacted by the proposal. It would not impact on the operation of existing passenger trains using the Broken Hill line.

Impacts to operation of freight trains

Prior to the opening of Inland Rail as a whole, the proposal would be used by existing rail traffic. The upgrades to the rail infrastructure would allow for an increase in train operating speeds between Parkes and Narromine. Proposed train speeds would vary according to axle loads, and range from 80 kilometres per hour (30 tonne) to 115 kilometres per hour (21 tonne). This is an improvement on existing train speeds, which are currently limited to a maximum of 90 kilometres per hour to 100 kilometres per hour, with local speed restrictions due to existing track condition.

The proposal would result in an increase in the number of freight trains travelling along the Parkes to Narromine line and the Broken Hill line. Further information on the operation of the proposal is provided in section 7.6.

Pedestrian and cyclist impacts

Given the low volume of pedestrian and cyclist activity in the study area, there is not expected to be any significant impacts to pedestrian and cyclists as a result of the proposal. An increase in the number of trains would result in an increase in the potential for a pedestrian or cyclist to encounter a train, however the likelihood of adverse impact remains low.

Measures to manage the potential for operational traffic impacts are provided in section 9.4.

9.4 Mitigation and management

9.4.1 Approach to mitigation and management

A traffic, transport and access management sub-plan would be prepared as part of the CEMP, and construction of the proposal would be undertaken in accordance with this plan.

All operational activities would be undertaken in accordance with ARTC's standard operating procedures and the EPL relevant to the proposal.

9.4.2 Consideration of the interactions between mitigation measures

All mitigation measures for the proposal would be consolidated and described in the CEMP. The plan would identify measures that are common between different aspects. Common impacts and common mitigation measures would be consolidated to ensure consistency and implementation.

9.4.3 Summary of mitigation measures

To mitigate the potential for traffic, transport and access impacts, the following measures would be implemented.

Table 9.7 Summary of mitigation measures

Stage	Impact	Mitigation measures
Detailed design/pre-construction	Traffic, transport and access	The detailed design of the proposal would minimise the potential for impacts to the surrounding road and transport network, and property accesses. Where any legal access to a property is permanently affected and a property has no other legal means of access, alternative access to and from a public road would be provided to an equivalent standard where feasible and practicable. Where an alternative access is not feasible or practicable, and a property is left with no access to a public road, negotiations would be undertaken with the relevant property owner for acquisition of the property in accordance with the provisions of the *Land Acquisition (Just Terms Compensation) Act 1991*.
	Consultation	Input would be sought from relevant stakeholders (including Parkes Shire Council, Narromine Shire Council, and Roads and Maritime) prior to finalising the detailed design of those aspects of the proposal that impact on the operation of road infrastructure under the management of these stakeholders.
	Level crossings	Level crossings would be provided with warning signage, line marking, and other relevant controls; in accordance with the relevant national and ARTC standards.
Pre-construction/construction	General impacts of construction activities on traffic, transport, access, pedestrians and cyclists	A traffic, transport and access management sub-plan would be prepared and implemented as part of the CEMP. It would include measures to minimise the potential for impacts on the community and the operation of the surrounding road and transport environment. It would address all the aspects of construction relating to the movement of vehicles, pedestrians and cyclists, and the operation of the surrounding road network, including: ▸ construction site traffic control, parking and access arrangements ▸ construction material, equipment and spoil haulage, including arrangements for oversize vehicles ▸ road pavement and access road condition management ▸ management of impacts to public transport, including school buses, pedestrian and cyclist access, and safety ▸ management of impacts to access for surrounding residents and business owners/operators ▸ arrangements for level crossings during construction ▸ road and driver safety. The traffic, transport and access management sub-plan would be developed in consultation with (where relevant) Parkes Shire Council, Narromine Shire Council, Roads and Maritime, and public transport/bus operators.
Construction	Access to properties	Property access would be maintained throughout the construction period, with suitable alternative access arrangements provided where required.

Stage	Impact	Mitigation measures
	Consultation	Consultation with relevant stakeholders would be undertaken regularly to facilitate the efficient delivery of the proposal and to minimise congestion and inconvenience to road users. Stakeholders would include the relevant local council, bus operators, Roads and Maritime, emergency services, and affected property owners/occupants. The community would be notified in advance of any proposed road network changes through signage, the local media, and other appropriate forms of communication. Where changes to access arrangements are required, ARTC would advise property owners/occupiers and consult with them in advance regarding alternative access arrangements.
Operation	Level crossings	The operation of level crossings that have been subject to changes as part of the proposal would be reviewed after the proposal commences operation to confirm: ▸ that the level of protection continues to be appropriate ▸ that the infrastructure is appropriate for the traffic conditions.

10. Biodiversity

This chapter provides a summary of the terrestrial and aquatic biodiversity impact assessments of the proposal undertaken by Umwelt (Australia) Pty Limited (Umwelt). It describes the existing biodiversity environment (both terrestrial and aquatic), assesses the impacts of construction and operation, and provides mitigation measures. The biodiversity assessments include the terrestrial biodiversity assessment report (prepared in accordance with the Framework for Biodiversity Assessment (OEH, 2014a)) (full report is provided as Technical Report 2) and the aquatic ecology assessment (full report is provided as Technical Report 3).

The chapter also considers the potential impacts on EPBC Act matters, including a summary of the full assessment provided in the assessment of Commonwealth matters report (full report is provided as Technical Report 4).

10.1 Assessment approach

10.1.1 Methodology

The impacts of the proposal on biodiversity were assessed using the methodology in the *Framework for Biodiversity Assessment* (OEH, 2014a) (for terrestrial ecology) and relevant aquatic ecology guidelines. The biodiversity assessments involved desktop literature reviews of flora and fauna listed as occurring or potentially occurring in the study area, supported by detailed field surveys and assessment. The methodology used is described in detail in Technical Reports 2 and 3, and is summarised below.

Literature and database review

Existing information on the terrestrial and aquatic biodiversity of the study area was obtained from a range of sources, including databases, aerial photographs and maps, previous studies carried out in the area, and consultation with representatives of relevant government agencies/organisations and landowners.

Previous documents and reports relevant to the study area were reviewed, including regional and sub-regional vegetation mapping reports, site-specific monitoring surveys, ecological surveys, and relevant ecological database searches.

Digital aerial photography was reviewed to identify spatial patterns in vegetation, land use, and landscape features.

Searches were undertaken of species databases to identify listed threatened species (under the TSC Act, EPBC Act, and the FM Act), known or likely to occur within the search area (a radius of ten kilometres around the existing rail corridor). The following databases were searched:

- Threatened Species Profile Database, accessed up to and including May 2016.
- The OEH Threatened Species Website for known/predicted threatened species in the Bogan-Macquarie and Lower Slopes Interim Biogeographic Regionalisation of Australia (IBRA) subregions, accessed in April 2016.
- PlantNET (Royal Botanic Gardens Sydney) database search for rare or threatened Australian plant species within the Parkes and Narromine LGAs, accessed in May 2016.
- The Protected Matters Search Tool for known/predicted threatened ecological communities listed under the EPBC Act, accessed in April 2016.

Field surveys

Field surveys were undertaken across a range of seasons and years. The survey design considered seasonality issues associated with maximising the opportunity of identifying threatened species with the potential to be impacted by the proposal. Surveys were undertaken on the following dates:

- 16 and 18 September 2014
- 15 to 16 October 2014
- 11 to 21 January 2016
- 2 to 5 May 2016.

Surveys were undertaken in the proposal site and the additional assessment areas, as described in section 2.2. Survey effort and habitat assessments were focused in known or potential habitat locations for threatened ecological communities, and potential habitat for threatened flora and fauna species. Surveys involved quadrats, plots, transects, random meanders, and rapid surveys. Further information on the surveys, including the locations of survey sites, is provided in Technical Reports 2 and 3.

Analysis and reporting

Vegetation mapping was undertaken using best-practice techniques to delineate plant communities. The BioBanking Credit Calculator Version 4.1 was applied in accordance with the *BioBanking Assessment Methodology* (OEH, 2014b) to identify the biodiversity credits that would be required to offset the impacts of the proposal. Potential fish habitats were classified in accordance with the *Policy and guidelines for fish habitat conservation and management* (DPI, 2013).

As described in section 2.2.1, the biodiversity assessment considers the potential impacts of the proposal on biodiversity in the proposal site (described in chapter 2) and, to provide flexibility for the design (particularly in relation to culvert and level crossing upgrades), it also considers additional assessment areas outside the proposal site, including:

- an approximate 60 metre buffer around culverts
- an approximate 120 metre buffer around the locations of level crossings.

As described in section 2.2.1, the need for works in these areas would be determined during detailed design. Calculations undertaken using the BioBanking Credit Calculator were based on the biodiversity assessment area (that is, the proposal site plus the additional assessment areas).

10.1.2 Legislative and policy context to the assessment

The main legislation relevant to the assessment are the EPBC Act, TSC Act, FM Act, and *Noxious Weeds Act 1993*. These acts provide the statutory basis for listing threatened species and communities, and/or assessment requirements in relation to impacts to biodiversity.

The main policy relevant to biodiversity assessments for State significant development and infrastructure in NSW is the *NSW Biodiversity Offsets Policy for Major Projects* (OEH, 2014c), which provides guidance in relation to biodiversity offsetting for major project approvals. A key principle underpinning the policy is that offset requirements should be based on a reliable and transparent assessment of biodiversity losses and gains. The offsets policy is underpinned by the *Framework for Biodiversity Assessment*, which sets out the process for assessing biodiversity impacts as a result of a development, and determining the biodiversity offset requirements for those impacts.

The BioBanking Credit Calculator is a web tool that is used in conjunction with the *Framework for Biodiversity Assessment* to apply the *BioBanking Assessment Methodology.*

As noted in section 3.5, the proposal is a controlled action under the EPBC Act, with the controlling provision being 'listed threatened species and communities', specifically in relation to the potential for impacts to/removal of:

- *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* CEEC
- *Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia* EEC
- known foraging habitat for the superb parrot
- potential foraging habitat for the swift parrot and regent honeyeater
- potential habitat for the flora species *Tylophora linearis* (a herbaceous climber).

The assessment and approval requirements under the EPBC Act are described in section 3.5.

The guidelines that apply to assessments of matters of national environmental significance under the EPBC Act include the *Matters of National Environmental Significance - Significant impact guidelines 1.1* (Department of Environment, 2013) and the *EPBC Act Environmental Offsets Policy* (DSEWPC, 2012).

10.2 Existing environment

10.2.1 General ecological context

The study area for the biodiversity assessment is typical of the South Western Slopes and Darling Riverine Plains bioregions. The study area is in the Lachlan River basin and north of the Lachlan River, with Goobang Creek the nearest named watercourse. The northern end is in the Macquarie River floodplain. The proposal site crosses a number of ephemeral watercourses. Further information on the hydrological context of the proposal site is provided in chapters 15 and 16.

The majority of the study area has been heavily modified by past and ongoing disturbances associated with the active rail corridor and surrounding rural and agricultural activities. Clearance and maintenance of the rail corridor has resulted in fragmentation, a high level of disturbance, and degradation of vegetation communities within the rail corridor. The majority of the proposal site is cleared or consists of non-native vegetation.

Patches of native vegetation are located within and near the proposal site, and are sometimes connected to small woodland patches in adjacent agricultural land. These patches generally comprise a woodland community, with the dominant canopy species including inland grey box (*Eucalyptus microcarpa*), fuzzy box (*Eucalyptus conica*), and yellow box (*Eucalyptus melliodora*). Patches of weeping myall (*Acacia pendula*) were also recorded.

10.2.2 Terrestrial biodiversity

Communities, habitats and species identified during field surveys

Plant communities

Nine native plant communities across 15 condition classes were identified during field surveys. These communities are listed in Table 10.1 and are shown in Figure 10.1. The most common native vegetation community is the Western Grey Box tall grassy woodland community. All of these communities have the potential to be affected by the proposal.

Table 10.1 Plant communities

Plant community type (PCT)	PCT[1] reference code	Condition	Total area (hectares)	Conservation status[2]	General description
Weeping Myall Open Woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	PCT26	*Moderate to good*	3.47	▸ Conforms to the TSC Act listed *Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South western Slopes bioregions* EEC ▸ 0.99 ha conforms to the EPBC Act listed *Weeping Myall Woodlands* EEC	Occurs as several small remnant or regenerating patches predominantly on red-brown clay soils. There is limited connectivity between patches due to the heavily disturbed nature of the biodiversity assessment area.
River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	PCT36	*Moderate to good*	0.87	Not listed	Occurs as one distinct patch bisected by the existing rail corridor and in the riparian zone along Burrill Creek near Peak Hill. This community is found on alluvial soils.
		Low	0.62	Not listed	Occurs as two distinct patches bisected by the existing rail corridor and in the riparian zone along Burrill Creek near Peak Hill. This community is found on alluvial soils with a heavily disturbed understorey.
Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	PCT55	*Moderate to good*	1.12	Not listed	Mainly occurs on the clay soils associated with Tomingley Creek. The community is well-connected with vegetation beyond the existing rail corridor despite disturbance from adjacent land uses.

Plant community type (PCT)	PCT[1] reference code	Condition	Total area (hectares)	Conservation status[2]	General description
		Moderate to good – derived native grasslands	7.12	Not listed	Mainly occurs on the clay soils associated with Tomingley Creek.
White Cypress Pine woodland on sandy loams in central NSW wheatbelt	PCT70	*Moderate to good*	1.95	Not listed	Mainly occurs as a small linear patch. The community occupies red clay soils and shares similarities with the upper storey characteristics of the Poplar Box grassy woodland community.
Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	PCT76	*Moderate to good*	10.13	▸ 7.33 hectares (ha) conforms to the TSC Act listed *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions* EEC ▸ 9.44 ha conforms to the EPBC Act listed *Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia* EEC	Occurs as several disturbed remnant patches. The largest patch is located in the southern portion of the biodiversity assessment area near Parkes. The community typically occurs on red to brown clay soils.

Plant community type (PCT)	PCT[1] reference code	Condition	Total area (hectares)	Conservation status[2]	General description
		Moderate to good - derived native grasslands	32.06	▸ Conforms to the TSC Act listed *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions* EEC ▸ Conforms to the EPBC Act listed *Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia* EEC	Occurs adjacent to Western Grey Box tall Grassy Woodland patches and lacks a canopy due to historic clearing. The community is generally heavily disturbed.
Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)	PCT244	*Moderate to good*	3.38	Not listed	Occurs as several small remnant or regenerating patches throughout the biodiversity assessment area on red-brown clay soils. Although widespread, the patches are relatively isolated due to historic clearing.
		Moderate to good - derived native grasslands	14.45	Not listed	Occurs adjacent to Poplar Box Grassy Woodland patches, and typically lacks a significant canopy due to historic clearing. The community is generally heavily disturbed.
Fuzzy Box Woodland on alluvial brown loam soils mainly in the NSW South Western Slopes Bioregion	PCT201	*Moderate to good*	1.88	▸ Conforms to the TSC Act listed *Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions* EEC	Occurs as small remnant patches on clay soils and in slight depressions. The patches are isolated likely due to historic clearing.

Plant community type (PCT)	PCT[1] reference code	Condition	Total area (hectares)	Conservation status[2]	General description
White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion	PCT267	*Moderate to good*	3.24	▸ Conforms to the TSC Act listed *White Box Yellow Box Blakely's Red Gum Woodland* EEC ▸ Conforms to the EPBC Act listed *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* CEEC	Occupies low rises and gentle slopes. The understorey is predominantly native with few non-native species. Recruitment of white box (Eucalyptus albens) is occurring.
		Moderate to good – derived native grasslands	9.46	▸ Conforms to the TSC Act listed *White Box Yellow Box Blakely's Red Gum Woodland* EEC ▸ Conforms to the EPBC Act listed *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* CEEC	Occupies low rises and gentle slopes. Occurs adjacent to Cypress Pine - Western Grey Box Woodland and lacks a canopy due to historic clearing. The community is generally heavily disturbed.
Yellow Box grassy tall woodland on alluvium or parna loams and clays on flats in NSW South Western Slopes Bioregion	PCT276	*Moderate to good*	7.16	▸ Conforms to the TSC Act listed *White Box Yellow Box Blakely's Red Gum Woodland* EEC ▸ Conforms to the EPBC Act listed *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* CEEC	Occupies alluvial plains and low hills on clay-loam soils. Patches within the biodiversity assessment area occur as isolated remnants.

Plant community type (PCT)	PCT[1] reference code	Condition	Total area (hectares)	Conservation status[2]	General description
		Moderate to good - derived native grasslands	13.96	▸ Conforms to the TSC Act listed *White Box Yellow Box Blakely's Red Gum Woodland* EEC ▸ Conforms to the EPBC Act listed *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* CEEC	Occupies alluvial plains and low hills on clay-loam soils adjacent to patches of Yellow Box grassy tall woodland. Patches of this community occur as isolated remnants.
Cleared/non-native vegetation	-	-	712	-	The majority of the existing rail corridor is cleared or consists of non-native vegetation. The community is frequently subjected to disturbances from surrounding land uses, weed spraying and frequent mowing regimes. This community is characterised by a predominantly dense understorey of non-native grasses, forbs and herbs.

Notes
1: Plant community types are as per the NSW Vegetation Information System database
2: Conservation status indicates conformity to threatened ecological communities (TECs) listed by the TSC Act and/or the EPBC Act. EEC – endangered ecological community, CEEC – critically endangered ecological community.

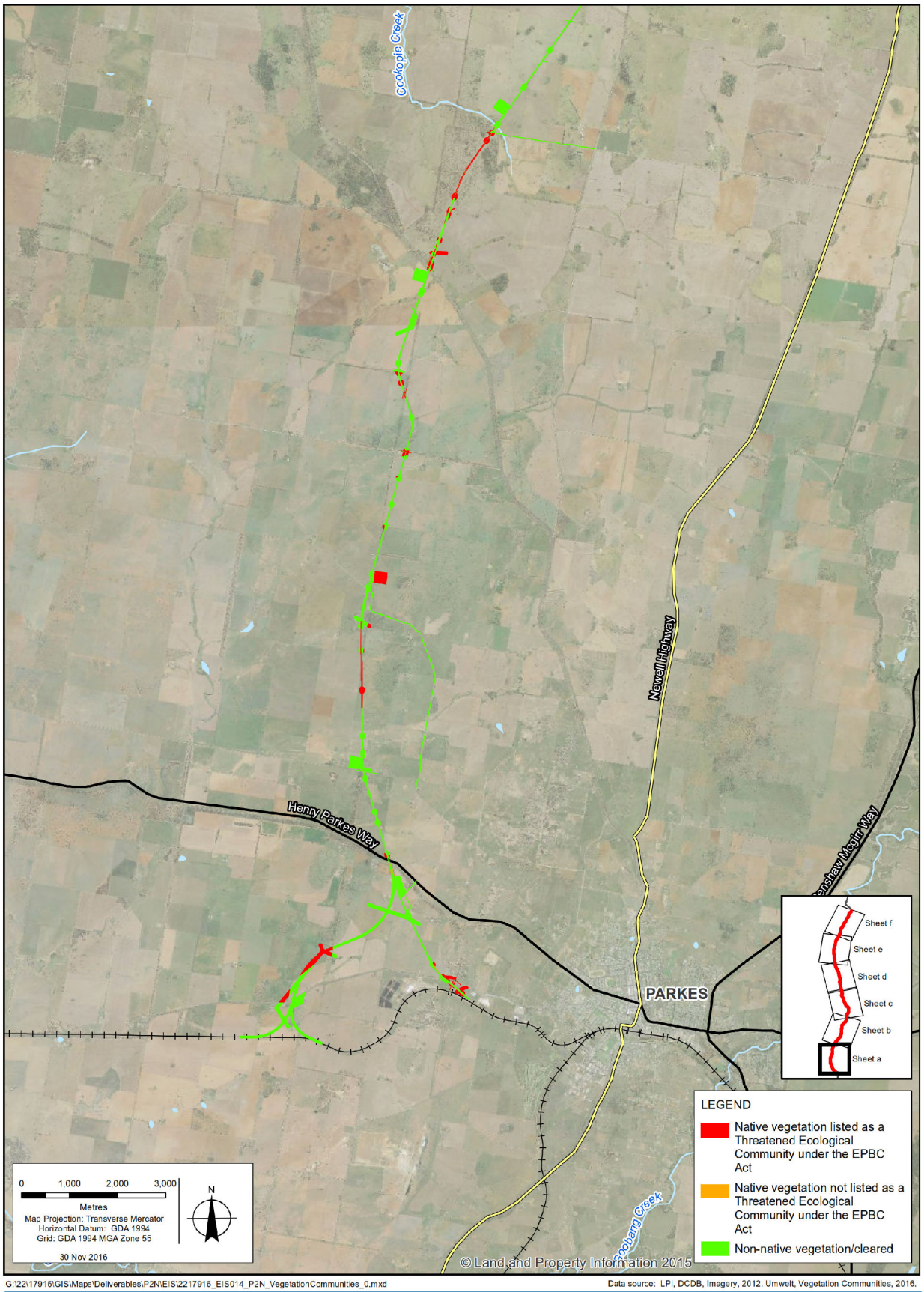


Figure 10.1a
Vegetation communities

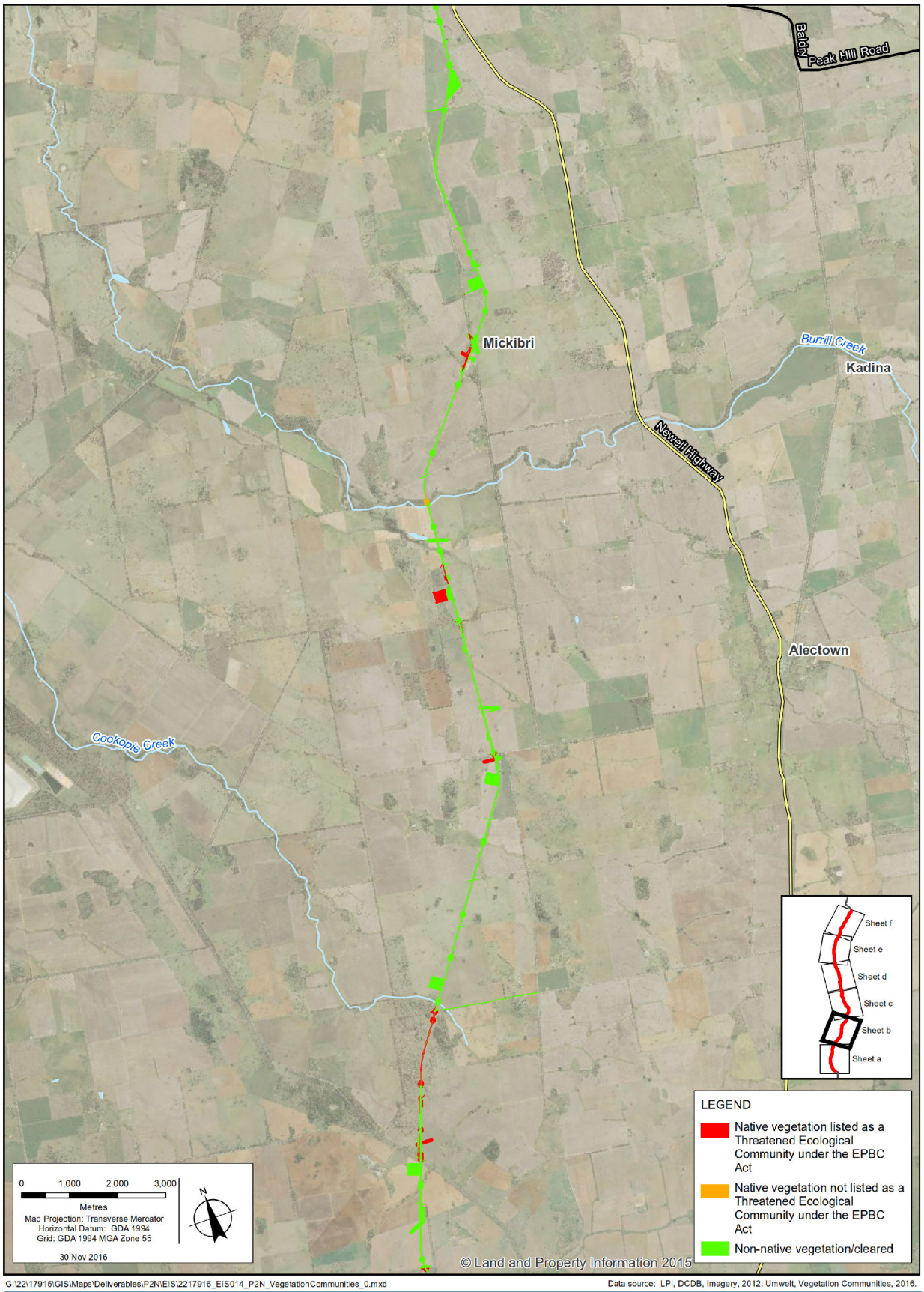


Figure 10.1b
Vegetation communities

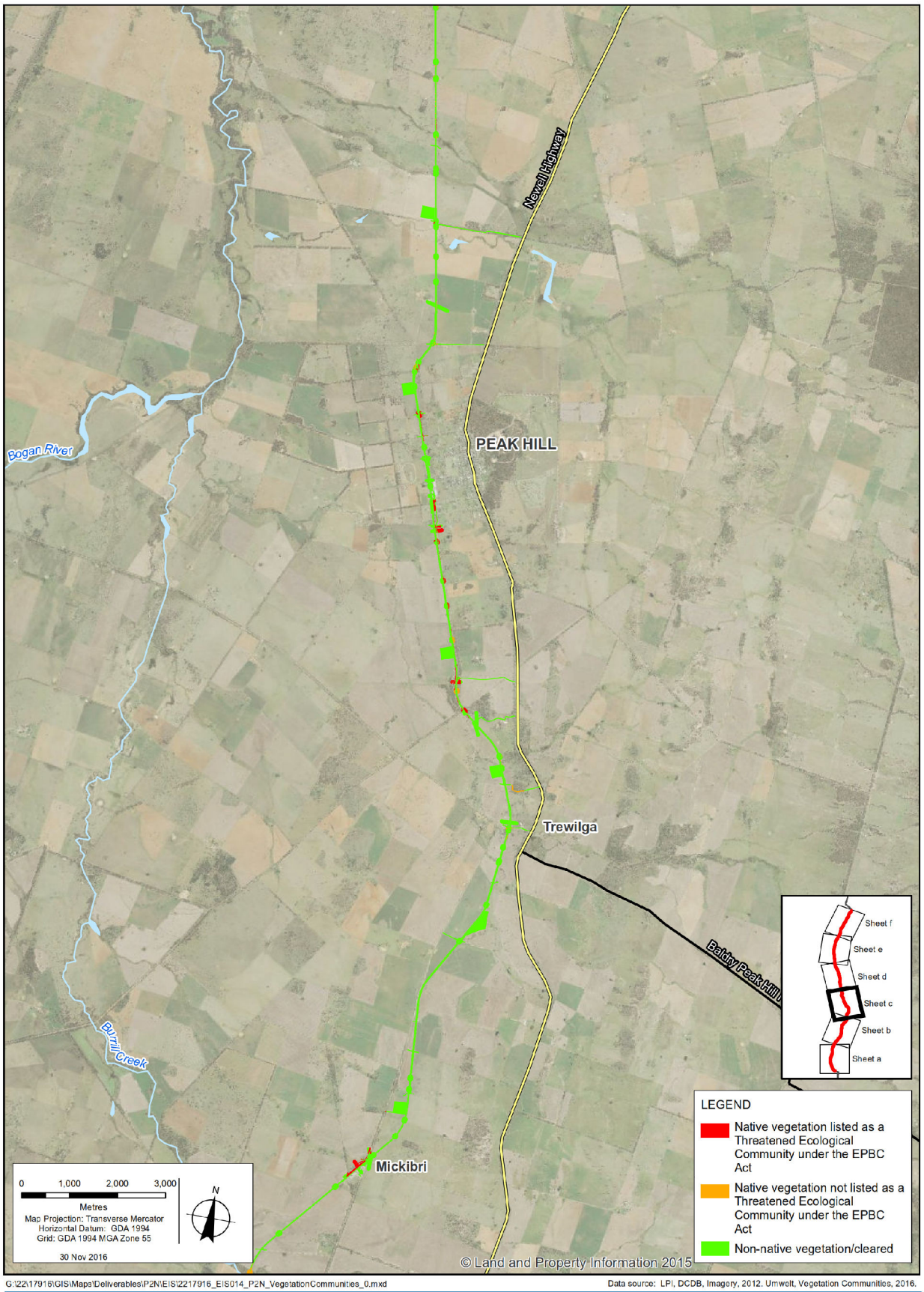
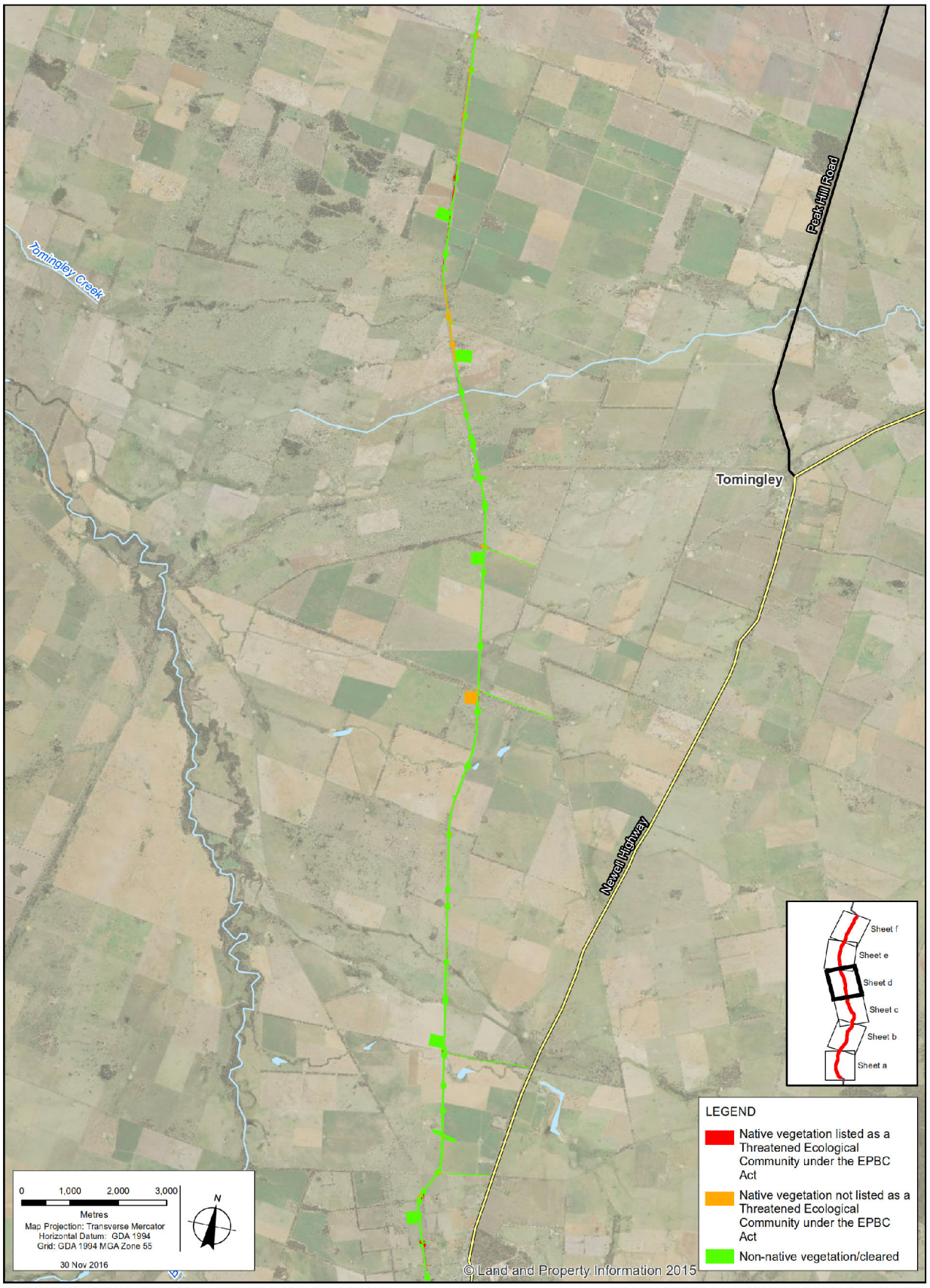


Figure 10.1c
Vegetation communities



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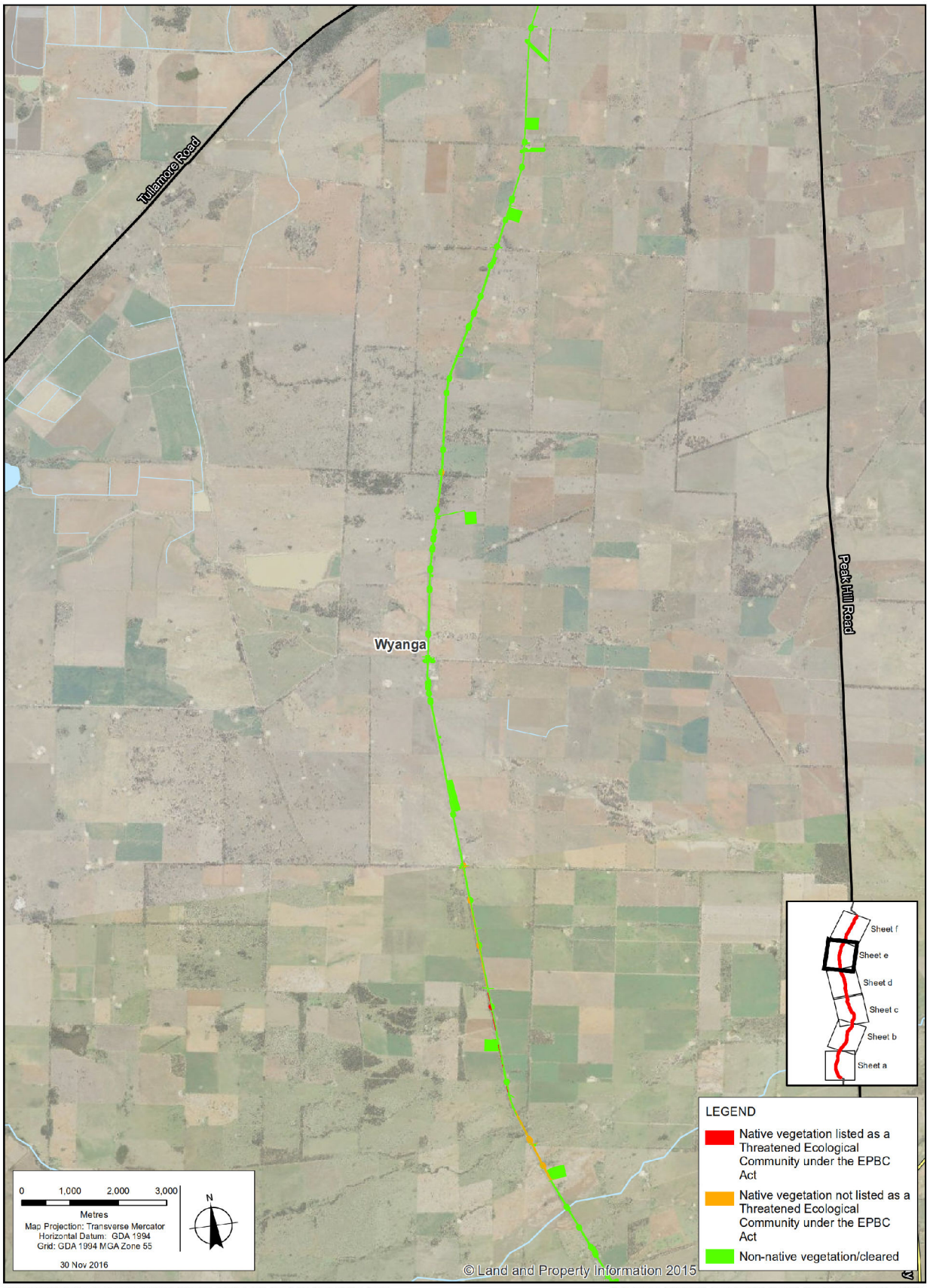
Data source: LPI, DCDB, Imagery, 2012. Umwelt, Vegetation Communities, 2016.

Figure 10.1d

Vegetation communities



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Data source: LPI, DCDB, Imagery, 2012. Umwelt, Vegetation Communities, 2016.

Figure 10.1e

Vegetation communities

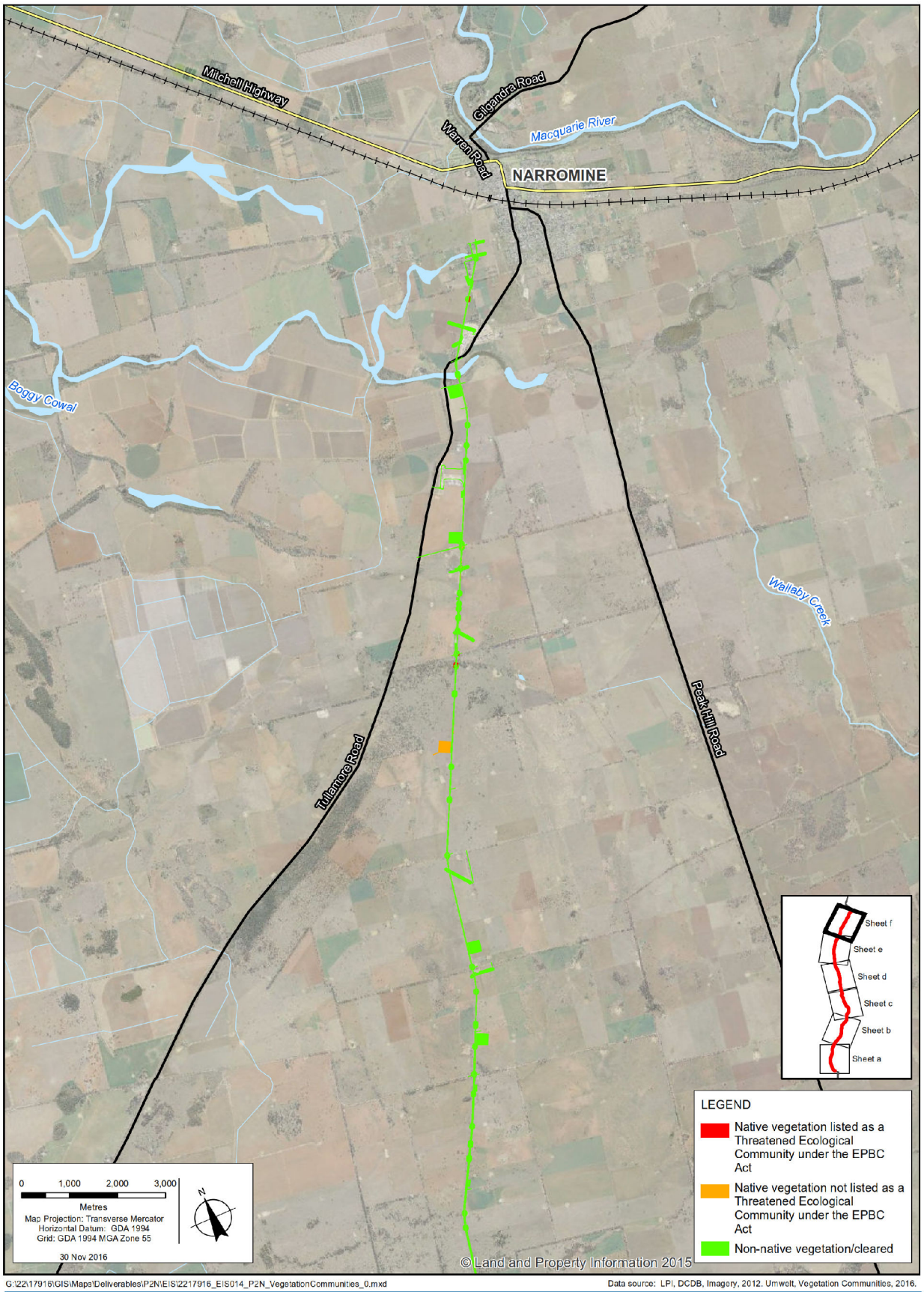

Figure 10.1f
Vegetation communities

Flora species

A total of 266 flora species were recorded during field surveys. Of the recorded species, 73 (27 per cent) are non-native. A full list of recorded species is provided in Technical Report 2.

Fauna habitats

The biodiversity assessment area occurs in a landscape that is dominated by crop land and introduced pastures, and contains only a small proportion of woodland and scattered tree cover. Patches of native woodland habitat exist sporadically and are typically associated with road verges or small woodland patches on farmland. As such, native fauna habitats within the biodiversity assessment area are minimal.

Several general fauna habitat types were identified during field surveys. Each of these habitat types has a range of characteristics that influence habitat value, and the range of fauna species that are likely to be identified. Sparse woodland areas may provide nesting resources for small birds or hollow resources for micro-bat species. Open grassland may provide a foraging resource for macropods, and a foraging and refuge habitat for reptile species. The broad habitat types recorded within the biodiversity assessment area consist of grasslands, scattered woodland, and riparian and aquatic habitat. Aquatic ecology is described in section 10.2.3.

Fauna species

A total of 66 fauna species were recorded during field surveys. This included 51 bird species, five amphibian species, and 10 mammal species. Commonly recorded species included the eastern grey kangaroo (*Macropus giganteus*), apostlebird (*Struthidea cinerea*), and red-rumped parrot (*Psephotus haematonotus*).

Of the fauna species recorded, three were introduced species, being the domestic dog (*Canis lupus familiaris*), brown hare (*Lepus capensis*), and sheep (*Ovis aries*).

A full list of recorded species is provided in Technical Report 2.

TSC Act protected matters and threatened species

Flora

None of the threatened flora species listed under the TSC Act that are known to occur in the study area were recorded during field surveys. The likelihood of threatened flora species occurring in the biodiversity assessment area is low given the level of disturbance described in section 10.2.1.

Fauna

Two fauna threatened species, listed as vulnerable under the TSC Act, were recorded in the biodiversity assessment area during field surveys – the superb parrot (*Polytelis swainsonii*) and the grey-crowned babbler (*Pomatostomus temporalis temporalis*).

While the koala (*Phascolarctos cinereus*) was not recorded during field surveys, the species has been previously recorded in the study area, and the biodiversity assessment area contains six known koala food tree species. A total of 18.88 hectares of suitable foraging habitat for the koala occurs within the biodiversity assessment area.

Threatened ecological communities

Five of the plant community types in the biodiversity assessment area (listed in Table 10.1) conform to four threatened ecological communities listed under the TSC Act, comprising:

- *Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South western Slopes bioregions* EEC
- *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions* EEC
- *Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions* EEC
- *White Box Yellow Box Blakely's Red Gum Woodland* EEC.

No critical habitat listed under the TSC Act occurs within the biodiversity assessment area.

EPBC Act protected matters and threatened species

Flora

None of the threatened flora species listed under the EPBC Act that are known to occur in the study area were recorded during field surveys, and the likelihood of threatened flora species occurring in the biodiversity assessment area is low.

Fauna

The only threatened species listed under the EPBC Act that was recorded during field surveys is the superb parrot (*Polytelis swainsonii*), which is listed as vulnerable under the EPBC Act. Potential habitat exists within the biodiversity assessment area for five EPBC Act listed species – the superb parrot, the swift parrot, the regent honeyeater, painted honeyeater, koala, and the south-eastern long-eared bat (*Nyctophilus corbeni*).

No migratory species listed under the EPBC Act were considered to have the potential to be impacted by the proposal, as little or no suitable habitat is present within the biodiversity assessment area.

Threatened ecological communities

Five of the plant community types listed in Table 10.1 conform to three threatened ecological communities listed under the EPBC Act as endangered or critically endangered, where condition thresholds are met:

- *Weeping Myall Woodlands* EEC
- *Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia* EEC
- *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* CEEC.

Noxious weeds and exotic species

The majority of the biodiversity assessment area is cleared or contains non-native vegetation. Non-native vegetation in the biodiversity assessment area is characterised by a predominantly dense understorey of non-native grasses, forbs and herbs. Dominant non-native grasses typically include paspalum (*Paspalum dilatatum*), bearded oats (*Avena barbata*) and urochloa grass (*Urochloa panicoides*). Coffee senna (*Senna occidentalis*) is frequently present in the midstorey. Dominant non-native forbs and herbs include Patterson's curse (*Echium plantagineum*), red-flowered mallow (*Modiola caroliniana*), cobbler's pegs (*Bidens pilosa*), saffron thistle (*Carthamus lunatus*) and flaxleaf fleabane (*Conyza bonariensis*).

Noxious weeds that occur in the biodiversity assessment area include African boxthorn (*Lycium ferocissimum*), blue heliotrope (*Heliotropium amplexicaule*), galvinized burr (*Sclerolaena birchii*), Johnson grass (*Sorghum halepense*), Mexican poppy (*Argemone mexicana*), and tiger pear (*Opuntia aurantiaca*). Three weeds of national environmental significance were identified – African boxthorn, tiger pear, and silver-leaved nightshade (*Solanum elaeagnifolium*).

10.2.3 Aquatic ecology

General description of aquatic flora and fauna habitat

Watercourses that cross and/or are located near the proposal site are described in chapter 15. Most are either cleared or contain non-native vegetation. Few aquatic plant species, such as *Persicaria decipiens*, occur in the weed-dominated vegetation characterising the bed and banks of watercourses.

The majority of watercourses that cross the proposal site are first order streams with intermittent flow following rain events, little or poorly defined channels, and no aquatic flora species. These watercourses contain minimal aquatic fauna habitat with little or no defined drainage channels, and little or no flow or freestanding water. Some areas of intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna (eg fish, yabbies) are present.

The location of key fish habitat is described in section 10.2.4. A full list of recorded species is provided in Technical Report 3.

Threatened species

The database searches identified a number of threatened species, endangered populations and aquatic matters of national environmental significance listed under the FM Act, TSC Act and/or EPBC Act in the study area. However, none of the listed threatened species or endangered populations were assessed as likely to occur within aquatic habitats in the watercourses in and around the proposal site.

Threatened ecological communities

The proposal site does not contain any threatened aquatic ecological communities. However, it occurs within the mapped distribution of two threatened communities listed as endangered under the FM Act:

- *Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River*
- *Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Lachlan River.*

Groundwater dependent ecosystems

Groundwater dependent ecosystems are ecosystems in which species composition and ecological processes are determined by groundwater (DLWC, 2002). Ephemeral waterways in the biodiversity assessment area are likely to be fed by both surface and groundwater, and the associated riparian vegetation is therefore likely to be dependent, at least in some part, on groundwater.

The River Red Gum Forest along Burrill Creek is likely to be a groundwater dependent ecosystem under the *NSW State Groundwater Dependent Ecosystems Policy* (DLWC, 2002).

10.2.4 Protected and sensitive lands

Protected areas

No protected areas, defined as areas/reserves managed by OEH and/or DPI NSW Fisheries under the *National Parks and Wildlife Act 1974*, are located near the proposal site. The nearest reserve is the Goobang National Park, located about nine kilometres to the east of the proposal site at the closet point.

Key fish habitat

Table 10.2 lists the areas of key fish habitat within/around the proposal site. These are areas classified as class 3 (minimal key fish habitat) or above, in accordance with the *Policy and guidelines for fish habitat conservation and management* (DPI, 2013).

All watercourses except for Burrill Creek are considered to have minimal habitat sensitivity and minimal key fish habitat. Burrill Creek is the only watercourse crossing the proposal site that was classifed as ‘type 2 moderately sensitive habitat’ and ‘class 2 moderate fish habitat’.

Table 10.2 Key fish habitat

Watercourse	Strahler stream order	Habitat sensitivity type[1]	Classification of watercourse for fish passage[1]
Unnamed tributary of Burrill Creek	Third order	Type 3 – Minimal	Class 3 - Minimal
Burrill Creek	Fifth order	Type 2 – Moderate	Class 2 - Moderate
Ten Mile Creek	Fourth order	Type 3 – Minimal	Class 3 - Minimal
Barrabadeen Creek	Fifth order	Type 3 – Minimal	Class 3 - Minimal
Bulldog Creek	Fourth order	Type 3 – Minimal	Class 3 - Minimal
Tomingley Creek	Fourth order	Type 3 – Minimal	Class 3 - Minimal
Bradys Cowal	Fourth order	Type 3 – Minimal	Class 3 - Minimal
Backwater Cowal	Fourth order	Type 3 – Minimal	Class 3 - Minimal

Note 1: As per the Policy and guidelines for fish habitat conservation and management (DPI, 2013)

Critical habitat

No land or waters identified as critical habitat under the TSC Act, FM Act, or EPBC Act are located in the study area.

Biobank sites, private conservation lands and other lands identified as offsets.

No BioBank sites, private conservation land, or other lands identified as offsets are located in or in the vicinity of the study area.

10.3 Impact assessment

10.3.1 Risk assessment

Potential impacts

The environmental risk assessment for the proposal (provided in Appendix B) included an assessment of the potential risks of the proposal in relation to biodiversity. The assessed risk level for the majority of potential risks to biodiversity was between low and medium. Risks with an assessed level of medium or above include:

- clearing of native vegetation resulting in loss of fauna habitat, habitat fragmentation and loss of connectivity
- direct impacts on terrestrial threatened species and endangered populations and communities from clearing
- direct impacts on aquatic threatened species and endangered populations and communities from clearing
- increased potential for the occurrence and spread of pest plants and animals during construction and maintenance from movement of vehicles, machinery and materials in and out of the site, particularly in greenfield sections such as the Parkes north west connection
- indirect impacts due to increased dust, sedimentation and erosion, noise, light

- disturbance to aquatic habitats and reduced water quality as a result of fugitive sediments and altered hydrology
- alterations to surface water flow regimes and interruptions to fish passage
- fauna mortality from vehicle strikes.

The SEARs (Attachment B) also identified the following specific matters as having potential to be impacted by the proposal and requiring further assessment:

- *Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigelow Belt South* EEC
- *White Box Yellow Box Blakely's Red Gum Grassy Woodland* EEC and CEEC
- *Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions* EEC
- *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions* EEC
- a spear-grass (*Austrostipa wakoolica*)
- spiny peppercress (*Lepidium aschersonli*)
- small purple-pea (*Swainsona recta*)
- silky swainson-pea (*Swainsona sericea*).

The SEARs provide the requirements for the assessment of the potential impacts on these matters (listed in Table A.3 of Appendix A). Further information on relevant statutory requirements under the EPBC Act is provided in section 3.5.1.

How potential impacts have been avoided

The option development and assessment process for the Inland Rail location/route options is summarised in chapter 6. As noted in chapter 6, the shortlist of route options was subject to a detailed assessment, and the proposed alignment was refined based on evaluation of key considerations, including environmental impacts. The majority of Inland Rail (about 65 per cent) would be located on upgraded tracks in existing rail corridors, minimising as far as practicable the potential for biodiversity impacts.

The proposal minimises the potential for direct impacts, as the majority of works would be undertaken within areas subject to existing disturbance within the rail corridor. For works outside the corridor (the Parkes north to west connection), environmental impacts were included in the list of selection criteria used for the analysis of options (summarised in chapter 6).

Potential impacts on biodiversity would continue to be avoided by:

- designing, constructing, and operating the proposal to minimise the potential for impacts outside the rail corridor
- managing the potential impacts on biodiversity in accordance with relevant legislative and policy requirements, as described in section 10.1.2
- implementing the biodiversity mitigation measures provided in section 10.4
- implementing the noise, air quality, soils, and water quality mitigation measures provided in chapters 11, 13, 14 and 16.

10.3.2 Construction impacts – terrestrial ecology

Potential impacts on biodiversity during construction include:

- direct impacts as a result of permanent removal (clearing) or temporary disturbance of vegetation in the proposal site to enable the proposal to be constructed
- indirect impacts on flora and fauna located outside the proposal site as a result of activities within the proposal site.

Impacts on native vegetation

Direct impacts include the removal of vegetation for the location of permanent infrastructure. Clearing of vegetation would be required to construct and locate the infrastructure. Direct impacts also include temporary disturbance of vegetation. Vegetation has the potential to be temporarily disturbed for construction facilities such as compounds and temporary access tracks. Native vegetation occurring in these areas is not expected to be fully impacted (that is, not cleared), but would be subject to some disturbance, and is expected to recover. While the vegetation and habitats in these areas would be impacted in the short term, it is expected that these areas would regenerate following completion of construction and rehabilitation undertaken in accordance with the proposed rehabilitation strategy (described in section 10.4). As a result, these temporary impacts are not included in the calculation of biodiversity credits.

The assumptions used to calculate the potential impacts on terrestrial biodiversity are provided in Technical Report 2. This impact assessment is based on calculating potential vegetation removal using a conservative worst-case scenario. The actual amount of vegetation with the potential to be directly impacted would be subject to further refinement during the detailed design phase. The estimate of potential clearing would continue to be refined as the design of the project progresses, with the aim of reducing the potential clearing required.

The estimated areas of vegetation (according to plant community types) that would be directly impacted by the proposal are listed in Table 10.3. In summary, it is estimated that the proposal would result in:

- permanent removal or modification (clearing) of about 75.8 hectares of native vegetation
- temporary disturbance of about 35.3 hectares of native vegetation.

Table 10.3 Estimated area of each plant community type that would be impacted

Plant community type		Permanent disturbance area (ha)	Temporary disturbance area (ha)
Listed threatened ecological communities (under the TSC and/or EPBC Acts)			
Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	*Moderate to good*	3.16	0.31
Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	*Moderate to good*	8.58	1.55
	Derived native grassland	23.64	8.59
Fuzzy Box Woodland on alluvial brown loam soils mainly in the NSW South Western Slopes Bioregion	*Moderate to good*	1.50	0.38
White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion	*Moderate to good*	3.12	0.12
	Derived native grassland	9.35	0.11
Yellow Box grassy tall woodland on alluvium or parna loams and clays on flats in NSW South Western Slopes Bioregion	*Moderate to good*	3.40	3.76
	Derived native grassland	10.32	3.64

Plant community type		Permanent disturbance area (ha)	Temporary disturbance area (ha)
Area impacted - listed communities		**63.07**	**18.46**
Non-listed communities			
River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	*Moderate to good*	0.87	0
	Derived native grassland	0.62	0
Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	*Moderate to good*	0.94	0.18
	Derived native grassland	6.13	0.99
White Cypress Pine woodland on sandy loams in central NSW wheatbelt	*Moderate to good*	1.54	0.41
Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)	*Moderate to good*	1.41	1.97
	Derived native grassland	1.20	13.25
Area impacted – non-listed communities		**12.71**	**16.8**
Total area impacted		**75.78**	**35.26**

The largest areas of permanent impacts (more than five hectares removed) on native vegetation would occur within the following vegetation communities, all of which conform to threatened ecological communities listed under the TSC and/or EPBC Acts:

- Western Grey Box tall grassy woodland
- White Box – White Cypress Pine – Western Grey Box – derived native grassland
- Yellow Box grassy tall woodland – derived native grassland
- Western Grey Box tall grassy woodland derived native grassland.

Threatened ecological communities – TSC Act

The proposal would result in direct impacts to the following TSC Act listed threatened ecological communities:

- *Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions* EEC
- *Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions* EEC
- *White Box Yellow Box Blakely's Red Gum Woodland* EEC
- *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions* EEC.

The area impacted is listed in Table 10.3.

None of the communities in the biodiversity assessment area are considered to consist of an 'important area' of the EEC as defined by the *Framework for Biodiversity Assessment*. An important area comprises an area of a CEEC or EEC that is necessary for the community's long-term persistence and recovery. The areas of EECs within the biodiversity assessment area with the potential to be impacted by the proposal are unlikely to be necessary for the long-term persistence and recovery of the EECs overall. These areas occur as fragmented and disturbed patches, and do not constitute a large area in comparison with other stands of the EEC.

While the proposal would result in an increase in the level of fragmentation of the EECs at the local scale, the increase in fragmentation is considered to be negligible, given the already highly fragmented nature of the EECs in the study area.

To mitigate the potential impacts to biodiversity as a result of the proposal, biodiversity offsets would be provided in accordance with the *NSW Biodiversity Offsets Policy for Major Projects*, as described below and in section 10.4.1.

Threatened ecological communities – EPBC Act

The proposal would result in the following permanent impacts to EPBC Act listed threatened ecological communities:

- *Weeping Myall Open Woodlands* EEC – 0.99 hectares would be removed
- *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* CEEC – 26.19 hectares would be removed
- *Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia* EEC – 32.22 hectares would be removed.

To mitigate the potential impacts to biodiversity as a result of the proposal, biodiversity offsets would be provided, as described in Table 10.5 and section 10.4.1.

Flora species

Species listed under the TSC Act

As no threatened flora species were recorded during field surveys, and the likelihood of threatened flora species occurring in the biodiversity assessment area is low, the proposal is not expected to affect threatened flora species.

Species listed under the EPBC Act

Field surveys were undertaken within the biodiversity assessment area across a range of seasons and years. The survey design considered seasonality issues associated with maximising the opportunity of identifying threatened plant species. None of the EPBC Act threatened flora species that are known to occur in the study area were recorded during field surveys, and the likelihood of threatened flora species occurring in the biodiversity assessment area is considered low as a result of a lack of suitable habitat and a high level of disturbance.

The Australian Government Department of Environment and Energy determined that the proposal may result in a significant impact on *Tylophora linearis*. However, although this species was specifically targeted during the flora surveys, it was not identified. Potential habitat for the species is characterised as dry scrub and open forest, with records from low-altitude sedimentary flats in dry woodlands of *Eucalyptus fibrosa*, *Eucalyptus sideroxylon*, *Eucalyptus albens, Callitris endlicheri, Callitris glaucophylla, and Allocasuarina luehmannii*. The disturbed nature of much of the potential habitat occurring within the biodiversity assessment area limits the likelihood of this species occurring. However, due to the presence of the *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* CEEC and White Cypress Pine woodland on Sandy Loams in Central NSW Weatbelt in the biodiversity assessment area, there is a low potential for this species to occur.

To mitigate the potential impacts to *Tylophora linearis* as a result of the proposal, biodiversity offsets would be provided for the *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* CEEC, as described in Table 10.5 and section 10.4.1.

Fauna species

Species listed under the TSC Act

Removal of the vegetation communities described above would impact on fauna habitats in the biodiversity assessment area. Up to 75 hectares of native plant communities would be removed during construction. Fauna habitat resources that would be removed include foraging and shelter resources.

Threatened fauna species recorded in the biodiversity assessment area are described in section 10.2.2. As per the *Framework for Biodiversity Assessment* methodology:

- The superb parrot is an ecosystem-credit species for habitat other than breeding habitat and is a species-credit species for breeding habitat only. Breeding habitat was not identified in the biodiversity assessment area and is not considered likely to occur.
- The grey-crowned babbler is an ecosystem-creditspecies predicted by the landscape features of the biodiversity assessment area.

The koala was not recorded during surveys but has been previously recorded in the study area. The biodiversity assessment area contains food tree species and suitable foraging habitat for the koala. The koala is a species credit species.

There are a range of additional threatened ecosystem-credit species that are predicted to occur in the biodiversity assessment area that were not recorded during the field investigations (refer to Table 5.1 in Technical Report 2). Potential habitat for these species will also be removed as a result of the proposal.

To mitigate the potential impacts of the proposal on the above threatened species that have been recorded or that are predicted to occur, biodiversity offsets would be provided, as described in Table 10.4 and section 10.4.1.

Species listed under the EPBC Act

Targeted surveys undertaken for the assessment recorded the superb parrot flying over the proposal area at three survey locations. Potential habitat was also identified for the EPBC Act listed swift parrot, regent honeyeater, painted honeyeater, koala, and the south-eastern long-eared bat.

A total of 66.72 hectares of foraging habitat for the superb parrot was identified in the biodiversity assessment area, and would be removed as part of the proposal. Although the proposal would result in the removal of known and potential habitat for the superb parrot, it is unlikely to modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species would be likely to decline. Pre-clearing surveys and other mitigation measures would minimise the potential impacts on this species by minimising the impacts on the species habitat. Within the biodiversity assessment area, potential box-gum woodland habitat for the swift parrot and regent honeyeater is restricted to small linear patches and scattered trees, comprising an area of about 15 hectares. The swift parrot and regent honeyeater were not recorded during targeted surveys, and have not been previously recorded within 10 kilometres of the biodiversity assessment area. The biodiversity assessment area does not support breeding habitat for the swift parrot and does not occur within the known core breeding areas of the regent honeyeater, being the Bundarra-Barraba area of NSW, the Capertee Valley in NSW, and north-eastern Victoria. The removal of potential box-gum woodland habitat is not expected to result in a reduction in the area of occupancy of the swift parrot or regent honeyeater or lead to a long-term decrease in the size of either population.

To mitigate the potential impacts to the superb parrot, regent honeyeater and swift parrot as a result of the proposal, biodiversity offsets would be provided, as described in Table 10.5 and section 10.4.1. As discussed above, the koala was not recorded during surveys but has been previously recorded in the study area. The proposal will result in the removal of suitable foraging habitat for the koala. The koala is a species credit species and potential impacts resulting from habitat removal in the biodiversity assessment area will be offset through the retirement of species credits as detailed in Table 10.4.

The south-eastern long-eared bat was not recorded in the study area but is predicted to occur based on the habitat types present in the biodiversity assessment area. The south-eastern long-eared bat is an ecosystem credit species. Potential impacts to this species as a result of the proposal will be offset through the retirement of ecosystem credits as detailed in Table 10.4.

Biodiversity offsets

The number and type of biodiversity credits required to offset the impacts of the proposal have been calculated in accordance with the *Framework for Biodiversity Assessment*, and are listed in Table 10.4. The TSC Act and EPBC Act listed threatened ecological communities that these plant community types conform to are listed in Table 10.1. The ecosystem credits required for offsetting incorporate relevant offsets for the threatened ecological communities and ecosystem credit species recorded or predicted to occur required as a result of the clearing of native vegetation. Species credits are required for offsetting impacts on the koala.

Like-for-like credit retirement is to be undertaken for matters of national environmental significance affected by the proposal in accordance with the *Framework for Biodiversity Assessment* as indicated in Table 10.5.The final application of offset credits for relevant matters of national environmental significance following the like-for-like principal will be determined during detailed design. Species credits required to offset impacts on the koala are listed in Table 10.4.

The offsets would be delivered as outlined in the Phase 1 biodiversity offset strategy, described in section 10.4.1.

Table 10.4 Credits required for offsetting impacts

Plant community type/species	Credits required
Ecosystem credits	
PCT26 Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	146
PCT36 River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	54
PCT55 Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	342
PCT70 White Cypress Pine woodland on sandy loams in central NSW wheatbelt	38
PCT76 Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	1,029
PCT244 Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)	114
PCT201 Fuzzy Box Woodland on alluvial brown loam soils mainly in the NSW South Western Slopes Bioregion	70
PCT267 White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion	185
PCT276 Yellow Box grassy tall woodland on alluvium or parna loams and clays on flats in NSW South Western Slopes Bioregion	583
Total ecosystem credits required for offsetting	2,561
Species credits	
Koala	491
Total species credits required for offsetting	491

Table 10.5 Summary of the offset requirement for relevant matters of national environmental significance

Matters of national environmental significance	Like-for-like offset In accordance with NSW FBA
White Box Yellow Box – Blakely's Red Gum Woodland and Derived Native Grassland CEEC	Subject to the revision of credits as part of the detailed design process, 768 ecosystem credits will be retired to offset impacts to this CEEC, in accordance with the Biodiversity Offset Strategy and the NSW FBA.
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia EEC	Subject to the revision of credits as part of the detailed design process, 1029 ecosystem credits will be retired to offset impacts to this EEC, in accordance with the Biodiversity Offset Strategy and the NSW FBA.
Tylophora linearis	Subject to the revision of credits as part of the detailed design process, 442 ecosystem credits will be retired to offset impacts to White Box Yellow Box – Blakely's Red Gum Woodland CEEC, which provides potential habitat for this species, in accordance with the Biodiversity Offset Strategy and the NSW FBA.
Superb parrot	Subject to the revision of credits as part of the detailed design process, 2,561 ecosystem credits will be retired to offset impacts to the habitat of this threatened species, in accordance with the Biodiversity Offset Strategy and the NSW FBA.
Regent honeyeater	Subject to the revision of credits as part of the detailed design process, 877 ecosystem credits will be retired to offset impacts to habitat for this species, in accordance with the Biodiversity Offset Strategy and the NSW FBA.
Swift parrot	Subject to the revision of credits as part of the detailed design process, 877 ecosystem credits will be retired to offset impacts to habitat for this species, in accordance with the Biodiversity Offset Strategy and the NSW FBA.

Indirect impacts

Indirect impacts could include the following:

- Edge effects – can occur in adjoining or adjacent areas of vegetation and habitat as a result of weed growth, increased noise and light, erosion and sedimentation, and can result from vegetation clearance, where a new edge is created between vegetation and cleared areas, or from widening or extending of cleared easements through existing vegetation.
- Light and noise – could impact breeding, foraging and roosting activities where fauna are located close to construction activities.
- Erosion, sedimentation, and dust generation – uncontrolled erosion can cause weed problems, reduce habitat values, and stifle plant growth.
- Weeds – dispersal of weed propagules (seeds, stems and pollen) into areas of native vegetation through erosion (wind and water) and the movement of workers and vehicles.

- Plant pathogens – potential spread of soil-borne pathogens of native plants (for example, Phytophthora (*Phytophthora cinnamomi*) spread on machinery.
- Disease – potential spread of Chytrid fungus into local native frog populations, through soil and water carried on machinery and by the movement of workers between different areas.
- Fauna injury and mortality – as a result of vegetation clearing (particularly hollow-bearing trees), boulder removal and excavations.

These impacts can be readily managed through the implementation of standard construction soil and water management measures (listed in chapters 14 and 16), and the mitigation measures listed in section 10.4. With the implementation of these measures, no significant indirect impacts on biodiversity are predicted.

Summary of potential impacts on biodiversity values not covered by the Framework for Biodiversity Assessment

Biodiversity values not considered by the *Framework for Biodiversity Assessment* include marine mammals, wandering sea birds, and biodiversity endemic to Lord Howe Island. None of these occur or have the potential to occur within the biodiversity assessment area, and as such do not require further consideration.

In addition, the *Framework for Biodiversity Assessment* does not assess the direct impacts of a proposal that are not associated with clearing of vegetation. The main impact related to the proposal would be vehicle (train) strike during operation (considered in section 10.3.4).

The impacts on potentially groundwater dependent ecosystems are summarised in section 10.3.3. As the proposal does not involve substantial excavations that are likely to interfere with groundwater, the risk of impacts to groundwater and groundwater dependent ecosystems is low.

The impacts on aquatic ecology are provided in Technical Report 3 and summarised in section 10.3.3.

Summary of potential impacts on EECs, threatened species and/or populations listed in Attachment B to the SEARs

EECs

The proposal would impact on the EECs specifically identified in the SEARs. The impacts to EECs are summarised in Table 10.3. It is unlikely that the proposal would impact these communities in such a way as to change the characteristic and functionally important species, impact their quality and integrity, or fragment an important area of the community in the study area.

Table 5.4 of Technical Report 2 provides detailed information for the threatened ecological communities identified in the SEARs as requiring further consideration.

To mitigate the potential impacts to EECs as a result of the proposal, biodiversity offsets would be provided in accordance with the *NSW Biodiversity Offsets Policy for Major Projects*, as described in section 10.4.1.

Threatened species

No known populations of the threatened species identified in the SEARs as requiring further consideration occur within the biodiversity assessment area, and no change in known habitat would occur as a result of the proposal. These species would not be impacted by the proposal.

Potential impacts on biodiversity values that require further consideration

Under the *Framework for Biodiversity Assessment*, certain impacts on biodiversity values may require further consideration by the consent authority. These are impacts that are considered to be complicated or severe and include:

- impacts on landscape features
- impacts on native vegetation that are likely to cause the extinction, or significantly reduce the viability, of an EEC/CEEC from an IBRA subregion
- impacts on critical habitat or on threatened species or populations that are likely to cause the extinction, or significantly reduce the viability, of a species or population from an IBRA subregion.

The proposal would not result in any of the above severe impacts.

Key threatening processes

The proposal is not classified as a key threatening process.The proposal may contribute to the following key threatening processes through clearing and edge effects:

- aggressive exclusion of birds by noisy miners (*Manorina melanocephala*)
- clearing of native vegetation
- loss of hollow-bearing trees
- removal of dead wood and dead trees
- competition and grazing by the feral European rabbit (*Oryctolagus cuniculus*)
- predation by the European red fox (*Vulpes vulpes*)
- invasion of native plant communities by exotic perennial grasses.

The mitigation and management of the impacts of the proposal, including measures to mitigate contributions to the above key threatening processes where appropriate, are described in section 10.4.

10.3.3 Construction impacts – aquatic ecology

Potential impacts on aquatic ecology include:

- removal of riparian vegetation on the banks of watercourses to replace some of the culverts
- temporary obstruction of fish passage associated with any vehicle access across watercourses and culvert works
- impacts to fish within any semi-permanent pools within the proposal site
- any impacts to water quality during construction (described in chapter 16) has the potential to impact on aquatic ecology in receiving watercourses.

These potential impacts would be minimised by the implementation of appropriate design features to minimise watercourse impacts (described in chapters 15 and 16), the soil and water mitigation measures provided in chapters 14 to 16, and the mitigation measures provided in section 10.4. It is noted that only Burrill Creek is considered to have more than a minimal potential for key fish habitat.

As no listed threatened species, endangered populations or aquatic matters of national environmental significance are assessed as likely to occur within aquatic habitats in the watercourses in and around the proposal site, no impacts are predicted.

As noted in section 10.2.3, the proposal site is located within the mapped distribution of two aquatic threatened ecological communities. An assessment of significance of the potential impact on these communities was undertaken and is provided in Technical Report 3. The assessment concluded that the proposal is unlikely to have an adverse impact on either of these communities, with the adoption of appropriately designed fish friendly crossing structures and other mitigation measures to further reduce impacts.

10.3.4 Operation impacts

Increased rail movements may result in adverse impacts on locally occurring fauna species, particularly terrestrial mobile species as a result of vehicle strikes. Although there would be an increase in the number of trains using the operational rail line, no significant vehicle strike impacts are predicted.

Weed species could be inadvertently brought into the proposal site with imported materials, or could invade naturally through removal of native vegetation. Mitigation measures outlined in section 10.4 would minimise the potential for weed encroachment into surrounding areas around the proposal site.

No other operational activities, such as maintenance inspections or monitoring, are expected to impact on native flora and fauna or other biodiversity values.

10.4 Mitigation and management

10.4.1 Approach to mitigation and management

ARTC is committed to minimising the environmental impact of the proposal and is investigating opportunities to reduce actual impact areas where practicable. The area that would be directly impacted by construction activities would depend on factors such as presence of significant vegetation, constructability, construction management and safety considerations, landform, slopes and anticipated sub-soil structures. Direct impacts would be reduced as far as practicable. The exact amount of clearance (within the proposal site) would be refined during detailed design.

ARTC has, where possible, altered the proposal to avoid and minimise ecological impacts in the proposal planning stage, and a range of impact mitigation strategies have been included in the proposal to mitigate the impact on ecological values prior to the consideration of offsetting requirements. Further refinement will be made during detailed design, where possible, to minimise ecological impacts.

Biodiversity offsets

ARTC is committed to delivering a Biodiversity Offset Strategy that appropriately compensates for the unavoidable loss of biodiversity values as a result of the proposal under the *NSW Biodiversity Offsets Policy for Major Projects*.

The proposal will include the retirement of credits calculated in accordance with the NSW *Framework for Biodiversity Assessment* (provided in section 10.3.2). This includes all plant community types that would be directly and permanently impacted as a result of the proposal. The retirement of credits associated with the plant community types occurring in the biodiversity assessment area also ensures that the habitat for threatened fauna and flora species are offset as part of the proposal.

In accordance with the *Framework for Biodiversity Assessment*, there are two options, which can be used separately or together to fulfil offset requirements:

- securing like for like offsets to retire credits
- contributing to supplementary measures.

Analysis undertaken to date suggests that potential offsets would be identified within either the subregion in which the proposal site is located, or an adjoining subregion.

Biodiversity offset strategy for the proposal

A Phase 1 biodiversity offset strategy has been developed for the proposal and is provided in Appendix L. The strategy is summarised below.

The approach to biodiversity offsets for the proposal has been developed in accordance with the FBA, and based on the calculated offset credits described in section 10.3.2. This will provide for the offset requirements (for both plant community types and species requiring offsets) in accordance with the *NSW Biodiversity Offsets Policy for Major Projects*.

Efforts to secure these credits will continue throughout the detailed design of the proposal. The tasks undertaken and proposed are summarised in Table 10.6.

Table 10.6 Proposal biodiversity offset strategy tasks

Step	Actions
Check for available credits	The OEH biodiversity credits register was checked on 15 December 2016 to determine if ecosystem credits matching the proposal offset requirements have been issued and are available.
Check for expressions of interest	The OEH Biobank site expression of interest register was checked on 16 December 2016 to determine if a landholder may have credits matching the proposal offset requirements, but have not yet issued those credits.
Identify potential like for like offset sites	A desktop analysis was undertaken in December 2016.
Put a request on the credits wanted list	A 'credits wanted' request will be prepared and submitted on the OEH credits wanted register for the approximate number and type of credits required for the proposal once these are confirmed with assessing agencies. Estimated to occur early 2017.
Test landholder interest	If the proposal is approved, contact would be made with shortlisted landholders to determine their interest in entering into a BioBanking agreement and selling credits to ARTC.
Validate offset credits	Potential offset sites would be ground-truthed to validate the presence of ecosystem and/or species credit requirements, and assess overall suitability as an offset. Shortlisted offset properties would then be taken to the next level of assessment.
Investigate options for supplementary measures and estimate costs	The indicative cost of supplementary measures is estimated with similar credits already sold as part of the BioBanking scheme acting as a guide to pricing.

A search of the OEH biodiversity credits register and expression of interest register in December 2016 identified there were no suitable ecosystem credits available for purchase in the impact subregions or adjoining regions that satisfy the *Framework Biodiversity Assessment* criteria for the proposal. For koalas, there are three offset sites on the OEH credit register for the whole of NSW available for use. Two are classified with a credit status of 'Issued' and have a combined credit number of 1,074, which would meet the proposal's requirements.

To assess offset availability more broadly, a spatial analysis of OEH's vegetation information system database and mapping has been undertaken. The results of the spatial analysis indicate that there are mapped areas of each plant community type requiring offsets within at least one of the impact subregions. In addition, each impacted plant community type has been identified and mapped within at least two of the adjoining subregions that can also be considered for offsetting purposes.

The analysis shows there is opportunity to identify potential offsets for affected plant community types within either the impacted subregion or adjoining subregion.

10.4.2 Consideration of the interactions between mitigation measures

Mitigation measures to minimise potential impacts associated with noise, air quality, soils, hydrology, and water quality and would also assist in mitigating the potential impacts to biodiversity. These mitigation measures are detailed in chapters 11 and 13 to 16.

The rehabilitation strategy would also assist in mitigating identified land use, and landscape and visual impacts.

10.4.3 Summary of mitigation measures

To mitigate the potential impacts to biodiversity, the following measures would be implemented.

Table 10.7 Biodiversity mitigation measures

Stage	Impact	Mitigation measures
Detailed design/ pre-construction	Biodiversity offset strategy	The biodiversity offset strategy (phase 1) for the proposal would be finalised, in accordance with the requirements of the *Framework for Biodiversity Assessment* (OEH, 2014a) and the *NSW Biodiversity Offsets Policy for Major Projects* (OEH, 2014c). The offset strategy would be approved by the Department of Planning and Environment prior to the commencement of construction work that would result in the disturbance of relevant ecological communities, threatened species, or their habitat, unless otherwise agreed.
	Direct impacts to biodiversity	Detailed design and construction planning would minimise the construction footprint and avoid impacts to native vegetation as far as practicable.
	Riparian vegetation	Compounds would be located an appropriate distance from riparian vegetation to avoid impacts on aquatic habitat. This includes (for the proposal site) a minimum of 50 metres for type 2 class 2 and 3 watercourses (Burrill Creek), and 10 to 50 metres for type 3 class 2 to 4 watercourses (other watercourses). Direct impacts to in-stream vegetation and native vegetation on the banks of watercourses would be avoided as far as practicable.
	Fish passage	Detailed design and construction planning would minimise the potential for impacts to fish passage. To ensure that fish passage is maintained, watercourse crossing structures would be designed in accordance with the guideline *Why do fish need to cross the road? Fish passage requirements for waterway crossings* (Fairfull and Witheridge, 2003) and the minimum design requirements specified in Table 4.1 of Technical Report 3.
Pre-construction/ construction	General biodiversity impacts	A biodiversity management sub-plan would be prepared and implemented as part of the CEMP. It would include measures to minimise the potential for biodiversity impacts. The sub-plan would address: ▸ a pre-clearance survey and tree-felling procedure ▸ procedures to manage micro-bats ▸ avoiding impacts on surrounding vegetation ▸ weed management ▸ dewatering of standing pools in watercourses ▸ measures to minimise impacts on aquatic ecology.

Stage	Impact	Mitigation measures
	Rehabilitation strategy	A rehabilitation strategy would be prepared to guide the approach to rehabilitation of disturbed areas following the completion of construction. The strategy would include: ▸ clear objectives and timeframes for rehabilitation works (including the biodiversity outcomes to be achieved) ▸ details of the actions and responsibilities to progressively rehabilitate, regenerate, and/or revegetate areas, consistent with the agreed objectives ▸ identification of flora species and sources ▸ procedures for monitoring the success of rehabilitation ▸ corrective actions should the outcomes of rehabilitation not conform to the objectives adopted.
	Pre-clearing surveys	Pre-clearing surveys and inspections would be undertaken prior to construction. The surveys and inspections, and any subsequent relocation of species, would be undertaken in accordance with the biodiversity management sub-plan in the CEMP.
Construction	Avoidance of impacts	Areas of biodiversity value outside the proposal site would be marked on plans, and fenced or signposted where practicable, to prevent unnecessary disturbance.
	Weed management	Noxious weeds would be managed in accordance with the *Noxious Weeds Act 1993*. Weeds of national environmental significance would be managed in accordance with the *Weeds of National Significance Weed Management Guide*. Any herbicides would be applied such that impacts on surrounding agricultural properties are avoided.
	Rehabilitation	Rehabilitation of disturbed areas would be undertaken progressively and in accordance with the rehabilitation strategy.
Operation	Fish passage	Culverts would be regularly inspected and maintained to minimise blockage of fish passage.
	Weed management	Annual inspections would be undertaken for weed infestations and to assess the need for control measures. Any outbreak of noxious and/or weeds of national environmental significance would be managed in accordance with the *Noxious Weeds Act 1993*, the *Weeds of National Significance Weed Management Guide,* and the requirements of relevant authorities.